VFC Index - Watershed (Plan)

Program: Watershed

IDEM Document Type: Plan

Document Date: 1/14/2022

Security Group: Public

Project Name: Lake Monroe WMP

Plan Type: Watershed Management Plan

HUC Code: 05120208 Lower East Fork White

Sponsor: Friends of Lake Monroe

Contract #: 37065

County: Monroe

Cross Reference ID: 82857054

Comments: Brown, Jackson

Additional WMP Information

Checklist: 2009 Checklist

Grant type: 319

Fiscal Year: 2019

IDEM Approval Date: 1/14/2022

EPA Approval Date: 2/14/2022

Project Manager: Kathleen Hagan

Lake Monroe Watershed Management Plan

Maggie Sullivan
February 23, 2022

FRIENDS OF LAKE MONROE

Acknowledgements

Development of the Lake Monroe Watershed Management Plan was funded in part by the United States Environmental Protection Agency under assistance agreement (C9-97548218) to the Indiana Department of Environmental Management. The contents of this document do not necessarily reflect the views and policies of the Environmental Protection Agency, nor does mention of trade names or commercial products constitute endorsement or recommendation for use.

Additional financial support was provided by the Monroe County Stormwater Board, the City of Bloomington Utilities Service Board, City of Bloomington Office of Economic and Sustainable Development and Sassafras Audubon Society. This project would not have been possible without their generous support.

Many thanks to our other partners including the Indiana Department of Environmental Management; Monroe, Brown, and Jackson Soil and Water Conservation Districts; Natural Resource Conservation Service; Indiana University Limnology Lab; the Indiana Department of Natural Resources; the U.S. Army Corps of Engineers; the U.S. Forest Service; The Nature Conservancy; the League of Women Voters of Bloomington and Monroe County; the League of Women Voters of Brown County; Visit Bloomington; Indiana Geological and Water Survey; Monroe County Council; Bloomington Chamber of Commerce; Bloomington Environmental Commission; Monroe County Commission; and Brown County Regional Sewer District;

Many thanks to our steering committee members: Terry Ault (Jackson County Soil & Water Conservation District), Cara Bergschneider (Natural Resources Conservation Service), Lee Florea (Indiana Geological and Water Survey), Richard Harris (Friends of Lake Monroe), Bill Jones (Sassafras Audubon Society), Erin Kirchhofer (Brown County Soil & Water Conservation District), Melissa Laney (Indiana University School of Public and Environmental Affairs), Mary Madore (Friends of Lake Monroe), Mike McAffee (Visit Bloomington), Duane McCoy (Indiana Department of Natural Resources Forestry Division), Chad Menke (Hoosier National Forest), Martha Miller (Monroe County Soil & Water Conservation District), Sherry Mitchell-Bruker (Friends of Lake Monroe), Melissa Moran (The Nature Conservancy), Cheryl Munson (Monroe County Council), Dave Parkhurst (Bloomington Environmental Commission), Sarah Powers (Indiana University Limnology Lab), Erin Predmore (Bloomington Chamber of Commerce), Cate Reck (Indiana University Department of Chemistry), Jim Roach (Indiana Department of Natural Resources Parks Division), Allison Shoaf (Natural Resources Conservation Service), Tyler Steury (City of Bloomington Utilities), Tony Smith (Fourwinds Marina), Julie Thomas (Monroe County Commissioners), Lauren Travis (City of Bloomington Economic and Sustainable Development), Sam Whiteleather (Indiana Department of Natural Resources Fish and Wildlife Division), and Zac Wolf (United States Army Corps of Engineers).

Thank you to the Friends of Lake Monroe Board of Directors: Keith Bobay, Lily Bonwich, Kevin Dogan, Tom Gallagher, Richard Harris, Shelby Hoshaw, Jim Krause, Mary Madore, Sherry Mitchell-Bruker, Cheryl Munson, Joe Ryan, and Carolyn Waldron.

Special thanks to the League of Women Voters of Bloomington and Monroe County, the League of Women Voters of Brown County, the First United Methodist Church, and the Brown County Public Library for their assistance with our community forums. Many thanks to Vickie Dacey for creating our forum surveys and Dave Simcox for organizing the events. Thank you to Anne Fraker, Ann Birch, Nancy Boerner, Joe Bonnert, Patty Dennison, Tom Duffy, Gini Emigh, Julie Lowe, Shari Frank, Elaine Gaul, Kara Hammes, George Hegeman, JoAnne Himebaugh, Jeanne Lager, Deborah Meader, Heather Nicholson, Pam Raider, Allison Shoaf, Laura Teal, Susan Wensel, MaryAnn Williams, and Laura Young for facilitation at the forums.

We are grateful to Roger Kelso and Robin Willey of the Nashville Sewage Treatment Plant; Mike Kelly and Jeff Riegel of Stone Head Nature Preserve; and Clint Studebaker of the Brown County Regional Sewer District for presenting during our Lake Monroe Watershed Tour.

Special thanks to Amanda Duba for assistance with graphic design and to Chuck Wills of Content Management Systems, Inc. for web support.

We are grateful to the Hoosier Trails Council Boy Scouts of America in Bloomington, Brown County Inn in Nashville, Story Inn in Story, Gatesville Country Store in Gatesville, and the Pershing Volunteer Fire Department in Freetown for hosting our volunteers during the watershed sampling blitz events. Huge thanks to Lynnette Murphy for coordinating the event. Thank you to all the volunteers who assisted with sample collection.

Table of Contents

Index of Figures

Index of Tables

Appendices

Appendix A – Stakeholder Concerns
Appendix B – Practitioner Survey
Appendix C – Tributary and Lake Monroe Monitoring Lab Data 2020-2021 IU Limnology Lab
Appendix D – Tributary and Lake Monroe Monitoring Field Data 2020-2021 IU Limnology Lab
Appendix E – Lake Monroe Watershed Monitoring Blitz Data 2020-2021 IU Limnology Lab
Appendix F – Brown County Regional Sewer District E. Coli Sampling Data
Appendix G – Fecal Contamination Source Sampling Methodology and Results
Appendix H – CBU Contaminant Testing List
Appendix I – HUC-12 Subwatershed Ranking Methodology
Appendix J– Detailed HUC-12 Subwatershed Detailed Assessment
Appendix K – Best Management Practices
Appendix L – Water Budget, Nutrient Budget, and Flow Frequency Analysis Calculations

Commonly Used Acronyms

BCRSD	Brown County Regional Sewer District
CAFO	Concentrated Animal Feeding Operation
CBU	City of Bloomington Utilities
CFO	Confined Feeding Operation
CFS	Cubic Feet per Second
CFU	Colony Forming Units
CQHEI	Citizens Qualitative Habitat Evaluation Index
FEMA	Federal Emergency Management Agency
FLM	Friends of Lake Monroe
HUC	Hydrologic Unit Code
IDEM	Indiana Department of Environmental Management
IDNR	Indiana Department of Natural Resources
IU	Indiana University
IUPUI	Indiana University Purdue University Indianapolis
LARE	Lake and River Enhancement Program (IDNR)
mIBI	Macroinvertebrate Index of Biotic Integrity
MS4	Municipal Separate Storm Sewer System
NPDES	National Pollutant Discharge Elimination System
NRCS	Natural Resources Conservation Service
NWI	Nastional Wetlands Inventory
QHEI	Qualitative Habitat Evaluation Index
SPEA	School of Public and Environmental Affairs
SRP	Soluble Reactive Phosphorus
SWCD	Soil and Water Conservation District
TMDL	Total Maximum Daily Load
TN	Total Nitrogen
TP	Total Phosphorus
TSI	Trophic State Index

TSS	Total Suspended Solids
USACE	United States Army Corps of Engineers
USFS	United States Forest Service
USGS	United States Geological Survey
WMP	Watershed Management Plan
WWTP	Waste Water Treatment Plant

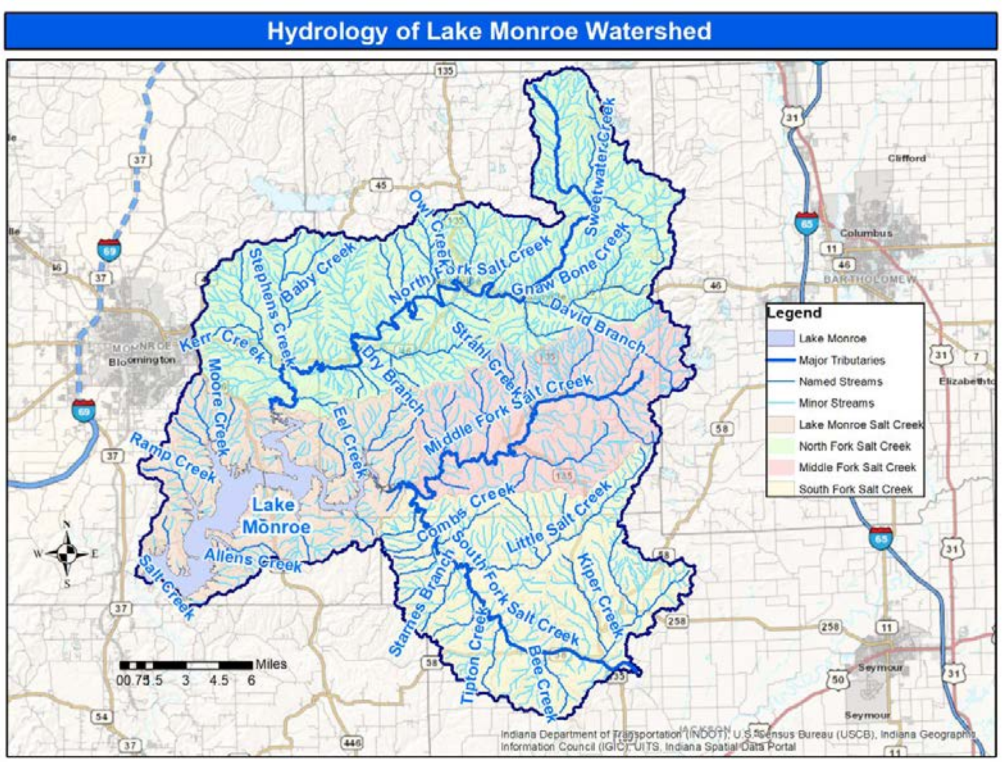
Executive Summary

Friends of Lake Monroe has published a watershed management plan

Lake Monroe is the largest lake in Indiana, providing drinking water for over 130,000 people and generating over $40 million annually in recreational spending. Friends of Lake Monroe worked for three years to develop the 2022 Lake Monroe Watershed Management Plan. This report identifies the top threats to water quality in Lake Monroe and provides an action plan to address those threats over the next 20 years. Protecting water quality in Lake Monroe will require reducing phosphorus, nitrogen, sediment, and E. coli loads entering the lake from the watershed.

The Lake Monroe watershed spans 441 square miles

Water quality in the lake is directly connected to activities in its watershed, the area of land that drains into the lake. Lake Monroe's watershed is large (441 square miles) and spans portions of Brown, Jackson, and Monroe Counties. Topography is steep and soil is highly erodible. Over 82% of the watershed is forested and farming is generally limited to the wide valleys of Lake Monroe's three main tributaries (North Fork, Middle Fork, and South Fork Salt Creek). The area is largely rural and an estimated 9,000 households are served by on-site septic systems. Pollutants in the watershed such as fertilizer, animal manure, sediment, and septic system leakage are washed into the lake when it rains.



Hundreds of community members and organizations participated

A big part of the planning process was building community support and collaboration. More than 20 partner organizations spanning Monroe, Brown, and Jackson Counties participated in the plan development. Over 100 community members attended our public forums and voiced their concerns about Lake Monroe. Over 200 community members learned about the project through public presentations and school programs. Over 100 community members volunteered to assist with water quality sampling in the watershed.

Hundreds of measurements were made to understand water quality

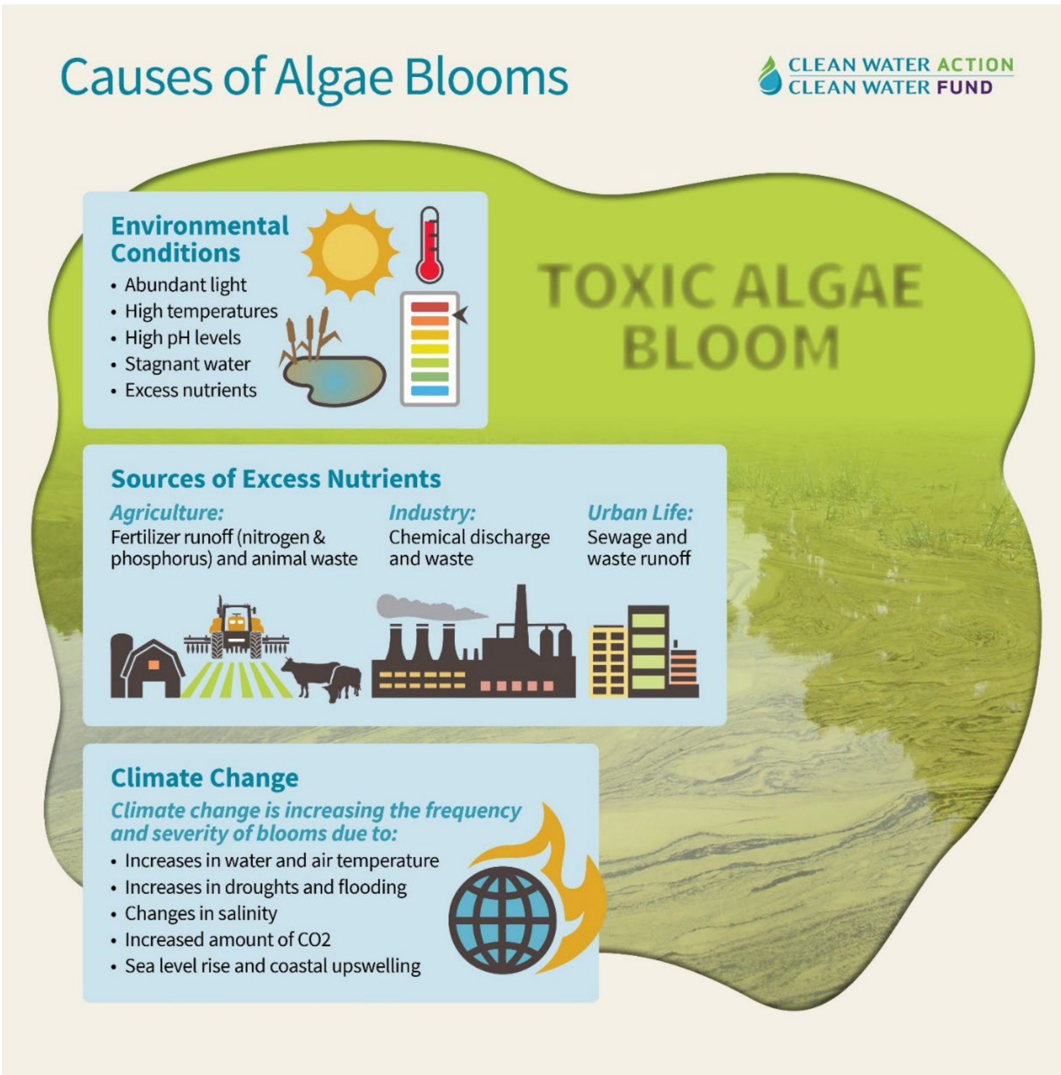
Our water quality monitoring program had three main components. Lake Monroe was sampled monthly from April 2020 – October 2020. Four tributaries feeding Lake Monroe and the tailwaters leaving Lake Monroe were sampled monthly from April 2020 – March 2021. Two sampling blitz events were held to collect samples from 125 sites in the watershed to get a snapshot view of water quality in both large and small streams. Over 240 stream crossings throughout the watershed were inspected to document streambank erosion, width of riparian buffer, livestock access to streams, and other stream conditions. This information was used to develop sediment and nutrient budgets for the lake and to identify areas of concern in the watershed.

Harmful algal blooms impact recreation and drinking water treatment

Harmful algal blooms (HABs) are caused by a type of plankton called cyanobacteria. Although they are often referred to as blue-green algae, they are technically bacteria. Several species of cyanobacteria have the potential to produce toxins. Even when cyanotoxins are absent, swimmers can experience skin irritation and the algae can cause taste and odor issues in drinking water. Recreational advisories based on elevated levels of blue-green algae were issued at Lake Monroe for the Fairfax and Paynetown beaches annually 2011-2021. City of Bloomington Utilities has recently upgraded their algae monitoring equipment and treatment train options to quickly respond to elevated algae levels in the raw water entering their drinking water treatment plant.

Nutrients promote harmful algal blooms

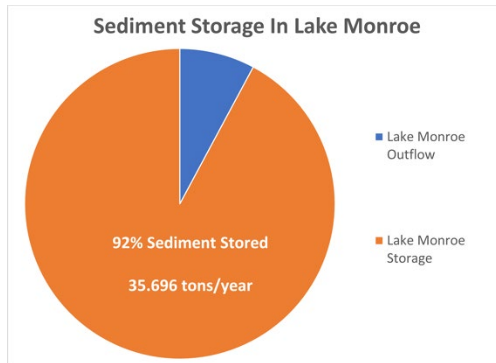
Lakes with phosphorus concentrations over 20 µg/L are considered eutrophic and can be expected to have more severe and frequent algal blooms. Phosphorus concentrations in Lake Monroe historically and today are regularly above that threshold. North Fork Salt Creek appears to be the largest contributor of phosphorus with the South Fork not far behind. Potential sources of phosphorus include fertilizer (from agricultural, commercial, or residential usage), animal manure, septic system leachate, and sediment.



Elevated nitrogen concentrations also increase the likelihood of harmful algal blooms. Nitrogen levels in Lake Monroe were above target levels in more than half of the 2020 samples. South Fork Salt Creek appears to be the largest contributor of nitrogen by a significant margin. This correlates strongly with the fact that the South Fork sub-watershed has the highest percentage of agricultural land. Potential sources of nitrogen include fertilizer, animal manure, septic system leachate, and sediment.

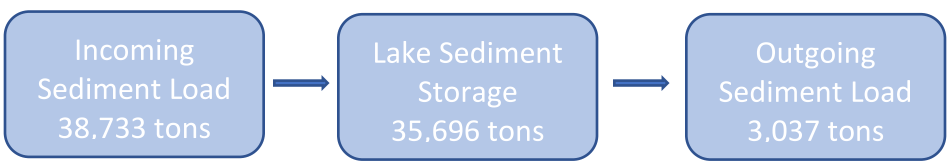
There are other factors that influence algal blooms such as high water temperature and low mixing of water, seen most commonly in the late summer. Climate change models suggest that Indiana is likely to experience warmer weather and more severe summer droughts, which would encourage algal blooms. Since the weather is beyond our control, it is critical to reduce nutrient loads entering Lake Monroe.

Sediment carries nutrients and accumulates in the lake



Sediment carries both phosphorus and nitrogen as it moves through the watershed. While sediment movement is natural in streams and rivers, human activity can increase the rate of sedimentation due to soil disturbance, channelized streams, and faster runoff rates. Reservoirs accumulate sediment, so minimizing sedimentation is key to maximizing the lifespan of Lake Monroe. Sediment can also carry other pollutants.

Water quality monitoring in Lake Monroe showed generally low levels of total suspended solids. However, monitoring of the main tributaries and the outlet of the lake showed that significant volumes of sediment are accumulating in the lake. Lake Monroe retains almost 92% of the sediment that enters, with an estimated accumulation rate of 35,696 tons per year. The North Fork sub-watershed appears to be the largest contributor of sediment.



Multiple sources of sediment were identified

Approximately 76% of the Lake Monroe watershed is considered highly erodible due to its steep slopes and soil type. One potential source of sediment is streambank erosion, which was documented at 86% of observed stream sites. Another potential source is conventionally tilled cropland. There are roughly 10,000 acres of cropland (4% of the watershed) and conventional tillage is still commonly practiced. Other potential sources of sediment include livestock with free access to streams, construction sites with insufficient erosion control, and forestry sites with insufficient erosion control.

Community members expressed concern that boating may be contributing to lakeshore erosion. While insufficient data was available to quantify the impact of boating on erosion, established no-wake zones should be respected to reduce the possibility of exacerbating shoreline erosion and stirring up sediment from the lake bottom.

Fecal contamination from humans and animals is widespread in streams

E. coli is an indicator of fecal contamination. While E. coli itself is generally not harmful, many other harmful bacteria and viruses are present in fecal matter. E. coli levels in all the 2020 Lake Monroe samples were well below the state standard of 235 CFU/100 ml (CFU = colony forming units of bacteria). However, historical beach sampling data shows E. coli exceedances in 2015 and 2016 ranging from 632 CFU/100 ml to >2,400 CFU/100 ml.

There were multiple E. coli exceedances in streams throughout the watershed. The South Fork sub-watershed appears to be the largest contributor of E. coli. Source analysis indicates that both human and animal fecal contamination are present. This widespread contamination renders streams unsafe for swimming or wading and contributes to nutrient overloading in the lake. Potential sources include livestock manure, pet waste, wildlife manure, and septic system leachate.

Actions in the watershed are needed to improve water quality in the lake

Anything on the ground in the watershed can be washed into the lake when it rains. The key to protecting and improving water quality in the lake is to keep pollutants such as sediment, fertilizer, animal manure, and septic system leakage from reaching the streams that flow into Lake Monroe. A key strategy will be increasing the use of best management practices on agricultural, forested, residential, and urban land in the watershed.

Best management practices for livestock can reduce nutrient and bacteria input

Livestock are one potential source of nutrients and bacteria. This source can be addressed by increasing the use of conservation practices like fencing livestock out of streams (as shown in photo to the left), installing heavy use area protection, and improving manure management. Streams can be further protected by planting pollinator habitat or trees along streams to create a riparian buffer that filters runoff before it reaches the stream and helps stabilize the stream banks.

Septic system maintenance and repair can reduce nutrient and bacteria input

Poorly functioning septic systems are another potential source of nutrients and bacteria. There are over 9,000 septic systems in the watershed. Many homeowners are unaware that their septic tank should be pumped and inspected about every 3 years. While a properly functioning septic system can be highly effective, another strategy to reduce potential leakage is to expand existing sewer lines and decrease the number of active septic systems.

Best management practices for cropland and forest can reduce sediment and nutrient input

Any activity that disturbs the soil increases the likelihood of sediment (and its associated nutrients) being washed into Lake Monroe. Common examples of soil disturbance are tillage for planting crops, building trails for timber harvests, and clearing sites for construction. Best management practices are available for all these situations that decrease the amount of sediment loss.

For crop land, strategies include cover crops, reduced tillage, filter strips of permanent vegetation at the edge of crop fields, and riparian buffers of permanent vegetation along stream banks. For forested land, strategies include developing a forest management plan, carefully planning trail locations, installing water bars, and seeding trails that are not in use.

Streambank and shoreline stabilization can reduce sediment and nutrient input

While some erosion of stream banks is inevitable (streams by nature move sediment downstream), human activities in the watershed can increase the volume of sediment being transported. Fluctuations in water level within the lake are also believed to directly exacerbate erosion of both the lakeshore and the stream banks. Strategies to address stream bank and lakeshore erosion include stabilization in areas where erosion is severe, fencing livestock out of streams, installing riparian buffers of permanent vegetation along stream banks, adding vegetation to existing riprap, and instituting operational changes at the dam that would reduce water level fluctuations in Lake Monroe.

Our Action Plan is a twenty-year plan

Improving water quality by modifying the watershed is a long-term process. The 2022 Lake Monroe Watershed Management Plan outlines a twenty-year timeline of activities. Key strategies include

- Increasing the adoption of best management practices on agricultural and forested land.
- Expanding riparian buffer along streams.
- Maintaining and repairing septic systems.
- Encouraging green boating practices and "leave no trace" principles.
- Stabilizing key sections of shoreline and streambanks.
- Protecting and restoring floodplains, especially along the three main tributaries (South Fork, Middle Fork, and North Fork Salt Creek).
- Reducing the amount of littering in the watershed.
- Promoting collaboration between different governmental bodies in the watershed.
- Monitoring water quality to evaluate impacts.

Our first steps begin in 2022

Friends of Lake Monroe has launched the "Lake Monroe Community Action Initiative" to promote the watershed management plan and begin implementation. This program is supported in part by the Community Foundation of Bloomington and Monroe County. The focus of this effort is to inform the local community about the watershed plan and engage their support in implementation. Specific components include hosting public forums, organizing a watershed summit for local leaders, launching a social media campaign about how to protect water quality in Lake Monroe, and laying groundwork for a larger implementation project this fall.

Another component of the initiative is a pilot septic system maintenance cost-share program in the Lake Monroe watershed portion of Monroe County. It will help reduce the cost of the septic tank pumpout that should be done every three years to keep a septic system in good shape and catch any problems while they are small. We hope to expand the program into neighboring counties in the future.

Best Management Practice Cost-Share Program 2022-2025

This fall, Friends of Lake Monroe anticipates receiving a second round of funding through the 319 grant program of the Indiana Department of Environmental Management. This grant would pay for a cost-share program subsidizing the installation of best management practices on land throughout the watershed. Examples include establishing pollinator habitat or trees adjacent to streams, fencing livestock out of streams, planting cover crops, and reforesting floodplains. The grant would also fund a variety of education and outreach programs including agricultural field days, forestry trainings, septic system maintenance workshops, boat tours, trash cleanups, green boating campaigns, and educational brochures mailed to every resident in the watershed.

Education and outreach will engage the community in making the plan a reality

Community support at both the individual and governmental level is key to making the Lake Monroe Watershed Management Plan successful. Making improvements to the watershed is a long-term effort that will require participation from governing bodies, landowners, and residents. Our goal is to activate the local community throughout the watershed to collaborate and protect our local water resources. Together we can ensure the health of Lake Monroe and its tributaries for years to come.

For more information, please contact
Maggie Sullivan, Watershed Coordinator
watershed@friendsoflakemonroe.org
(812) 558-0217
www.friendsoflakemonroe.org

Executive Summary Photo Credits

1. Lake Monroe paddler photo courtesy of Visit Bloomington; 2. Hydrology of Lake Monroe map by Friends of Lake Monroe; 3. Community forum photo by Martha Fox; 4. Lienne Sethna sampling photo by Lynnette Murphy; 5. Blue-green algae photo courtesy of CSIRO; 6. Causes of Algal Blooms graphic by Clean Water Fund; 7. Sediment storage pie chart by Friends of Lake Monroe; 8. Sediment storage graphic by Friends of Lake Monroe; 9. Streambank erosion photo by Allison Shoaf; 10. Lakeshore erosion photo by Cathy Meyer; 11. Beach closure sign image courtesy of Indiana Department of Environmental Management; 12. Livestock exclusion fencing courtesy of Western Pennsylvania Conservancy; 13. Septic pumping photo by Daniel Friedman; 14. Riparian buffer photo by Lynn Betts of NRCS/SWCS; 15. Stream restoration photo courtesy of Little Almance Creek Healthy Streams Cooperative; 16. Lake Monroe Needs You graphic by Friends of Lake Monroe; 17. Streambank tree planting photo by Jeff Vanuga of NRCS/SWCS.

1 Community Watershed Initiative

While several research projects and watershed improvement plans were conducted within the Lake Monroe watershed in the late 1990's, the development of a comprehensive watershed management plan can be traced back to the creation of the non-profit Friends of Lake Monroe (FLM) in 2016. The mission of FLM is "to protect and enhance Lake Monroe and its watershed through science, advocacy, and public involvement: working collaboratively with citizens, government, and business to improve and support lake water quality." The group initially focused on compiling existing water quality data, educating the public, and hosting volunteer events such as lakeshore cleanups.

Data compiled by FLM revealed that Lake Monroe can be characterized as eutrophic by national trophic state index (TSI) rankings and at times exceeds this threshold, becoming hypereutrophic with all TSI parameters (total phosphorus, Secchi depth transparency, and chlorophyll-a). Additionally, the Indiana Department of Environmental Management (IDEM) has reported elevated levels of harmful algal blooms in Lake Monroe during each of the 10 years that samples were taken, leading to the issuance of recreational advisories. These recreational advisories have a negative impact on the local economy, as Lake Monroe is a recreational destination that attracts nearly 1,000,0000 visits (person-days) annually per the United States Army Corps of Engineers. Algal blooms also correspond with increased concentrations of total organic carbon (TOC) which can contribute to elevated levels of disinfectant by-products in drinking water produced by the City of Bloomington. Algal blooms can additionally cause taste and odor issues in drinking water. Over 130,000 residents in Monroe, Brown, and Lawrence Counties depend on Lake Monroe as their only source of drinking water. Within the watershed, several streams have been designated as impaired due to elevated levels of E. coli.

As discussed in past studies, the best way to address these and other concerns is with a comprehensive watershed management plan for the Lake Monroe watershed. In 2018, FLM brought together local public officials and concerned citizens to apply for a 319 grant from IDEM to develop a plan. Over thirty organizations submitted letters of support in order to preserve and improve Lake Monroe water quality. In November 2019, FLM hired Maggie Sullivan to be the watershed coordinator and assembled a steering committee (Table 1-1). The organization also began a campaign to increase public awareness with several local newspapers publishing articles as well as radio and TV interviews about the project.

1.1 Community Leadership

The Lake Monroe Watershed Management Plan development was guided by a steering committee with members who represent a multitude of stakeholder groups within the watershed. Individuals representing farmers, businesses, city government, town government, county government, natural resource professionals, educational entities, land managers, and environmental groups comprised the steering committee. Many members came from partnering organizations and stakeholders who had supported the initial grant application.

Potential members were solicited via direct mailing, phone calls, and personal communication. The first informational/steering committee meeting was held on January 20, 2020.

Table 1-1 Steering Committee Members for the Lake Monroe Watershed Management Plan

First Name	Last Name	Organization
Terry	Ault	Jackson County Soil and Water Conservation District
Cara	Bergschneider	Natural Resources Conservation Service
Lee	Florea	Indiana Geological and Water Survey
Richard	Harris	Friends of Lake Monroe
Bill	Jones	Sassafras Audubon Society
Erin	Kirchhofer	Brown County Soil and Water Conservation District
Melissa	Laney	Indiana University School of Public and Environmental Affairs
Mary	Madore	Friends of Lake Monroe
Mike	McAfee	Visit Bloomington
Duane	McCoy	Indiana Department of Natural Resources Forestry Division
Chad	Menke	Hoosier National Forest
Martha	Miller	Monroe County Soil and Water Conservation District
Sherry	Mitchell-Bruker	Friends of Lake Monroe
Melissa	Moran	The Nature Conservancy
Cheryl	Munson	Monroe County Council
Dave	Parkhurst	Bloomington Environmental Commission
Sarah	Powers	Indiana University School of Public and Environmental Affairs
Erin	Predmore	Bloomington Chamber of Commerce
Cate	Reck	Indiana University Chemistry
Jim	Roach	Indiana Department of Natural Resources Parks Division
Allison	Shoaf	Natural Resources Conservation Service
Tyler	Steury	City of Bloomington Utility Service
Tony	Smith	Fourwinds Marina
Julie	Thomas	Monroe County Commission
Lauren	Travis	City of Bloomington Economic and Sustainable Development
Sam	Whiteleather	Indiana Department of Natural Resources Fish and Wildlife Division
Zac	Wolf	United States Army Corps of Engineers

1.2 Stakeholder Involvement

Two community forums were held at the beginning of the project with support from the Bloomington-Monroe County and Brown County chapters of the League of Women Voters. These forums were promoted through articles in local newspapers and organizational e-newsletters as well as via direct e-mail invitations to key community members identified by the League of Women Voters. The first forum was held in Bloomington (Monroe County) in November 2019. The second forum was held in Nashville (Brown County) in January 2020. Both forums followed the same format. Participants were asked to complete a pre-session survey upon arrival. Dr. Sherry Mitchell-Bruker, president of Friends of Lake Monroe, gave a brief presentation about Lake Monroe and the watershed management plan development process. Then participants worked in small groups of 6-8 to brainstorm concerns about the lake. Each group identified their top three concerns and reported back to the entire forum. At the end of the event, each participant completed a post-session survey.

There were three primary goals of the community forums.

1. Explain the purpose and process of developing a watershed management plan.
2. Solicit input from the public on their concerns for Lake Monroe and its watershed.
3. Inform the public on how they can be involved and stay updated on the project.

In total, 114 citizens participated in the forums. Feedback about the forums was very positive. About 60% of attendees were from Monroe County, about 25% were from Brown County, and about 1% were from Jackson County. The remainder included representatives whose agencies work within the watershed but are located in other geographic areas (e.g., Army Corps of Engineers in Louisville, Indiana Department of Natural Resources and other organizations in Indianapolis, Hoosier National Forest in Bedford, etc.) Friends of Lake Monroe created a contact list of all the attendees to provide updates and solicit volunteers for the project. Updates were also provided to the general public at FLM meetings, through the FLM website, through FLM posts on Facebook, as well as in press releases sent to local newspapers.

1.3 Stakeholder Concerns List

After the forums were concluded, the concerns were compiled and consolidated. A full list of stakeholder concerns can be found in Appendix A. The top three concerns from each group were compiled and duplicates were eliminated. The resulting list of 46 concerns is presented below.

Table 1-2 Stakeholder Concerns for the Lake Monroe Watershed

Category	Concern
Drinking Water	• Drinking water quality (nitrates, phosphates, dangerous bacteria, E. coli, toxic blue-green algae) • Drinking water treatment costs as a homeowner • Taste and odor issues with drinking water • Actual ownership of water; ensure water stays here • Fear that lake water would be so undrinkable so it is no longer available as our water supply • Algae blooms affect drinking water treatment
Sedimentation, Siltation, and Erosion	• Silting in of lake – can we stop it • Lake getting more shallow due to sedimentation • Need to quantify siltation rate and identify source(s) • Shoreline erosion • Sedimentation/erosion - entire watershed
Nutrients and Algae	• Algae blooms caused by nutrient loading make the lake unswimmable • Nutrient loading (urban lawns, agriculture, septic systems) • Inappropriate agricultural practices • Lawn maintenance (and its downstream effects) • Effects of septic systems on nutrient loading
Pathogens and E coli	• Waterways are not up to standards; clean up E coli • Pathogens from humans and animals • Failed septic systems • Ensure that boat toilets are properly sealed
Pollution - Chemicals and Trash	• Trash and plastic pollution • Need to quantify what chemicals/pollutants are entering lake • Use of herbicides/pesticides in residential/commercial • Toilet flush of prescription pharmaceuticals
Development	• Development on and around the lake
Forestry	• Effects of logging/forest management (herbicides – amphibians, heavy equipment – road damage) • Keep forests as forests • Unregulated forest management
Invasive Species	• Invasive plants • Asian Carp • Effects of invasive species control

Category	Concern
Lack of Knowledge or Education	• Poor public understanding of how lakes/watersheds function • Educate public and school children • Need more data about water quality and trends
Lack of Management or Clear Jurisdiction	• Lack of oversight/enforcement of polluters, landowners • Uneven distribution of economic return from the lake • Long-term management plan implementation, monitoring, and funding • No drainage ordinance • Deregulation of environmental protection • Collaboration between multiple governments required for implementation; unclear who is in charge
Recreation	• Maintain recreational value • Recreational pollution - how to limit effects, dispel myths • Recreation - boating impacts; responsible use • Large boat engines contribute to erosion, turbidity

1.4 Practitioner Survey

In addition to soliciting input from the general public, a selection of land managers and conservation professionals in the watershed were interviewed to gain a better understanding of conservation practices currently used in the watershed. Melissa Moran with the Nature Conservancy and Richard Harris of Friends of Lake Monroe conducted fifteen interviews with conservation professionals, public land managers, and private landowners. The goal was to understand the best management practices that are working well, the work they would like to implement to better protect Lake Monroe, the current level of investment in conservation work, and what range of investment might be needed to implement the desired but currently unfunded practices. The full report is provided in Appendix B.

The conservation practitioners interviewed represent the Natural Resources Conservation Service (NRCS) offices and the Soil and Water Conservation Districts (SWCD) serving Monroe, Brown, and Jackson counties. These agencies collaborate regularly and work directly with individual landowners to promote conservation of natural resources. Their general takeaways were as follows:

- These organizations in the three counties see many of the same practices implemented, including access roads, brush management, comprehensive nutrient management plans, cover crops, critical area plantings, forest management plans, forest stand improvement, heavy use area pads, high tunnels, invasive species management, mulching, nutrient management plans, and underground outlets.

- However, each county has a different landscape and different property sizes which leads to a different emphasis on soil and water conservation practices in each county.
    - Brown – small to medium projects to assist small livestock operations while leading the way in the implementation of forestry-related practices.
    - Monroe – smaller projects with a diverse mix including livestock, crops, forestry, and urban projects.
    - Jackson – larger projects with an emphasis on crop management, particularly cover crops. Their work is most concentrated in the eastern portion of the county, with few projects in the Lake Monroe watershed.
- They identified the top challenge as increasing public awareness of what conservation practices and funding opportunities are available.
- Specific practices where they would like to see increased implementation to address water quality:
    - More livestock practices such as heavy use area protection, exclusion fencing, watering facility and pipeline, and prescribed grazing.
    - More cover crop adoption.
    - Connecting with hobby farm owners who may not be as aware of erosion issues and conservation programs as traditional farmers.
    - Educating forest owners about forestry best management practices before they conduct a timber harvest so they can implement conservation practices from the beginning (rather than reaching out for help after a harvest has taken place without good BMPs).
    - Streambank stabilization, though there are limited funding opportunities for these projects through NRCS and SWCDs.

The public land managers interviewed represent the Indiana Department of Natural Resources (IDNR) State Park Division, IDNR Forestry Division, United States Forest Services (USFS), United States Army Corps of Engineers (USACE), and Camp Atterbury. Each agency has its own set of internal requirements for BMP application and each agency indicated that their requirements are protective of water quality. Some of their challenges center around lack of capacity in terms of staff and financial resources. Specific challenges are as follows:

- IDNR used to have funds to provide cost-sharing on forest BMPs on private property which they felt was very valuable but budget keeps decreasing.
- IDNR used to offer a logger training at low-to-no cost but will likely need to charge a fee in the future.
- Multiple organizations mentioned the challenges of maintaining trails and a desire for more resources to reduce potential soil compaction, erosion, and sedimentation.
- Multiple organizations mentioned the challenge of upgrading stream crossings to restore natural hydrologic functions, reducing channel incision, and allowing aquatic organisms to pass through easily.
- USFS mentioned floodplain restoration as a goal, with an emphasis on protecting and restoring forested riparian buffer along streams.

- Brown County State Park mentioned the challenge of managing horse manure at their horseman's camp which can contain as many as 600 horses during peak usage; they are pursuing a plan to have the manure hauled away.
- Two organizations mentioned concerns about managing shoreline erosion around Lake Monroe. USFS is currently exploring potential stabilization projects.
- IDNR mentioned that logjam removal is an ongoing challenge that they have not had sufficient resources to tackle.
- Another commonly mentioned challenge was invasive species management.

Three private landowners were interviewed who collectively manage livestock, crops, and forest. They utilize a range of different BMPs. Areas where these landowners see a need for improvement include:

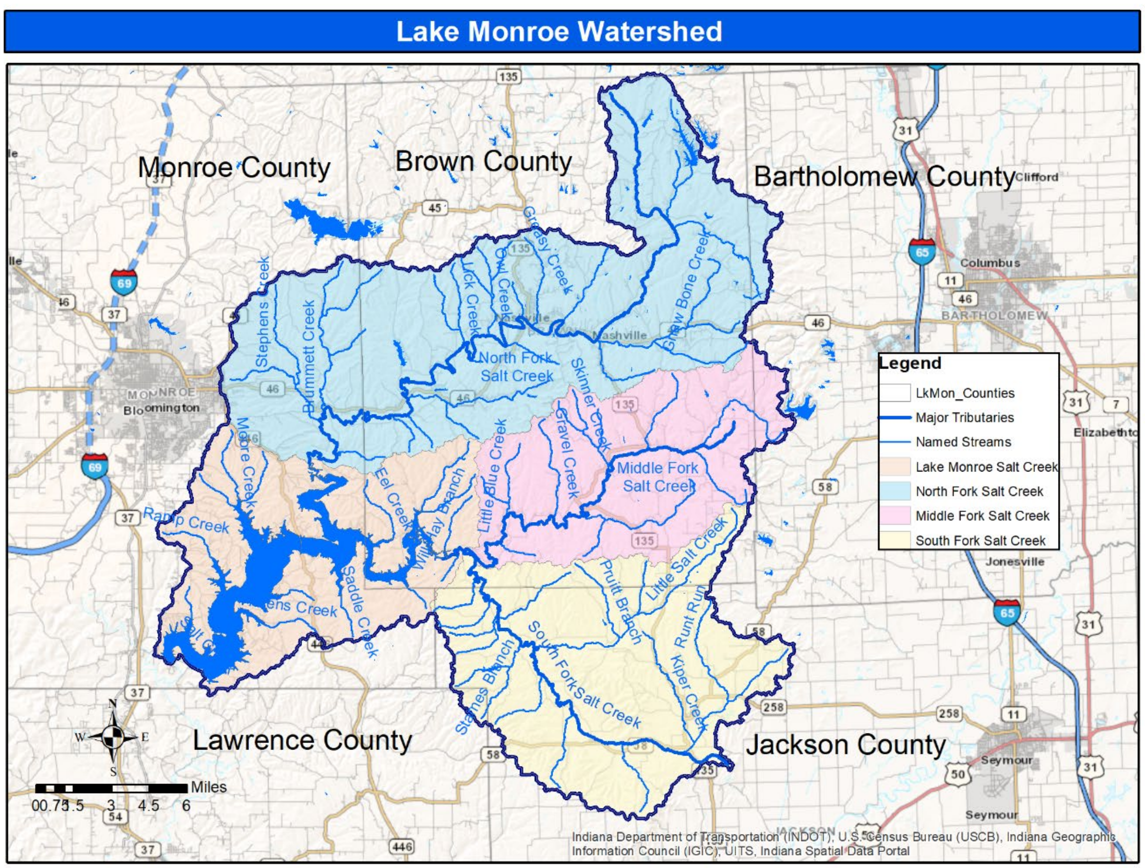
- Education of landowners is key to increasing conservation practice adoption. One landowner noted that it is easier to engage landowners in conservation practices if they have personal ownership and economic ties to their land, rather than landowners who don't earn a living or income from the land.
- All three landowners participate in programs through NRCS and mentioned the importance of outreach and education conducted by NRCS and the county soil and water conservation districts. One landowner participates in the Classified Forest Program through IDNR and mentioned forestry management trainings through IDNR, the Indiana Forestry and Woodland Owners Association, and The Nature Conservancy.
- Landowners in Brown County and Jackson County may not benefit directly from Lake Monroe and may require a different approach to explaining the importance of water quality protection.
- Planting trees, shrubs, grasses, or other buffer vegetation along streams and in floodways is key for protecting water quality though it can be hard to convince famers to take land out of production when crop prices are high.
- Several landowners mentioned that log jam removal is important but also difficult and potentially hazardous.
- Invasive species were also mentioned as an ongoing concern.

2 Description of the Lake Monroe Watershed

Lake Monroe was constructed by the United States Army Corps of Engineers (USACE) in 1964 by damming Salt Creek approximately 10 miles southeast of Bloomington. One primary purpose of the reservoir is to provide flood control in the Ohio River basin and the East Fork of the White River. Another is to provide water supply to the State of Indiana which is currently used as Drinking water for the City of Bloomington. The USACE is also required to store water for low-flow augmentation of Salt Creek and the East Fork of the White River when needed. Other benefits of the lake include recreational use, wildlife preservation, and economic development.

The drainage basin (Fig 2-1) is 441 square miles (282,240 acres) with the majority located in Brown County (56%), followed by significant portions located in Monroe County (21%), Jackson County (21%), and very small portions of Bartholomew County (2%) and Lawrence County (<1%). The drainage basin can be divided into four 10-digit Hydrologic Unit Code (HUC) regions – one for each main tributary and a fourth for the area directly surrounding Lake Monroe. The four 10-digit HUCs are Lake Monroe Salt Creek (0512020807), North Fork Salt Creek (0512020806), Middle Fork Salt Creek (0512020805), and South Fork Salt Creek (0512020804).

Figure 2-1 Lake Monroe Watershed

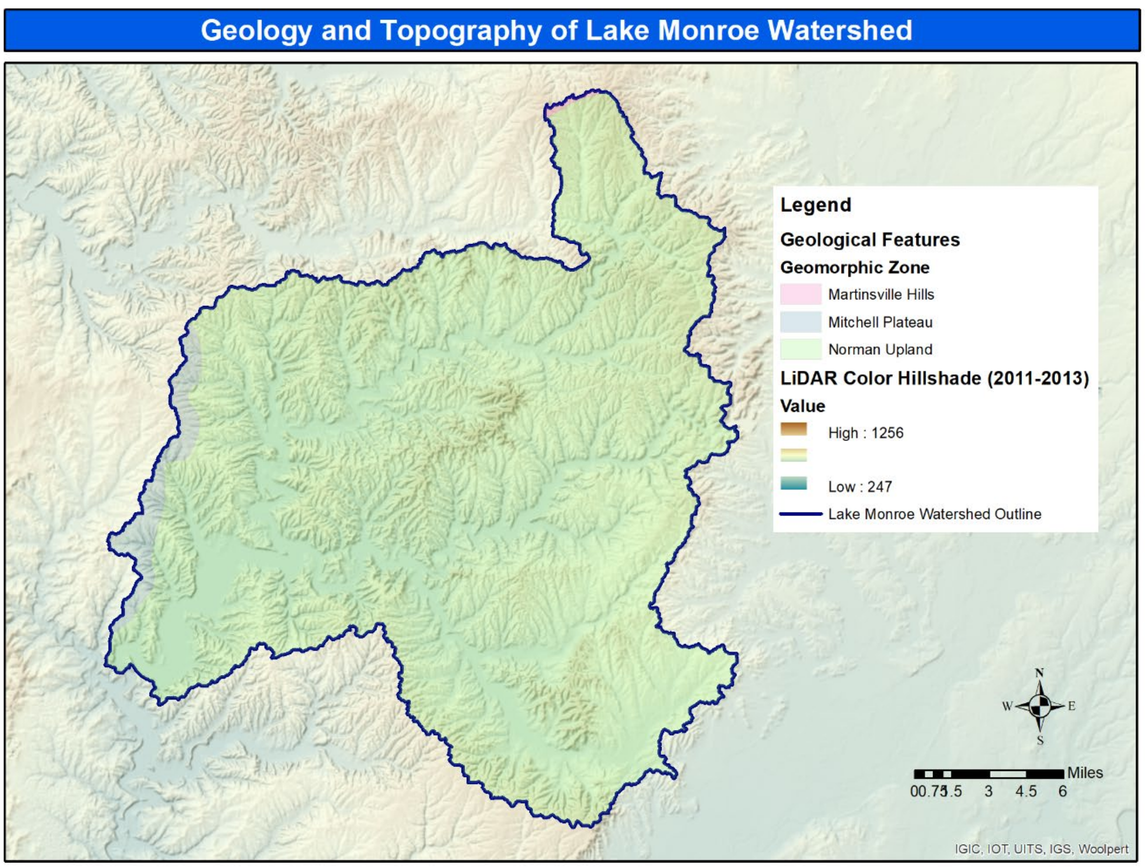


2.1 Geology and Topography

The Lake Monroe watershed lies almost entirely within the unglaciated part of the Norman Upland physiographic unit of southern Indiana (see Figure 2-2). The Norman Upland features steep, high hills and narrow valleys carved into siltstone and shale bedrock. Soils can be thin and patchy in many places, leading to limited suitability for septic systems. Topography ranges between 4 and 26 percent with an average slope of around 15 percent. Steep slopes combined with slow permeability leads to soils that are highly susceptible to erosion.

Karst features are rare in the Norman Upland area, particularly when contrasted with the Mitchell Plateau to the immediate west. A handful of sinkholes are present in the watershed, primarily in Monroe County. Sinkholes provide a potential pathway for surface water to move rapidly and directly into the subsurface with little or no filtration by soil and bedrock. For that reason, it is important to keep potential water pollutants away from sinkholes.

Figure 2-2 Geology and Topography of Lake Monroe Watershed



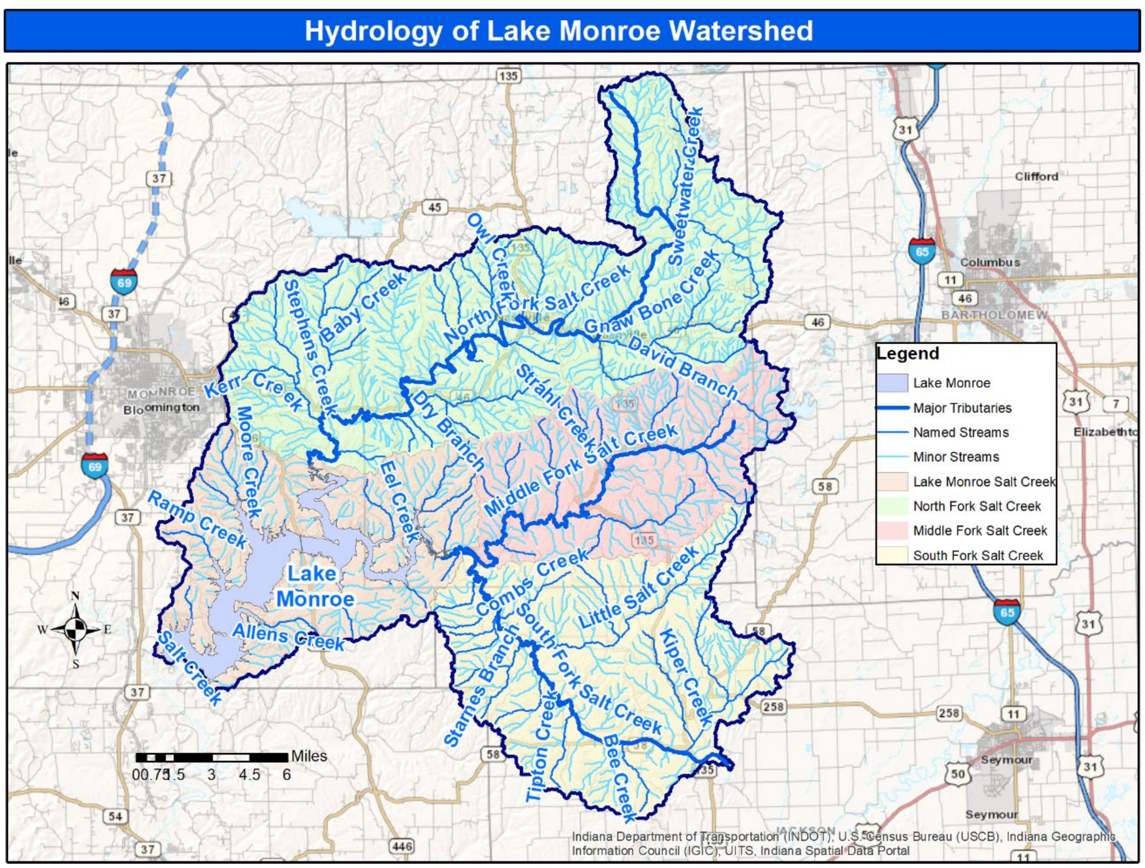
Bedrock is Mississippian and almost entirely (95%) Borden Group, comprised mostly of siltstone with lenses of crinoidial limestone in the upper part. The remaining 5% is Sanders Group, comprised mostly of skeletal limestone that is cherty in the lower part.

Topography in the Lake Monroe watershed is characterized by steep hills with a small percentage of relatively flat land located in the valleys of the three main tributaries (North Fork Salt Creek, Middle Fork Salt Creek, South Fork Salt Creek). Elevations range from about 510 feet to about 1,060 feet. Water flow is generally from east to west, converging on Lake Monroe in the southwest corner of the watershed. The steep topography is the main reason much of the watershed is forested. Attempts by early settlers to farm the hills proved unsuccessful, leading to large scale erosion and gullying. As a result, the land generally reverted to forest.

2.2 Hydrology

The Lake Monroe watershed contains approximately 1,251 miles of mapped streams (see Figure 2-3). Of these, approximately 387 miles are named. The three primary tributaries to Lake Monroe are North Fork Salt Creek, Middle Fork Salt Creek, and South Fork Salt Creek. The North Fork in particular is valued for recreational use by fishers, kayakers, and hunters. Few streams in the watershed appear to have been channelized, and no streams within the watershed are considered legal drains. There are no legal drains in Monroe or Brown Counties. The legal drains in Jackson and Bartholomew Counties are outside the Lake Monroe watershed.

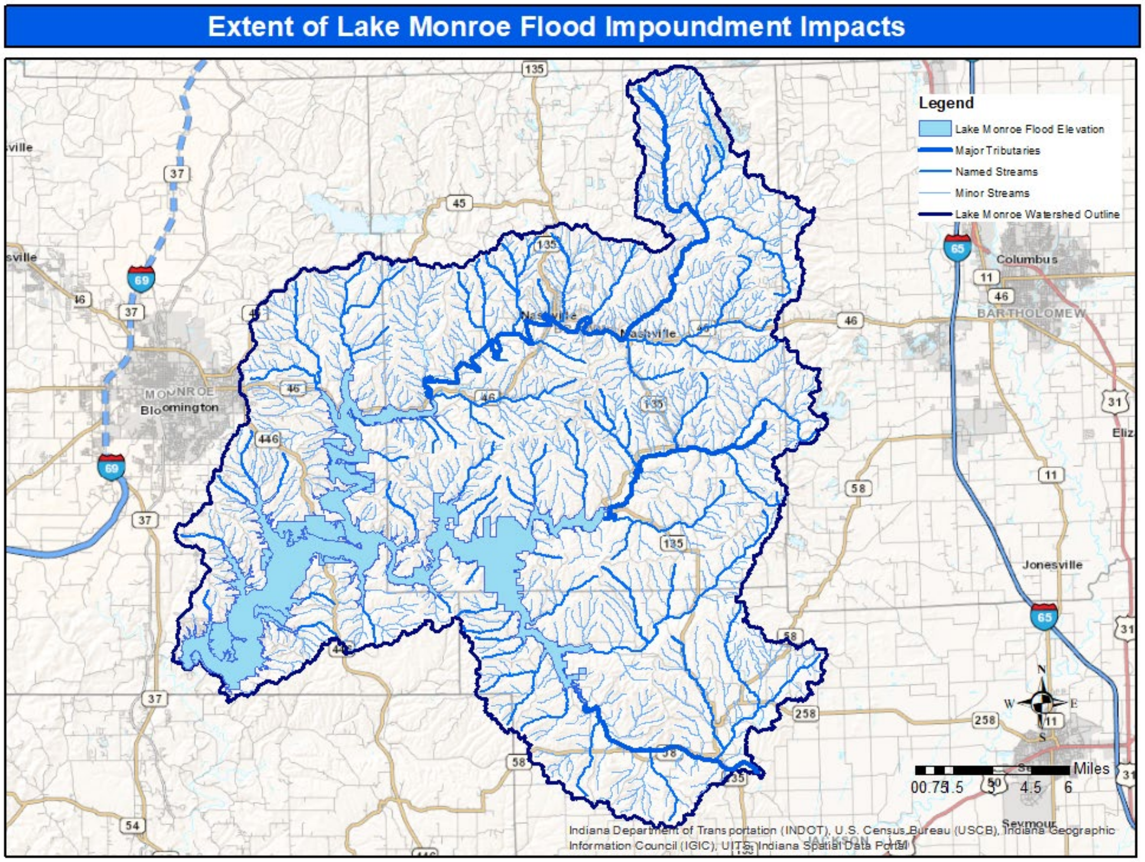
Figure 2-3 Hydrology of Lake Monroe Watershed



Many smaller streams have been dammed to create ponds and lakes for drinking water, wildlife, and recreational use (see section 2.2.4 for more details). Other hydrologic modifications include numerous bridges, culverts, and stabilization efforts along roads. Due to the steep topography of the watershed, many roads run alongside streams to take advantage of the flat valleys. As the watershed is largely rural, few storm drain systems are present and many roads rely on roadside ditches for stormwater conveyance. Ditches are periodically dredged out which leaves exposed soil that can contribute to sediment loads in the waterways. Flood control activities in Lake Monroe have the most significant impact on stream hydrology throughout the watershed. This is most notable in the streams that drain directly into the lake. In most years there is a period in the spring when heavy rains cause the water level in the lake to rise at least ten feet above normal pool elevation. In extreme flooding conditions, the level can rise as much as eighteen feet. (Normal pool elevation is 538 feet and the emergency spillway elevation is 556 feet). The Army Corps of Engineers determines how much water to release at the dam and generally the water is released slowly to prevent downstream flooding. This keeps water levels elevated in the lake for weeks or months, especially if there is heavy rainfall.

Elevated water levels in the lake affect the streams feeding into the lake, effectively turning the lower portions of the streams into still water extensions of the lake. Water flow backs up into the tributaries and becomes stagnant for several miles. This is regularly observed in the main tributaries (North Fork, Middle Fork, South Fork) as well as smaller streams that flow directly into the lake (Moore Creek, Ramp Creek, Allens Creek, Wolfpen Branch). The extent of water backing up in an extreme flood event can be approximated by examining the limits of DNR property management for Lake Monroe (see Figure 2-4) which was set based on the elevation of the emergency spillway. All areas behind the dam that are below the spillway elevation of 556 feet (area in light blue) are owned by the United States Army Corps of Engineers and managed by the Corps, the Indiana DNR, or the US Forest Service. This includes acreage along the streams that flow directly into the lake.

Figure 2-4 Extent of Lake Monroe Flood Impoundment Impacts



Impacts from water level fluctuations in the lake impact streams throughout the watershed, even the headwater ephemeral streams (personal communication with Dr. Bob Barr, IUPUI). This is true for all reservoirs. Changes in flow and streambed composition have a ripple effect that moves upstream to the very beginning of the water system. Streams by nature work to establish a steady channel slope and changes to the stream depth at the downstream end send signals to the upstream end to make adjustments. In lower elevation streams, the most commonly observed change is channel incision. Channel incision is when the streambed (bottom of the stream) digs deeper into the ground in an attempt to modify the stream slope and depth to optimize water movement. An unfortunate side effect of channel incision is that the stream becomes cut off from its floodplain, meaning it cannot overflow its regular banks as easily during large flows. The stream attempts to correct this problem by moving laterally (sideways) to try and create a new floodplain.

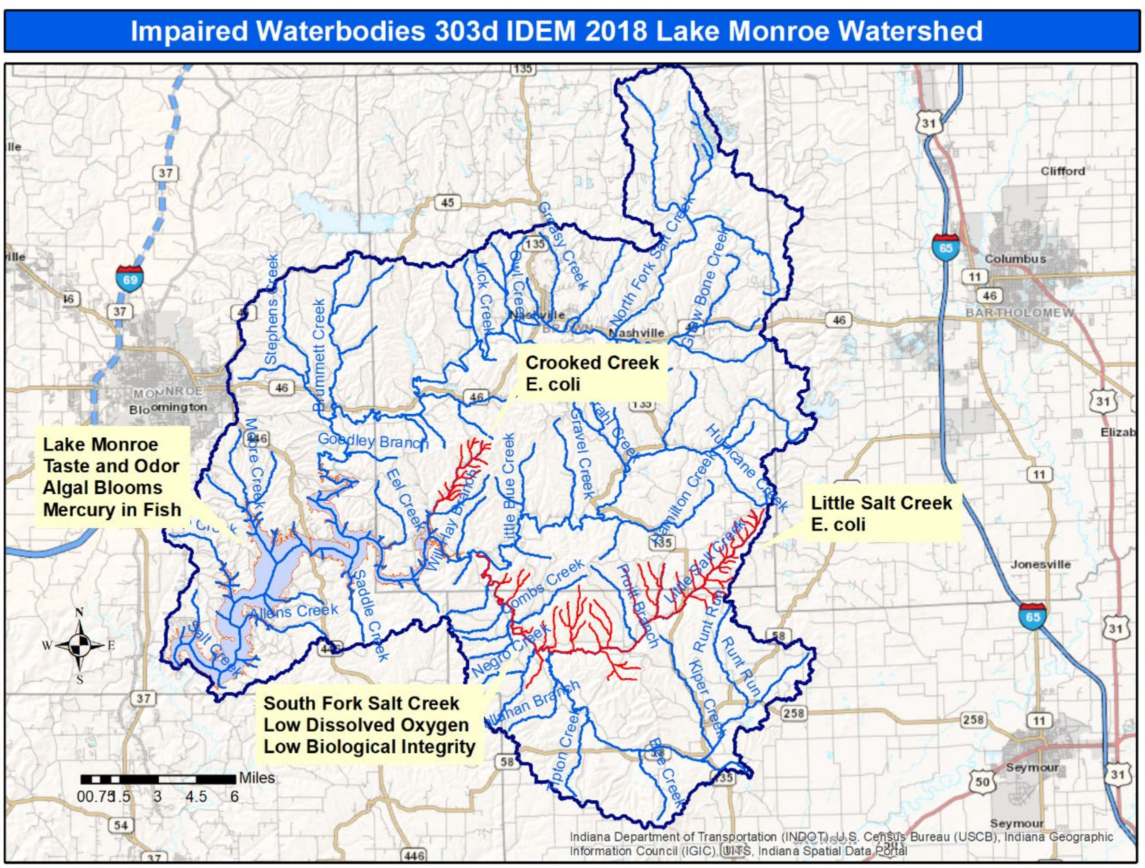
In smaller streams, particularly ephemeral headwater streams, the most commonly observed change is the creation of rills. Rills are abnormally deep channels cut into the ground where an ephemeral stream would normally be located. They often feature a headcut, meaning a location where the streambed drops suddenly in elevation. Headcuts typically migrate upstream over time as the stream attempts to find a consistent stream slope.

Channel incision, lateral movement of streams, and rills generate sediment that flows downstream and is captured in Lake Monroe. While some sediment erosion is inevitable (streams by nature move sediment downstream), these stream adjustments increase the volume of sediment being transported. Fluctuations in water level within the lake are also believed to directly exacerbate erosion of both the lakeshore and the stream banks.

2.2.1 Water Quality Impairments

According to the 2018 Impaired Water Bodies 303(d) list, there are five impaired water bodies in the Lake Monroe watershed. Little Salt Creek and Crooked Creek are impaired for E. coli. South Fork Salt Creek is impaired for dissolved oxygen and biological integrity. Both the upper and lower basins of Lake Monroe are impaired for taste and odor, algal blooms, and mercury in fish.

Figure 2-5 Impaired Water Bodies in Lake Monroe Watershed



2.2.2 Lakeshore and Stream Bank Erosion

For at least 30 years, community members have voiced concerns about Lake Monroe filling in with silt and becoming unusable for recreation or drinking water. While the issue is not nearly as dramatic or pressing as in nearby Lake Lemon, it is a valid concern for every reservoir. Reservoirs by nature trap sediment and it is important to understand the rate of sedimentation and the impacts on different sections of the lake. Anecdotal reports indicate that there are several areas around stream inlets that appear shallower than 10 or 20 years ago. More data are needed to fully understand the issue.

Figure 2-6 Lakeshore Erosion Along Lake Monroe (photo courtesy of Cathy Meyer)

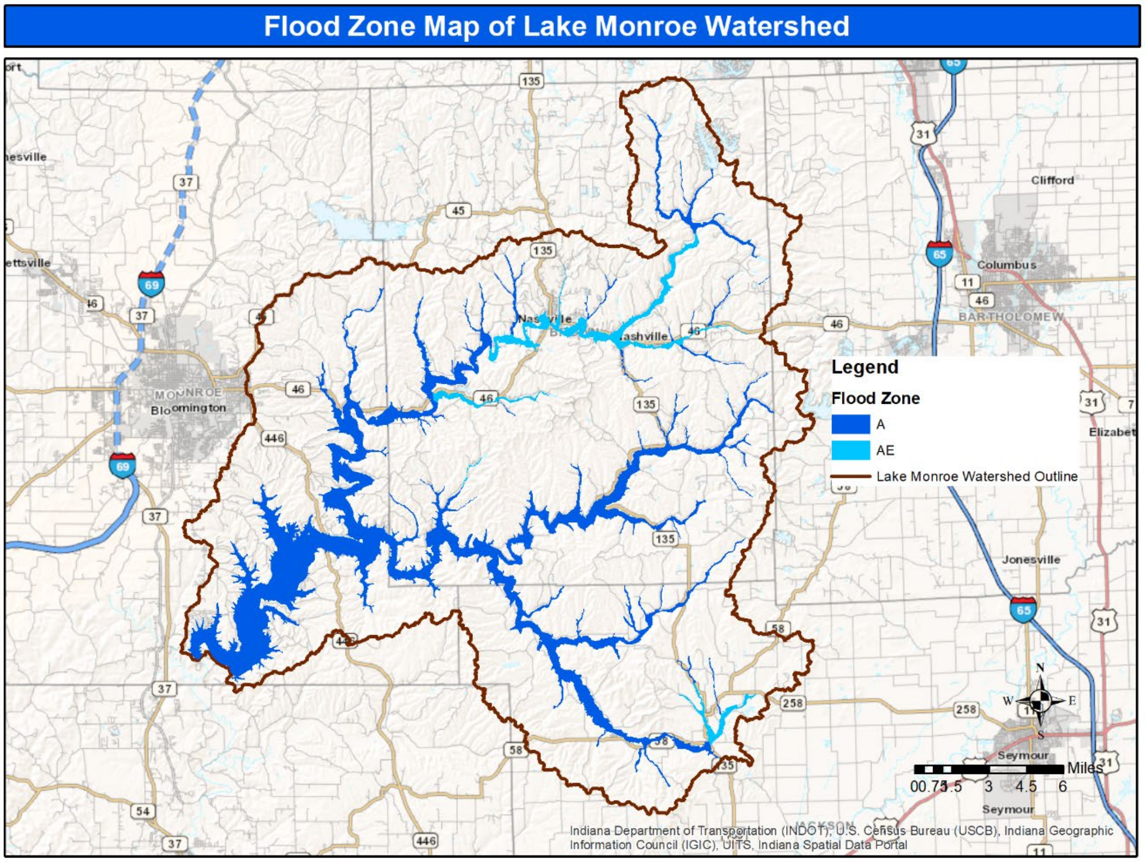
Many community members also expressed concerns about lakeshore erosion as a sediment source and an eyesore. Significant erosion is visible along several stretches of Lake Monroe's shoreline, particularly when water levels are low. Though it is difficult to quantify, shoreline erosion may be a significant source of sediment in the lake. Shoreline erosion is exacerbated by fluctuations in water level due to management of the reservoir for flood control. When water levels are elevated for an extended period of time, the soil becomes saturated and can slough off in large chunks.

Streambank erosion was also observed throughout the watershed during the windshield survey. Severe stream erosion that threatens property was noted along several smaller creeks in the watershed. Many of these areas were on residential property that was mowed to the edge of the stream, eliminating the protection of a riparian buffer. Landowners did not seem aware that their landscaping could be contributing to the problem.

2.2.3 Flooding

Another concern related to stream hydrology is that of property damage from flooding and lateral stream movement. A flood zone map from FEMA reveals wide flood zones along the main tributaries (see Figure 2-7).

Figure 2-7 Flood Zone Map of Lake Monroe Watershed



Concerns are most prominent along North Fork Salt Creek, particularly near the town of Nashville. Several businesses at the intersection of Salt Creek Road and State Road 46 (east of Nashville) flooded in 2015, 2019, and 2020. However, flooding is extremely localized and the Town of Nashville with support from the Brown County Commissioners recently requested a Letter of Map Revision to refine the Federal Emergency Management Agency (FEMA) maps in the Nashville area to more accurately reflect which properties are at risk for flooding and require flood insurance. These revisions were not yet finalized as of November 2021.

Salt Creek Preservation Group, a community group focused on cleaning and improving North Fork Salt Creek, has been working to remove problematic obstructions (log jams) to reduce erosion, improve stream flow, and mitigate flooding. Log jams have potential to increase flooding and lateral stream movement as well as obstructing recreational boating. Log jams seem to be most prevalent on the North Fork Salt Creek but it is likely they are more commonly observed there due to higher recreational traffic levels. Salt Creek Preservation Group pursued and received two IDNR Lake and River Enhancement (LARE) grants to remove logjams in the early 2010's, including one of the state's largest logjams near the Howard farm. They are currently exploring the idea of preserving and naturalizing the floodplains of North Fork Salt Creek and Middle Fork Salt Creek.

Fewer concerns were voiced along Middle Fork Salt Creek and South Fork Salt Creek, perhaps because the areas are more sparsely populated and include a lot of United States Forest Service property. Much of the land along South Fork Salt Creek is used for agriculture, primarily row crops. The Indiana Division of Natural Resources manages two units of land along South Fork Salt Creek that are rented to tenant farmers for crop production. In two of the last four years (2017-2020), tenants were not able to farm due to flooding. Private landowners have presumably had the same experience.

Flooding of roads is another concern. Several rural roads in Monroe County have a history of flooding during high water events in the lake (Monroe County Long Term Stormwater Management Plan 2016). Two notable roads near Lake Monroe are Stipp Road and Moores Creek Road. The county is currently pursuing a project to elevate portions of both roads and enhance the roadside ditches in order to decrease the frequency of flooding. Roberts Road and Valley Mission Road are also known to flood periodically due to water levels in the lake. Additional roads are known to flood periodically due to high water levels in North Fork Salt Creek (Monroe County Long Term Stormwater Management Plan 2016). These include Brummett Creek Road, Friendship Road, Gross Road, McGowen Road, Old State Road 46, and Kent Road. Baby Creek Road is prone to flooding due to its minimal elevation above Baby Creek (a tributary to Brummett Creek, a tributary of North Fork Salt Creek).

Along South Fork Salt Creek, several roads north and west of Kurtz were identified as flooding regularly, including portions of Pike Road and Cornett Road. Several smaller stream crossings in Hoosier National Forest have been updated to improve both hydrologic flow and stream biology. These crossings were designed so aquatic wildlife could move easily upstream and downstream while also permitting larger stream flows without road flooding.

Figure 2-8 Windshield Site 905 County Road 1200N at Negro Creek in Hoosier National Forest

2.2.4 Wetlands and Ponds

Many wetland areas exist in the Lake Monroe watershed, as determined by the National Wetlands Inventory (NWI). According to the NWI, approximately 17,500 acres, or 6% of the watershed, is comprised of wetlands, mostly in the form of lakes and ponds. This estimate is slightly higher than the land cover map estimation of 4.6% water coverage due to presence of numerous small ponds and wetlands that are not captured by land cover maps (developed from satellite images) but are recorded in the NWI.

Figure 2-9 NWI Wetlands in Lake Monroe Watershed

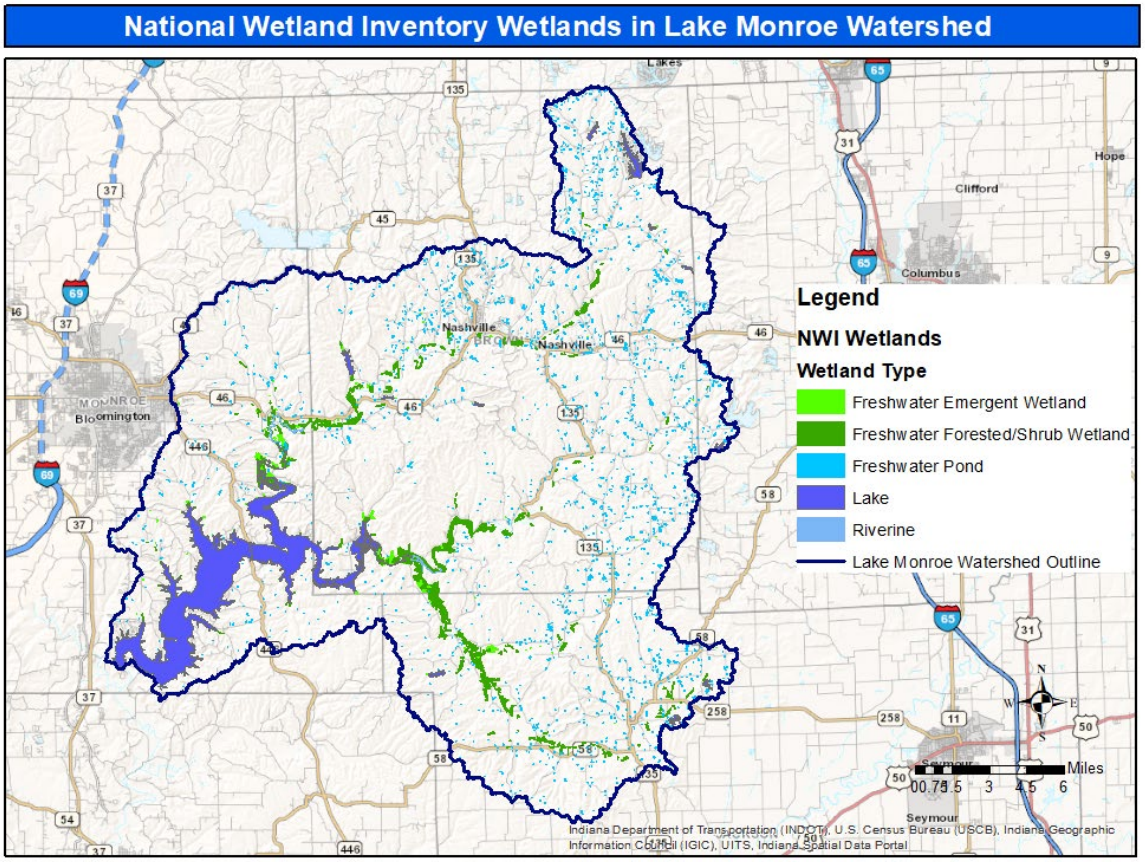


Table 2-1 Wetlands in Lake Monroe Watershed

Wetland Type	Count	Acreage	% of wetlands	% of watershed
Lake	63	11,800	67.4	4.3
Freshwater Pond	2,375	1,685	9.6	0.6
Freshwater Emergent Wetland	136	528	3.0	0.2
Freshwater Forested/Shrub Wetland	276	3,441	19.6	1.2
Riverine	3	60	0.3	0.0

Lake Monroe by itself accounts for nearly 3.8% of the watershed with other lakes making up an additional 0.5%. A summary of the 12 largest lakes is presented in Table 2-2 below. In addition, nearly 2,400 ponds are identified in the NWI, primarily in Brown County, account for another 0.6% of the watershed. Many of the ponds are used for drinking water while others are maintained for recreation, agriculture, or to attract wildlife. It should be noted that none of the lakes and ponds are naturally occurring – all are human-made impoundments.

Table 2-2 The Twelve Largest Lakes in the Lake Monroe Watershed

Lake Name	Subwatershed	Approximate Acreage
Lake Monroe	Lake Monroe	10,750
Sweetwater Lake	North Fork	280
Yellowwood Lake	North Fork	123
Lake Tarzian	South Fork	55
Green Lake	North Fork	54
Springhill Lake	South Fork	40
Sawmill Lake	Middle Fork	36
Persimmon Lake	South Fork	30
Tousley Lake	North Fork	30
Somerset Lake	North Fork	25
Hidden Valley Lake	North Fork	24
Ogle Lake	North Fork	22

Most of the remaining wetland areas (1% of the watershed) are in the form of freshwater forested/shrub wetlands. These are generally located along the three main tributaries to Lake Monroe – North Fork, Middle Fork, and South Fork Salt Creek. These stream valleys also contain freshwater emergent wetlands, which comprise about 0.2% of the watershed. Several of the wetland areas adjacent to Lake Monroe are managed for wildlife by the Indiana Department of Natural Resources, notably the Stillwater North Fork Waterfowl Resting Area, Middlefork Waterfowl Resting Area, and Southfork Marsh. These areas provide important habitat for migrating and resident waterfowl.

The Stillwater North Fork wetland complex was constructed in 1974. Low berms create multiple impoundments and small mounds create islands of dry land for nesting. IDNR staff plant a variety of crops that may include corn, millet, sunflower, sorghum, or buckwheat. The area is flooded in early October by pumping water from nearby North Fork Salt Creek to an approximate depth of 18”. The area is closed to the public October 1 to April 15 with the exception of hunting draws every three days from October through January for the 22 duck blinds in the complex. The water is slowly drained in the spring though flooding in Lake Monroe can cause water levels in North Fork Salt Creek to exceed water levels in the wetland, delaying drawdown.

2.2.5 Recreational Use

Lake Monroe is heavily used for recreation including boating, swimming, fishing, and hunting. Three public swimming beaches are available. Fairfax and Paynetown State Recreational Areas are run by the Indiana Department of Natural Resources while Hardin Ridge Recreation Area is run by the United States Forest Service. Lake Monroe also has at least one private beach (Ransburg Scout Reservation).

There are eight public boat launches on Lake Monroe operated by the Indiana Department of Natural Resources, one public boat launch operated by the United States Forest Service, and a handful of private marinas/docks. Motorboats, sailboats, kayaks, and paddle boards are all common on the lake.

According to the United States Army Corps Master Plan for Lake Monroe, there are two zones that control boat speed as well as a third unrestricted zone. Zone 1 calls for idling speeds with no wake and encompasses the entire upper basin of the lake (east of State Road 446), any area within 200 feet of the shoreline or docks, and any embayment that is less than 1,500 feet at the mouth. Zone 2 calls for idling speeds with no wake from April 16 – September 30 and is closed to watercraft to protect waterfowl habitat from October 1 to April 15. This zone encompasses the North Fork Recreational Area and the Middle Fork Recreational Area. Zone 3 is the majority of the lower basin of the lake, where there are no boating restrictions.

Some community members expressed concerns that heavy recreational use, particularly of motorboats, could be contributing to lakeshore erosion and stirring up sediment in the lakes. There are also concerns that rules are insufficiently enforced on the lake, particularly in no wake zones, and to limiting speed when passing non-motorized watercraft.

Several other lakes in the watershed also allow boating. These include Crooked Creek Lake, Yellowwood Lake, Sweetwater Lake, and Sundance Lake. Sweetwater Lake also operates a private swimming beach for its residents. Deer Run Park in Nashville has a boat launch on North Fork Salt Creek and small boats can also be launched on the creek from Brown County State Park. Brown County Wilderness Canoe Rental used to offer canoe tours of the Middle Fork Salt Creek near Story but has recently ceased operations.

Fishing is very popular in Lake Monroe and North Fork Salt Creek and occurs from boats, piers, and the shoreline. Designated waterfowl areas along the inlets of Crooked Creek, North Fork Salt Creek, and Middle Fork Salt Creek are managed for birding and hunting and are closed to the public October 1 – April 15 annually.

The Indiana Department of Natural Resources monitors algae levels at Paynetown and Fairfax public beaches in partnership with the Indiana Department of Environmental Management. Recreational advisories were issued for both beaches every year from 2011-2021 based on elevated algal cell counts.

2.2.6 Drinking Water

Lake Monroe is also a significant source of drinking water, serving over 125,000 people. Many community members expressed concerns about water quality in the lake potentially affecting drinking water quality. Others expressed concern that sediment entering the lake could accelerate the rate of siltation and lead to loss of the lake as a public water supply.
There are three organizations that the United States Army Corps of Engineers currently allows to pull water out of the reservoir:

1. City of Bloomington Utilities Water Treatment Plant (aka CBU) is permitted to draw 16-23 million gallons per day
2. Eagle Pointe Golf Resort (development on the lake in Monroe County)
3. Salt Creek Services (rural water distribution to about 90 households)

CBU distributes water directly to customers in the Bloomington area and also sells water wholesale to nine rural cooperatives. Per IDEM Drinking Water Watch, the total number of customers served via wholesale cooperatives is over 45,700.
(https://myweb.in.gov/IDEM/DWW/)

Table 2-3 Wholesale Water Distribution from Lake Monroe via CBU

Wholesale Water Company	Population Served
B and B	5,075
East Monroe	4,618
Ellettsville	12,800
Nashville	3,315
RHS	870
Shady Side	95
Southern Monroe	8,600
Van Buren	6,670
Washington Township	3,725
TOTAL WHOLESALE	**45,768**
CBU Customers	83,000
TOTAL CUSTOMERS	**128,768**

1. B and B Waters Project serves Benton and Bloomington Townships in Monroe County
2. East Monroe Water Corporation serves customers in eastern Monroe County and western Brown County.
3. Ellettsville serves the town of Ellettsville in northern Monroe County.
4. Nashville has in some years purchased water from City of Bloomington Utilities and in other years has purchased water from Brown County Utility in Morgantown.
5. The RHS Water Corporation is a rural water utility serving customers in the vicinity of Rhorer Road, Harrell Road, and Schacht Road in southern Monroe County.

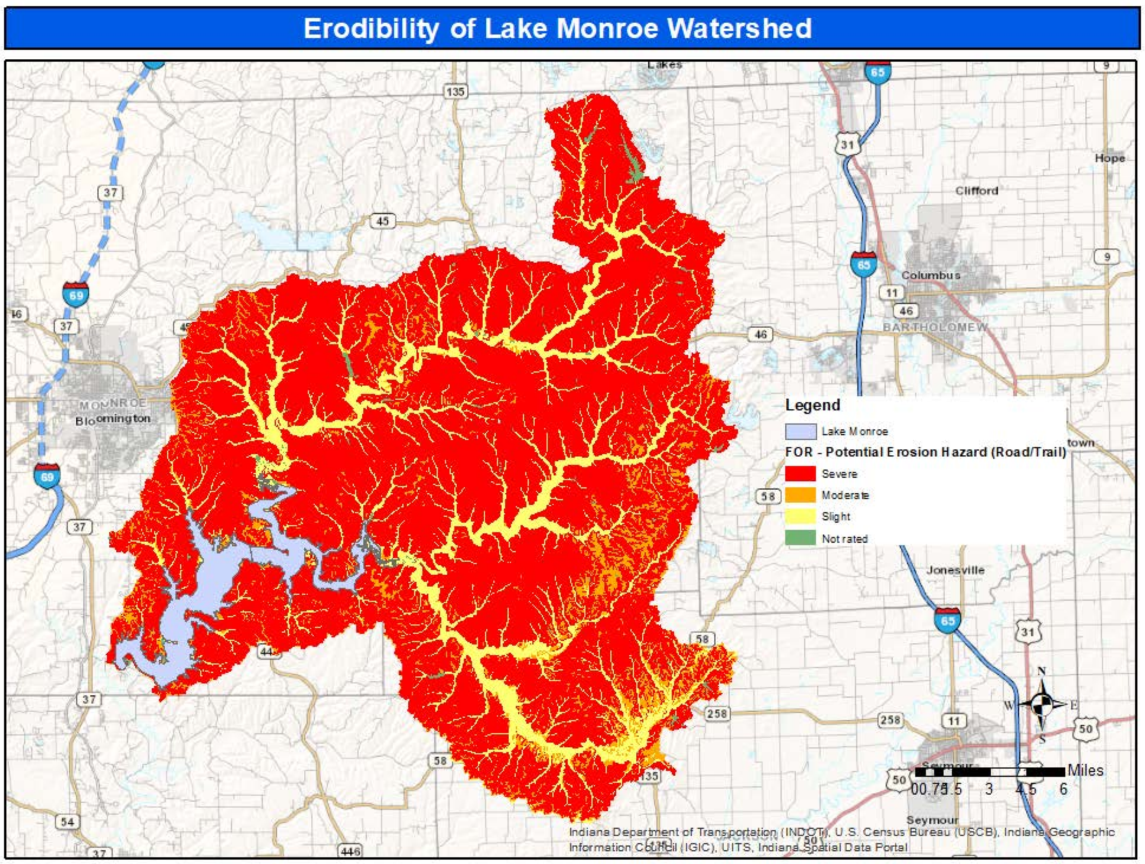
6. Shady Side serves residents on Shady Side Drive near Moore's Creek State Recreation Area.
7. Southern Monroe Water Authority serves parts of southern Monroe County near Lake Monroe in the vicinity of Fairfax Road.
8. Van Buren serves customers in Monroe and Greene Counties around the towns of Stanford and Kirksville as well as Van Buren Township and Indian Creek Township.
9. Washington Township Water serves customers in Washington, Bloomington, and Bean Blossom Townships of Monroe County; and Baker and Washington Townships of Morgan County.

2.3 Soils

2.3.1 Highly Erodible Soil

Approximately 76% of the Lake Monroe watershed is considered highly erodible due to its steep slopes and soil type. The predominant soil type (over 80%) is Wellston-Berks-Gilpin which typically occurs in upland areas and has a predominant texture of silt loam. Extensive soil erosion was recorded in the first half of the 20th century as land was cleared for farms. Subsequent efforts to restore forests and vegetative cover stabilized the remaining soil.

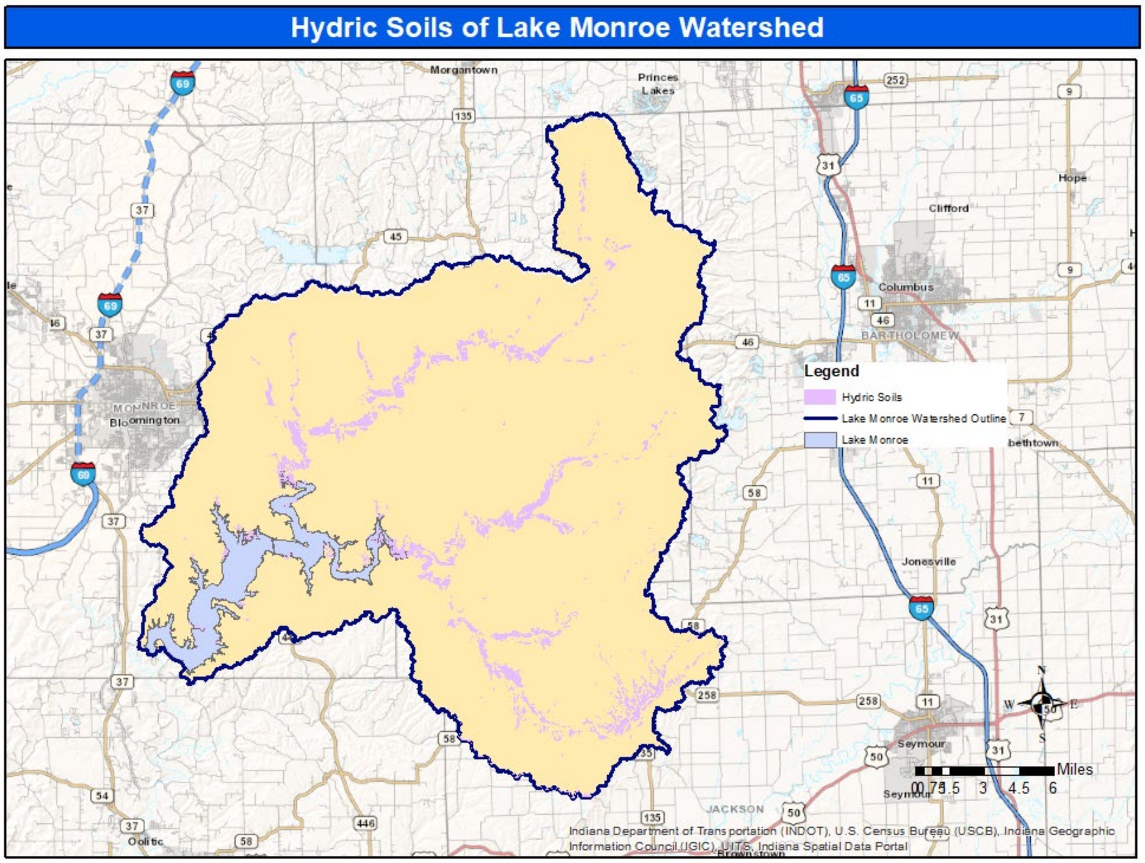
Figure 2-10 Erodibility of Lake Monroe Watershed



2.3.2 Hydric Soils

About 5% of the Lake Monroe watershed features hydric soils. These soil types are generally found in the valleys of the three branches of Salt Creek with a few instances along smaller tributaries. Several areas along the North Fork and Middle Fork are currently being preserved and managed as wetlands, as discussed in section 2.2.1. Some others are being used as farmland.

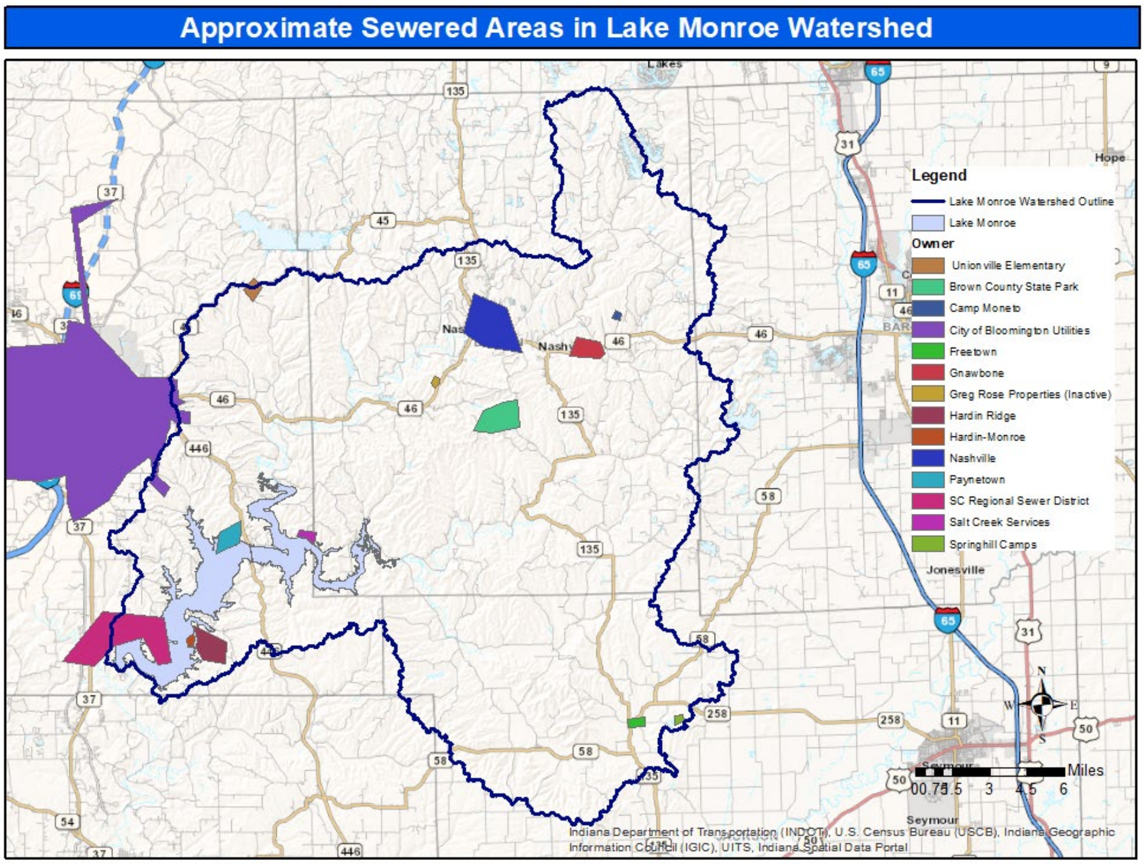
Figure 2-11 Hydric Soils in Lake Monroe Watershed



2.3.3 Septic Systems and Sewers

There are fourteen sewer systems in the Lake Monroe Watershed which serve approximately 3% of the watershed. Most of the systems are quite small, with the City of Bloomington Utilities as the primary exception.

Figure 2-12 Approximate Sewered Areas in Lake Monroe Watershed



The City of Bloomington Utilities runs a very large sewer system with two treatment plants but most of its service area and both discharge locations lie outside the watershed. The South Central Regional Sewer District also discharges outside the watershed. It serves an area along the west end of Lake Monroe that includes The Pointe, Lakewood Hills, Harbour Hills, Harrodsburg, Bryn Mawr, and Fourwinds.

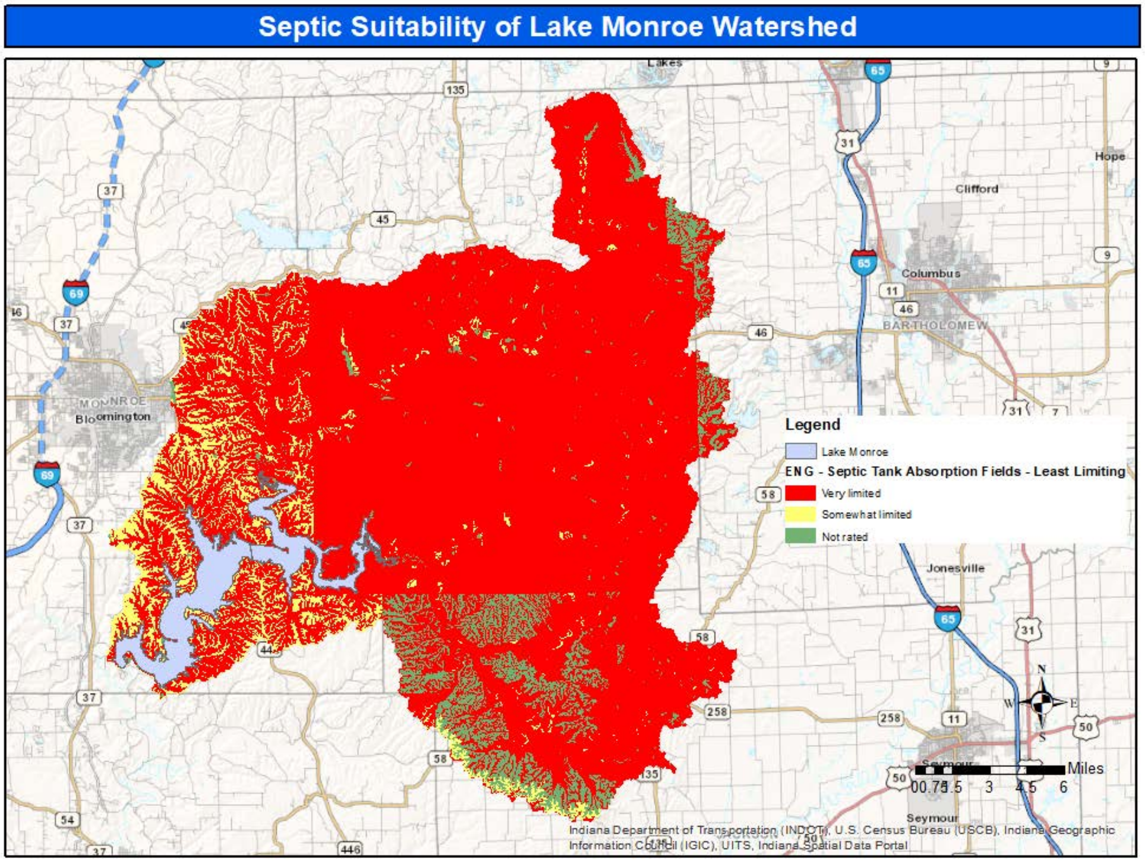
The three other significant systems in the watershed are the Town of Nashville, the Town of Gnaw Bone, and the Jackson County Regional Sewer District (in Freetown). Other systems serve small neighborhoods, recreational areas, and resident camps. The Brown County State Park treatment plant only handles the central portion of the park (campgrounds, nature center, office) while the Abe Martin Lodge sends its waste to Nashville and the horseman's camp has an on-site septic system. The Greg Rose Properties system west of Nashville has been permitted but not yet constructed as the neighborhood has not yet been developed.

Table 2-4 Sewer Systems in Lake Monroe Watershed

Wastewater Treatment Plant	Type	Discharge Location	Size
City of Bloomington (2 WWTPs)	Municipal	Outside Watershed	21.00 MGD
Town of Nashville	Municipal	North Fork Salt Creek	0.60 MGD
Town of Gnaw Bone	Municipal	Unnamed Tributary to Gnaw Bone Creek	0.05 MGD
Jackson County Regional Sewer District	Municipal	Little Salt Creek	0.09 MGD
South Central Regional Sewer District	Private	Outside Watershed	0.30 MGD
Hardin-Monroe	Private	Lake Monroe	0.03 MGD
Greg Rose Properties (Inactive)	Private	Schooner Creek	0.01 MGD
Brown County State Park	Government	Schooner Creek	0.04 MGD
Salt Creek Services	Private	Unnamed Tributary to Lake Monroe	0.02 MGD
Paynetown State Park	Government	Lake Monroe	0.05 MGD
Hardin Ridge	Government	Jarrell Ditch to Lake Monroe	0.03 MGD
Camp Moneto (near Gnaw Bone)	Private	Unnamed Tributary to Gnaw Bone Creek	0.02 MGD
Springhill Camps (near Freetown)	Private	Unnamed Tributary to Little Salt Creek	0.02 MGD
Unionville Elementary School	Semi-public	Unnamed Tributary to Brummett Creek	0.02 MGD

The remaining 97% of the watershed depends on septic systems for wastewater disposal, despite data from the NRCS Soil Survey showing that the Lake Monroe watershed is poorly suited for septic systems (see Figure 2-13). Approximately 82% is rated as “Very Limited” and another 7% is rated as “Somewhat Limited.” The remaining 11% is “Not Rated.” Several streams in the watershed are listed as impaired for E. coli in the 2018 IDEM 303d impaired streams list. Community members have expressed concerns for other streams as well, particularly in Brown County where investigations are underway to determine if additional sewer systems might be appropriate. It is unclear whether E. coli is coming from human wastewater or if the source is animals such as livestock or wildlife.

Figure 2-13 Septic Suitability of Lake Monroe Watershed



It should be noted that county soil surveys provide general information on whether or not a certain area is likely to have suitable soils. An on-site investigation may reveal an area within a particular site that is suitable for a conventional or modified onsite system to treat wastewater. Septic systems are comprised of a septic tank for settling out solids and a soil absorption field (aka leach field) to treat the wastewater via filtration through the soil.

Purdue University published a Census of Wastewater Disposal by Indiana County using soil survey data and census data from 1990 (the last year census takers were asked about wastewater disposal). Despite the fact that soils have poor septic system suitability, they are widely used. In 1990, 90% of Brown County households were served by onsite systems as were 35% of Jackson County households and 30% of Monroe County households. Using household counts from the 2018 census, percentage of septic system usage from the 1990 census, and approximate acreage within the watershed for each county, this data indicate that there are roughly 9,000 septic systems in the watershed. Over half are in Brown County and only about a tenth are in Jackson County. The Monroe County estimates may be a little high – the number of households in Monroe County increased significantly between 1990 and 2018 (approximately 35%) and it is unclear how much was in the Lake Monroe watershed and how much within the watershed was within sewered areas.

Table 2-5 Estimated Number of Septic Systems in Lake Monroe Watershed

County	1990 Percent of Households on Septic*	% of the county that is in the watershed**	2018 Census Data Households per County	2018 Estimated Number of Households on Septic in Watershed
Brown	90%	78%	6,093	4,286
Jackson	35%	18%	16,746	1,056
Monroe	30%	23%	55,537	3,754
TOTAL				**9,096**

*Note: Percent of households with each wastewater disposal method are from the 1990 Census, which continues to be the most recent information.
https://engineering.purdue.edu/~frankenb/NU-prowd/census.htm
**Note: The percentage of the county that is in the watershed is different from the previously referenced percentage of the watershed that is in each county.

Brown County in particular has grappled with questions about septic systems for many years. There were no rules for septic systems until approximately 1977 so it is unclear what kinds and sizes of systems were installed for homes built in the 1950's and 1960's. Records are limited for systems built throughout the 20th century. The Brown County Health Department is currently working to digitize its records and the Brown County Regional Sewer District is working to develop a strategic wastewater management plan for all unsewered areas within the county (further discussed section 2.5.5).

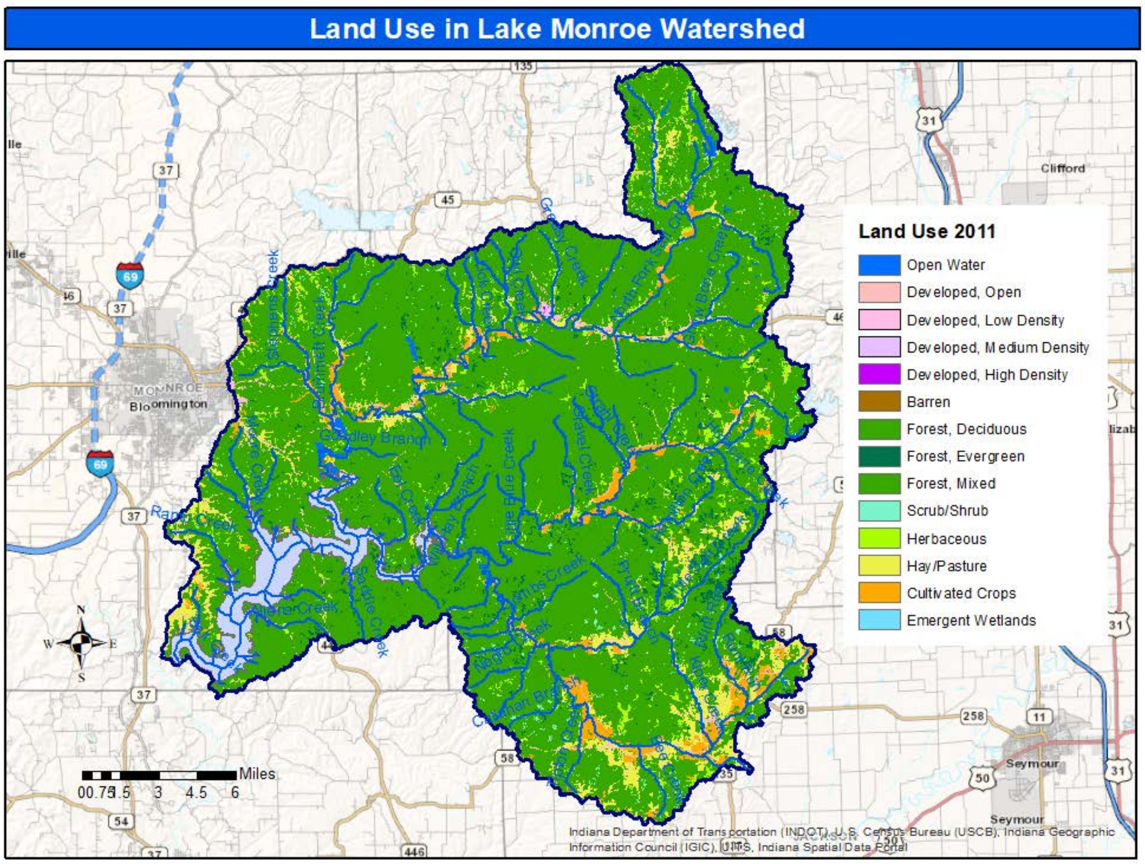
There are a few high density residential areas within the watershed that are not served by wastewater treatment plants. Probably the densest is Sweetwater Lake, part of the Cordry-Sweetwater Conservancy in northeastern Brown County. Approximately 1,500 houses have been built around the two lakes in a 2,300-acre area and all are served by septic systems. The Conservancy conducts a mandatory inspection and maintenance program to ensure that septic systems within the Conservancy are fully operational.

2.4 Land Cover

2.4.1 Overview

Unlike most watersheds in Indiana, the Lake Monroe watershed is largely forested (see Figure 2-14). Approximately 82% of the watershed is forested including large tracts of land managed by the Indiana DNR and the United States Forest Service. Other forested areas in Brown and Jackson County are generally comprised of small homesteads where the owners may or may not actively manage their forest.

Figure 2-14 Land Cover in Lake Monroe Watershed



Many community members expressed concern about potential water quality impacts from forest management activities such as logging, burning, and applying herbicides/pesticides. While Indiana has developed guidelines for Forestry Best Management Practices, there are no laws or regulations requiring their use. There were anecdotal reports of timber buyers offering owners cash and coming to harvest timber without developing a contract, management plan, or erosion control strategy and without engaging a certified forester.

Development is very low density with only the town of Nashville and the outskirts of the city of Bloomington registering as medium intensity developed land. Development in Nashville and Brown County is relatively slow, with the county population projected to decline over the next twenty years. In contrast, development is increasing in Bloomington and Monroe County, with many new subdivisions appearing southeast of Bloomington in the Lake Monroe watershed. Monroe County has restrictions in place to guide development in the watershed via the Environmental Constraints Overlay (ECO) Zone and construction sites are regularly inspected through the MS4 storm water program, as discussed in the planning section below.

There are three golf courses located within the watershed. The Golf Club at Eagle Pointe is located in Monroe County along the west end of Lake Monroe. Salt Creek Golf Course is located just east of Nashville in Brown County and straddles North Fork Salt Creek. Brown County Country Club is located just north of Nashville and recently (circa 2016) transitioned into a disc golf course. These are likely to be areas that regularly apply fertilizer, along with lawns in the more developed sections of the watershed.

Developed areas are also more likely to have concentrated amounts of pet waste, though it was not explicitly mentioned during community forums. Wildlife were identified as a potential source of fecal contamination, particularly in the forested portion of the watershed. Deer are prevalent in the area along with many species of birds and small mammals. Geese were mentioned as a concern at Sweetwater Lake and are likely present at smaller lakes and ponds around the watershed as well.

Agriculture is primarily limited to the valleys formed by each branch of Salt Creek (North Fork, Middle Fork, and South Fork) and a few of the larger tributaries. The primary agricultural activity is hay/pasture for cows and horses, followed by cultivated crops (generally a rotation of corn and soybeans).

Table 2-6 Land Cover in Lake Monroe Watershed

Land Cover	Approximate Acreage	Approximate Percentage
Forested	230,937	81.8%
Water/Wetlands	13,004	4.6%
Hay/Pasture	11,670	4.2%
Cultivated Crops	9,926	3.5%
Herbaceous	8,333	3.0%
Developed	6,085	2.2%
Other	2,285	0.8%

Both cows and horses are common in Brown and Jackson Counties. Horses are more prevalent in Brown, as are small “hobby farms.” Some of the land identified as herbaceous is likely to be hay fields or fallow fields.

Land cover was also analyzed at the subwatershed level to give a general idea of variation. The South Fork subwatershed contains the highest concentration of pasture, crops, and developed land though the densest development is in the North Fork subwatershed. The Lake Monroe Basin subwatershed has the highest concentration of open water.

Table 2-7 Land Cover by HUC-10 Subwatershed

Subwatershed	Forest	Water/ Wetlands	Hay/ Pasture	Crops	Herbaceous	Developed	Other
North Fork	86.5%	1.0%	2.6%	3.1%	3.5%	2.5%	0.8%
Middle Fork	87.7%	0.3%	2.1%	4.0%	3.9%	1.4%	0.5%
South Fork	78.3%	0.5%	8.4%	6.5%	2.7%	2.6%	1.1%
Lake Monroe	72.4%	19.6%	3.7%	0.5%	1.4%	1.6%	0.7%

2.4.2 Tillage Transect

Tillage transects are conducted twice a year by county soil and water conservation districts. These windshield surveys provide county-level data of the usage of cover crops and conservation tillage. The fall transect measures how many farms have left crop residue on the field (rather than tilling after harvest) and how many farms have planted a cover crop for winter soil stabilization. The spring transect determines how many farms are practicing conservation tillage (including no-till farming) by planting into crop residue without tilling the soil. Both evaluations differentiate between crop land that was most recently used for corn and crop land that was most recently used for soybeans. Corn leaves a heavier crop residue than soybeans.

Table 2-8 Conservation Practices in Lake Monroe Watershed per Tillage Transect

Conservation Practice Adoption by Percentage	Brown County	Monroe County	Jackson County	Statewide Average
Spring Corn Residue Not Tilled (%)	23	44	72	23
Spring Soybean Residue Not Tilled (%)	71	55	72	51
Fall Corn Residue Not Tilled (%)	98	100	85	71
Fall Soybean Residue Not Tilled (%)	100	98	85	76
2019 Cover Crops in Corn (%)	17	0	23	6
2019 Cover Crops in Soybeans (%)	42	13	29	10.5
2019 Cover Crops (acres)	1,148	989	26,469	N/A

Based on the fall tillage transects, most farms in Brown, Monroe, and Jackson Counties retain crop residue on their fields for the winter months. Brown and Monroe Counties have almost 100% participation while Jackson County is at 85% for both corn and soybeans, still significantly above the state average of 71% for corn and 76% for soybeans.

Based on the spring tillage transects, conservation tillage is most prevalent in Jackson County with 72% of both corn and soybean farms retaining crop residue during spring planting. In Brown and Monroe Counties, conservation tillage was much more common for fields that had previously been planted in soybeans, perhaps because soybean residue is minimal compared to corn. Brown County had 71% conservation tillage while Monroe County had 55% compared to a statewide average of 51%. For fields that had previously been planted in corn, Monroe County had 44% use of conservation tillage while Brown County matched the statewide average of 23%.

With the exception of corn fields in Monroe County, cover crop usage in the target counties is much higher than the statewide average, in terms of percentage. Cover crops on soybean fields ranged from 13-42% as compared to the statewide average of 10.5%. Cover crops on corn fields were more varied, with 0% adoption recorded in Monroe County, 17% in Brown, and 23% in Jackson versus a statewide average of 6%. It appears that the use of cover crops on fields that previously held soybeans is more common than on fields that previously held corn.

Table 2-9 Conservation Practices in Lake Monroe Watershed by Acreage

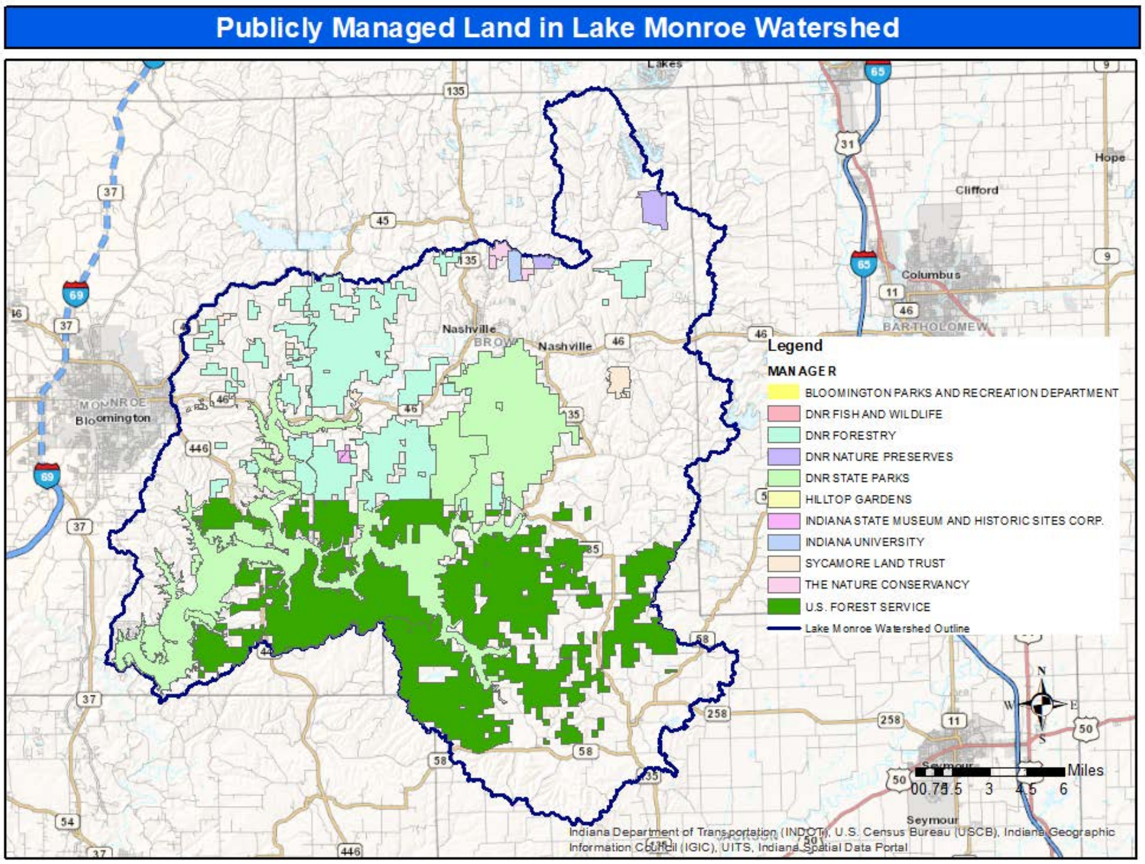
Conservation Practice Adoption by Acreage	Brown County	Monroe County	Jackson County	Statewide Total
Spring Corn Residue Not Tilled (acres)	424	2,532	39,601	1,230,000
Spring Soybean Residue Not Tilled (acres)	1,617	3,897	56,086	3,125,000
2019 Cover Crops in All Crops (acres)	1,148	989	26,469	950,000
2019 Cover Crops in Corn (acres)	334	0	7,929	330,000
2019 Cover Crops in Soybeans (acres)	814	989	18,540	585,000
2019 Cover Crops in Fallow Land (acres)	512	378	6,912	230,000

It should be noted that row crops are much more prevalent in Jackson County than in Brown or Monroe. Per the 2017 USDA Census of Agriculture, Jackson County has over 130,000 acres of cropland compared to roughly 10,000 acres in Monroe County and 3,000 acres in Brown County. There is also significant variation of farm size within each county. Generally, farming is more prevalent and farms are much larger outside the Lake Monroe watershed, meaning the county-level data may not always represent farms within the watershed, particularly in Jackson County.

2.4.3 Public Lands

Approximately 42% of the land in the Lake Monroe watershed is publicly owned by either Indiana or the United States (see Figure 2-15). About 27% is owned by the federal government and 16% is owned by the state government. Of the federal property, about two-thirds belongs to the United States Forest Service (USFS) and about a third belongs to the United States Army Corps of Engineers (USACE). The USACE property contains Lake Monroe and most of the surrounding land up to the designated flood elevation, which includes portions of North Fork, Middle Fork, and South Fork Salt Creek. This area, totaling 22,663 acres and comprising 9% of the watershed, is leased to and managed by the Indiana Department of Natural Resources State Parks Division. This lease was extended in the early 21st century to run until 2032. Therefore, from a management standpoint, 18% of the land in the watershed is managed by the federal government and 25% is managed by the state government.

Figure 2-15 Publicly Managed Land in Lake Monroe Watershed



A little less than one fifth (18%) of the watershed is owned and managed by the United States Forest Service, primarily in southern Brown County and northwestern Jackson County. This includes parts of the Hoosier National Forest and all of the Charles Deam Wilderness Area. Lake Monroe up to its flood elevation (as determined by the emergency spillway elevation of 556 feet) makes up another 9%. Other significant holdings include Yellowwood State Forest (7%), portions of Morgan-Monroe State Forest (2%), and Brown County State Park (6%), all under the jurisdiction of the Indiana Department of Natural Resources.

There are also several nature preserves and research forests that are owned and protected by private and semi-private organizations such as the Nature Conservancy (0.2%), Sycamore Land Trust (0.4%), and Indiana University (0.1%).

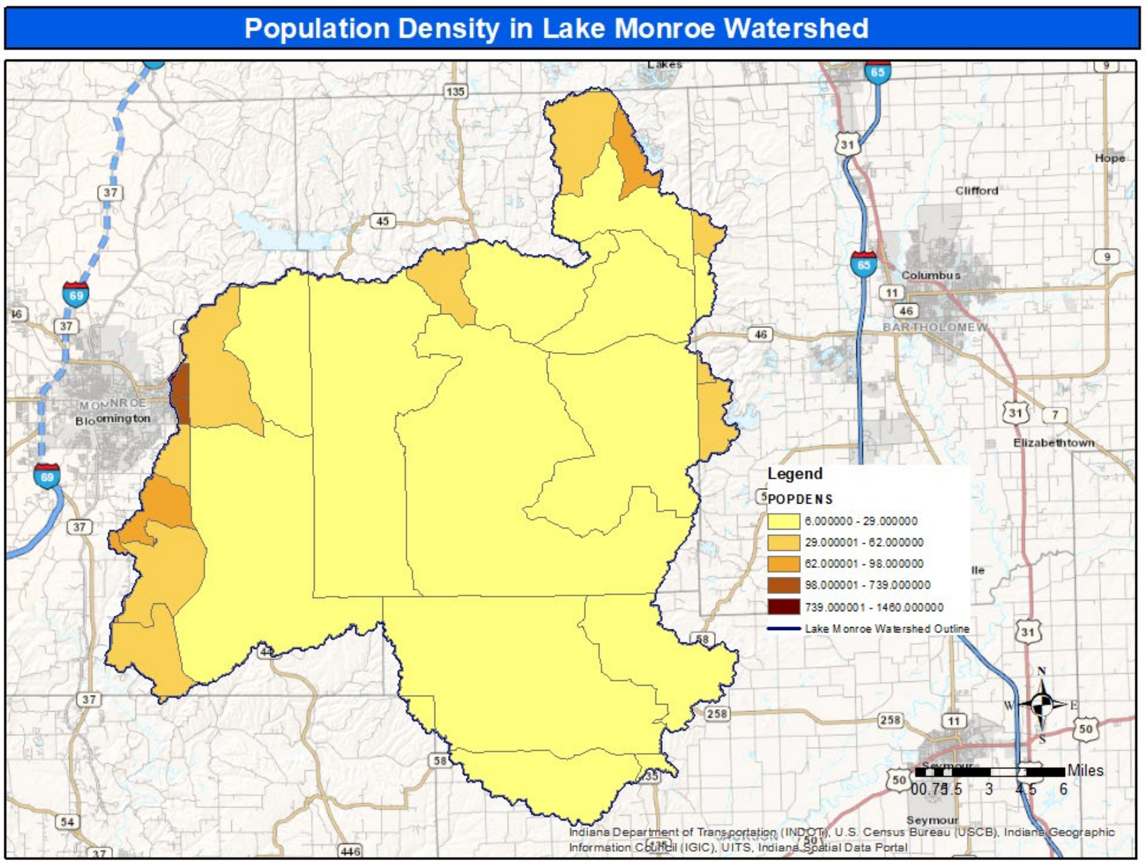
Table 2-10 Public Land in the Lake Monroe Watershed

Property	Owned By	Managed By	Acreage	% of Watershed
Hoosier National Forest	U.S. FOREST SERVICE	U.S. FOREST SERVICE	40872.92	14.8%
Charles Deam Wilderness (HNF)	U.S. FOREST SERVICE	U.S. FOREST SERVICE	9104.60	3.3%
Lake Monroe	U.S. ARMY CORPS	DNR STATE PARKS	24801.70	9.0%
Brown County State Park	DNR STATE PARKS	DNR STATE PARKS	16140.04	5.8%
Yellowwood State Forest	DNR FORESTRY	DNR FORESTRY	18932.21	6.8%
Morgan-Monroe State Forest	DNR FORESTRY	DNR FORESTRY	5142.95	1.9%
DNR Nature Preserves	DNR NATURE PRESERVES	DNR NATURE PRESERVES	1116.44	0.4%
T.C. Steele State Historic Site	INDIANA STATE MUSEUMS	INDIANA STATE MUSEUMS	192.52	0.1%

2.4.4 Population Density

Population density in the Lake Monroe watershed is generally low with over 80% of the watershed showing a density of less than 29 persons per square kilometer (compared to the national average of 36 and the state average of 72). Density is highest near Bloomington (west edge of the watershed), Nashville (north central edge), Sweetwater Lake (northeast), and Grandview Lake (east).

Figure 2-16 Population Density in Lake Monroe Watershed



2.4.5 Potential Pollution Sources

A desktop survey was conducted in 2020 to identify pollution sources that are documented in state and federal databases. IndianaMAP, a publicly available collection of Indiana geographic information system (GIS) map data, was used to determine what facilities of interest are located within the watershed.

<u>NPDES Facilities</u>

Several types of facilities and discharges are regulated by the National Pollutant Discharge Elimination System (NPDES). This program is administered by IDEM and the USEPA to regulate direct (point source) discharges. Permits are issued for each facility and limits are established for the amount of each pollutant that the facility is allowed to discharge into waters of the state. There are several different types of permits including: sanitary wastewater, construction storm water, municipal storm water, industrial storm water, and industrial process water. There are 14 sites within the Lake Monroe watershed with NPDES permits for wastewater discharges (13 from wastewater treatment plants and 1 from drinking water treatment plants) and 2 sites with unspecified NPDES permits.

Table 2-11 NPDES Facilities in the Lake Monroe Watershed

Facility	NPDES-ID	Address	City	Subwatershed
SPRINGHILL CAMPS	IN0044211	2221 W SR 258	FREETOWN	Kiper Creek (SF)
JACKSON COUNTY WWTP	IN0052949	4241 W CR 675 N	FREETOWN	Kiper Creek (SF)
GREG ROSE PROPERTIES	IN0063789	1462 SR 46 W	NASHVILLE	Clay Lick (NF)
WRIGHTS AUTO PARTS	INRM00827	4881 OLD SR 46	NASHVILLE	Clay Lick (NF)
SHELBY MATERIALS INCORPORATED	INRM01001	SR 46 E and SR 135 S	NASHVILLE	Clay Lick (NF)
NASHVILLE WWTP	IN0023876	10 W SR 46	NASHVILLE	Clay Lick (NF)
GNAW BONE WWTP	IN0060526	108 MT LIBERTY RD	GNAW BONE	Gnaw Bone (NF)
CAMP MONETO WWTP	IN0048453	551 N CAMP MONETO RD	NASHVILLE	Gnaw Bone (NF)
BROWN COUNTY STATE PARK	IN0030325	SR 46 and SR 135	NASHVILLE	Brummett (NF)
UNIONVILLE ELEMENTARY	IN0041009	8144 E SR 45	UNIONVILLE	Brummett (NF)
SALT CREEK SERVICES INC	IN0043699	GILMORE RIDGE and DECKARD RIDGE	MONROE COUNTY	Crooked (LM)
SOUTH CENTRAL INDIANA RSD WWTP	IN0050105	8980 ELLA STREET	BLOOMINGTON	Moore Creek (LM)

Facility	NPDES-ID	Address	City	Subwatershed
HARDIN MONROE INC	IN0038326	8029 HARDIN RIDGE RD	HELTONVILLE	Allens Creek (LM)
USDA FOREST SERVICE HARDIN RD	IN0024953	6464 HARDIN RIDGE ROAD	HELTONVILLE	Allens Creek (LM)
PAYNETOWN SRA WWTP	IN0030163	4850 S SR 446	BLOOMINGTON	Moore Creek (LM)
CBU/MONROE COUNTY WTP	IN0060810	7470 SHIELDS RIDGE RD	BLOOMINGTON	Moore Creek (LM)

A detailed discussion of the facilities and issues identified from a review of the IDEM Virtual Filing Cabinet is provided in the subwatershed analysis in Appendix J. Two facilities were found to have ongoing concerns.

The Nashville wastewater treatment plant has been operating under an agreed order since 2019 when IDEM issued a notice of violation and proposed agreed order for the plant. The primary issue is documented and alleged overflows to North Fork Salt Creek. The town of Nashville has been working to remedy the issues at the plant and has also started work on a sanitary sewer utility master plan. This study will determine how well the plant is currently functioning, investigate options for expansion or reconstruction, and explore possibilities for expanding service outside town limits. One of the challenges that the treatment plant faces is its location in the floodway of North Fork Salt Creek, meaning it is at high risk for flooding. There are additional studies being conducted to explore the possibility of a treatment plant that would serve multiple communities. The Brown County Regional Sewer District is working on its own plan for all areas of the county that are not currently served by wastewater treatment plants.

The Brown County State Park wastewater treatment plant handles wastewater from the central portion of the park (campgrounds, nature center, office) while the Abe Martin Lodge sends its wastewater to the Nashville treatment plant and the horseman's camp has an on-site septic system. The treatment plant has received and responded to a series of compliance letters since 2015. Issues include repeated instances of inflow/infiltration into the sewage system causing potential overflows, an exceedance in E. coli levels in June 2016, and a sewer overflow that may have reached North Fork Salt Creek in March 2020. The park will most likely close down their WWTP and begin sending all their waste to the Nashville WWTP in 2023.

<u>CAFOs/CFOs</u>

There are no documented Confined Feeding Operations (CFO) or Concentrated Animal Feeding Operations (CAFO) within the watershed per IDEM's Confined Feeding Operation Facilities map. There is one CFO that is right outside the Kiper Creek (South Fork) watershed and that is Rose Acre Farms Brooder Farm at 7585 CR 100W in Jackson County.

Manure Land Application

There is one large commercial dairy farm, Wagler Farms, that has permits to apply manure on cropland as fertilizer on a number of fields in Brown County. IDEM rules treat manure application as proprietary and do not require disclosure of information about how much manure is land-applied in a given watershed or a given field. There are also no local ordinances that requires reporting on this topic. Kenny Wagler stated in an interview that they do not apply manure within the Lake Monroe watershed as it is too far from the dairy to make transportation worthwhile. He did provide a tour of a farm field in the adjacent Bean Blossom watershed and explained that manure is injected into soil rather than being surface applied.

Municipal Sludge Application

Jackson County Regional Sewer District operates a waste water treatment plant in Freetown and has a permit for applying municipal sludge but it is unclear when and where sludge has been applied.

2.5 Existing Planning Efforts

2.5.1 County Comprehensive Plans

The Lake Monroe watershed encompasses portions of five counties. Approximately 56.1% of the watershed is within Brown County, 21% is within Monroe County, 20.7% is within Jackson County, 1.9% is within Bartholomew County, and 0.3% is within Lawrence County.

Brown County last updated its Comprehensive Plan in 2011. Its plan is a Policy Plan, which does not include a proposed future land use map but does outline goals, objectives, and policies. The plan emphasizes fostering economic development while conserving the county's natural and cultural heritage. Modest growth of about 7% per decade is anticipated and is encouraged to occur in areas where both approved water supply and approved sewage handling facilities can be provided. However, more recent data indicate that population growth has been negligible since 2010. Brown County does not have any local ordinances in place regarding erosion control or slope restrictions. IDEM has authority to regulate any area of land disturbance greater than one acre.

Jackson County adopted a Comprehensive Plan in 2006. Their plan has more of an emphasis on supporting agriculture and managing flood impacts than the other counties. However, common values remain such as fostering economic development and conserving natural resources. Water quality is mentioned numerous times, as is preserving natural lands. Jackson County specifically mentioned increasing recreational opportunities as a goal. Growth is predicted around existing towns. The primary area of growth identified within the Lake Monroe watershed is around Freetown. Much of the land north and west of Freetown is owned and managed by USFS as part of the Hoosier National Forest which likely precludes large-scale development.

Monroe County most recently updated their comprehensive plan in 2012. The county anticipates growth of at least 10% per decade and expresses a goal of keeping rural areas rural in character while encouraging urban densities and services in five designated communities – Bloomington, Ellettsville, Stinesville, Harrodsburg, and Smithville-Sanders. Bloomington is identified as an urbanizing area while the other four are identified as rural community areas. Growth should be directed towards areas with existing infrastructure (e.g., sewer, water, roads). Development should be avoided whenever feasible on slopes of 15% or greater. Subdivision development is to be limited within specified areas in the watersheds of Lake Lemon, Lake Griffy and Lake Monroe.

The plan acknowledges that the area around Lake Monroe is a popular area for new home construction and emphasizes the importance of the Environmental Constraints Overlay (ECO) Zone. This zoning was initially established in the late 1990's as part of the Monroe County Master Plan and was included in the most recent 2018 zoning ordinance. Much of the focus of the overlay is to prevent erosion by maintaining tree cover, minimizing grading work, and regularly inspecting erosion control measures. Any project with a grading permit is required to be inspected after heavy rains (10 year storm) and at least once every two weeks from ground breaking to stabilization. Riparian buffer zones are required with a minimum width of 100 feet from each side of all intermittent and perennial streams shown on USGS 7.5 minute topographic maps.

The ECO Zone identifies 3 areas radiating out from the 3 lakes (Monroe, Griffy, and Lemon). Area 1, closest to the lake, only allows land disturbance where slopes are less than or equal to 12%. Area 2 has a maximum land slope of 15% and the remainder of the watershed has a maximum land slope of 18%. The maximum residential density allowed is 1 house per 2.5 acres with the exception of Zone 3, where density can be increased to 3 houses per acre if sanitary sewers are present.

2.5.2 MS4 Stormwater Entities

There are two Municipal Separate Storm Sewer System (MS4) entities that have jurisdiction within the watershed. The City of Bloomington MS4 is responsible for the city of Bloomington, of which only a few acres are within the Lake Monroe watershed. The Monroe County MS4 covers all unincorporated sections of Monroe County, which includes roughly a fifth of the Lake Monroe watershed. Brown County has no MS4 entities. The MS4 entities in Bartholomew, Jackson, and Lawrence Counties are located outside the Lake Monroe watershed. Jackson County SWCD hires a company to do their Rule 5 plan review and monthly inspections on projects in the county outside the city of Seymour MS4. Brown County SWCD works with their regional IDEM stormwater specialist to do the technical review and site visits.

2.5.3 Watershed Management Plans

Several subwatersheds in the Lake Monroe watershed have developed Watershed Management Plans.

<u>Cordry-Sweetwater Watershed Management Plan 2006</u>
Cordry-Sweetwater Lake Conservancy developed a watershed management plan for Sweetwater Creek in the northeast corner of the watershed in 2006. The plan includes approximately 19 square miles that includes East Sweetwater Creek (the outlet of Sweetwater Lake), Sweetwater Creek, Wolfpen Hollow, and the headwaters of North Fork Salt Creek. While sampling revealed no obvious water quality impairments, the plan included recommendations for multiple water quality protection strategies including goose management, regular septic system inspections, and periodic water quality monitoring.

Yellowwood Lake Watershed Management Plan 2006

Yellowwood Lake also developed a watershed management plan in 2006. The plan covers the approximately 7 square miles that drain into Yellowwood Lake, which flows into Jackson Creek and then North Fork Salt Creek. The two main pollutants of concern were sediment and E. coli. The plan calls for a reduction of storm event total suspended solid (TSS) loads in Jackson Creek by 145 pounds per day and a reduction of average E coli loads by 40,000 units per day within 10 years in order to meet the state water quality standards. Yellowwood Lake was dredged as a direct result of the plan, with roughly 5.8 million cubic feet of sediment removed from the lake.

Lower Salt Creek Watershed Management Plan 2022

While not located within the Lake Monroe watershed, it is relevant to note that a watershed management plan is currently being developed for the watershed immediately downstream, the Lower Salt Creek watershed (HUC 0512020808). The main concern is E. coli and in 2018, the Indiana Department of Environmental Management published a Total Maximum Daily Load (TMDL) for the Lower Salt Creek watershed for E. coli. The TMDL report did not identify Lake Monroe as a source of E. coli. However, there may be opportunities for the Lake Monroe group and the Lower Salt Creek group to partner on education, outreach, and other joint ventures related to water quality issues.

2.5.4 Lake Monroe Studies

Several additional studies have been conducted looking at Lake Monroe.

Lake Monroe Diagnostics and Feasibility Study (Jones Study) 1997

This study of the Lake Monroe Watershed included sampling of five tributaries that feed into Lake Monroe – North Fork Salt Creek, Middle Fork Salt Creek, South Fork Salt Creek, Brummett Creek, and Stephens Creek – as well as sampling within the lake. The authors also developed a sediment budget for the lake and estimated sediment accumulation rate of 0.03 inches per year (32,825 tons per year). Sediment and phosphorus were identified as two major concerns as well as lakeshore erosion, turbidity, overrecreation, urbanization of the watershed, algal blooms, and the lack of a comprehensive watershed management plan.

IU SPEA Capstone Course 2018 – Sediment Budget for Lake Monroe

A class of Indiana University graduate students in the School of Public and Environmental Affairs developed a rough sediment model for Lake Monroe to quantify sources of sediment in the lake. Using the RUSLE soil loss model with a number of assumptions, the model indicated a total soil loss of 38,726 tons/year in the Lake Monroe Watershed, which translates to a watershed soil loss rate of 0.14 tons/acre/year. This was believed to be an underestimate due to the assumptions made and the lack of data around shoreline erosion. The group also estimated that Lake Monroe has a trap efficiency of 90.77% and a lake lifetime of 347,917 years.

IU SPEA Capstone Course 2019 – Economic Value of Lake Monroe
A class of Indiana University graduate students in the School of Public and Environmental Affairs gathered data in order to calculate the economic value of Lake Monroe. They considered the economic value of drinking water, property, and business income from recreational use. They considered the effect of water quality on treatment costs and property values, the economic impact of recreational activities on local businesses, the value of ecosystem service provided by the lake, and the general valuation of the lake by local residents and businesses.

IU SPEA Capstone Course 2020 – Shoreline Erosion Modeling for Lake Monroe
A class of Indiana University graduate students in the School of Public and Environmental Affairs worked on quantifying shoreline erosion at Lake Monroe. They developed a mathematical model to extrapolate an erosion rate of 0.01 cubic feet of soil per foot of shoreline per year. This translates to roughly 649 tons of sediment loss per year, or 1.7% of the annual soil loss calculated by the 2018 capstone class. This model considers erosion due to wave action at normal pool and does not account for shoreline erosion caused by prolonged high water levels in the lake. The project included guidelines for collecting future measurements that could be used to refine the model.

2.5.5 Other Planning Efforts in the Watershed

Brown County Regional Sewer District
Several sewer districts have formed in Brown County to address wastewater treatment needs. Nashville built a wastewater treatment plant in the early 1960's that has been rebuilt and expanded several times. Around 1997, the Helmsburg Sewer District (outside the Lake Monroe watershed) was formed and eventually constructed its own plant. In 2000, the Gnaw Bone Sewer District began operating. In 2006, the Bean Blossom Sewer District was formed by order of the Indiana Department of Environmental Management to address concerns about failing septic systems.

In 2015, the group changed its name to the Brown County Regional Sewer District and broadened its focus to encompass all areas of Brown County not already being serviced by other sewer districts. This group initially continued research on the Bean Blossom area but is currently conducting an evaluation of all the unserved areas of the county to identify potential solutions. This strategic wastewater management plan is expected to be published in 2022 and will include reports of E. coli concentrations in streams around the county as well as an analysis of the source (human vs. animal). Preliminary data are included in the water quality section of this report.

Brown County Septic Ordinance Updates
In May 2021, Brown County adopted a newly revised septic ordinance to replace the ordinance that had been in place since 1997. The goal was to clarify requirements, standardize enforcement, and provide an appeals process for enforcement situations.

Monroe County Drainage Ordinance
The Monroe County Stormwater Board is currently considering a drainage ordinance for the county that would clarify requirements and responsibilities for stormwater conveyance.

2.6 Endangered and Threatened Species

According to the Indiana Heritage Database, the Lake Monroe watershed contains four high quality natural areas – Mesic Floodplain Forest, Highland Rim Dry-Mesic Upland Forest, Highland Rim Dry Upland Forest, and Highland Rim Mesic Upland Forest. Brown County and Jackson County are well known for their forestland, much of which is managed by either the Indiana Department of Natural Resources or the United States Forest Service. These forests provide crucial habitat for a variety of species including songbirds, bats, salamanders, snakes, and turtles.

The Indiana Heritage Database also identified 41 animal species and 16 plant species within the Lake Monroe watershed that are being monitored as rare, threatened or endangered. Perhaps the most easily recognized, the Bald Eagle, is closely associated with Lake Monroe since its reintroduction in the late 1980's. Other species are more commonly found in the forests of the watershed or in nearby caves.

Table 2-12 Rare, Threatened, and Endangered Animal Species in the Lake Monroe Watershed

Scientific Name	Common Name	Type	State Status	Federal Status
Acris blanchardi	Blanchard's Frog	Amphibian	SSC	--
Hemidactylium scutatum	Four-toed Salamander	Amphibian	SSC	--
Accipiter striatus	Sharp-shinned Hawk	Bird	SSC	--
Aimophila aestivalis	Bachman's Sparrow	Bird	--	--
Ammodramus henslowii	Henslow's Sparrow	Bird	SE	--
Buteo platypterus	Broad-winged Hawk	Bird	SSC	--
Dendroica virens	Black-throated Green Warbler	Bird	--	--
Haliaeetus leucocephalus	Bald Eagle	Bird	SSC	--
Helmitheros vermivorus	Worm-eating Warbler	Bird	SSC	--
Ixobrychus exilis	Least Bittern	Bird	SE	--
Lanius ludovicianus	Loggerhead Shrike	Bird	SE	--
Mniotilta varia	Black-and-white Warbler	Bird	SSC	--
Setophaga cerulea	Cerulean Warbler	Bird	SE	--
Setophaga citrina	Hooded Warbler	Bird	SSC	--
Pseudocandona jeanneli	An Ostracod	Crustacean	SE	--

Scientific Name	Common Name	Type	State Status	Federal Status
Conotyla bollmani	Bollman's Cave Milliped	Millipede	WL	--
Hypogastrura gibbosus	Humped Springtail	Springtail	WL	--
Isotoma anglicana	A Springtail	Springtail	WL	--
Pseudosinella argentea	A Springtail	Springtail	SE	--
Pseudosinella collina	Hilly Springtail	Springtail	SR	--
Pseudosinella fonsa	Fountain Cave Springtail	Springtail	ST	--
Sinella alata	A Springtail	Springtail	WL	--
Atheta annexa	Rove beetle	Insect	WL	--
Cicindela patruela	A Tiger Beetle	Insect	SR	--
Autochton cellus	Gold-banded Skipper	Insect	SE	--
Hyperaeschra georgica	A Prominent Moth	Insect	ST	--
Pieris virginiensis	West Virginia white butterfly	Insect	ST	--
Rhionaeschna mutata	Spatterdock Darner	Insect	ST	--
Mustela nivalis	Least Weasel	Mammal	SSC	--
Myotis septentrionalis	Northern Long Eared Bat	Mammal	SE	LT
Myotis sodalis	Indiana Bat	Mammal	SE	LE
Sorex fumeus	Smoky Shrew	Mammal	SSC	--
Sorex hoyi	Pygmy Shrew	Mammal	SSC	--
Villosa lienosa	Little Spectaclecase	Mollusk	SSC	--
Punctum minutissimum	Small Spot	Mollusk	--	--
Paracapnia angulata	Angulate Snowfly	Insect	SE	--
Clonophis kirtlandii	Kirtland's Snake	Reptile	SE	--
Crotalus horridus	Timber Rattlesnake	Reptile	SE	--
Opheodrys aestivus	Rough Green Snake	Reptile	SSC	--
Opheodrys vernalis	Smooth Green Snake	Reptile	SE	--
Terrapene carolina carolina	Eastern Box Turtle	Reptile	SSC	--

State: SE = State endangered; ST= State threatened; SR = State rare; SSC = State species of special concern; SG = State significant; WL = watch list; no rank - not ranked but tracked to monitor status. **Federal**: LE= Listed Federal endangered; LT = Listed Federal threatened

Table 2-13 Rare, Threatened and Endangered Plant Species in Lake Monroe Watershed

Scientific Name	Common Name	State Status	Federal Status
Castanea dentata	American chestnut	SE	--
Cladrastis kentukea	yellowwood	SE	--
Cypripedium parviflorum var. pubescens	large yellow lady's-slipper	WL	--
Dichanthelium bicknellii	panic-grass	SE	--
Dichanthelium mattamuskeetense	panic-grass	SX	--
Epigaea repens	trailing arbutus	ST	--
Hydrastis canadensis	golden seal	WL	--
Hypericum pyramidatum	great St. John's-wort	ST	--
Juglans cinerea	butternut	ST	--
Oenothera perennis	small sundrops	ST	--
Oxalis illinoensis	Illinois woodsorrel	WL	--
Panax quinquefolius	American ginseng	WL	--
Rubus odoratus	purple flowering raspberry	ST	--
Spiranthes ochroleuca	yellow nodding ladies'-tresses	ST	--
Stachys clingmanii	Clingman's hedge-nettle	WL	--
Tsuga canadensis	eastern hemlock	WL	--

State: SE = State endangered; ST= State threatened; SR = State rare; SSC = State species of special concern; SG = State significant; SX = state extirpated; WL = watch list

2.7 Watershed Overview Summary

The Lake Monroe watershed is characterized by a hilly terrain with shallow erodible soils. The steepest slopes are generally forested, which helps to keep soils stable. Agriculture is generally found in the flatter valley lands surrounding the main tributaries to the lake (South Fork, Middle Fork, and North Fork).

Septic systems are prevalent throughout the watershed despite the lack of suitable soils. Wastewater treatment plants serve most of the more heavily populated areas such as the town of Nashville, the community of Gnaw Bone, and several dense developments located near Lake Monroe. One notable area lacking sewage treatment is the Sweetwater-Cordry Conservancy community though they require regular inspection of all septic systems in order to catch and address any issues.

Brown County and Jackson County lack MS4 entities and staff to inspect construction sites for erosion despite an abundance of highly erodible soils. Monroe County does have an MS4 program that provides site inspection and contractor education. Monroe County also has implemented tighter development restrictions in the watershed through their ECO Zone overlay.

Community concerns center largely around protecting Lake Monroe and its tributaries from sediment, nutrients, and E. coli.

3 Watershed Inventory: Environmental and Water Quality Data

3.1 Water Quality Targets

Water quality targets for each parameter have been selected based on applicable Indiana Administrative Code, the Lower Salt Creek Total Maximum Daily Load (TMDL), and other standards accepted by the Indiana Department of Environmental Management. Table 3-1 Water Quality Parameters and Target Levels are used for the Lake Monroe Watershed to assess the water quality throughout the drainage area. The chosen targets for nutrients in particular are very conservative in order to minimize the likelihood of algal blooms in Lake Monroe.

Table 3-1 Water Quality Parameters and Target Levels for Lake Monroe Watershed

Parameter	Target Level	Source
pH	> 6 and < 9	Indiana Administrative Code Article 2 327-IAC
Temperature	Monthly Standard	Indiana Administrative Code Article 2 327-IAC
Dissolved Oxygen	> 4 mg/L and < 12 mg/L	Indiana Administrative Code Article 2 327-IAC
E. coli	< 235 colony forming units (cfu) per 100 mL sample < 125 cfu per 100 mL for geometric mean of 5 samples in 30 days	Indiana Administrative Code Indiana Administrative Code
Total Phosphorus	0.02 mg/L in lakes and streams	USEPA Ecoregion IX Nutrient Guidance for Lakes and Reservoirs (minimizes HABs)
Ortho-phosphate	Max: 0.005 mg/L	Wawassee Area Conservancy Foundation recommendation for lake systems, NESWP344
Total Nitrogen	0.36 mg/L in lakes 0.69 mg/L in streams	USEPA Ecoregion IX Nutrient Guidance for Lakes USEPA Ecoregion IX Nutrient Guidance for Streams and Rivers
Nitrate-nitrogen (NO3)	0.633 mg/L in lakes and streams	USEPA Ecoregion Nutrient Guidance for Streams and Rivers
TSS	< 30.0 mg/L	IDEM draft TMDL target
Chlorophyll-a	4.93 ug/L for lakes	EPA Ecoregion IX Nutrient Guidance
Atrazine	3.0 ppb	Indiana Administrative Code (and USEPA Drinking Water Limit)
Citizen Qualitative Habitat Evaluation Index (CQHEI)	> 60 (Generally Healthy)	Hoosier River Watch/ Ohio EPA

Parameter	Target Level	Source
Qualitative Habitat Evaluation Index (QHEI)	>= 45 (Fair), >= 60 (Good)	Ohio EPA QHEI Manual minimum “Fair” score for large streams (>= 20 sq mile drainage area)
Macroinvertebrate Index of Biotic Integrity (mIBI)	>= 36 (Unimpaired)	IDEM 2017 Performance Measures Monitoring Work Plan for Selected Indiana Subwatersheds
Fish-based Index of Biotic Integrity (IBI)	>= 45 (Good)	IDEM 2017 Performance Measures Monitoring Work Plan for Selected Indiana Subwatersheds

Table 3-2 QHEI Interpretation per Ohio EPA Manual

QHEI Score Headwaters Stream (<= 20 square miles drainage area)	QHEI Score Larger Stream (<= 20 square miles drainage area)	Narrative Description
>= 70	>= 75	Excellent
55-69	60-74	Good
43-54	45-59	Fair
30-42	30-44	Poor
<30	<30	Very Poor

Table 3-3 IBI Interpretation per IDEM 2017 Performance Measures Monitoring Work Plan

Fish-Based IBI Score	Integrity Class	Attributes
53-60	Excellent	Comparable to “least impacted” conditions, exceptional assemblage of species.
45-52	Good	Decreased species richness (intolerant species in particular), sensitive species present.
36-44	Fair	Intolerant and sensitive species absent, skewed trophic structure.
23-35	Poor	Top carnivores and many expected species absent or rare, omnivores and tolerant species dominant.
12-22	Very Poor	Few species and individuals present, tolerant species dominant, diseased fish frequent.
< 12	No Fish	No fish captured during sampling.

Table 3-4 mIBI Interpretation per IDEM 2017 Performance Measures Monitoring Work Plan

mIBI Score	Integrity Class
>= 36	Unimpaired
< 36	Impaired

3.2 Historical Water Quality Data

Several historical sets of water quality data were reviewed and are summarized here. Further details are provided in the subwatershed analysis presented in Appendix K.

<u>Lake Monroe Diagnostics and Feasibility Study (Jones Study) 1997</u>
This study of the Lake Monroe Watershed identified sediment and phosphorus as two major concerns as well as lakeshore erosion, turbidity, over-recreation, urbanization of the watershed, algal blooms, and the lack of a comprehensive watershed management plan. The study included sampling of five tributaries that feed into Lake Monroe – North Fork Salt Creek, Middle Fork Salt Creek, South Fork Salt Creek, Brummett Creek, and Stephens Creek – as well as sampling within the lake. Sampling was conducted monthly from April 1992 to May 1993. The authors developed a hydrologic model for the lake which was used to calculate sediment and phosphorus budgets.

<u>Cordry-Sweetwater Watershed Management Plan 2006</u>
The Cordry-Sweetwater Conservancy District developed a watershed management plan to address concerns about Sweetwater Lake and its residential development. Sweetwater Lake flows into Sweetwater Creek and then North Fork Salt Creek, which flows into Lake Monroe. Initial concerns were failing septic systems, erosion and sedimentation, geese, and lawn chemicals. Sampling conducted in the summer of 2005 did not identify any parameters exceeding the Indiana surface water quality standards. The watershed team focused on educating the community about best management practices.

<u>Yellowwood Lake Watershed Management Plan 2006</u>
A watershed management plan was developed for Yellowwood Lake, which is part of Jackson Creek and drains into North Fork Salt Creek which drains into Lake Monroe. The main concerns were sediment, invasive species, E. coli, and potential chemical contamination. Water testing did not detect any chemical contamination but did detect elevated levels of E. coli in some samples which were believed to come from failing septic systems in the watershed.

<u>Source Water Assessment for the City of Bloomington Utilities' Public Water Supply From Monroe Reservoir 2006</u>
The Indiana Department of Environmental Management in cooperation with the U.S. Geological Survey prepared source water assessments for water supplies in Indiana that utilize surface water. The assessment describes the watershed, identifies contaminants of concern and their potential sources, and gives a brief overview of selected water quality data (primarily from CBU). Ninety-one potential point sources associated with sixty-one different contaminants of concern were identified. Examples include gas stations, quarries, scrapyards, and historic landfills. A review of water quality data from IDEM, IDNR, and USGS revealed no contaminant concentrations at or above a maximum contaminant level. A review of water quality data from City of Bloomington Utilities between 1993 and 2002 showed that none of the sampled

contaminants were detected above their respective maximum contaminant levels (MCL). Beryllium and thallium were the only constituents of concern detected at a concentration equal to their MCLs and those samples were collected in the 1990's.

Lake Monroe Water Quality Summary 1990-2017 (2018)
Prepared by the Indiana University School of Public and Environmental Affairs for The Nature Conservancy, this report summarized water quality data in Lake Monroe based on annual sampling activities conducted by the Indiana Clean Lakes Program and the United States Army Corps of Engineers between 1990 and 2017. The data were used to calculate the trophic state index (TSI) based on different sampling parameters. The study concluded that Lake Monroe appears to be mildly eutrophic and that algal blooms could be affecting water quality.

DNR Blue-Green Algae Beach Advisories (annually)
The Indiana Department of Natural Resources works with the Indiana Department of Environmental Management and the Indiana State Department of Health to monitor the presence of blue-green algae in lakes during the summer recreation season (Memorial Day-Labor Day). Water samples are collected and analyzed weekly at select swimming areas around the state. Samples are collected from Paynetown and Fairfax on Lake Monroe every other week except when the beaches are closed due to high water levels. Beach Advisory Alerts were issued annually 2011-2021 at both beaches based on algal counts over 100,000 cells/ml. These recreational advisories were typically issued in July and stayed in effect through the end of sampling (Labor Day). During a beach advisory alert, swimming and boating is permitted but visitors are advised to avoid contact with algae and take a bath after coming in contact with the water. No cyanotoxins were detected at levels that would trigger elevated recreational advisories.

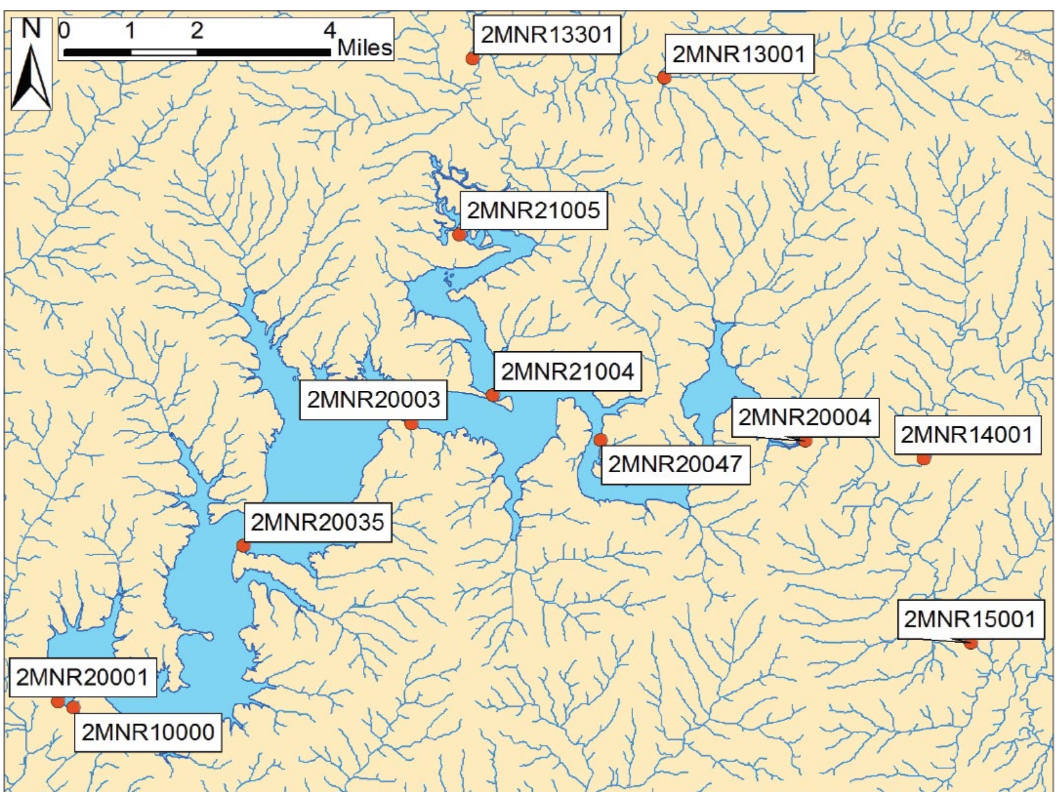
USFS Beach Advisories (annually)
The United States Forest Service monitors E. coli concentrations at the Hardin Ridge beach weekly from Memorial Day to Labor Day. Data reviewed from 2015-2020 revealed four exceedances (of the 235 CFU/100 ml standard) out of fifty-four total samples. Two occurred in August 2015, one in July 2016, and one in August 2016. No exceedances occurred in 2017-2020 and the highest recorded concentration in those years was 28 CFU/100 ml.

City of Bloomington Utilities Sampling (ongoing)
The City of Bloomington Utilities Department conducts multiple types of regular sampling events at the Monroe Water Treatment Plant located on the north side of the lake near the middle of the lower basin. Raw lake water at the intake to the water treatment plant is monitored hourly but digital records are maintained for samples collected once monthly. Those parameters include total organic carbon, dissolved organic carbon, and UV254. CBU also conducts periodic sampling for a wide variety of constituents at different frequency intervals. Every five years CBU samples in accordance with EPA's Unregulated Contaminant Monitoring Rule program, and those samples were most recently collected in 2020.

U.S. Army Corps of Engineers Lake Monroe Monitoring (annually)

The U.S. Army Corps of Engineers generally conducts ambient sampling events at Lake Monroe every summer and conducts an intensive three-season sampling program approximately once every twelve years. Sampling locations and frequencies have changed slightly over the years but generally samples are collected from the lower basin of the lake just above the dam, the middle of the center basin, the edge of the upper basin (just downstream of the causeway), the confluence with North Fork Salt Creek, and the confluence with Middle/South Fork Salt Creek. Additional samples have been collected certain years in North Fork Salt Creek in the waterfowl resting area, North Fork Salt Creek at Belmont, Brummett Creek where it enters North Fork Salt Creek, Middle Fork Salt Creek where it combines with South Fork, and South Fork Salt Creek at Maumee. Lake samples are collected at three depths – epilimnion, metalimnion, and hypolimnion. A wide variety of parameters are analyzed that have included (in various years) alkalinity, aluminum, ammonia, calcium, chloride, dissolved organic carbon, hardness, iron, magnesium, nitrate + nitrite, Kjeldahl nitrogen, orthophosphate, phosphorus, potassium, sodium, sulfate, total dissolved solids, total solids, total suspended solids, total organic carbon, atrazine, antimony, arsenic, barium, beryllium, cadmium, chromium, copper, lead, manganese, mercury, nickel, selenium, silver, and zinc. Samples within the lake area also analyzed for chlorophyll-α and phytoplankton. At the dam, zooplankton are investigated using a 20 foot vertical pull.

Figure 3-1 USACE Sampling Locations in Lake Monroe



IDEM 303d Assessment Sampling (2013)
(references: 2018 integrated report and appendices found at https://www.in.gov/idem/nps/watershed-assessment/water-quality-assessments-and-reporting/integrated-water-monitoring-and-assessment-report/)
The Indiana Department of Environmental Management (IDEM) operates a number of monitoring programs throughout the state. Probabilistic monitoring is conducted in one basin per year on a nine-year rotating cycle. The Lake Monroe watershed is located within the East Fork White River Basin which was monitored in 2013 (used to develop the 2016 303(d) impairment list) and is scheduled to be monitored again in 2022. Additionally, IDEM contracts with the Indiana University SPEA Clean Lakes Program to conduct trophic status monitoring on approximately 80 lakes annually out of 401 public lakes (see section above).

Hoosier National Forest Stream Monitoring for Biological Integrity in South Fork Watershed (2017-2019)
Hoosier National Forest staff periodically conduct fish sampling to evaluate water quality in streams within the forest. Data were provided for South Fork Salt Creek and several of its tributaries from 2017, 2018, and 2019 showing generally healthy biological integrity for fish.

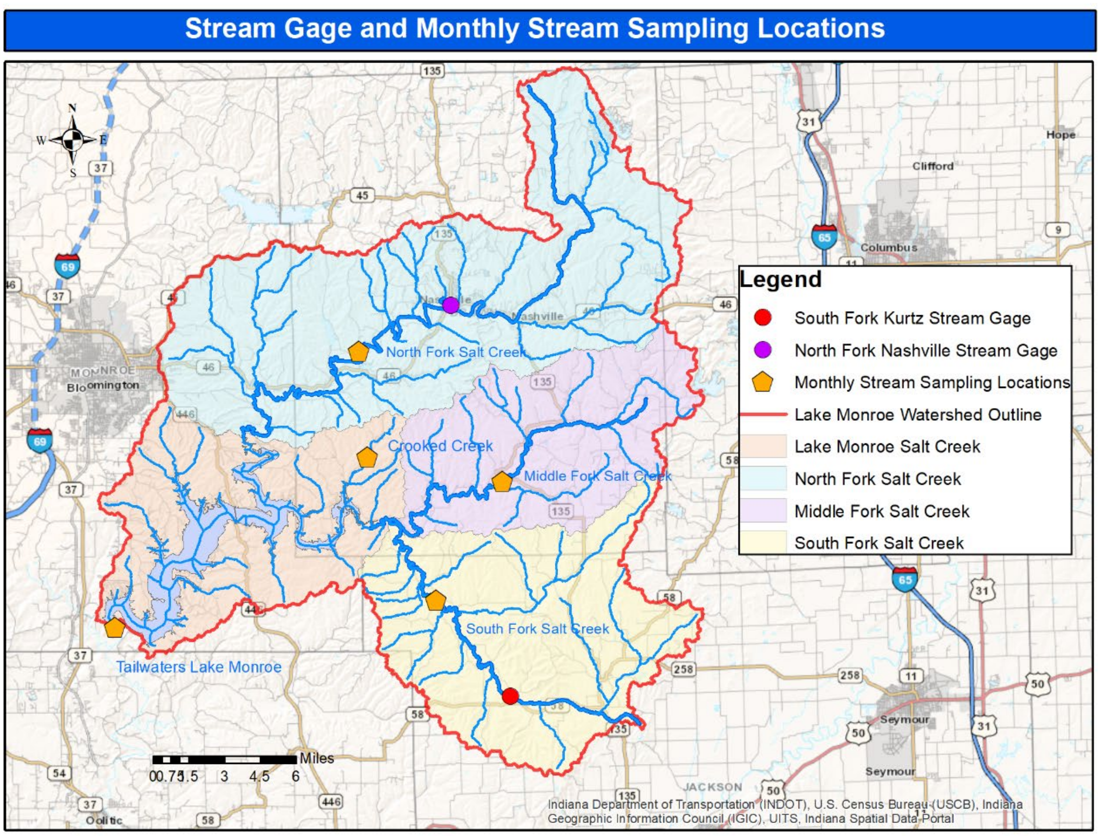
3.3 New Water Quality Data

<u>Stream Monitoring Program (April 2020 – March 2021)</u>
The Indiana University Limnology Lab collected samples monthly for one year from four streams flowing into Lake Monroe as well as the tailwaters exiting the lake.

- North Fork Salt Creek
- Middle Fork Salt Creek
- South Fork Salt Creek
- Crooked Creek
- Lake Monroe Tailwaters

Samples were analyzed for pH, temperature, dissolved oxygen, nitrate+nitrite, total nitrogen, ammonia nitrogen, total and dissolved phosphorus, turbidity, conductivity, total suspended solids, discharge, and E. coli. The lab also conducted stream macroinvertebrate sampling once to calculate Indiana's macroinvertebrate Index of Biotic Integrity (mIBI) for each stream and conducted a habitat assessment using Indiana's Qualitative Habitat Evaluation Index (QHEI) for each stream. Data are provided in Appendices C and D.

Figure 3-2 Stream Gage and Monthly Stream Sampling Locations in Lake Monroe Watershed



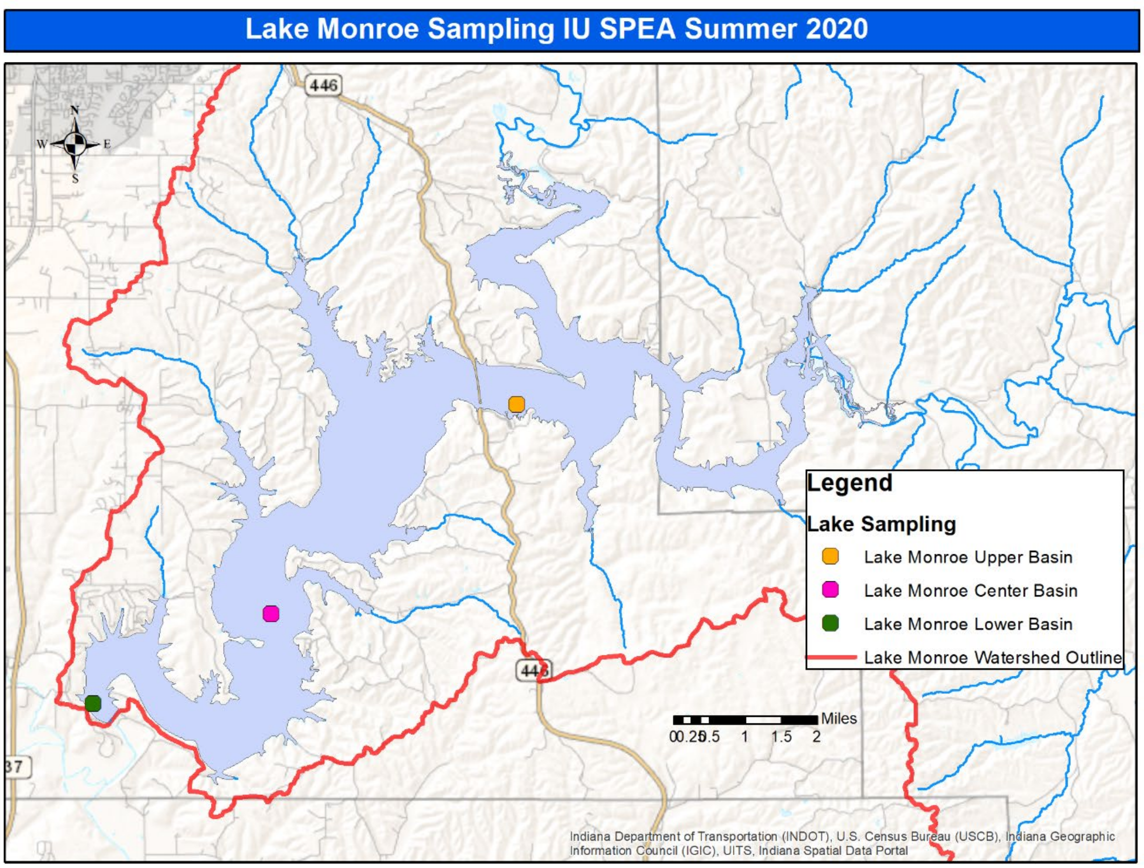
Lake Monitoring Program (May – October 2020)

The Indiana University Limnology Lab collected samples monthly during the summer season at three locations within Lake Monroe at two depths (epilimnetic and hypolimnetic) when the lake was stratified and one depth when the lake was not stratified.

- Upper Basin
- Center of Lake
- Lower Basin Near Dam

Samples were analyzed for temperature, dissolved oxygen, soluble reactive phosphorus, total phosphorus, total nitrogen, ammonia, nitrate nitrogen, alkalinity, conductivity, and chlorophyll-α (epilimnetic sample only). The lab also tested temperature and dissolved oxygen at one-meter levels as well as measuring Secchi disk transparency, number of meters at one percent light level, phytoplankton species distribution with 2-meter integrated sampler, and zooplankton species distributed through the full water column with a 50 micron tow net. Data are provided in Appendices C and D.

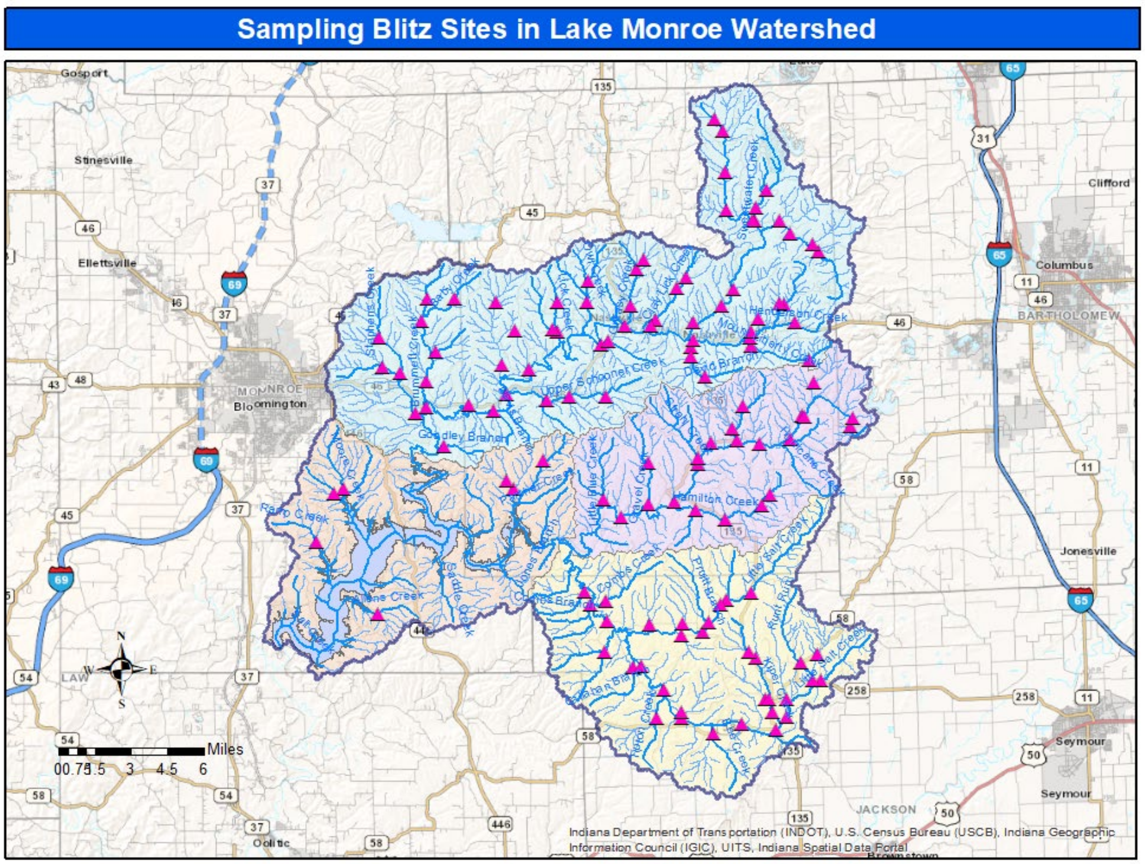
Figure 3-3 Lake Monroe Sampling Locations IU SPEA Summer 2020



Volunteer Monitoring Program aka Sampling Blitz (September 2020 and April 2021)

The Indiana University Limnology Lab worked with the Friends of Lake Monroe to conduct two volunteer monitoring events collecting water samples at 125 sites in the watershed. The fall blitz was held on September 18, 2020 with samples collected from 88 sites (the remaining stream sites were dry). The spring blitz was held on April 2, 2021 with samples collected from 122 sites (three sites were missed due to volunteer cancellations). Samples were analyzed for soluble reactive phosphorus, nitrate, hardness, pH, total phosphorus, ammonia, total nitrogen, and E. coli. Data are provided in Appendix E.

Figure 3-4 Sampling Blitz Sites in Lake Monroe Watershed



Brown County Regional Sewer District Sampling (May 2020)

The Brown County Regional Sewer District (BCRSD) collected and analyzed samples from various streams in Brown County for E. coli as part of a larger project developing a wastewater strategic management plan for the county. Samples were initially collected weekly for five weeks (5/5/20-6/2/20) to calculate the E. coli geometric mean. Data are provided in Appendix F.

Fecal Contamination Source Analysis (April 2021)

The Indiana University Limnology Lab partnered with BCRSD to determine whether fecal contamination is coming from human or animal sources. BCRSD used their sampling data to select 18 sites for source analysis, of which 7 were within the Lake Monroe watershed. The Lake Monroe watershed coordinator used the BCRSD data in combination with the data from the sampling blitz events to identify an additional 10 sites in the Lake Monroe watershed. Samples were collected on April 27, 2021 and sent to Scientific Methods for source analysis using genotyping of male-specific RNA coliphages to determine whether the fecal contamination is coming from humans or animals. Data are provided in Appendix G.

3.4 Windshield Surveys

Windshield surveys were conducted February – June 2020 using standardized field sheets as shown in Table 3-5 and Table 3-6. The surveys were conducted by the watershed coordinator and community volunteers at 243 of 540 identified road sections that cross a stream. The relevant concerns noted were:

1. Water odor, color, or algae
2. Stream buffer width by quadrant (upstream left, upstream right, downstream left, downstream right)
3. Areas of active streambank erosion
4. Areas where livestock were present and whether or not they had access to waterways
5. Evidence of channelization

Figure 3-5 Recording observations at a stream site.

Figure 3-6 Windshield Survey Observations in Lake Monroe Watershed

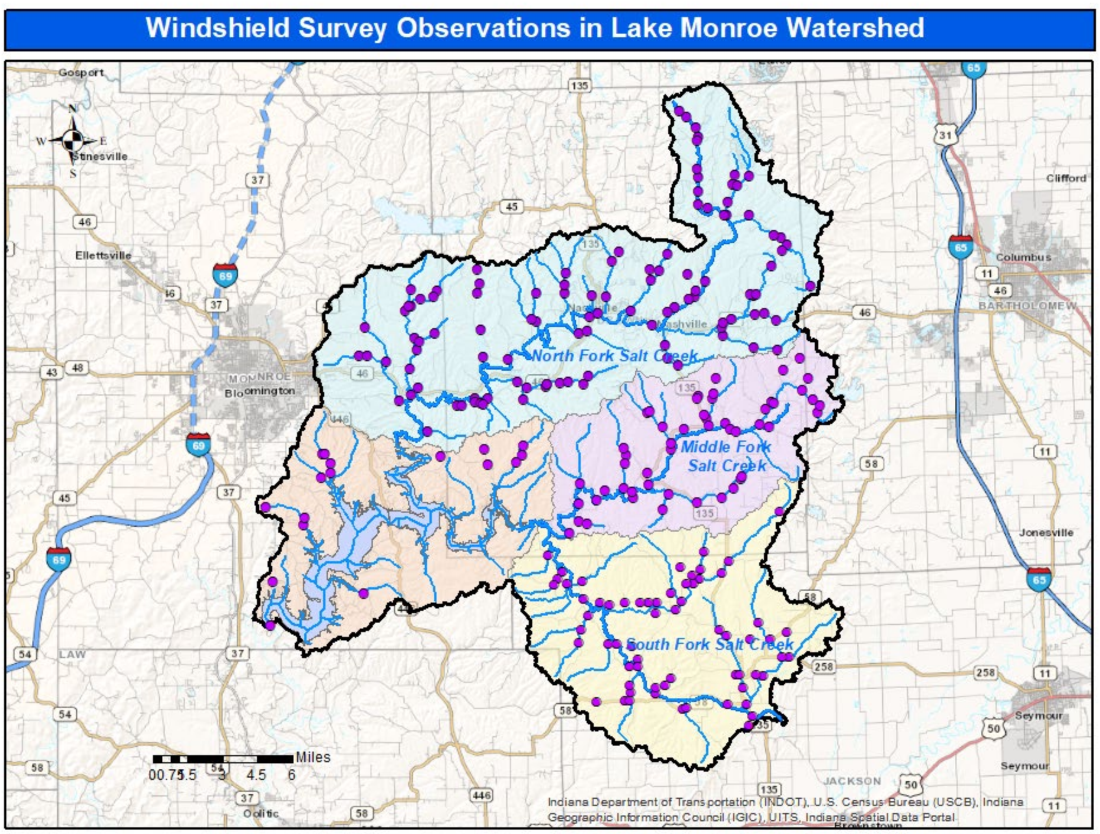


Table 3-5 Windshield Survey Field Sheet Page 1

Windshield Survey Field Sheet

Site ID ____________	Sub-Watershed ____________
Date ____________	Cross Street ____________
Time ____________	Investigator(s) ____________

Weather (past 24 hours)	Weather (now)	Observations
☐ Rain ☐ Snow	☐ Rain ☐ Snow	☐ Pipes flowing into stream
☐ Heavy	☐ Heavy	How many? ____________
☐ Steady	☐ Steady	☐ Wildlife observed
☐ Intermittent	☐ Intermittent	____________
☐ Overcast	☐ Overcast	
☐ Partly cloudy	☐ Partly cloudy	☐ Hanging culvert?
☐ Clear	☐ Clear	

Land Use - *Check land uses that best apply*

☐ Residential	☐ Agricultural
☐ Single Family	☐ Row Crop
☐ Multi-family	☐ no-till
☐ Stormdrain marking present	☐ reduced till (50% residue)
☐ Stormwater management practices	☐ conventional
☐ curb and gutter	☐ Pasture
☐ retention basins	☐ Stream access
☐ naturalized drainage systems	☐ Fenced from stream
☐ Industrial	☐ Cattle
☐ Commercial (Strip malls, restaurants, etc)	☐ Hogs
☐ Forestry	☐ Horses
☐ Ruts or gullies	☐ Other ____________
☐ Noticeable drainage issues	☐ Feedlot
☐ Logging debris in streams	☐ Cattle (dairy)
☐ Logging debris adjacent to streams	☐ Cattle (other)
☐ Unstabilized Soil	☐ Hogs
☐ Mining	☐ Other ____________
☐ Wetlands	Estimated # of animals
	____________

Available Shade/Stream Cover	In-Stream Habitat *check all that apply*	
☐ 0% Cover		
☐ 1-25% Cover	☐ Underwater tree roots	☐ Deep Areas
☐ 25-75% Cover	☐ Boulders	☐ Shallow Areas
☐ 75-100% Cover	☐ Downed Trees	☐ Undercut Banks

Table 3-6 Windshield Survey Field Sheet Page 2

Windshield Survey Field Sheet (cont.)

Site ID ____________ Sub-Watershed ________________ Date ____________

Water Odors
check all that apply
- ☐ Normal
- ☐ Sewage
- ☐ Petroleum
- ☐ Chemical
- ☐ Other ____________

Water Color/Appearance
check all that apply
- ☐ Clear
- ☐ Green
- ☐ Brown
- ☐ Murky
- ☐ Oily Sheen
- ☐ Other ____________

Algae
check all that apply
- ☐ Floating
- ☐ Attached to Substrate
- ☐ Thick mats
- ☐ Limited growth
- ☐ Moderate growth
- ☐ Excessive growth

Stream Buffer

	up	down
left		
right		

Buffer Type
check all that apply
- ☐ Trees
- ☐ Shrubs
- ☐ Grasses

Estimated Width of Buffer
- ☐ < 10'
- ☐ 10-25'
- ☐ 25-50'
- ☐ >50'

Stream Erosion
- ☐ Absent
- ☐ Stabilized (rip-rap, coir log, etc.)
- ☐ Present

Estimated Height of Erosion
- ☐ < 1'
- ☐ 1-3'
- ☐ > 3'

In-Stream Debris
check all that apply
- ☐ Trash
- ☐ Deposits
- ☐ Beaver Dam
- ☐ Log Jam
- ☐ Logging Debris
- ☐ Other

Sampling Blitz Site Assessment

Safe Place to Park?
- ☐ Yes Where: ________________
- ☐ No

Safely Accessible?
- ☐ Yes
- ☐ No

Where: ________________

1	→→	3	→→
≈≈ ≈≈		≈≈ ≈≈	
2		4	

width/depth

Fences or Blockages?
- ☐ Yes
- ☐ No

Excessive Erosion or Dangerous Loose Rocks?
- ☐ Yes
- ☐ No

Deep muck, silt, or sand at entry point?
- ☐ Yes
- ☐ No

Steepness at Entry Point ____________

Water Depth at Entry Point ____________

Recommended Sampling Site?
- ☐ Yes
- ☐ No

Photographs were taken of each site and sites were evaluated to determine suitability for volunteer water quality monitoring. A brief summary is presented below with additional discussion presented in Section 4.

Table 3-7 Windshield Survey Summary for Lake Monroe

HUC 10 Windshield Survey Summary	North Fork Salt Creek	Middle Fork Salt Creek	South Fork Salt Creek	Lake Monroe Basin	Entire Watershed
Number Sites Observed	111	51	64	17	243
% Sites with No Buffer (<5 feet)	27%	20%	9%	12%	20%
% Sites with Minimal Riparian Buffer (5-19 feet)	43%	43%	33%	29%	40%
% Sites with Moderate Riparian Buffer (20-100 feet)	18%	20%	38%	24%	24%
% Sites with Healthy Riparian Buffer (>100 feet)	12%	18%	20%	35%	17%
% Sites with Active Erosion	89%	90%	88%	53%	86%
% Sites with Minimal Erosion (~1 feet)	16%	16%	14%	6%	15%
% Sites with Moderate Erosion (~2 feet)	46%	41%	45%	35%	44%
% Sites with Severe Erosion (3+ feet)	27%	33%	28%	12%	28%
% Sites with Livestock Present	23%	25%	23%	12%	19%
% Sites with Livestock Stream Access	7%	4%	13%	0%	7%
% Sites with Obvious Channelization	0%	0%	2%	0%	0%

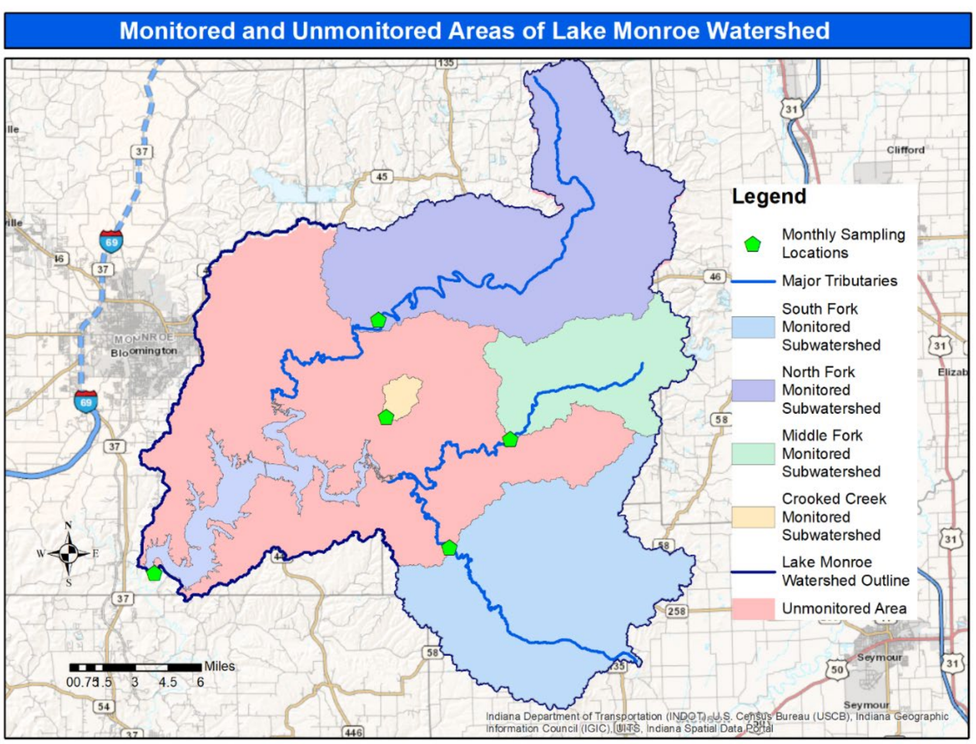
4 Analysis of Available Data

The water quality monitoring program was developed to both understand what is happening within the lake and how activities in the watershed impact water quality in the lake. Both components provide increased understanding of the challenges facing Lake Monroe and the best strategies for improvement.

4.1 Nutrient and Sediment Budgets

Nutrient and sediment budgets were developed for Lake Monroe to calculate the amount of phosphorus, sediment, and nitrogen entering and exiting the lake annually. The hydrologic year used was 04/01/2020 – 03/31/2021. Regression models were developed for the four monitored tributaries (South Fork, Middle Fork, North Fork, and Crooked Creek). These represent approximately 45% of the watershed (Figure 4-1). Inputs from the remaining unmonitored area were estimated by multiplying the unmonitored drainage area (excluding the lake) by the areal loads (lbs/acre) for the North Fork subwatershed. North Fork was chosen because the land cover in the unmonitored area most closely resembles the land cover in the North Fork subwatershed. These loads were added together to calculate the total loads coming into Lake Monroe.

Figure 4-1 Monitored and Unmonitored Areas of Lake Monroe Watershed



Nutrient and sediment loads leaving Lake Monroe were calculated using a regression model based on monthly monitoring data from the outlet and flow data out the dam provided by the USACE. Based on these calculations, Lake Monroe retains 48% of the incoming phosphorus load, 92% of the incoming sediment load and 15% of the incoming nitrogen load.

Table 4-1 Nutrient and Sediment Budgets for Lake Monroe

	Phosphorus Load (lbs/yr)	**Percent of Inflow**	**Sediment Load (tons/yr)**	**Percent of Inflow**	**Nitrogen Load (lbs/yr)**	**Percent of Inflow**
South Fork above Maumee	7,652		2,273		181,750	
Middle Fork above Story	1,048		489		24,013	
North Fork above Yellowwood	13,427		13,393		142,929	
Crooked Creek above Tecumseh	35		5		886	
Unmonitored Area	22,630		22,573		240,897	
Lake Monroe Inflow	44,792		38,733		590,474	
Lake Monroe Outflow	23,229		3,037		501,996	
Lake Storage	21,563	48%	35,696	92%	88,478	15%

As shown in the table above, the models show that North Fork is the largest contributor of phosphorus and sediment while South Fork is the largest contributor of nitrogen. This is true even when the drainage areas are taken into account and areal loads (lbs/acre-year) are calculated as shown in Table 4-2 below.

Table 4-2 Areal Pollutant Loads into Lake Monroe

Sub-Watershed	**Drainage Area (acres)**	**Areal Load Phosphorus (lbs/ acre-yr)**	**Drainage Area (acres)**	**Areal Load Sediment (tons/ acre-yr)**	**Drainage Area (acres)**	**Areal Load Nitrogen (lbs/ acre-yr)**
South Fork above Maumee	56,825	**0.13**	56,825	**0.04**	56,825	**3.20**
Middle Fork above Story	24,400	**0.04**	24,400	**0.02**	24,400	**0.98**
North Fork above Yellowwood	68,100	**0.20**	68,100	**0.20**	68,100	**2.10**
Crooked Creek above Tecumseh	1,700	**0.02**	1,700	**0.00**	1,700	**0.52**
Unmonitored Area	114,778	**0.20**	114,778	**0.05**	114,778	**2.10**

Based on land use analysis, the South Fork subwatershed was expected to be the largest contributor of all three parameters due to it having the highest concentration of agricultural land. One possible explanation for the high loads in the North Fork is that nonpoint source pollution could be coming primarily from non-agricultural sources such as leakage from septic systems or fertilizer use on commercial and residential properties.

Another possible explanation is that the difference in flows captured during the sampling events caused a difference in the models. The highest discharge recorded during a monthly sampling event occurred on 2/25/21 for both streams. Daily flow at the South Fork Kurtz gage was 168 cfs, the 20th highest daily flow for the hydrologic year. Daily flow at the North Fork Kurtz gage was 571 cfs, the 10th highest daily flow for the hydrologic year. Since the data set for the North Fork model included a higher flow event, it better predicts loads during larger flow events and therefore generates higher annual load estimates than the South Fork model.

4.2 Flow Frequency Analysis

When evaluating nutrient and sediment models, it is important to understand if the captured stream flow events are representative of typical stream flow. If the sampling events only captured low flow conditions, the models would likely underestimate nutrient and sediment loads. It is also useful to know if the hydrologic year is typical of the stream over time or if it was an unusually wet or dry year. The full flow frequency analysis is provided in Appendix L.

Peak discharge for the monitored hydrologic year (4/1/2020-3/31/2021) was compared to historical records of peak discharge for both the Kurtz stream gage and the Nashville stream gage. For the South Fork at the Kurtz gage, the probability of a peak discharge exceeding the monitored hydrologic year peak discharge is 38%, corresponding to a 3-year return period. For the North Fork gage, the probability of a peak discharge exceeding the monitored hydrologic year peak discharge is 53%, corresponding to a 2-year return period. These values indicate that the study year was not unusually wet or dry.

The highest discharge recorded during a monthly sampling event for each stream was also compared to the historical records of peak discharge. Both streams had the highest discharge recorded during the 2/25/21 sampling event. Daily flow at the Kurtz gage on 2/25/21 was 168 cfs, corresponding to less than a 1-year return period. Daily flow at the Nashville gage on 2/25/21 was 571 cfs, corresponding to less than a 1-year return period. These very low return periods mean that the 2/25/21 sampling event was not during a particularly high flow event for either stream.

This information indicates that our nutrient and sediment load calculations are based on regression models that do not contain representative peak flows. Therefore, the models likely underestimate the nutrient and sediment load to the lake.

4.3 Water Budget for Lake Monroe

Water budget calculations provide insight into the balance between water coming into the lake and water leaving the lake. The water budget also helps to evaluate the reliability of the hydrologic measurements used to calculate nutrient and sediment loads. Annual streamflow into Lake Monroe from the four monitored tributaries (South Fork, Middle Fork, North Fork, and Crooked Creek) was calculated using regression models based on sampling data and stream gage data. These streamflow calculations account for approximately 55% of the watershed. Streamflow from the remaining unmonitored area was calculated using the areal flow rate for North Fork because land cover is the most similar. These flows were combined to get the annual streamflow into Lake Monroe.

Table 4-3 Annual Total and Areal Flow in Tributaries to Lake Monroe

Sub-watershed	Annual Flow From Regression Models 8-17-2021 (cubic feet/yr)	Catchment Area (acres)	Areal Flow (cubic feet/acre-yr)
South Fork - Maumee	3,987,393,636	56,825	70,170
Middle Fork - Story	665,491,732	24,400	27,274
North Fork - Yellowwood	3,673,311,759	68,100	53,940
Crooked Creek - Tecumseh	57,152,217	1,700	33,619
Unmonitored – Excluding Lake Monroe	6,191,121,543	114,778	53,940
Total Inflow Via Tributaries	**14,574,470,887**	**265,803**	**54,832**

The total input of water coming into Lake Monroe is streamflow + precipitation. Streamflow accounts for 90% of inputs and precipitation accounts for the remaining 10%. Outputs include drinking water withdrawals, evaporation, and outlet flow through the dam. Outlet flow accounts for 88% of outputs. Drinking water withdrawals by the City of Bloomington account for 5% of outputs, while evaporation from the lake surface accounts for 7% of outputs. (See Appendix L for the detailed water budget and data sources.)

The water budget is balanced when the difference between inflow and outflow is equal to the change in water stored in the lake. By comparing storage to the difference between inflow and outflow we can estimate the accuracy of our calculations. Calculations used to estimate streamflow, precipitation, evaporation and changes in storage are prone to error. The reliability of our calculations can be judged by the relative significance of this error. Error is expressed in the table below as a percentage of the total inputs to the lake.

Table 4-4 Monthly Water Budget for Lake Monroe 4/1/20-3/31/21

Month	Inflow	Outflow	Storage	In-Out-Storage	% Error
Apr-20	1397251288	4693361171	-2861148290	-434961592	-31.13%
May-20	3,377,286,254	2202127146	1032813390	142345718	4.21%
Jun-20	396,007,328	2,591,922,052	-2369099941	173185217	43.73%
Jul-20	448,329,344	288,530,924	224801710	-65003289	-14.50%
Aug-20	556,210,201	972,393,550	-246022649	-170160699	-30.59%
Sep-20	23,659,418	226,490,745	-332202228	1,293,709,00	546.81%
Oct-20	232,975,719	224,374,741	194814936	-186213958	-79.93%
Nov-20	907,889,896	393,208,251	806769218	-292087573	-32.17%
Dec-20	459,973,932	826,777,351	-455838595	89035176	19.36%
Jan-20	1,630,558,036	1,542,918,328	134879501	-47239794	-2.90%
Feb-20	3,195,459,649	2,245,576,345	375909437	573973866	17.96%
Mar-20	3,149,066,163	1,821,861,581	2622607851	-1,295,403,270	-41.14%
Annual Total	**15,774,667,227**	**18,029,542,186**	**-871,715,661**	**-1,383,159,298**	**-8.77%**

On a monthly basis, errors are large, but on an annual basis, the 8.77% error is very good. A cursory comparison of streamflow discharge and reported outflows suggests a tendency to underestimate outflow during periods of small releases to Salt Creek. High errors occurring in September 2020 are likely due to underestimation of outflow. Additionally, the lake level-volume and lake level-area curves most likely originate from the 1960’s. No lake-wide bathymetric surveys have been conducted since the lake was constructed in the early 1960’s and so the changes in the lake level-volume and lake level-area tables are unknown.

4.4 Water Quality in Lake Monroe

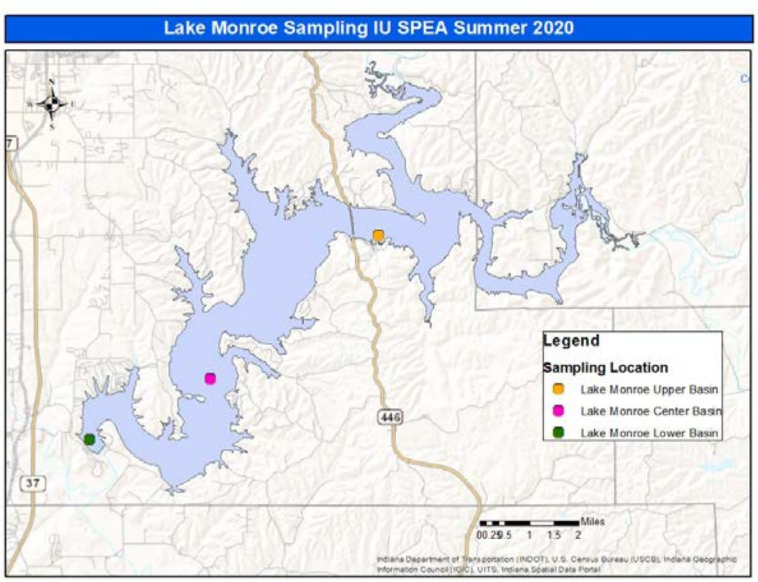
Historical Information

Historical data indicates that Lake Monroe is mildly eutrophic, resulting in periodic algal blooms. The 2018 report "Lake Monroe Water Quality Summary 1990-2017" determined that total phosphorus, Secchi disk transparency, and chlorophyll-a met or exceeded the eutrophic threshold in more than 40% of the samples collected by USACE and the Indiana Clean Lakes Program during the summer stratification period from 1990 to 2017. The 1997 "Lake Monroe Diagnostic and Feasibility Study" also reported total phosphorus concentrations and soluble reactive phosphorus concentrations regularly exceeding the eutrophic threshold. Mean total phosphorus concentrations in each basin ranged from 0.02 to 0.07 mg/L. TP concentrations were generally low in early summer, rising throughout the summer, and falling throughout the winter months. TP concentrations were highest and most consistently above the threshold in the upper basin which tends to be shallowest.

Current Study

Indiana University conducted water quality monitoring in Lake Monroe during the summer and fall of 2020 to evaluate current chemical and biological conditions. Nutrient concentrations were measured in the upper, center and lower basins as shown in Figure 4-2. During the summer months, many lakes become stratified which means the top layer of water (epilimnion) does not mix with the bottom layer of water (hypolimnion). Samples were collected from both the epilimnion and hypolimnion during periods of stratification as determined based on temperature and dissolved oxygen profiles for each basin.

Figure 4-2 Lake Monroe Sampling Locations IU SPEA Summer 2020

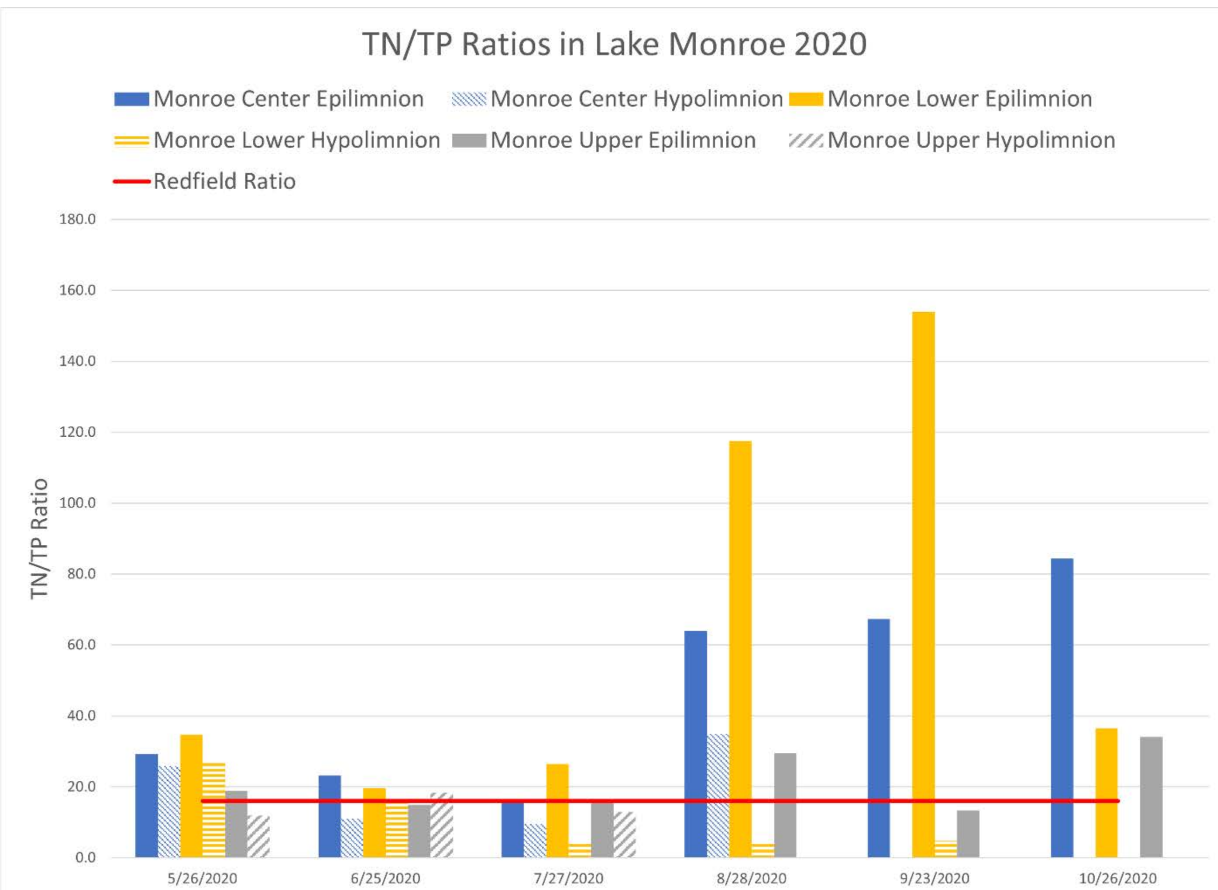


4.4.1 Limiting Nutrient (Nitrogen-Phosphorus Ratio)

Lakes in Indiana are generally presumed to be phosphorus limited, meaning that an increase in phosphorus will cause an increase in algal growth and that reducing the concentration of phosphorus will reduce algal growth. The total nitrogen to total phosphorus ratio (TN/TP) is an indicator of nutrient limitation in Lake Monroe. A ratio of TN/TP of 16 or higher is generally considered to indicate phosphorus limitation (Redfield, 1934). Below the threshold, algal growth is limited by the availability of nitrogen. Recent researchers have suggested using a slightly higher ratio, such as 20 or 30, due to variability in phytoplankton and in freshwater systems.

TN/TP ratios are generally above 16 in both the epilimnion and the hypolimnion in May and June, indicating phosphorus limitation, as shown in Figure 4-3. However, in July the TN/TP ratio drops below 16 in the hypolimnion of all three basins, indicating nitrogen limitation in the hypolimnion. This is believed to occur because the hypolimnion has become anoxic, allowing phosphorus release from the sediments. The drop is the most pronounced and sustained in the lower basin, which is the deepest.

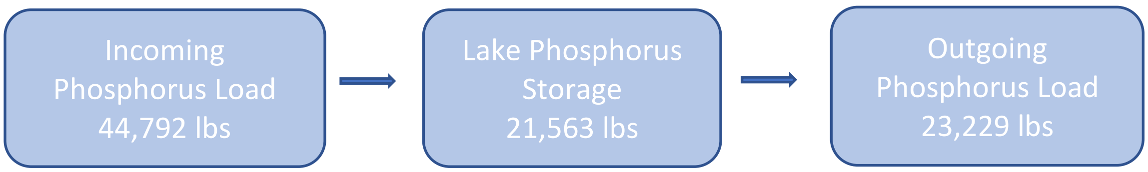
Figure 4-3 Total Nitrogen to Total Phosphorus Ratio in Lake Monroe 2020



4.4.2 Phosphorus in Lake Monroe

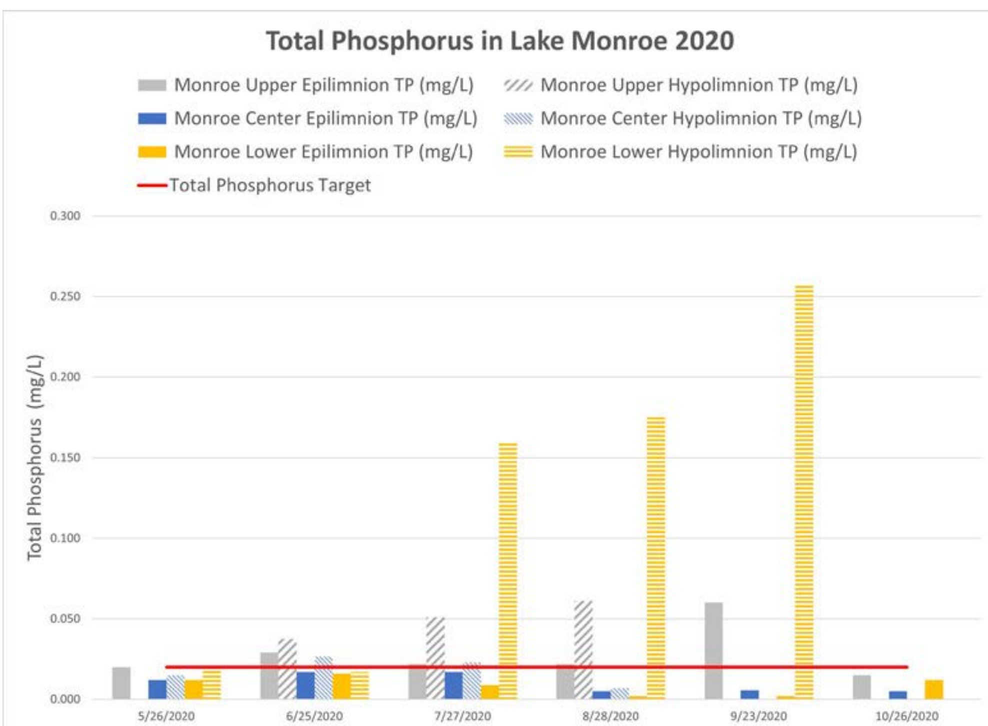
Lake Monroe acts as a phosphorus sink, as shown in Figure 4-4. 44,792 pounds of phosphorus enter the lake annually and 23,229 pounds leave the lake, leaving 21,563 pounds stored in the lake. Storage of phosphorus in the lake can be dissolved in the water column, bound to sediment or, tied up in fish, algae and other life forms.

Figure 4-4 Phosphorus Movement Through Lake Monroe



Elevated phosphorus levels increase the likelihood of algal blooms. Total phosphorus was measured at levels above the water quality target of 0.020 mg/L in 86% of the hypolimnion samples, with 100% of upper basin hypolimnion, 50% of center basin hypolimnion, and 67% of lower basin hypolimnion samples exceeding the water quality target. Total phosphorus concentrations were highest in the lower basin hypolimnion, where concentrations exceeded 0.150 in July, August, and September. This is three times the concentrations seen in the upper basin.

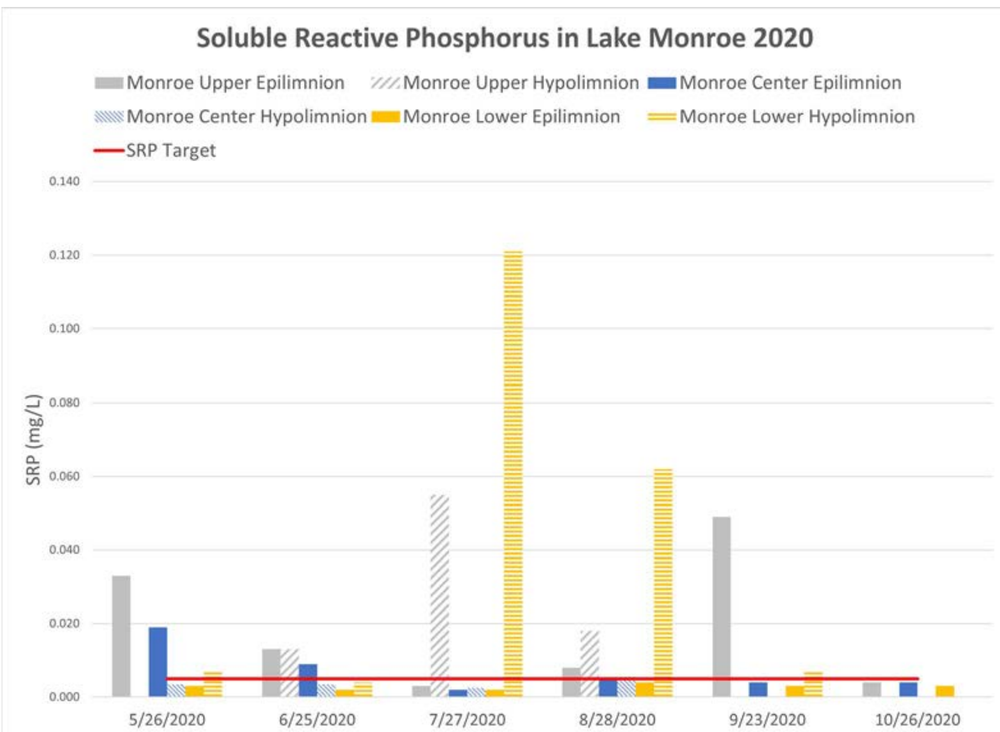
Figure 4-5 Total Phosphorus Concentrations in Lake Monroe Summer 2020



The high concentrations in the lower basin most likely occur because the lower basin is the deepest portion of the lake and stratification causes dissolved oxygen levels to drop to zero, as discussed in section 4.4.3. These anoxic conditions allow for phosphorus release from the sediments and in turn that phosphorus is taken up by algae. No total phosphorus exceedances were reported in the center and lower basin epilimnions. Concentrations in the upper basin epilimnion were slightly over the target in June, July, and August before jumping to 0.060 mg/L in September. The elevated concentration in September may reflect the mixing of the epilimnion and hypolimnion as the lake began to turn over.

While total phosphorus increased in the upper and lower basin hypolimnion through the summer months, Soluble Reactive Phosphorus (SRP) concentrations decreased (Figure 4-6). SRP is the form of phosphorus that is available to fuel algae growth. SRP is highest in the lower and upper basin hypolimnions where stratification occurs and SRP is released from bottom sediments.

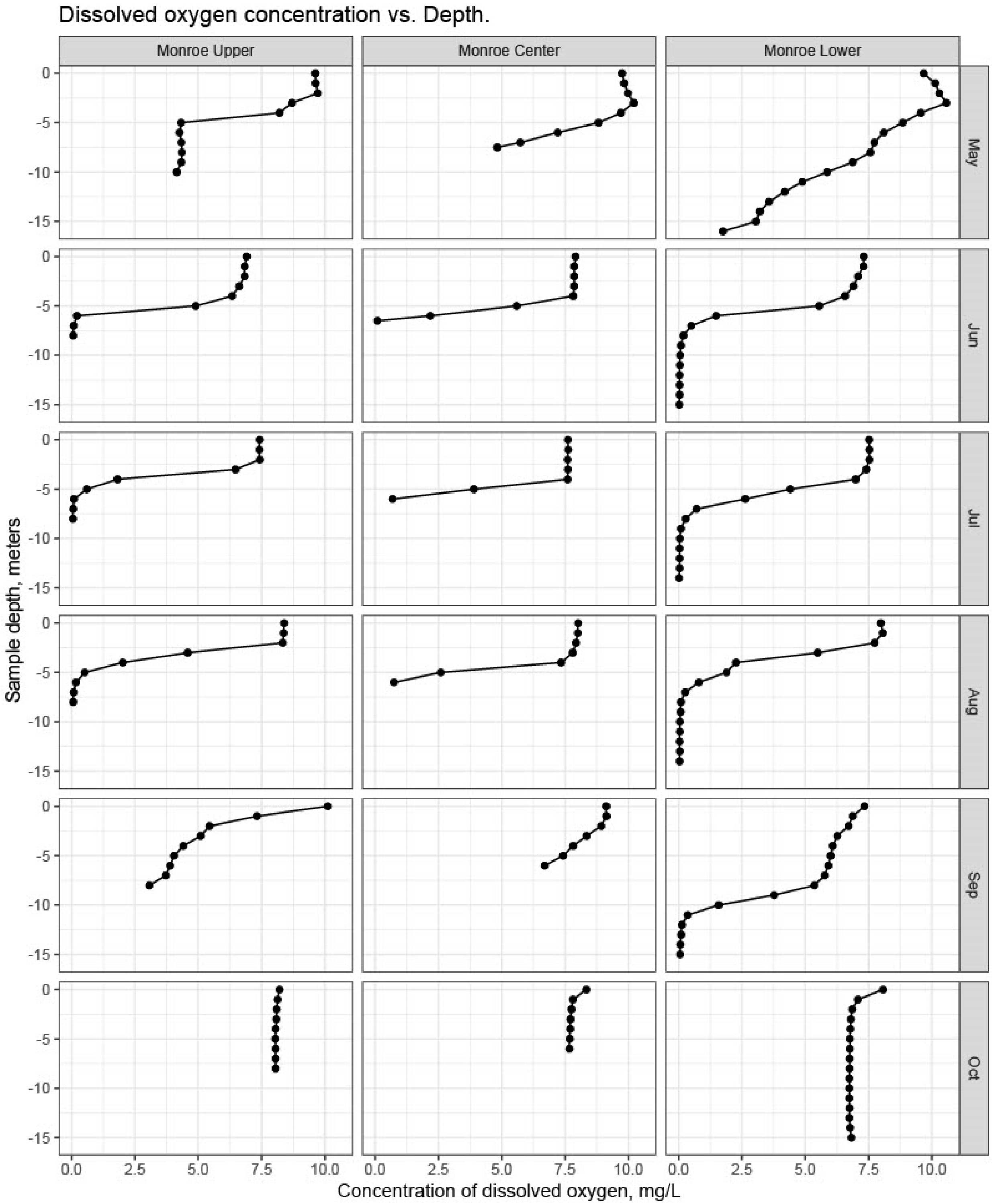
Figure 4-6 Soluble Reactive Phosphorus in Lake Monroe 2020



4.4.3 Stratification and Anoxia

During stratification, the epilimnion has higher temperatures and more dissolved oxygen due to exposure to sunlight and mixing with air. In contrast, the hypolimnion will have lower temperatures and less dissolved oxygen because it is not mixing with the surface water. Dissolved oxygen in the hypolimnion is at or near zero from June-August in the upper basin and June-September in the lower basin, as shown in Figure 4-7. In the center basin, low oxygen concentrations occurred in June-August but only at the bottom, likely because this sampling point was shallow, allowing mixing to occur in most of the water column.

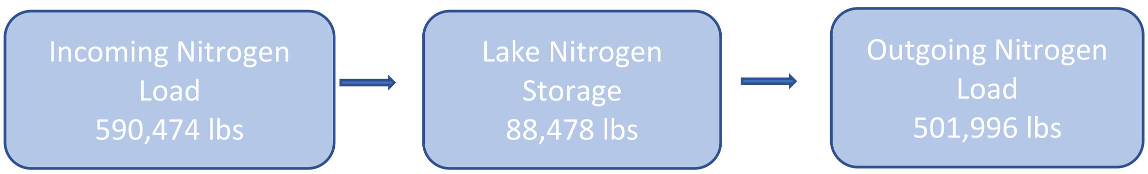
Figure 4-7 Dissolved Oxygen Concentration vs. Depth



4.4.4 Nitrogen in Lake Monroe

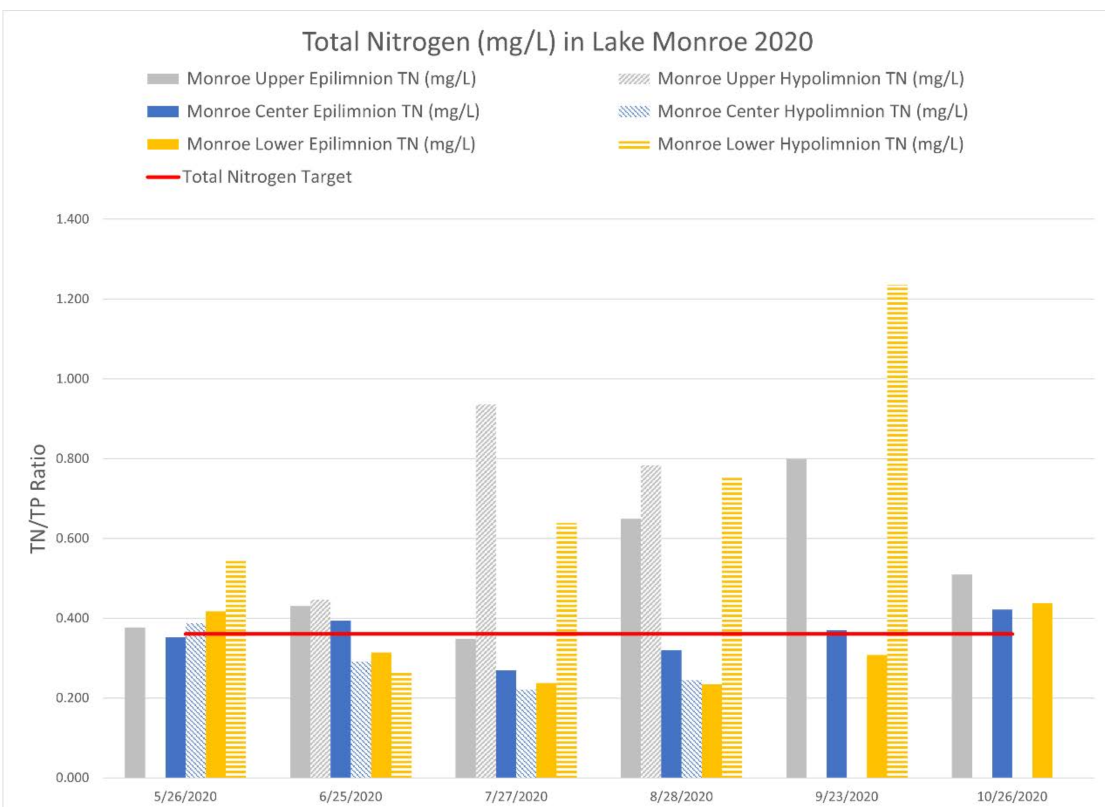
Lake Monroe retains about 15% of its incoming nitrogen load, as shown in Figure 4-8. 590,474 pounds of nitrogen enter the lake annually and 501,996 pounds leave the lake, leaving 88,478 pounds stored in the lake.

Figure 4-8 Nitrogen Movement Through Lake Monroe



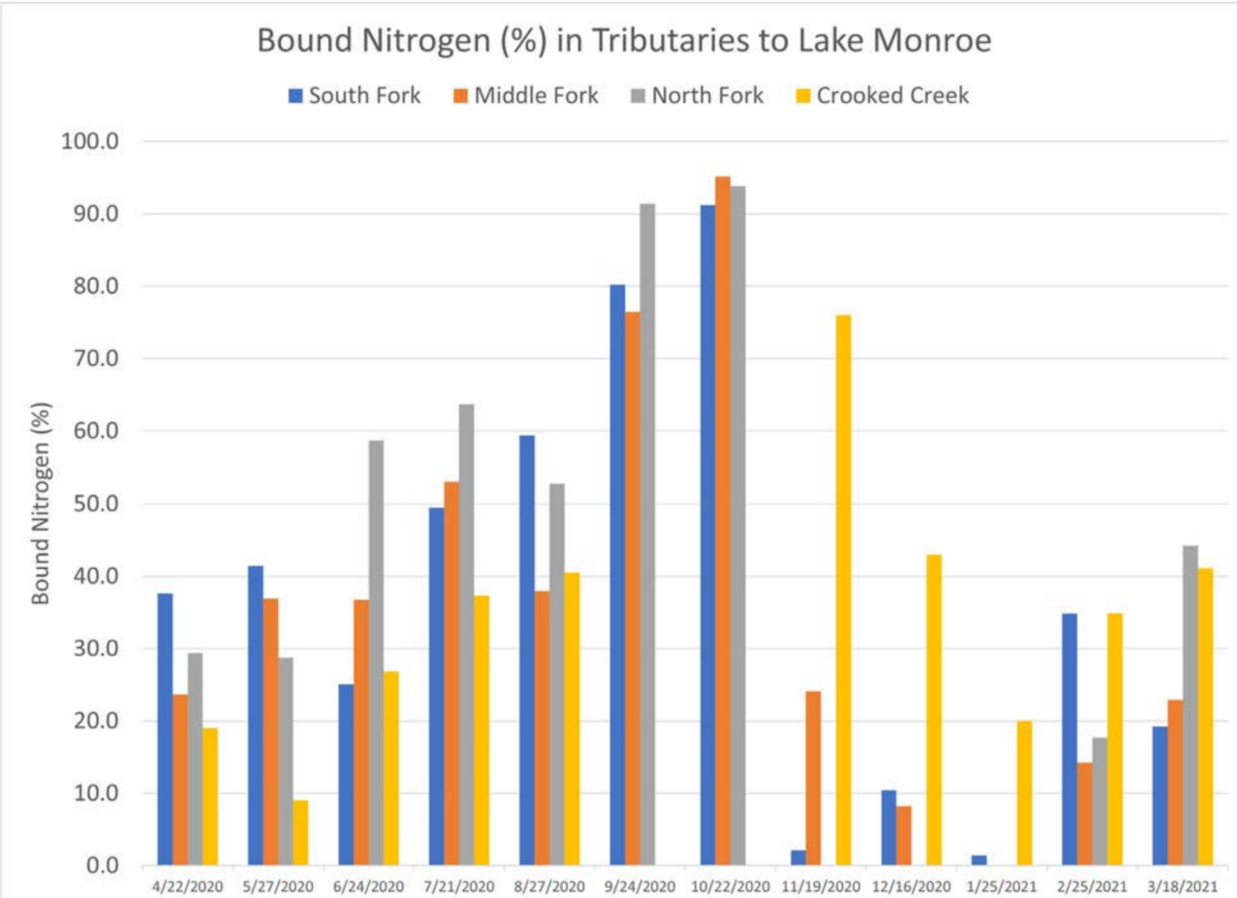
Total nitrogen was detected in Lake Monroe at levels above the target water quality goal of 0.69 mg/L in 17% of Upper Basin epilimnion samples, 67% of Upper Basin hypolimnion samples, and 40% of Lower Basin hypolimnion samples. No total nitrogen exceedances were detected in the Center Basin samples.

Figure 4-9 Total Nitrogen in Lake Monroe 2020



A significant portion of the nitrogen loads to Lake Monroe are in the form of sediment bound nitrogen. Bound nitrogen was calculated by subtracting nitrate and ammonia from the total nitrogen concentration. Bound nitrogen was divided by total nitrogen to get the percent of bound nitrogen as shown in Figure 4-10. Four data points were excluded because the reported ammonia concentrations were higher than the reported total nitrogen concentrations.

Figure 4-10 Percent Bound and Organic Nitrogen in Tributaries to Lake Monroe



4.4.5 Chlorophyll-a in Lake Monroe

Samples were collected from the epilimnion at each lake sampling site and analyzed in the lab for Chlorophyll-a concentrations. Chlorophyll-a concentration is an indicator of algal growth. According to Carlson (Carlson 1977), concentrations over 7.3 ug/L indicate eutrophic conditions. 83% of upper basin samples, 50% of center basin samples, and 33% of lower basin samples exceed that threshold.

Chlorophyll-a was reported at levels above the water quality target of 4.93 ug/L in 100% of upper basin epilimnion samples, 83% of center basin epilimnion samples, and 67% of lower basin epilimnion samples. The average concentration, maximum concentration, and percent of samples exceeding the water quality target were all highest in the upper basin with the center basin second and the lower basin third. These results indicate decreasing algal concentration as water moves through the lake, presumably due to the depletion of incoming nutrients as water flows through the lake and nutrient-laden sediments are deposited on the lake bottom.

Chlorophyll-a concentrations were highest in the upper and center basin during the late September sampling event. These high concentrations are likely due to coincident warm temperatures, destratification and mixing of nutrient rich hypolimnetic water with the epilimnion.

Table 4-5 Chlorophyll-a in Epilimnion of Lake Monroe 2020

Sample Date	Monroe Upper Chlorophyll-a (ug/L)	Monroe Center Chlorophyll-a (ug/L)	Monroe Lower Chlorophyll-a (ug/L)
5/26/2020	8.59	6.81	6.76
6/25/2020	6.19	4.42	2.97
7/27/2020	19.32	6.07	2.50
8/28/2020	26.49	11.34	7.96
9/23/2020	31.00	16.97	6.15
10/26/2020	18.57	13.78	7.73
Average	18.36	9.90	5.68
Max	31.00	16.97	7.96
Min	6.19	4.42	2.50
% > 4.93	100%	83%	67%

4.4.6 Blue-Green Algae in Lake Monroe

Blue-green algae monitoring by IDEM and ISDH led to Beach Advisory Alerts being issued annually 2011-2021 at Fairfax and Paynetown Beaches based on algal counts over 100,000 cells/ml. These recreational advisories were typically issued in July and stayed in effect through the end of sampling (Labor Day). During a beach advisory alert, swimming and boating is permitted but visitors are advised to avoid contact with algae and take a bath after coming in contact with the water. Cyanotoxins are also measured as part of the monitoring program. However, no cyanotoxins were detected at levels to trigger elevated recreational advisories in Lake Monroe.

Table 4-6 Historical Algal Counts at Paynetown per IDEM/IDNR/ISDH Beach Monitoring Program

Historical Algal Counts (cells/ml) at Paynetown							
	Mid June	**Late June**	**Early/Mid July**	**Mid/Late July**	**Early August**	**Mid August**	**Late August**
2011	—	46,960	—	110,240	604,400	599,160	541,800
2012	—	19,680	—	298,153	—	1,114,200	422,800
2013	—	52,800	—	77,093	—	161,019	148,284
2014	15,952	—	77,763	—	189,919	391,463	—
2015	2,083	—	61,589	—	147,960	87,385	—
2016	—	21,601	—	122,060	798,760	394,318	—
2017	13,078	—	42,699	—	222,759	242,444	—
2018	13,600	—	138,036	235,616	185,624	254,214	—
2019	84,519	—	—	—	508,684	586,131	—
2020	—	30,188	—	—	543,604	656,807	550,698

Chlorophyll-a measurements collected by the Indiana Limnology Lab from April showed peak concentrations during the late September (9/23/2020) sampling event. This indicates that algal counts likely continue to increase in the early fall after the IDEM beach monitoring program ends (Labor Day – late August). Peak algal counts likely occur in September or possibly October. While recreational use decreases significantly after Labor Day, there are still plenty of swimmers and boaters in September and October.

4.4.7 Legacy Nutrients in Lake Monroe

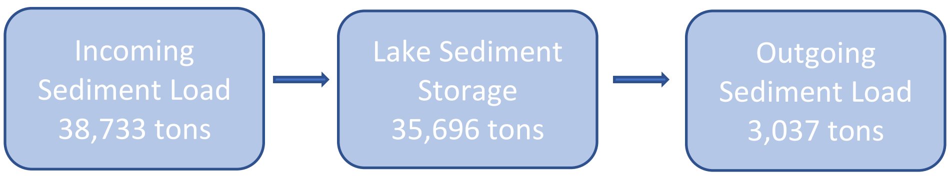
One challenge to understanding nutrient loads in Lake Monroe is evaluating the impact of legacy nutrients in lake sediments. Our data point to a process in which nutrients are transported to the lake primarily as sediment but also in dissolved form. The sediment is then deposited on the lake bottom and released to the hypolimnion during periods when stratification creates anoxic conditions. Under anoxic conditions SRP is available to feed algal growth and SRP is incorporated into the algae, causing an increase in TP. The nutrient loads entering from the streams are external loads while the nutrient loads released from the lake bottom sediments are internal loads. Even if all of the incoming nutrient load were eliminated, there would still be internal nutrient loads. These are called legacy nutrients.

Additional study is needed to quantify legacy nutrients in Lake Monroe. However, phosphorus release from the sediment under anoxic conditions was observed as described in section 4.4.2.

4.4.8 Sediment in Lake Monroe

Lake Monroe acts as a sediment sink, as shown in Figure 4-11. 38,733 tons of sediment enter the lake annually and 3,037 tons exit the lake, leaving 35,696 tons stored in the lake. Sediment accumulates at the bottom of the lake.

Figure 4-11 Sediment Movement Through Lake Monroe



Total suspended solids (TSS) concentrations in the lake were generally well below the water quality target of 30 mg/L. The single exceedance was the June sample from the Upper Basin hypolimnion, with a concentration of 36.4 mg/L. This elevated concentration may have been related to elevated sediment and nutrient levels in the South Fork stream samples collected on June 22, though TSS levels in the upper basin epilimnion were low.

Figure 4-12 Total Suspended Solids in Lake Monroe 2020

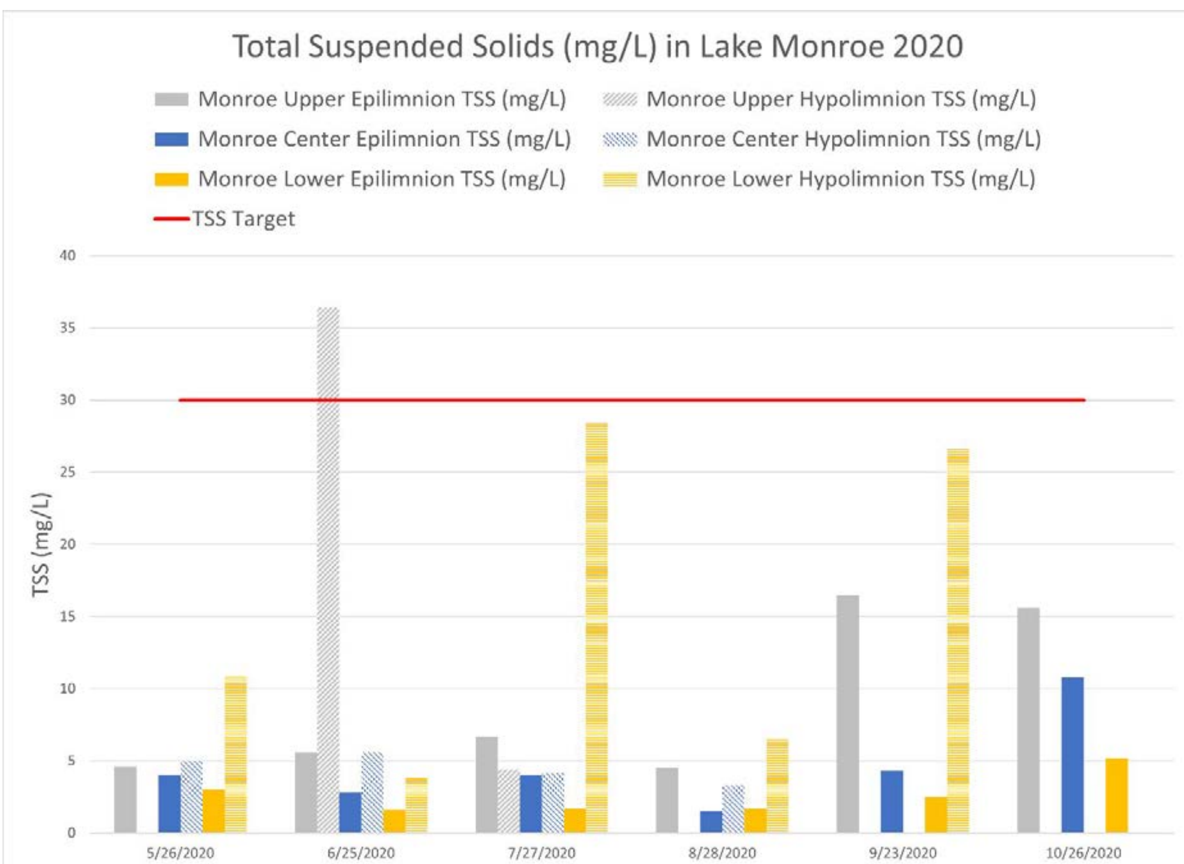


Table 4-7 Total Suspended Solids in Lake Monroe 2020

Sample Date	Monroe Upper Epilimnion TSS (mg/L)	Monroe Upper Hypolimnion TSS (mg/L)	Monroe Center Epilimnion TSS (mg/L)	Monroe Center Hypolimnion TSS (mg/L)	Monroe Lower Epilimnion TSS (mg/L)	Monroe Lower Hypolimnion TSS (mg/L)
5/26/2020	4.6		4	5	3	10.9
6/25/2020	5.6	36.4	2.8	5.6	1.6	3.8
7/27/2020	6.7	4.4	4	4.15	1.7	28.4
8/28/2020	4.5		1.5	3.3	1.7	6.5
9/23/2020	16.5		4.3		2.5	26.7
10/26/2020	15.6		10.8		5.2	

4.4.9 E. coli in Lake Monroe

The CBU Lab analyzed the monthly 2020 Lake Monroe samples for E. coli. All samples were well below the state E. coli standard of 235 CFU/100 ml. Furthermore, all samples were below 15 CFU/100 ml and 64% were below the detection limit of 1 CFU/ml.

Table 4-8 E. coli in Lake Monroe Epilimnion 2020

Sample Date	Monroe Upper Epilimnion E. coli (CFU/100 ml)	Monroe Center Epilimnion E. coli (CFU /100 ml)	Monroe Lower Epilimnion E. coli (CFU/100 ml)
5/26/2020	1.0	1.0	10.9
6/25/2020	1.0	1.0	1.0
7/27/2020	1.0	1.0	1.0
8/28/2020	1.0	1.0	1.0
9/23/2020	1.0	1.0	1.0
10/26/2020	1.0	1.5	2.0

Based on these data, E. coli does not appear to be an active concern in Lake Monroe. However, historical beach sampling data shows there have been E. coli exceedances in the past. Samples collected by USFS at the Hardin Ridge beach from 2015-2020 revealed four exceedances of the 235 CFU/100 ml standard out of fifty-four total samples. Two occurred in August 2015 (>2,400 and 727), one in July 2016 (>2,400), and one in August 2016 (632). All other samples had reported levels below 50 CFU/100 ml. No exceedances occurred in 2017-2020 and the highest recorded concentration in those years was 28 CFU/100 ml.

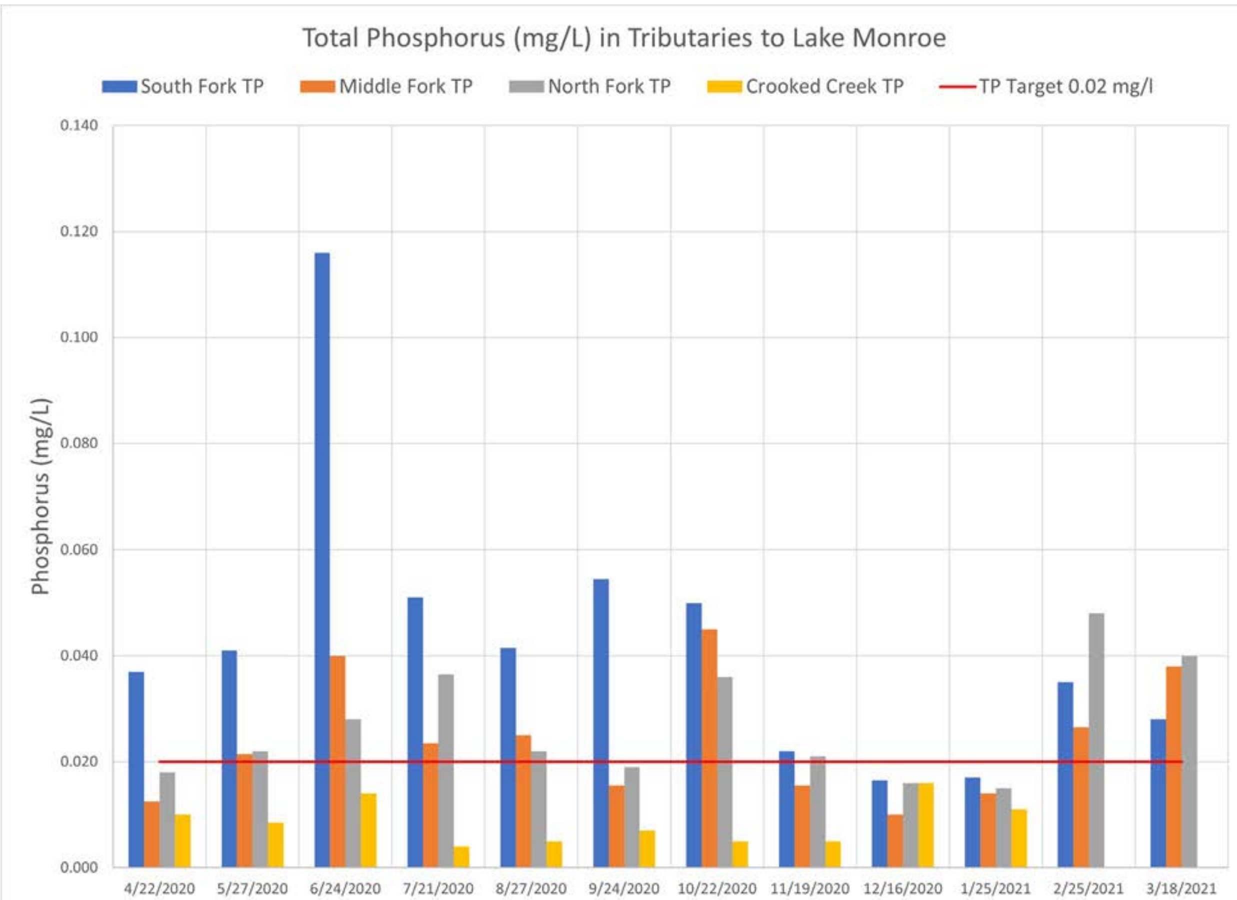
E. coli exceedances were reported in streams throughout the watershed, as discussed in section 4.8, and will need to be addressed. In the meantime, levels of E. coli in the lake should continue to be monitored to ensure that they stay well below levels of concern.

4.5 Potential Phosphorus Sources

Data from the nutrient budgets, tributary monitoring, and sampling blitz events were reviewed to evaluate the geographic distribution of phosphorus sources in the watershed.

While the nutrient budget indicates that the North Fork subwatershed generates the highest phosphorus load, monthly tributary monitoring shows the most phosphorus exceedances in the South Fork. Total phosphorus was reported at levels above the water quality target of 0.020 mg/L in 83% of South Fork samples, 58% of Middle Fork samples, and 67% of North Fork samples (Figure 4-13). Only one sample exceeded 0.060 mg/L, the June 2020 sample from South Fork Salt Creek which measured 0.116 mg/L.

Figure 4-13 Total Phosphorus in Lake Monroe Tributaries

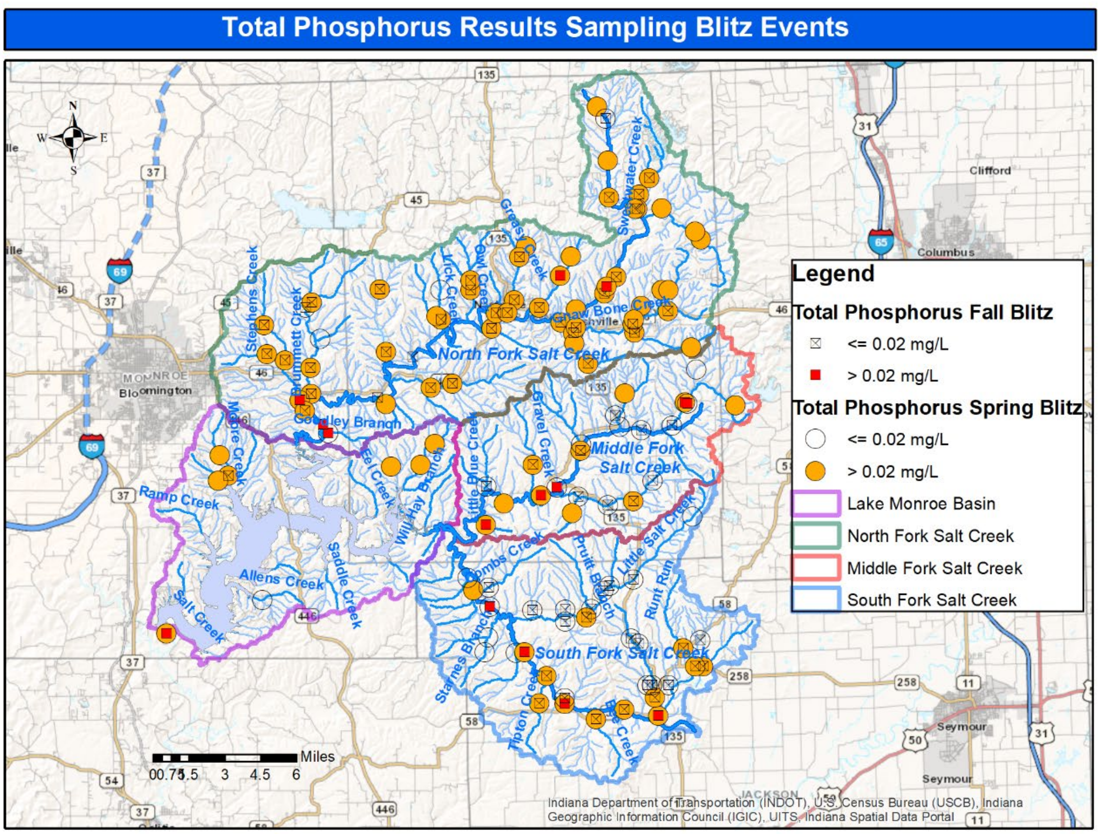


The sample collected from South Fork Salt Creek on June 24th is notable for its exceptionally high levels of E. coli, total phosphorus, and total nitrogen. This data point was reviewed to determine if it should be excluded from the data set as an outlier or mismeasurement. A review of flow data revealed that stream flows were elevated at the site in the three days preceding sampling, which could mean that the elevated levels were due to increased runoff from the watershed. Average daily stream flow measured in South Fork Salt Creek at Kurtz was 79.7 cubic feet per second (cfs) the day before sampling, dropping to 19.0 cfs the day of sampling. (Measured flow in North Fork at Nashville remained fairly constant during the same period, dropping from 9.6 to 8.7 cfs.)

Data collected from South Fork Salt Creek at Kurtz by the CBU Storm Team during flows between 20 cfs and 100 cfs was reviewed for comparison. This data indicated that the June values were within the expected range for elevated flow conditions with the exception of total nitrogen, which was considerably higher than the CBU data range. Ultimately the data point was kept in the report and analysis.

Data from the sampling blitz events reveal total phosphorus exceedances throughout the watershed, particularly during the spring blitz.

Figure 4-14 Total Phosphorus Results Sampling Blitz Events



Results were very different between the two blitz events. During the fall blitz, only 17% of samples were above the phosphorus target while during the spring blitz, 68% were above the target. During the fall blitz, Lake Monroe Basin had the highest percentage of phosphorus exceedances, followed by Middle Fork. During the spring blitz, Lake Monroe basin had the highest percentage of phosphorus exceedances, followed by North Fork. However, it should be noted that only 2 samples were collected in the Lake Monroe Basin during the fall blitz and only

8 samples during the spring blitz, meaning that each sample strongly influenced the overall percentage of exceedances.

Only four sites had total phosphorus exceedances during both the spring and fall blitz events. Two were in Middle Fork, one in South Fork, and one in North Fork. Site 488 in the North Fork subwatershed had the highest total phosphorus concentration (of these four sites) during both events.

Table 4-9 Sites With Phosphorus Exceedances During Both Blitz Events

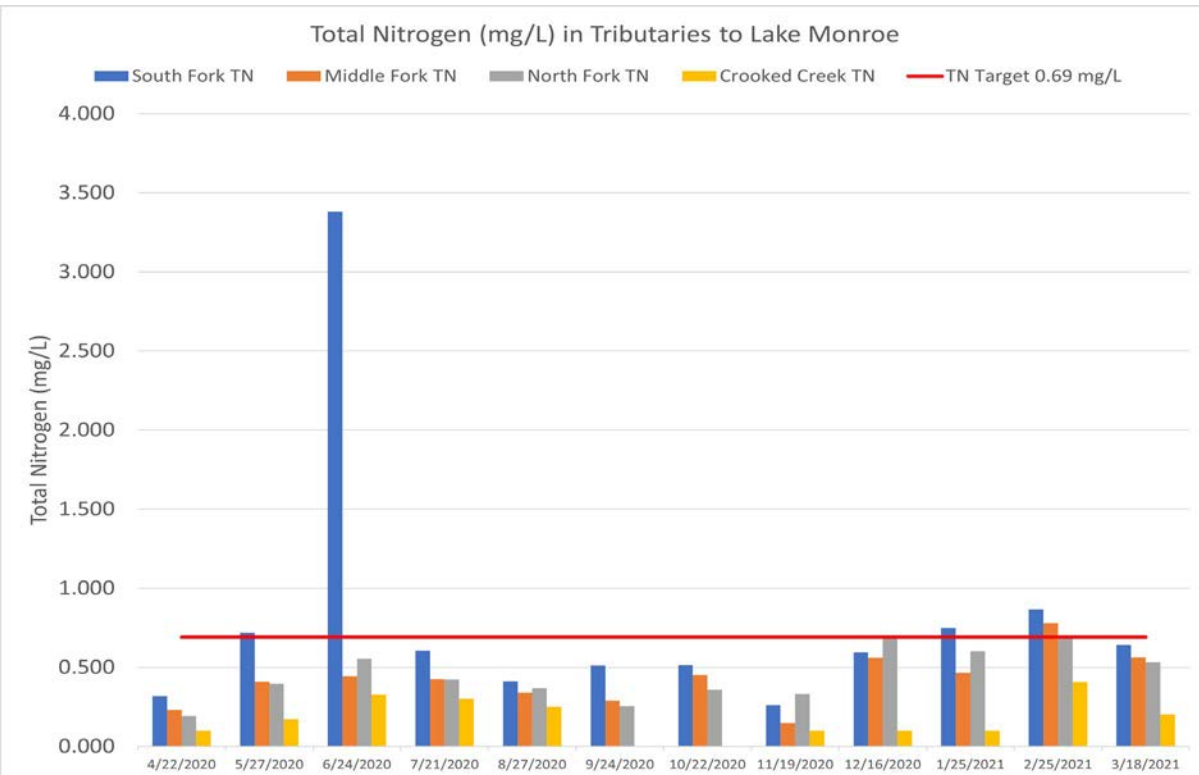
Blitz ID	Stream Name	HUC12 Subwatershed	Fall TP (mg/L)	Spring TP (mg/L)
814	South Fork Salt Creek	Tipton Creek (SF)	0.037	0.026
644	Unnamed tributary of South Branch Salt	Headwaters (MF)	0.033	0.022
662	Middle Fork Salt Creek	Gravel Creek (MF)	0.101	0.022
488	Unnamed tributary of NF Salt	East Fork Salt (NF)	0.235	0.031

4.6 Potential Nitrogen Sources

Data from the nutrient budgets, tributary monitoring, and sampling blitz events were reviewed to evaluate the geographic distribution of nitrogen sources in the watershed. All three data sets indicate that South Fork is the primary source of nitrogen, followed by North Fork.

Total nitrogen was detected at levels above the target water quality goal of 0.69 mg/L in 33% of South Fork samples, 8% of Middle Fork samples, and 8% of North Fork samples. Only one sample exceeded 1 mg/L, the June 2020 sample from South Fork Salt Creek which measured 3.379 mg/L.

Figure 4-15 Total Nitrogen in Tributaries to Lake Monroe

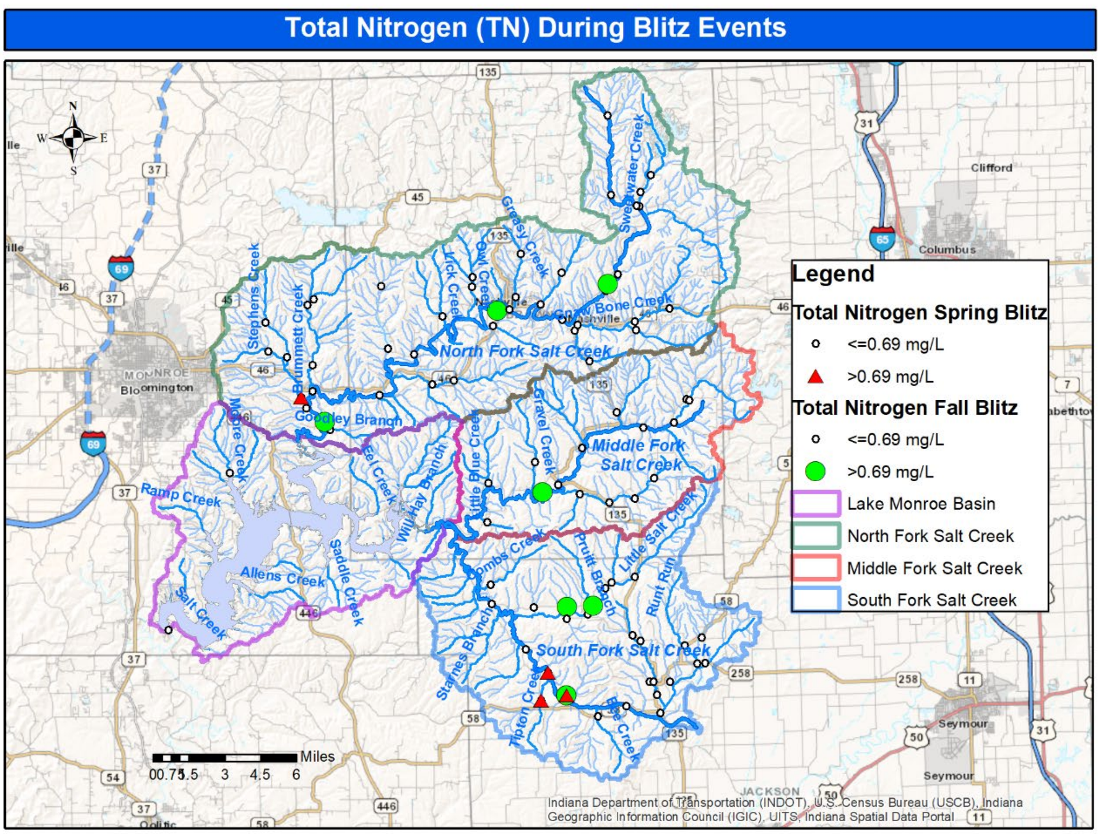


Total nitrogen was detected at levels above the target water quality goal of 0.69 mg/L in 7 of 88 fall samples (8%) and 4 of 122 spring samples (5%). The South Fork subwatershed had the highest percentage of total nitrogen exceedances during both blitz events, corresponding well with the nutrient budget. Only one site, #855 in an unnamed tributary of South Fork Salt Creek, had exceedances in both the spring and fall blitz events.

Table 4-10 Total Nitrogen at Select Blitz Sites (Concentrations >0.69 mg/L)

Site ID	Stream Name	Subwatershed	Fall TN (mg/L)	Spring TN (mg/L)
903	Pruitt Branch	Little Salt Creek (SF)	1.87	0.58
915	Unnamed tributary of Little Salt	Little Salt Creek (SF)	1.17	0.31
836	Tipton Creek	Tipton Creek (SF)	0.10	0.98
855	Unnamed tributary of SF Salt	Tipton Creek (SF)	1.04	1.17
857	South Fork Salt Creek	Tipton Creek (SF)	0.27	0.72
662	Middle Fork Salt Creek	Gravel Creek (MF)	1.21	0.36
488	Unnamed tributary of NF Salt	East Fork Salt Creek (NF)	2.15	0.15
385	North Fork Salt Creek	Clay Lick Creek (NF)	6.79	0.41
258	Stephens Creek	Stephens Creek (NF)	0.16	0.83
499	North Fork Salt Creek	Stephens Creek (NF)	2.42	--

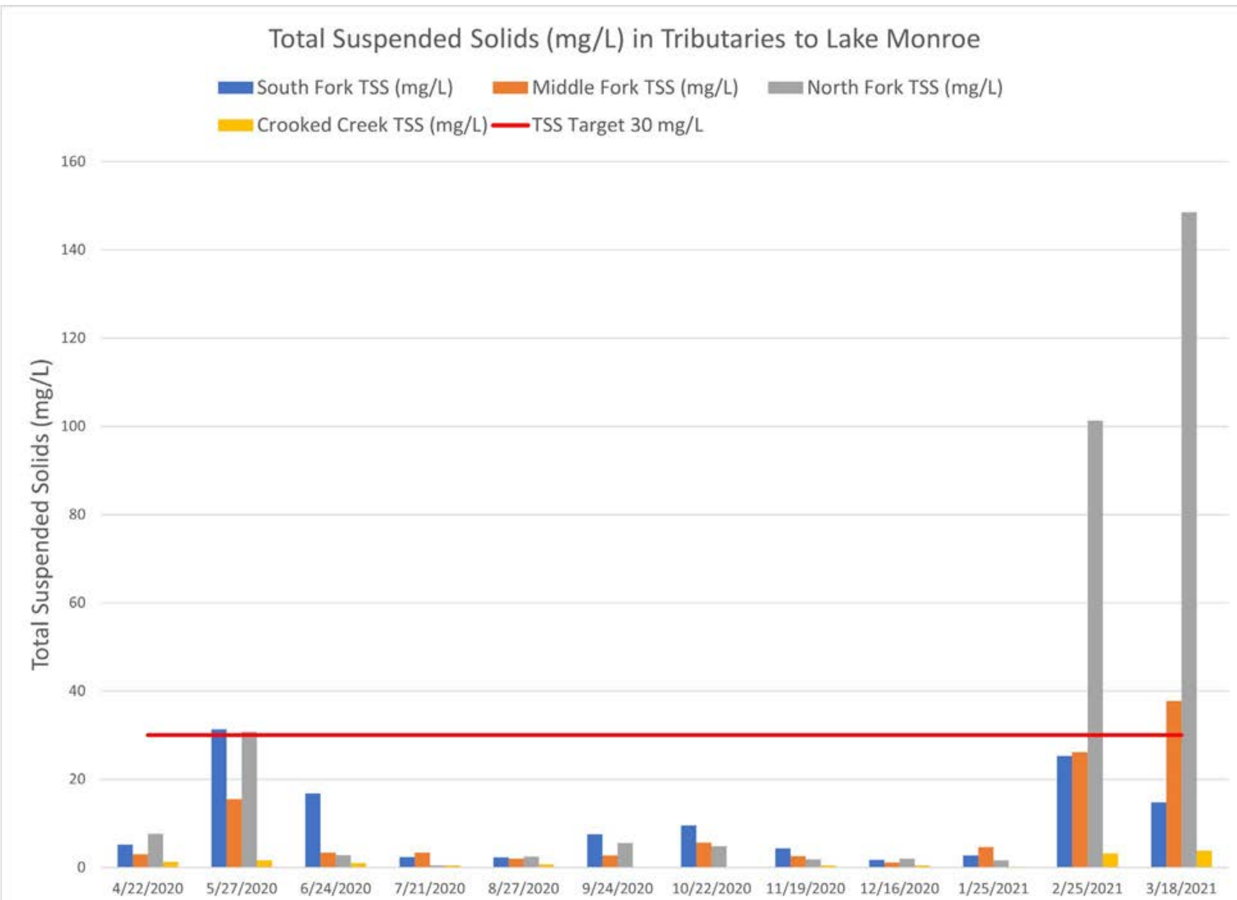
Figure 4-16 Total Nitrogen in Sampling Blitz Events



4.7 Potential Sediment Sources

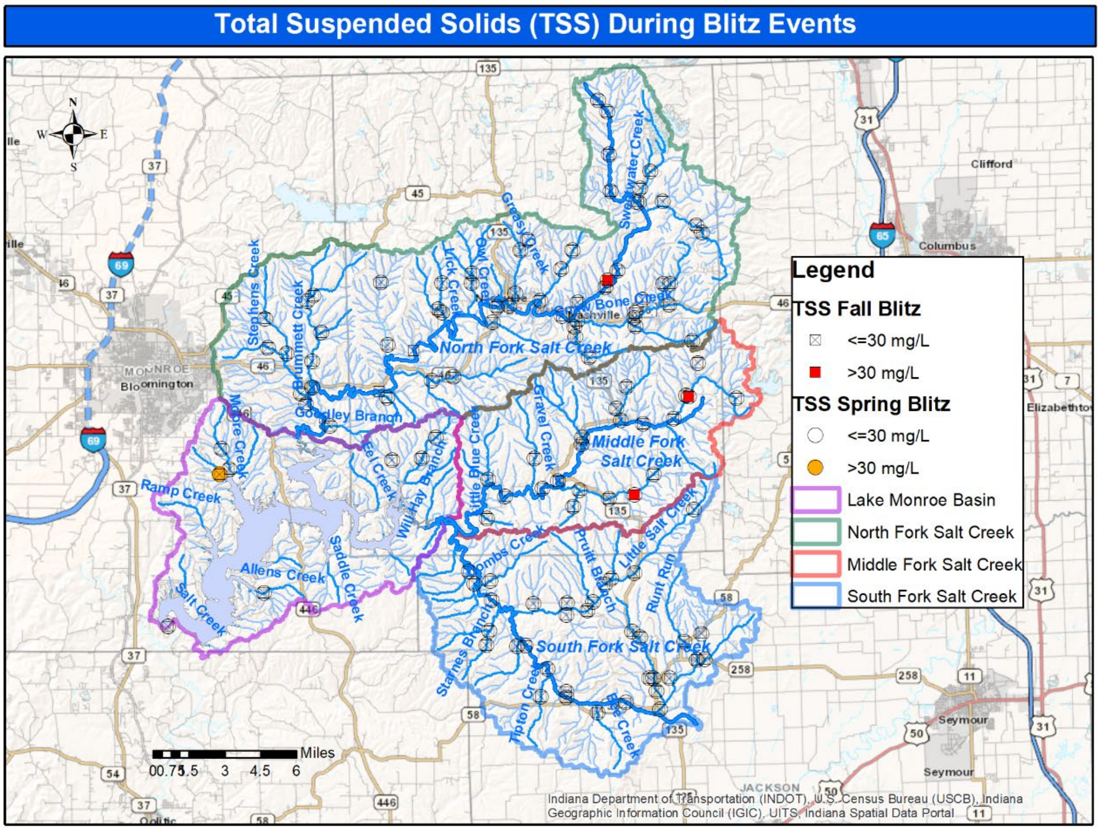
Based on the sediment budget developed using monthly tributary sampling, the primary source of sediment appears to be the North Fork followed by the South Fork. This was also reflected in the tributary sampling. Total suspended solids were reported at levels above the water quality target of 30 mg/L in 8% of South Fork samples, 8% of Middle Fork samples, and 25% of North Fork samples. North Fork had the two highest results, of 101.3 and 148.6 in February and March, respectively. Although there was not a strong correlation of total suspended solids concentration with total phosphorus concentration, evidence presented in sections 4.4.2 and 4.4.4 indicates that sediment is the primary source of nutrients entering the lake from streams.

Figure 4-17 Total Suspended Solids (TSS) in Lake Monroe Tributaries



Very few sediment exceedances were reported during the sampling blitz events. Total suspended solids concentrations were extremely low during the spring blitz with only one sample (of 122) exceeding the target concentration of 30 mg/L. This sample was collected in the Lake Monroe Basin subwatershed from a stream just before it enters Lake Monroe. During the fall blitz, three samples (of 88) exceeded the target concentration. Two were relatively small streams in the Middle Fork subwatershed and the third was from a very small stream in the North Fork subwatershed.

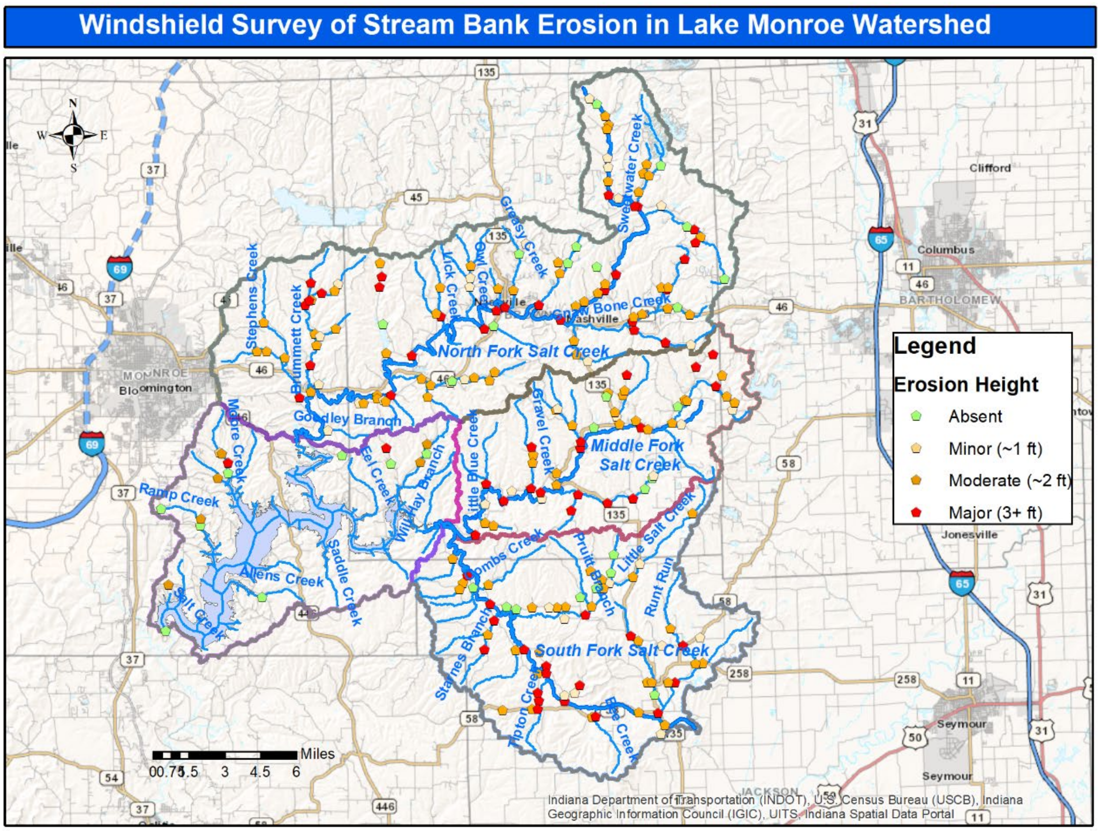
Figure 4-18 Total Suspended Solids (TSS) During Blitz Events



Streambank Erosion

Streambank erosion was identified as one potential source of sediment. During the windshield survey, 243 stream sites were evaluated. Erosion was observed at 209 sites throughout the watershed (86% of observed sites) ranging from minimal (1 foot) to severe (3 or more feet). Severe erosion was observed on both small and large streams.

Figure 4-19 Windshield Survey of Stream Bank Erosion in Lake Monroe Watershed



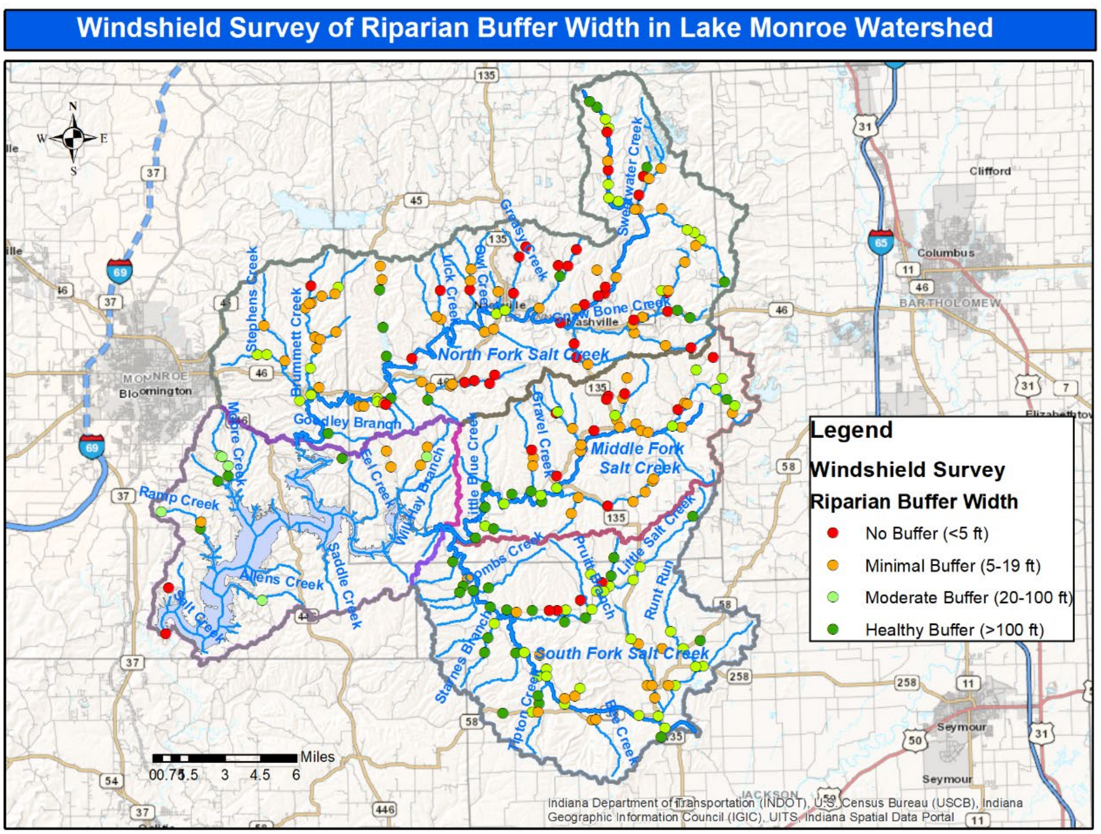
It is difficult to determine if streambank erosion has occurred recently or is historic in nature. Much of the watershed was deforested in the early twentieth century and it is possible that some of the observed streambank erosion occurred at that time. Streambanks may also be eroding due to hydrologic changes caused by the fluctuating water levels in Lake Monroe.

Riparian Buffer

Despite the large amount of forest in the watershed, sites lacking riparian buffer were prevalent and were distributed throughout the watershed. This includes sites where there is insufficient riparian buffer adjacent to agricultural land and also residential and commercial sites that are mowed to the edge of the stream. While mowed grass is clearly a better alternative than tilled ground, its root system is much shallower than most native flowers and grasses and it does not provide shade or other habitat benefits.

Of the 243 stream sites evaluated, 48 (20% of observed sites) had less than five feet of buffer and 97 (40% of observed sites) had between five and nineteen feet of buffer. Lack of buffer was most common for small and medium sized streams. The North Fork sub-watershed had the highest percentage of stream sites lacking sufficient riparian buffer, followed closely by the Middel Fork sub-watershed.

Figure 4-20 Windshield Survey of Riparian Buffer Width in Lake Monroe Watershed



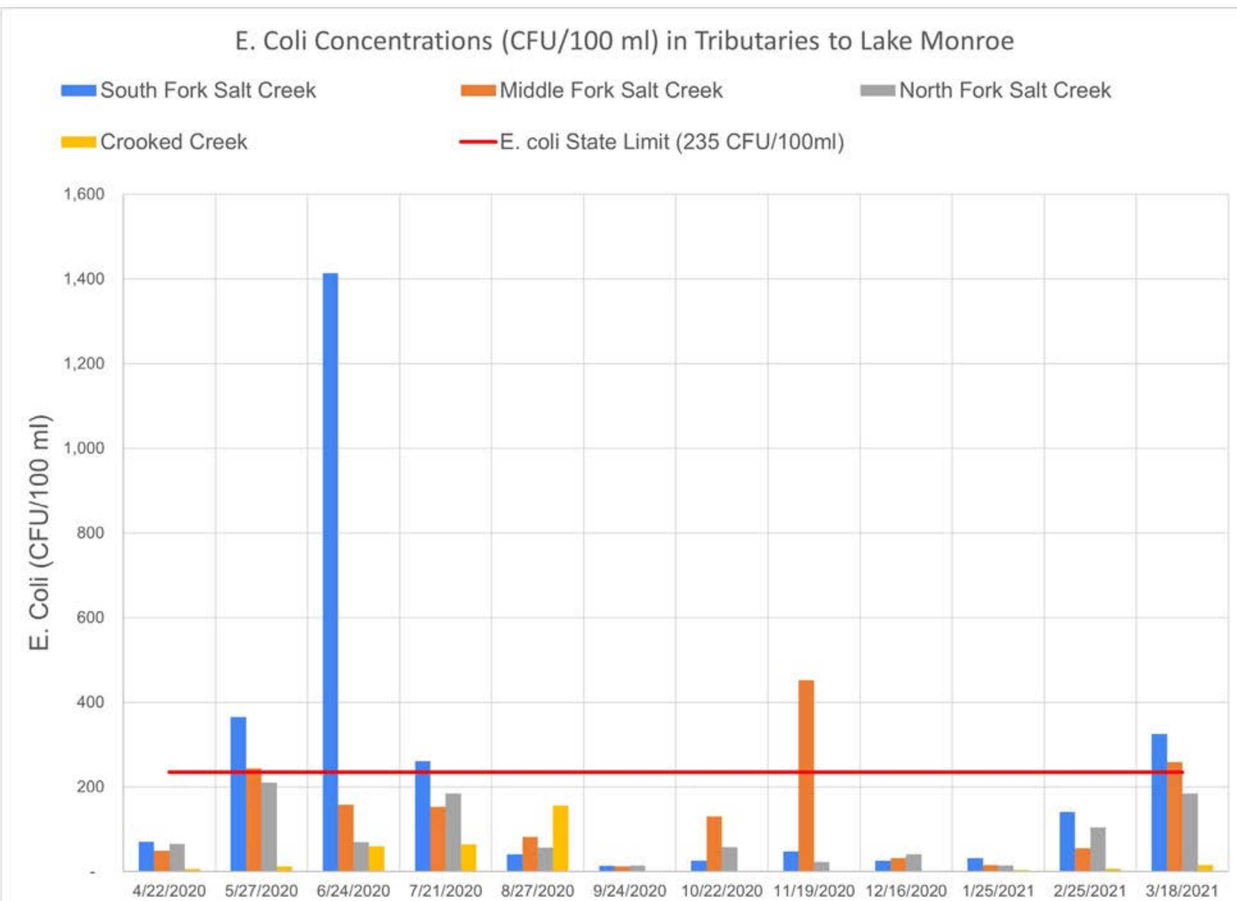
There was not as strong of a correlation between erosion and lack of riparian buffer as expected. This could be an indicator that streambank erosion happened in the early twentieth century when deforestation was widespread. Another possibility is that riparian buffer helps reduce lateral (sideways) movement of streams but is not as effective in combatting channel incision downward which could be caused by fluctuation of water levels in Lake Monroe.

Regardless, riparian buffer still plays an important role in both streambank stabilization and in filtering runoff from adjacent land, trapping sediment before it arrives in the stream. Forested buffer also provides shade and in-stream habitat.

4.8 Potential E. coli Sources

While E. coli does not appear to be a current concern in Lake Monroe, it was detected at levels above the state standard of 235 CFU/100 mL in 33% of monthly samples of South Fork Salt Creek and 25% of monthly samples of Middle Fork Salt Creek. No exceedances were measured in monthly samples of North Fork, Crooked Creek, or the Lake Monroe Outlet.

Figure 4-21 E. Coli Results from Monthly Sampling of Tributaries



E. coli exceedances were also reported in 16 of 88 samples during the fall blitz and 1 of 123 samples during the spring blitz. Tabulating exceedances from the fall blitz by subwatershed, 19% of Middle Fork subwatershed samples, 13% of North Fork subwatershed samples, 12% of South Fork subwatershed samples, and no Lake Monroe Basin subwatershed samples exceeded the E. coli threshold. The single spring blitz exceedance was in the South Fork subwatershed. Most of the E. coli exceedances were in relatively small streams. All exceedances were upstream of another sample location where E. coli concentrations were reported below the target level, suggesting that bacterial loads were diluted as water moved downstream.

Figure 4-22 Sites with E. Coli Exceedances During Either Sampling Blitz Event

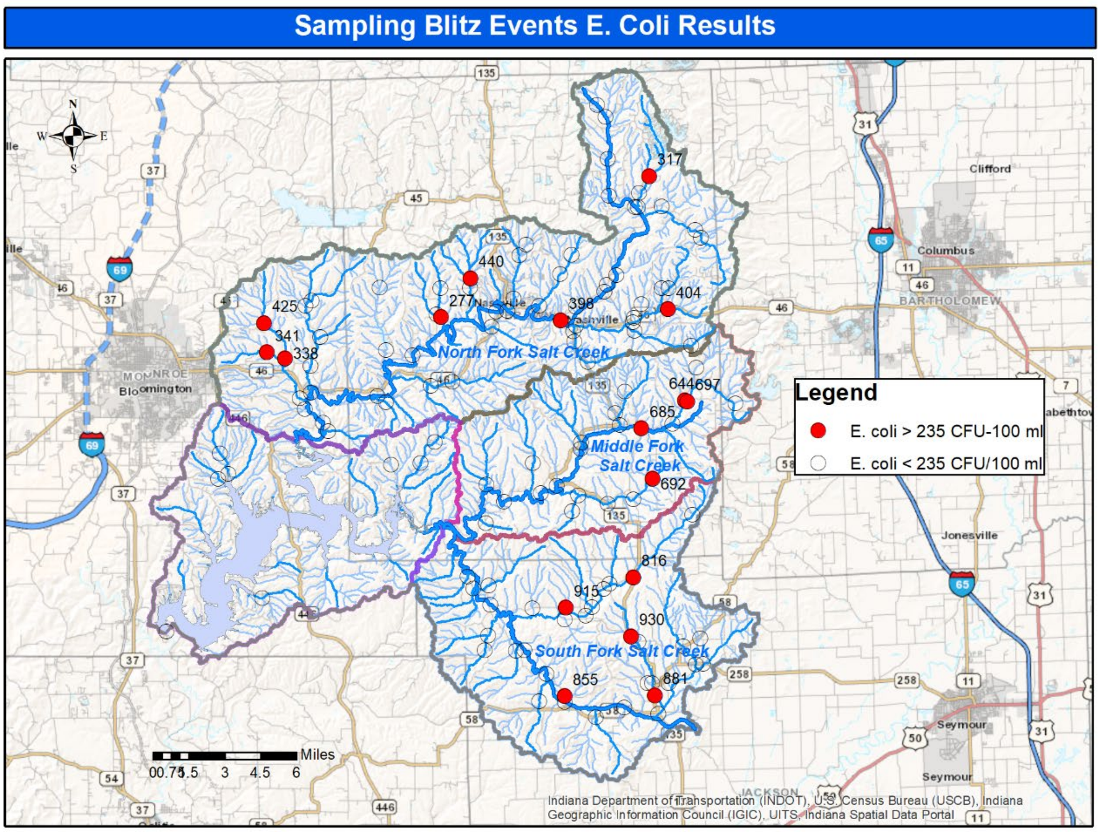


Table 4-11 E. Coli Exceedances During Sampling Blitz Events

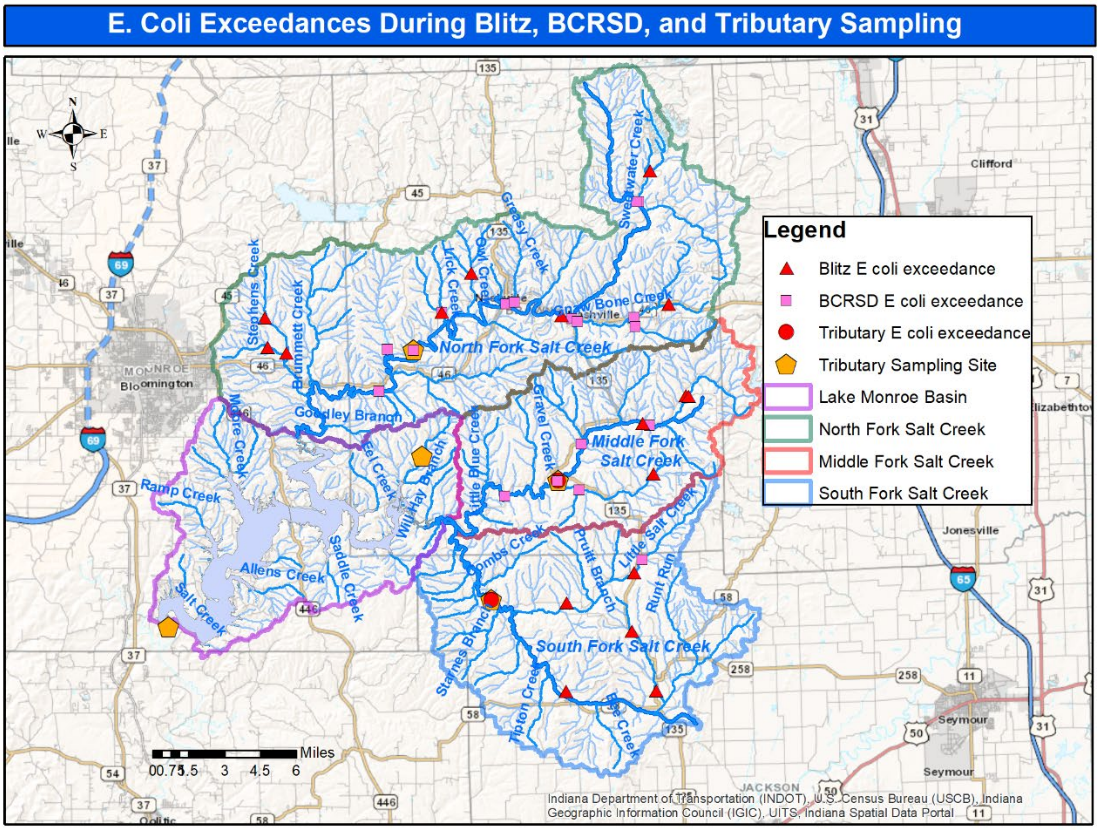
Blitz ID	Stream Name	Sub-watershed	Fall Blitz E. Coli (MPN/100 ml)	Spring Blitz E. Coli (MPN/100mL)
930	Kiper Creek	Kiper Creek (SF)	435.2	4.1
915	Unnamed tributary of Little Salt	Little Salt Creek (SF)	613.1	4
881	Kiper Creek	Kiper Creek (SF)	145.5	488.4
855	Unnamed tributary of SF Salt	Tipton Creek (SF)	>2419.6	3.1
816	Little Salt Creek	Little Salt Creek (SF)	>2419.6	11
697	South Branch Salt Creek	Headwaters (MF)	2419.6	6.3
692	Unnamed tributary of Hamilton Creek	Pleasant Valley (MF)	488.4	0
685	Middle Fork Salt Creek	Headwaters (MF)	648.8	18.9
644	Unnamed tributary of South Branch Salt	Headwaters (MF)	>2419.6	0
440	Owl Creek	Clay Lick Creek (NF)	298.7	8.6
425	Stephens Creek	Stephens Creek (NF)	1986.3	5.2
404	Henderson Creek	Gnaw Bone Creek (NF)	727	14.2
398	North Fork Salt Creek	Clay Lick Creek (NF)	1986.3	14.5
341	Kerr Creek	Stephens Creek (NF)	410.6	4.1
338	Stephens Creek	Stephens Creek (NF)	920.8	3.1
317	East Branch Sweetwater Creek	Sweetwater Creek (NF)	920.8	17.1
277	Lick Creek	Clay Lick Creek (NF)	378	20.3

Data from the BCRSD sampling efforts was also reviewed (Table 4-13). A map of the combined data sets (Fig 4-22) shows E. coli exceedances throughout the North Fork, Middle Fork, and South Fork subwatershed. While none of the monthly samples collected from North Fork Salt Creek at Yellowwood had levels of E. coli above the target level, samples collected by BCRSD in North Fork Salt Creek both upstream and downstream of the site had E. coli levels well above the target.

Table 4-12 Brown County Regional Sewer District E. Coli Sampling 2020

Site ID	Stream	Sub-watershed	5/5/2020	5/12/2020	5/19/2020	5/26/2020	6/2/2020	Geo. Mean
EF01	Sweetwater Creek	Sweetwater (NF)	115	12	379	365	82	109
EF02	North Fork Salt Creek	Sweetwater (NF)	338	9	219	61	77	80
EF03	Outlet Sweetwater Lake	Sweetwater (NF)	75	--	--	--	--	
EF04	North Fork Salt Creek	Brummett (NF)	338	112	1,630	365	128	310
EF05	Outlet Yellow-wood Lake	Clay Lick (NF)	87	33	87	461	13	69
EF06	North Fork Salt Creek	Clay Lick (NF)	705	310	1,170	32	126	253
EF07	Lick Creek	Clay Lick (NF)	449	22	401	93	59	117
EF08	North Fork Salt Creek	Clay Lick (NF)	1,440	58	811	1,990	122	439
EF09	Clay Lick	Clay Lick (NF)	85	36	171	187	25	76
EF10	North Fork Salt Creek	Gnaw Bone (NF)	424	195	661	345	96	283
EF11	Gnaw Bone	Gnaw Bone (NF)	449	78	620	186	141	224
EF12	Gnaw Bone	Gnaw Bone (NF)	338	21	276	172	84	122
EF13	Mount Liberty	Gnaw Bone (NF)	401	61	449	228	118	197
EF14	Middle Fork Salt Creek	Gravel Creek (MF)	705	63	1,220	548	144	336
EF15	Middle Fork Salt Creek	Pleasant Valley (MF)	310	115	925	866	122	322
EF16	Hamilton Creek	Pleasant Valley (MF)	1,020	43	705	548	166	309
EF17	Middle Fork Salt Creek	Pleasant Valley (MF)	755	31	755	861	192	310
EF18	Middle Fork Salt Creek	Headwaters (MF)	1,440	89	1,170	461	122	385
EF20	Greasy Creek	Clay Lick (NF)	755	83	276	365	228	270
EF21	Little Salt Creek	Little Salt Creek (SF)	136	4	190	461	93	85

Figure 4-23 E. Coli Exceedances During Blitz, BCRD, and Tributary Sampling

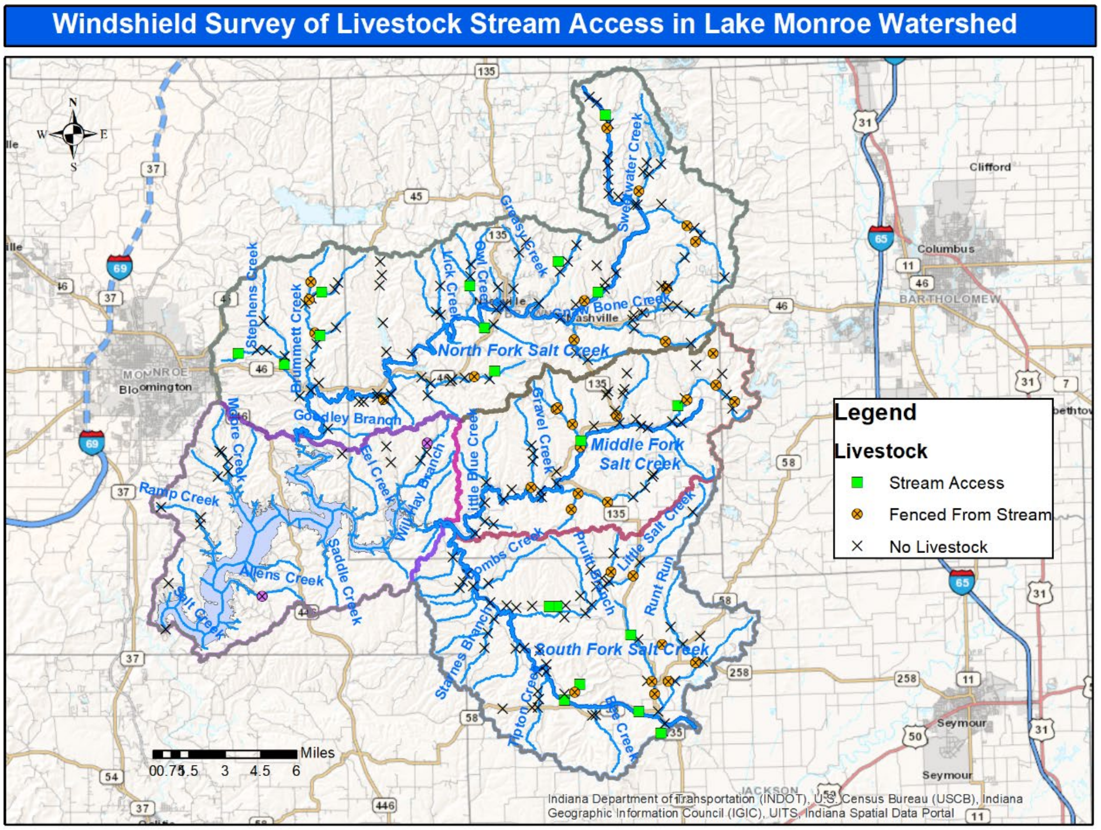


Interestingly, Crooked Creek had no E. coli exceedances despite appearing on the 303(d) impaired water bodies list as impaired for E. coli. The highest reported E. coli concentration in Crooked Creek was 157 CFU/100 mL and 70% of samples were below 20 CFU/100 mL.

Livestock in Streams

Livestock were observed at 44 sites, 19% of total observed sites (Fig 4-23). Livestock with free access to streams were observed at 17 sites, a little over a third of the livestock sites and 7% of total observed sites. Livestock operations tend to be small with a variety of animals observed including cows, horses, goats, and donkeys. There are also at least two exotic animal farms in the watershed. Livestock operations tend to be somewhat larger in the Middle Fork and South Fork subwatersheds.

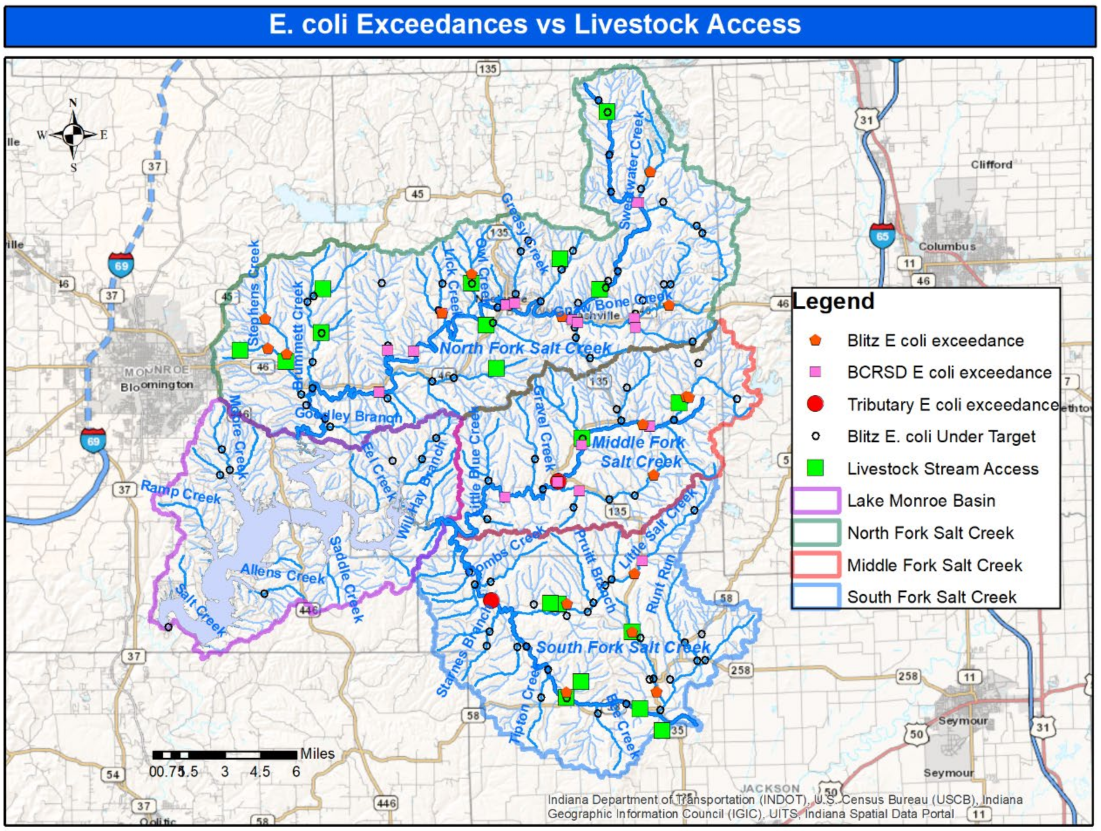
Figure 4-24 Windshield Survey of Livestock Stream Access in Lake Monroe Watershed



E. coli and Livestock

All E. coli exceedances were mapped and compared to sites where livestock have free access to streams, as observed during the windshield survey.

Figure 4-25 E. Coli Exceedances vs Livestock Access



There was not a strong correlation observed between livestock access to streams and E. coli. Some sites at or downstream from livestock access points showed elevated E. coli concentrations and others showed concentrations below the target level.

Failing Septic Systems

The Lake Monroe watershed has an estimated 9,096 septic systems. Limited data are available to quantify the number that are inadequate or failing. The Indiana State Department of Health estimates that 200,000 of the 800,000 on-site wastewater systems statewide are failing, a failure rate of 25% (Purdue Extension HENV-1-W). That failure rate would indicate 2,274 failing septic systems in the Lake Monroe watershed.

The Monroe County Health Department had 17 sewage discharge complaints on file within the Lake Monroe watershed. Given an estimated 3,754 households in the Monroe County portion of the watershed, the failure rate would be 0.5%. However, this is likely a gross underestimate as the Health Department relies on complaints to identify failing systems. Additional failing systems may be undetected because they have not caused ponding or odor issues that impact neighbors.

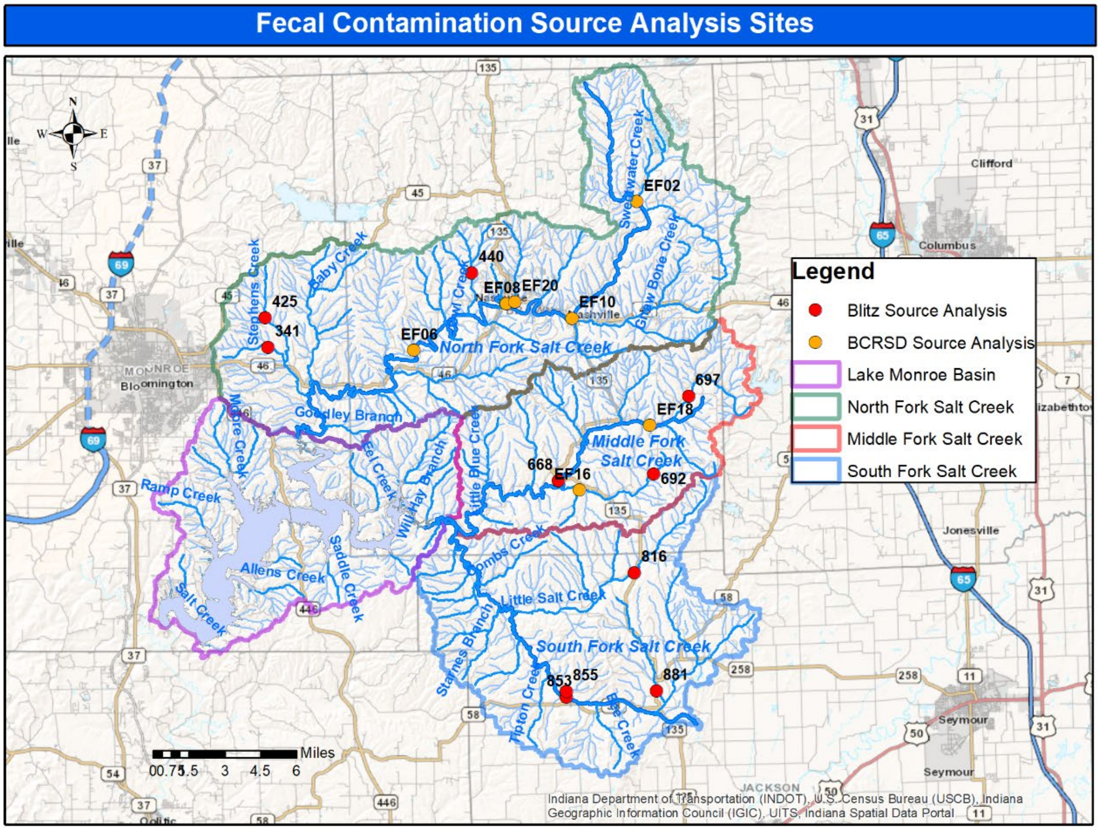
Septic system failure is likely to increase in frequency as systems age. BCRSD reviewed septic system records in Brown County and estimated that 50% of the 7,700 septic systems in Brown County were installed prior to 1990. Assuming this is true throughout the watershed, 4,548 septic systems in the watershed are over 30 years old and the average septic system life expectancy is 25 years. Proactive education and outreach can help households and businesses identify and address septic system issues promptly, protecting water quality in streams and waterbodies throughout the watershed.

Fecal Contamination Source Analysis

The Brown County Regional Sewer District (BCRSD) has been studying E. coli as part of a larger effort to develop a wastewater strategic plan for Brown County. They collected 5 samples weekly in May and early June of 2020 at twenty sites in the Lake Monroe watershed (as well as twelve sites in the adjacent Bean Blossom watershed) and analyzed for E. coli. For water to meet the recreation standards in Indiana, the geometric mean of 5 samples over a 30-day period is required to be less than 125 CFU/100 mL, with no sample testing higher than 235 CFU/100 mL.

Based on the sampling results and land use data for each site, seven sites in the Lake Monroe watershed were selected by BCRSD for source analysis. Friends of Lake Monroe reviewed their data in conjunction with data from the sampling blitz events and identified an additional ten sites to sample. Water was collected from the seventeen sites and sent to Scientific Methods where it was analyzed using coliphage serotyping. This method studies residue from coliphages, which are viruses that infect coliform bacteria such as E. coli. Certain species of coliphages can be directly linked to human sources and others to animal sources. Other coliphage species cannot be linked to a particular source.

Figure 4-26 Fecal Contamination Source Analysis



While coliphage residue does not correlate directly with E. coli concentration, both indicate the presence of fecal contamination. Many of the samples did not contain enough coliphage residue (plaque forming units or pfu/100 ml) to provide probable source results (see Table 4-13). Of the five samples that produced results, four were very close to having a 50%/50% split between coliphage strains connected to human sources and coliphage strains connected to animal sources.

One sample, collected from Greasy Creek at site EF20, showed 94% coliphage strains connected to human sources and 6% coliphage strains connected to animal sources. However, these percentages do not reflect the true source probability as there are species of coliphage that cannot be traced to a particular source. The primary conclusion to be drawn from these results is that both human and animal fecal contamination were present in the five samples where results were obtained.

Table 4-13 Fecal Contamination (Coliphage) Source Analysis Results April 2021

BC_ID	LM_ID	Subwatershed	Stream	pfu/100ml	% probability human source	% probability animal source
	425	Stephens (NF)	Stephens Creek	< 1	NA	NA
	341	Stephens (NF)	Kerr Creek	< 1	NA	NA
	440	Clay Lick (NF)	Owl Creek	< 1	NA	NA
EF06	256	Clay Lick (NF)	North Fork Salt Creek	0.6	54	46
EF08	near 389	Clay Lick (NF)	North Fork Salt Creek	< 1	NA	NA
EF20	near 309	Clay Lick (NF)	Greasy Creek	0.4	94	6
EF10	near 398	Gnaw Bone (NF)	North Fork Salt Creek	< 1	NA	NA
EF02	332	Sweetwater (NF)	North Fork Salt Creek	0.1	NA	NA
EF18	near 685	Headwaters (MF)	Middle Fork Salt Creek	0.4	50.5	49.5
	697	Headwaters (MF)	South Branch Salt Creek	< 1	NA	NA
EF16	623	Pleasant Valley (MF)	Hamilton Creek	0.3	NA	NA
EF15	668	Pleasant Valley (MF)	Middle Fork Salt Creek	< 1	NA	NA
	692	Pleasant Valley (MF)	unnamed tributary to Hamilton Creek	< 1	NA	NA
	816	Little Salt Creek (SF)	Little Salt Creek	< 1	NA	NA
	853	Tipton Creek (SF)	South Fork Salt Creek	0.1	50.5	49.5
	855	Tipton Creek (SF)	unnamed tributary to South Fork Salt Creek	< 1	NA	NA
	881	Kiper Creek (SF)	Kiper Creek	0.1	50.5	49.5

4.9 Metals, Inorganic Compounds, and Other Parameters in Lake Monroe

While the water quality monitoring for this study focused on nutrients and sediment, historical data was reviewed to evaluate other parameters in Lake Monroe.

USACE Historic Sampling

USACE evaluates a wide variety of parameters in its annual sampling events includes atrazine, antimony, arsenic, barium, beryllium, cadmium, chromium, copper, lead, manganese, mercury, nickel, selenium, silver, and zinc. Most parameters consistently measure below levels of concern. However, copper was flagged in the tailwaters sample of the USACE 2019 annual report (based on 2018 sampling) and iron was flagged in the USACE 2020 annual report (based on 2019 sampling).

Reported copper levels in Lake Monroe from 2007-2020 were generally extremely low with almost all samples below 5 ug/L (0.005 mg/L). The exception was the 2018 tailwaters sample with a concentration of 11.4 ug/L which exceeded the acute aquatic criterion of 7.79 ug/L. This is a very conservative threshold. For comparison, the drinking water limit for copper is 1300 ug/L, or 1.3 mg/L. Ultimately copper was not selected as a contaminant of concern for this study.

Reported iron levels in Lake Monroe from 2007-2020 have ranged from below the detection limit to 6.6 mg/L with a median of 1.1 mg/L. Iron cycling in lakes and streams is complex and it is normal for concentrations to vary considerably over both time and space. The EPA acute aquatic criterion is hardness dependent and must be calculated for each sampling event. The 2019 tailwater sample had an iron level of 4.28 mg/L, exceeding the acute aquatic criterion of 2.744 mg/L. While any exceedance is concerning, the concentrations of iron in Lake Monroe appear to be within normal variations for the state. Iron concentrations in samples from all the Louisville District ACOE lakes ranged from below the detection limit to 20.8 mg/L. Due to the limited data availability and the lack of obvious potential sources of iron within the watershed, iron has been excluded from this watershed plan.

City of Bloomington Utilities (CBU)

CBU routinely analyzes drinking water samples for a variety of parameters at different frequencies. A full list of contaminants monitored in 2019 is provided as Appendix H. Although this is treated drinking water, the presence of a constituent in drinking water would likely indicate its presence in the raw lake water, with the exception of chloramine, disinfection by-products, and fluoride.

- Tests are run quarterly for a list of twenty-one Synthetic Organic Carbons (SOCs) and a much longer parameter list is run every three years.
- Tests are run annually for eighteen Inorganic Compounds (IOCs), twenty-one regulated Volatile Organic Compounds (VOCs), and nineteen unregulated Volatile Organic Compounds.

- Tests are run every six years for radioactive contaminants (most recently in 2015).
- Chloramine, a chemical used for water treatment, is regularly monitored throughout the treatment plant and water distribution system.
- Disinfection By-Products (DBPs), chlorine by-products formed during disinfection, are monitored monthly.
- EPA's Unregulated Contaminant Monitoring Rule program requires sampling for additional parameters every five years (currently underway in 2020).

Based on the 2020 Annual Drinking Water Report (using 2019 data), the two detected constituents that are likely to come from raw lake water are barium and atrazine. Barium was detected at 0.012 ppm, well below EPA's maximum contaminant level of 2 ppm, and is attributed to the erosion of natural deposits. Atrazine was detected at 0.2 ppb, well below EPA's maximum contaminant level of 3.0 ppb, and is attributed to runoff from herbicide used on row crops. Barium has been present at consistent levels for the last ten years. Atrazine was reported at levels between 0.2 and 0.3 ppb in the 2013, 2014, 2015, 2018, 2019, and 2020 annual water quality reports.

Hexachlorocyclopentadiene was detected in 2018, 2016, and 2015 at 0.1 ppb, well below the EPA maximum contaminant level of 50 ppb. Di(2-ethylhexyl)phthalate was detected in 2016 at 1.6 ppb compared to the EPA maximum contaminant level of 6 ppb. Both constituents are associated with chemical manufacturing. Nitrate was detected in 2011 at 0.02 ppm and in 2012 at 3.7 ppb compared to the action level of 15 ppb and was attributed to nonpoint source pollution (fertilizer, septic systems, sewage, or erosion of natural deposits).

Lead and copper were also detected in the drinking water in all years. Copper levels ranged from 0.017 ppm to 0.037 ppm, well below the EPA regulatory limit for drinking water of 1.3 ppm. Lead levels ranged from 4.9 to 7.0 ppb with an EPA action level of 15 ppb and a target of 0 ppb. Lead and copper were both attributed in the annual report to a combination of corrosion of household plumbing and erosion of natural deposits. For comparison, USACE lake sampling data from 2007-2016 show copper levels ranging from under detection limits to 4.4 ug/L (0.0044 mg/L). Lead levels in thirty-five of thirty-seven samples were below 3.0 ppb. The two elevated results were 4.5 and 6.9 ppb, comparable to the CBU samples.

In 2020, samples of raw lake water collected by CBU via a pipe from the raw water intake tower showed elevated copper levels of 0.32 ppm, an order of magnitude higher than the typical drinking water results. The elevated copper levels were due to a new pilot program where copper sulfate is introduced at the intake tower to fight algae. This will likely be adopted as a standard operating procedure during the summer months. CBU will change their sampling point to a spot in the intake tower prior to the copper sulfate addition.

4.10 Habitat Evaluation (QHEI and CQHEI)

Habitat data was gathered by the IU Limnology Lab once at each of the five monthly sampling locations using the Qualitative Habitat Evaluation Index (QHEI) guidelines. While this data set is inadequate for studying trends in the watershed, it was analyzed to see if there was a connection between low water quality results and low habitat results. North Fork Salt Creek had the highest QHEI score, at 60, meriting the "good" classification according to the Ohio EPA QHEI handbook. This was also the only score to meet or exceed the IDEM recommended minimum score of 51. In Indiana streams with a QHEI score less than 51, "habitat is likely having a negative impact on aquatic communities" according to IDEM's Procedures for Completing the Qualitative Habitat Evaluation Index.

Crooked Creek, a headwaters stream, would be classified as "fair" based on Ohio EPA criteria with a score of 49 but would be considered impaired per IDEM criteria. Middle Fork, South Fork, and the Lake Monroe Outlet would all be considered "poor." The Lake Monroe Outlet scored the lowest which is unsurprising given it is a highly modified channel lined with riprap that receives highly variable flow from the Lake Monroe Dam.

Table 4-14 QHEI Evaluation of Main Tributaries by IU Limnology Lab

Site Name	**Substrate**	**Instream cover**	**Channel Morphology**	**Bank Erosion and Riparian Zone**	**Pool/glide and Riffle/run quality**	**Riffle**	**Gradient**	**QHEI TOTAL**
South Fork (Site 914)	1	6	9	7	7	0	4	**34**
Middle Fork (Site 668)	2	8	11	6.5	9	0	4	**40.5**
North Fork (Site 256)	8.5	16	15	5.5	8	3	4	**60**
Crooked Creek (Site 123)	13	4	16	10	2	0	4	**49**
Monroe Outlet (Site 111)	0	6	6	6	9	0	4	**31**

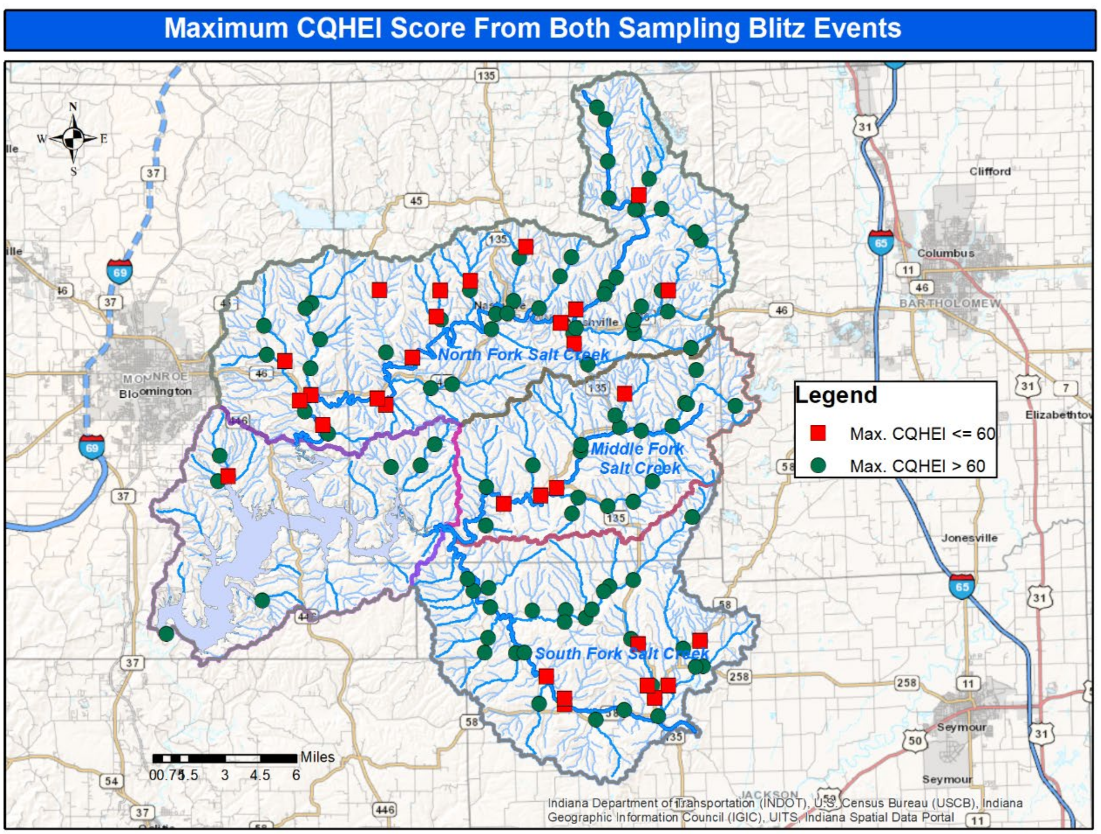
Volunteers gathered habitat data at our 125 Blitz locations twice, once in fall 2020 (during drought conditions) and once in spring 2021 (after a recent rainfall), using the Citizen's Qualitative Habitat Evaluation Index (CQHEI). This index is a simplified version of QHEI that is easier to evaluate but generally considered less accurate. While there is no established rating scale for CQHEI, Hoosier Riverwatch suggests that scores above 60 indicate good habitat.

Table 4-15 Average CQHEI Scores From Blitz Events

Subwatershed	Spring CQHEI Average	Fall CQHEI Average	Spring CQHEI % Sites > 60	Fall CQHEI % Sites > 60
South Fork	67.3	58.1	71%	29%
Middle Fork	66.9	57.9	76%	41%
North Fork	68.1	57.4	73%	36%
Lake Monroe Basin	70.7	60.7	88%	75%

CQHEI scores tabulated during the spring sampling blitz were on average ten points higher than scores tabulated during the fall sampling event. This is largely attributable to the drought conditions in the fall that eliminated stream flow in many places. However, the range in differences was substantial with some scores differing as much as 33 points between the two sampling events, indicating some inconsistency in scoring between volunteers. Figure 4-27 shows sites with scores at or below 60 during both blitz events in red, indicating poor habitat.

Figure 4-27 Maximum CQHEI Score From Both Sampling Blitz Events



4.11 Biological Evaluation (mIBI)

A macroinvertebrate assessment was conducted once at each of the five monthly sampling locations by the IU Limnology Lab. Specimens were collected on August 27, 2020 and tabulated to calculate the macroinvertebrate index of biotic integrity (mIBI). Results indicate that all sampling locations are impaired (scores below 36). The highest score was for Crooked Creek.

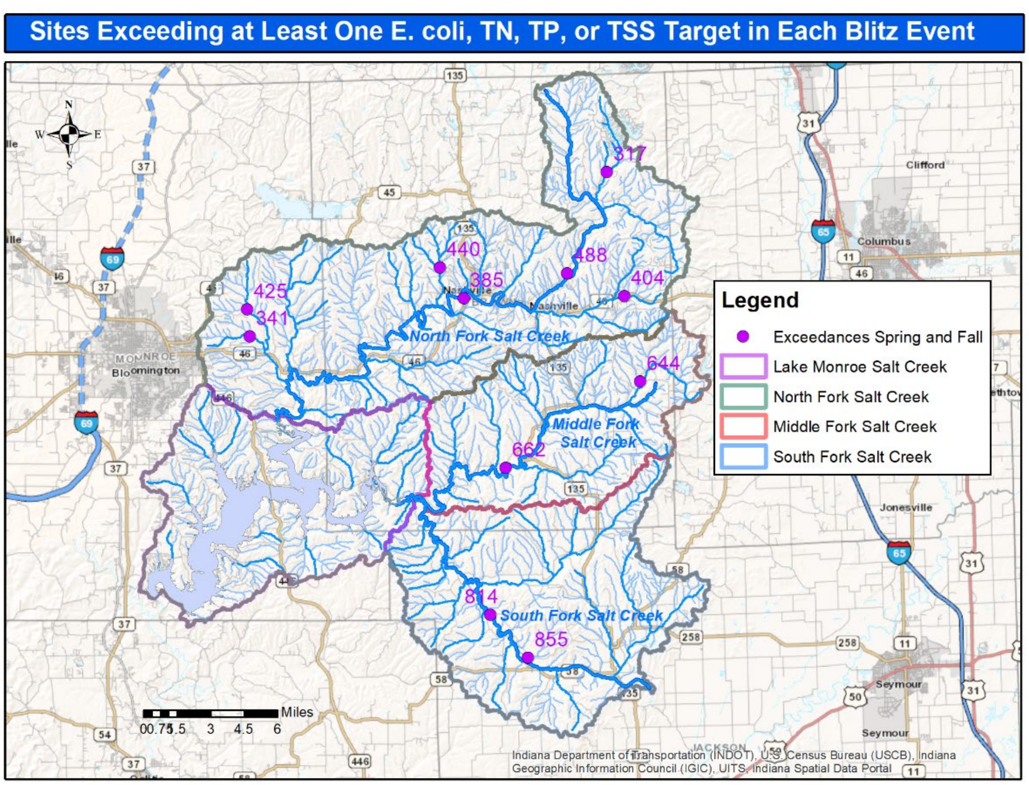
Table 4-16 Macroinvertebrate Assessment (mIBI) of Tributaries by IU Limnology Lab

Site ID	Site Name	Date	mIBI	Description
914	South Fork	8/27/2020	20.0	Impaired
668	Middle Fork	8/27/2020	24.0	Impaired
256	North Fork	8/27/2020	20.0	Impaired
123	Crooked Creek	8/27/2020	28.0	Impaired
111	Monroe Outlet	8/27/2020	20.0	Impaired

4.12 Sites of Concern

Of the 85 sites that were sampled during both the spring and fall blitz events, 11 sites had at least one E. coli, TP, TN, or TSS exceedance in each event.

Figure 4-28 Sites Exceeding at Least One E. coli, TN, TP, or TSS Target in Each Blitz Event



Seven sites are located in the North Fork subwatershed, two in the Middle Fork subwatershed, and two in the South Fork subwatershed.

Table 4-17 Sites of Concern Based on Sampling Blitz Exceedances

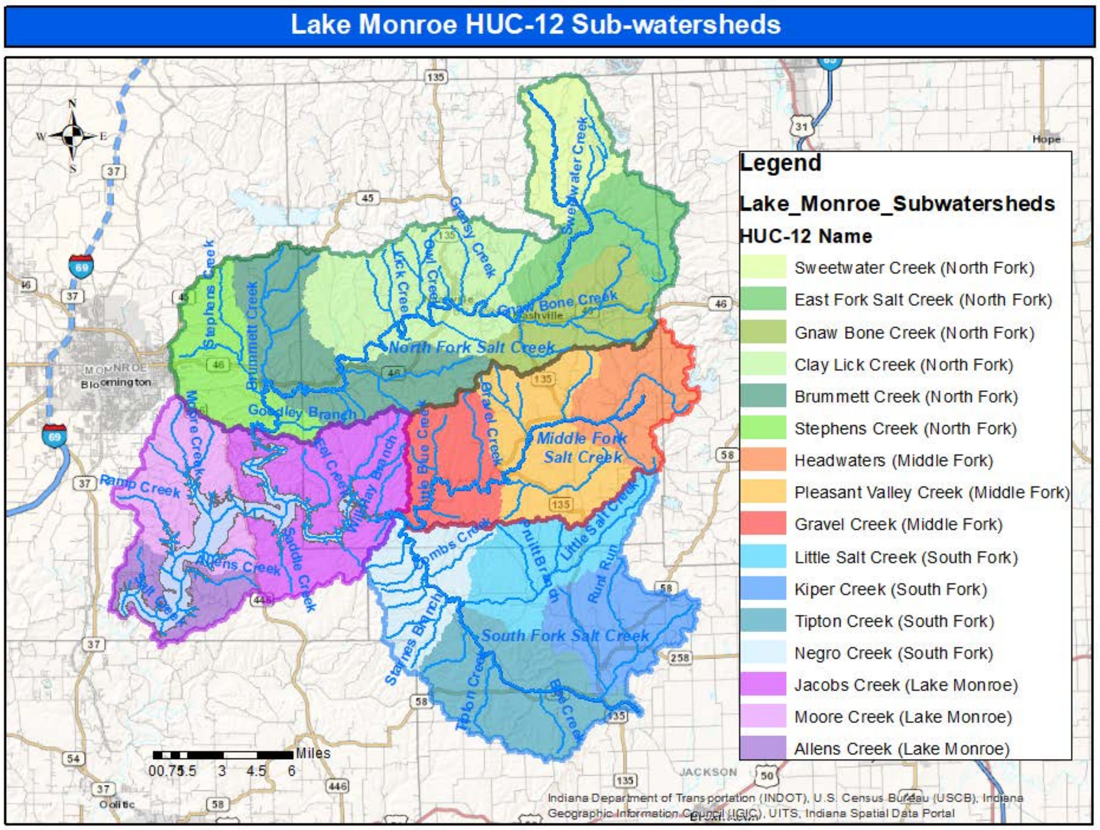
Blitz ID	Creek Name	Fall E. Coli (MPN/ 100 mL)	Spring E. coli (MPN/ 100mL)	Fall TN (mg/L)	Spring TN (mg/L)	Fall TSS (mg/L)	Spring TSS (mg/L)	Fall TP (mg/L)	Spring TP (mg/L)
317	East Branch Sweetwater Creek	920.8	17.1	0.136	0.198	2.3	1	0.002	0.024
341	Kerr Creek	410.6	4.1	0.1	0.342	2	0.5	0.002	0.029
385	North Fork Salt Creek	9.7	27.2	6.792	0.406	2.8	1.6	0.002	0.026
404	Henderson Creek	727	14.2	0.1	0.169	0.5	0.5	0.002	0.026
425	Stephens Creek	1986.3	5.2	0.269	0.271	3	0.5	0.002	0.032
440	Owl Creek	298.7	8.6	0.402	0.267	17.2	0.5	0.006	0.032
488	Unnamed tributary of NF Salt	180.7	3.1	2.154	0.1515	639.2	0.5	0.235	0.0305
644	Unnamed tributary of South Branch Salt	2419.6	0	0.446	0.374	10	1.6	0.033	0.022
662	Middle Fork Salt Creek	1	13.5	1.208	0.361	28.5	1.8	0.101	0.0215
814	South Fork Salt Creek	156.5	14.5	0.258	0.6885	5.5	3.6	0.037	0.026
855	Unnamed tributary of SF Salt	2419.6	3.1	1.0365	1.169	1.8	0.5	0.0175	0.014

These sites are discussed further in the detailed HUC-12 subwatershed analysis in Appendix J as areas to target during the implementation phase of the project.

4.13 HUC-12 Subwatershed Assessment

Data from the desktop survey, windshield survey, monthly tributary sampling, spring sampling blitz, fall sampling blitz, and the Brown County Regional Sewer District E. coli study were analyzed at the HUC-12 subwatershed level (dividing the watershed into sixteen subwatersheds). Underlying data and calculations is provided in Appendix I and detailed maps of each HUC-12 subwatershed with further discussion are provided in Appendix J.

Figure 4-29 Lake Monroe HUC-12 Subwatershed Map



In order to make comparisons across variable data sets, a ranking system was used where the highest value represents the highest impact (worst water quality) and the lowest value represents the lowest impact (best water quality).
The following data sets were evaluated:

- IDEM's 303(d) Impaired Waterbodies List
- Point Source Assessment
- Land Cover Assessment
- Nutrient, Suspended Sediment, and E. coli Load Assessment
- Watershed Visual Assessments
    - Streambank Erosion Assessment

- Adequate Buffer Zone Assessment
- Livestock Access Assessment

- Fall Sampling Blitz Water Quality Assessment
- Spring Sampling Blitz Water Quality Assessment
- Habitat Assessment
- Brown County RSD E. Coli Assessment

Methodology

For each data set, a value was calculated for each subwatershed in order to evaluate relative prioritization. In some cases, the value was a simple count (e.g. number of impaired waterbodies). For data sets like visual assessments, the value was a percentage of total sites in that subwatershed (e.g. percent of stream sites with severe erosion) in order to account for differences in the number of sites per subwatershed. For water quality data, results were compared to water quality targets in order to determine the percentage of samples in a subwatershed that exceeded the water quality target (e.g. percentage of samples exceeding E. coli target of 235 CFU/100 ml).

In all cases, subwatersheds were compared to evaluate relative prioritization. Each subwatershed was assigned a rank for each parameter with "1" indicating the highest water quality (least exceedances) and "16" indicating the lowest water quality (most exceedances). Detailed methodology and the full data analysis is available in Appendix I.

Once all subwatersheds were ranked for all parameters, parameters were divided into two major categories:

1. Level of Degradation based on water quality parameters
2. Level of Vulnerability based on land usage assessments

With all parameters equally weighted, the average for each category was calculated and the subwatersheds were ranked according to their Level of Degradation (Category 1) and Vulnerability (Category 2). The ranks of these two categories were then averaged to give an overall Rank Score. As with the individual parameter rankings, the most impacted subwatershed received the highest rank (most concerns) and the least impacted received the lowest rank (least concerns).

4.13.1 HUC-12 Water Quality Degradation Assessment

Parameters used to calculate Water Quality Degradation Rank were the number of 303(d) impaired water bodies and the percentage of exceedances for E. coli, Total Nitrogen, Nitrates, Total Phosphorus, Soluble Reactive Phosphorus, and Total Suspended Solids from the monthly tributary monitoring, fall blitz monitoring, spring blitz monitoring, and BCRSD monitoring (E. coli only).

Impaired Water Bodies

Impairments listed in the IDEM 303(d) list of impaired water bodies were tabulated for each sub-watershed. Based on the 303(d) list of impaired water bodies, Jacobs Creek had the most impairments, followed by Moore Creek, Allens Creek, Negro Creek, and Little Salt Creek.

Table 4-18 HUC-12 Sub-watershed Comparison of 303(d) Impairments

HUC-12-Subwatershed	303(d) Waterbodies and Impairments	Number of Impairments	303(d) Rank
Kiper Creek (SF)	None	0	1
Little Salt Creek (SF)	Little Salt Creek (E. Coli)	1	12
Tipton Creek (SF)	None	0	1
Negro Creek (SF)	South Fork Salt Creek (Dissolved Oxygen, Biological Integrity)	2	13
Headwaters Middle Fork (MF)	None	0	1
Pleasant Valley Creek (MF)	None	0	1
Gravel Creek (MF)	None	0	1
Sweetwater Creek (NF)	None	0	1
East Fork Salt Creek (NF)	None	0	1
Gnaw Bone Creek (NF)	None	0	1
Clay Lick Creek (NF)	None	0	1
Brummett Creek (NF)	None	0	1
Stephens Creek (NF)	None	0	1
Jacobs Creek (LM)	Crooked Creek (E. Coli), Lake Monroe Upper Basin (Algae, Mercury in Fish, and Taste and Odor)	4	16
Moore Creek (LM)	Lake Monroe Lower Basin (Algae, Mercury in Fish, and Taste and Odor)	3	14
Allens Creek (LM)	Lake Monroe Lower Basin (Algae, Mercury in Fish, and Taste and Odor)	3	14

E. coli
Three data sets were reviewed to evaluate E. coli impact – the fall sampling blitz, the spring sampling blitz, and the Brown County Regional Sewer District sampling.

The two subwatersheds with the greatest E. coli concerns are Kiper Creek (SF) and Headwaters Middle Fork (MF). The following four subwatersheds of concern are Clay Lick Creek (NF), Little Salt Creek (SF), Gnaw Bone Creek (NF), and Stephens Creek (NF).

Table 4-19 HUC-12 Sub-watershed Comparison of E. coli Impairments

Site Name	Fall Blitz E Coli Rank	Spring Blitz E Coli Rank	BCRSD E Coli Rank	Average E Coli Rank
Kiper Creek (SF)	8	16		**12.0**
Little Salt Creek (SF)	14	1	9	**8.0**
Tipton Creek (SF)	9	1		**5.0**
Negro Creek (SF)	1	1		**1.0**
Headwaters Middle Fork (MF)	16	1	13	**10.0**
Pleasant Valley Creek (MF)	9	1	13	**7.7**
Gravel Creek (MF)	1	1	13	**5.0**
Sweetwater Creek (NF)	11	1	10	**7.3**
East Fork Salt Creek (NF)	1	1		**1.0**
Gnaw Bone Creek (NF)	11	1	12	**8.0**
Clay Lick Creek (NF)	13	1	11	**8.3**
Brummett Creek (NF)	1	1	13	**5.0**
Stephens Creek (NF)	15	1		**8.0**
Jacobs Creek (LM)	1	1		**1.0**
Moore Creek (LM)	1	1		**1.0**
Allens Creek (LM)	1	1		**1.0**

Phosphorus

Phosphorus scores varied considerably across blitz events and between total phosphorus and soluble reactive phosphorus. Although Allens Creek scored the worst during the fall blitz, this is somewhat of a sampling artifact as there was only one sample collected and it exceeded the target, meaning 100% of the samples in the subwatershed exceeded the target. However, Allens Creek was the only subwatershed to score poorly during both blitz events, indicating that there is a phosphorus concern present.

The subwatershed with the highest (worst) ranking for phosphorus is Allens Creek in the Lake Monroe subwatershed. The second through fourth ranked (worst) for phosphorus were East Fork Salt Creek (NF), Stephens Creek (NF), and Tipton Creek (SF).

Table 4-20 HUC-12 Sub-watershed Comparison of Phosphorus Impairments

Site Name	Fall Blitz TP Rank	Fall Blitz SRP Rank	Spring Blitz TP Rank	Spring Blitz SRP Rank	Average Phosphorus Rank
Kiper Creek (SF)	8	13	5	4	**7.5**
Little Salt Creek (SF)	1	8	1	1	**2.8**
Tipton Creek (SF)	10	15	9	6	**10.0**
Negro Creek (SF)	13	14	2	1	**7.5**
Headwaters Middle Fork (MF)	13	1	5	5	**6.0**
Pleasant Valley Creek (MF)	9	4	4	10	**6.8**
Gravel Creek (MF)	13	8	9	1	**7.8**
Sweetwater Creek (NF)	1	11	11	11	**8.5**
East Fork Salt Creek (NF)	11	11	16	12	**12.5**
Gnaw Bone Creek (NF)	1	7	16	15	**9.8**
Clay Lick Creek (NF)	7	4	12	9	**8.0**
Brummett Creek (NF)	1	4	9	6	**5.0**
Stephens Creek (NF)	12	10	10	13	**11.3**
Jacobs Creek (LM)	1	1	16	16	**8.5**
Moore Creek (LM)	1	1	16	8	**6.5**
Allens Creek (LM)	16	16	6	13	**12.8**

Nitrogen

There were relatively few total nitrogen and nitrate exceedances during both blitz events. However, nitrogen scores were consistently poor in the Tipton Creek (SF) watershed. Of the four following subwatersheds of concern, Little Salt Creek is also in the South Fork subwatershed while East Fork, Clay Lick, and Stephens Creek are in the North Fork subwatershed.

Table 4-21 HUC-12 Sub-watershed Comparison of Nitrogen Impairments

Site Name	Fall Blitz TN Rank	Fall Blitz NO3 Rank	Spring Blitz TN Rank	Spring Blitz NO3 Rank	Average Nitrogen Rank
Kiper Creek (SF)	1	1	1	1	**1.0**
Little Salt Creek (SF)	14	15	1	1	**7.8**
Tipton Creek (SF)	12	14	16	16	**14.5**
Negro Creek (SF)	1	1	1	1	**1.0**
Headwaters Middle Fork (MF)	1	1	1	1	**1.0**
Pleasant Valley Creek (MF)	1	1	1	1	**1.0**
Gravel Creek (MF)	14	1	1	1	**4.3**
Sweetwater Creek (NF)	1	1	1	1	**1.0**
East Fork Salt Creek (NF)	16	16	1	1	**8.5**
Gnaw Bone Creek (NF)	1	1	1	1	**1.0**
Clay Lick Creek (NF)	11	13	1	1	**6.5**
Brummett Creek (NF)	1	1	1	1	**1.0**
Stephens Creek (NF)	12	1	15	1	**7.3**
Jacobs Creek (LM)	1	1	1	1	**1.0**
Moore Creek (LM)	1	1	1	1	**1.0**
Allens Creek (LM)	1	1	1	1	**1.0**

Sediment
Total suspended solids concentrations were low during both blitz events, generating few exceedances. During the fall blitz only three samples (of 88) exceeded the target concentration. During the spring blitz only one sample (of 122) exceeded the target concentration of 30 mg/L.

Based on these data, the four subwatersheds of concern for sediment are Headwaters (MF), Pleasant Valley (MF), East Fork Salt (NF), and Moore Creek (LM).

Table 4-22 HUC-12 Sub-watershed Comparison of Sediment Impairments

Site Name	Fall Blitz TSS Rank	Spring Blitz TSS Rank	Average Sediment Rank
Kiper Creek (SF)	1	1	**1.0**
Little Salt Creek (SF)	1	1	**1.0**
Tipton Creek (SF)	1	1	**1.0**
Negro Creek (SF)	1	1	**1.0**
Headwaters Middle Fork (MF)	15	1	**8.0**
Pleasant Valley Creek (MF)	14	1	**7.5**
Gravel Creek (MF)	1	1	**1.0**
Sweetwater Creek (NF)	1	1	**1.0**
East Fork Salt Creek (NF)	16	1	**8.5**
Gnaw Bone Creek (NF)	1	1	**1.0**
Clay Lick Creek (NF)	1	1	**1.0**
Brummett Creek (NF)	1	1	**1.0**
Stephens Creek (NF)	1	1	**1.0**
Jacobs Creek (LM)	1	1	**1.0**
Moore Creek (LM)	1	16	**8.5**
Allens Creek (LM)	1	1	**1.0**

Water Quality Degradation Summary

Overall, the Tipton Creek subwatershed (South Fork) scored the highest (worst) for water quality degradation, followed by East Fork Salt Creek (North Fork), Stephens Creek (North Fork), Clay Lick Creek (North Fork), and Little Salt Creek (South Fork). This indicates that these five subwatersheds have the poorest water quality. These subwatersheds match fairly well with the tributary monitoring data suggesting that the South Fork is the primary source of E. coli and nitrogen while the North Fork as the primary source of phosphorus and sediment.

Table 4-23 HUC-12 Subwatershed Water Quality Degradation Ranking

HUC-12 Subwatershed	# Parameters	Sum of Scores	Level of Degradation
Kiper Creek (SF)	14	66	5
Little Salt Creek (SF)	15	81	12 – High
Tipton Creek (SF)	14	120	16 – High
Negro Creek (SF)	14	53	2
Headwaters Middle Fork (MF)	15	80	10 - Medium
Pleasant Valley Creek (MF)	15	74	8 - Medium
Gravel Creek (MF)	15	75	5
Sweetwater Creek (NF)	15	74	3
East Fork Salt Creek (NF)	14	120	15 - High
Gnaw Bone Creek (NF)	15	86	8
Clay Lick Creek (NF)	15	98	13 - High
Brummett Creek (NF)	15	51	1
Stephens Creek (NF)	14	103	14 - High
Jacobs Creek (LM)	14	74	3
Moore Creek (LM)	14	79	7 - Medium
Allens Creek (LM)	14	79	11 - Medium

0-6 Low, 7-11 Medium, 12-16 High

The full set of parameter scores are presented in Table 4-25 on the next page.

Table 4-24 HUC-12 Subwatershed Water Quality Degradation Calculations

HUC-12 Sub-watershed	# Parameters	303(d) Rank	Fall Blitz E Coli Rank	Fall Blitz TSS Rank	Fall Blitz TP Rank	Fall Blitz SRP Rank	Fall Blitz TN Rank	Fall Blitz NO3 Rank	Spring Blitz E Coli Rank	Spring Blitz TSS Rank	Spring Blitz TP Rank	Spring Blitz SRP Rank	Spring Blitz TN Rank	Spring Blitz NO3 Rank	BCRSD E Coli Rank
Kiper Creek (SF)	14	1	8	1	8	13	1	1	16	1	5	4	1	1	
Little Salt Creek (SF)	15	12	14	1	1	8	14	15	1	1	1	1	1	1	9
Tipton Creek (SF)	14	1	9	1	10	15	12	14	1	1	9	6	16	16	
Negro Creek (SF)	14	13	1	1	13	14	1	1	1	1	2	1	1	1	
Headwaters Middle Fork (MF)	15	1	16	15	13	1	1	1	1	1	5	5	1	1	13
Pleasant Valley Creek (MF)	15	1	9	14	9	4	1	1	1	1	4	10	1	1	13
Gravel Creek (MF)	15	1	1	1	13	8	14	1	1	1	9	1	1	1	13
Sweetwater Creek (NF)	15	1	11	1	1	11	1	1	1	1	11	11	1	1	10
East Fork Salt Creek (NF)	14	1	1	16	11	11	16	16	1	1	16	12	1	1	
Gnaw Bone Creek (NF)	15	1	11	1	1	7	1	1	1	1	16	15	1	1	12
Clay Lick Creek (NF)	15	1	13	1	7	4	11	13	1	1	12	9	1	1	11
Brummett Creek (NF)	15	1	1	1	1	4	1	1	1	1	9	6	1	1	13
Stephens Creek (NF)	14	1	15	1	12	10	12	1	1	1	10	13	15	1	
Jacobs Creek (LM)	14	16	1	1	1	1	1	1	1	1	16	16	1	1	
Moore Creek (LM)	14	14	1	1	1	1	1	1	1	16	16	8	1	1	
Allens Creek (LM)	14	14	1	1	16	16	1	1	1	1	6	13	1	1	

4.13.2 HUC-12 Vulnerability Assessment

The level of vulnerability represents observed sources of pollutants in the watershed and utilizes all windshield survey data – erosion, riparian buffer, livestock access – as well as NPDES facilities, land cover, and habitat data. Individual rankings are averaged and compared between watersheds to calculate a vulnerability rank.

Point Source Pollution (NPDES)

The number of facilities with point discharge permits (NPDES) was tabulated for each sub-watershed to evaluate relative prioritization. Based on NPDES permits, the largest impact is from the Clay Lick Creek sub-watershed followed by Moore Creek. Additional areas of concern include the Kiper Creek, Gnaw Bone Creek, Brummett Creek, Allens Creek, and Jacobs Creek sub-watersheds.

Table 4-25 HUC-12 Subwatershed Comparison of Point Discharge Facilities

HUC-12 Subwatershed	NPDES Permits	# Permits	Rank
Kiper Creek (SF)	Jackson County Regional Sewer District WWTP, Springhill Camps WWTP	2	11
Little Salt Creek (SF)	None	0	1
Tipton Creek (SF)	None	0	1
Negro Creek (SF)	None	0	1
Headwaters Middle Fork (MF)	None	0	1
Pleasant Valley Creek (MF)	None	0	1
Gravel Creek (MF)	None	0	1
Sweetwater Creek (NF)	None	0	1
East Fork Salt Creek (NF)	None	0	1
Gnaw Bone Creek (NF)	Gnaw Bone WWTP, Camp Moneto WWTP	2	11
Clay Lick Creek (NF)	Nashville WWTP, Greg Rose Properties WWTP, Wrights Auto Parts, Shelby Materials	4	16
Brummett Creek (NF)	Brown County State Park WWTP, Unionville Elementary WWTP	2	11
Stephens Creek (NF)	None	0	1
Jacobs Creek (LM)	Salt Creek Services WWTP	1	10
Moore Creek (LM)	Paynetown SRA WWTP, SCI RSD WWTP, CBU Drinking Water Plant	3	15
Allens Creek (LM)	USFS Hardin Ridge WWTP, Hardin-Monroe WWTP	2	11

Land Cover Assessment
Nonpoint source pollution is most likely to come from agricultural land or developed land (as opposed to forest, water/wetlands, or scrub/shrub). The percentage of agricultural and developed land was tabulated for each sub-watershed to evaluate relative prioritization.

The four sub-watersheds with the highest percentage of combined agricultural and developed land were Kiper Creek, Tipton Creek, Allens Creek, and Stephens Creek. The five sub-watersheds with moderate percentage of combined agricultural and developed land were Little Salt Creek, Pleasant Valley Creek, Sweetwater Creek, Brummett Creek, and Moore Creek.

Table 4-26 HUC-12 Subwatershed Comparison of Land Cover

HUC-12 Sub-watershed	% Agricultural	% Developed	% Agricultural or Developed	Land Cover Rank
Kiper Creek (SF)	24.6%	4.8%	29.4%	16
Little Salt Creek (SF)	8.0%	1.7%	9.8%	10
Tipton Creek (SF)	21.5%	2.6%	24.1%	15
Negro Creek (SF)	1.8%	1.0%	2.7%	2
Headwaters Middle Fork (MF)	5.8%	1.7%	7.5%	6
Pleasant Valley Creek (MF)	8.7%	1.8%	10.5%	10
Gravel Creek (MF)	2.4%	0.7%	3.0%	2
Sweetwater Creek (NF)	5.8%	2.8%	8.6%	8
East Fork Salt Creek (NF)	5.1%	1.2%	6.3%	4
Gnaw Bone Creek (NF)	4.2%	2.1%	6.4%	4
Clay Lick Creek (NF)	5.2%	2.6%	7.8%	7
Brummett Creek (NF)	6.8%	2.2%	8.9%	8
Stephens Creek (NF)	7.1%	4.1%	11.2%	13
Jacobs Creek (LM)	0.4%	0.8%	1.2%	1
Moore Creek (LM)	7.4%	2.4%	9.8%	10
Allens Creek (LM)	9%	3%	12%	14

Windshield Survey

The windshield survey evaluated streambank erosion, riparian buffer, and where livestock have free access to streams. Results were variable across the different parameters, with no obvious correlation between erosion and riparian buffer or between erosion and livestock access.

Three subwatersheds tied for having the highest percentage of streambank erosion – Tipton Creek (SF), Gravel Creek (MF), and Stephens Creek (NF). The fourth was Brummetts Creek (NF). The subwatershed with the highest percentage of sites lacking riparian buffer (less than twenty feet on each side of the stream), was Pleasant Valley Creek (MF), Gnaw Bone Creek (NF), and a tie between Clay Lick Creek (NF) and Brummett Creek (NF). Two subwatersheds tied for having the highest percentage of sites with livestock access to streams – Tipton Creek (SF) and Stephens Creek (NF). Third place was Little Salt Creek (SF).

Table 4-27 HUC-12 Subwatershed Comparison of Windshield Survey Observations

Subwatershed	Erosion Rank	Riparian Buffer Rank	Livestock Access Rank
Kiper Creek (SF)	10	12	10
Little Salt Creek (SF)	6	5	14
Tipton Creek (SF)	14	6	15
Negro Creek (SF)	4	1	1
Headwaters Middle Fork (MF)	10	8	10
Pleasant Valley Creek (MF)	8	16	7
Gravel Creek (MF)	14	3	1
Sweetwater Creek (NF)	9	7	8
East Fork Salt Creek (NF)	4	9	12
Gnaw Bone Creek (NF)	12	15	1
Clay Lick Creek (NF)	7	13	12
Brummett Creek (NF)	13	13	8
Stephens Creek (NF)	14	4	15
Jacobs Creek (LM)	2	9	1
Moore Creek (LM)	3	2	1
Allens Creek (LM)	1	9	1

Habitat

Habitat assessments were conducted during both blitz events using the CQHEI methodology. The average CQHEI score was calculated for each subwatershed and ranks were assigned. Rankings vary somewhat between blitz events but the two worst subwatersheds had consistently low scores during both events.

The three subwatersheds with the lowest average CQHEI scores were Kiper Creek (SF), Gravel Creek (MF), and East Fork Salt Creek (NF). Four subwatersheds tied for fourth place – Tipton Creek (SF), Pleasant Valley Creek (MF), Clay Lick Creek (NF), and Moore Creek (LM).

Table 4-28 HUC-12 Subwatershed Comparison of Habitat (CQHEI)

Subwatershed	Fall Blitz CQHEI Rank	Spring Blitz CQHEI Rank	Average CQHEI Rank
Kiper Creek (SF)	15	15	15.0
Little Salt Creek (SF)	2	1	1.5
Tipton Creek (SF)	7	13	10.0
Negro Creek (SF)	11	6	8.5
Headwaters Middle Fork (MF)	3	3	3.0
Pleasant Valley Creek (MF)	11	9	10.0
Gravel Creek (MF)	13	16	14.5
Sweetwater Creek (NF)	3	4	3.5
East Fork Salt Creek (NF)	15	10	12.5
Gnaw Bone Creek (NF)	9	8	8.5
Clay Lick Creek (NF)	9	11	10.0
Brummett Creek (NF)	14	5	9.5
Stephens Creek (NF)	6	13	9.5
Jacobs Creek (LM)	5	7	6.0
Moore Creek (LM)	8	12	10.0
Allens Creek (LM)	1	2	1.5

Water Quality Vulnerability Summary

The Kiper Creek subwatershed (South Fork) scored the highest (worst) for vulnerability, followed by Clay Lick Creek (North Fork), Brummett Creek (North Fork), Tipton Creek (South Fork), and Stephens Creek (North Fork). This indicates that these five subwatersheds have the highest concentration of documented pollution sources.

Sub-watershed	# Parameters	Sum of Scores	Level of Vulnerability
Kiper Creek (SF)	7	89	16 - High
Little Salt Creek (SF)	7	39	3
Tipton Creek (SF)	7	71	13 - High
Negro Creek (SF)	7	26	1
Headwaters Middle Fork (MF)	7	41	6
Pleasant Valley Creek (MF)	7	62	11
Gravel Creek (MF)	7	50	7
Sweetwater Creek (NF)	7	40	5
East Fork Salt Creek (NF)	7	55	9
Gnaw Bone Creek (NF)	7	60	10
Clay Lick Creek (NF)	7	75	15 - High
Brummett Creek (NF)	7	72	14 - High
Stephens Creek (NF)	7	66	12 - High
Jacobs Creek (LM)	7	35	2
Moore Creek (LM)	7	51	8
Allens Creek (LM)	7	39	3

0-6 Low, 7-11 Medium, 12-16 High

4.13.3 HUC-12 Overall Assessment

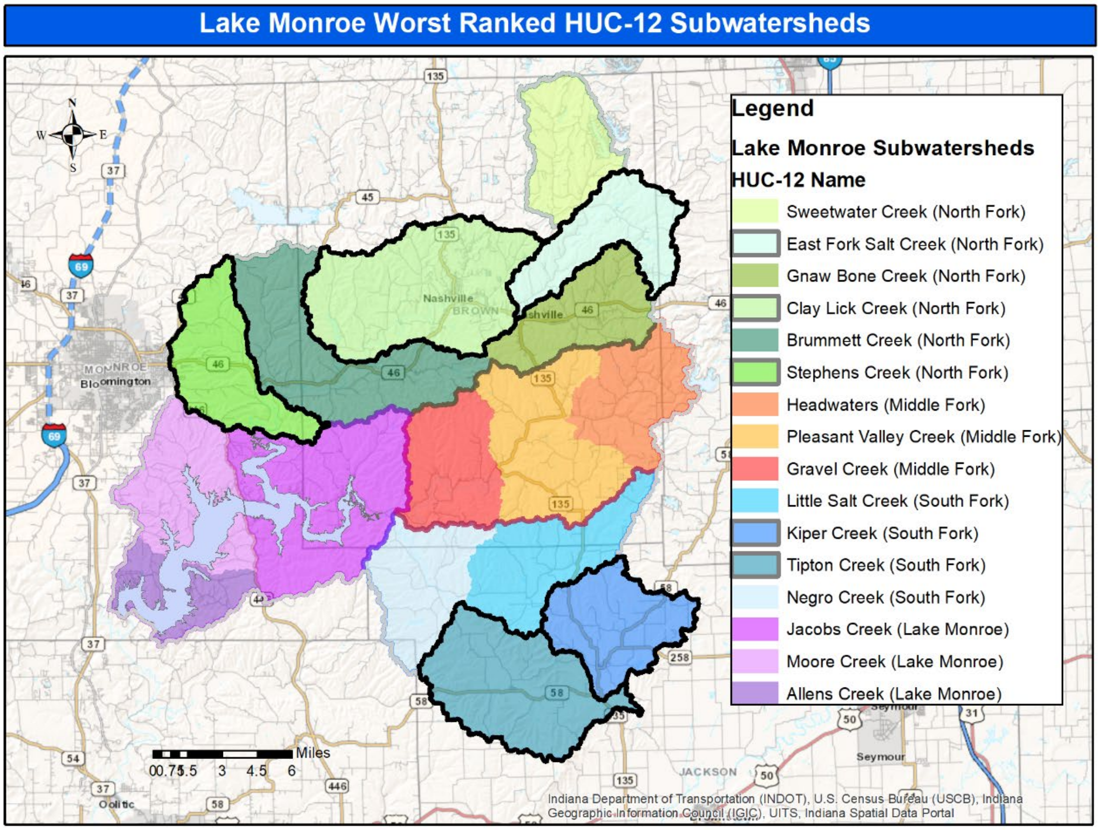
Combining the two sets of rankings, the five highest priority HUC-12 subwatersheds are Kiper Creek and Tipton Creek in the South Fork subwatershed; and East Fork Salt Creek, Clay Lick Creek, and Stephens Creek in the North Fork subwatershed as shown in Table 4-30. These subwatersheds are mapped on Figure 4-30.

Table 4-29 HUC-12 Subwatershed Combined Ranking

HUC-12 Subwatershed	Level of Degradation	Level of Vulnerability	Sum	Overall Rank
Kiper Creek (SF)	5	16 - High	24	12 - High
Little Salt Creek (SF)	12 – High	3	15	6
Tipton Creek (SF)	16 – High	13 - High	29	16 - High
Negro Creek (SF)	2	1	3	1
Headwaters Middle Fork (MF)	10 - Medium	6	16	9 - Medium
Pleasant Valley Creek (MF)	8 - Medium	11 - Medium	19	11 - Medium
Gravel Creek (MF)	5	7 - Medium	12	4
Sweetwater Creek (NF)	3	5	8	3
East Fork Salt Creek (NF)	15 - High	9 - Medium	24	13 - High
Gnaw Bone Creek (NF)	8 - Medium	10 - Medium	18	10 - Medium
Clay Lick Creek (NF)	13 - High	15 - High	28	15 - High
Brummett Creek (NF)	1	14 - High	15	6
Stephens Creek (NF)	14 - High	12 - High	26	14 - High
Jacobs Creek (LM)	3	2	5	2
Moore Creek (LM)	7 - Medium	8 - Medium	15	6
Allens Creek (LM)	11 - Medium	3	14	5

0-6 Low, 7-11 Medium, 12-16 High

Figure 4-30 Lake Monroe Worst Ranked HUC-12 Subwatersheds



4.14 HUC-12 Subwatershed Detailed Assessment

All available data was compiled and reviewed at the HUC-12 subwatershed level in order to identify specific areas of concern. Maps of each subwatershed and accompanying data are available in Appendix J.

5 Identifying Problems and Causes

Results from the analysis were used to determine which community concerns were supported by data, to craft problem statements, and to identify the potential causes and sources of each problem.

5.1 Key Findings of Watershed Assessment

Several water quality impairments were identified during the watershed inventory process, based on data collected 2020-2021 by the IU Limnology Lab and the Brown County Regional Sewer District as well as historic data collected by IDEM, CBU, USFS, and USACE. These include elevated total phosphorus, elevated total nitrogen, elevated E. coli concentrations, poor macroinvertebrate communities, and poor habitat. Field observations identified streambank erosion, insufficient riparian buffer, and livestock access to streams in most subwatersheds.

Total phosphorus concentrations above the water quality target were reported in all subwatersheds during the spring blitz and more than half the subwatersheds during the fall blitz. Total phosphorus exceedances were also regularly reported in monthly samples collected from South Fork Salt Creek, Middle Fork Salt Creek, North Fork Salt Creek, and the Lake Monroe Outlet. The one exception was Crooked Creek, which did not have elevated total phosphorus during the monthly sampling events.

Total nitrogen concentrations above the water quality target were reported in two of sixteen subwatersheds during the fall blitz and six of sixteen subwatersheds during the spring blitz. The two subwatersheds with exceedances in both events were Tipton Creek (SF) and Brummett Creek (NF).

E. coli concentrations above the water quality target were reported in nine of sixteen subwatersheds during the fall blitz and one subwatershed during the spring blitz. The subwatershed with exceedances in both events was Kiper Creek (SF). Additionally, E. coli concentrations above the water quality target were reported in all eight subwatersheds sampled by BCRSD.

Stream sections with CQHEI habitat scores below 60 were reported in eleven of sixteen subwatersheds during the spring blitz.

Water quality impairments were also identified in Lake Monroe. Samples collected in 2020 confirm elevated total phosphorus concentrations with over 50% of hypolimnion samples and upper basin epilimnion samples exceeding the water quality target of 0.02 mg/L. This correlates well with historical data indicating that Lake Monroe is mildly eutrophic and that concentrations of phosphorus and total organic carbon appear to be trending upward. Chlorophyll-a levels were also well above water quality targets, which is unsurprising given that harmful algal blooms are becoming more common, with recreational advisories issued annually from 2011 through 2021.

Table 5-1 Summary of Subwatershed Concerns

Subwatershed (HUC12)	Total Phosphorus Exceedance (Fall or Spring Blitz)	Total Nitrogen Exceedance (Fall or Spring Blitz)	E. coli Exceedance (Fall or Spring Blitz)	E. coli Exceedance (BCRSD)	CQHEI < 60 (Spring Blitz)
Kiper Creek (SF)	X		X		X
Little Salt Creek (SF)	X	X	X	X	
Tipton Creek (SF)	X	X	X		X
Negro Creek (SF)	X				
Headwaters Middle (MF)	X		X	X	
Pleasant Valley Creek (MF)	X		X	X	X
Gravel Creek (MF)	X	X		X	X
Sweetwater Creek (NF)	X		X	X	X
East Fork Salt Creek (NF)	X	X			X
Gnaw Bone Creek (NF)	X		X	X	X
Clay Lick Creek (NF)	X	X	X	X	X
Brummett Creek (NF)	X			X	X
Stephens Creek (NF)	X	X	X		X
Jacobs Creek (LM)	X				
Moore Creek (LM)	X				X
Allens Creek (LM)	X				

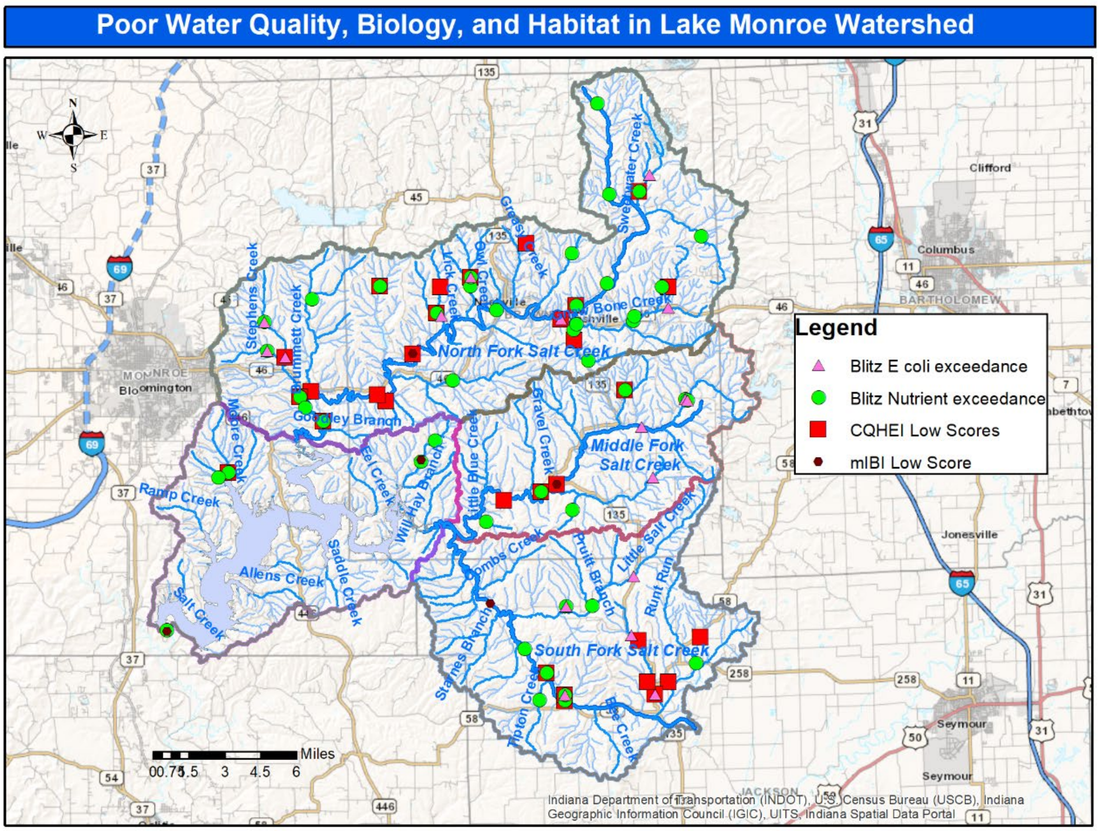
Tributary monitoring data indicate that the South Fork Salt Creek subwatershed is the largest contributor of nitrogen and E. coli. This is not unexpected since the subwatershed contains the largest acreage of agricultural land and two impaired streams. However, the North Fork subwatershed appears to be the largest contributor of phosphorus and sediment.

The HUC-12 subwatershed assessment indicates that there are priority subwatersheds in both the South Fork and North Fork areas – Kiper Creek and Tipton Creek in the South Fork subwatershed; and East Fork Salt Creek, Clay Lick Creek, and Stephens Creek in the North Fork subwatershed. These areas have a higher percentage of agricultural land, including both row crop agriculture and livestock, while Kiper, Clay Lick, and Stephens also have high concentrations of developed land. Projects within these subwatersheds should be prioritized for funding and implementation.

Source analysis for fecal contamination suggests that both human and animal sources are present. While it is still unclear which source is the largest contributor, both livestock and failing septic systems should be addressed throughout the watershed.

Sites with nutrient, E. coli, habitat, and biological concerns are shown in Figure 5.1.

Figure 5-1 Poor Water Quality, Biology, and Habitat in Lake Monroe Watershed



5.2 Analysis of Stakeholder Concerns

Two community forums were held at the beginning of the project with support from local chapters of the League of Women Voters. The first forum was held in Bloomington (Monroe County) in November 2019 and the second forum was held in Nashville (Brown County) in January 2020. Participants worked in small groups of 6-8 to brainstorm concerns about the lake. Each group identified their top three concerns and reported back to the entire forum. The top three concerns from each group were compiled and duplicates were eliminated. Then the steering committee reviewed the concerns to determine which were within the project's scope and what data were available to evaluate each concern.

While most concerns were selected for further exploration, a few fell outside of the project's scope and/or focus. The following concerns were outside the scope of the watershed management plan.

- Several community members raised concerns about drinking water costs to homeowners and potential loss of access to Lake Monroe as a drinking water source for Bloomington, since the water is ultimately owned and controlled by the US Army Corps of Engineers. While lake water quality does affect drinking water treatment costs, it is beyond the scope of this project to directly address drinking water cost or community concerns related to future allocations of Lake Monroe water. These concerns are not directly connected to nonpoint source pollution.
- Likewise, the issue of uneven distribution of economic return from the lake was raised and is a concern in this and many other watersheds. It is important to be aware that the communities that receive the most economic benefits from Lake Monroe are different from the communities whose activities most directly impact water quality in the lake. While this issue will not be directly addressed as a problem statement, uneven distribution of economic benefits will be considered when determining how best to implement the plan and prioritize projects.
- Prescription pharmaceuticals were mentioned as a concern, particularly in the context of failed septic systems. Very limited data are available and there are no established water quality standards in Indiana. The steering committee determined that pharmaceuticals are outside the scope of this project.
- Drinking water quality was mentioned several times. It is important to note that this watershed management plan will only address watershed and lake management and will not address drinking water treatment. While drinking water treatment processes can change depending on the quality of raw lake water, this project will not proscribe changes to drinking water treatment.

Several concerns were identified that are not supported by existing data.

- Improper management of boat toilets was mentioned as a concern. Conversations with Indiana DNR staff on Lake Monroe indicate that there have been no complaints related to illicit dumping of boat toilets or other evidence that indicates this is an issue at the lake.

- Asian Carp were mentioned as a potential concern. According to reports from Indiana DNR, Asian carp have been observed in Salt Creek downstream from Lake Monroe but have not yet been found within the lake or its tributaries.
- One concern raised was that lake water will become so polluted/undrinkable that it is no longer available as our water supply. Current data show Lake Monroe is far from this extreme scenario.
- Pesticide usage (including herbicides) was mentioned multiple times in conjunction with forest management, terrestrial invasive species management, and agricultural production. Atrazine was reported in drinking water at levels between 0.2 and 0.3 ppb in six of the last ten years and was detected in lake samples at levels up to 0.5 ppb in samples collected by the Army Corps of Engineers over the last ten years. All are well below EPA's maximum contaminant level of 3.0 ppb. No other herbicide data are available. Because the available data show levels well below regulatory thresholds, pesticide usage will be addressed only as a component of public education.
- Copper was identified as a potential concern based on a water sample collected by the US Army Corps of Engineers from the Lake Monroe tailwaters in 2018. This sample had a reported copper concentration of 11.4 ug/L. The acute aquatic criterion for copper (calculated based on hardness measured during the sampling event) is 7.79 ug/L, and therefore an exceedance occurred. However, there were no exceedances in any other Lake Monroe samples analyzed by the USACE from 1999 through 2019. Over 70% of the reported copper concentrations from USACE were less than 2 ug/L and all but one were less than 10 ug/L. The acute aquatic criterion is also a very conservative value – in comparison, the drinking water action limit for copper is 1300 ug/L (1.3 ppm). Based on this data, copper does not appear to be a significant concern.

Additional concerns were raised that have not been chosen by the steering committee for further investigation as part of this watershed management plan.

- Iron was identified as a potential concern based on water samples collected by the USACE. Over 20% of the 87 samples analyzed for total iron between 1999 and 2017 exceeded the acute aquatic criterion for iron of 2.744 mg/L. The maximum reported value was 6.6 mg/L and the median was 1.1 mg/L. Iron cycling in lakes and streams is complex and it is normal for concentrations to vary considerably over both time and space. Iron concentrations in samples from all the Louisville District ACOE lakes ranged from below the detection limit to 20.8 mg/L. The concentrations of iron in Lake Monroe appear to be within normal variations for the state. Due to the limited data availability and the lack of obvious potential sources of iron within the watershed, iron has been excluded from this watershed plan.

Table 5-2 Stakeholder Concern Analysis

Concern	Supported by Data?	Evidence for Concern	Quantifiable?	Within Project Scope?	Focusing on?
Algae blooms caused by nutrient loading make the lake unswimmable	Yes	IDEM/IDNR sampling data leading to recreational advisories (for algae) at Paynetown and Fairfax beaches 2011-2021	Yes	Yes	Yes
Nutrient loading (urban lawns, agriculture, septic systems)	Yes	Sampling data - 11% of monthly stream samples exceed total nitrogen target; 55% of monthly stream samples exceed total phosphorus target	Yes	Yes	Yes
Inappropriate agricultural practices	Yes	Livestock with stream access observed at 24% of the sites where livestock were present; tillage transect indicates low cover crop usage for corn fields (17% Brown, 0% Monroe, 23% Jackson); lack of riparian buffer observed throughout watershed	Estimates	Yes	Yes
Lawn maintenance (and its downstream effects)	Yes	Anecdotal observations of lawn care at residential and commercial properties throughout the watershed	Estimates	Yes	Yes
Effects of septic systems on nutrient loading	Yes	Monroe County Health Department and Brown County Health Department both maintain lists of failing septic systems within the watershed	Estimates	Yes	Yes
Waterways are not up to standards; clean up E coli	Yes	IDEM 303d list (Crooked Creek), sampling data - 33% of monthly samples from South Fork, 25% of monthly samples from Middle Fork,	Yes	Yes	Yes

Concern	Supported by Data?	Evidence for Concern	Quantifiable?	Within Project Scope?	Focusing on?
		18% of samples from fall blitz, and 45% of BCRSD samples exceeded the state standard of 235 CFU/100 ml.			
Pathogens from humans and animals	Yes	IDEM 303d list (Crooked Creek), sampling data – source sampling suggests both human and animal sources of fecal contamination	Yes	Yes	Yes
Failed septic systems	Yes	Monroe County Health Department and Brown County Health Department both maintain lists of failing septic systems within the watershed	Estimates	Yes	Yes
Ensure that boat toilets are properly managed	No	Anecdotal; DNR reports no boat toilet incidents in recent years	No	Yes	No
Need to quantify what chemicals/pollutants are entering lake	Maybe	Lake sampling data; CBU data; Brown County Health Department data	Yes	Yes	Yes
Trash and plastic pollution	Yes	Shoreline Cleanups, Microplastics sampling by Bloomington Utilities	Yes	Yes	Yes
Metals	Maybe	ACOE 2018-2019 lake sampling	Yes	Yes	No
Use of herbicides/pesticides in residential/commercial	No	Finished water sampling by Bloomington Utilities; ACOE sampling	Yes	Yes	No
Toilet flush of prescription pharmaceuticals	No	Insufficient data and standards available.	Yes	No	No

Concern	Supported by Data?	Evidence for Concern	Quantifiable?	Within Project Scope?	Focusing on?
Drinking water treatment costs as a homeowner	Yes	Steadily increasing rates	Yes	No	No
Taste and odor issues with drinking water	Yes	IDEM 303d list; Bloomington Utilities concerns record	Yes	Yes	Yes
Actual ownership of water; ensure water stays here	Yes	Newspaper articles about Indianapolis exploring drinking water options	No	No	No
Drinking water quality (nitrates, phosphates, dangerous bacteria, E. coli, toxic blue-green algae)	Yes	Monitored by CBU; outside scope of this project	Yes	No	No
Algae blooms affect drinking water treatment	Yes	CBU data show increased treatment cost based on raw water quality	Yes	Yes	Yes
Fear that lake water would be so undrinkable so it is no longer available as our water supply	No	Current data show Lake Monroe is far from extreme scenarios	Estimates	No	No
Silting in of lake – can we stop it	Yes	Anecdotal reports of siltation near boat ramps; USGS Reservoir Sedimentation Database (silting in is inevitable but rate can be slowed)	Yes	Yes	Yes
Lake getting more shallow due to sedimentation	Yes	Anecdotal reports of siltation near boat ramps; Jones 1997	Yes	Yes	Yes
Shoreline erosion	Yes	Visual observation 2020-2021; limited shoreline documentation 2020; documentation Jones 1997	Yes	Yes	Yes
Sedimentation/erosion - entire watershed	Yes	Visual observation 2020-2021 – 85% of stream sites showed signs of erosion; Jones 1997	Yes	Yes	Yes

Concern	Supported by Data?	Evidence for Concern	Quantifiable?	Within Project Scope?	Focusing on?
Need to quantify siltation rate and identify source(s)	Yes	Jones 1997	Yes	Yes	Yes
Development on and around the lake	Yes	Anecdotal reports of development causing erosion; Monroe County Comprehensive Plan; Monroe County ECO Overlay	Estimates	Yes	Yes
Effects of logging/forest management (herbicides – amphibians, heavy equipment – road damage)	Yes	Visual observation of sediment from some logging sites; insufficient data about herbicides	Estimates	Yes	Yes
Keep forests as forests	No	Land use trends	Yes	Yes	Yes
Unregulated forest management	Yes	Anecdotal reports of buyers offering owners cash for timber and not developing forest management plan; controversial timber harvest on public land in Brown County where expectations were not clear	Yes	Yes	Yes
Log jams	Yes	Multiple log jams observed on North Fork Salt Creek, Brummett Creek	Yes	Yes	Yes
Flooding	Yes	Monroe County Long-Term Stormwater Plan, Newspaper articles about flooding of North Fork Salt Creek	Yes	Yes	Yes
Invasive plants	Yes	Garlic mustard, Asian bush honeysuckle, and Japanese honeysuckle vine were documented at more than 10% of blitz sampling sites.	Yes	Yes	Yes
Asian Carp	No	USACE data show Asian Carp are not yet in lake	Yes	No	No

Concern	Supported by Data?	Evidence for Concern	Quantifiable?	Within Project Scope?	Focusing on?
Effects of invasive species control	No	Insufficient data are available to quantify impacts from herbicide use or other invasive species control efforts.	No	No	No
Poor public understanding of how lakes/watersheds function	Yes	Survey data from other communities	Yes	Yes	Yes
Educate public and school children	Yes	Survey data from other communities	Yes	Yes	Yes
Need more data about water quality and trends	Yes	Existing data are primarily from annual sampling in the lake (INCLP, ACOE) and does not consider the larger watershed; minimal analysis done on ACOE data	Yes	Yes	Yes
Lack of oversight/enforcement of polluters, landowners	Uncertain	Anecdotal	Estimates	Yes	Yes
Uneven distribution of economic return from the lake	Uncertain	Anecdotal	Yes	No	No
Long-term management plan implementation, monitoring, and funding	Yes	Other WMPs that were not implemented	Yes	Yes	Yes
No drainage ordinance	Yes	No consistent drainage ordinance exists across the watershed	Yes	Yes	Yes
Deregulation of environmental protection	Uncertain	Proposals to Indiana legislature limiting local ordinances	Yes	Yes	Yes
Collaboration between multiple governments required for implementation; unclear who is in charge	Yes	Watershed crosses multiple counties and towns	Yes	Yes	Yes
Maintain recreational value	Yes	303d listing; IDEM recreational advisories (algae)	Yes	Yes	Yes

Concern	Supported by Data?	Evidence for Concern	Quantifiable?	Within Project Scope?	Focusing on?
Recreational pollution - how to limit effects, dispel myths	Yes	Jones 1997	Estimates	Yes	Yes
Recreation - boating impacts; responsible use	Yes	Jones 1997	Yes	Yes	Yes
Large boat engines contribute to erosion, turbidity	Yes	Jones 1997	Yes	Yes	Yes

The steering committee further reviewed the list of public concerns and used them to craft problem statements. These problem statements combine overlapping issues in order to identify root issues to be addressed.

Table 5-3 Problem Statements

Public Concern	Problem Statement
Silting in of lake – can we stop it Lake getting more shallow due to sedimentation Shoreline erosion Sedimentation/erosion - entire watershed Effects of logging Inappropriate agricultural practices Large boat engines contribute to erosion, turbidity Need to quantify siltation rate and identify source(s)	Sediment accumulation in the lake decreases its lifespan, reduces recreational capability, and increases turbidity of the water. Sediment carries nutrients and total organic carbon, which can contribute to algal blooms.
Algae blooms affect drinking water treatment Taste and odor issues with drinking water Drinking water quality (nitrates, phosphates, dangerous bacteria, E. coli, toxic blue-green algae) Algae blooms caused by nutrient loading make the lake unswimmable Need to quantify what chemicals/pollutants are entering lake Need more data about water quality and trends Nutrient loading (urban lawns, agriculture, septic systems) Inappropriate agricultural practices Lawn maintenance (and its downstream effects) Effects of septic systems on nutrient loading	Elevated nutrient loads lead to excessive growth of aquatic plants and algae. Harmful algal blooms (HAB) can limit recreational use, harm pets and, in extreme cases, cause lakes to become unswimmable. Each year HAB recreational advisories are issued for Lake Monroe. The US EPA lists Lake Monroe as impaired for algae as well as taste and odor, which is often linked to algal blooms.

Public Concern	Problem Statement
Waterways are not up to standards; clean up E coli	Elevated levels of E. coli in some waterways within the watershed indicate the likely presence of fecal matter that may be associated with pathogens making it unsafe to swim and recreate. Two streams are listed as impaired for E. coli on the IDEM 303d list of impaired water bodies. The source of E. coli is unclear, but could be due to livestock, failing septic systems, boat discharge, or wildlife.
Need to quantify what chemicals/pollutants are entering lake	
Need more data about water quality and trends	
Pathogens from humans and animals	
Failed septic systems	
Maintain recreational value	Boating is a popular activity on Lake Monroe. Recreational value of the lake must be preserved while minimizing recreational pollution through education and enforcement.
Recreational pollution - how to limit effects, dispel myths	
Lack of oversight/enforcement of polluters	
Recreation - boating impacts; responsible use	
Effects of logging/forest management (herbicides – amphibians, heavy equipment – road damage)	Over 82% of the watershed is forested and forestry management activities such as logging, burning or herbicide application may have a negative impact on water quality.
Keep forests as forests	
Unregulated forest management	
Invasive plants	
Waterways are not up to standards	The downstream section of South Fork Salt Creek is listed as impaired for "biological integrity" on the IDEM 303d list, meaning that the stream does not provide good habitat for aquatic wildlife.
Impact of stream flooding	Periodic flooding of streams causes property damage, increased stream bank erosion, and lateral stream movement. Log jams and lack of healthy floodplains may exacerbate the issue.
Sedimentation/erosion - entire watershed	
Impact of log jams	
Collaboration between multiple governments required for implementation; unclear who is in charge	Lack of cohesive regulations and governance across the watershed makes funding and implementation of a watershed plan challenging. There is no uniform drainage ordinance for the watershed. There is no single government body that oversees the watershed.
Long-term management plan implementation, monitoring, and funding	
Need more data about water quality and trends	

Public Concern	Problem Statement
No drainage ordinance Lack of oversight/enforcement of polluters, landowners	
Poor public understanding of how lakes/watersheds function Recreation - boating impacts; responsible use Educate public and school children	Education of the public, both adults and children, is needed to increase awareness of water quality protection needs and solutions.
Trash and plastic pollution	Trash and plastic pollution are negatively impacting the lake and its tributaries.
Invasive plants	Invasive plant species displace native plant species, which may disrupt food chains and decrease biodiversity. Invasive plant species may also be less effective at stabilizing stream banks and may alter nutrient cycling in the soil.
Deregulation of environmental protection Development on and around the lake	Local regulations are key to minimizing impacts from development in the watershed. Deregulation, including proposed state regulations that would take away local control, poses a threat to the watershed.

5.3 Potential Causes and Sources of Each Problem

Each problem statement can be tied to one or more causes (a particular pollutant, a lack of awareness) and one or more sources (a location or activity where the cause came from). Additional discussion is provided to review data limitations and key considerations.

Table 5-4 Problems, Causes, Potential Sources, and Discussion

Problem:	**Elevated nutrient loads lead to excessive growth of aquatic plants and algae. Harmful algal blooms (HAB) can limit recreational use, harm pets and, in extreme cases, cause lakes to become unswimmable. Each year HAB recreational advisories are issued for Lake Monroe. The US EPA lists Lake Monroe as impaired for algae as well as taste and odor, which is often linked to algal blooms.**
Potential Causes:	Nitrogen and phosphorus concentrations exceed target levels.
Potential Sources:	• Application of fertilizers with phosphorus (agriculture, commercial, residential) – Almost 10,000 acres (3.5%) in the watershed are used for row crops with regular fertilizer application. Anecdotal reports indicate that fertilizer use is also prevalent on commercial and residential properties. • Overapplication of fertilizer for its specific use – Conversations with farmers in Jackson County indicate that many farmers apply fertilizer based on product recommendations rather than testing the soil and adjusting appropriately. • Inadequate riparian buffers – 60% of sites observed for the windshield survey had less than 20 feet of riparian buffer; 20% had less than 5 feet of riparian buffer • Livestock access to streams – 17 livestock stream access points were observed during the windshield survey (7% of sites) • Lack of manure management – Anecdotal reports indicate that few farms in the watershed have manure management plans; Brown County State Park struggles with horse manure management • Inadequately functioning septic systems – County Health Departments maintain list of failing septic systems that include sites in the watershed • Exceedances in NPDES permitted discharges – NPDES permit exceedances were documented for five facilities in the watershed • Legacy nutrients stored in lake sediment – Lake monitoring indicates that phosphorus is released from lake sediments during anoxic conditions when the lake is stratified. • Nutrients bound to sediment – Phosphorus and nitrogen are often carried with sediment

Discussion:	One of the biggest challenges facing Lake Monroe is algal blooms and the key to addressing algal blooms is to minimize nutrient levels, particularly phosphorus. Phosphorus was detected at concentrations above target levels in all three basins of Lake Monroe and all three major tributaries. Phosphorus may be arriving in the lake from fertilizers, manure, leaking septic systems, or bound to sediment. It is also important to consider phosphorus contained within sediment at the bottom of Lake Monroe that can be released during anoxic conditions. Reducing the level of phosphorus in the lake will require addressing both incoming sources of phosphorus and legacy phosphorus stored in lake sediment.
Problem:	**Sediment accumulation in the lake decreases its lifespan, reduces recreational capability, and increases turbidity of the water. Sediment carries nutrients and total organic carbon, which can contribute to algal blooms.**
Potential Causes:	Sediment concentrations exceed target levels
Potential Sources:	• Streambank erosion – 86% of observed stream sites exhibited streambank erosion; 28% of sites exhibited severe erosion (3+ feet) • Inadequate riparian buffers – 60% of sites observed for the windshield survey had less than 20 feet of riparian buffer; 20% had less than 5 feet of riparian buffer • Livestock access to streams – 17 livestock stream access points were observed during the windshield survey (7% of sites) • Farmed wetland areas – Farmland is concentrated in the floodplains of the major tributaries which is also where hydric soils are located • Lakeshore erosion – Visual observations 2020-2021 indicate widespread erosion; Jones 1997 study documented widespread lakeshore erosion • Crop tillage – 67% of corn fields in Brown County, 56% of corn fields in Monroe County, and 28% of corn fields in Jackson County are tilled per the 2019 tillage transects • Livestock heavy usage – Anecdotal reports indicate high density of livestock on some small farms leading to soil disturbance • Boat resuspension of sediment – Anecdotal reports indicate increased water turbidity in Lake Monroe during and immediately after periods of high boat traffic • Poorly designed driveways and stream crossings – Interviews with SWCD representatives and stakeholders indicate that roads through streams, steep driveways without water bars, and undersized culverts all contribute to sediment in streams during storm events

	• Logging without BMPs – Two active logging sites with sediment issues were observed during the windshield survey; anecdotal reports indicate timber buyers regularly offer owners cash for timber and do not develop forest management plans that suggest BMPs or timber sale contracts that require BMPs • Lack of temporary erosion control on construction sites – Anecdotal reports indicate construction sites lacking erosion control particularly where there is no MS4 jurisdiction • Lack of Rule 5 enforcement – Rule 5 enforcement is limited in the Brown County and Jackson County portions of the watershed due to the lack of MS4 jurisdiction
Discussion:	Sediment is a concern because it accumulates in the lake, decreasing the lake's lifespan, but it also is a concern because it can carry nutrients and other contaminants. While only a few samples collected during the 2020-2021 water quality monitoring revealed levels of total suspended solids above target levels, this is largely because samples were largely collected during periods of low or medium flow. Some studies estimate that 80% of annual sediment load is delivered during the 20% highest flow periods. Eroded stream banks, areas of bare soil in the watershed, and anecdotal reports of sediment accumulation in the lake all clearly indicate that sediment is an issue. Reducing sediment loads is key to reducing nutrient loads as well as lengthening the lifespan of Lake Monroe.
Problem:	**Elevated levels of E. coli in some waterways within the watershed indicate the likely presence of fecal matter that may be associated with pathogens making it unsafe to swim and recreate. Two streams are listed as impaired for E. coli on the IDEM 303d list of impaired water bodies. The source of E. coli is unclear, but could be due to livestock, failing septic systems, boat discharge, or wildlife.**
Potential Causes:	E. coli concentrations exceed target levels.
Potential Sources:	• Inadequately functioning septic systems – The local health departments maintain a list of known septic system issues that include sites in the watershed • Livestock access to streams – 17 livestock stream access points were observed during the windshield survey (7% of sites) • Lack of manure management – Anecdotal reports indicate that few farms in the watershed have manure management plans • Inadequate riparian buffers – 60% of sites observed for the windshield survey had less than 20 feet of riparian buffer; 20% had less than 5 feet of riparian buffer • Exceedances in NPDES permitted discharges – NPDES permit exceedances were documented for five facilities in the watershed

	• Wildlife manure deposits – While difficult to quantify, the watershed has large wildlife populations that produce large quantities of manure. • Boat toilet discharges – Anecdotal reports from DNR indicate this is not an issue in Lake Monroe
Discussion:	While E. coli does not currently appear to be an issue in Lake Monroe, it is an issue in certain streams in the watershed. Addressing E. coli in these streams will ensure that E. coli does not become an issue in Lake Monroe while also making the streams more suitable for recreation. Source sampling indicates that fecal contamination is likely coming from both human and animal sources. Both potential sources should be addressed. Educating the public about E. coli concerns is also a way to increase community engagement and awareness of water quality issues.
Problem:	**Trash and plastic pollution are negatively impacting the lake and its tributaries.**
Potential Causes:	Trash accumulates in streams and lake
Potential Sources:	• Littering – Friends of Lake Monroe sends volunteers to collect litter at Lake Monroe monthly and they always find litter to collect • Illegal dumping – Keep Brown County Beautiful reports that they frequently deal with trash that is illegally dumped, particularly in ravines in the Brown County portion of the watershed
Discussion:	While trash generally does not impact the commonly monitored water quality parameters like nutrient levels, dissolved oxygen, or pH, the presence of trash discourages recreational use. Trash can also negatively impact wildlife, a key attraction at Lake Monroe. One systemic challenge to addressing trash dumping in the watershed is the limited availability of trash disposal options in rural areas. This should be explored in addition to engaging volunteers in trash cleanups and organizing anti-litter educational campaigns.
Problem:	**Boating is a popular activity on Lake Monroe. Recreational value of the lake must be preserved while minimizing recreational pollution through education and enforcement.**
Potential Causes:	Sediment concentrations exceed target levels Trash accumulates in streams and lakes
Potential Sources:	• Boat resuspension of sediment – Anecdotal reports indicate increased water turbidity in Lake Monroe during and immediately after periods of high boat traffic • Lakeshore erosion – Visual observations 2020-2021 indicate widespread erosion; Jones 1997 study documented widespread lakeshore erosion • Littering – Friends of Lake Monroe sends volunteers to collect litter at Lake Monroe monthly and they always find litter to collect

Discussion:	There are limited data available to quantify the impact of boating on water quality in Lake Monroe or its tributaries. One anecdotal report states that sampling conducted by SPEA students during a high traffic weekend showed much higher turbidity levels than sampling during a quiet weekday. However, it is difficult to determine if boating increases rates of lakeshore erosion or merely stirs up sediment that had previously been deposited. Recent studies involving wakeboats suggest that they may be having a measurable impact on water quality but wakeboats have not yet become an issue at Lake Monroe. Ultimately, boats should follow no wake restrictions in shallow water to reduce the possibility of exacerbating shoreline erosion and increasing water turbidity. Boaters have also been identified as a potential source of trash and educational campaigns should specifically include recreational users of Lake Monroe.
Problem:	**Over 82% of the watershed is forested and forestry management activities such as logging, burning or herbicide application may have a negative impact on water quality.**
Potential Causes:	Sediment concentrations exceed target levels
Potential Sources:	• Logging without BMPs – Two active logging sites with sediment issues were observed during the windshield survey; anecdotal reports indicate timber buyers regularly offer owners cash for timber and do not develop forest management plans that would require BMPs
Discussion:	Over 82% of the watershed is forested. While intact forest is excellent at protecting water quality, forest management activities such as timber harvests have the potential to generate sediment that can impact nearby streams. Branches and logs dumped in streams can create log jams that exacerbate streambank erosion. These impacts can be minimized if best management practices are used, ideally with a forest management plan put in place prior to project implementation. Concerns were also raised about potential water quality impacts from burning and herbicide application. However, insufficient data were available to quantify impacts. Following best management practices for these activities is still recommended.
Problem:	**The downstream section of South Fork Salt Creek is listed as impaired for "biological integrity" on the IDEM 303d list, meaning that the stream does not fully support aquatic life use.**
Potential Causes:	Biological assessment scores, including the fish-based Index of Biotic Integrity (IBI) and the macroinvertebrate Index of Biotic Integrity (mIBI), are below the desired target
Potential Sources:	• Disconnect between stream channel and floodplain – Anecdotal information suggests that many streams in the watershed are incised; hydrologic studies indicate that reservoirs cause their tributaries to become incised due to changing water levels (see Section 2.2) • Modified stream channel – Interview with Len Kring (USFS Fisheries Biologist) suggests that portions of Tipton Creek and other tributaries to South Fork Salt Creek were channelized at some point

	• Lack of forested riparian buffer (provides shade and woody debris) – 60% of sites observed for the windshield survey had less than 20 feet of riparian buffer; 20% had less than 5 feet of riparian buffer
Discussion:	Biological impairment is determined by surveying fish and/or macroinvertebrate communities in a stream section. Poor biological integrity can be linked to poor habitat, poor water quality, or both. Increasing riparian buffer and decreasing the load of sediment and nutrients should theoretically improve biological integrity. In lower South Fork, mIBI scores were poor but fish-based IBI scores were fair. This portion of the stream is also known to be heavily influenced by operations in the lake, becoming stagnant when lake levels are high, which may contribute to the poor mIBI scores.
Problem:	**Periodic flooding of streams causes property damage, increased stream bank erosion, and lateral stream movement. Log jams and lack of healthy floodplains may exacerbate the issue.**
Potential Causes:	Damage from flooding observed
Potential Sources:	• Disconnect between stream channel and floodplain – Anecdotal information suggests that many streams in the watershed are incised; hydrologic studies indicate that reservoirs cause their tributaries to become incised due to changing water levels (see Section 2.2) • Modified stream channel – Interview with Len Kring (USFS Fisheries Biologist) suggests that portions of Tipton Creek and other tributaries to South Fork Salt Creek were channelized at some point • Log jams – Brown County SWCD identified multiple log jams in North Fork Salt Creek (see Section 4.11); other log jams in smaller streams were reported by stakeholders • Lack of wetlands – Many areas with hydric soil are currently farmland • Impoundment in the lake disrupting natural hydrology of streams and altering stream cross-sections – hydrologic studies indicate that reservoirs cause their tributaries to become incised due to changing water levels (see Section 2.2) • Lack of unified government strategy about watershed flooding – each county has different regulations about construction in flood zones and floodways
Discussion:	While flooding is in many cases a natural event, it can be exacerbated by log jams, poorly designed culverts, and even Lake Monroe itself (as an artificial reservoir). Rather than seeking to eliminate flooding, the focus should be on preventing property damage and minimizing stream bank erosion. Strategies include limiting construction in flood zones, removing structures that frequently flood, establishing conservation easements around riparian zones, restoring riparian zones by planting native vegetation, addressing log jams that pose a significant threat, and restoring wetlands.

Problem:	**Lack of cohesive regulations and governance across the watershed makes funding and implementation of a watershed plan challenging. There is no uniform drainage ordinance for the watershed. There is no single government body that oversees the watershed.**
Potential Causes:	Lack of unified approach Lack of perceived benefits/impacts Lack of interest Lack of time and commitment
Potential Sources:	• Not applicable for social issues.
Discussion:	Large scale efforts to improve water quality across the watershed will need to be coordinated across multiple counties, primarily Monroe County, Brown County, and Jackson County. Efforts should also include the City of Bloomington and the Town of Nashville as well as the state and federal agencies that manage land within the watershed – the United States Forest Service, the Indiana Department of Natural Resources Forestry Division, and the Indiana Department of Natural Resources State Parks Division.
Problem:	**Education of the public, both adults and children, is needed to increase awareness of water quality protection needs and solutions.**
Potential Causes:	Lack of perceived benefits/impacts Lack of interest
Potential Sources:	• Not applicable for social issues.
Discussion:	Education is key to encouraging community members to take direct action. Community members who feel connected to their local streams and lakes are much more likely to get involved. They also need information about how to improve and protect water quality. This could include activities like maintaining septic systems and using fertilizer appropriately or it could be larger engagement in citizen science projects. Education should be combined with opportunities for community members to spend time exploring lakes and streams so that they become local stewards and protectors.
Problem:	**Invasive plant species displace native plant species, which may disrupt food chains and decrease biodiversity. Invasive plant species may also be less effective at stabilizing stream banks and may alter nutrient cycling in the soil.**
Potential Causes:	Lack of native vegetation Presence of invasive non-native vegetation
Potential Sources:	• Public introducing non-native species in yards – MC IRIS and Brown County Native Woodlands Project have both documented the presence of invasive species throughout Monroe and Brown Counties

	• Seeds and starts transferred within streams – Garlic mustard, Asian bush honeysuckle, and Japanese honeysuckle vine were documented at more than 10% of blitz sampling sites (along streams). • Public transporting seeds when hiking – Educational signage at shoe cleaners have been installed at multiple nature preserves in the area
Discussion:	Invasive plant species were mentioned by multiple stakeholders as a major concern. They are also an area of focus for local conservationists due to their negative impact on local ecosystems. However, there are few studies that show a direct impact on water quality from invasive plants. Some studies suggest that invasive plants may be less effective at soil stabilization. Others clearly identify streams and floods as common ways that invasive plants spread. While addressing invasive plants may not directly improve water quality, it is a powerful way to educate and engage community members in stewardship of natural resources. Educating the public about invasive plants and engaging volunteers in weed wrangles can be an effective part of a larger strategy to engage the public in protection of the watershed while also increasing ecosystem resiliency.
Problem:	**Local regulations are key to minimizing impacts from development in the watershed. Deregulation, including proposed state regulations that would take away local control, poses a threat to the watershed.**
Potential Causes:	State legislature attempting to remove local control Lack of MS4 entity in Brown County
Potential Sources:	• Not applicable for social issues
Discussion:	Local regulations are a tool that can be used to protect water quality if carefully developed and implemented. Further investigation is needed to determine if there are opportunities to expand protection of water quality through regulations in any of the counties, cities, or towns included in the watershed. Two current possibilities include an upcoming update to the Monroe County Development Ordinance and an upcoming update to the Monroe County Stormwater Ordinance.

6 Current Loads and Targets

The four main pollutants of concern were identified as phosphorus, nitrogen, sediment, and E. coli. While E. coli does not appear to be a concern in the lake, samples from multiple streams exceeded the daily threshold of 235 CFU/100 mL. Phosphorus and sediment are concerns in Lake Monroe and in streams throughout the watershed due to their potential for causing harmful algal blooms (HABs). Nitrogen and nitrates are of secondary concern as it is phosphorus concentrations that tend to drive HABs (many blue-green algae are nitrogen fixers). However, load modeling indicates that nitrogen reductions are also needed to achieve water quality targets.

Two modeling approaches were used to calculate loads. The first was a regression analysis of water quality monitoring data in the main tributaries, which was used to model phosphorus, sediment, and E. coli loads. The second was the STEPL model, a spreadsheet tool based on land use in the watershed which was used to model phosphorus, nitrogen, and sediment. Sediment and phosphorus loads were also compared to loads developed as part of the Lake Monroe Diagnostics and Feasibility Study (Jones 1997).

6.1 Regression Model Loads and Needed Reductions

Phosphorus, sediment, nitrogen, and E. Coli loads were calculated using regression models, as discussed in section 4.4.1 with additional information provided in Appendix L. These models were developed using the monthly stream sampling data and continuous flow records from stream gages on North Fork Salt Creek at Nashville and South Fork Salt Creek at Kurtz. Loads in the unmonitored area were based on areal pollutant loads in the North Fork subwatershed as it had the most similar land cover. Target loads were calculated using modeled flow and target concentrations.

Table 6-1 Annual Phosphorus and Sediment Loads Based on Regression Models

	Total Phosphorus				Sediment			
Subwatershed	Current P Load (lbs/yr)	Target P Load (lbs/yr)	Load Reduction Required (lbs/yr)	Percent Reduction Needed	Current Sed. Load (tons/yr)	Target Sed. Load (tons/yr)	Load Reduction Required	Percent Reduction Required
South Fork above Maumee	7,652	4,978	2,674	35%	2,273	3,734	-	0%
Middle Fork above Story	1,048	831	217	21%	489	623	-	0%
North Fork above Yellowwood	13,427	4,586	8,841	66%	13,393	3,440	9,953	74%
Crooked Creek above Tecumseh	35	71	-	0%	5	54	-	0%
Unmonitored Area	22,630	7,730	14,900	66%	22,573	5,797	16,776	74%
Totals	**44,792**	**18,197**	**26,595**	**59%**	**38,733**	**13,648**	**25,085**	**65%**

Table 6-2 Annual Nitrogen and E. coli Loads Based on Regression Models

	Nitrogen				E. Coli			
Subwatershed	Current Nitrogen Load (lbs/yr)	Target N Load (lbs/yr) @ 0.69 mg/L	Load Reduction Required (lbs/yr)	Percent Reduction Needed	E. Coli Load (CFU/yr)	Target E. Coli Load (CFU/yr)	Load Reduction Required (CFU/yr)	Percent Reduction Needed
South Fork above Maumee	181,750	171,758	9,992	5%	9.21E+14	2.65E+14	6.56E+14	71%
Middle Fork above Story	24,013	28,666	-	0%	1.58E+13	3.82E+13	--	0%
North Fork above Yellowwood	142,929	157,781	-	0%	1.90E+14	2.44E+14	--	0%
Crooked Creek above Tecumseh	886	2,459	-	0%	1.27E+11	3.01E+12	--	0%
Unmonitored Area	240,897	266,684	-	0%	3.20E+14	4.11E+14	--	0%
Totals	**590,474**	**627,348**	-	0%	**1.447E+15**	**9.61E+14**	6.56E+14	45%

According to the regression models, the total current annual phosphorus load is 44,792 lbs/year, the annual sediment load is 38,733 tons per year, and the annual nitrogen load is 590,474 pounds per year. The North Fork subwatershed is the primary source of both phosphorus and sediment while the South Fork subwatershed is the primary source of nitrogen and E. coli.

Based on the target loads, significant reductions are required. Total phosphorus loads must be reduced by 59% overall, primarily in the North Fork and Unmonitored Area, to achieve the target phosphorus concentration of 0.02 mg/L. Total sediment loads must be reduced by 65% overall with no reduction needed in the South Fork, Middle Fork, and Lake Monroe Basin subwatersheds, 74% in North Fork and 74% in the Unmonitored Area. Total nitrogen loads overall are below target levels even though South Fork nitrogen loads should be reduced by 5%.

One limitation of the regression model is that it is based on monthly sampling results, which generated a small data set. There were also few samples collected during periods of high flow. Additional samples were collected from South Fork Salt Creek by the CBU Storm Team twice a month at the Kurtz stream gage starting in July 2020. These samples were collected primarily during high flow events. Because the samples were collected at a different location on the stream, the two data sets could not be directly combined. However, a regression model developed using that data suggest that the annual loads in South Fork Salt Creek may be 2-3 times higher than what is presented here.

The regression model results for E. Coli show that only the South Fork subwatershed requires reductions to meet the water quality target of 235 CFU/100 ml. These results seem consistent with data from monthly tributary monitoring, which showed E. coli exceedances in 4 of 12 South Fork samples (including one sample with a concentrations six times the target level) and minor E. coli exceedances in 3 of 12 Middle Fork samples.

6.2 STEPL Model Current Loads and Needed Load Reductions

The STEPL model is a spreadsheet tool developed for USEPA to model nutrient and sediment loads in a watershed based on various land uses and management practices. The model is highly dependent on land cover data which means that the South Fork subwatershed with 8% cropland is expected to have a significantly higher pollutant load than the Lake Monroe Basin subwatershed with 1% cropland.

Table 6-3 Phosphorus and Sediment Loads Based on STEPL Model

	Total Phosphorus				**Sediment**			
Sub-watershed	**Current Phos. Load (lbs/yr)**	**Target Phos. Load (lbs/yr)**	**P Load Reduction Required (lbs/yr)**	**Percent Reduction Needed**	**Current Sed. Load (tons/yr)**	**Target Sed. Load (tons/yr)**	**Sed. Load Reduction Required**	**Percent Reduction Needed**
South Fork	36,732	5,013	31,719	86%	9,463	3,760	5,704	60%
Middle Fork	14,082	3,292	10,790	77%	4,119	2,469	1,650	40%
North Fork	31,336	7,525	23,811	76%	8,282	5,644	2,638	32%
Lake Monroe Basin	11,051	3,273	7,778	70%	2,219	2,455	--	--
Totals	**93,201**	**19,103**	**74,098**	**80%**	**24,083**	**14,327**	**9,992**	**41%**

Table 6-4 Nitrogen Loads Based on STEPL Model

	Total Nitrogen			
Subwatershed	**Current Nitrogen Load (lbs/yr)**	**Target Nitrogen Load (lbs/yr)**	**Load Reduction Required (lbs/yr)**	**Percent Reduction Needed**
South Fork	170,437	90,233	80,204	47%
Middle Fork	56,683	59,253	--	--
North Fork	130,175	135,452	--	--
Lake Monroe Basin	47,302	58,915	--	--
Totals	**404,597**	**343,853**	**80,204**	**20%**

As anticipated, the South Fork Salt Creek subwatershed has the largest STEPL-modeled sediment, phosphorus, and nitrogen loads both by annual weight (lbs/year – see Tables 6-1 and 6-2) and by areal load (lbs/acre-year – see Tables 6-3 and 6-4). This indicates that the South Fork subwatershed is the most impaired and therefore has the most opportunity for improvement. The North Fork Salt Creek subwatershed has the second largest pollutant load by annual weight and is only about 15% smaller than the South Fork Salt Creek subwatershed while the Middle Fork Salt Creek subwatershed has a pollutant load about 55% smaller than the South Fork Salt-Creek subwatershed. However, North Fork's areal load is comparable to Middle Fork.

Table 6-5 Areal Phosphorus and Sediment Loads Based on STEPL Model

Subwatershed	**Areal Phosphorus Loads**			**Areal Sediment Loads**		
Subwatershed	**Current P Load (lbs/yr)**	**Size (acres)**	**Areal P Load (lbs/ acre-yr)**	**Current Sed. Load (tons/yr)**	**Size (acres)**	**Areal Sed. Load (lbs/ acre-yr)**
South Fork	36,732	65,599	0.56	9,463	65,599	0.14
Middle Fork	14,082	46,779	0.30	4,119	46,779	0.09
North Fork	31,336	106,937	0.29	8,282	106,937	0.08
Lake Monroe Basin	11,051	46,512	0.24	2,219	46,512	0.05

Table 6-6 Areal Nitrogen Loads Based on STEPL Model

Subwatershed	**Areal Nitrogen Loads**		
Subwatershed	**Current Nitrogen Load (lbs/yr)**	**Subwatershed Size (acres)**	**Areal Nitrogen Load (lbs/acre-yr)**
South Fork	170,437	65,599	2.60
Middle Fork	56,683	46,779	1.21
North Fork	130,175	106,937	1.22
Lake Monroe Basin	47,302	46,512	1.02

Target loads were calculated by multiplying water quality target concentrations by annual flow volume as determined using a ratio of drainage areas compared to stream gage data. Continuous flow measurements were available from USGS Stream Gage 03371650 on North Fork Salt Creek in Nashville and USGS Stream Gage 03371600 on South Fork Salt Creek in Kurtz. A proportional flow was calculated using the ratio between the catchment area of the gage and the subwatershed. For example, the catchment area above the North Fork Stream Gage in Nashville is 48,500 acres while the entire North Fork subwatershed is 65,600 acres so the annual flow for the entire North Fork subwatershed was estimated to be the annual flow volume measured at the Nashville stream gage x 65,600/48,500 or roughly 2.7 times the annual gaged flow. The Middle Fork and Lake Monroe Basin subwatershed flow estimates were also based on the Nashville stream gage while the South Fork subwatershed flow estimate was based on the Kurtz stream gage.

Based on these target loads, significant reductions are required. Total phosphorus loads must be reduced by 80% overall with subwatershed reductions ranging from 70% in the Lake Monroe Basin to 86% in the South Fork subwatershed to achieve the target phosphorus concentration of 0.02 mg/L. Total nitrogen loads must be reduced by 20% overall with no reduction needed in the North Fork, Middle Fork, or Lake Monroe Basin subwatersheds but 47% reduction needed in South Fork. Total sediment loads must be reduced by 41% with no reduction needed in the Lake Monroe Basin subwatershed, 32% in North Fork, 40% in Middle Fork, and 60% in South Fork.

6.3 Jones 1997 Model Loads and Needed Reductions

The 1997 Jones study was used as a point of comparison for reviewing load models and needed reductions. The study developed a sediment budget and phosphorus budget for Lake Monroe based on data collected in 1992 and 1993. Total estimated annual incoming sediment load is 29,779,000 kg/yr (32,825 tons/yr). About 5% (~1,500,000) passes through the outlet of the lake and the rest is retained. This can also be expressed as a sediment accumulation rate of 0.03 inches per year. However, it is known that sediment does not distribute evenly across the lake. Studies done by Bradbury in 1976 show that sedimentation during the 11 years since the reservoir was completed was about 1 inch thick in the middle and lower basins but 2-4 inches thick in the upper basin. Based on the stream modeling, Middle Fork Salt Creek has the highest contribution rate per acre followed by the unmonitored area and Brummett Creek. It is unclear why this is the case.

Total estimated phosphorus loading was 46,544 kg/yr (102,612 lbs/yr). The greatest contribution (kg/yr) was from the unmonitored areas followed by the North Fork Salt Creek. However, the greatest areal rate of loading (kg/ha-yr) was from the South Fork Salt Creek, which was somewhat expected since it has the most agricultural land use. The South Fork also had the highest measured mean total phosphorus concentration for the five stream sites at 0.0728 mg/L. In the report it was noted that South Fork discharge rates were likely underestimated.

The Jones study also ran the Reckhow (1980) phosphorus export model using land use and slope to predict phosphorus loads and came up with a load of 46,257 kg/year which is very close to the modeled phosphorus budget. Based on the Reckhow model, South Fork drainage area contributes a greater share of the total phosphorus loading – 32.8% in the Reckhow model compared to 16.8% in the Jones phosphorus budget. Overall, the Reckhow model calculates that agricultural land contributes 48.5% of the total P loading and forests contribute 47.2% due to the substantial amount of acreage in forested land use.

Jones calculated how much phosphorus reduction is needed to avoid eutrophic conditions. The current loading rate was determined to be 1.07 grams/square meter-year. Using the Richard Vollenweider (1975) model to relate areal phosphorus loading with mean lake depth and hydraulic flushing rate, the target in-lake summertime phosphorus concentration to avoid eutrophic conditions is 0.3 grams/square meter-year. This translates to a 72% reduction in phosphorus loading over current rates to achieve the target in-lake phosphorus concentration of 0.020 mg/L. If the target in-lake phosphorus concentration is 0.030 mg/L, then a 63% reduction is needed.

6.4 Current Loads and Needed Reductions

The three methods used for nutrient and sediment reductions (STEPL, new regression model, and Jones historic regression model) all generated differing results. The largest difference was for phosphorus, with the STEPL model and the Jones Study both indicating an annual load around 95,000 lbs/year while the regression model indicated an annual load of 44,752 lbs/year, less than half as much. The low estimates of the regression model are most likely due to the relatively low peak discharges of our study year and sampling dates.

Table 6-7 Comparison of Load Models for Lake Monroe Watershed

	Current Phosphorus Load (lbs/yr)	Current Sediment Load (tons/yr)	Current Nitrogen Load (lbs/yr)	Current E. coli Load (CFU/yr)
Regression Model 2021	44,792	38,733	590,474	1.447E+15
STEPL Model	93,201	24,083	404,597	Not Calculated
Jones Regression Model 1997	102,612	32,825	Not Calculated	Not Calculated

The STEPL Model was used to establish current loads and needed reductions for phosphorus, sediment, and nitrogen because it correlated reasonably well with the Jones study and is easy to replicate.

The regression model was used to establish current loads and needed reduction for E. coli.

Table 6-8 Needed Load Reductions for Nutrients, Sediment, and Bacteria

	Phosphorus Load (lbs/yr)	Sediment Load (tons/yr)	Nitrogen Load (lbs/yr)	E. coli Load (CFU/yr)
Current Load	93,201	24,083	404,597	1.447E+15
Target Load	19,103	14,327	343,853	9.61E+14
Needed Reduction	**74,098**	**9,992**	**80,204**	**6.56E+14**

One limitation of these models is that they do not address pollutant accumulation within Lake Monroe. As discussed in section 4, sediment and nutrients accumulate in the lake over time. Bound phosphorus can be released from the sediment under anoxic conditions, increasing phosphorus concentrations in the lake regardless of the amount of incoming phosphorus from the streams. Improving and restoring the lake's natural health will require more than just reducing inflows of nitrates, phosphorus, sediment, and E. coli. Legacy pollutants in the lake must be addressed to avoid increasing eutrophication and an increased frequency in algal blooms.

7 Goal Statements and Indicators for each Pollutant and Problem

A total of twelve problem statements were identified. Goal statements and indicators were identified for each.

7.1 Sediment Accumulation

Problem Statement: Sediment accumulation in the lake decreases its lifespan, reduces recreational capability, and increases turbidity of the water. Sediment carries nutrients and total organic carbon, which can contribute to algal blooms.

Vision Statement: Clear water and minimal sediment accumulation. While some sediment accumulation in a reservoir is inevitable, it is important to limit the rate of sedimentation.

Goal Statement: Reduce sediment loads to meet the IDEM statewide draft TMDL target of 30 mg/L for TSS within 20 years. The estimated reduction needed is 9,992 tons/year.

Indicators of Progress:

- Steady or downward trend in documented TSS values.
- Number of BMPs implemented.
- Number of farmers implementing conservation tillage and acreage involved.
- Number of farmers using cover crops and acreage involved.
- Number of farmers and land managers attending field days and workshops.
- Linear feet of stabilized streambank.
- Linear feet of stabilized lakeshore.
- Calculated load reductions from all BMPs and conservation practices.

7.2 Nutrient Accumulation

Problem Statement: Elevated nutrient loads lead to excessive growth of aquatic plants and algae. Harmful algal blooms (HAB) can limit recreational use, harm pets and, in extreme cases, cause lakes to become unswimmable. Each year HAB recreational advisories are issued for Lake Monroe. IDEM lists Lake Monroe as impaired for algae as well as taste and odor, which is often linked to algal blooms.

Vision Statement: A fishable and swimmable lake, raw lake water that is cost-effective to process into drinking water, and elimination of HAB.

Goal Statement: Reduce phosphorus loads by 74,098 lbs/year and nitrogen loads by 80,204 lbs/year within 20 years.

Indicators of Progress:

- Decrease in phosphorus concentrations over time.

- Decrease in nitrogen concentrations over time.
- Number of farmers implementing conservation tillage and acreage involved
- Number of farmers using cover crops and acreage involved
- Number of nutrient management plans completed
- Number of livestock stream access sites eliminated
- Number of BMPs implemented.
- Calculated load reductions from all BMPs and conservation practices.
- Decreased frequency of harmful blue-green algal blooms

7.3 Elevated E. Coli Levels

Problem Statement: Elevated levels of E. coli in some waterways within the watershed indicate the likely presence of fecal matter that may be associated with pathogens making it unsafe to swim and recreate. Two streams are listed as impaired for E. coli on the IDEM 303d list of impaired water bodies. The source of E. coli is unclear, but could be due to livestock, failing septic systems, boat discharge, or wildlife.

Vision Statement: Swimmable streams throughout the watershed. Reduction of E. coli and associated pathogens to safe levels.

Goal Statement: Reduce E.coli concentrations to meet the state standard of 235 CFU/100mL. This would entail an E. coli load reduction of 6.56E+14 CFU/year within 20 years.

Indicators of Progress:

- Sampling will show a continuing decline in E. coli counts
- Calculated load reductions for Best Management Practices installed
- Number of livestock restricted from stream access
- Improvement of agricultural waste management practices: number of practices implemented
- Improvements in septic system maintenance and care as a result of disseminated information and attendance at workshops

7.4 Boating

Problem Statement: Boating is a popular activity on Lake Monroe. Recreational value of the lake must be preserved while minimizing recreational pollution through education and enforcement.

Vision Statement: Sustainable recreational use of the lake and its tributaries while ensuring that water quality is preserved or improved. Negative impacts from recreation must be clearly identified and controlled.

Goal Statement: Develop and implement a responsible boating education and outreach program within the watershed that includes recommendations for policy changes (if identified) and increased enforcement within 10 years.

Indicators of Progress

- Number of boaters taking the Indiana Clean Boaters pledge
- Completion of responsible boating program
- Stakeholder participation in workshops, field days, and lake cleanups
- Improved water clarity

7.5 Forestry Management

Problem Statement: Over 82% of the watershed is forested and forestry management activities such as logging, burning or herbicide application may have a negative impact on water quality.

Vision Statement: Maintain forested land within the watershed as forested land. Minimize impacts to water quality from forest management.

Goal Statement: Develop and implement a responsible forest management education and outreach program within the watershed that includes recommendations for policy changes (if identified) within 10 years. Encourage and financially support the use of forestry best management practices as part of efforts to reduce sediment and nutrient loads to the lake within 20 years.

Indicators of Progress

- Number of forestry management plans in the watershed
- Number of forestry BMPs implemented in the watershed
- Stakeholder participation in forestry workshops and field days
- Number of workshops and field days held
- Number of educational materials developed and distributed

7.6 Biological Integrity

Problem Statement: The downstream section of South Fork Salt Creek is listed as impaired for "biological integrity" on the IDEM 303d list, meaning that the stream does not fully support aquatic life use.

Vision Statement: High biological integrity in all watershed streams.

Goal Statement: Improve stream quality so IBI (fish) and mIBI (macroinvertebrates) meet "fair" criteria (>42) in all stream reaches within 20 years.

Indicators of Progress

- Improved CQHEI scores (an indirect indicator of biological integrity)
- Improved fish survey scores (IBI)
- Improved macroinvertebrate survey scores (mIBI)
- Reduced nutrient and sediment concentrations meeting the goals set forth above

- Increase in linear feet of riparian buffer

7.7 Flooding

Problem Statement: Periodic flooding of streams causes property damage, increased stream bank erosion, and lateral stream movement. Log jams and lack of healthy floodplains may exacerbate the issue.

Vision Statement: Healthy streams that can carry floodwaters without excessive stream bank erosion in order to minimize property damage and sediment load to the lake.

Goal Statement: Identify and remove key log jams to reduce flooding and lateral stream movement in key areas within 20 years. Restore floodplains, riparian buffer, and wetlands where practical within 20 years.

Indicators of Progress

- Number of log jams removed
- Increase in linear feet of restored stream bank
- Increase in linear feet of stream buffer
- Acres of floodplain restored
- Acres of wetland restored/constructed
- Decrease in number of flooding events

7.8 Lack of Cohesive Regulations

Problem Statement: Lack of cohesive regulations and governance across the watershed makes funding and implementation of a watershed plan challenging. There is no uniform drainage ordinance for the watershed. There is no single government body that oversees the watershed.

Vision Statement: A comprehensive plan to address watershed concerns with committed participation from local communities and all government bodies across the watershed. A structure for funding and overseeing projects to improve and protect water quality.

Goal Statement: Obtain support of this watershed management plan from all affected government bodies within 5 years. Support the development of a water fund or other structure to financially support watershed improvements within 5 years.

Indicators of Progress

- Government participation in watershed management plan implementation at all levels (Brown County, Monroe County, Jackson County, Indiana, Town of Nashville)
- Permanent watershed coordinator position
- Organizational capacity of Friends of Lake Monroe to spearhead watershed management plan implementation into the future

- Organizational capacity of Lake Monroe Water Fund to financially support watershed improvement
- Increase in funds available for watershed improvement

7.9 Lack of Public Understanding

Problem Statement: Education of the public, both adults and children, is needed to increase awareness of water quality protection needs and solutions.

Vision Statement: Members of public who understand how watersheds work and embrace strategies to preserve and enhance the watershed.

Goal Statement: Develop and implement an education and outreach program within the Watershed within 5 years.

Indicators of Progress

- Number of educational materials developed and circulated
- Number of workshops, field days, recreational outings, and trash cleanups held
- Stakeholder participation in workshops and other events
- Exit surveys showing behavior change due to educational events

7.10 Trash and Plastic Pollution

Problem Statement: Trash and plastic pollution are negatively impacting the lake and its tributaries.

Vision Statement: No trash in the lake and its tributaries.

Goal Statement: Develop and implement a trash removal and education program within the Watershed within 10 years.

Indicators of Progress

- Number of educational materials developed about proper waste management
- Number of trash cleanup events held
- Number of stakeholders participating in cleanup events

7.11 Invasive Plant Species

Problem Statement: Invasive plant species displace native plant species, which may disrupt food chains and decrease biodiversity. Invasive plant species may also be less effective at stabilizing stream banks and may alter nutrient cycling in the soil.

Vision Statement: Remove invasive species and restore native species throughout the watershed.

Goal Statement: Develop and implement an invasive species removal and education program within the watershed within 10 years.

Indicators of Progress

- Number of invasive species removal events
- Monitoring data show a decrease in invasive species density

7.12 Local Regulations

Problem Statement: Local regulations are key to minimizing impacts from development in the watershed. Deregulation, including proposed state regulations that would take away local control, poses a threat to the watershed.

Vision Statement: Expanded local ordinances that ensure appropriate development within the watershed.

Goal Statement: Develop and implement local ordinances to protect the watershed within 20 years. Organize opposition to state regulations that would limit local control within 10 years.

Indicators of Progress

- Government participation in watershed management plan implementation
- Number of local ordinances created or modified to protect water quality

8 Critical Area Selection

Critical areas for watershed management planning purposes are places where implementing the management plan can reduce nonpoint source pollution and improve water quality (or protect future water quality). Critical areas also serve to narrow the focus to areas where implementation of BMPs or other projects will have the greatest impact on water quality. There are multiple ways to identify critical areas. One method is to rank the subwatersheds based on different parameters (number of impaired streams, number of exceedances for a particular parameter, percentage of sites lacking riparian buffer). The resulting prioritization specifies which geographic areas have the most need for improvement. A second method is to utilize source identification, where the data are reviewed to identify the most significant pollutant sources.

When defining critical areas based on subwatersheds, one concern is establishing an area that is too small for successful implementation of the management plan, particularly the adoption of best management practices. Since implementation is voluntary, program success rests upon attracting enough interested landowners. The smaller the designated critical area, the smaller the number of potential landowners. This is an especially important consideration when the intent is to implement agricultural BMPs and the amount of agricultural land is limited, which it is in the Lake Monroe watershed (8%). Marketing is also a consideration, as it can be difficult to explain subwatershed boundaries to landowners.

With those concerns in mind, the steering committee chose to define critical areas based on sources rather than subwatersheds. Focusing on sources also seems appropriate given that subwatershed analysis (see section 5) shows the presence of potential sources of pollution throughout the watershed.

8.1 Critical Area Definition

Critical areas were defined based on potential sources rather than geographical locations. As discussed in Section 5, there are multiple sources associated with each pollutant. The location and extent of some sources are better documented than others.

Table 8-1 Potential Sources of Pollution as Critical Areas

Pollutant	Source	Location	Documentation
Sediment Nutrients	Streambank Erosion	Throughout (most prominent in Middle Fork, North Fork)	Windshield Survey
Sediment Nutrients	Lakeshore Erosion	Lake Monroe (Paynetown, Branigan Peninsula, Deam Wilderness, other)	Informal Observations
Sediment Nutrients	Lack of Riparian Buffer	Throughout (most prominent in North Fork, Middle Fork)	Windshield Survey
Sediment Nutrients	Conventionally Tilled Cropland	Throughout (largest amount of cropland in South Fork)	Land Cover Map, Tillage Transect
Sediment Nutrients	Forestry Sites and Timber Harvests Without Adequate BMPs	Documented in North Fork; Potential Throughout	Documented During Windshield Survey
Sediment Nutrients	Site Construction Without Adequate BMPs	Documented in North Fork; Potential Throughout	Documented During Windshield Survey
Sediment Nutrients	Poorly Installed Roadside Ditches	Documented in North Fork; Potential Throughout	Documented During Windshield Survey
Nutrients	Fertilizer on Cropland	Throughout (largest amount of cropland in South Fork)	Land Cover Map
Nutrients	Fertilizer on Commercial/ Residential Land	Throughout (largest amount of developed land in North Fork and South Fork)	Land Cover Map
Nutrients E. Coli	Manure on Pasture	Throughout (largest amount of pasture in South Fork; largest percentage of stream sites with livestock access in South Fork)	Land Cover Map, Windshield Survey
Sediment	Livestock In Streams	Throughout (largest percentage in South Fork)	Windshield Survey
Nutrients E. Coli	Failed Septic Systems	Throughout (largest number of septic systems in North Fork, Lake Monroe Basin	GIS Building Layer, Brown and Monroe County Health Department Data

The primary potential sources of pollution appear to be agricultural land with resource concerns; eroding stream banks and lakeshores; lack of riparian buffer; and failing septic systems. Secondary sources include timber harvests with erosion concerns, site construction with insufficient erosion control, severely dredged roadside ditches, and fertilizer usage on commercial and residential land.

Most strategies for reducing sediment and nutrient loads focus on land management (cover crops, erosion control practices, reduced fertilizer usage, streambank stabilization) to limit the amount of sediment and nutrients that reach the streams. However, another strategy to consider is to reduce the frequency and intensity of high stream flows. High flow events are responsible for most of the sediment load which in turn delivers bound phosphorus and nitrogen into Lake Monroe. Peak flows can be reduced by restoring stream meanders, restoring wetlands, adding retention basins, and encouraging infiltration of storm water before it reaches streams.

Similarly, it is worth considering how water movement within Lake Monroe contributes to sediment and nutrient levels within the lake. High water levels and wave action result in soil saturation and slumping along vulnerable shoreline areas, which delivers sediment, bound phosphorus, and bound nitrogen into the lake. Wave action can be caused by wind or by motorboats generating wake near the shoreline. Water levels are controlled by USACE operation of the dam. While their primary goal is reducing flood events downstream, there may be opportunities to adjust operations with the goal of minimizing the duration of high water levels.

Table 8-2 Critical Areas in the Lake Monroe Watershed

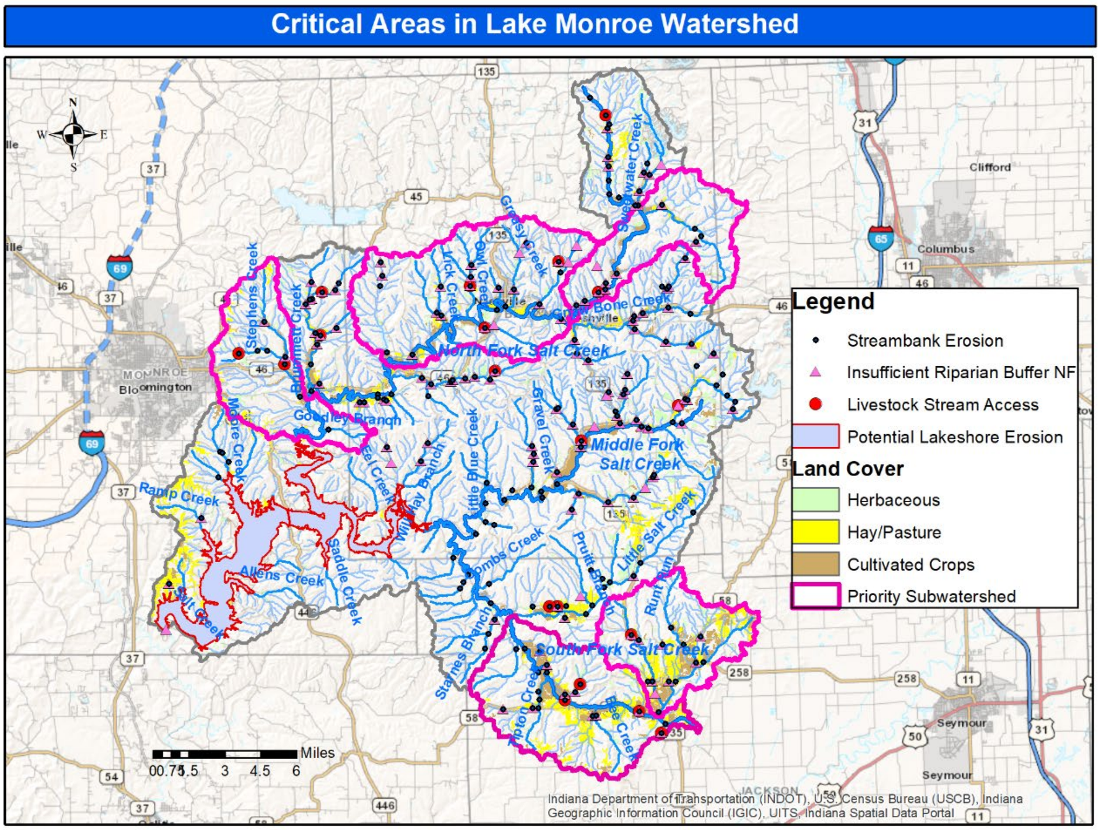
Critical Areas (Source-Based)
Areas with active agriculture and resource concerns
Forestry sites with active erosion
Eroding stream banks
Stream sections with insufficient riparian buffer (less than 20 feet)
Eroding lakeshore
Areas with failing septic systems

For the purposes of implementing land management practices, critical areas in the Lake Monroe watershed are defined as areas with active agriculture and resource concerns, forestry sites with active erosion, eroding stream banks, stream sections with insufficient riparian buffer (less than 20 feet), sections of eroding lakeshore, or areas with failing septic systems.

Contributions to water quality concerns from these lands will be evaluated through site reviews to determine whether they are considered as a significant contributor. Any land that has visibly notable problems, including but not limited to, highly erodible land, livestock with access to streams, conventional row cropping practices, poor pasture management, unprotected manure piles, and lack of riparian buffers will be considered a significant contributor.

Figure 8-1 shows the approximate locations of critical areas in the watershed. This figure should be used as a starting point rather than an exhaustive map of potential projects. Further investigation is needed to identify specific locations. Some specific sites are mapped based on observations of streambank erosion, insufficient riparian buffer, and livestock access to streams but there many stream sections in the watershed that were not inspected as part of the windshield survey. Agricultural land is shown as a starting point for identifying areas with active agriculture and resource concerns. The Lake Monroe shoreline is shown as a starting point for identifying sections of lakeshore erosion. No sites are mapped corresponding with active forestry sites or failing septic systems due to insufficient data availability.

Figure 8-1 Approximate Locations of Critical Areas in Lake Monroe Watershed



While critical areas were defined based on pollutant sources, the subwatershed analysis revealed that certain subwatersheds are at higher risk than others based on current water quality data and observed stream conditions. These five subwatersheds are shown on Figure 8-1 as priority subwatersheds. During the implementation phase, these areas should be given priority when there may be more interested landowners than available funds. A ranking system will be developed prior to implementing any cost-share programs that assigns a weighted score to each potential project based on its subwatershed.

9 Best Management Practices

There are many different best management practices (BMPs) available for on-the-ground implementation to address water quality concerns. A master list of BMPs was reviewed by the project steering committee and project partners. The following list of practices were deemed most likely to successfully meet load reduction targets, be feasible to implement, and address stakeholder concerns. No practice list is exhaustive and additional techniques may be both possible and necessary to reach water quality goals. Descriptions of each practice are available in Appendix K.

Table 9-1 Priority Best Management Practices

Critical Area/Source	Pollutant(s)	Suggested BMP
Agricultural Resource Concerns – Livestock Access to Streams	bacteria, sediment, nutrients	Livestock exclusion fencing
		Livestock watering systems
Agricultural Resource Concerns – Erosion of Pasture	sediment, nutrients	Heavy use area protection
		Critical area seeding
		Forage and biomass planting
Agricultural Resource Concerns – Conventional Tillage or Erosion of Cropland	sediment, nutrients	No till or reduced till agriculture
		Cover crops
		Field border or filter strip
		Riparian forested or herbaceous buffer
		Land retirement
		Tree or shrub establishment
Forestry sites with active erosion	sediment, nutrients	Forest management plan
		Training of foresters and loggers
		Critical area seeding
		Forest trails and landing improvement
Streambank Erosion	sediment, nutrients	Riparian forested or herbaceous buffer
		Streambank stabilization
		Logjam removal
		Wetland creation or restoration
		Improved stream crossing
		Land Retirement
Streams Lacking Riparian Buffer	sediment, nutrients	Riparian forested or herbaceous buffer
Failing Septic Systems	bacteria, nutrients	Septic system maintenance
		Septic system repair
		Septic system alternatives
		Education of homeowners

Critical Area/Source	Pollutant(s)	Suggested BMP
Lakeshore Erosion	sediment, nutrients	Lakeshore stabilization
		Boating restrictions
		Education of boaters
		Modifying dam operations

9.1 Proposed BMPs and Pollutant Reduction Values

The following table summarizes a potential combination of BMPs that could be put in place during our first round of implementation (3 years) along with their pollutant reduction value and financial cost to implement.

Table 9-2 BMP Load Reductions for Initial Implementation Phase (3 years)

Practice	Acres/ Ft Applied	Total E. coli Reduction CFU/yr	Reduction Sediment t/ac/yr	Total Sed. Reduction tons/yr	Reduction P lb/ac/yr	Total P Reduction lb/yr	Reduction N lb/ac/yr	Total N Reduction lb/yr	Cost per acre or lf	Total Cost
Cover Crops (x2 years)	600	-	6.9	4,140	7.2	4,320	14.5	8,700	$40	$48,000
No Till 60% or More	250	-	26	6,500	21	5,250	43	10,750	$15	$3,750
Field Border (15 ft)	50	-	9.1	455	10.7	535	21.3	1,065	$400	$20,000
Riparian Herbaceous Buffer - 35 feet	-	-	9.1	-	10.7	-	21.3	-	$350	-
Riparian Forested Buffer - 35 feet	-	-	7.6	-	9.2	-	17.9	-	$400	-
Land Retirement and Tree Establishment	10	1.03E+12	4.6	46	4.6	46	9.2	92	$450	$4,500
Exclusion Fencing	1,000	4.75E+12	0.057	57	0.0655	66	0.131	131	$3	$3,000
Forage and Biomass Planting	50	-	8.9	445	10.2	510	20.5	1,025	$200	$10,000
Critical Area Planting	-	-	8.9	-	10.2	-	20.5	-	$200	-
Heavy Use Area Protection	2	-	88	176	58	116	114	228	$15,000	$30,000
Streambank Stabilization	-	-	0.114	-	0.131	-	0.262	-	$1,000	-
Lakeshore Stabilization	-	-	0.107	-	0.123	-	0.246	-	$1,000	-
TOTAL		**5.77E+12**		**11,819**		**10,843**		**21,991**		**$119,250**
GOAL		**6.56E+14**		**9,992**		**74,098**		**80,204**		
REMAINING		**6.50E+14**		**(1,827)**		**63,255**		**58,213**		

While it should be possible to reduce sediment to target levels within the first round of implementation, additional work will be needed to achieve the phosphorus target. This table presents a series of BMPs to achieve the phosphorus target within 20 years. BMP installation was divided over 20 years to establish annual targets. Interim load reduction targets at 5-year intervals are presented in section 10.3.

Table 9-3 BMP Load Reductions for Over 20-Year Implementation Project

Practice	Acres/ Ft Applied	Total E. coli Reduction CFU/yr	Reduction Sediment t/ac/yr	Total Sed. Reduction tons/yr	Reduction P lb/ac/yr	Total P Reduction lb/yr	Reduction N lb/ac/yr	Total N Reduction lb/yr	Cost per acre or lf	Total Cost
Cover Crops (x2 years)	4000	-	6.9	27,600	7.2	28,800	14.5	58,000	$40.00	$320,000
No Till 60% or More	2000	-	26	52,000	21	42,000	43	86,000	$15.00	$30,000
Field Border (15 ft)	400	-	9.1	3,640	10.7	4,280	21.3	8,520	$400.00	$160,000
Riparian Herbaceous Buffer - 35 feet	50	3.96E+12	9.1	455	10.7	535	21.3	1,065	$350.00	$17,500
Riparian Forested Buffer - 35 feet	100	4.57E+12	7.6	760	9.2	920	17.9	1,790	$400.00	$40,000
Land Retirement and Tree Establishment	60	5.15E+12	4.6	276	4.6	276	9.2	552	$450.00	$27,000
Exclusion Fencing	2500	1.19E+14	0.057	143	0.0655	164	0.131	328	$3.00	$7,500
Forage and Biomass Planting	250	-	8.9	2,225	10.2	2,550	20.5	5,125	$200.00	$50,000
Critical Area Planting	350	-	8.9	3,115	10.2	3,570	20.5	7,175	$200.00	$70,000
Heavy Use Area Protection	10	-	88	880	58	580	114	1,140	$15,000.00	$150,000
Streambank Stabilization	200	-	0.114	23	0.131	26	0.262	52	$1,000.00	$200,000
Lakeshore Stabilization	200	-	0.107	21	0.123	25	0.246	49	$1,000.00	$200,000
TOTAL		**1.32E+14**		**90,693**		**83,216**		**168,771**		**$1,272,000**
GOAL		**6.56E+14**		**9,992**		**74,098**		**80,204**		
REMAINING		**5.24E+14**		**(80,701)**		**(9,118)**		**(88,567)**		

10 Action Plan

The following action plan outlines strategies for achieving each of our goals for improving Lake Monroe and its tributaries. Each identified objective (strategy) is associated with series of milestones (measurable achievements) to measure progress. Each milestone has an associated timeframe, target audience, possible partners, and estimated cost. This is the roadmap for meeting the target water quality goals as well as the less tangible watershed improvement goals.

10.1 Action Plan Milestones

Pollutant reduction from each quantifiable milestone is summarized in the previous section. Many milestones do not have easily quantifiable pollutant reduction benefits but are key to overall improvements in water quality. Based on the Region 5 model for pollutant load reduction, it is likely that the sediment goal will be achieved much sooner than the phosphorus and nitrogen goals. To achieve the phosphorus and nitrogen reduction goals, the model may demonstrate a reduction in sediment over the twenty-year period larger than the current estimated sediment load. While this is clearly incorrect, the action plan was developed using the phosphorus goal and Region 5 model calculations as a conservative method for achieving water quality improvements.

Table 10-1 Action Plan for Lake Monroe Watershed

Goal	Objective	Target Audience	Milestone	Target Date	Estimated Cost	Potential Partner/ Technical Assistance
Sediment Nutrients Bacteria	Implement a conservation education and cost-share program to encourage	Agricultural Producers, Landowners, Operators	By the end of the first quarter, develop cost-share program and application process	2023	$2,000	Steering committee (P), SWCDs (P/T), NRCS (P/T), ISDA (T),
			By the end of the first quarter, develop promotional strategy for cost-share program	2023	$2,000	

Goal	Objective	Target Audience	Milestone	Target Date	Estimated Cost	Potential Partner/ Technical Assistance
	adoption of agricultural best management practices		By the end of the second quarter, create 2 brochures or fact sheets (one for agricultural producers and one for other landowners) and a page on the Friends of Lake Monroe website.	2023	$1,000 staff + $2,000 graphics = $3,000	Purdue Extension (P)
			Send targeted mailing promoting cost-share program	2023	Estimated 500 @ $2 = $1,000	
			Launch targeted social media campaign	2023	$1,000	
			By end of first year, identify alternate funding sources for BMPs to increase participation	2023	$2,000	
			Every year administer cost-share program including personal visits with prospective agricultural landowners and operators and tracking BMP installations	Annually	$20,000/yr	
Sediment Nutrient	Increase adoption of agricultural best management practices on cropland to	Crop Producers, Landowners, Operators	Increase cover crop acreage by 200 acres annually (1.75% of watershed cropland). 200 acres x $40/acre x 2 years	Annually	$16,000/year	NRCS (P/T), Purdue Extension (P), ISDA (T), IDNR (P), IDEM (P), Soil and Water
			Increase no-till acreage by 100 acres annually (0.88% of cropland). 100 acres x $15/acre	Annually	$1,500/year	

Goal	Objective	Target Audience	Milestone	Target Date	Estimated Cost	Potential Partner/ Technical Assistance
	reduce nutrient and sediment runoff		Install 20 acres of filter strips or field borders annually (0.2% of cropland). 20 acres x $400/acre	Annually	$8,000/year	Conservation Districts (P/T)
			Install 2.5 acres of herbaceous riparian buffer (to treat 16 acres farmland) annually. 2.5 acres x $350/acre	Annually	$875/year	
			Install 5 acres of forested riparian buffer (to treat 31 acres of farmland) annually. 5 acres x $400/acre	Annually	$2,000/year	
Sediment Nutrient Bacteria	Increase adoption of agricultural best management practices on pasture to reduce nutrient, sediment, and bacteria runoff	Livestock Producers, Landowners, Operators	Install 12.5 acres of forage and biomass planting on pasture annually. 12.5 acres x $200/acre	Annually	$2,500/year	NRCS (P/T), Purdue Extension (P), ISDA (T), IDNR (P), IDEM (P), Soil and Water Conservation Districts (P/T)
			Install 17.5 acres of critical area planting on pasture annually. 17.5 acres x $200/acre	Annually	$3,500/year	
			Install 0.5 acres of heavy use area protection annually. 0.5 acre x $15,000/acre	Annually	$7,500/year	
			Install fencing to exclude livestock from 125 linear feet of stream and install alternate watering systems as needed. 125 feet x $3/foot	Annually	$375/year for fencing $1,000-$8,000 per watering system	

Goal	Objective	Target Audience	Milestone	Target Date	Estimated Cost	Potential Partner/ Technical Assistance
Nutrient Bacteria	Reduce nutrient and bacteria contributions from malfunctioning septic systems	General Public (Owners of Septic Systems)	Host or actively participate in at least 1 regional workshop annually to promote septic system maintenance for water quality protection in partnership with local health departments and regional sewer districts	Annually	$2,000/year	SWCDs (P/T), Health Departments (P), Regional Sewer Districts (P), Monroe County Stormwater (P), Purdue Extension (P), Community Foundations (P)
			Develop an educational mailer for watershed residents about proper septic system care and maintenance	2023	$3,000	
			Identify funding source for septic system maintenance cost-share program	2023	$2,000	
			Identify funding source for septic system repair cost-share program	2024	$2,000	
			Work with local health departments and regional sewer districts to identify and replace straight pipe systems	2024	$4,000	
			Work with local health departments and regional sewer districts to explore alternatives to septic systems	2027	$4,000	

Goal	Objective	Target Audience	Milestone	Target Date	Estimated Cost	Potential Partner/ Technical Assistance
			Work with local health departments and regional sewer districts to explore potential expansion of existing sewer systems	2028	$4,000	
Sediment Nutrient Bacteria Flooding Habitat	Protect and restore riparian floodplains in agricultural areas	Agricultural Owners and Operators	Convert 3 acres of floodplain farmland to forest annually. 3 acres x $1,350/acre	Annually	$1,350/year	NRCS (P/T), Purdue Extension (P), ISDA (T), IDNR (P), IDEM (P), Soil and Water Conservation Districts (P/T), Lake Monroe Water Fund (P)
			Identify and quantify farmland in the 100-year floodplain of North, Middle, and South Fork Salt Creek	2025	$4,000	
			Develop a strategy to encourage taking floodplain land out of production.	2028	$4,000	
			Contact and work with agricultural landowners to identify barriers to retiring farmland and track their responses annually beginning in 2030.	Annually	$2,000	
Sediment Nutrient Bacteria Flooding	Protect and restore riparian floodplains in	Local government, floodplain landowners	Identify and quantify non-agricultural land in the 100-year floodplain of North, Middle, and South Fork Salt Creek	2029	$4,000	Salt Creek Preservation Group (P), Brown County

Goal	Objective	Target Audience	Milestone	Target Date	Estimated Cost	Potential Partner/ Technical Assistance
Habitat	non-agricultural areas		Develop a strategy to encourage protection of non-agricultural floodplain land through easements, removal of structures, and installation of wetlands or bottomland forest	2031	$4,000	Redevelopment Commission (P), SWCDs (P), Sycamore Land Trust (P)
			Contact and work with landowners to explore floodplain land protection and track their responses annually beginning in 2030.	Annually	$2,000	
			Identify specific properties in floodplain that should be acquired and converted to forest or wetland	2031	$1,000	
Sediment Nutrient Forestry	Increase adoption of forest conservation plans on private lands to reduce sediment and nutrient contributions from forestland.	Private Forest Owners and Managers	Host or actively participate in one regional workshop annually to promote forestry best management practices.	Annually	$2,000	The Nature Conservancy (P), The Indiana Department of Natural Resources Forestry Division (P/T), Indiana Forestry and Woodlands Owners Association (P),
			Publish at least one article annually promoting forestry best management practices.	Annually	$100	
			Identify funding sources to introduce cost-share program for forest management plans and forestry best management practices.	2025	$2,000	

Goal	Objective	Target Audience	Milestone	Target Date	Estimated Cost	Potential Partner/ Technical Assistance
			Increase adoption of forest management plans by 2 annually starting in 2026.	Annually	$1,000/year	NRCS (P/T), SWCD (P/T), National Wild Turkey Federation (P/T)
Sediment Nutrient Forestry	Increase logger and forester knowledge of forestry best management practices	Forestry practitioners – loggers, foresters, etc.	Host or actively participate in at least one regional training session annually on forestry best management practices for loggers and foresters	Annually	$2,000	The Nature Conservancy (P), The Indiana Department of Natural Resources Forestry Division (P/T), Indiana Forestry and Woodlands Owners Association (P), NRCS (P/T), SWCD (P/T)
	Increase use of forestry best management practices in the watershed		Explore possibility of introducing local ordinances to guide forestry management (e.g., require a certified forester)	2028	$4,000	
Sediment Nutrient	Reduce sediment contribution from streambank erosion	Landowners with streams	Identify streambank sections for stabilization	2026	$2,000	NRCS (P/T), SWCDs (P/T), LARE staff (T)
			Acquire funding for streambank stabilization projects	2028	$2,000	
			Stabilize 100 feet of streambank	2030	$108,000	
			Stabilize an additional 100 feet of streambank	2035	$108,000	

Goal	Objective	Target Audience	Milestone	Target Date	Estimated Cost	Potential Partner/ Technical Assistance
			Develop system for tracking and addressing logjams	2024	$4,000	LARE staff (T)
Sediment Nutrient	Reduce sediment contribution from lakeshore erosion by stabilizing lakeshore	Lake Monroe – DNR State Parks Division and US Army Corps of Engineers	Acquire funding for adding vegetation to riprap using live stakes	2022	$1,000	DNR State Parks (P), US Army Corps of Engineers (P), Sycamore Land Trust (P), NRCS (P/T), LARE staff (T)
			Install live stake vegetation using community volunteers	2022	$2,000	
			Identify section of Lake Monroe shoreline for pilot stabilization project	2023	$2,000	
			Acquire funding for pilot lakeshore stabilization project	2025	$2,000	
			Stabilize 100 feet of lakeshore via shoreline stabilization project	2026	$104,000	
			Research alternative strategies for reducing shoreline erosion such as adding aquatic plants near the shoreline	2030	$500	
			Identify, acquire funding, and install an additional 100 feet of lakeshore stabilization	2031	$108,000	
Sediment Nutrient	Reduce sediment contribution from	U.S Army Corps of Engineers	Meet with U.S. Army Corps of Engineers to discuss modifications to water level management at the dam	2024	$4,000	U.S. Army Corps of Engineers (P), DNR Parks Division (P)

Goal	Objective	Target Audience	Milestone	Target Date	Estimated Cost	Potential Partner/ Technical Assistance
	lakeshore erosion by reducing water level fluctuations in the lake		Modify dam operation (if feasible) to reduce water level fluctuations in Lake Monroe in coordination with U.S. Army Corps of Engineers	2030	In-kind (ACOE)	
Sediment Nutrient Recreation	Reduce sediment contribution from lakeshore erosion exacerbated by boating activity	Boaters, DNR State Parks Division	Circulate 1,000 copies of existing "green boating" brochure developed by FLM	2024	$3,000	DNR Parks Division (P), Visit Bloomington (P), Local Marinas (P), US Army Corps of Engineers (P), Indiana Geological and Water Survey (T)
			Add educational signs at 4 recreational areas explaining water quality concerns and best practices for visitors	2026	$8,000 design, $16,000 print	
			Create or modify existing responsible boating program to address lakeshore erosion from boating and other potential impacts	2025	$4,000	
			Add 8 signs delineating no-wake zones	2028	$2,000 design, $8,000 print	
			Update map of Lake Monroe to more clearly show no-wake zones	2026	$8,000 design	
			Circulate new map	2027	In-kind (DNR)	
			Identify funding and/or legislation to increase boating regulation enforcement at Lake Monroe	2028	$2,000	

Goal	Objective	Target Audience	Milestone	Target Date	Estimated Cost	Potential Partner/ Technical Assistance
			Work with DNR and state government to increase boating regulation enforcement at Lake Monroe	2030	$2,000	
Sediment Nutrient	Create sediment traps or wetlands to capture sediment before it reaches Lake Monroe.	IDNR State Parks Division, US Army Corps, private landowners with land suitable for wetland restoration	Conduct preliminary analysis to evaluate feasibility of using North Fork Waterfowl Resting Area as a sedimentation basin	2027	$4,000	LARE staff (T), DNR State Parks Division (P), US Army Corps of Engineers (P), NRCS (P/T)
			Acquire funding for design work to modify North Fork Waterfowl Resting Area to enhance effectiveness as a sedimentation basin	2027	$4,000	
			Modify North Fork Waterfowl Resting Area (if feasible) to enhance effectiveness as a sedimentation basin	2029	$104,000	
			Locate and review old proposal to use Crooked Creek area as a sedimentation basin	2030	$2,000	
			Identify funding for Crooked Creek sediment basin project	2031	$2,000	
			Install Crooked Creek sediment basin project (if feasible)	2032	$506,000	
			Identify areas for creating or restoring wetlands in floodplains	2030	$2,000	

Goal	Objective	Target Audience	Milestone	Target Date	Estimated Cost	Potential Partner/ Technical Assistance
Sediment Nutrient Flooding			Conduct preliminary feasibility work to install one wetland project	2030	$2,000	
			Identify funding for wetland project	2031	$2,000	
			Install wetland project	2032	$52,000	
Nutrient	Reduce nutrient loading with in-lake treatment	U.S. Army Corps of Engineers, City of Bloomington Utilities, DNR State Parks	Conduct feasibility analysis of using in-lake aeration system to reduce phosphorus concentrations	2028	$5,000	U.S. Army Corps of Engineers (P), City of Bloomington Utilities (P), DNR State Parks (P)
			Conduct feasibility analysis of adding flocculant to lake to reduce phosphorus concentrations	2029	$5,000	
Sediment Nutrients Bacteria	Evaluate success of action plan and modify as needed	Steering committee, Friends of Lake Monroe	Annually evaluate watershed management goals, tasks, and indicators of success. This includes tabulating total load reductions using the Region 5 load model and Indiana E. coli calculator to determine if project goals have been satisfied.	Annually	Included in cost-share program administration	Steering committee (P)
			Modify action plan based on annual evaluation	Annually		
Sediment Nutrients	Monitor water quality to	General public	Collect and analyze water samples from Lake Monroe in late summer.	Annually	$7,500	IU Limnology Lab (P/T), City

Goal	Objective	Target Audience	Milestone	Target Date	Estimated Cost	Potential Partner/ Technical Assistance
Bacteria Education	evaluate watershed health		Summarize and report results of available water quality data in annual report.	Annually	$2,000/year	of Bloomington Utilities (P/T), US Army Corps of Engineers (P), US Forest Service (P), IDEM (P)
			By end of fourth year, identify funding sources for conducting an additional water quality monitoring event to evaluate program impacts	2026	$2,000	
			Explore options for integrated water quality monitoring	2026	$2,000	
			After two rounds of implementation projects, conduct an additional water quality monitoring event to evaluate program impacts	2029	IU Contract $75,000	
			Organize citizen scientist water sampling in conjunction with water quality monitoring	2029	$7,000	
Capacity	Acquire support of all affected local government bodies	Policymakers, government employees, elected officials	Organize a multi-county watershed summit to align policymakers around watershed issues	2022	$4,000	SWCDs (P), Purdue Extension (P), government bodies (P)
			Give presentations to all affected local government bodies at least once annually	Annually	$2,000	

Goal	Objective	Target Audience	Milestone	Target Date	Estimated Cost	Potential Partner/ Technical Assistance
	Establish long-term capacity for watershed work	Steering Committee, Friends of Lake Monroe	Create a long-term strategic plan for funding watershed work and establishing a permanent watershed coordinator position	2023	$8,000	Lake Monroe Water Fund (P), SWCDs (P), Community Foundations (P)
			Implement strategic plan for funding watershed work (2024-2042)	2024	$1,000/year	
			Establish permanent watershed coordinator position	2030	See annual cost estimates	
Education	Conduct educational workshops for the public with the goal of changing behaviors to positively impact water quality	General Public	Host at least two community forums presenting watershed management plan	2022	$6,000	SWCDs (P/T), Health Departments (P/T), League of Women Voters (P), Brown County Regional Sewer District (P/T), Visit Bloomington (P)
			Conduct at least one public meeting (community forum) each year	Annually	$4,000	
			Host or actively participate in one regional workshop annually to promote septic system maintenance.	Annually	See Sediment and Nutrients Section	
			Develop an educational mailer for watershed residents about proper septic care and maintenance.	2023	See Sediment and Nutrients Section	
			Develop an educational mailer for watershed residents about streambank stewardship.	2023	$3,000	

Goal	Objective	Target Audience	Milestone	Target Date	Estimated Cost	Potential Partner/ Technical Assistance
			Develop an educational mailer for watershed residents about landscaping for water quality.	2023	$3,000	
			Develop an educational mailer for watershed residents about soil protection.	2023	$3,000	
			Mail the newly developed educational brochures to 7,000+ stakeholders with information on how their actions have a positive or negative impact on water quality.	2023	$3 x 4 x 7,000 = $84,000	
			Develop an educational brochure about the watershed management plan to be used at events.	2023	$3,000	
Education	Activate community members as watershed stewards by connecting them with local waters	General public	Hold at least one large stream or lake cleanup annually	Annually	$500/year	Keep Brown County Beautiful (P), Salt Creek Preservation Group (P), local marinas (P), Indigo Birding
			Hold at least one boat tour annually	Annually	$500/year	
			Host at least one watershed tour annually	Annually	$500/year	
			Continue monthly trash cleanups at Lake Monroe	Annually	$200/year	

Goal	Objective	Target Audience	Milestone	Target Date	Estimated Cost	Potential Partner/ Technical Assistance
	and hands-on activities		Coordinate citizen science project monitoring shoreline erosion within Lake Monroe.	2025	Summer intern = $5,000	(P), Brown County Parks and Rec (P), Monroe County Stormwater (P), IDNR State Parks (P), USFS (P)
Education	Engage community members through regular updates and information.	General Public	Post quarterly updates on FLM website	Annually	$200/year	Steering committee (P), SWCDs (P)
			Publish watershed-related articles in FLM newsletter at least quarterly	Annually	$200/year	
			Use social media to provide meeting notices/reminders, and informational updates on a monthly basis.	Annually	$100/year	
			Provide media releases to local newspaper(s) and/or radio and television stations about watershed protection at least twice a year.	Annually	$100/year	
			Share information at a minimum of four public events annually.	Annually	$500/year	

Goal	Objective	Target Audience	Milestone	Target Date	Estimated Cost	Potential Partner/ Technical Assistance
Trash Education	Increase awareness of the negative impacts of littering and trash dumping.	General Public	Develop and launch an anti-litter campaign	2026	$6,000	Keep Brown County Beautiful (P), SWCDs (P), local parks and rec departments (P)
	Increase availability of trash collection options in all counties	General Public	Identify funding sources to increase waste management options	2025	$2,000	Keep Brown County Beautiful (P/T), local waste management districts (P/T)
			Meet with county solid waste management districts to discuss expanding waste disposal options	2025	$2,000	
Invasives	Increase citizen action removing invasive species.	General Public	Host Indiana Weed Wrangle events within watershed	2025	$500	MC-IRIS (P/T), Brown County Native Woodlands Project (P/T), Southern Indiana Cooperative Invasives Management (SICIM) (P/T)
			Facilitate private landowner interactions with the local CISMA so citizens can learn invasive species on their properties and develop a management plan to deal with them	2023	N/A	
Governance	Explore the need for ordinance	Local governments	Organize a committee to review ordinances and meet quarterly for one year.	2028	$2,000	Monroe County (P), Brown County (P),

Goal	Objective	Target Audience	Milestone	Target Date	Estimated Cost	Potential Partner/ Technical Assistance
	updates or new ordinances to increase protection of Lake Monroe		Develop action plan based on ordinance review	2029	$1,000	Jackson County (P), City of Bloomington (P), Town of Nashville (P)
			Implement ordinance update action plan	2030	$5,000	

Many of the Action Plan objectives will be repeated annually, including administering a cost-share program to encourage BMP adoption (as funds allow) and hosting annual workshops on topics like septic system maintenance, agricultural BMPs, forestry BMPs, and general updates on the state of the watershed. Other objectives occur only once. Below is a breakdown of tasks by calendar year.

Table 10-2 Action Plan By Year

Year	Staff	BMP Install	Supplies	Services	Total	Area of Focus
Annually	$ 34,200	$ 47,600	$ 1,700	$ 7,500	$ 91,000	Annually administer cost-share program, hold 4 annual workshops, keep local government officials informed, conduct public education and outreach
2022	$ 22,100	$ 1,000	$ 1,700	$ -	$ 24,800	Community forums to present watershed management plan, developing educational materials, presenting at events, laying groundwork for implementation, live stake project
2023	$ 58,200	$ 47,600	$ 86,700	$ 19,500	$ 212,000	Initial round of implementation – launching cost-share program, develop and send educational mailers, summer sampling of Lake Monroe, groundwork for shoreline stabilization project, strategic planning for long-term funding
2024	$ 49,200	$ 47,600	$ 3,700	$ -	$ 108,000	Implement strategic plan for long-term funding, work with health departments of septic issues, develop logjam system, educate about green boating, summer sampling of Lake Monroe, initial conversations with Army Corps about modifying dam operation
2025	$ 50,700	$ 47,600	$ 1,700	$ 5,000	$ 110,500	Shoreline erosion project, responsible boating education, identifying waste management expansion options, quantifying floodplain farmland, monitoring shoreline erosion, acquiring funding for forestry work

Year	Staff	BMP Install	Supplies	Services	Total	Area of Focus
2026	$ 58,200	$ 147,600	$ 1,700	$ 24,000	$ 239,000	Lakeshore stabilization pilot, install educational signage at beaches, update boating map of Lake Monroe, launch anti-litter campaign, acquire funding for large water quality monitoring event, research integrated water monitoring options
2027	$ 53,200	$ 47,600	$ 1,700	$ -	$ 110,000	Preparation work for North Fork Waterfowl Resting Area project, circulate updated boating map
2028	$ 48,200	$ 47,600	$ 9,700	$ 5,000	$ 118,000	Develop strategy for taking agricultural floodplain land out of production, install 8 signs delineating no-wake zones, explore increasing boat regulation enforcement, conduct local ordinance review, continue work with health departments
2029	$ 47,200	$ 147,600	$ 1,700	$ 80,000	$ 283,000	Water quality monitoring event with citizen science component, install North Fork sediment trap (if feasible), develop action plan based on ordinance review, investigate floodplain protection options, conduct feasibility analysis of adding flocculant to lake
2030	$ 53,700	$ 147,600	$ 1,700	$ -	$ 210,200	Establish permanent watershed coordinator position, stabilize 100 feet of streambank, modify dam operation (if feasible), preliminary work for Crooked Creek sediment trap project, preliminary work for wetland project, begin contacting floodplain landowners about land protection
2031	$ 46,200	$ 147,600	$ 1,700	$ -	$ 203,000	Stabilize an additional 100 feet of lakeshore, continue preliminary work for Crooked Creek and wetlands
2032	$ 42,200	$ 597,600	$ 1,700	$ -	$ 649,000	Install Crooked Creek sediment trap, install new wetlands
2033	$ 34,200	$ 47,600	$ 1,700	$ -	$ 91,000	Continue with annual task list
2034	$ 34,200	$ 47,600	$ 1,700	$ -	$ 91,000	Continue with annual task list

Year	Staff	BMP Install	Supplies	Services	Total	Area of Focus
2035	$ 42,200	$ 147,600	$ 1,700	$ -	$ 198,000	Stabilize an additional 100 feet of streambank
2036 to 2042	$ 34,200	$ 47,600	$ 1,700	$ -	$ 91,000	Continue with annual task list

10.2 Potential Funding Sources

For successful implementation of the watershed management plan, multiple funding sources will need to be explored and accessed. Here is a starting list of potential funding sources to consider.

- Lake Monroe Water Fund
- Indiana Department of Environmental Management (IDEM) Nonpoint source 319 grant
- Natural Resource Conservation Services (NRCS) Farm Bill Conservation Programs including EQIP, CRP, CSP, WRP
- Indiana State Department of Agriculture (ISDA) Clean Water Indiana Grants
- Indiana Department of Natural Resources (IDNR) Lake and River Enhancement (LARE) grant
- IDNR Reservoir Habitat Enhancement Program
- Duke Energy Foundation
- Office of Rural Affairs
- Local Community Foundations (Monroe County, Brown County, Jackson County)
- National Fish and Wildlife Federation Five Star and Urban Waters Restoration Grant Program
- United States Department of Agriculture (USDA) Rural Development
- Regional Opportunity Investment
- Environmental Protection Agency (EPA) Clean Water Revolving Fund
- Indiana Department of Natural Resources (IDNR) Forestry BMP Cost-Share Program
- Indiana Forestry Educational Foundation
- United States Forest Service grants
- USACE Section 206 Aquatic Ecosystem Restoration and other USACE grants

10.3 Tracking Effectiveness

The effectiveness of implementation efforts will be tracked through load reduction models using Region 5 modeling and Indiana E. coli calculator for all installed BMPs. Load reductions will be calculated on an ongoing basis and BMP locations will also be tracked using GIS. These load reductions are likely to differ from year to year based on available funds and landowner interest. Substantial load reductions are expected from the proposed floodplain/wetland restoration projects in the North Fork Salt Creek and Crooked Creek areas. However, these projects will require feasibility studies and extensive design work before accurate load reductions can be calculated. Therefore, interim load reduction targets were developed for five-year intervals assuming a constant load reduction each year (see table 10-3). These interim milestones will provide a general metric for evaluating progress within the twenty-year timeframe.

Table 10-3 Load Reduction Targets Over 20-Year Timeline

	Phosphorus Load Reduction (lbs/yr)	**Sediment Load Reduction (tons/yr)**	**Nitrogen Load Reduction (lbs/yr)**	**E. coli Load Reduction (CFU/yr)**
Year 3 Reduction Goal	11,115	1,499	12,031	9.84E+13
Year 5 Reduction Goal	18,525	2,498	20,051	1.64E+14
Year 10 Reduction Goal	37,049	4,996	40,102	3.28E+14
Year 15 Reduction Goal	55,574	7,494	60,153	4.92E+14
Year 20 Reduction Goal (Total)	**74,098**	**9,992**	**80,204**	**6.56E+14**

Costs for installation will be borne on a cost-share basis with landowners when grant funding can be obtained by Friends of Lake Monroe and its partners. Friends of Lake Monroe will work closely with NRCS and local SWCD offices to identify additional funding sources when cost-share programs are not available or applicable. Technical assistance in either case will be provided by potential project partners NRCS and ISDA in coordination with the SWCDs.

Education and outreach will be tracked on an ongoing basis using social and administrative indicators such as databases of workshop/event participants, pre- and post- surveys collected at workshops, personal interviews at events, and testimonials. At the end of each year, the implementation plan and its strategies will be reviewed for effectiveness. All problems and concerns will be identified, evaluated, and used to adjust future strategies.

Watershed scale water quality monitoring will be reintroduced after two rounds of implementation projects (approximately 6 years). Data collection will utilize the same methodology used during the watershed planning phase and will be performed by our partners at the Indiana University Limnology Lab for an approximate cost of $75,000. Sampling results will be compared to data collected during the watershed planning phase to evaluate impacts from initial plan implementation. Additional water quality monitoring will be scheduled based on future implementation work with an anticipated frequency of once every 6-8 years.

Detailed information on milestones and costs related to tracking environmental, social, and administrative indicators are included in the Action Register.

10.4 Description of future WMP activity

The Lake Monroe Watershed Management Plan summarizes historical information about the watershed as well as newly collected data in order to analyze water quality concerns and present strategies for addressing those concerns. To make this information common knowledge, Friends of Lake Monroe will host two community forums upon plan completion to present the key findings of the plan and engage community member participation in implementation. Executive summaries will be presented to community leaders in all affected local governments. A full copy of the report and all water quality monitoring data will be available through the Friends of Lake Monroe website. A Story Map of water quality monitoring data developed by the IU Limnology Lab will also be available online and linked from the Friends of Lake Monroe website.

Friends of Lake Monroe has applied for a FFY 2022 Clean Water Act Section 319 grant that would fund an initial phase of implementation starting in November 2022. In the meantime, Friends of Lake Monroe is working to secure funding to continue project work through the gap period between grants (February-October 2022). The Monroe County Stormwater Board has pledged funds towards keeping the watershed coordinator on contract to continue education and outreach about the watershed and water quality issues while also laying the groundwork for the initial phase of implementation.

One long-term goal is to create a permanent watershed coordinator position to ensure continuity and maintain project momentum. Friends of Lake Monroe will develop a strategic plan for funding watershed work long-term and establishing a permanent watershed coordinator position.

Since watersheds are constantly evolving, the watershed management plan will need to be revisited and updated periodically. Friends of Lake Monroe along with its partners will meet at least annually to evaluate the plan for effectiveness then consider and adjust the plan as needed to make it more effective. If implementation efforts are on track and interim milestones are being met, no adjustments will be needed. However, if interim milestones or pollutant reduction goals are not being met, the steering committee will consider the following questions to determine if minor adjustments to the plan would increase its feasibility and effectiveness:

- Were there weather-related issues beyond our control that postponed or affected implementation?
- Was there a shortage of technical assistance?
- Are the practices taking longer to install than estimated in the watershed management plan?
- Are there socio-economic or other barriers to adoption that need to be overcome?
- Are the BMPs being installed correctly?
- Is it simply too soon to see measurable improvements?

In most cases, the action plan will be adjusted as needed and implementation will continue. However, Friends of Lake Monroe will contact IDEM to discuss rewriting or revising the plan if at least five years have passed and any of the following have occurred:

- Water quality impairments still persist after the plan has been implemented and there are no more viable BMP options in the original critical areas (necessitating a revised definition of critical areas)
- Land use has changed significantly
- Plan evaluation shows pollutant reduction goals are not being met and the group believes the plan is not effective in its current form
- A nonpoint source Total Maximum Daily Load (TMDL) has been developed for the Lake Monroe watershed which impacts water quality targets

This watershed management plan is meant to be a living document. Revisions and updates to the plan will be necessary as stakeholders begin to implement the plan and as stakeholders become more active in implementing the plan. Friends of Lake Monroe will be responsible for holding and revising the Lake Monroe Watershed Management Plan as appropriate based on stakeholder feedback. The primary contact is Maggie Sullivan, watershed coordinator (watershed@friendsoflakemonroe.org, 812-558-0217).

Appendix A – Stakeholder Concerns for Lake Monroe Watershed

Bloomington Community Forum 11/14/2019
Nashville Community Forum 1/14/2020

Category	Concern	Date	Group
Agriculture	Inappropriate agricultural practices	1/14/2020	3
Agriculture	Agricultural best management practices	1/14/2020	8
Agriculture	Farmers collaborating across county lines	1/14/2020	8
Agriculture	Strong leadership from USDA, NRCS, other statewide or national agricultural groups	1/14/2020	8
Agriculture	Watershed impacts - agriculture	11/14/2019	3
Agriculture	Cover crop funding	11/14/2019	6
Algae	Blue-green algae	1/14/2020	9
Algae	Blue green algae	11/14/2019	9
Algae	Algae (nutrients, ag, septic, lawns-residential)	11/14/2019	10
Algae	Algae (nutrients, ag, septic, lawns-residential)	11/14/2019	3
Algae	Algae blooms	11/14/2019	2
Algae	Blue-green algae and swimming	11/14/2019	6
Algae	Algal blooms	11/14/2019	6
Algae	Algae blooms making unswimmable or unusable for recreation or drinking	11/14/2019	7
Algae	Algae blooms and the effect of domestic animals.	11/14/2019	9
Chemical Pollution	Household chemicals	1/14/2020	1
Chemical Pollution	Boating (gas/oil)	1/14/2020	1
Chemical Pollution	Road treatment chemicals	1/14/2020	1
Chemical Pollution	Pollution	1/14/2020	2
Chemical Pollution	Pollutants from ground (fertilizers, pesticides)	1/14/2020	3
Chemical Pollution	Use of herbicides/pesticides in residential/commercial	1/14/2020	10
Chemical Pollution	Pollution	1/14/2020	6
Chemical Pollution	Impact of herbicide/Roundup used for invasives management	1/14/2020	8
Chemical Pollution	Health of lake - who is dumping what where (chemicals, pesticides, herbicides) - need a list of all and runoff	1/14/2020	7
Climate Change	Climate change - flooding	1/14/2020	3
Climate Change	Climate change - bigger flood events	1/14/2020	8
Climate change	Impact of extreme climate change	11/14/2019	9
Climate change	Climate change drought/rain patterns	11/14/2019	3
Climate change	Climate change - extreme droughts/flood	11/14/2019	7
Collaboration	How are the major stakeholders/players working together?	1/14/2020	2

Category	Concern	Date	Group
Collaboration	Value of public input - how do we increase?	1/14/2020	2
Collaboration	Competing interests of land use	1/14/2020	6
Collaboration	Compliance of private landowners	1/14/2020	5
Collaboration	Participation of young people	1/14/2020	8
Collaboration	All counties must participate for effective change	1/14/2020	8
Collaboration	Face the facts our lifestyles will have to change in response to the problem; band together for common good	1/14/2020	7
Collaboration	Need for collaboration	1/14/2020	7
Collaboration	Encourage homeowners associations to collaborate and monitor watershed	1/14/2020	e-mail
Conservation	Wasting water with baths, dishwash. Handwash vs dishwash. Allowing water to run	11/14/2019	9
Conservation	Education on water conservation	11/14/2019	9
Development	Development/urban sprawl	1/14/2020	10
Development	Development	11/14/2019	9
Development	Development/subdivisions	11/14/2019	3
Development	Human impacts development	11/14/2019	6
Development	Preserving, maintaining, improving health of water. Development on and around the lake	11/14/2019	9
Drinking Water	Drinking Water Quality	1/14/2020	1
Drinking Water	Drinking water treatment costs as a homeowner	1/14/2020	6
Drinking Water	Drinking water	1/14/2020	9
Drinking Water	Drinking water quality	1/14/2020	8
Drinking Water	Water quality	1/14/2020	4
Drinking Water	Drinking water	1/14/2020	4
Drinking Water	Keeping it drinkable	11/14/2019	9
Drinking Water	Water quality - price for treatment	11/14/2019	10
Drinking Water	Drinking water quality	11/14/2019	3
Drinking Water	Drinking water quantity	11/14/2019	3
Drinking Water	Drinking water quality (nitrates, phosphates, dangerous bacteria, e coli, toxic blue green algae)	11/14/2019	2
Drinking Water	Disinfectant byproducts (haloalkanes, chloramines)	11/14/2019	2
Drinking Water	Water quality	11/14/2019	1
Drinking Water	Water purification process - problems associated with old pipes	11/14/2019	1
Drinking Water	Development effects on water quality	11/14/2019	1
Drinking Water	Drinking water quality	11/14/2019	5
Drinking Water	Water supply - quality, quantity, impacting factors	11/14/2019	6
Drinking Water	Quality of drinking water	11/14/2019	6
Drinking Water	Highest water quality without overstepping property rights within reason	11/14/2019	7

Category	Concern	Date	Group
Drinking Water	Disinfection by-products (chemical composition, regulating pollutants)	11/14/2019	4
Drinking Water	Drinking water - do not like the taste of water. We have filtration system in health of water	11/14/2019	9
Education	Education in schools at all levels K-12 and beyond	1/14/2020	2
Education	Poor understanding of how lakes/watershed function	1/14/2020	10
Education	Educating recreational users	1/14/2020	6
Education	Lack of public understanding of problems	1/14/2020	9
Education	Lack of education of general population	1/14/2020	8
Education	Education in schools at all levels K-12 and beyond	1/14/2020	8
Education	Brown County residents not aware they are part of the watershed	1/14/2020	7
Education	Educate everyone - what is a watershed, let them know they are in a watershed	1/14/2020	7
Education	Lack of wawareness - raise consciousness	1/14/2020	7
Education	Understanding aspects of reservoir vs lake	11/14/2019	2
Education	Know what endpoint is - how clean can we expect	11/14/2019	1
Education	Huge educational issue especially with watershed residents	11/14/2019	1
Education	Photo of boat from concerned business to illustrate trash pollution	11/14/2019	1
Education	Public needs more knowledge about Lake Monroe	11/14/2019	5
Education	Community education	11/14/2019	6
Education	Protections and regulations in the watershed	11/14/2019	6
Education	USACE - role, interaction, influence	11/14/2019	4
Education	Terminology - translate for the public what is being measured	11/14/2019	4
Education	Authority, sampling campaign, procedure and feedback	11/14/2019	4
Erosion	Erosion	1/14/2020	1
Erosion	In-Stream Erosion	1/14/2020	3
Erosion	Impervious surfaces/bare soil makes greater soil erosion and water runoff	1/14/2020	10
Erosion	Erosion	1/14/2020	6
Erosion	Erosion problems	1/14/2020	9
Erosion	Erosion of bank - turbidity	1/14/2020	5
Erosion	Erosion	1/14/2020	8
Erosion	Erosion - lake getting more shallow due to sedimentation	1/14/2020	7
Erosion	Erosion (shoreline)	11/14/2019	9
Erosion	Shoreline erosion	11/14/2019	2
Erosion	Flooding in spring (climate related) and runoff erosion	11/14/2019	5

Category	Concern	Date	Group
Erosion	Monitoring erosion	11/14/2019	6
Erosion	How much the shore erodes in the state recreation area	11/14/2019	9
Erosion	Secure shoreline - riprap to tolerate fluctuations of water levels	11/14/2019	4
Fish	Fisheries	1/14/2020	8
Fish	Fishery health (invasive species, fish kill)	11/14/2019	10
Fish	Fish quality	11/14/2019	2
Fish	Healthy fish/animal population (less mercury)	11/14/2019	5
Flooding	Flooding from increased rain events	1/14/2020	6
Flooding	Constant excessive flooding	1/14/2020	9
Flooding	Flooding - trash, debris, erosion	1/14/2020	5
Forestry	Logging	1/14/2020	2
Forestry	Unregulated forest management	1/14/2020	3
Forestry	Forest management overconcern - not warrented if BMPs in place; overlooks other issues	1/14/2020	5
Forestry	Deforestation and its effects on everything	1/14/2020	8
Forestry	Forestry is being discouraged although forests protect watersheds	1/14/2020	8
Forestry	Forest health	1/14/2020	8
Forestry	Logging	1/14/2020	4
Forestry	Logging/forest management (herbicides - amphibians, heavy equipment, road damage)	11/14/2019	10
Forestry	Keep forests as forests	11/14/2019	3
Forestry	Expand forests	11/14/2019	3
Forestry	Logging causes erosion	11/14/2019	7
Forestry	Effects of logging	11/14/2019	4
Funding	Funding for maintenance/inspection in Brown County	1/14/2020	2
Invasive Species	Asian Carp	1/14/2020	1
Invasive Species	Invasive Species	1/14/2020	1
Invasive Species	Invasive Species	1/14/2020	2
Invasive Species	Invasive species - plant & animal	1/14/2020	3
Invasive Species	Invasive species	1/14/2020	10
Invasive Species	Invasive species (Asian carp)	1/14/2020	6
Invasive Species	Invasive species - both land and water	1/14/2020	9
Invasive Species	Losing native plants	1/14/2020	9
Invasive Species	Invasive species	1/14/2020	5
Invasive Species	Invasives	1/14/2020	8
Invasive Species	Asian Carp	1/14/2020	8
Invasive Species	Invasive species/use of chemicals to eradicate invasives	1/14/2020	7
Invasive Species	Invasive species (aquatic and terrestrial)	11/14/2019	9

Category	Concern	Date	Group
Invasive Species	Invasive species	11/14/2019	3
Invasive Species	Terrestrial invasive plants & effects on forest health and sediment erosion	11/14/2019	1
Invasive Species	Less invasive plants and animals	11/14/2019	5
Invasive Species	Monitor for the worst invasives: zebra mussels, asian carp	11/14/2019	5
Invasive Species	Exotics - drainage system? Species and terrestrials	11/14/2019	6
Invasive Species	Invasive species control	11/14/2019	6
Invasive Species	Invasive species (animals and plants)	11/14/2019	7
Land Use	Land clearing (logging and construction)	1/14/2020	1
Land Use	Land development (protection from)	1/14/2020	2
Land Use	Controlling the influence of urban, ag, forestry practices impacting runoff	1/14/2020	8
Land Use	Concreting of the county (increasing runoff)	1/14/2020	8
Land Use	Apartment buildings and growth of Bloomington - restrictions in place?	1/14/2020	7
Land Use	Acquire and protect all riparian zones within watershed	1/14/2020	e-mail
Nutrients	Nutrient loading (urban lawns, agriculture, septics)	1/14/2020	1
Nutrients	Lawn maintenance (and its downstream effects)	1/14/2020	1
Nutrients	Nutrient loading (urban lawns, agriculture, septics)	1/14/2020	6
Nutrients	Nutrient loading	1/14/2020	8
Nutrients	Nitrogen levels (fertilizer, blue-green algae)	11/14/2019	9
Nutrients	Lawn fertilizer - runoff	11/14/2019	3
Nutrients	Can we stop various types of pollution in lake	11/14/2019	1
Nutrients	Nutrient runoff - ag and lawn fertilizers, algae blooms	11/14/2019	5
Nutrients	Water quality, sedimentation, and nutrients	11/14/2019	9
Nutrients	Fertilizers (nitrogen and phosphorus in particular) coming into water (nutrification) cafo	11/14/2019	7
Other	Bioterrorist attack	1/14/2020	2
Other	Equality of return from the lake	1/14/2020	2
Other	Poorly designed culverts that impeded fish movement and cause erosion	1/14/2020	8
Other	Adequate/healthy riparian buffers	11/14/2019	3
Other	Maintaining multiple uses of the lake	11/14/2019	6
Other	Mercury levels	11/14/2019	6
Other	Implementing solutinos	11/14/2019	4
Other	Everything that was on the powerpoint	11/14/2019	9
Recreation	Swimming restrictions	1/14/2020	9
Recreation	Maintaining recreational value	1/14/2020	9
Recreation	Overuse - recreation (boats)	1/14/2020	8
Recreation	Motorized watercrafts and pollution	1/14/2020	7

Category	Concern	Date	Group
Recreation	Overrecreation	11/14/2019	9
Recreation	Pollution from recreation/boating - oil, fuel	11/14/2019	10
Recreation	Two cycle engine limits	11/14/2019	3
Recreation	FLM keep recreational concerns a primary concern	11/14/2019	1
Recreation	Recreational pollution - how to limit effects, dispell myths	11/14/2019	1
Recreation	Don't limit motorized boats	11/14/2019	1
Recreation	Need to keep recreation and have good quality drinking water	11/14/2019	5
Recreation	Recreation - boating impacts; responsible use	11/14/2019	6
Recreation	The amount of power boats, oil/gas pollution from those and invasive species transported to the lake from those boats. Lack of regulation/enforcement	11/14/2019	9
Recreation	Overcrowding of boats	11/14/2019	7
Recreation	Boat traffic - large engines contribute to erosion, turbidity	11/14/2019	4
Regulation	Deregulation of Environmental protection and implementing additional protection	1/14/2020	2
Regulation	No one is managing the lake (who is responsible for this)	1/14/2020	10
Regulation	Preserve water quality for the future/ avoid worst case scenario (Ohio lake example)	1/14/2020	6
Regulation	Lack of watershed protection	1/14/2020	9
Regulation	No comprehensive erosion control plan or ordinances	1/14/2020	9
Regulation	No drainage ordinance	1/14/2020	9
Regulation	No "Top Dog" ie.e conflicting authority	1/14/2020	9
Regulation	Water quality in lake; lax standards in Indiana	1/14/2020	5
Regulation	State laws and enforcement	1/14/2020	8
Regulation	Enforcement	1/14/2020	8
Regulation	Government coordination	1/14/2020	8
Regulation	Lack of oversight/enforcement of polluters	1/14/2020	4
Regulation	Landowner management practices & regulation thereof	1/14/2020	7
Regulation	Have state of IN declare a state of emergency for the watershed	1/14/2020	7
Research	Inventory of source/causes of problems	1/14/2020	10
Research	Feeder streams and water quality of them	1/14/2020	7
Research	Regular water quality monitoring	1/14/2020	e-mail
Research	Not enough data - aquatic filter feeder, mussels, good grasses	11/14/2019	9
Research	Have clear idea of aquatic invasives - monitoring benthic layer organisms	11/14/2019	1

Category	Concern	Date	Group
Research	Study more - water trends? Evaluate water quality	11/14/2019	4
Sediment	Sedimentation	1/14/2020	2
Sediment	Sedimentation	1/14/2020	6
Sediment	Sediment in lake	1/14/2020	9
Sediment	Sediment runoff from roads and hillsides in heavy rain events	1/14/2020	5
Sediment	Silting in of lake	1/14/2020	8
Sediment	Turbidity/water clarity	1/14/2020	4
Sediment	Sedimentation	1/14/2020	4
Sediment	Sedimentation	11/14/2019	9
Sediment	Sedimentation (need more data, fish finders may have data)	11/14/2019	10
Sediment	Sedimentation rates	11/14/2019	3
Sediment	Sedimentation and erosion; compressed leaf matter, creek inlets	11/14/2019	2
Sediment	Dredging	11/14/2019	2
Sediment	Silting in of lake - can we stop it	11/14/2019	1
Sediment	Siltation - could be from runoff and erosion - fill in lake	11/14/2019	5
Sediment	Sedimentation/erosion - entire watershed	11/14/2019	6
Sediment	Silt - possible dredging	11/14/2019	7
Sediment	The degree with which the dam has silted	11/14/2019	9
Sustainability	Sustainability	1/14/2020	2
Sustainability	Longevity/sustainability of lake	1/14/2020	4
Trash	Trash discarded by people (plastics, styrofoams)	1/14/2020	3
Trash	Garbage from recreational use	1/14/2020	3
Trash	Historic dumping (ie old cars)	1/14/2020	3
Trash	Solid waste impact on watershed	1/14/2020	10
Trash	Boating trash	1/14/2020	5
Trash	Trash coming down creeks	1/14/2020	5
Trash	Squalor and blight and trash	1/14/2020	4
Trash	Plastics	11/14/2019	9
Trash	Plastics - trash and microplastics	11/14/2019	3
Trash	Microplastic measurements	11/14/2019	3
Trash	Plastics/microplastics	11/14/2019	2
Trash	Illegal dumping	11/14/2019	2
Trash	Trash near SRA's significant	11/14/2019	5
Trash	All the plastic pollution	11/14/2019	9
Waste water	Septic system failure	1/14/2020	2
Waste water	Pathogens from humans and animals	1/14/2020	2
Waste water	Septic pollution	1/14/2020	3
Waste water	What are e-coli sources	1/14/2020	10
Waste water	Septic effluent	1/14/2020	10

Category	Concern	Date	Group
Waste water	Federal or state grants for septic improvement	1/14/2020	10
Waste water	Septic failures	1/14/2020	9
Waste water	Waterways not to standards; clean up e coli	1/14/2020	5
Waste water	Failing septics	1/14/2020	5
Waste water	Failed septic systems	1/14/2020	4
Waste water	Septic systems	11/14/2019	9
Waste water	Septic systems	11/14/2019	3
Waste water	Huge number of boats in the marinas. Need to ensure that toilets are sealed	11/14/2019	9
Waste water	Wastewater - toilet flush of prescription pharmaceuticals	11/14/2019	4
Water availability	Exporting	1/14/2020	2
Water availability	Increasing demand for water (allocation)	11/14/2019	9
Water availability	Carrying capacity (population)	11/14/2019	3
Water availability	That lake water would be so undrinkable so it is no longe available as our water supply	11/14/2019	7
Water availability	Invasive cities (Indianapolis)	11/14/2019	7
Water availability	If large populations can not be supported except through water impoundments, we must take care of it	11/14/2019	7
Water availability	Actual ownership of water; ensure water stays here	11/14/2019	4
Water availability	Control - what are controls, who controls	11/14/2019	4
Wildlife	Wildlife management	1/14/2020	9
Wildlife	Wildlife habitat	11/14/2019	3
Wildlife	Wildlife preservation	11/14/2019	6

CONSERVATION PRACTICES IN THE LAKE MONROE WATERSHED

A Survey of Practitioners

Final Summary

June 2021

Hundreds of people work in the Lake Monroe Watershed to prevent soil loss, protect water quality, maintain forests, and improve habitats for wildlife. This report documents conversations with practitioners who practice conservation of natural resources as part of their everyday work and life and identifies key conservation practices used in the watershed.

Contents

Appendices

Acknowledgements

Many thanks to:

Friends of Lake Monroe and the Indiana Department of Environmental Management's
Clean Water Act Section 319 Grants program for your leadership in this Watershed Management Plan effort
and for bringing attention to the importance of a healthy Lake Monroe watershed
for both water quality and for people.

Terry Ault, Doug Baird, Cara Bergschneider, Darren Bridges, Michael Chaveas, Jeff Fisher,
Charles Garrett, Maj. Jerry Hartley, Paige Hudson, Gerry Long, Chad Menke, Martha Miller,
Jim Roach, Kevin Schneider, Allison Shoaf, Kenny Wagler, and Zac Wolf
for your participation in this process, sharing your knowledge, experience, and time.

The landowners in the Lake Monroe Watershed
who invest their time and resources to care for their land and the waters that flow over their land.

The soil and water, forestry, and conservation professionals
and the local, state, and federal organizations
who directly care for the land and water and inspire others with their knowledge of best practices.

Dan Shaver, Richard Harris, and Maria Clemens
for their participation in the surveys, synthesis of the survey information,
and review of this document.

The Nature Conservancy
620 East Ohio Street
Indianapolis, IN 46202

1.0 Supporting Development of the Watershed Plan for Lake Monroe

The mission of The Nature Conservancy (TNC) is to conserve the lands and waters on which all life depends. Since 1959, The Nature Conservancy in Indiana has helped to protect nearly 100,000 acres of forests, wetlands, prairies, lakes and streams for current and future generations to enjoy.

Friends of Lake Monroe (FLM) is a citizens group dedicated to finding solutions to improve the water quality of Lake Monroe by enhancing its use as a drinking water, recreational, and ecological resource for all who use it. In 2018, FLM proposed to develop a watershed management plan in accordance with state and federal section 319 requirements and in 2019 was awarded the 319 grant to complete the watershed plan. Working with IU SPEA Limnology Lab, a watershed coordinator and other partners, FLM engaged stakeholders to identify community concerns, conducted a watershed inventory including measurement of discharge, nutrients, total suspended sediments and basic chemical parameters to calculate sediment and nutrient loading. This information was used to identify key sources of sediment and nutrients in the watershed and lake, which allowed FLM to prioritize recommendations to reduce sediment and nutrient loading. FLM has developed this watershed management plan with expected outcomes, interim measures and an implementation schedule.

1.1 Scope of this In-Kind Effort

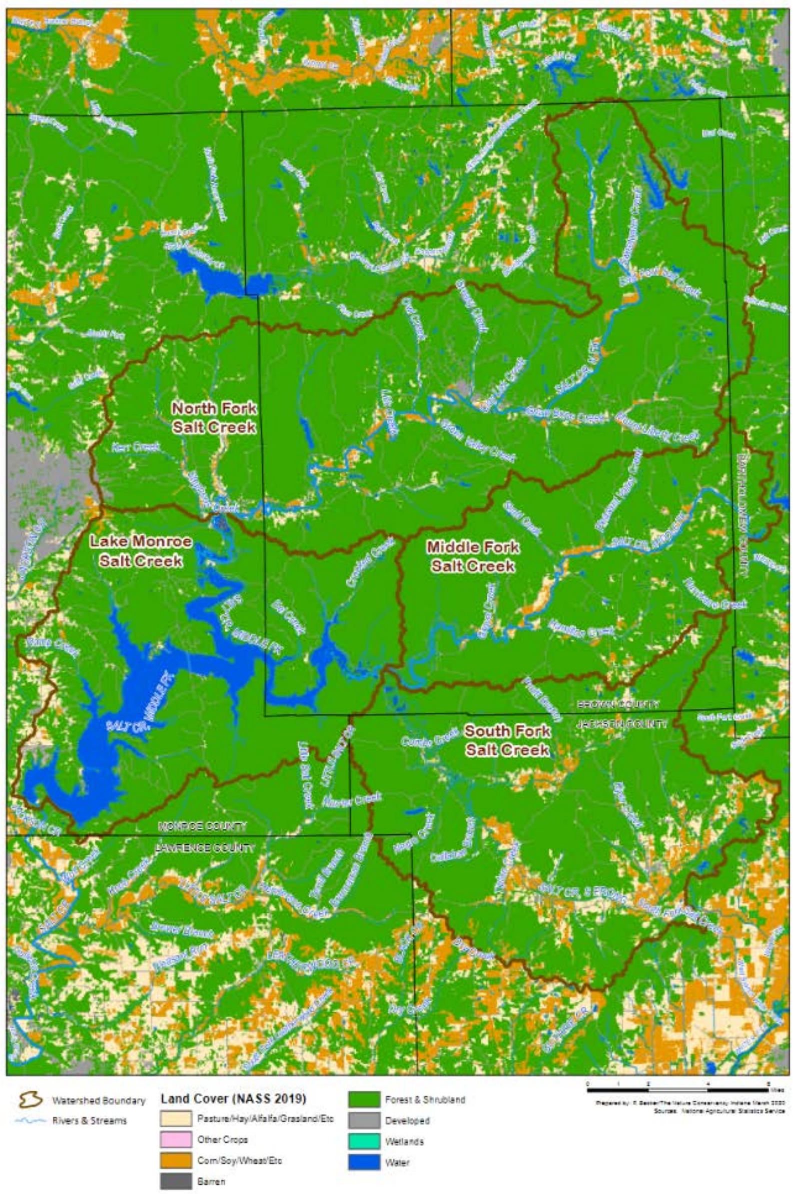
TNC provided in-kind support of the FLM 319 project by gathering input from conservationists on the best practices being implemented in the watershed for inclusion in the 319 watershed plan. Per our scope, TNC organized meetings with soil and water conservation districts (at least three), federal and state property owners and managers (at least two), and private landowners or managers (at least two). The purpose of these meetings was to:

1. Understand the best practices that are working well in their district or on their land,
2. Define the current level of investment in conservation implementation in their work,
3. Discuss the work that they would most like to implement to better protect Lake Monroe from nutrients and sediments in runoff, and
4. Establish a range of potential investments that might help their organization to implement the desired, yet currently unfunded, best practices.

The information gathered from these meetings and conversations provides the basis for this report.

1.2 Location of the Lake Monroe Watershed

Watershed boundaries are demarcated purely by natural and geophysical features of a land area, rather than governmental or political boundaries. Watersheds are defined by streams and rivers that drain into a single, larger body of water. The Lake Monroe watershed (Figure 1) encompasses portions of 5 counties (Bartholomew, Brown, Jackson, Lawrence, and Monroe). However, 98% of the 441 square mile watershed lies within three counties: Brown County (56%), Jackson County (21%), and Monroe County (21%). Therefore, the conservation programs based in those counties served as the focus for this information gathering process.



2.0 Soil, Water, and Natural Resource Conservation Organizations

To understand local organizations helping to apply conservation practices in the Monroe Watershed, TNC contacted the two programs that lead soil, water, and natural resource best management practices in the counties of focus: the Soil and Water Conservation Districts (SWCD) and US Department of Agriculture's (USDA) Natural Resources Conservation Service (NRCS). The SWCD's and NRCS both contribute funding and assist with implementation of a wide variety of conservation practices within their respective county-based jurisdictions. As described in their mission statements, both organizations prioritize conservation of natural resources by working directly with individual landowners and operators within their districts.

For example, the mission statement for Brown County SWCD states that they *provide leadership and partner with residents and interested environmental groups on management of the land and water resource*. They also conduct outreach and education as well as provide options for stewardship/conservation to private landowners.

The Jackson County SWCD *promotes the protection and improvement of the natural resources of Jackson County through leadership, education, and technical assistance to both the rural and urban communities*.

The Monroe County SWCD mission statement states: *Our mission is to identify and prioritize local soil and water resource concerns, provide information on soil, water, and related natural resource conservation, and to connect land users to sources of education and technical and financial assistance to implement conservation practices and technologies.*

The NRCS is an agency committed to *helping people help the land*. Their mission is *to provide resources to farmers and landowners to aid them with conservation in order to ensure productive lands and protect the environment*.

To begin the information gathering process, TNC created and shared a survey, then scheduled a virtual meeting via Zoom with the representative of each organization. The detailed responses to the surveys and conversations are included in Appendices A-F, organized by county and organization. This section describes the practices being implemented, documents funding sources for this soil, water, and natural resource conservation, and notes challenges and opportunities for protecting the water quality in Lake Monroe.

2.1 Most Commonly Used Best Management Practices

The SWCD's and NRCS's within the watershed shared which practices were most effective within their region. Generally, the most implemented soil and water conservation practices within the three counties are described below (Table 1).

Table 1 Types of Conservation Practices Used in Lake Monroe Watershed **Grouped by NRCS in Indiana** **Conservation Practices Physical Effects**[1]	
Practice Group	**Practices**
Agronomy	Cover Crops, Nutrient Management, High Tunnel System, Residue & Tillage Management
Invasive Species	Brush Management, Herbaceous Weed Control
Livestock – Grazing/Confined	Access Control, Fence, Prescribed Grazing, Livestock Pipeline, Watering Facility, Heavy Use Area Protection, Roof Runoff Structure
Biology – Wildlife	Upland Wildlife Habitat Management, Wildlife Habitat Planting
Forest Management	Forest Stand Improvement, Grapevine Control, Forest Trails and Landings, Brush Management
Buffer – Grass	Critical Area Plantings, Filter Strips, Riparian Buffer
Agronomy – Erosion	Grassed Waterway, Cover Crops, Residue & Tillage Management

At the same time, each county has different landscapes and the various NRCS and SWCD offices work with different types of landowners:

- Within Brown County, the land is hilly and forested. Farms tend to be smaller (less than 200 acres) and focus more on livestock than crops.
- In Jackson County, the land is flatter and consists of larger farms (more than 1,000 acres) compared to Brown County. There are a smaller number of farmers within Jackson County because farms tend to be larger.
- Monroe County has more urban areas incorporated into the county's landscape compared to the other counties. Since there are more densely populated areas within the county, projects tend to be smaller scale and applied within smaller areas.

Given the different landscapes and landowner types, the application of soil and water conservation practices has different emphasis in each of the three counties.

---

[1] The Field Office Technical Guides describe the national conservation practices standards, and are available at https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/technical/cp/ncps/

- Due to the large amount of forests and prevalence of small livestock farms in Brown County, NRCS and SWCD support a blend of project types to promote soil and water conservation, including heavy-use area protection (HUAP), roof runoff structures, brush management, forest management, cover crops, and herbaceous weed control.
- Given the larger row crop farming operations in Jackson County, cover crops tend to make the largest difference in improving soil and water health. Therefore, the SWCD in Jackson County focuses their funding entirely on implementing cover crops. NRCS also supports cover crop adoption in Jackson County, in addition to measures related to brush management, access control (for livestock), prescribed grazing, and livestock watering areas.
- With a combination of rural and urban landscapes, Monroe County finds success in working on a variety of projects. Generally, smaller projects can be implemented more quickly by the SWCD, and their top practices include brush management, herbaceous weed control, pollinator habitat, cover crops, row crop practices, and critical area plantings. The NRCS supports more cover crops, brush management, nutrient management, access control, livestock watering, and high tunnel projects.

NRCS records conservation practices that have been implemented with the support of their programs and funding. For the five-year period including 2015 through 2019, the three counties benefited from the implementation of the practices presented below (Table 2).

Table 2
Practices Implemented through NRCS Funding
Five Year Period from 2015 to 2019[2]

Conservation Practice	Brown County	Jackson County	Monroe County
Access Control (acres)	---	---	328
Access Road (ft)	1,400	541	400
Brush Management (acres)	1,730	90	1,200
Comprehensive Nutrient Management Plan	1	2	2
Conservation Cover (acres)	15	---	6.5
Conservation Plan Supporting Organic Transition	1	---	2
Cover Crop (acres)	1,550	7,845.3	1,500
Critical Area Planting (acres)	1	1.8	2
Diversion (ft)	---	26.3	---
Fence (ft)	---	25,093	33,500
Field Border (acres)	1.4	---	---
Firebreak (ft)	3,370	---	---
Forage and Biomass Planting (acres)	---	---	175

[2] Practices implemented data are for the entire county, not just the portion of each county that falls within the Lake Monroe watershed.

Table 2 Practices Implemented through NRCS Funding Five Year Period from 2015 to 2019[2]			
Conservation Practice	Brown County	Jackson County	Monroe County
Forest Management Plans	6	2	2
Forest Stand Improvement (acres)	600	579.2	210
Grassed Waterways	---	4.4	2
Hedgerow Planting (ft)	---	---	400
Herbaceous Weed Control (acres)	300	---	145
Heavy Use Area Pads	48	25	48
High Tunnels for Season Extension	8	1	16
Integrated Pest Management (acres)	1	---	100
Lined Waterway/Outlet (ft)	---	145	---
Livestock Pipeline (ft)	---	---	26,200
Mulching (acres)	0.5	4.5	1.5
Nutrient Management Plan (acres)	1	1,335.3	2,350
Pasture and Hay Planting (acres)	---	53.9	---
Pipeline	---	2,650	---
Prescribed Burning (acres)	---	---	2
Prescribed Grazing (acres)	---	216.9	530
Pumping Plant	1	---	1
Roof Runoff Structure	4	5	4
Roof of Cover	---	---	1
Spring Development	---	---	2
Stream Crossing	---	1	1
Subsurface Drain (ft)	---	7,295	1,100
Tree/Shrub Planting (acres)	3	---	---
Underground Outlet (ft)	1,265	391	1,200
Use Exclusion	---	2.8	---
Waste Storage Facilities	---	---	2
Watering Facilities	---	16	47
Windbreak (ft)	---	---	870

Observations from the practices implemented (Table 2):

- All three counties used: access roads, brush management, comprehensive nutrient management plans, cover crops, critical area plantings, forest management plans, forest stand improvement, heavy use area pads, high tunnels, mulching, nutrient management plans, and underground outlets. So, they share a lot of similar practices.

- In addition to Jackson County leading in the implementation of cover crops with more than 7,800 acres covered, they also implemented more subsurface drains. This makes sense given the prevalence of larger crop-producing farms in the county.
- Brown County led implementation of herbaceous weed control, brush management, firebreak, and access road conservation measures. Leading in these areas is logical considering the terrain is more forested and hillier in this county.
- Monroe County uses the greatest variety of practices and leads in assisting with the implementation of prescribed grazing, livestock pipeline, and fencing practices. This reflects the large number of smaller projects completed in this urban county.

2.2 Common Themes from Soil and Water Conservation Practitioners

Some experiences were universal among the soil and water conservation professionals in the watershed.

- The conservation practices promoted by NRCS and the SWCDs are all known to work effectively for the intended purpose when they are implemented correctly and maintained appropriately. If there is a failure of a conservation practice, it occurs mainly through mismanagement of the practice.
- Cover crops were mentioned by all the organizations contacted as being an important and effective practice to improve soil health and water quality.
- The most important part of each funded project, no matter the scale or type of practice, is the maintenance that follows initial implementation. Without the continued diligence of landowners, the implemented projects may not result in a lasting improved health of the landscape. NRCS and the SWCDs provide continued support to landowners after practices are implemented to maximize the probability that the practice will be effectively maintained.
- Project success is measured by completion of the installation per program standards; water quality monitoring is not done by NRCS or SWCDs currently in these counties.
- Education of landowners on the wide variety of available conservation measures for their land uses is believed to be the among the most important efforts to protect the watershed. The SWCD and NRCS program leaders work with landowners over long periods of time to continue to achieve buy-in for practices.
- Information about conservation or grant programs offered is typically shared via social media, websites, newsletters, outreach events and occasional news media coverage. Word of mouth is also an important way for people to learn of SWCD and NRCS.

2.3 Partner Groups for Implementing Conservation Practices

Both NRCS and the SWCDs partner with other organizations to promote soil and water conservation and collaborate to achieve additional ecological conservation goals. Examples of the types of work completed and/or funded by other organizations working in the watershed include:

- The NRCS partners with National Wild Turkey Fund Federation to employ a forester to assist with forestry related practices and education in a 10-county area that includes Brown and Monroe Counties.
- NRCS also partners with Pheasants Forever to employ a wildlife biologist to assist with wildlife related practices and education in about a 12-county region that includes Brown and Monroe Counties.
- U.S. Fish and Wildlife Service funds wildlife projects including pollinator habitats and wildlife focused conservation work.
- Indiana DNR offers a tax incentive program for conservation practices through the Classified Forests and Wildlands Program and funding through LARE (Lake and River Enhancement).
- South Central REMC has small, private funding sources. A recent example was for an invasive species removal and educational signage project on a Brown County property; the project was organized by the Brown County Native Woodlands Project.
- In Monroe County, MCIRIS (Monroe County Identify and Reduce Invasive Species) implements invasive control projects.
- The Nature Conservancy (TNC) manages forest lands and the Sycamore Land Trust manages forests, wildlands, and wetlands to achieve diverse and healthy forests
- Purdue Extension educates landowners in all three counties about conservation practices.
- In the urban areas of Monroe County, the Neighborhood Tree Planting Project does urban conservation, the City of Bloomington Parks and Recreation Department created the Bloomington Community orchard, hosts educational events, and manages two community gardens, and an IU campus farm promotes small farm conservation practices implementation and education.
- Southern Indiana Cooperative Invasive Management (SICIM) does invasive species control, identification and replacement. Local Cooperative Invasive Species Management Areas (CISMAs) are established in each of the three counties that cooperate with SICIM: the Brown County Native Woodlands Project, the Jackson County Invasive Partnership, and MCIRIS (Monroe County Identify and Reduce Invasive Species).

2.4 Current Investments in Soil & Water Conservation

The funding available to each of the soil and water conservation organizations that works in the Lake Monroe Watershed remains fairly consistent through federal and state programs. For the NRCS, the US Department of Agriculture directly funds the staff and conservation programs. The goal of NRCS's primary program, EQIP (environmental quality incentives program), is for the NRCS to provide 75% funding for a conservation practice and the customer to provide 25%.

For the SWCDs, the Clean Water Indiana program is the primary source of funding for the staff and conservation measure implementation. Monroe and Brown Counties also have mini grants that are administered at a local level. Funding available for soil and water conservation practice implementation in Brown, Jackson, and Monroe Counties is presented in Table 3.

Table 3 Soil and Water Related Conservation Annual Funding in Counties Included within Lake Monroe Watershed					
	2015	2016	2017	2018	2019
USDA Natural Resources Conservation Service (obligated for conservation program contracts)					
Brown	$101,000	$62,100	$252,800	$204,900	$130,100
Jackson	$135,956	$114,001	$76,964	$4,625	$151,325
Monroe	$122,635	$81,811	$301,339	$141,444	$445,523
ISDA Soil & Water Conservation Districts					
Brown[3]					$10,000
Jackson[4]					$10,000
Monroe[5]					$10,000

The average funding per year for each NRCS program varies by county, with Brown County averaging about $150,000/year, Jackson County averaging about $97,000/year, and Monroe County averaging about $219,000/year. Each SWCD in the state of Indiana receives $10,000 from CWI funds for basic operational expenses, if they have a way to match that funding locally. Usually a county SWCD employee is considered match. In addition, each SWCD can apply for additional CWI grants for various amounts annually, though those funds are not consistent. Some SWCDs, including Monroe County, receive funds locally from their county for support. In recent years, an additional $10,000 to $30,000 per year has been available for mini grant programs in these three counties.

Note that the NRCS and SWCD funding is not exclusively applied to practices within the watershed because it is available to any landowner within the county, and some landowners receiving funding are outside of the boundaries of the watershed.

The education and outreach for promoting the conservation programs plus the follow-up with landowners over many years is accomplished with a dedicated team of conservation staff (Table 4). In the counties comprising most of the Lake Monroe watershed, the SWCD and NRCS staff work closely together to achieve their shared missions. The staff share offices in Monroe and Jackson counties. One NRCS staff member is dedicated to Brown County, Jackson County, and Monroe County, respectively. These NRCS staff members are in addition to the SWCD employees in each county, so there are two full time staff focused on soil and

[3] During this period, Brown County SWCD's Mini Grant program invested an additional $2,000 to $6,000 in conservation practices each year. From 2017 to 2019 they were part of a CWI grant, with Monroe Co. handling the funds. In 2016, Brown County SWCD also received a larger LARE grant to pay for one big log jam removal; the funds did not go to individual landowners.

[4] Jackson County SWCD currently has a CWI grant for a cost-share program to incentivize cover crops and forage and biomass plantings. The $40,000 grant is for a 3-year period and is shared with the Lawrence County SWCD. Jackson County SWCD also has a grant to remove log jams.

[5] Monroe County SWCD usually receives $35,000 a year from the County for their Mini Grant program. Monroe and Brown Counties are both part of a CWI grant with the Southwestern Counties for Cover Crop Promotions for the next 2 years.

water conservation practice implementation within these counties (and an additional part-time staff member in Brown County).

Table 4 Soil and Water Related Staff Assigned to Counties within Lake Monroe Watershed			
Agency/County	**NRCS**	**SWCD**	**Combined**
Brown	1.0	1.25	2.25
Jackson	1.0	1.0	2.0
Monroe	1.0	1.0	2.0

2.5 Potential Opportunities to Expand Implementation of Conservation Practices

NRCS and the SWCDs have a long and successful history of working with private landowners to support and fund implementation of soil and water conservation practices. For this survey, each practitioner was asked "*What kind of work would you like to implement to better protect Lake Monroe from nutrients and sediments in runoff*?" Opportunities to do more included:

2.5.1 Increase Outreach and Education

Awareness of the conservation practices that improve soil and water quality while reducing soil erosion vary widely. Helping people understand the connection between healthy soil and the quality of our water is important. An increase in understanding the purpose of these soil and water conservation practices and how to maintain them would be an excellent way to help keep the water quality clean in the watershed.

Word of mouth is how most people find out about the programs. Landowners learn about the conservation practices from other landowners, extension offices, or crop or forestry consultants, who then refer landowners to NRCS and the SWCDs. New people may learn about conservation practices and funding opportunities through workshops, newsletters, and landowner site visits where NRCS and the SWCDs make them aware of funding available.

Both the NRCS and the SWCDs see more opportunities to make people aware of conservation practices, especially if partners and others working in the watershed can help spread the word.

2.5.2 Promote Underutilized Practices to Target Audiences

Some soil and water conservation practices are very effective and could be implemented more frequently or more effectively in the counties and the Lake Monroe Watershed, but due to lack of familiarity with the practices, landowners do not apply for support. Examples cited include:

- Lack of demand from livestock owners wanting to implement best management practices. Promoting the benefits of Heavy Area Use Protection (HUAP), Watering Facility and Pipeline, Access Control Fence and Prescribed Grazing to livestock owners would improve soil and water health.

- Growth of hobby farms and agritourism as an increasing concern for water quality. Livestock are more likely to be living in high density conditions on poorer soil, and the hobby farm owners are less likely to be aware of erosion issues and conservation programs as traditional farmers.
- In Brown, Monroe, and Jackson Counties, more cover crops within the Lake Monroe Watershed would be beneficial; fewer farmers from within the Lake Monroe watershed apply for SWCD and NRCS programs to implement cover crops. In Jackson County, the farmers who most stand out as cover crop champions are in the east, outside of the Lake Monroe watershed. The SWCDs would need to find out from farmers what it would take to implement more cover crops in those areas.
- More cover crop seeding techniques are needed for farm fields surrounded by woodlands; the trees limit successful cover crop application by airplane.
- Belated recognition of the need for forest management practices. For forest harvesting, the landowner often discovers the need for conservation practices after the contractor is hired and the harvest begins, when it is too late. With forestry, practices such as soil stabilizing on skid trails, seeding after timber harvest, stream protection, stone cover for crossings can be encouraged more so that landowners are aware of them and are prepared to implement them ahead of a harvest.

2.5.3 Practices Without Funding Support

For various reasons, some conservation practices do not have a dedicated funding source. The practitioners noted these practices or needs:

- Stream bank stabilization is one practice that used to be funded by NRCS but is no longer supported due to the high cost of implementation and difficulty in achieving a successful outcome. In Jackson County, more programs that assist in preventing or slowing stream bank erosion issues are needed. It is a high demand and important issue, but NRCS doesn't have practices available that include financial assistance for landowners.
- Jackson County SWCD currently funds only cover crop implementation. An increase in funding would allow them to implement additional practices such as filter strips and grassed waterways along creek banks to help capture sediment, which would help protect water quality.
- Septic tank improvements are not funded through the State of Indiana's 319 non-point source program, nor through the soil and water focused agencies. If a need is identified for septic system upgrades as part of the Lake Monroe 319 Watershed Plan, a funding source may need to be explored.

2.5.4 Ideas to Expand Soil & Water Conservation Practice Implementation

Each of the practitioners was asked to identify potential investments or resources that could help their organizations implement more best practices. The following ideas were generated:

- A dedicated NRCS staff member for Brown County so there is a physical presence in the county; there is currently one NCS staff member serving both Brown and Monroe Counties. With the staff that are available, NRCS is leveraging all the federal resources that are available. Potentially, there could be more NRCS funding invested in Monroe County or the Lake Monroe watershed if additional NRCS staff were available to assist customers in the application and implementation process. Across NRCS' Southwest Indiana 23-county region that includes both Brown and Monroe Counties, however, the interest in the NRCS programs exceeds the capacity. Alternatively, the local SWCDs could train another technician to support NRCS and to follow-up with projects, as another way to approach the staff need.

- A mini grants program for driveway construction and maintenance. Often, projects don't have drainage or culverts in their driveways, causing gravel and sediment to enter roads and streams. This could be a potential opportunity for SWCDs to help with water quality. Research is needed to determine whether the practice would be defined as a water quality improvement as opposed to a personal property improvement.
- Survey of farmers and agricultural landowners in Jackson County who are within the watershed to assess interest in implementing best management practices; most program applicants in Jackson County are outside of the Lake Monroe Watershed. The survey would establish landowner needs for conservation on their land.
- Livestock owner programs will benefit from more funding and more education for Heavy Use Area Protection and other livestock practices, including exclusion of livestock from streams. Funding for fencing and stream crossings is needed because in Brown County animals are often confined to a small pasture and not rotationally grazed.
- Survey of Brown County farmers to determine what it would take to implement more cover crops.
- A stream bank erosion assistance program promoting grassed waterways or filter strips to assist in preventing or slowing stream bank erosion.
- Forest timber sale protection measures. If a landowner doesn't require a logger to implement best management practices, then SWCDs can make funding available after-the-fact to the landowner to help protect the areas where forests have been cut from runoff. With the Federal programs, there can be up to a 1.5-year timeframe before funds can be obtained.
- An additional $20,000/year/county would go a long way to help each county SWCD implement more livestock, forestry, and agronomy practices to address soil and water resource concerns.
- A technician hired by SWCD, trained to support the NRCS programs could be one way to approach the staff need. This may be the approach that Lawrence County has taken.

3.0 Public Lands & Best Management Practices

Several organizations manage public lands that lie within the Lake Monroe Watershed. The purposes for which the land is managed vary according to the organization. Each organization that was contacted to participate in this survey is listed below along with its mission statement.

Table 5 Public Land Managers in the Lake Monroe Watershed: Participants in the Practitioner Survey and Organization Mission Statement
National Guard Indiana, Camp Atterbury, Department of Defense *Atterbury-Muscatatuck Training Center serves as a major training site for individual, collective, and joint operations providing realistic venues for live, virtual and constructive training and testing events in order to increase training readiness, attract commercial defense industry participation and build strategic partnerships. On order, activate as a Mobilization Force Generation Installation in support of Forces Command and Combatant Commander requirements.* *Atterbury-Muscatatuck has three primary mission areas: (1) provide traditional training and testing support to ARNG, Active, Reserve and Joint Forces as a proposed Regional Collective Training Capability (RCTC) installation; (2) provide users with state-of-the-art multi-domain training opportunities; (3) on order, serve as a Primary Mobilization Force Generation Installation (pMFGI) as identified by Forces Command.*
Hoosier National Forest *The mission of the Forest Service is to sustain the health, diversity, and productivity of the nation's forests and grasslands to meet the needs of present and future generations.*
Indiana Department of Natural Resources (DNR), Brown County State Park *The mission of Indiana State Parks is to conserve, manage, and interpret our resources while creating memorable experiences for everyone.*
Indiana DNR Division of Forestry, Morgan-Monroe & Yellowwood State Forest *The Indiana Department of Natural Resources' Division of Forestry promotes and practices good stewardship of natural, recreational and cultural resources on Indiana's public and private forest lands. This stewardship produces continuing benefits, both tangible and intangible, for present and future generations.*
Indiana DNR Division of State Parks, Monroe Lake *The mission of Indiana State Parks is to conserve, manage, and interpret our resources while creating memorable experiences for everyone.*
US Army Corps of Engineers - Louisville District *Deliver solutions and manage resources supporting regional and national requirements through an expert team of multidisciplinary professionals utilizing best engineering practices and strategic partnerships to reduce disaster risk, strengthen the economy and support national security.*

To initiate the survey process, TNC drafted and shared a list of questions, then scheduled a virtual meeting via Zoom with the representative(s) of each organization. Summaries of the responses to the survey questions, including notes from the conversation with each organization, are included in Appendices G-L.

In the following sections, common themes that emerged from the individual discussions with the public land managers are summarized. Challenges and opportunities for protecting the watershed and the water quality in Lake Monroe are noted.

3.1 Sustainable timber harvesting

The Hoosier National Forest (HNF) and the Indiana Department of Natural Resources' (IDNR) Division of Forestry implement best management practices during timber harvests. The programs that guide timber harvests on their properties are described below. Unless a tree poses danger to visitors, timber is not actively harvested at IDNR's Brown County State Park

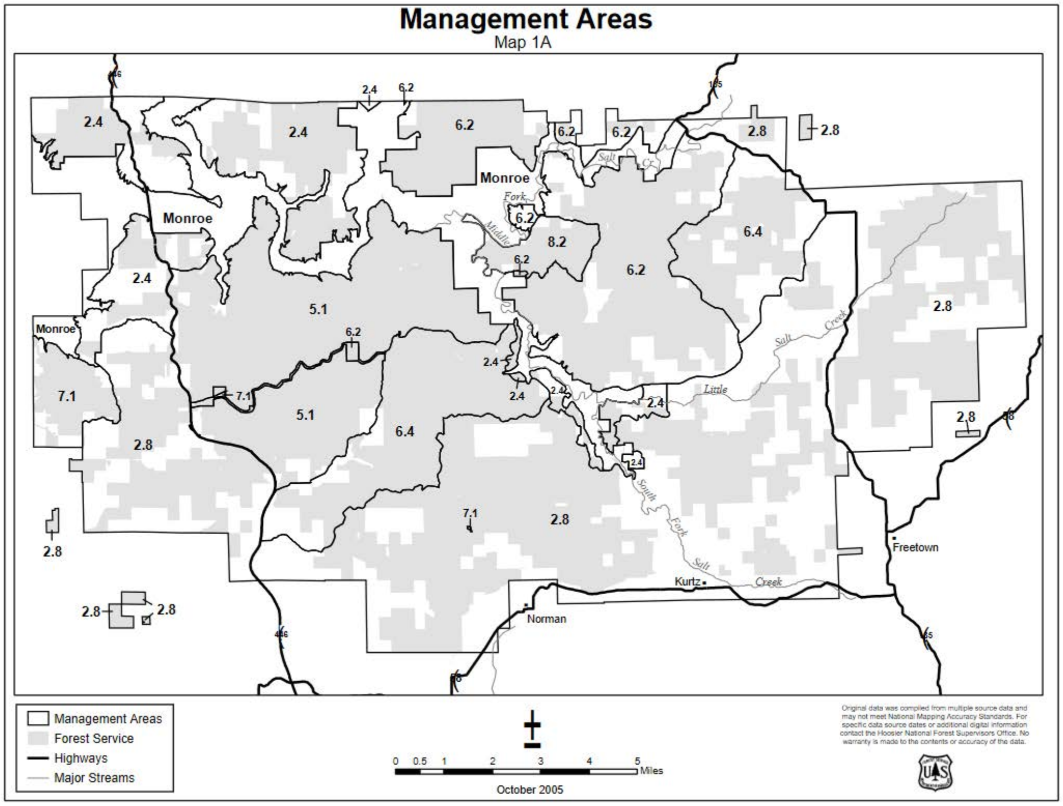
3.1.1 US Forest Service Hoosier National Forest

Management of the Hoosier National Forest (HNF) is guided by the Forest's Land and Resource Management Plan (Forest Plan). The Forest Plan identifies Management Areas in which different priorities are set and appropriate, or inappropriate, management actions are identified to achieve the desired future conditions of each Management Area (MA).

Within those HNF lands located within the Lake Monroe watershed, commercial timber harvest is identified as an appropriate tool in only MA 2.8 to achieve desired conditions for plant and animal habitat diversity. MA 2.8 makes up about 32% of the HNF acres in the watershed (or about 6% of the watershed acres). This does not mean that 32% of the HNF acres will have commercial harvests; rather, those lands are where it is possible to implement a harvest as a management tool. Timber harvests occur on a very small percentage of this land in any given year. In addition, per the management planning, unharvested areas are left between harvest sites, so that there is a mosaic of conditions on the landscape when timber harvest occurs. With these practices, far less than the entire management area would have a harvest occurring there.

Nearly all commercial timber harvest in the HNF occurs in MA 2.8 and MA 3.3 (no 3.3 lands are in the Lake Monroe watershed), which means that commercial timber harvests are limited to only the MA 2.8 acres. There are, however, somewhat narrow conditions that can allow for use of timber harvests in some of the other MAs to address specific needs, though those are situation dependent and rare.

Specifically, the Forest Plan states that in MA 2.4 "*Limited vegetation management is appropriate to create and improve habitat for wildlife and plant species within riparian corridors. Limited vegetation management includes maintenance of forest openings, wildlife habitat improvement for riparian dependent species, prescribed fire, or salvage and sanitation harvest when it is compatible with overall objectives.*" For MA 6.2 and 6.4, the plans say "*Removal of commercial vegetation is not appropriate, other than salvage or sanitation harvest when it is compatible with overall objectives*."



[6]

Approval of timber harvest is subject to comprehensive environmental analyses and public comment prior to approval, consistent with the National Environmental Policy Act (NEPA).

The Hoosier National Forest writes all logging contracts by tiering to (i.e., directly referencing and requiring implementation of) the "Indiana Logging and Forest Best Management Practices: BMP Field Guide" and HNF's "Forest Land and Resource Management Plan". Both documents are also intended to serve as a model for other land users to encourage similar approaches to limiting soil erosion and non-point source pollution. Several positions on forest are dedicated to administrating contracts, doing harvest inspections and monitoring for effective BMP's during and after harvest activity. If any extra mitigations are needed, timber purchasers must pay to have them done. Sale contracts are not closed without an acceptable performance rating based on BMP implementation and effectiveness. Contracts are inspected by a certified Harvest Inspector routinely during sale activity. Soil disturbance monitoring is also done throughout random or specific areas of sale activity usually no sooner than 6 months from sale closure to assess and ensure no detrimental impacts occurred and if so what kind of extra mitigations need to be conducted.

The National Best Management Practices (BMP) Program, followed by the HNF, was developed to improve management of water quality consistent with the Federal Clean Water Act (CWA) and State water quality programs. BMPs are specific practices or actions used to reduce or control impacts to water bodies from nonpoint sources of pollution, most commonly by reducing the loading of pollutants from such sources into

[6] USDA Forest Service Land and Resource Management Plan (2006), Appendix J.

storm water and waterways. BMPs can be applied before, during, and after pollution-producing activities to reduce or eliminate the introduction of pollutants to receiving waters. A section of the National BMP program and its monitoring focuses on vegetation management regarding harvesting and ground-based skidding within aquatic management zones (AMZ). An AMZ is an area within or nearby a body of water such as: lake, pond, wetland, ephemeral stream, intermittent stream or perennial stream. This information confirms that the harvesting mitigations and monitoring are effective or dictates a need for more adaptive management strategies in the future.

When it comes to USFS forests, there are many uses of the land, and the required BMPs are defined according to the activity. Practices related to vegetation management or timber harvest are certainly a part of the USFS National BMP Program (such as water bars or reseeding after a harvest), but there are many other activities where BMPs are implemented. For example, BMPs are also defined for aquatic ecosystems, chemical use, facilities and nonrecreational special uses (e.g., utility rights-of- way, research equipment or structures), recreation (e.g., camping, trails, motorized vehicle use) and road management.

As an example, the HNF lands are highly fragmented, and private land is interspersed between forest properties such that the USFS must provide access to the property owner through the national forest. In this case, the USFS uses BMPs for road location and design, road construction, stream crossings, snow removal, and storm damage to manage such an access road. There are also BMPs for decommissioning roads and redirecting traffic when a road is not accessible.

Similar BMPs apply to trail design, installation, and maintenance, and to repairing levees on a pond. The objective is always to stabilize an area disturbed by management activities as soon as is practical. To properly apply the BMPs in each location, a site assessment is needed, and the USFS team regularly conducts site assessments when work is happening on the HNF.

The top BMPs applied in the Hoosier National Forest (HNF) include revegetation by seeding & mulching, silt fencing, armoring stream banks and slopes, drainage restoration so that natural drainage flow is not interrupted, repairs where erosion is already happening. Keeping natural waterways open is important to minimize channel erosion. BMPs are listed in the Hoosier National Forest's Forest Land and Resource Management Plan.

3.1.2 Indiana Department of Natural Resources

IDNR Division of Forestry requires all logging contracts to follow the Logging and Forest Best Management Practices: BMP Field Guide. The BMP Field Guide guides IDNR's work and is also intended to serve as a model for other land users to encourage similar approaches to limiting soil erosion and non-point source pollution. One member of each logging crew is required to have completed IDNR's Logger Training, and a Trained Logger must always be on site during an active logging project. Contracts are inspected by an IDNR forester throughout the timber sale process, daily for large harvests, and every other day for smaller harvests. Six months after the harvest, a follow up site assessment is conducted. Contractors must also make a damage deposit that is withheld or partially withheld if the BMPs in the BMP Field Guide are not followed. IDNR uses any money withheld from the damage deposit to make repairs protecting soil and water quality. IDNR intends these contract and training requirements to teach contractors about and encourage them to adopt best practices so that they will still apply BMPs when contracting on private property.

Indiana's Logging and Forestry Best Management Practices: 2005 BMP Field Guide (BMP Field Guide) is what the Indiana Department of Natural Resources (IDNR) follows for BMP implementation in their forestry work. The document not only guides IDNR's work, it also is intended to serve as a model for other land uses. It is hoped that others will undertake similar approaches to control soil erosion and non-point source pollution.

For logging done on IDNR property, this is the guidance used, whether the work is completed by IDNR or others. Some logging for pine removal is done with IDNR crews. It is required that someone on the logger's crew must have completed the logger training that IDNR gives. Loggers that have completed various levels of the IDNR Logger Training are identified on the IDNR website. A Trained Logger must be onsite all the time during an active logging project.

IDNR contracts require that loggers working on IDNR properties follow the BMP Field Guide. Throughout timber sale process, an IDNR forester goes out to inspect. Visits are daily for larger harvests, or approximately every-other-day for smaller harvests. Contractors are required to make a damage deposit payment that can be withheld or partially withheld if the BMPs in the BMP Field Guide are not followed. Any withheld portion of the damage deposit will be used by IDNR to make the repairs that protect from soil erosion and water quality degradation. The IDNR contracts and training requirements are intended to help contractors learn about and adopt best practices so that when the same contractors do work on private property, the same BMPs will be applied.

As of the time of this report writing, the IDNR Division of Forestry no longer has funds available for cost sharing on forest BMPs. Until recently, the logger training has remained free and has had some donors to help offer training at low-to-no cost; however, this low-to-no cost training will likely not continue.

3.1.3 Indiana Army National Guard

The Indiana Army National Guard's (INARNG) Camp Atterbury is in the northeastern most part of the Lake Monroe watershed. At about 35,000 acres in size, only the southwest corner of the property is within the Lake Monroe watershed. The southwest portion of the property is also near Whippoorwill Woods, a nature preserve owned and managed by The Nature Conservancy. This area in the southwest portion of the property drains to the North Fork of Salt Creek.

Camp Atterbury, together with Muscatatuck, serves as a major training site for the US military "providing realistic venues for live, virtual and constructive training and testing events in order to increase training readiness, attract commercial defense industry participation and build strategic partnerships." Training is the first mission of Atterbury-Muscatatuck. In addition, the Department of Defense (DoD) places high value on protecting the threatened and endangered species on Camp Atterbury. The US Fish & Wildlife Service (USFWS) regularly partners with Atterbury-Muscatatuck to assist with the protection of habitat and species that live on their properties.

A significant portion of the property is forested. For forest management, the INARNG follows Indiana Department of Natural Resources (DNR) and USFWS BMPs. The Indiana bat, a state and federally listed endangered species, lives at Camp Atterbury and the INARNG must manage the property and its activity to protect Indiana bat habitat. INARNG follows the USFWS Bloomington Field Office guidelines for forest management to protect the Indiana bat, and implements BMPs to protect storm water from pollutants. Prescribed burning is used in some areas of the property, generally on open grasslands and ranges. For example, to reduce risk of fires starting and spreading out of control due to a training activity on the fire range, INARNG conducts prescribed burns to minimize available fuel on or near the firing rage.

3.2 Trail maintenance

Multiple organizations, including the HNF, IDNR Brown County State Park and IDNR Division of Forestry, have hiking, mountain biking, and horseback riding trails within their properties.

3.2.1 US Forest Service Hoosier National Forest

For trails on HNF properties, the HNF Recreation staff uses the Forest Service Trails Management Handbook and Hoosier National Forest Land and Resource Management Plan to implement best management practices for constructing and maintaining trails. Recreation staff oversee the implementation of BMPs for those trails, with advice from a Forest Hydrologist as needed. Authorized trail uses include horseback riding, hiking, and mountain biking. Periodically, trails are impacted by weather disturbances and the USFS will identify problem areas for relocation of the trail or other improvements. During rainy periods, trails become muddy and maintaining these trails is difficult, especially when it is overused. When excessively saturated, trails may occasionally be closed to reduce soil and water quality impairments due to higher risk of accelerated compaction, erosion and sedimentation.

3.2.2 Indiana Department of Natural Resources: Brown County State Park

For IDNR State Parks, the funding for trail maintenance, which includes practices to minimize soil erosion, is from the State Parks budget. Occasionally, federal programs have organized youth to assist with park maintenance activities. The Young Hoosiers Conservation Corps was a program about ten years ago that engaged youth to work on hiking and horse trails at state parks around Indiana and the program was a boost to trail maintenance in Brown County State Park (Park).

The Hoosier Mountain Biking Association helped pursue funding to build a trail in the Park about 15 years ago. Volunteers have been consistently and effectively leading the maintenance on the mountain biking trails, which now include 13 trails covering over 37 miles. The bike trails are well-designed and are sustainable designs when well maintained.

The Indiana Trail Rider Association helps with horse trail maintenance at the Park. Horse trail maintenance and repair often requires heavy equipment, which means that individual volunteers using rakes, shovels, etc. have limited capability when working on horse trails. The existing horse trails are not as well laid out, and often follow old county roads, fire breaks, or other pre-existing path without being designed especially for horse traffic. The Park staff provides the heavy equipment for these repairs as resources allow.

Occasionally, the Park receives an allotment for supplies and materials that are needed for trail preventative maintenance work, though those allotments do not cover the hiring of staff to complete the repairs. When major trail restoration is needed, IDNR is careful to consider the appropriate cultural resources and archeological permits needed before proceeding.

More funding for hiking trails and horse trail maintenance would be beneficial for minimizing soils loss from trails. The hills in the Park are steep, and erosion occurs, even in the heavily forested areas of the park, so care and maintenance of trails is an ongoing need.

3.2.3 Indiana Department of Natural Resources: Division of Forestry

The IDNR Division of Forestry budget covers horse and hiking trails, including inspections of the trails and stream crossings. IDNR sends a staff member out once per week to check on trails. The Hoosier Hikers Council also helps with trail maintenance on Division of Forestry properties to keep trails open. An additional seasonal staff member would help IDNR Division of Forestry be able to respond more quickly to needs and keep up with trail repairs during peak season.

3.3 Stream crossings

3.3.1 Indiana Army National Guard

Indiana Army National Guard (INARNG) has a vested interest in the water quality entering and leaving the Camp Atterbury property. Sustaining the land is a vital activity because the land is the only property for training. INARNG consistently uses buffered setbacks on streams, maintaining 100 feet of buffer on both sides of perennial streams as the primary strategy. On intermittent streams, a 50- foot buffer is applied. The training live fire range is a large tract of land cut into a contiguous tract of hardwood forest. The range is an intense use of training land, which is in the Lake Monroe watershed. The areas that drain to the Lake Monroe are mostly forested. INARNG monitors the water quality leaving the property and reports that the water quality leaving the property is better than the stream quality entering the property for several parameters.

During training exercises, soldiers are trained not to drive through streams for maneuvering except at designated, hardened crossings. Where stream crossings are made, INARNG seeks to construct each crossing with best management practices (BMPs), such as three-sided culverts, to minimize stream erosion and maintain natural stream bottoms. Also, the INARNG standard training procedures instruct the soldiers to not discharge pyrotechnics near or in surface waters.

INARNG controls the number of vehicle crossings, and uses a variety of practices in the design of those crossings. Cable-concrete crossings are good for vehicle crossings, but expensive and difficult to install correctly. Cable-concrete crossings are very heavy and cumbersome to work with, but very effective at protecting the bottom of the stream. Fish and water can flow through the crossing. The budget to implement this best practice is limited, which sometimes means that culverts or bridges must be made with other designs. Army Construction Engineering Research Lab researches and designs solutions similar to the cable-concrete stream crossings so that the Army will be able to implement best management practices that sustain the environment while achieving the military mission.

With the training that occurs at the range, there is intense use of the stream crossings, including daily military traffic. Being at the upper end of the watershed, INARNG seeks to replace some of the water crossings with three-sided culverts. As existing stream crossing designs reach the end of their life cycle, INARNG will replace them with improved designs such as the three-sided culverts that stabilize the stream bed while allowing water and aquatic life to pass.

3.3.2 US Forest Service Hoosier National Forest

The Hoosier National Forest Land and Resource Management Plan is utilized for stream crossing mitigations. Stream crossings are addressed by many personnel on forest. Engineering addresses maintenance and construction of forest road and county road stream crossings within forest property. Recreation addresses trail crossings for maintenance and construction. The Fisheries Biologist and Hydrologist also address stream crossings based on aquatic organism passageways (AOP) needs and restored hydrologic function of streams.

The HNF uses BMPs for road location and design, road construction, stream crossings, snow removal, and storm damage as they manage access roads. Similar BMPs apply to trail design, installation, and maintenance; the objective is always to stabilize areas disturbed by management activities as soon as is practical.

AOP's are designed to restore natural hydrologic functions which allow a minimum of bank-full flows through bigger designed structures. This reduces channel incision and erosion/sedimentation. This restored hydrologic function allows for aquatic organisms to pass through non-perched structures at low flows. Keeping aquatic organisms healthy and established throughout waterways can indicate the water quality changes in the future.

Crossing construction and maintenance are designed to mitigate sedimentation and erosion. The HNF regularly conducts site assessments when work is conducted within the forest boundary.

A section of the National BMP program and its monitoring focuses on roads stream crossing maintenance or construction within aquatic management zones (AMZ). An AMZ is an area within or nearby a body of water such as: lake, pond, wetland, ephemeral stream, intermittent stream or perennial stream. Recent maintenance or construction will be evaluated. This information confirms that the stream crossing maintenance mitigations and monitoring are effective or dictates a need for more adaptive management strategies in the future.

HNF lands are highly fragmented by private land that is interspersed between forest properties, and it is necessary for the USFS to provide access to the property owner through the national forest. When this occurs, the USFS uses BMPs for road location and design, road construction, stream crossings, snow removal, and storm damage as they manage such an access road. Similar BMPs apply to trail design, installation, and maintenance; the objective is always to stabilize areas disturbed by management activities as soon as is practical. To properly apply the BMPs in each location, a site assessment is needed, and the USFS team regularly conducts site assessments when work is happening on their land.

3.3.3 Indiana Department of Natural Resources

As mentioned above, the IDNR Forestry budget covers inspections of horse and hiking trails, including stream crossings. On a weekly basis, an IDNR staff member checks on Forestry Division trails. An additional seasonal staff member would help IDNR be able to respond more quickly to needs and keep up with trail repairs during peak season.

The horse trails at Brown County State Park are heavily used. Horse crossings of creeks exist in numerous places and are especially challenging to maintain during the rainy seasons. The Park staff would like to have more resources available to monitor and maintain the horse trails.

3.4 Agricultural Lands Managed by DNR

IDNR Monroe Lake has five management areas that are leased to tenant farmers for four years at a time. The tenant farmers are required to maintain a 35-foot buffer along streams and intermittent streams, and the tenants follow a four-year rotation of two years of corn and/or beans, wheat, then fallow. Tenants can use fertilizers and work with IDNR to use herbicides, but manure application and most pesticides are not allowed. Cover crops (except after beans have been planted) and no till are not required. In the leases, there is an opportunity to encourage implementation of more conservation agriculture practices such as no till, as well as more consistent use of cover crops, etc.

Two of IDNR Monroe Lake's agricultural units have been fallow for several years and are returning to successional growth. IDNR seeks to maintain some of these fallow areas in wet hardwood oak-hickory plantings by managing the areas to reduce the amount of softwood maple, cottonwood, sassafras, and sycamore and work towards hardwood forest. Restoring portions of these two South Fork units, especially those in floodways, should be a priority for collaborating.

3.5 Horse manure

At Brown County State Park (Park), the horseman's camp is near Strahl Lake, which drains to Middle Fork Salt Creek, and includes more than 200 horseman's camp sites. During peak summer season, with an average of 3 horses per site, there can be as many as 600 horses in the area. In winter, there are significantly fewer horses.

The primary maintenance for the horseman's camp is mowing the campground for horses and cleaning up horse manure. Previously, the horse manure was stockpiled for spreading in a field within the Park. The manure stockpile was vulnerable to water ponding following heavy rain events, and the ponded water would eventually trickle out and make its way to nearby waterways. The Indiana Department of Environmental Management (IDEM) reviewed the stockpiling practice and cited concerns of potential bacterial contamination in the waterways. Following their review, IDEM asked the Park to undertake a contract to have the horse manure hauled away. This practice of hauling the horse manure away from the site began in 2019. Currently, the Park staff are exploring options to have farmers haul it away for use in their fields, as the contract for hauling the manure represents a large expense for the Park.

3.6 Shoreline erosion

Around Lake Monroe, a significant source of sediments is coming from shoreline. The first so many feet from the shoreline is very difficult to protect because wave action constantly erodes the shoreline.

3.6.1 US Forest Service Hoosier National Forest

The Hoosier National Forest observes shoreline erosion on their property that is adjacent to the lake. A specific example is the peninsula in the Charles C. Deam Wilderness area. It experiences heavy recreational use and the shoreline erosion is very difficult to stop. The Recreation staff within the Hoosier National Forest continues to seek new ideas to address this. One approach would be to consider a soft "hardening" of the shoreline, in contrast to the hard rip rap that bounces waves from one shoreline to another, as opposed to softening the wave action altogether. This is an area where a solution is not readily apparent, and the Hoosier National Forest staff continue to pursue new ways to implement erosion control that are economically viable and consistent with managing the area for Wilderness values.

3.6.2 Indiana Department of Natural Resources

At the IDNR Division of State Parks, Monroe Lake location, riprap has been used regularly to minimize shoreline erosion along Lake Monroe for many years. However, there has been very limited funding for shoreline erosion since the last large allotment of $400,000 in 1989. Increasing high water events due to spring rains and runoff over the last 40 years means that even places where shoreline erosion projects have been previously implemented are being compromised as water levels are rising above these formerly stabilized areas. IDNR also notes that, to complete any shoreline protection work, they must receive USACE's approval for work at or below 530-ft pool elevation.

3.7 Boater Pump-Out Facilities

IDNR has found that the boater pump-out facilities are effective at protecting water quality in Lake Monroe. For larger boats that have permanently installed toilets on board, the wastewater sanitation tanks must be emptied periodically. By providing a free place to empty wastewater at the boat launch site, DNR helps assure that wastewater is treatment and managed according to Indiana Department of Environmental Management (IDEM) requirements and does not end up in the lake.

In 2016 IDEM provided a grant to replace the pump out facility at Paynetown State Park. The Marina at the Cutright State Recreation Area, the Inn at Four Winds, and the Two Herons boat launches also have pump-out facilities. A fourth pump out, the Lake Monroe Sailing Association, recently received a grant from IDEM to have a pump-out system installed; this station is now installed and operational. Any organization receiving an IDEM grant is required to have a permit to operate the pump-out facility, and IDEM conducts an annual inspection. Facilities cannot charge to pump out if they have been built using IDEM grant dollars.

In the early 1990s, IDNR conducted on-boat inspections for boats with toilets and gave inspection stickers. In addition, boaters may bring reports to Conservation Officers, who then will follow-up and conduct an inspection on boats where concerns have been identified. Occasionally the Conservation Officers will walk the docks. During the tenure of the IDNR staff who participated in this survey, they have never found a boat that has dumped its wastewater in Lake Monroe. The boaters do a good job of self-policing.

3.8 Other practices

3.8.1 U.S. Forest Service Hoosier National Forest

The US Forest Service (USFS) also uses the National BMP Monitoring Program and Hoosier National Forest Land and Resource Management Plan as stated above to address mitigations for other management practices such as: chemical use for invasive species control, prescribed burning, and facilities maintenance and construction. . Prescribed burning assessment would evaluate revegetation, erosion, and mineral charring. Facilities example would be a utility right-away assessment of erosion/sedimentation and vegetation establishment during routine utility company maintenance. Random or selected sites are assessed to ensure no adaptive management strategies need to be implemented and current BMPs are effective.

3.8.2 Indiana Department of Natural Resources

IDNR Division of Forestry mentioned that prescribed burning is an important tool to control invasive species. While IDNR Division of Forestry has reasonable funding for prescribed burning, it can be expensive for private landowners.

IDNR Division of State Parks noted that trees and log jams will redirect flow into the banks. If not removed, a log jam grows bigger every year and erodes the stream bank. It is expensive and labor intensive to remove these jams. Recently IDNR has not had the staffing to remove these jams as they have in the past. IDNR would like to collaborate with soil and water conservation leaders to help local and small landowners with log jam removal.

3.9 Summary of Land Uses and Management Practices

From these conversations with the organizations that manage public land within the Lake Monroe watershed, a summary matrix of the most frequently mentioned practices and which organizations use them follows. Each organization maintains and follows internal guidance for the management practices, in addition to the local, state, or federal regulations that may apply the circumstance.

Table 6
Public Land Managers in the Lake Monroe Watershed[7]:
Most Frequently Mentioned Management Practices

Organization/Practice	Indiana DNR Division of Forestry	Indiana DNR Brown County State Park	Indiana DNR Monroe Reservoir	Indiana Army National Guard, Camp Atterbury	US Forest Service Hoosier National Forest
Forest Management & Timber Harvesting	●			●	●
Trail Maintenance	●	●			●
Stream Crossings		●		●	●
Agricultural Land Management			●		
Horse manure		●			
Shoreline erosion			●		●
Boater pump out			●		

[7] The US Army Corps of Engineers was not included in this table because, although they own the land around the lake (as established by a specific water level designation), the Indiana Department of Natural Resources has been granted a long-term lease to manage the property as a state recreation area (Monroe Reservoir).

Table 6
Public Land Managers in the Lake Monroe Watershed[7]:
Most Frequently Mentioned Management Practices

Organization/Practice	Indiana DNR Division of Forestry	Indiana DNR Brown County State Park	Indiana DNR Monroe Reservoir	Indiana Army National Guard, Camp Atterbury	US Forest Service Hoosier National Forest
Other (e.g., log jams, invasives, prescribed burns, species of concern)	●		●	●	●

4.0 Private Lands & Best Management Practices

Private individuals own and manage an estimated 58% of the land in the Lake Monroe Watershed. For this survey, three private landowners were contacted to better understand how each applies conservation practices on their properties.

4.1 Private Landowner Management Practices

To initiate the process, TNC shared a list of questions, then scheduled a virtual meeting via Zoom with the landowner. Summaries of the responses to the survey questions, which include notes from the conversation with each landowner, are included in Appendices M-O.

Of the three landowners contacted, two have property in Brown County and another in Jackson County. Two raise livestock (one of these two is phasing out their livestock operation), and the third landowner purchased a farm so that he could replant the open land with trees and convert it to forest.

Management practices used on these three properties or referenced by the landowners include:

Table 7 Private Landowners in the Lake Monroe Watershed: Management Practices Used
Agronomy • Cover crops, especially in bottomland areas • No till • Soil scientist assistance, using a precise formula for fertilizer application *<u>Supporting programs</u>*: NRCS and SWCD programs and funding. Conservation Reserve Program (CRP), administered by Farm Services Agency (FSA), farmers enrolled in the program agree to remove environmentally sensitive land from agricultural production and plant species that will improve environmental health and quality, in exchange for a yearly rental payment. Contracts for land enrolled in CRP are 10-15 years in length
Livestock & Grazing • Feeding pads for cattle (heavy use area protection) • Fencing • Ponds for cattle watering and runoff control • Hay production in place of raising cattle or crop production *<u>Supporting programs</u>*: NRCS and SWCD programs and funding. Grassland reserve program (GRP), a voluntary conservation program that emphasizes support for working grazing operations, enhancement of plant and animal biodiversity, and protection of grassland under threat of conversion to other uses.
Forest Management • Timber harvest with oversight to ensure BMPs such as grading and lining logging trails, water bars, grading and reseeding are implemented • Reforestation • Habitat restoration • Invasive species removal: many invasive species are becoming endemic on private property

Table 7 Private Landowners in the Lake Monroe Watershed: Management Practices Used
<u>Supporting program</u>: IDNR Classified Forest and Wildlands Program, where the land is managed for timber production, wildlife habitat, and the protection of watersheds, while conserving other natural resources. . NRCS and SWCD programs and funding.
Buffers & Streams • Riparian corridor plantings (e.g., riparian buffer, filter strips) • Streambank stabilization *<u>Supporting programs</u>*: Conservation Reserve Program (CRP), which incorporates filter strips and grassed waterways. NRCS and SWCD Filter Strip, Riparian Forest Buffer and Riparian Herbaceous Cover practices.
Infrastructure & Human Access • Horse trail improvements & maintenance • Driveway maintenance • Road maintenance

4.2 Private Landowner Experience, Observations and Ideas

The private landowners were asked for their observations about helpful practices being used on other properties, challenges that landowners face, and for their ideas on how to encourage more landowners to adopt land management practices that help protect Lake Monroe and its watershed. Collectively, these private landowners have had positive experiences and many successes with the practices they have implemented on their land.

One landowner has implemented feeding pads, cross fencing to prevent overgrazing, and ponds on his property. Pond construction was previously a higher priority with NRCS; since the time the pond was installed on the farm so the cattle could drink from it, the pond has been helpful for keeping water from the pastures from running directly into streams. Watering systems for the cattle, also called spring developments, have also been very helpful for keeping cattle out of the streams on this property.

Another landowner owns a lot of bottomland that has been reforested, which he did to 1) improve the forest, 2) to allow timber production in the long term, 3) provide wildlife habitat as the timber stand matures. This land is enrolled in the classified forest program with Indiana DNR. This means that, in exchange for developing a forest management plan by working with a District Forester and implementing BMPs, the enrolled land has low property taxes. The landowner appreciates the opportunity to get input from a professional to help manage the forest to achieve his goals for the forest. During a past timber harvest on his land, the work was planned for late summer or early fall to work in dry conditions and the Indiana DNR Division of Forestry District Forester observed the contractor’s work to ensure that Best Management Practices (BMPs) were followed. In another harvest, the landowner required the contractor to close-out the tree harvest work with proper water bars on slopes, followed by grading and reseeding afterwards. This landowner’s experience is that most loggers will do a good job of BMPs if they know it is important to the landowner to do so.

A third landowner reflected on his past and current management practices. In the past, fodder on his farm would be removed from the fields and put into silage, a practice which left the land bare. With assistance from the Brown County NRCS, the landowner now applies cover crops, which has been helpful to stop washes over the farm fields. With only a thin layer of topsoil, cover crops help retain this valuable resource on his farm. On the cropland in the Lake Monroe watershed, the landowner had practiced minimum till for many years and now practices no-till, leaving corn fodder on the field and over-planting with cover crop. This landowner now also works with a soil scientist to develop a precise formula for fertilizer application to the crops so he can avoid investing in fertilizer that would be vulnerable to runoff.

Some additional observations provided by the private landowners included:

- Sharing about the importance of conservation practices (and implementing those practices) is more difficult if the landowner doesn't earn a living from the land (e.g., absentee landowners).
- When prices of corn and soybean crops increase, farmers like to plant. During these times, the incentives to use best management practices are not always enough to balance the higher value of the crops.
- A lot of land in the Lake Monroe watershed is in Brown and Jackson counties, though these counties do not benefit from Lake Monroe. Landowners in the rural areas of the watershed and the users of Lake Monroe are disconnected and connecting the dots for these different users' perspectives is important.
- The tax base in Brown and Jackson Counties is less than that in Monroe County. Investing in the Brown and Jackson County portions of the watershed would help demonstrate the importance of these lands and counties for watershed protection.
- Some gravel roads in rural areas wash out with each heavy rain or flood, then every car that passes through it generates more sediment. County road departments are not adequately funded to address roads in this condition.
- Log jams in the creeks create dams that the cause fields to flood. When this happens, large flows can wash away creek banks and increase soil loss from the fields. Large equipment is needed to remove log jams and property access can be difficult, either due to the terrain or in obtaining permission from property owners. Log jam removal is dangerous work.
- Stream bank stabilization is not as simple as putting stone along a stream bank and is expensive to do well.

4.3 Additional Options for Private Landowners

A few additional options are available to private landowners for protecting or restoring the legacy of the land that they own.

4.3.1 Land Management

In addition to the programs offered by the US Department of Agriculture's NRCS and FSA organizations, where landowners are supported in applying best management practices, the Forest Bank offers another approach for woodland owners in the hills of Brown County. The Forest Bank is a conservation alternative from The Nature Conservancy (TNC) in Indiana that is intended to conserve working woodlands while preserving opportunities for recreation, wildlife habitat, natural beauty and solitude.

Woodlands enrolled in the Forest Bank remain private property. Landowners can still hike, hunt, fish, cut firewood and use their woodland just as they normally would as long as the health and growth of timber is not hampered. The Forest Bank program provides consistent, professional management for woodlands to protect biodiversity, wildlife habitat, and timber production; 10 and 30-year management agreement options are available. The Forest Bank is certified sustainable by the Forest Stewardship Council.

4.3.2 Conservation Alternatives

Some landowners are interested in preserving their land while maintaining ownership. In this circumstance, a conservation easement may be appropriate. With a conservation easement, a landowner voluntarily makes an agreement to permanently restrict the amount and type of development that can occur on their property. Conservation easements become part of the deed to the property; the recorded restrictions that limit the use of the land are permanent and remain with the land regardless of who owns the land in the future. Conservation easements can be held and enforced by the entity that holds them.

Some landowners may wish to preserve their land by donating it to a public agency or land trust to become part of a park, public land, or nature preserve. In the Lake Monroe watershed, the Indiana Department of Natural Resources, Sycamore Land Trust and The Nature Conservancy are among several organizations that hold conservation easements and own and maintain land for permanent wildlife habitat and conservation purposes.

5.0 Takeaways from the Practitioner Survey

Fifteen conversations were held to gather information for this survey. The following list summarizes points (in no particular order) offered by individual participants, repeated feedback about how best management practices come into practice, and some thoughtful notes about why this work is a challenge.

1. Many participants (8 of 15) mentioned awareness and education as the first step to engaging more landowners (or land users) in best management practices (BMPs). As one landowner said, “While incentive programs always help, the first and most important step is that the landowner wants to implement conservation practices on their land.”
2. On private land, the most common BMPs applied in the watershed result from the work and outreach of NRCS and the county soil and water conservation districts, who encourage adoption of NRCS conservation practices according to detailed implementation guidelines developed by the NRCS.
3. Landowners with personal ownership and economic ties to their land tend to be more vested in actively managing the land. Sharing information about conservation practices and implementing those practices is more difficult when the landowner doesn’t earn a living or income from the land.
4. For crop producers, when prices of corn and soybean crops increase, farmers will plant. During these times, the conservation practice incentives offered by the NRCS and SWCDs are not always enough to balance the higher value of the crops, and conservation practices may be reduced due to the higher crop value.
5. Most (77%) of the Lake Monroe watershed is in Brown and Jackson counties. Landowners in the rural areas of the watershed are disconnected from the users of Lake Monroe (e.g., in Bloomington or on

the lake). These rural counties do not benefit from Lake Monroe as much as Monroe County. Helping to connect the dots for these different users' perspectives is important work.

6. The tax base in Brown and Jackson Counties is less than that in Monroe County. Investing in the Brown and Jackson County portions of the watershed would help demonstrate the importance of lands in the rural counties for protection of Lake Monroe.
7. Federal and state-owned or managed properties apply internal standards for best management practices that are used for any work done on their land. These same standards apply to contractors who do work on their land.
8. Most participants (10 of 15) mentioned invasive species as a concern for the health of the lands and habitats in the watershed and are actively working to remove them.

The Nature Conservancy Indiana	Appendix A **Conservation Practitioner Survey** **For Lake Monroe 319 Watershed Plan** Cara Bergschneider, District Conservationist Brown County NRCS April 6, 2020

1. **What are the most effective practices you have used?**
   Cover Crops, Brush Management, Forest Stand Improvement, Forest Management Plan

2. **What practices have not worked?**
   Honestly, I would say that all of the conservation practices work effectively for the intended purpose when they are implemented correctly and maintained appropriately. The failure of conservation practices occurs mainly through mismanagement of the practice.

3. **Are there successful conservation practices being implemented by other agencies or groups that are not coordinated through you?**
   I will defer to Dan Shaver's and Allison Shoaf's response here so as not to duplicate answers.

4. **What current levels of investments in conservation are being implemented through your programs?**
   Below are the number of dollars obligated for conservation program contracts in Brown County for the last 5 years:
   2015: $101,000
   2016: $62,100
   2017: $ 252,800
   2018: $204,900
   2019: $130,100

5. **What agencies are funding the current level of conservation in your programs?**
   NRCS: 100% of program funding
   NRCS partners with National Wild Turkey Federation to employ a Forester to assist with forestry related practices and education in a 10 county region (Monroe included).
   NRCS partners with Pheasants Forever to employ a Wildlife Biologist to assist with wildlife related practices and education in a 12 (??) county region (Monroe included).

6. **Are investments in conservation mandatory if funding is provided, or are all practices voluntary regardless of whether funding is provided?**
   The goal of NRCS's primary program, EQIP, is for the NRCS to provide 75% funding for a conservation practice and the customer to provide 25%.
   All NRCS programs and practices are voluntary.

7.	**What kind of work would you like to implement to better protect Lake Monroe from nutrients and sediments in runoff?** EDUCATION!!! On all conservation practices that improve soil and water quality while reducing soil erosion but especially on livestock focused conservation practices. It would also be helpful to have a NRCS staff member dedicated fully to Brown County so there is a physical presence in the county.
8.	**What range of potential investments would help you implement desirable, but currently underfunded, best practices?**
9.	**Questions/Comments**

The Nature Conservancy Indiana	Appendix B **Conservation Practitioner Survey** **For Lake Monroe 319 Watershed Plan** Charles Garrett, District Conservationist Jackson County NRCS May 4, 2020

1. **What are the most effective practices you have used?**
   Cover Crops, Brush Management, Waterways, Access Control (which includes Fencing), Prescribed Grazing, Livestock Pipeline and Waterers,

2. **What practices have not worked?**
   When done to the specification we provide the practices work. NRCS has been around long enough and made enough mistakes with enough failures that we've narrowed down our practices to those that get results.

3. **Are there successful conservation practices being implemented by other agencies or groups that are not coordinated through you?**
   YES! Our Soil & Water Conservation District also implements seeding practices that serve our county quite well.

4. **What current levels of investments in conservation are being implemented through your programs?** (This was sent as a separate attachment)

5. **What agencies are funding the current level of conservation in your programs?**
   NRCS: Funds nearly 100% of program funding
   SWCD also has acreages in prevent planting after the flooding of 2019.

6. **Are investments in conservation mandatory if funding is provided, or are all practices voluntary regardless of whether funding is provided?**
   The goal of NRCS's primary program, EQIP, is for the NRCS to provide 75% funding for a conservation practice and the customer to provide 25%. All NRCS programs and practices are voluntary.

7. **What kind of work would you like to implement to better protect Lake Monroe from nutrients and sediments in runoff?**
   EDUCATION!!! On all conservation practices that improve soil and water quality while reducing soil erosion.

8. **What range of potential investments would help you implement desirable, but currently underfunded, best practices?**
   Jackson County could use a lot more programs that assist in preventing or slowing stream bank erosion issues. It is a high demand issue that NRCS cares about but doesn't have practices offering financial assistance.

9. **Questions/Comments**

Appendix C

Conservation Practitioner Survey
For Lake Monroe 319 Watershed Plan

Cara Bergschneider, District Conservationist
Monroe County NRCS
April 6, 2020

1. **What are the most effective practices you have used?**
   Cover Crops, Brush Management, Nutrient Management, Access Control (which includes Fencing), Prescribed Grazing, Livestock Pipeline and Waterers, High Tunnels

2. **What practices have not worked?**
   Honestly, I would say that all of the conservation practices work effectively for the intended purpose when they are implemented correctly and maintained appropriately. The failure of conservation practices occurs mainly through mismanagement of the practice.

3. **Are there successful conservation practices being implemented by other agencies or groups that are not coordinated through you?**
   YES! Invasive species control through MCIRIS; wildlife-focused practices through USFWS; forest management through TNC; Forest, wildlands and wetland management through Sycamore Land Trust; Conservation practice education through Purdue Extension; Urban conservation through Neighborhood Tree Planting Project, City of Bloomington Parks and Rec and Bloomington Community Orchard; Small farm conservation practices implementation and education through IU Campus Farm; Classified Forest and Wildlands program through DNR; invasive species control, identification and replacement through Southern Indiana Cooperative Invasive Management (SICIM). I'm sure I am forgetting groups- these are just what come to mind immediately. Aren't we lucky in Monroe County!!!

4. **What current levels of investments in conservation are being implemented through your programs?**
   Below are the number of dollars obligated for conservation program contracts in Monroe County for the last 5 years:
   2015: $122,635
   2016: $81,811
   2017: $ 301,339
   2018: $141,444
   2019: $445,523

5. **What agencies are funding the current level of conservation in your programs?**
   NRCS: 100% of program funding
   NRCS partners with National Wild Turkey Federation to employ a Forester to assist with forestry related practices and education in a 10 county region (Monroe included).
   NRCS partners with Pheasants Forever to employ a Wildlife Biologist to assist with wildlife related practices and education in a 12 (??) county region (Monroe included).

6. **Are investments in conservation mandatory if funding is provided, or are all practices voluntary regardless of whether funding is provided?**

	The goal of NRCS's primary program, EQIP, is for the NRCS to provide 75% funding for a conservation practice and the customer to provide 25%. All NRCS programs and practices are voluntary.
7.	**What kind of work would you like to implement to better protect Lake Monroe from nutrients and sediments in runoff?** **EDUCATION!!! On all conservation practices that improve soil and water quality while reducing soil erosion.**
8.	**What range of potential investments would help you implement desirable, but currently underfunded, best practices?**
9.	**Questions/Comments**

The Nature Conservancy Indiana	Appendix D **Conservation Practitioner Survey** **For Lake Monroe 319 Watershed Plan** Allison Shoaf, District Manager Brown County SWCD March 16, 2020

1. **What are the most effective practices you have used?**

The Brown County Soil and Water Conservation District (BCSWCD) works closely with the Natural Resources Conservation Service to implement BMPs because the NRCS has more funding. Since the farm community in Brown County is relatively small, the availability of services is spread by word of mouth. Newsletters and site visits are also used to communicate programs.

On a small-scale using a local grants program, the BCSWCD funds heavy-use area pads (HUAP) and rain catchment systems. If installed properly, these are effective for small scale. Heavy use area pads in areas where livestock congregates and waters – add a layer of gravel and limestone over the soil so that accumulated mud can be cleaned. Cover crops are better for broader scale projects.

Due to lack of funding, BCSWCD does not monitor water quality and there is no mandatory follow-up for farmers. BCSWCD measures projects by defining how the practice was installed (1st measure of success); designs are usually simple (e.g., pollinator garden) and the measure is to complete the installation per the design.

Each small grant program lasts one year, and there is no mandatory follow-up after that. BCSWCD would like to get more funds in this program and have had applications for grant money every year for many years.

There are more smaller farms in the area; farmers provide feedback that the HUAPs are helpful. BCSWCD does an 80/20 cost share. Projects typically cost ~$2K but can be up to $6K. BCSWCD also funds rain catchment systems for barns or outbuildings to help reduce runoff with HUAPs.

Process for cover crops: when seed is planted, BCSWCD goes out after 3 weeks to check that the seed has sprouted, and the farmer provides receipts for the seed. Cover crops have a different cost share program.

Brown County has a lot of land to implement practices on but needs more awareness and education. Due to much of the county being heavily forested, there are many forestry projects managed by the BCSWCD.

The Mini grant program supports any conservation practices, including projects for forest landowners. Mini grants of up to $2000-$5000 are available for BMPs, with a total of $10,000 available.

2. **What practices have not worked?**

   Some practices – like filter strips are not sought after by the landowner. Requires an area of land to be taken out of production so landowners do not request this often. Cost-share assistance is offered through other programs but has not caught on because BCSWCD doesn't see enough interest in filter strips in Brown County.

   Best management practices (BMPs) for livestock are not implemented enough either. Owners are concerned that practices are really affecting their operations and therefore are not interested. There is also a general lack of awareness on the part of livestock farmers about the problems associated with improper farm practices.

   For forest timber sales, if landowners don't require a logger to do BMPs, then (after a harvest) talk to the USDA Natural Resources Conservation Service (NRCS), there is an 18-month lag before NRCS can make funding available to the landowner. Often in these situations, water bars would help protect runoff from areas where forests have been cut. With the Federal programs, there is a 1.5-year timeframe before you can get funds. SWCDs can work more quickly.

   Landowners often come to the SWCD after improper forestry practices have led to problems, and it would be cheaper and more effective if landowners came to the district for advice before logging. If SWCDs had more money, they could help applicants correct erosion immediately, instead of a year from the time of occurrence.

   Stream bank stabilization- NRCS no longer funds these programs. They are expensive efforts, and there are a lot of failed projects.

   Timber stand improvement and invasive species management are implemented but they are understudied in forested settings.

   Proper stream crossings and water bars on forested properties are underutilized but should be implemented more. Farmers are unlikely to use these practices unless advised by their consultant. Farmers may not be educated in the need for these practices.

3. **Are there successful conservation practices being implemented by other agencies or groups that are not coordinated through you?**
   SWCD is generally aware of the status of other programs and agencies (e.g., USFWS will fund wildlife projects such as pollinator habitat; IDNR also has funding). NRCS has been the most consistent funding agency on an annual basis. Projects from these other organizations may be implemented without the participation of the SWCD.

4. **What current levels of investments in conservation are being implemented through your programs?**
   With the small grants program, BCSWCD had 2 applications in 2017 and 5 applications in 2019. Funding includes:
   - $10K for mini grant program, comes from the state of Indiana, and funding is fairly guaranteed each year

- Another grant funded through the Clean Water Indiana (CWI) grant program. For the past 3 years, BCSWCD has had an additional $6K for invasive species removal.
- An additional $2-3K is dedicated for cover crops from CWI funding.

So, on average, about ~$15K in local funding available per year. This funds approximately 8-10 projects, with an average grant of about $1K. The landowner will pay up front, and their work will count as match for the grant. SWCD pays 80% of a project, while the owner pays 20%.

5. **What agencies are funding the current level of conservation in your programs?**

From NRCS, funded projects were valued at $90K in 2018 and $144K in 2019.

Most funding is government sourced. South Central REMC does have some small funding sources but the only programs available to individual landowners are through the BCSWCD.

Private funding from the community foundation or REMC has been for invasive removal and educational signage. A recent example is for the Native Woodland Project and the project was implemented on school property.

6. **Are investments in conservation mandatory if funding is provided, or are all practices voluntary regardless of whether funding is provided?**

All programs are voluntary thru NRCS, SWCDs, and others. The only time that projects are mandatory is if there is mitigation required. SWCDs do not provide cost-share with mitigation projects.

A Rule 5 permit is required for construction in county. The business owner or contractor must be responsible for Rule 5 permit. Some contractors do a good job protecting water quality, but not all. BCSWCD tries to be eyes and ears on the ground, though does not always see the project in time.
It is important to get the best practices in place before it rains. The enforcement is up to the Indiana Department of Environmental Management (IDEM), but sometimes there is a lag in response time when concerns are raised.

County regulates drains and drainage ditches. Brown County does not have a drainage or ditch board. Jackson County might have a board.

7. **What kind of work would you like to implement to better protect Lake Monroe from nutrients and sediments in runoff?**

HUAPs could use more funding and more education for livestock owners. All have an impact in Brown County because animals are often confined to a small pasture. There needs to be more exclusion of livestock from streams, so funding for fencing and stream crossings is needed.

More cover crops are needed, although BCSWCD will need to find out from farmers what it would take to do more cover crops.

For forestry practices: soil stabilizing/water bars on skid trails, seeding after timber harvest (a really simple, low cost item!), stream protection, stone down near crossings would be good additional practices to encourage more of.

Best bang for the buck: education would be crucial in the beginning to raise awareness. Currently, there is not a demand from livestock owners wanting to implement BMPS. The BCSWCD could not identify anyone they consider to be model farmer for conservation practices. Only 5 farmers in the county have large production areas where the farmer grows and harvests crops. Hobby farms are also a big concern because they are not as likely to be aware of erosion issues as traditional farmers. Agritourism – hobby farms for people to visit can also be problematic because high density livestock live on poor soil and conservation is not currently a high priority in this business.

8. What range of potential investments would help you implement desirable, but currently underfunded, best practices?

Receiving \$20-30K/year above the \$10K that BCSWCD receives from the state would go a long way. However, receiving significantly more money would be difficult for their current staff to manage. For example, having \$100K available would require additional staffing to manage the projects.

9. Questions/Comments

How do people start BMPs? BCSWCD works closely with NRCS. NRCS programs are what BCSWCD promotes because funding is more consistent.

Word of mouth is how people find out about the programs. Crop or forestry consultants refer landowners to NRCS and BCSWCD. New people find out through workshops, newsletters, and landowner site visits where BCSWCD makes others aware of funding available.

NRCS has a list of BMPs that are possible. SWCD also funds a lot of pollinator projects. Depending on the location of the pollinator garden, it may or may not have a great impact on water quality as these are not necessarily along streams.

Driveway construction and maintenance and trails for logging or recreation are also concerns for water quality. Often, projects don't have drainage or culverts causing gravel and sediment to enter roads and streams. This would be a potential BCSWCD opportunity to help with water quality. Need to determine whether it is a water quality improvement versus personal property improvement. A driveway won't be funded through NRCS, so it might be more suited to a local mini grants program. NRCS programs can help with forest trails and recreation trails.

Appendix E

Conservation Practitioner Survey
For Lake Monroe 319 Watershed Plan

Terry Ault, District Manager
Jackson County SWCD
March 16, 2020

1. **What are the most effective practices you have used?**

   The Jackson County SWCD (JCSWCD) focuses almost exclusively on cover crops. In 2019, JCSWCD provided cost share for about 1,000 acres of cover crops. In previous years, grants provided funding for cover crops on 500 to 1,000 acres. Grants for 2020 will (cut-likely) offer landowners cost-share of $20/acre for cover crops up to 100 acres/person. The total grant amount is $40,000, shared with Lawrence County. JCSWCD portion is for cover crops (3-year grant and hope to complete in 1 year). Asked for $80K in funding and received half of the request.

   Some farmers see value in cover crops and will stick with it even if they don't get into a cost share program. Multiple farmers keep coming back for funding.

   Funding is a great resource in getting more cover crops on the ground. The JCSWCD is not aware of a need for other conservation practices because they don't survey landowners.

   The JCSWCD has a grant to get log jams out of the river and is also active with the local Cooperative Invasive Species Management Area (CISMA) helping with invasive weed control.

   JCSWCD rents no-till drills, straw crimpers, and other equipment to farmers to assist with conservation farming practices. This rental equipment is available for farmers to rent.

   Charles Garrett, the new USDA Natural Resources Conservation Service (NRCS) representative, started in April.

2. **What practices have not worked?**

   JCSWCD has only worked with cover crops. Farmers turn in invoices and their seed tags, then JCSWCD checks to see that the right amount of seed has been applied for cover crops before payment is made.

3. **Are there successful conservation practices being implemented by other agencies or groups that are not coordinated through you?**

   Through NRCS, landowners can get support for timber stand improvement as well as for other agricultural best management practices (BMPs) beyond cover crops. NRCS has other programs and can provide better cost share rates for waterway improvements, filter strips, cattle watering systems, heavy-use pads, roof runoff, access roads.)

   NRCS provides the SWCD office space where Terry works.

   NRCS works with the Indiana Department of Natural Resources (DNR) forester and wildlife biologist to develop forestry plans and wildlife enhancements.

Requests for funding and support for fencing installation go to NRCS.

The JCSWCD doesn't have any way of knowing the dollar value of private funds invested in conservation practices for protecting water quality.

4. **What current levels of investments in conservation are being implemented through your programs?**

   State funds are provided for SWCD operating costs through the Clean Water Indiana (CWI) grant. JCSWCD uses the funding of about $10K from the state of Indiana for office supplies, equipment repair, and cover crops.

   CWI grant funding of $20K is dedicated for cover crop implementation, and forage and biomass plantings. Lawrence county landowners mostly request for forage and biomass plantings and Jackson County landowners request cover crops.

5. **What agencies are funding the current level of conservation in your programs?**

   Clean Water Indiana and JCSWCD are the primary funders of JCSWCD work.

6. **Are investments in conservation mandatory if funding is provided, or are all practices voluntary regardless of whether funding is provided?**

   All programs through the JCSWCD are voluntary. Email newsletter, Facebook, newspaper articles, are the primary ways that SWCD advertises in Jackson County.

7. **What kind of work would you like to implement to better protect Lake Monroe from nutrients and sediments in runoff?**

   JCSWCD believes cover crops, filter strips along the creek banks and grassed waterways would work best to capture sediment, which would help protect water quality. Not as many farmers come to SWCD from the Lake Monroe watershed area. Most participants in their programs are from the cropland areas outside of the Lake Monroe watershed.

8. **What range of potential investments would help you implement desirable, but currently underfunded, best practices?**

   Filter strips and grassed waterways would be beneficial. Keeping cattle out of streams by adding watering tank systems for farms and potentially heavy-use pads. JCSWCD would want to survey downstream farmers and agricultural landowners to assess interest in implementing other best management practices.

9. **Questions/Comments**

The farmers who most stand out as cover crop champions are in the eastern part of the county, outside of the Lake Monroe watershed.

Previously, JCSWCD has been part of a field day with a farmer who has cattle. The owner installed an access road, roof runoff practice (rocks placed under the gutter on the ground to protect the soil), cattle watering system, and believes some fencing. All those practices help to protect streams. In addition, they rotate cattle from one pasture to another to minimize grazing impacts. All these best management practices were projects supported through NRCS.

Appendix F
Conservation Practitioner Survey
For Lake Monroe 319 Watershed Plan

Martha Miller, District Manager Monroe County SWCD and Cara Bergschneider, District Conservationist Monroe County NRCS

1. **What are the most effective practices you have used?**
   For Monroe county USDA Natural Resources Conservation Service (NRCS): Cover Crops, Brush Management (woody invasive species control that seeks 95% reduction after 3-year treatment period), Nutrient Management, Access Control (which includes Fencing), Prescribed Grazing, Livestock Pipeline and Waterers, High Tunnels (hoop houses for specialty crop production)

   Soil and Water Conservation Districts (SWCD) and NRCS have the same customers, are co-housed in office spaces. Offer to support same practices, bigger practices are often deferred to NRCS. Locally, Monroe County SWCD (MCSWCD) has support and funding from Monroe County Stormwater. Smaller projects can be implemented more quickly with MCSWCD.

   MCSWCD receives funding from grants, County stormwater, and the state of Indiana. In 2012-2015, the MCSWCD had a 319 grant. Conservation practices in the agricultural world can be brought to bear in urban spaces too.

   Top practices for MCSWCD: Invasive species control impacts runoff and erosion, pollinator habitat, forest management, cover crops, row crop practices, critical area plantings. The practices are very specific to the different sections of watershed, meaning that effectiveness of the practice varies from region to region.

2. **What practices have not worked?**
   Honestly, NRCS would say that *all of the conservation practices work effectively* for the intended purpose when they are implemented correctly and maintained appropriately. The failure of conservation practices occurs mainly through mismanagement of the practice.

   Smaller crop fields with woodlands nearby makes aerial application of cover crop seed difficult; this can happen in the more wooded areas of Monroe and Brown Counties.

   Maintaining the practice is the key part of achieving the conservation goal of the practice.

   Cover cropping is relatively inexpensive but is a big management shift in how a landowner is managing their land. Addresses soil quality, soil erosion, wildlife habitat, soil compaction, air quality – there are many benefits from this practice. The education to help landowner continue with the practice is key to keep practice in place after funding is complete.

   Grass waterway can be $1,000-10,000 and is a one-time practice that has a more permanent long-term benefit. By comparison, cover crops can be applied for the same budget, but continued implementation after the cover crops are applied is what leads to success.

Programs with MCSWCD and NRCS are voluntary. Staff work with landowners over long periods of time to continue to work on buy-in for practices. Funding helps those who are most interested to implement.

3. **Are there successful conservation practices being implemented by other agencies or groups that are not coordinated through you?**

YES! Invasive species control through MCIRIS; wildlife-focused practices through US Fish and Wildlife Service (FWS); forest management through TNC; Forest, wildlands and wetland management through Sycamore Land Trust; Conservation practice education through Purdue Extension; Urban conservation through Neighborhood Tree Planting Project, City of Bloomington Parks and Rec and Bloomington Community Orchard; Small farm conservation practices implementation and education through IU Campus Farm; Classified Forest and Wildlands program through DNR; invasive species control, identification and replacement through Southern Indiana Cooperative Invasive Management (SICIM). I'm sure I am forgetting groups- these are just what come to mind immediately. Aren't we lucky in Monroe County!!!

MCSWCD also works to partner with other agencies to promote others' efforts and collaborate on conservation programs.

4. **What current levels of investments in conservation are being implemented through your programs?**

The NRCS dollars obligated (different than practices implemented) for conservation program contracts in Monroe County for the last 5 years:
2015: $122,635
2016: $81,811
2017: $ 301,339
2018: $141,444
2019: $445,523 (includes 200-acre forest for invasive species control and forest stand improvement)

NRCS funding obligated varies with interest of application to participate in programs. It also varies with funding available to Indiana through the federal Farm Bill, and also depends on the relative ranking of proposals received by NRCS (e.g., forest applications compete w/other forestry applications in 23 county area; ranked projects receive funding until all funding in that category is gone). Other applications such as specialty crop applications compete with others from around the entire state. The best applications include producer practices that landowners are most excited to implement on their land. NRCS help applicants assemble strong applications.

Brown County almost always gets funding for forest stand improvement and invasive species removal due to its unique geographic location: it has 303d impaired waters, home of several endangered species, proximity to public lands (has greater impact). On the other hand, Monroe will rank more like other counties due having fewer unique geographic factors.

Smaller acreage farms are predominant in Monroe and Brown Counties. A farm of 200-300 acres is considered a larger farm for Brown or Monroe Counties, while a large farm in other counties would be over 1,000 acres.

For MCSWCD, funding is from a variety of sources: grants, Marion County Stormwater, state of Indiana.

5. **What agencies are funding the current level of conservation in your programs?**
NRCS: 100% of program funding

NRCS partners with National Wild Turkey Federation to employ a Forester to assist with forestry related practices and education in a 10-county region (Monroe included).

NRCS partners with Pheasants Forever to employ a Wildlife Biologist to assist with wildlife related practices and education in a 12 (??) county region (Monroe included).

6. **Are investments in conservation mandatory if funding is provided, or are all practices voluntary regardless of whether funding is provided?**
The goal of NRCS's primary program, EQIP (Environmental Quality Incentive Program), is for the NRCS to provide 75% of the funding for a conservation practice and the customer to provide 25% of the resources. All NRCS programs and practices are voluntary.

MCSWCD practices are also all voluntary. 75-80% of the work is education, and the remaining 20-25% of the work provides funding to help the landowners implement practices. For a project to be successful in the long-term, it is Important for the landowner to have buy in, whether through their time or own investment.

7. **What kind of work would you like to implement to better protect Lake Monroe from nutrients and sediments in runoff?**
EDUCATION!!! On all conservation practices that improve soil and water quality while reducing soil erosion. And not just NRCS doing the work - others can help too.

NRCS has maximized their capacity with the current staff. Interest in and awareness of NRCS programs is very high. Monroe and Brown County NRCS applications are being rolled over into the next year. The local team has requested additional staff: Monroe and Brown County had the 2nd largest number of contracts 2 years ago, and the 3rd highest number of contracts last year. To be able to help more applicants with their applications for funding, more staff would be needed. Brown County customers are at a disadvantage because NRCS staff is not located in their county. People seem to be more comfortable being able to work directly with staff. The local SWCD very successfully refers customers to NRCS for their programs, and Cara spends one day every 2 weeks at the Brown County SWCD office to stay connected with Brown County SWCD and customers interested in programs. Monroe County customers text and email; Brown County customers seem to prefer to visit more in person. There is also more potential for more livestock work in Brown County.

Regarding prescribed grazing, fencing to subdivide pastures allows grazing animals to rotate their grazing location (prescribed grazing) to keep root mass intact. External fencing for a livestock operation is not typically funded, so most of the NRCS work is with already established farmers to achieve prescribed grazing. EQIP funding can help if a landowner is converting highly erodible land to pasture. Rotational grazing is a valuable conservation practice, though it is more difficult to implement, because landowners often consider the practice to be adverse.

Helping people understand the connection between healthy soil and the quality of our water. Soil health is so important for healthy water. Fixing water quality is a great goal, and helping soil be healthy is the first step.

8. **What range of potential investments would help you implement desirable, but currently underfunded, best practices?**

People know about the NRCS programs and are applying. NRCS needs help processing applications from those who are interested to implement the practices.

MCSWCD would appreciate help promoting their local programs. Would also like a technician locally to help with practices in both the urban community as well as to follow up on projects that are being implemented.

9. **Questions/Comments**

NRCS is leveraging all the federal resources that are available, with the resources that they have available. Potentially, there could be more NRCS funding invested in Monroe County or the Lake Monroe watershed if there was more NRCS staff to assist customers in the application and implementation process. The interest in the NRCS programs exceeds the capacity in NRCS' Southwest Indiana 23 counties that include both Brown and Monroe Counties.

If the local SWCDs were able to have another technician trained to support NRCS, this could be one way to approach the staff need. This may be the approach that Lawrence County has taken.

Lessons learned from Martha's experience with the Bean Blossom Creek 319 project process: a plan was created outside of the soils & water conservation expertise, and the report needed to get the right practices listed in order to qualify for implementation. Eventually Monroe County SWCD hired a watershed coordinator to write plan, a living document. The next phase of funding is 319 implementation dollars, and those are often are started through SWCDs in Indiana. To go after 319 implementation funding, it is important to include what you want to implement. No septic systems should be included; the 319 funding is not available to invest in septic system improvements. If there are MS4 (for cities >10K) that include specific practices in their plan, those same practices cannot be in the 319 plan.

Suggestion for the TNC/FLM team: Incorporate cropland and livestock producer perspectives? Cara can provide a recommendation.

The Nature Conservancy Indiana	Appendix G **Conservation Practitioner Survey** **For Lake Monroe 319 Watershed Plan** Jerry Hartley, Chief Environmental Branch, National Guard Indiana Camp Atterbury, Department of Defense June 2, 2020

1. **What are the most effective practices you have used to manage your land to protect water quality?**

Camp Atterbury is in the northeastern most part of the Lake Monroe watershed. At about 35,000 acres in size, only the southwest corner of the property is within the Lake Monroe watershed. The southwest portion of the property is also near Whippoorwill Woods, a nature preserve owned and managed by The Nature Conservancy. This area in the southwest portion of the property drains to the North Fork of Salt Creek.

Camp Atterbury, together with Muscatatuck, serves as a major training site for the US military "providing realistic venues for live, virtual and constructive training and testing events in order to increase training readiness, attract commercial defense industry participation and build strategic partnerships.[1]" Training is the first mission of Atterbury-Muscatatuck. In addition, the Department of Defense (DoD) places high value on protecting the threatened and endangered species on Camp Atterbury. The US Fish & Wildlife Service (USFWS) regularly partners with Atterbury-Muscatatuck to assist with the protection of habitat and species that live on their properties.

Indiana Army National Guard (INARNG) has a vested interest in the water quality entering and leaving the Camp Atterbury property. Sustaining the land is a vital activity because the land is the only property for training. INARNG consistently uses buffered setbacks on streams, maintaining 100 feet of buffer on both sides of perennial streams as the primary strategy. On intermittent streams, a 50-foot buffer is applied. The training live fire range is a large tract of land cut into a contiguous tract of hardwood forest. The range is an intense use of training land, which is in the Lake Monroe watershed. The areas that drain to the Lake Monroe are mostly forested. INARNG monitors the water quality leaving the property and reports that the water quality leaving the property is better than the stream quality entering the property for a number of parameters.

During training exercises, soldiers are trained not to drive through streams for maneuvering except at designated, hardened crossings. Where stream crossings are made, INARNG seeks to construct each crossing with best management practices (BMPs), such as three-sided culverts, to minimize stream erosion and maintain natural stream bottoms. Also, the INARNG standard training procedures instruct the soldiers to not discharge pyrotechnics near or in surface waters.

A significant portion of the property is forested. For forest management, the INARNG follows Indiana Department of Natural Resources (DNR) and USFWS BMPs. The Indiana bat, a state and federally listed endangered species, lives at Camp Atterbury and the INARNG must manage the property and its activity to protect Indiana bat habitat. INARNG follows the USFWS Bloomington Field Office

[1] https://www.atterburymuscatatuck.in.ng.mil/

guidelines for forest management to protect the Indiana bat, and implements BMPs to protect storm water from pollutants. Prescribed burning is used in some areas of the property, generally on open grasslands and ranges. For example, to reduce risk of fires starting and spreading out of control due to a training activity on the fire range, INARNG conducts prescribed burns to minimize available fuel on or near the firing rage.

INARNG and the Army maintain a goal to continuously reduce the total pounds of pesticides applied to the property year-over-year. NGI accomplishes this through adaptive management and integrated pest management strategies.

2. What practices have not worked or do not seem efficient?

INARNG controls the number of vehicle crossings, and uses a variety of practices in the design of those crossings. Cable-concrete crossings (example here) are good for vehicle crossings, but very expensive and very difficult to install correctly. Cable-concrete crossings are very heavy and cumbersome to work with, but very effective at protecting the bottom of the stream. Fish and water can flow through the crossing. The budget to implement this best practice is limited, which sometimes means that culverts or bridges must be made with other designs. Army Construction Engineering Research Lab researches and designs solutions similar to the cable-concrete stream crossings so that the Army will be able to implement best management practices that sustain the environment while achieving the military mission.

3. What agencies are funding the current level of watershed conservation in your programs? What is the approximate annual investment from your programs in watershed conservation practices?

At Atterbury, the land is federally owned. The National Guard Bureau, through a cooperative agreement with the State of Indiana, funds all work performed at the site for both mission-driven training activity and land and water protection. The budget includes professional services, employees, goods & services or equipment for land management and environmental protection. The training program budget also covers Integrated Training Area Management (ITAM) to restore damage caused by training. Annually this budget is in the range of $100,000 - $300,000 per year across the entire Atterbury property. An estimated 1/6 or 1/7th of the property acreage lies within the Lake Monroe Watershed.

Jerry's staff in the Environmental Branch acts as an internal consultant to Atterbury-Muscatatuck assisting with both EPA and IDEM compliance. Generally, conservation work done on the property is completed in-house. One example of an ITAM project is the new helicopter landing zone. The staff used an adaptive management approach in the implementation of the helicopter landing zone, and in the process, removed invasive species from the entire area, then replanted with native seed mixes. In other projects for large fields, the staff have applied cover crops on a field to retain soils and improve soil health.

4. **What kind of work would you like to implement to better protect the water quality of Lake Monroe?**

With the training that occurs at the range, there is intense use of the stream crossings, including daily military traffic. Being at the upper end of the watershed, INARNG seeks to replace some of the water crossings with three-sided culverts. As existing stream crossing designs reach the end of their life cycle, INARNG wants to replace them with improved designs such as the three-sided culverts that stabilize the stream bed while allowing water and aquatic life to pass.

5. **What additional investments would help you implement desirable, but currently underfunded, best practices?**

As a branch of the US military, it is required that the Army pays for improvements in their property themselves; funds from outside the federal budget are generally not able to be invested. One example of a way that partners could collaborate at Atterbury would be by providing in-kind assistance with clearing of invasive species or land management practices.

6. **Do you offer matching funding programs that could be leveraged to protect water quality in Lake Monroe on private land?**

The DoD has a few programs that could be available.

The Army Compatible Use Buffer (ACUB) Program[2] is a tool to protect an installation's accessibility, availability, and capability for training, testing, and operations by sustaining natural habitats, open space, working lands, cultural resources, and communities. It forms an integral component of the Army's triple bottom line: mission, environment, and community. The ACUB program achieves conservation objectives and supports the Soldiers' combat readiness training through partnerships with public and private organizations and willing landowners. For example, a private landowner adjacent to Atterbury could receive a fee to do something besides a non-compatible use (e.g., not a mall or retirement home because that would not be compatible w/training mission). Wildlife habitat and forest conservation would be examples of ACUB buffers to help limit encroachment.

Readiness and Environmental Protection Integration (REPI) Program[3] is intended to address encroachment that can limit or restrict military training, testing, and operations. The REPI Program protects military missions by helping remove or avoid land-use conflicts near installations and addressing regulatory restrictions that inhibit military activities. One program within REPI, the Sentinel Landscape Partnership, promotes natural resource sustainability in areas surrounding military installations. The Partnership identifies opportunities that benefit national defense, local economies and conservation of natural resources. With this program, Camp Atterbury could pay landowners to set up or implement practices.

Currently, the INARNG Environmental Program is understaffed to deliver on the work that they already have on-site. The Environmental Branch wishes to use these programs but anticipates needing some time to be prepared to use these programs.

[2] https://aec.army.mil/application/files/8715/0170/0424/eoys-fy12.pdf
[3] https://www.repi.mil/

7. Questions/Comments

Jerry offered to host visitors for the 319 project if there is interest to see Camp Atterbury.

The Nature Conservancy Indiana	Appendix H **Conservation Practitioner Survey** **For Lake Monroe 319 Watershed Plan** Hoosier National Forest Mike Chaveas and Chad Menke May 29, 2020

1. **What are the most effective practices you have used to manage your land to protect water quality?**

The US Forest Service (USFS) uses a wide variety of best management practices. From the USFS website: *The National Best Management Practices (BMP) Program was developed to improve management of water quality consistently with the Federal Clean Water Act (CWA) and State water quality programs. BMPs are specific practices or actions used to reduce or control impacts to water bodies from nonpoint sources of pollution, most commonly by reducing the loading of pollutants from such sources into storm water and waterways. BMPs can be applied before, during, and after pollution-producing activities to reduce or eliminate the introduction of pollutants to receiving waters.*

When it comes to USFS forests, there are many uses of the land, and the required BMPs are defined according to the activity. Practices related to vegetation management or timber harvest are certainly a part of the USFS National BMP Program (such as water bars or reseeding after a harvest), but there are many other activities where BMPs are implemented. For example, BMPs are also defined for aquatic ecosystems, chemical use, facilities and nonrecreational special uses (e.g., utility rights-of-way, research equipment or structures), recreation (e.g., camping, trails, motorized vehicle use) and road management.

As an example, for some USFS forests, the land is fragmented, and private land is interspersed between forest properties such that the USFS must provide access to the property owner through the national forest. In this case, the USFS uses BMPs for road location and design, road construction, stream crossings, snow removal, and storm damage as they manage such an access road. There are also BMPs for decommissioning roads and redirecting traffic when a road is not accessible.

Similar BMPs apply to trail design, installation, and maintenance, and to repairing levees on a pond. The objective is always to stabilize areas disturbed by management activities as soon as is practical. To properly apply the BMPs in a given location, a site assessment is needed, and the USFS team regularly conducts site assessments when work is happening on their land.

Common soil and water mitigation BMPs from post-project disturbances that are applied in the Hoosier National Forest (HNF) include revegetation by seeding & mulching, silt fencing, armoring stream banks and slopes, drainage restoration so that natural drainage flow is not interrupted, repairs where erosion is already happening. Keeping natural waterways open is important to minimize channel erosion. BMPs are listed in the Hoosier National Forest's Forest Land and Resource Management Plan.

Regarding trails, the HNF Recreation group oversees the implementation of BMPs for those trails, with advice from Forest Hydrologist as needed. Authorized trail uses include horseback riding, hiking and mountain biking. Often, the trails have disturbances and the USFS will identify problem areas for relocation or improvements. In the Indiana climate where there is rain and trails become muddy maintaining these trails is difficult, especially when it is overused. HNF Staff in both the Tell City and Bedford offices address trail maintenance needs. When trails are too wet, the HNF will close trails to protect the forest's soils from compaction and rutting, which could contribute to accelerated erosion and sedimentation.

When contracting for project, the HNF prepares National Environmental Policy Act (NEPA) documentation. At the project start, HNF staff (often Chad, though many employees can conduct inspections and report any issues) will visit the site to verify that practices are in place. As a project progresses, HNF staff visit regularly, often daily, to observe that BMPs are in place. At the end of the project, a HNF staff member observes and monitors that BMPs are implemented and working effectively. Contractors that work with HNF know the requirements and realize the importance and take pride in the work. Many people on the ground to verify performance.

Per their agreements, contractors are required to meet BMP requirements. This may take the form of cleaning equipment, repairing damage from the activity, completing the project correctly. Timber sales contracts with the HNF include legally binding requirements to implement BMPs, and contractors can be held liable for damages or failure to complete the project. Although it happens rarely, a blatant error in failing to implement BMPs can lead to financial penalties or, in severe cases, a contractor being banned from future federal work. Most contractors who bid know the USFS rules and know how to complete the work following the necessary BMPs.

2. **What practices have not worked or do not seem efficient?**

Around Lake Monroe, a major source of sediments is coming from shoreline. The first so many feet from the shoreline is very difficult to protect because wave action constantly erodes the shoreline. The HNF sees shoreline erosion on their property that is adjacent to the lake.

A specific example is the peninsula in the Deam wilderness area. It experiences heavy recreational use and the shoreline erosion there is very difficult to stop. The Recreation (Rec) group within the HNF continues to seek new ideas to address this. One approach would be to consider a soft "hardening" of the shoreline, in contrast to the hard rip rap that bounces waves from one shoreline to another, as opposed to softening the wave action altogether. This is an area where HNF continues to look into economically viable new ways to implement erosion control.

Stream banks are also very difficult to maintain. The best approach is to maintain riparian area on the stream banks with trees. Once trees on either side of the stream are cut, the protection for the streams is gone. Native grass plantings don't hold the soil as well as the trees. A woody riparian area is vital for protection of the stream banks. The USFS has a set of BMPs for riparian management corridors.

3. **What agencies are funding the current level of watershed conservation in your programs? What is the approximate annual investment from your programs in watershed conservation practices?**

The most significant funding to the HNF is by congressional appropriations. One budget category is dedicated for watershed protection activities, but other funding categories also are directed toward watershed protection. For example, improving roads and access routes after timber harvests is a conservation measure that is in another funding bucket. In a timber contract, the contractor must meet BMPs as part of the work, though funding for the project is not specifically from the watershed protection budget.

Another smaller funding source is from stewardship contracting. In stewardship contracting, the contractor removes trees in exchange for conducting restoration or conservation actions, and if the value of the timber exceeds the services outlined in the contract, the Forest can retain the additional funds (known as "retained receipts) and apply those to other restoration work, often associated with watershed improvements and erosion protection, elsewhere on the Forest. The work funded with retained receipts can even be for non-USFS land if the project also benefits a USFS property or resource. In Indiana, stewardship harvesting is not as common, so HNF doesn't have as many retained receipts. HNF follows an internal process to decide on investments to be made with retained receipts. In Indiana, there is not a collaborative group work with HNF on these topics, though an attempt was made several years ago to form such a group.

Projects are also funded by USFS internal grants known as "joint chiefs projects", where partners collaborate to fund specific projects. The HNF and IN NRCS were a recipient of such additional funding from 2016-18.

Other investments are made by others. If a utility right-of-way traverses USFS property, then the utility pays for the maintenance of property and required BMPs. For example, if the utility mows, then ATVs decide to ride on the mowed pathway, erosion can be induced and the utility will work to resolve the erosion problem.

Locally, the National Wild Turkey Federation has contributed to projects that aid in habitat restoration, working in collaboration with the USFS biologist. Nationally, many partner organizations fund water quality related projects on NFs.

4. **What kind of work would you like to implement to better protect the water quality of Lake Monroe?**

Habitat restoration. In other regions of the US (e.g., Oregon), groups help advise and make recommendations on use of USFS timber receipts. For example, Trout Unlimited and others provide funding and USFS staff can match contributions with their time to accomplish mutual goals. In Indiana, there are not as many fishing groups interested to support these projects.

Floodplain restoration. Channel incision is prevalent in Indiana, as streams are made to be straight and open for drainage purposes. In Indiana forests, riparian vegetation is crucial in stabilizing stream banks that connect the channel to its floodplain instead of allowing for barren channelized ditches. Wetland and floodplain restoration can keep the wetland and riparian areas functional, slowing the water and capturing excess nutrients and sediment.

USFS has a long list of projects that they would like to implement when funding becomes available: aquatic organism passageways (AOP), dam removal, re-routing of trails. Each can help protect water quality but only limited progress can be made each year with HNF's federal appropriation. HNF will gradually chip away at their project list with annual appropriations, sometimes supplemented with internal competitive grants, and partnership funding.

KV funds come from more traditional timber sales and can be available to do more reforestation and restoration work.

5. **What additional investments would help you implement desirable, but currently underfunded, best practices?**

Acquiring new land to add to the HNF ensures that the land remains forested for the long term. This is a more expensive investment and is funding dependent. HNF is continually acquiring land annually to add to the NF, on a willing seller basis. ~470 ac. have been added in the Lake Monroe watershed in last couple of years.

Another source of funding that HNF is trying to tap into is the State In-lieu Program for stream mitigation credits to get projects done on forest land. It is a newer program and HNF is working to establish a partnership with this program currently. Watershed projects are sometimes the most expensive in the forest which is why this may be a good potential source of funding for future projects. Basically, when other landowners do an activity within the watershed on private land that impacts the watershed, they then pay the state for mitigation credits. The State of Indiana then pursues needed watershed mitigation projects within the same watershed and funds them. https://www.in.gov/dnr/heritage/8340.htm

6. **Do you offer matching funding programs that could be leveraged to protect water quality in Lake Monroe on private land?**

From the USFS State and Private branch:

The first is the Community Forest Program (https://www.fs.usda.gov/managing-land/private-land/community-forest/program). These are funds for targeted land acquisitions by non-federal entities. Can be tribal or county or municipal governments, or qualified conservation non-profits (which I think means land trusts) as long as land to be acquired will provide "community benefits", including provision of clean water. These require a 50:50 funding match and the land acquired must be at least 75% forested, under threat of conversion to non-forest uses, and once acquired needs to be open to the public. Parcels need to be at least 5 ac in size. There is not an upper acreage limit, but a cap of $600,000 max for any one grant recipient. Last year the call for applications came in August.

The other is a Landscape Scale Restoration (LSR) Grants (https://www.fs.usda.gov/naspf/working-with-us/grants/landscape-scale-restoration-grants). These applications must come through the DNR Division of Forestry and must support goals of the State Forest Action Plan, but they often originate from community based organizations, local governments or universities who work with the state to ensure their objectives are supported and ultimately are sponsored by the State Forester. The purpose of these is to support collaborative, science-based restoration of forested landscapes, to help ensure forests continue to provide public benefits, including wildlife habitat, watershed protection,

timber and fuel wood, and support rural jobs. These also require a 50:50 cost share. Grants can range from $25,000 and the max any one state can receive is 15% of the total appropriated by Congress for this program in a given year. This number will vary from year to year, but to give an idea of the ballpark, it appears the highest amount of funding received by any one project in this region this FY was about $398K. The program has a lot of resources and application guidance and aides, as well as info on all the funded projects over the last several years. Examples of uses include actions to improve fish and wildlife habitats, improve watershed function, mitigate invasive species, and prescribed burning for forest restoration. The State Division of Forestry is a key partner for the above programs. Also, retained receipts, described earlier, can be seen as a funding opportunity to support watershed protection efforts.
7. Questions/Comments A USFS philosophy is for continual learning, adaptive management, and to modify and experiment with practices to learn how to do the work better. This philosophy provide staff an opportunity to pursue innovative solutions. For example, Chad has been involved in a project to create log landings that also provide pollinator habitat. A recent press release describes the making of a log landing with biochar to help revegetate an area; the soil stays on site, and it helps reduce erosion and runoff. The HNF was innovative, producing biochar onsite to apply on this site to stabilize the soil, retain nutrients, and reduce runoff. http://www.wbiw.com/2020/05/22/hoosier-national-forest-contractor-tests-production-of-biochar-for-use-as-soil-amendment/

	Appendix I **Conservation Practitioner Survey** **For Lake Monroe 319 Watershed Plan** Doug Baird, Property Manager and Kevin Schneider, Assistant Manager Indiana Department of Natural Resources (DNR) Division of State Parks, Brown County State Park June 18, 2020

1. **What are the most effective practices you have used to manage your land to protect water quality?**

Brown County State Park (Park) includes 15,815 acres, most of which is heavily forested. The North Fork of Salt Creek runs through the northernmost portion of the park, while the southern portion of the Park drains to the Middle Fork of Salt Creek.

Within the Park, the Upper Schooner Creek has been dammed to create Ogle Lake. Ogle Lake is the source of water for the Park's drinking water treatment plant. During heavy rain events, increasing amounts of sediment are carried into Ogle Lake, where they eventually settle out. In June of 2019, a downpour event carried excessive sediment to Ogle Lake, overcoming the ability of the Park's small water plant to treat to drinking water standards. On June 16, 2019, the water treatment plant had to close, which meant that the Park also needed to close.

Since the 1960s, the Park has maintained a sewage treatment plant that treats sewage and graywater from the campgrounds, park offices, on-site residences, and the nature center. The horseman's camp has a separate septic system for treating the wastewater generated there. The Abe Martin Lodge sends its wastewater to the Town of Nashville for treatment.

Timber is not actively harvested from the park, though dead trees that pose a hazard to visitors or property are removed. Forest openings for overlooks are maintained by IDNR staff; trees and brush are removed from these areas by hand or using controlled burns. There are vegetated fire trails within the Park, though erosion rarely occurs around these trails.

Contractors who work in the Park are required to adhere to IDNR best management practices to prevent soil loss and erosion on their work area from affecting the quality of the water leaving the site.

The main approach to protecting water quality is to keep the soil stabilized to prevent runoff and erosion. DNR staff visit hiking trails regularly to repair areas with erosion or soil loss problems so that the soil can be retained. For horse trails, however, staff are not able to visit the horse trails regularly. On the horsemen's trails, the soil is exposed and becomes compacted with the footsteps of all the horses. When this soil becomes worn down, it is vulnerable to soil migration during flooding periods, though most of the soil is believed to stay on the property given the buffer zones between the horseman's camp and the streams.

2. **What practices have not worked or do not seem efficient?**

The horseman's camp is near Strahl Lake, which drains to Middle Fork Salt Creek, and includes 204 horseman's camp sites. During peak summer season, with an average of 3 horses per site, there can be as many as 600 horses in the area; there are significantly fewer horses there in the winter.

The primary maintenance for the horseman's camp is mowing the campground for horses and cleaning up horse manure. Previously, the horse manure was stockpiled for spreading in a field within the Park. The manure stockpile was vulnerable to water ponding following heavy rain events, and the ponded water would eventually trickle out and make its way to nearby waterways. The Indiana Department of Environmental Management (IDEM) reviewed the stockpiling practice and cited concerns of causing bacterial contamination in the waterways. Following their review, IDEM asked the Park to undertake a contract to have the horse manure hauled away. This practice of hauling the horse manure away from the site began in 2019. Currently, the Park staff are exploring options to have farmers haul it away for use in their fields, as the contract for hauling the manure represents a large expense for the Park.

The horse trails at the Park are heavily used. Horse crossings of creeks exist in numerous places and are especially challenging to maintain during the rainy seasons. The Park staff would like to have more resources available to monitor and maintain the horse trails.

3. **What agencies are funding the current level of watershed conservation in your programs? What is the approximate annual investment from your programs in watershed conservation practices?**

All funding for trail maintenance, which includes practices to minimize soil erosion, is from the State Parks budget.

Occasionally, federal programs have organized youth to assist with park maintenance activities. Young Hoosiers Conservation Corps was a program about ten years ago that engaged youth to work on hiking and horse trails at state parks around Indiana and that was a boost to trail maintenance in the Park.

The Hoosier Mountain Biking Association helped pursue funding to build a trail about 15 years ago. Volunteers have so far done all of the maintenance on the mountain biking trails (we now have 13 trails covering over 37 miles.) and have been doing a good job. The bike trails are well-designed and are sustainable designs when well maintained.

The Indiana Trail Rider Association helps with horse trail maintenance. Horse trail maintenance and repair often requires heavy equipment, so individual volunteers using rakes, shovels, etc. have limited capability when working on horse trails. The horse trails are not as well laid out, often following old county roads, fire breaks, or other pre-existing path without being designed especially for horses. The Park staff provides the heavier equipment for these repairs as resources allow.

Occasionally, the Park receives an allotment for supplies and materials that are needed for trail preventative maintenance work, though those allotments do not cover the hiring of staff to complete the repairs. When major trail restoration is needed, IDNR is careful to consider the appropriate cultural resources and archeological permits needed before proceeding.

4. **What kind of work would you like to implement to better protect the water quality of Lake Monroe?**

In the past, Indiana State Parks has kept a heavy equipment crew that moves from property to property and can help with trail alignment, erosion, and repairs. The availability of this crew has been limited in recent years due to limited State Parks budgets. In some places, horse trails are getting rough and need maintenance that is lacking due to the absence of the heavy equipment crew.

O'Bannon Woods State Park has developed plans to realign their horse trails to be more sustainable and reduce erosion; this was cited as an example of some work that staff would like to undertake at Brown County State Park. While the plans have been developed, it is unclear whether the work to install the new horse trails has been completed. At O'Bannon Woods, some FEMA funds that became available following tornado damage allowed new stone to be put on their horse trails along with the realignment.

5. **What additional investments would help you implement desirable, but currently underfunded, best practices?**

More funding for hiking trails and horse trail maintenance would be beneficial for minimizing soils loss from trails. The hills in the Park are steep, and erosion occurs, even in the heavily forested areas of the park, so care and maintenance of trails is an ongoing need.

6. **Do you offer matching funding programs that could be leveraged to protect water quality in Lake Monroe on private land?**

The Park does not have any funding of its own available to leverage other funding. Friends of Brown County State Park have implemented projects over the years such as a handicapped accessible hiking trail, and purchase of specialized rescue equipment that staff have not been able to purchase themselves. The group's primary mission is to support the education efforts of the Park nature center. The makeup of the group has been changing, with one or two members of the founding group remaining active, plus some new members; the group has been smaller and less active in recent years.

7. **Questions/Comments**

The Park does not have any active agricultural lands on the property.

Kevin noted that he has observed greenway programs/conservation districts that have been effective to teach citizens about leaving buffers between disturbed soil areas and streams (Pulaski County experience).

The Nature Conservancy Indiana	Appendix J **Conservation Practitioner Survey** **For Lake Monroe 319 Watershed Plan** Darren Bridges, Indiana DNR Division of Forestry, Fire Coordinator, Morgan-Monroe & Yellowwood State Forest June 12, 2020

1. **What are the most effective practices you have used to manage your land to protect water quality?**

Indiana's Logging and Forestry Best Management Practices: 2005 BMP Field Guide (BMP Field Guide) is what the Indiana Department of Natural Resources (IDNR) follows the guide for BMP implementation in their forestry work. The document not only guides IDNR's work, it also in intended to *serve as a model for other land uses. It is hoped that others will undertake similar approaches to control soil erosion and non-point source pollution.*

For logging done on IDNR property, this is the guidance used, whether the work is completed by IDNR or others. Some logging for pine removal is done with IDNR crews. It is required that someone on the logger's crew must have completed the logger training that IDNR gives. Loggers that have completed various levels of the IDNR Logger Training are identified on the IDNR website. A Trained Logger must be onsite all the time during an active logging project.

IDNR contracts require that loggers working on IDNR properties follow the BMP Field Guide. Throughout timber sale process, an IDNR forester goes out to inspect. Visits are daily for larger harvests, or approximately every-other-day for smaller harvests. Contractors are required to make a damage deposit payment that can be withheld or partially withheld if the BMPs in the BMP Field Guide are not followed. Any withheld portion of the damage deposit will be used by IDNR to make the repairs that protect from soil erosion and water quality degradation. The IDNR contracts and training requirements are intended to help contractors learn about and adopt best practices so that when the same contractors do work on private property, the same BMPs will be applied.

2. **What practices have not worked or do not seem efficient?**

The BMPs in the BMP Field Guide are effective for protecting water quality and for minimizing and controlling soil erosion. A critical aspect of the project during a harvest, however, is the oversight of a contractor's work to ensure that proper BMPs are in place at the onset and throughout the project. Contractor projects completed without oversight can lead to damage in the harvested area. For this reason, IDNR foresters regularly inspect contractor work during a harvest.

3. **What agencies are funding the current level of watershed conservation in your programs? What is the approximate annual investment from your programs in watershed conservation practices?**

IDNR employs two staff in Indianapolis who focus on watersheds and water quality. Their group generates reports related to forests and water quality, dedicating the equivalent of about an 0.25 full-time equivalent to watersheds and water quality in the areas where the IDNR Division of Forestry maintains properties.

Darren's team conducts inspections after a harvest, then sign off on completion reports for the contractor's or internal team's work. Approximately 6 months after the completion reports are signed-off, the IDNR Division of Forestry team from Indianapolis conducts a follow-up inspection of the harvested property to check on quality of the harvest site and report on the effectiveness of the BMPs used. IDNR will make updates to further protect the site from soil erosion if something is missing, though such intervention is rarely needed because the oversight is provided during the logging period.

4. **What kind of work would you like to implement to better protect the water quality of Lake Monroe?**

Prescribed fire is a tool that is not used enough, and more invasive control is needed. Prescribed fire promotes the growth of new trees, and especially helps to promote oak and hickory growth. IDNR uses prescribed fire to remove tree species that are more shade tolerant and to remove invasive species of undergrowth. This type of prescribed fire helps create the conditions where the more slow-growing oak and hickory species can grow. Prescribed fires do not "burn hot" like a wildfire. Prescribed fires are conducted on days (usually in the springtime) that keep fires from exposing the soil or roots of trees and plants.

5. **What additional investments would help you implement desirable, but currently underfunded, best practices?**

Additional funding to do more prescribed fire. IDNR is reasonably well-funded, but on private land, prescribed fire could be beneficial for improved control of invasive species.

Some funds are available through the Natural Resources Conservation Service's Environmental Quality Incentive Program (EQIP) for landowners to burn old fields or old season grasses, but not much funding is available private landowners. It can be expensive for private landowners to conduct a prescribed fire burn on their land, even though it is less expensive for private landowners to hire tree removal with heavy equipment.

The IDNR Forestry budget also covers horse and hiking trails, including inspections of the trails and stream crossings. IDNR has a staff member out once per week to check on trails. Hoosier Hikers Council also helps with trail maintenance to keep trails open. An additional seasonal staff member would help IDNR be able to respond more quickly to needs and keep up with trail repairs during peak season.

6. **Do you offer matching funding programs that could be leveraged to protect water quality in Lake Monroe on private land?**

From the IDNR website:

Logging operations in the State of Indiana are eligible to apply for cost-share dollars that will help defray the expense of BMP installations on harvest sites, depending on the location and timing of the harvest. Limitations are based on specific grant parameters and available dollars. The available cost share on each harvest operation is 75% of the actual cost of implementing the BMP's on the operation, not to exceed $650.

Cost share programs from other agencies are here: https://www.in.gov/dnr/forestry/2861.htm
7. Questions/Comments A general idea or observation: It is important to keep forests whole to protect the watershed. Much of the watershed is privately owned, and private landowners do rely on timber income. When considering incentives to participate in watershed protection programs, it is Important to protect the private landowner's ability to draw income. Without the ability to draw income, there may be financial motivation to subdivide property and sell off into smaller parcels.

Appendix K

Conservation Practitioner Survey
For Lake Monroe 319 Watershed Plan

Jim Roach, Indiana DNR
Division of State Parks, Monroe Lake
June 25, 2020

1. **What are the most effective practices you have used to manage your land to protect water quality?**

<u>Background</u>
An estimated 155 miles of the Lake Monroe shoreline are managed by the Indiana Department of Natural Resources (DNR). The only area not managed by DNR are the segments that the US Forest Service (USFS) owns and manages, known as the Deam Wilderness. The US Army Corps of Engineers (ACOE) owns the entire shoreline up to elevation 556 feet.

<u>Shoreline Protection</u>
Shoreline protection to minimize erosion using riprap has been a regularly used and effective practice. A large investment in shoreline protection was made at Paynetown in 1989, with the implementation of a $400,000 project to protect around the campground with riprap. When any equipment needs to work in the water or below the 530-foot pool elevation, the project requires a permit to comply with Clean Water Act Section 401; the DNR obtained this permit for the Paynetown shoreline stabilization project in 1989.

Since then, smaller projects have been completed around the recreation areas, such as the marina. The east side of the reservoir is more susceptible to erosion than the south side, because the east side experiences more wave action. In the 1990s, a private homeowner put in more than 800 cubic yards of riprap to protect a highly erodible bank below the property.

Since 1986, spring rains and runoff are increasing the frequency of high-water events. Even where major shoreline improvements have been made previously, the water level is now rising above those levels and compromising those formerly-stabilized areas. More recently, the ACOE has been advocating for the least disturbance to shorelines as a better approach to retaining soil and maintaining a shoreline.

<u>Boater Pump-out Facilities</u>
DNR also has found that the boater pump-out facilities are effective at protecting water quality in Lake Monroe. For larger boats that have permanently installed toilets on board, the wastewater sanitation tanks must be emptied periodically. By providing a free place to empty wastewater at the boat launch site, DNR helps assure that wastewater is treatment and managed according to Indiana Department of Environmental Management (IDEM) requirements and does not end up in the lake.

In 2016 IDEM provided a grant to replace the pump out facility at Paynetown SP. The Marina at the Cutright State Recreation Area, the Inn at Four Winds, and the Two Herons boat launches also have pump-out facilities. A fourth pump out, the Lake Monroe Sailing Association, just received a grant from IDEM to have a pump-out system installed. With any organization receiving an IDEM grant, a permit required to operate the pump-out facility, and IDEM conducts an annual inspection. Facilities cannot charge to pump out if they have been built using IDEM grant dollars.

In the early 1990s, the DNR conducted on-boat inspections on boats with toilets and gave inspection stickers. In addition, boaters may bring reports to Conservation Officers, who then will follow-up and conduct an inspection on boats where concerns have been identified. Occasionally the Conservation Officers will walk the docks. During Jim's time at Lake Monroe, they have never found a boat that has dumped its wastewater in the lake. The boaters do a good job of self-policing.

Activities on DNR-Managed Land

DNR has a management agreement to maintain and manage the entire land area around lake, except the immediate vicinity of the dam, which ACOE maintains. ACOE maintains control of access, trails, etc. within a certain elevation. For example, to build a driveway below elevation 538, ACOE requires a permit. Operation of the reservoir is determined by ACOE, which controls the water levels.

DNR has five management units in the property adjacent to the lake, where tenant farmers farm the land. Three units are in the North Fork sub watershed of about 600 acres (east of Bloomington to Nashville), and two units are in the South Fork that have been fallow for a few years. DNR works closely with the tenant farmers, especially in the North Fork region. The tenant farmers obtain a 4-year lease with DNR, and the farm using a DNR-specified rotation.

The leases require tenants to maintain fences, ditches, waterways. They must cultivate the property, and harvest crops in a timely manner. The four-year rotation is corn and/or beans for two years, then wheat in the third year, and the fourth year must remain idle.

The use of pesticides; if the farmer wants to use herbicides work with DNR, pesticides are much more restricted use. Manure application is not allowed, but the tenant can fertilize. The tenant must maintain a 35-foot buffer along streams or intermittent streams. DNR does not require complete no till and does not require cover crops except after beans have been planted. At least 10% of the farmed property must be left idle for wildlife, and DNR encourages that the wildlife-designated areas be maintained along streams. Livestock is not allowed on the management properties.

In two of the last four years, tenants in all units were not able to farm due to flooding. The two units in the South Fork have been fallow for several years and are currently returning to successional growth. DNR seeks to maintain some of these fallow areas in wet hardwood hickory-oak plantings, managing to reduce the amount of softwood maple, cottonwood, sassafras, sycamore and work towards hardwood forest.

There are no official horse trails on the DNR properties at Lake Monroe, though some illegal riding activity is suspected in the vicinity of Maumee and Houston.

2. What practices have not worked or do not seem efficient?

The projects implemented for shoreline protection, boater pump-out facilities, and the land management program for tenant farmers all have benefits that help protect water quality.

Trees or log jams in the streams will redirect flow into the banks. Removing these trees is labor intensive and sometimes requires special equipment, which also can disturb the soil. DNR does wish to remove the log jams, and has done so in the past, but more recently staffing has not been available to do log jam removals.

Notes on changing rainfall patterns and more intense rains:
Significant rain events in the past few years have particularly affected the north shore. Small stream stabilization projects that were installed previously and have been successful under less intense rainfall conditions have been overcome; the stream stabilization improvements have been washed away and can no longer be located.

In one example, the DNR planted willows along a 100-foot bank, 1 foot apart. The willow planting was installed side-by-side with an interlocking block structure. Both worked very well for many wet weather events. Then a heavy rainfall event came and brought the water level above both the willows and the block structures; both systems failed. Plus, the many beaver in the area liked cutting the willow.

3. **What agencies are funding the current level of watershed conservation in your programs? What is the approximate annual investment from your programs in watershed conservation practices?**

Funding for the operations of the Paynetown Recreation Area and management of other lands around Lake Monroe is from the Indiana General Fund. Some Pittman Robinson money for wildlife management comes through DNR Division of Fish & Wildlife. Mostly has been used to supplement salaries.

Occasionally, the Division of Parks, Monroe Lake will be included as a large line item in the state budget if there is a large capital project, such as for Paynetown shoreline protection. In the past four or five years, special allocations for projects dedicated to minimizing shoreline erosion have been included in the budget, providing about $30,000 to $40,000 per year. Those special allocations may be lost when the state budget is reduced, as is anticipated during this economic downturn following COVID-19.

The US Fish & Wildlife Service (FWS) provides financial assistance to DNR through the federal Pittman-Robertson and Dingell-Johnson Acts. These federal funds can be used to restore wildlife habitat or to acquire habitat that benefits Indiana Sportsmen. In Indiana, DNR uses Dingell-Johnson for fish restoration and related management plans or projects around the state, and occasionally (though rarely) some of the funding will be directed to Lake Monroe.

4. **What kind of work would you like to implement to better protect the water quality of Lake Monroe?**

A top priority for Division of State Parks, Monroe Lake is a program of reforestation in some of the smaller agricultural land units along the tributary streams that are leased to tenant farmers. Currently, the limitation to implementing this work is with staff resources. A recent retirement is leaving a gap in the staff, and with the state budget being reduced, the position is at risk of not being filled.

Jim observes that siltation is coming from stream bank erosion upstream, particularly when trees fall across streams and logs are not removed. The following year, the log jam increases in size, and the water begins to erode into the bank. It is labor intensive and expensive to remove log jams. DNR

would like to see a collaboration with soil and water conservation leaders to help local landowners and smaller landholders with log removal.
Additional shoreline protection at Paynetown is needed. There is another 2,000-foot section of shoreline that is highly erodible that Jim would like to see protected. The projects are complicated and expensive. Because heavy equipment must have access in and around lake, federal permits are needed to complete the work.

Horse trails around Lake Monroe follow old logging roads, county roads, and other access routes that were not intended to be permanent. Trails that are designed for horse traffic will help keep the horses on the trails and better protect water quality. By comparison, in Monroe County there are many hikers, and the trails are well-designed with water quality controls. They are also well maintained by volunteer groups like the Hoosier Hiking Council. Mountain biking clubs in the area have also developed trails in a thoughtful way that protects water quality. At Paynetown specifically, however, there are fewer hikers with most visitors being boaters.

5. **What additional investments would help you implement desirable, but currently underfunded, best practices?**

A different source of funding will be needed to implement the ideas mentioned in Question #4 above. Funding is expected to be limited with DNR budget cuts due to the economic downturn that has come with COVID-19. Wildlife management operations staff mow and reforest, and those positions are often the first place to be cut. Additional funding could help with equipment rental, personnel, hiring additional staff for maintenance. May need to use prescribed fire management approach with reduced mowing budgets.

To implement more shoreline protection, larger budgets are needed to complete the work.

6. **Do you offer matching funding programs that could be leveraged to protect water quality in Lake Monroe on private land?**

DNR Division of State Parks and Reservoirs does not have a matching fund program. Other DNR programs such as the Lake & River Enhancement (LARE) program. Ginger Murphy is recommended as a good contact for this program.

DNR applied for and received an ACOE Environmental Restoration Section 1135 grant, a funding source that supports freshwater wetland restoration, fish passage, and river restoration projects. DNR proposed the placement of sub-impoundments to slow siltation coming into the reservoir from the Crooked Creek tributary. By holding a few feet of water in shallow field impoundments, the design would have slowed flow following heavy rain events and sediments would be retained on the land. The seasonal flood plains around Crooked Creek would have been flooded; these areas are currently open and under water.

However, once the permitting process started, the project could not move forward. The ACOE permitting group had soil sampling concerns related to the Clean Water Act Section 401 (for water quality protection) and Section 404 permit (for dredging and fill material). The project was estimated to cost $6,000,000, and DNR had identified the required match to complete the application. The project would also have improved access to the Crooked Creek Boat ramp.

7. **Questions/Comments** – No additional comments.

The Nature Conservancy Indiana	Appendix L **Conservation Practitioner Survey** **For Lake Monroe 319 Watershed Plan** US Army Corps of Engineers - Louisville District Zac Wolf, Limnologist, Water Quality Team July 27, 2020

Background

The US Army Corps of Engineers (Corps) owns the land around the lake (as established by a specific water level designation) and leases it to the State of Indiana in a long-term lease. The Indiana Department of Natural Resources has been granted the lease to manage the recreation areas land.

The Corps Louisville District's Monroe Lake Master Plan (2016) gives these descriptions:

Excerpt from p. 1-9
Land for Monroe Lake was acquired according to land acquisition policies that called for fee acquisition to the five-year flood frequency line and flowage easement from the five-year line to an established contour four feet above the flood control pool. Then in 1961, a memorandum recommended fee acquisition to elevation 560 instead of elevation 551 because of terrain steepness in the river valley and its tributaries. Additional fee land was acquired where needed for recreation areas. Easements were acquired mostly for required road relocations. The total project area is 24,630 acres: 23,604 acres were acquired in fee, 11 acres are under flowage easement, and 1,014 acres are under use permit. There are 14,371 acres of fee land above the seasonal pool elevation.

Excerpt from p. 1-11
In 1967, Indiana Department of Natural Resources (IDNR) was granted use and occupancy of 22,663 acres of land and water areas for public park and recreational and fish and wildlife for 40 years. The lease was amended in 1989 to extend the lease term to 30 April 2032. Additionally, IDNR has agreements with various concessionaires for management of recreation areas throughout the project area.

Excerpt from p. 1-13
The lake has a recreational pool elevation of 538 above mean sea level (msl). At recreational pool elevation, the lake is designed for 182,000 acre feet of storage with 190 miles of shoreline. The lake is designed to provide flood storage from elevation 538 to 556 msl with a 258,000 acre feet capacity. The spillway crest elevation is 556 msl.

1. **What are the most effective practices you have used to manage your land to protect water quality?**

While Corps does not have specific criteria for managing the land that it owns around the lake for the protection of water quality in the lake, they do have operational criteria to minimize the impacts of the dams to downstream water quality (tailwater). The Corps also conducts monitoring of the water quality of streams flowing into the reservoir.

- Annually, Corps collects water quality samples from the reservoir, in the tributaries, and the tailwater.

- During thermal stratifications between about May and December, staff collect temperature and DO as close near the control tower (at various depths), as well as in the tailwater every two weeks.

Operationally, the Corps' priority of business is to mitigate flooding in downstream communities. The Water Management Section of the Corps was created to support management of the entire water system. The Corps uses models to analyze the system and strategize on the best ways to mitigate the effects of flooding in downstream communities, and a water control plan provides the Corps with a set of operating rules for the operation of the dam.

Water quality also plays a role in the operational plan; selective withdrawal capabilities can be used to meet downstream water quality criteria. The Corps maintains the tailwater temperature within a range specified in the lake's water control plan and operates to achieve dissolved oxygen (DO) above the state criteria for dissolved oxygen. Low flow restrictions do affect releases and can be a part of the operational objectives as well.

Relative to the land that the Corps owns around the lake, the authorized purpose of the lake (i.e., flood control) creates an understanding of what happens if there is flooding. No other specific requirements are in place for the DNR regarding land use on the land that Corps owns. In both Indiana and Ohio, the recreational facilities are leased to the state.

Examples of collaborative work to protect the watersheds where they work include the locks and dams on the Ohio river, the Corps has added more native vegetation along the river to add habitat for pollinators and reduce maintenance costs. In other areas, Corps has had partnerships to develop wetlands.

When it comes to bank stabilization projects, the Corps doesn't directly manage for shoreline erosion. The Corps gives permission via permits for others like IDNR or private landowners to construct bank stabilization projects, such as installing rip rap on shoreline. At Harden Lake (aka Raccoon Lake) there was a time where the Corps purchased the rock material and individual landowners did their own installation of the material. So historically, there have been examples of indirect support of mitigating shoreline erosion, but typically this work is not undertaken directly by the Corps.

Observations: Lake Monroe seems to have a better protected watershed with the higher level of forestation. However, in recent years samples collected from the tailwater have exceeded the acute aquatic criteria (IAC Article 2 – Water Quality Standards) for total copper (2018) and total iron (2019). These criteria are established by IDEM for water quality in point source discharges. The Corps tracks a few parameters relative those aquatic life toxicity-based water quality limits. Harmful algal blooms (HAB) are also a concern in Lake Monroe and the Corps is providing data collection support to Indiana state agencies.

USEPA maintains recommendations for nutrients in natural water bodies and streams, and the Corps references those when reporting on water quality. The 2018 Monroe Lake Water Quality report provides an example of how this data is gathered and shared.

More frequent, large rainstorm events from climate change are making the Corps' job of flood mitigation more difficult. These climate change-related events are causing the operational plans to need to be updated.

2. What practices have not worked or do not seem efficient? Question not applicable to the Corps' work.
3. What agencies are funding the current level of watershed conservation in your programs? What is the approximate annual investment from your programs in watershed conservation practices? The Corps' work is funded by the federal government. The Indiana Department of Natural Resources (IDNR) submits an annual management plan to the Corps that describes how they plan to manage the land that they lease. Zac wasn't sure if that document is publicly available but encouraged us to inquire with IDNR about it.
4. What kind of work would you like to implement to better protect the water quality of Lake Monroe? Collaboration with other groups in support of watershed plans is one way that the Corps can help with water quality protection. Most often this is accomplished with data collection and sharing from the Corps monitoring programs. One example of this type of collaboration is the Corps' work with the Salamonie River Watershed Group, where conservation, soil and water, Indiana DNR and the Corps collaborated to address HABs.
5. What additional investments would help you implement desirable, but currently underfunded, best practices? Question not applicable to the Corps' scope of work.
6. Do you offer matching funding programs that could be leveraged to protect water quality in Lake Monroe on private land? In a separate program (apart from the Louisville office) the Corps does provide planning assistance to states, local governments, other non-federal entities, and eligible Native American Indiana tribes for "the preparation of comprehensive plans for the development, utilization, and conservation of water and related land resources." Recently funded projects have included "the preparation of comprehensive plans for the development, utilization, and conservation of water and related land resources." In a Louisville example, the Corps provides matching funds to support a survey for a local watershed project. In addition, the Corps' Louisville District has an Outreach cost sharing program that can "help resolve water resource problems and provide reliable technical assistance", responding to the needs of state and local communities. The Outreach Coordinator, Brandon Brummett, can be reached at 502-315-6883 or brandon.r.brummett@usace.army.mil
7. Questions/Comments The Public Affairs Office within the Corps helps respond to questions about lake levels, water quality, and manages local websites and site-specific social media.

The Nature Conservancy
Indiana

Appendix M

Conservation Practitioner Survey
For Lake Monroe 319 Watershed Plan
Private Land Managers

Jeff Fisher, Jackson County
Private Land Manager
March 2, 2021

1. What are the most effective best management practices you have used on your land?

Jeff works for the Department of Agriculture's Farm Service Agency (FSA) in Jackson County. He is a farmer, though his Income comes from his FSA job. His farm is 120 acres, with 10-15 acres near Norman Hill in the Lake Monroe Watershed (along Tipton Creek near Kurtz that flows into Salt Creek). The rest of his farmland drains to a different watershed.

Some of the most successful practices that Jeff has implemented on his farm include feeding pads, cross fencing to prevent overgrazing, and ponds. While NRCS has now made pond construction a lower priority, when the pond was installed on Jeff's farm for the cattle to drink it was helpful for keeping water from the pastures from running directly into streams. Watering systems for the cattle, also called spring developments, were also very helpful for keeping cattle out of the streams in Jeff's property.

2. What are the biggest threats to your land? What practices have not worked?

The biggest threat that Jeff reports on his farm is cocklebur, which is a problem for cattle because it takes over the grass. However, Jeff has observed that turkeys love cockle burs because he sees large numbers of turkeys where the cocklebur is most prevalent.

On other farms, Jeff has observed landowners installing drain tiles, which draw the water away too quickly and do not allow for slower adsorption of the water into the soil. When crops are profitable, more farmers add tiling to their land to drain the water away more quickly and carry that water directly to the streams.

An example of a practice that didn't work well on Jeff's farm was a particular spring development (i.e., watering system). For this project, Jeff ran electricity over a hill to reach the watering system, and it required a fair amount of maintenance. Springs that work by gravity are less work, requiring much less maintenance.

3. What other successful conservation practices are being implemented by other landowners, agencies or groups that are not applicable on your land? Or that you are not implementing?

The Conservation Reserve Program (CRP) has been used by many crop field owners. When in the program the period is 10 years, and landowners are required to use filter strips and grassed waterways with their crops. Many of those farmers who Jeff knew to previously have their land in the CRP program have brought their land out of CRP and now cash rent the land to others to farm. Most of the filter strips remain, but the large parcels of cropland have been brought out of CRP. Currently, the prices of corn & beans are high, so more farmers want to grow corn and beans.

Bringing land out of crop or cattle production and into hay production is another effective practice to protect water quality. In the winter months, cattle trample the soil and make a lot of mud that exposes the soil to runoff.

Cover crops are also a good practice. The Jackson County Soil and Water Conservation District (SWCD) has seen a lot of use with cover crops. In the Salt Creek area of Jackson County, there are more bottomlands in trees and pasture. The cropland areas would be helped by the cover crops. The other areas are not planted to a crop and cover crop isn't needed.

4. **What investments do you make for the conservation or best management practices being implemented on your land?**

Now, Jeff is getting out of the livestock business and only has a few remaining cattle. His farm is in the grassland reserve program with the Natural Resources Conservation Service (NRCS), which means that the land has an easement that only allows it to be used for pasture or hay. This easement program offers landowners an upfront payment; in exchange, the farmer cannot build on the land and it must remain in pasture or used to grow hay.

Jeff noted that growing hay is a better practice, because the areas where cattle stand become a muddy mess, and water runs off carrying the soil with it.

5. **What sources of funding support implementation of the best management practices or conservation programs on your land?**

Through the Environmental Quality Incentives Program (EQIP), NRCS provides agricultural producers with financial resources and one-on-one help to plan and implement conservation practices. Through EQIP, Jeff worked with NRCS to install a cattle waterer; Jeff cleaned out his pond as part of the cost share, which was more expensive than the cattle waterer. Some programs offer financial assistance at 75% NRCS -25% landowner. The programs used to offer a 90/10 cost share, though most have now dropped to 50/50.

Jeff also participates in the Grassland Reserve Program through NRCS as described above.

A third program is the Conservation Reserve Program offered by the Farm Services Agency (FSA). As the enrolled landowner, he receives a cost share for installing the practice, plus an annual rental payment.

6. **Are the practices that you implement voluntary? Are any of the funding sources that you use contingent upon the best management practices that you are using?**

Yes, while the practices that Jeff uses on his farm are voluntary, some of the programs have strings attached. The grassland easement program mentioned above gives landowners an upfront payment. In exchange, the landowner cannot build on the land and it must be used for pasture or to grow hay.

7. **What kind of practices would you like to implement on your property to better protect Lake Monroe from nutrients and sediments in runoff?**

As mentioned previously, Jeff is getting out of the livestock business, understanding that cattle make the soil prone to runoff. With his land enrolled in the grassland reserve program, he will only be using his farmland as pasture or for hay.

8. **What resource concerns do you have related to implementing best management practices on your land? What support would help you or your neighbors implement desirable, yet unimplemented (if any), best practices on your property?**

When prices of corn and soybean crops increase like they are now, farmers like to plant. During these times, the incentives are not always enough to balance the higher value of the crops.

9. **Questions/Comments**

	Appendix N **Conservation Practitioner Survey** **For Lake Monroe 319 Watershed Plan** Gerry Long, Private Land Manager December 14, 2020

1. What are the most effective best management practices you have used on your land?

Gerry Long's property is in western Brown County, on the North Fork of Salt Creek between Jackson Creek Road and Salt Creek. The property is situated only a few feet above the flood stage of the lake; when Lake Monroe is at flood level, the North Fork of Salt Creek is about half full. Gerry originally purchased the property to be near Yellowwood State Forest and have access to horse trails. Gerry bought the land as a farm and wanted to grow trees.

Most of Mr. Long's work is with forestry practices. He has a lot of bottomland that has been reforested, which was done to 1) improve the forest, 2) to allow timber production in the long term, 3) provide wildlife habitat as the timber stand matures. Gerry notes that managing creek or bottomland forest and flood plain is different than managing upland forest. Bottom ground is most of Gerry's land.

Gerry's land is enrolled in the classified forest program with Indiana DNR. In exchange for developing a forest management plan by working with a District Forester and implementing BMPs, the enrolled land has low property taxes. Gerry appreciates the opportunity to get input from a professional to help manage the forest for his landowner goals.

Gerry has had several timber harvests, the largest of which was a harvest of silver maple, taken from a flat floodplain. The work was planned to be completed in the late summer or early fall to be able to work in dry conditions. During the timber harvest, Zac Smith, the Indiana DNR Division of Forestry District Forester for Brown County, observed the contractor's work to ensure that Best Management Practices (BMPs) were followed. An important aspect of BMPs in this situation was keeping tree tops out of the creek.

Gerry conducted a smaller "mature harvest" in the upland portion of his property a few years ago. Before beginning the harvest, he lined out the skid trails and log yard with the logger. The contractor had to close-out the tree harvest work with proper water bars on slopes, followed by grading and reseeding afterwards. Gerry's experience is that most loggers will do a good job of BMPs if they know it is important to the land owner to do so..

To maintain these trails after they are installed (they are permanent trails), Gerry keeps working on them to keep them from eroding. On his property, this has included the installation of water deflections/water bars, laying rough mulch or wood chips on the trail to keep it intact.

2. **What are the biggest threats to your land? What practices have not worked?**

Late winter/early spring right after a freeze-thaw, the runoff conditions are at their worst and it doesn't take much to move the soil. The late winter/early spring floods in Salt Creek also carry a lot of mud (near where Jackson Creek comes into Salt Creek). In areas where Gerry has added tree plantings with small vegetation, including downed brush and small trees from thinning, the streams are successfully slowed in their path, and after a flood, Gerry gains soil.

Gerry also loses a lot of soil from the creek banks. It is a natural state for the creeks to lose soil during high water. Creeks get the most erosion when high flow is at upper limit of creek banks. Brown County Hills are formed by erosion with water, wearing down the sandstone and soil.

3. **What other successful conservation practices are being implemented by other landowners, agencies or groups that are not applicable on your land? Or that you are not implementing?**

Indiana Forestry and Woodland Owners Association (IFWOA) members advocate for best management practices. IFWOA members tend to do things the right way to protect the land; most often damage occurs on private lands where the owners are not aware of the effects of their activity. Unfortunately, only a small percentage of private woodland owners belong to IFWOA. This is because the management of the forest/woodland is low on their priority list of personal concerns.

IFWOA encourages landowners to work with professional foresters and woodland managers. Many landowners don't want regulations. Education is important to invite owners to participate on a voluntary basis; it is important that any incentives or programs are not too complicated. Organizations such as The Nature Conservancy are working on programs to give education and/or incentives to private landowners to better manage the woodlands.

Other opportunities for improvement that are not necessarily related to Gerry's properties: improving the roads, expanding the amount of Conservation Reserve Program (CRP) acres, more streambank stabilization, increase riparian corridor plantings. In Jackson County, Gerry has applied for cost-share to remove invasive species.

About the Conservation Reserve Program (CRP): In exchange for a yearly rental payment, farmers enrolled in the program agree to remove environmentally sensitive land from agricultural production and plant species that will improve environmental health and quality. Contracts for land enrolled in CRP are 10-15 years in length. The long-term goal of the program is to re-establish valuable land cover to help improve water quality, prevent soil erosion, and reduce loss of wildlife habitat.[1]

4. **What investments do you make for the conservation or best management practices being implemented on your land?**

Gerry works to clean up his properties as best as possible by removing invasive species before new trees are planted in
Gerry puts management of the driveway up the hill to the house in this category. This is a steep gravel driveway that has to be routinely graded to divert the water off the side and prevent erosion.

[1] https://www.fsa.usda.gov/programs-and-services/conservation-programs/conservation-reserve-program/

5. **What sources of funding support implementation of the best management practices or conservation programs on your land?**

Gerry's forest is enrolled in the classified forest program, which prohibits livestock, building of structures, and several other activities. Zac Smith, DNR District Forester, visits the enrolled property at least once every seven years to update the property management plan and to oversee the classified forest program. This reduces state taxes for the acres enrolled in the classified forest program.

Some of the eastern portions of the property are in the Conservation Reserve Program (CRP) with NRCS because Gerry took some agricultural land out of production and put in tree plantings. Has also used a USF&W cost-share program for reforestation, to remove silver maple and plant more hardwoods.

Gerry observes that a lot of the forestry cost-share programs are investing more toward invasive plant species control, which is part of timber stand improvement. Gerry is concerned that we are not able to get ahead of the invasives yet believes that the current approach is sporadic. On his land, he tries to control invasives so they don't strangle trees. The 'endemic' invasives on Gerry's property are Japanese honeysuckle and multiflora rose. Japanese stilt grass is becoming endemic, and is endemic in Yellowwood State Forest. A number of invasives appear on Gerry's property and he attempts to control them. This is a difficult process because many come in with the flood waters and some spread from adjacent properties, e.g. along the road.

6. **Are the practices that you implement voluntary? Are any of the funding sources that you use contingent upon the best management practices that you are using?**

Yes, the programs that Gerry participates in are voluntary. To receive the state tax credits from the classified forest program, he must comply with specified management practices for forestry and avoid certain activities on the land (e.g., cattle grazing, constriction, growing Christmas trees).

7. **What kind of practices would you like to implement on your property to better protect Lake Monroe from nutrients and sediments in runoff?**

Another challenge that Gerry observes on his property is that that there is floodplain in the North Branch of Salt Creek that drains the northern half of Brown County. His property is near the 'end' of the drainage, i.e. shortly before it reaches the floodplain of Lake Monroe. Most of the soil lost during flooding is from stream bank erosion. However, the nature of the flooplain in this area (mostly silt clay soil, deep creek banks with little stone), makes any work for stream bank stabilization a major undertaking. Trees and brush on his property helps to slow the flow and filter out sediments and trash. However, any major work to slow sediments and trash has to be done higher up in the drainage area of Salt Creek.

8. **What resource concerns do you have related to implementing best management practices on your land? What support would help you or your neighbors implement desirable, yet unimplemented (if any), best practices on your property?**

Incentives for establishing more wetlands like CRP land. More incentive programs are a positive, though many of the incentives are not enough unless you are going to do that practice anyway. Not much farmland exists in Brown County because of the terrain, and what is farmable is directly in the floodway.

The tax base in Brown County is not great. A lot of land in the Lake Monroe watershed is in Brown County, but Brown County does not get much benefit from Lake Monroe. How do we connect the dots for landowners?

Gerry has reported to the Brown County Highway Department that Jackson Creek Road is frequently flooded. Jackson Creek Road is a gravel road and is an example of a road that gets washed out each time there is a heavy rain or flood. Every car that runs through it generates more mud, but there are not enough funds in the Brown County Road Department to address this road and the many others that are in similar condition.

Gerry has been part of an effort at Yellowwood, to reroute horse trails to help prevent their erosion. A group of registered volunteers is working to add switchbacks instead of allowing the trail to run straight. The volunteers also clear downed limbs that block the trails. The IDNR Division of Forestry's budgets keep getting cut, and they are short on help. Many of the skid trails, access roads and horse trails in the state forest follow the original county roads and farm access roads which were wagon roads that were placed wherever people could get through. Some have been rerouted to be more 'manageable', but more work needs to be done.

9. **Questions/Comments**

Would be great if more could be done to plant in the floodway lands that are right along the lake. Such plantings could include shrubs or mature trees.

Stream bank stabilization is an expensive effort to do well; it's not as simple as putting stone along the stream bank.

In Brown County, Gerry has also wondered if small coffer dams in some of the upper drainages could be installed to hold back some of the sediment or filter out sediments instead of trying to stop the water entirely.

Appendix O

Conservation Practitioner Survey
For Lake Monroe 319 Watershed Plan

Kenny Wagler, Brown County
Private Land Manager
December 2, 2020; revised June 21, 2021

Introduction

Kenny Wagler's property has been a family farm since his father arrived in Brown County area in the 1950s; Kenny joined his father in the farming business in the 1970s. The land is in agricultural production, with the primary goal of raising dairy cattle. Part of the property is in the Monroe/Salt Creek watershed within Brown County and is farmed for livestock feed. The crops raised include corn, alfalfa hay, and soybeans.

The 750 milking dairy cattle and 750 growing heifers that eat this feed also reside in Brown County but in the Lake Lemon watershed, outside of the Lake Monroe watershed. The dairy cattle operation has a permit from the Indiana Department of Environmental Management (IDEM) and is inspected regularly by IDEM as a dairy operation.

1. **What are the most effective best management practices you have used on your land?**

In the past, fodder would be removed from the fields and put into silage, a practice which left the land bare. With assistance from the Brown County NRCS, Mr. Wagler now applies cover crops, which has been helpful to stop washes over the farm fields. With only a thin layer of topsoil, cover crops help retain this valuable resource. On some of the cropland in the Lake Monroe watershed Kenny had practiced minimum till for many years and now practices no-till, leaving corn fodder on the field and over-planting with cover crop. Occasionally, the fields will be tilled if the soil becomes compacted, but he prefers not to till. Kenny also works with a soil scientist to develop a precise formula for fertilizer application to the crops to avoid investing in fertilizer that would be vulnerable to runoff.

Generally, Kenny plants cover crops on manure ground (where manure from the dairy is applied) and ground where the corn stalks are chopped back. In other words, where the fields are made bare, that's where Kenny has applied cover crops to this point. There are a few fields in the Lake Monroe watershed where cover crops are not currently used, though Kenny is open to the possibility in the future; in these areas the corn is harvested by only removing the ear of corn, and the entire stalk is left in the field, making a corn stalk cover instead of a "live" cover crop.

In the Lake Lemon Watershed, the Watershed Plan was completed about 25 years ago. Kenny knows of a good example of a project implemented to protect a stream bank from erosion. In this example, downed trees and log jams were removed, then the creek banks were protected to better manage erosion.

2. **What are the biggest threats to your land? What practices have not worked?**

Some of the Wagler farm property is adjacent to Salt Creek. Log jams in the creeks are a threat, because they create dams that the cause fields to flood. When this happens, large flows can wash away creek banks and increase soil loss from the fields. Large equipment is needed to remove log jams and property access can be difficult, either due to the terrain or in obtaining permission from adjacent property owners.

To remove a log jam or woody debris that is impeding the flow of water, the landowner must obtain a permit from the Indiana Department of Natural Resources (DNR). A landowner cannot add riprap, concrete, or other slope stabilizer to stop erosion without a permit.

In Kenny's experience, healthy trees along the creeks and buffer strips are important to keeping the creeks clear. Once trees are compromised and they fall into the creeks, there is a negative effect. In one successful example where a log jam was removed near Kenny's farm, the streambanks were grassed afterwards.

3. **What other successful conservation practices are being implemented by other landowners, agencies or groups that are not applicable on your land? Or that you are not implementing?**

In the surrounding areas, no other farmers have the same business goals that Kenny has with respect to livestock and dairy farming, so there is not an opportunity to compare to other nearby dairy operations.

In some areas of his farm, crops cannot be rotated between corn and beans, so Kenny grows corn only. To grow corn in the Lake Lemon watershed fields, Kenny must apply organic material to the soil and can also put cover crop in to fix nitrogen over the winter. To apply the organic material from the dairy farm in the Lake Monroe watershed would require hauling it from 10 miles away, and it is too expensive for Kenny to haul that far. Therefore, Kenny is not applying the organic material (manure) from the dairy in the Lake Monroe watershed.

4. **What investments do you make for the conservation or best management practices being implemented on your land?**

Investments in conservation include cover crops, which Kenny has grown to love, especially seeing green fields in the fall and winter. Radishes are a frequently used cover crop that take up nitrogen to fix it in the soil, allowing another crop to be planted in the spring. Another family member farms DNR-leased farmland in fields that stretch between Nashville and Bloomington; all are planted in row crop, and most of those fields are planted with cover crop following harvest.

While incentive programs always help, the first and most important step is that the landowner wants to implement conservation practices on their land. There's more to farming than the dollar; many landowners want to leave an inheritance for a future generation or another person.

On the dairy farm in the Lake Lemon watershed, Kenny's cattle operation includes about five heavy use area pads to protect the soil from washing away after being disturbed by cattle hooves.

5. **What sources of funding support implementation of the best management practices or conservation programs on your land?**

Kenny has applied for and received funding through NRCS. He notes that most farmers won't use buffer strips along streams because it requires leaving acreage out of production which reduces yields. Incentives for the implementation of buffer strips are available through NRCS, but this incentive might need to be a bit greater to encourage more farmers to adopt the practice.

Cara Bergschneider's work in outreach and education at NRCS has been very effective in helping Kenny implement best management practices. In the past he has used Water and Sediment Control Basins, or WASCOBs (small grassy areas in low spots to slow water, carry it to a stable outlet and to help trap sediment/preserve topsoil) in hilly fields. Now buffer strips are used on his properties to protect the stream water quality.

6. **Are the practices that you implement voluntary? Are any of the funding sources that you use contingent upon the best management practices that you are using?**

All practices that Kenny uses on his farm are voluntary. The NRCS practices do have follow-up visits to verify implementation and discuss needs to carry the implementation forward into the future.

7. **What kind of practices would you like to implement on your property to better protect Lake Monroe from nutrients and sediments in runoff?**

Log jam removal is of great interest to Kenny, and he describes it as "a hot potato". Removing log jams is dangerous work; Kenny knows of someone who was trying to remove a jam and suffered a fatality. Support and resources are needed to do this work and do it safely.

8. **What resource concerns do you have related to implementing best management practices on your land? What support would help you or your neighbors implement desirable, yet unimplemented (if any), best practices on your property?**

On his own farm, Kenny has watched, lived and gained experience with different conservation practices. One thing that stands out is that information sharing and education for landowners is very important. Reaching out to share information about conservation practices is more difficult if the landowner is not financially connected to the management of the land (e.g., a landowner doesn't earn a living from the land). Working together with fellow landowners, partners, and informed agencies is also important.

Kenny knows someone who recently purchased a dairy. Then, a solar energy company rented that dairy land for $800-1,000/acre with a 30-year lease. In the long term, this likely means that the land will not return to agricultural production since most farmers consider $100/acre revenue to be a job well done. Agriculture cannot compete with the higher revenue that can be generated from green energy companies that have tax dollars supporting them.

Sites Information Table

IDEM Site Number	Latitude (Decimal Degree)	Longitude (Decimal Degree)	Short Description	Project Site Number	Waterbody
WEL-07-0019	39.107955	-86.313718	Crooked Creek Rd	Stream1	Crooked Creek
WEL-06-0008	39.173369	-86.319094	Yellowwood Rd	Stream2	North Fork Salt Creek
WEL-05-0001	39.089564	-86.220924	Kirks Ford Rd	Stream3	Middle Fork Salt Creek
WEL-04-0004	39.021974	-86.260526	1190 W, 1000 N	Stream4	South Fork Salt Creek
WEL-08-0036	39.004734	-86.508396	E Monroe Dam Ct Park Rds	Stream5	Monroe Lake Outlet
WEL-07-0018	39.072457	-86.40544	North Causeway	Lake1	Monroe Lake Upper
WEL-07-0020	39.030813	-86.472697	Center	Lake2	Monroe Lake Center
WEL-07-0021	39.00885	-86.516267	Dam	Lake3	Monroe Lake Lower

Data Qualifiers and Flags are applied to Environmental Results that do not meet the Required QC limits.

Data Qualifier Definitions for Environmental Results for NPS Funded Projects

(Sometimes Qualifiers will also be used with a Flag in the DQI Sheet as an Explanation for applying the Qualifier.)

U	The parameter result was not detected above the method detection limit. This Qualifier is typically used in analytical laboratories that provide data packages. NPS Projects may use this qualifier for a result that is below the reporting limit.
J	The result is an estimated quantity and the numerical value is the approximate concentration of the parameter in the sample.
J+	The result is an estimated quantity and may be biased high. Used for NPS projects to identify a contaminant found in a field blank collected during a sampling event.
R	The data are unusable due to serious deficiencies in meeting quality control criteria.

Table 2: Flags and their Application for Environmental Results for NPS Projects

Q Quality Control Checks, (Accuracy DQI) one or more QC checks or criteria were "Out of Control."

1. For data sets, when at least two QC checks or criteria was "Out of Control" a **QJ** flag should be added to results in data set. If only one parameter is involved then only that specific parameter should be flagged. The **QJ** flag & qualifier identifies the result as being an estimated value due to "Out of Control" QC checks.

2. For data sets that have many QC checks or criteria "Out of Control", professional judgment should be applied and if determined necessary then a **QR** flag should be applied. The **QR** flag and qualifier identified the result as rejected due to the multiple "Out of Control" QC Checks.

H

Holding Time flag is applied with the Qualifiers **"J"** or **"R"** when the holding time was not met.

1. The analysis exceeded the holding time by 1.5 times or less. The Result will be estimated **(HJ)**
2. The analysis exceeded holding time by greater than 1.5 times. The Result will be Rejected **(HR).**

D (SS) If Laboratory Splits sample for a duplicate analysis, then a control limit set by the analytical laboratory will be used for an acceptance criteria. The **D** flags for the SS or Laboratory Split samples are typically used for DQAL3 results.

DJ (SS) For Laboratory Split sample, if RPD is between established control limits and two times the established control limits, then the sample will be estimated. Assign as needed.

DR (SS) For Laboratory Split sample, if RPD is > twice the established control limits, then the sample will be rejected **(DR).** Assign as needed.

B Blank (Accuracy/Bias, DQI) For external projects, this usually refers to contamination found in field blank samples collected at a rate of one sample per sampling event or 5% rate, whichever is greatest. Analytical laboratories are also expected to report their method blank contaminates by using flags or identifiers. The flags will only be applied to the specific parameter in that sampling event. NPS projects will use the following rules for identifying contaminants in a data set. These are the rules:

1. If the Blank Contaminant is > Reporting Limit (RL) and Sample results are < 10 times RL, assign **J+** to specific sample result.
2. If Blank Contaminant is < RL, then **NO Flag** is assigned.
3. If Results are > 10 times Blank Contaminant, then **NO Flag** is assigned.
4. If Results are > 10 times RL, > 5 times Blank contaminant, and < 10 times Blank, assign **BJ** flag and qualifier to specific result or results.
5. If you need assistance in deciding on **B** flag applications, please contact the NPS QA Officer.

Table 3:	Flags and their Application for Biological Results (Fish, Macroinvertebrate, Habitat)
ALT	Alternate Method
CON	Value Confirmed
EFAI	Equipment Failure
FEQ	Field Equipment Questionable
FQC	Quality Control, failed
HIB	Likely Biased High
ISP	Improper Sample Preservation
JCW	Sample Container Damaged, Sample Lost
LAC	No Result Reported, Lab Accident
OTHER	Other, explain in Comments
R	Rejected
RPO	%RPD outside of acceptable limits
SCF	Suspected contamination, field
SCP	Suspected contamination, lab preparation
SCX	Suspected contamination, unknown
SUS	Result value is defined as suspect by data owner.
UNC	Value Not Confirmed
F*n*	Micellaneous flags (n=1,2,etc.) assigned by a field crew during a particular sampling visit (also used for qualifying samples). Explain reason for using each flag in Comments. For example, F1=seconds fished high for stream reach sampled; F2=net mesh larger than SOP.

E. coli Data Lake Monroe and its Tributaries

Number	Sample Date	EventID	Sample_ID	SampleName	Type	Concentration	Unit
WEL-04-0004	4/22/2020	0914	09144008	South Fork Salt Creek	Normal	70.3	CFU/100ml
WEL-04-0004	5/27/2020	0914	09144008	South Fork Salt Creek	Normal	365.4	CFU/100ml
WEL-04-0004	6/24/2020	0914	09144008	South Fork Salt Creek	Normal	1413.6	CFU/100ml
WEL-04-0004	7/21/2020	0914	09144008	South Fork Salt Creek	Normal	261.3	CFU/100ml
WEL-04-0004	8/27/2020	0914	09144008	South Fork Salt Creek	Normal	40.8	CFU/100ml
WEL-04-0004	9/24/2020	0914	09144008	South Fork Salt Creek	Normal	13.45	CFU/100ml
WEL-04-0004	10/22/2020	0914	09144008	South Fork Salt Creek	Normal	25.9	CFU/100ml
WEL-04-0004	11/19/2020	0914	09144008	South Fork Salt Creek	Normal	48	CFU/100ml
WEL-04-0004	12/16/2020	0914	09144008	South Fork Salt Creek	Normal	25.9	CFU/100ml
WEL-04-0004	1/25/2021	0914	09144008	South Fork Salt Creek	Normal	31.8	CFU/100ml
WEL-04-0004	2/25/2021	0914	09144008	South Fork Salt Creek	Normal	141.4	CFU/100ml
WEL-04-0004	3/18/2021	0914	09144008	South Fork Salt Creek	Normal	325.5	CFU/100ml
WEL-05-0001	4/22/2020	0668	06684008	Middle Fork Salt Creek	Normal	49.6	CFU/100ml
WEL-05-0001	4/22/2020	0668	06684108	Middle Fork Salt Creek (Duplicates)	Duplicate	49.6	CFU/100ml
WEL-05-0001	5/27/2020	0668	06684008	Middle Fork Salt Creek	Normal	261.3	CFU/100ml
WEL-05-0001	5/27/2020	0668	06684108	Middle Fork Salt Creek (Duplicates)	Duplicate	228.2	CFU/100ml
WEL-05-0001	6/24/2020	0668	06684008	Middle Fork Salt Creek	Normal	150	CFU/100ml
WEL-05-0001	6/24/2020	0668	06684108	Middle Fork Salt Creek (Duplicates)	Duplicate	166.4	CFU/100ml
WEL-05-0001	7/21/2020	0668	06684008	Middle Fork Salt Creek	Normal	167	CFU/100ml
WEL-05-0001	7/21/2020	0668	06684108	Middle Fork Salt Creek (Duplicates)	Duplicate	139.6	CFU/100ml
WEL-05-0001	8/27/2020	0668	06684008	Middle Fork Salt Creek	Normal	90.9	CFU/100ml
WEL-05-0001	8/27/2020	0668	06684108	Middle Fork Salt Creek (Duplicates)	Duplicate	71.7	CFU/100ml
WEL-05-0001	9/24/2020	0668	06684008	Middle Fork Salt Creek	Normal	5.2	CFU/100ml
WEL-05-0001	9/24/2020	0668	06684108	Middle Fork Salt Creek (Duplicates)	Duplicate	19.7	CFU/100ml
WEL-05-0001	10/22/2020	0668	06684008	Middle Fork Salt Creek	Normal	121	CFU/100ml
WEL-05-0001	10/22/2020	0668	06684108	Middle Fork Salt Creek (Duplicates)	Duplicate	139.6	CFU/100ml
WEL-05-0001	11/19/2020	0668	06684008	Middle Fork Salt Creek	Normal	579.4	CFU/100ml
WEL-05-0001	11/19/2020	0668	06684108	Middle Fork Salt Creek (Duplicates)	Duplicate	325.5	CFU/100ml
WEL-05-0001	12/16/2020	0668	06684008	Middle Fork Salt Creek	Normal	25.6	CFU/100ml
WEL-05-0001	12/16/2020	0668	06684108	Middle Fork Salt Creek (Duplicates)	Duplicate	37.3	CFU/100ml
WEL-05-0001	1/25/2021	0668	06684008	Middle Fork Salt Creek	Normal	12.2	CFU/100ml
WEL-05-0001	1/25/2021	0668	06684108	Middle Fork Salt Creek (Duplicates)	Duplicate	19.9	CFU/100ml
WEL-05-0001	2/25/2021	0668	06684008	Middle Fork Salt Creek	Normal	63.1	CFU/100ml
WEL-05-0001	2/25/2021	0668	06684108	Middle Fork Salt Creek (Duplicates)	Duplicate	47.9	CFU/100ml
WEL-05-0001	3/18/2021	0668	06684008	Middle Fork Salt Creek	Normal	290.9	CFU/100ml
WEL-05-0001	3/18/2021	0668	06684108	Middle Fork Salt Creek (Duplicates)	Duplicate	228.2	CFU/100ml
WEL-06-0008	4/22/2020	0256	02564008	North Fork Salt Creek	Normal	65.7	CFU/100ml
WEL-06-0008	5/27/2020	0256	02564008	North Fork Salt Creek	Normal	209.8	CFU/100ml
WEL-06-0008	6/24/2020	0256	02564008	North Fork Salt Creek	Normal	69.7	CFU/100ml
WEL-06-0008	7/21/2020	0256	02564008	North Fork Salt Creek	Normal	184.2	CFU/100ml
WEL-06-0008	8/27/2020	0256	02564008	North Fork Salt Creek	Normal	57.6	CFU/100ml
WEL-06-0008	9/24/2020	0256	02564008	North Fork Salt Creek	Normal	14.8	CFU/100ml
WEL-06-0008	10/22/2020	0256	02564008	North Fork Salt Creek	Normal	58.1	CFU/100ml
WEL-06-0008	11/19/2020	0256	02564008	North Fork Salt Creek	Normal	23.3	CFU/100ml
WEL-06-0008	12/16/2020	0256	02564008	North Fork Salt Creek	Normal	40.8	CFU/100ml
WEL-06-0008	1/25/2021	0256	02564008	North Fork Salt Creek	Normal	14.8	CFU/100ml
WEL-06-0008	2/25/2021	0256	02564008	North Fork Salt Creek	Normal	104.6	CFU/100ml
WEL-06-0008	3/18/2021	0256	02564008	North Fork Salt Creek	Normal	185	CFU/100ml
WEL-07-0018	5/26/2020	2830	28301008	Monroe Upper Epi	Normal	1	CFU/100ml
WEL-07-0018	5/26/2020	2830	28302008	Monroe Upper Hypo	Normal		CFU/100ml
WEL-07-0018	6/25/2020	2855	28551008	Monroe Upper Epi	Normal	1	CFU/100ml
WEL-07-0018	6/25/2020	2855	28552008	Monroe Upper Hypo	Normal		CFU/100ml
WEL-07-0018	7/27/2020	2917	29171008	Monroe Upper Epi	Normal	1	CFU/100ml
WEL-07-0018	7/27/2020	2917	29172008	Monroe Upper Hypo	Normal		CFU/100ml

E. coli Data Lake Monroe and its Tributaries

Number	Sample Date	EventID	Sample_ID	SampleName	Type	Concentration	Unit
WEL-07-0018	8/28/2020	2939	29391008	Monroe Upper Epi	Normal	1	CFU/100ml
WEL-07-0018	8/28/2020	2939	29392008	Monroe Upper Hypo	Normal		CFU/100ml
WEL-07-0018	9/23/2020	2942	29421008	Monroe Upper Epi	Normal	<1	CFU/100ml
WEL-07-0018	9/23/2020	2942	29422008	Monroe Upper Hypo	Normal		CFU/100ml
WEL-07-0018	10/26/2020	2947	29471008	Monroe Upper Epi	Normal	<1	CFU/100ml
WEL-07-0018	10/26/2020	2947	29472008	Monroe Upper Hypo	Normal		CFU/100ml
WEL-07-0019	4/22/2020	0123	01234008	Crooked Creek	Normal	6.3	CFU/100ml
WEL-07-0019	5/27/2020	0123	01234008	Crooked Creek	Normal	13.2	CFU/100ml
WEL-07-0019	6/24/2020	0123	01234008	Crooked Creek	Normal	60.2	CFU/100ml
WEL-07-0019	7/21/2020	0123	01234008	Crooked Creek	Normal	65	CFU/100ml
WEL-07-0019	8/27/2020	0123	01234008	Crooked Creek	Normal	156.5	CFU/100ml
WEL-07-0019	9/24/2020	0123	01234008	Crooked Creek	Normal		CFU/100ml
WEL-07-0019	10/22/2020	0123	01234008	Crooked Creek	Normal		CFU/100ml
WEL-07-0019	11/19/2020	0123	01234008	Crooked Creek	Normal	2	CFU/100ml
WEL-07-0019	12/16/2020	0123	01234008	Crooked Creek	Normal	1	CFU/100ml
WEL-07-0019	1/25/2021	0123	01234008	Crooked Creek	Normal	4.1	CFU/100ml
WEL-07-0019	2/25/2021	0123	01234008	Crooked Creek	Normal	7.4	CFU/100ml
WEL-07-0019	3/18/2021	0123	01234008	Crooked Creek	Normal	16	CFU/100ml
WEL-07-0020	5/26/2020	2831	28311008	Monroe Center Epi	Normal	1	CFU/100ml
WEL-07-0020	5/26/2020	2831	28311108	Monroe Center Epi (Duplicate)	Duplicate	< 1.0	CFU/100ml
WEL-07-0020	5/26/2020	2831	28312008	Monroe Center Hypo	Normal		CFU/100ml
WEL-07-0020	5/26/2020	2831	28312108	Monroe Center Hypo (Duplicate)	Duplicate		CFU/100ml
WEL-07-0020	6/25/2020	2856	28561008	Monroe Center Epi	Normal	< 1.0	CFU/100ml
WEL-07-0020	6/25/2020	2856	28561108	Monroe Center Epi (Duplicate)	Duplicate	< 1.0	CFU/100ml
WEL-07-0020	6/25/2020	2856	28562008	Monroe Center Hypo	Normal		CFU/100ml
WEL-07-0020	6/25/2020	2856	28562108	Monroe Center Hypo (Duplicate)	Duplicate		CFU/100ml
WEL-07-0020	7/27/2020	2918	29181008	Monroe Center Epi	Normal	<1	CFU/100ml
WEL-07-0020	7/27/2020	2918	29181108	Monroe Center Epi (Duplicate)	Duplicate	<1	CFU/100ml
WEL-07-0020	7/27/2020	2918	29182008	Monroe Center Hypo	Normal		CFU/100ml
WEL-07-0020	7/27/2020	2918	29182108	Monroe Center Hypo (Duplicate)	Duplicate		CFU/100ml
WEL-07-0020	8/28/2020	2940	29401008	Monroe Center Epi	Normal	<1	CFU/100ml
WEL-07-0020	8/28/2020	2940	29401108	Monroe Center Epi (Duplicate)	Duplicate	<1	CFU/100ml
WEL-07-0020	8/28/2020	2940	29402008	Monroe Center Hypo	Normal		CFU/100ml
WEL-07-0020	8/28/2020	2940	29402108	Monroe Center Hypo (Duplicate)	Duplicate		CFU/100ml
WEL-07-0020	9/23/2020	2943	29431008	Monroe Center Epi	Normal	<1	CFU/100ml
WEL-07-0020	9/23/2020	2943	29431108	Monroe Center Epi (Duplicate)	Duplicate	<1	CFU/100ml
WEL-07-0020	9/23/2020	2943	29432008	Monroe Center Hypo	Normal		CFU/100ml
WEL-07-0020	9/23/2020	2943	29432108	Monroe Center Hypo (Duplicate)	Duplicate		CFU/100ml
WEL-07-0020	10/26/2020	2945	29451008	Monroe Center Epi	Normal	2	CFU/100ml
WEL-07-0020	10/26/2020	2945	29451108	Monroe Center Epi (Duplicate)	Duplicate	<1	CFU/100ml
WEL-07-0020	10/26/2020	2945	29452008	Monroe Center Hypo	Normal		CFU/100ml
WEL-07-0020	10/26/2020	2945	29452108	Monroe Center Hypo (Duplicate)	Duplicate		CFU/100ml
WEL-07-0021	5/26/2020	2832	28321008	Monroe Lower Epi	Normal	10.9	CFU/100ml
WEL-07-0021	5/26/2020	2832	28322008	Monroe Lower Hypo	Normal		CFU/100ml
WEL-07-0021	5/26/2020	2832	28320008	Monroe Lower Blank	Field Blank		CFU/100ml
WEL-07-0021	6/25/2020	2857	28571008	Monroe Lower Epi	Normal	< 1.0	CFU/100ml
WEL-07-0021	6/25/2020	2857	28572008	Monroe Lower Hypo	Normal		CFU/100ml
WEL-07-0021	6/25/2020	2857	28570008	Monroe Lower Blank	Field Blank		CFU/100ml
WEL-07-0021	7/27/2020	2919	29191008	Monroe Lower Epi	Normal	<1	CFU/100ml
WEL-07-0021	7/27/2020	2919	29192008	Monroe Lower Hypo	Normal		CFU/100ml
WEL-07-0021	8/28/2020	2941	29411008	Monroe Lower Epi	Normal	1	CFU/100ml
WEL-07-0021	8/28/2020	2941	29412008	Monroe Lower Hypo	Normal		CFU/100ml
WEL-07-0021	8/28/2020	2941	29410008	Monroe Lower Blank	Field Blank		CFU/100ml
WEL-07-0021	9/23/2020	2944	29441008	Monroe Lower Epi	Normal	<1	CFU/100ml

E. coli Data Lake Monroe and its Tributaries

Number	Sample Date	EventID	Sample_ID	SampleName	Type	Concentration	Unit
WEL-07-0021	9/23/2020	2944	29442008	Monroe Lower Hypo	Normal		CFU/100ml
WEL-07-0021	9/23/2020	2944	29440008	Monroe Lower Blank	Field Blank		CFU/100ml
WEL-07-0021	10/26/2020	2946	29461008	Monroe Lower Epi	Normal	2	CFU/100ml
WEL-07-0021	10/26/2020	2946	29462008	Monroe Lower Hypo	Normal		CFU/100ml
WEL-07-0021	10/26/2020	2946	29460008	Monroe Lower Blank	Field Blank		CFU/100ml
WEL-08-0036	4/22/2020	0111	01114008	Lake Monroe Outlet	Normal	<1	CFU/100ml
WEL-08-0036	4/22/2020	0111	01110008	Lake Monroe Outlet Blank	Field Blank		CFU/100ml
WEL-08-0036	5/27/2020	0111	01114008	Lake Monroe Outlet	Normal	6.3	CFU/100ml
WEL-08-0036	5/27/2020	0111	01110008	Lake Monroe Outlet Blank	Field Blank		CFU/100ml
WEL-08-0036	6/24/2020	0111	01114008	Lake Monroe Outlet	Normal	5.2	CFU/100ml
WEL-08-0036	6/24/2020	0111	01110008	Lake Monroe Outlet Blank	Field Blank		CFU/100ml
WEL-08-0036	7/21/2020	0111	01114008	Lake Monroe Outlet	Normal	5.1	CFU/100ml
WEL-08-0036	7/21/2020	0111	01110008	Lake Monroe Outlet Blank	Field Blank		CFU/100ml
WEL-08-0036	8/27/2020	0111	01114008	Lake Monroe Outlet	Normal	4.1	CFU/100ml
WEL-08-0036	8/27/2020	0111	01110008	Lake Monroe Outlet Blank	Field Blank		CFU/100ml
WEL-08-0036	9/24/2020	0111	01114008	Lake Monroe Outlet	Normal	4.1	CFU/100ml
WEL-08-0036	9/24/2020	0111	01110008	Lake Monroe Outlet Blank	Field Blank		CFU/100ml
WEL-08-0036	10/22/2020	0111	01114008	Lake Monroe Outlet	Normal	5.2	CFU/100ml
WEL-08-0036	10/22/2020	0111	01110008	Lake Monroe Outlet Blank	Field Blank		CFU/100ml
WEL-08-0036	11/19/2020	0111	01114008	Lake Monroe Outlet	Normal	2	CFU/100ml
WEL-08-0036	11/19/2020	0111	01110008	Lake Monroe Outlet Blank	Field Blank		CFU/100ml
WEL-08-0036	12/16/2020	0111	01114008	Lake Monroe Outlet	Normal	<1	CFU/100ml
WEL-08-0036	12/16/2020	0111	01110008	Lake Monroe Outlet Blank	Field Blank		CFU/100ml
WEL-08-0036	1/25/2021	0111	01114008	Lake Monroe Outlet	Normal	4.1	CFU/100ml
WEL-08-0036	1/25/2021	0111	01110008	Lake Monroe Outlet Blank	Field Blank		CFU/100ml
WEL-08-0036	2/25/2021	0111	01114008	Lake Monroe Outlet	Normal	>1	CFU/100ml
WEL-08-0036	2/25/2021	0111	01110008	Lake Monroe Outlet Blank	Field Blank		CFU/100ml
WEL-08-0036	3/18/2021	0111	01114008	Lake Monroe Outlet	Normal	54.8	CFU/100ml
WEL-08-0036	3/18/2021	0111	01110008	Lake Monroe Outlet Blank	Field Blank		CFU/100ml

Total Organic Carbon Data Lake Monroe and Tributaries

Number	Sample Date	EventID	Sample_ID	SampleName	Type	Concentration	Unit
WEL-04-0004	4/22/2020	0914	09144008	South Fork Salt Creek	Normal	2.77	mg/L
WEL-04-0004	5/27/2020	0914	09144008	South Fork Salt Creek	Normal	4.03	mg/L
WEL-04-0004	6/24/2020	0914	09144008	South Fork Salt Creek	Normal	8.2	mg/L
WEL-04-0004	7/21/2020	0914	09144008	South Fork Salt Creek	Normal	4.65	mg/L
WEL-04-0004	8/27/2020	0914	09144008	South Fork Salt Creek	Normal	3.79	mg/L
WEL-04-0004	9/24/2020	0914	09144008	South Fork Salt Creek	Normal	4.29	mg/L
WEL-04-0004	10/22/2020	0914	09144008	South Fork Salt Creek	Normal	6.84	mg/L
WEL-04-0004	11/19/2020	0914	09144008	South Fork Salt Creek	Normal	3.8	mg/L
WEL-04-0004	12/16/2020	0914	09144008	South Fork Salt Creek	Normal	2.78	mg/L
WEL-04-0004	1/25/2021	0914	09144008	South Fork Salt Creek	Normal	2.08	mg/L
WEL-04-0004	2/25/2021	0914	09144008	South Fork Salt Creek	Normal	5.1	mg/L
WEL-04-0004	3/18/2021	0914	09144008	South Fork Salt Creek	Normal	3.74	mg/L
WEL-05-0001	4/22/2020	0668	06684008	Middle Fork Salt Creek	Normal	2.36	mg/L
WEL-05-0001	4/22/2020	0668	06684108	Middle Fork Salt Creek (Duplicates)	Duplicate	2.89	mg/L
WEL-05-0001	5/27/2020	0668	06684008	Middle Fork Salt Creek	Normal	2.78	mg/L
WEL-05-0001	5/27/2020	0668	06684108	Middle Fork Salt Creek (Duplicates)	Duplicate	2.78	mg/L
WEL-05-0001	6/24/2020	0668	06684008	Middle Fork Salt Creek	Normal	2.96	mg/L
WEL-05-0001	6/24/2020	0668	06684108	Middle Fork Salt Creek (Duplicates)	Duplicate	2.91	mg/L
WEL-05-0001	7/21/2020	0668	06684008	Middle Fork Salt Creek	Normal	3.73	mg/L
WEL-05-0001	7/21/2020	0668	06684108	Middle Fork Salt Creek (Duplicates)	Duplicate	4.3	mg/L
WEL-05-0001	8/27/2020	0668	06684008	Middle Fork Salt Creek	Normal	2.67	mg/L
WEL-05-0001	8/27/2020	0668	06684108	Middle Fork Salt Creek (Duplicates)	Duplicate	2.79	mg/L
WEL-05-0001	9/24/2020	0668	06684008	Middle Fork Salt Creek	Normal	3.39	mg/L
WEL-05-0001	9/24/2020	0668	06684108	Middle Fork Salt Creek (Duplicates)	Duplicate	3.33	mg/L
WEL-05-0001	10/22/2020	0668	06684008	Middle Fork Salt Creek	Normal	7.38	mg/L
WEL-05-0001	10/22/2020	0668	06684108	Middle Fork Salt Creek (Duplicates)	Duplicate	7.92	mg/L
WEL-05-0001	11/19/2020	0668	06684008	Middle Fork Salt Creek	Normal	2.47	mg/L
WEL-05-0001	11/19/2020	0668	06684108	Middle Fork Salt Creek (Duplicates)	Duplicate	3.12	mg/L
WEL-05-0001	12/16/2020	0668	06684008	Middle Fork Salt Creek	Normal	1.85	mg/L
WEL-05-0001	12/16/2020	0668	06684108	Middle Fork Salt Creek (Duplicates)	Duplicate	1.66	mg/L
WEL-05-0001	1/25/2021	0668	06684008	Middle Fork Salt Creek	Normal	1.56	mg/L
WEL-05-0001	1/25/2021	0668	06684108	Middle Fork Salt Creek (Duplicates)	Duplicate	11.7	mg/L
WEL-05-0001	2/25/2021	0668	06684008	Middle Fork Salt Creek	Normal	4.68	mg/L
WEL-05-0001	2/25/2021	0668	06684108	Middle Fork Salt Creek (Duplicates)	Duplicate	5.44	mg/L
WEL-05-0001	3/18/2021	0668	06684008	Middle Fork Salt Creek	Normal	4.07	mg/L
WEL-05-0001	3/18/2021	0668	06684108	Middle Fork Salt Creek (Duplicates)	Duplicate		mg/L
WEL-06-0008	4/22/2020	0256	02564008	North Fork Salt Creek	Normal	2.31	mg/L
WEL-06-0008	5/27/2020	0256	02564008	North Fork Salt Creek	Normal	2.81	mg/L
WEL-06-0008	6/24/2020	0256	02564008	North Fork Salt Creek	Normal	3.7	mg/L
WEL-06-0008	7/21/2020	0256	02564008	North Fork Salt Creek	Normal	4.47	mg/L
WEL-06-0008	8/27/2020	0256	02564008	North Fork Salt Creek	Normal	3.3	mg/L
WEL-06-0008	9/24/2020	0256	02564008	North Fork Salt Creek	Normal	3.7	mg/L
WEL-06-0008	10/22/2020	0256	02564008	North Fork Salt Creek	Normal	4.53	mg/L
WEL-06-0008	11/19/2020	0256	02564008	North Fork Salt Creek	Normal	4.03	mg/L
WEL-06-0008	12/16/2020	0256	02564008	North Fork Salt Creek	Normal	2.13	mg/L
WEL-06-0008	1/25/2021	0256	02564008	North Fork Salt Creek	Normal	2.05	mg/L
WEL-06-0008	2/25/2021	0256	02564008	North Fork Salt Creek	Normal	5.3	mg/L
WEL-06-0008	3/18/2021	0256	02564008	North Fork Salt Creek	Normal	5.72	mg/L
WEL-07-0018	5/26/2020	2830	28301015	Monroe Upper Epi	Normal	3.95	mg/L
WEL-07-0018	5/26/2020	2830	28302015	Monroe Upper Hypo	Normal		mg/L
WEL-07-0018	6/25/2020	2855	28551015	Monroe Upper Epi	Normal	4.87	mg/L

Total Organic Carbon Data Lake Monroe and Tributaries

Number	Sample Date	EventID	Sample_ID	SampleName	Type	Concentration	Unit
WEL-07-0018	6/25/2020	2855	28552015	Monroe Upper Hypo	Normal	4.3	mg/L
WEL-07-0018	7/27/2020	2917	29171015	Monroe Upper Epi	Normal	4.03	mg/L
WEL-07-0018	7/27/2020	2917	29172015	Monroe Upper Hypo	Normal	6.26	mg/L
WEL-07-0018	8/28/2020	2939	29391015	Monroe Upper Epi	Normal	4.39	mg/L
WEL-07-0018	8/28/2020	2939	29392015	Monroe Upper Hypo	Normal	5.71	mg/L
WEL-07-0018	9/23/2020	2942	29421015	Monroe Upper Epi	Normal	4.87	mg/L
WEL-07-0018	9/23/2020	2942	29422015	Monroe Upper Hypo	Normal		mg/L
WEL-07-0018	10/26/2020	2947	29471015	Monroe Upper Epi	Normal	4.22	mg/L
WEL-07-0018	10/26/2020	2947	29472015	Monroe Upper Hypo	Normal		mg/L
WEL-07-0019	4/22/2020	0123	01234008	Crooked Creek	Normal	2.92	mg/L
WEL-07-0019	5/27/2020	0123	01234008	Crooked Creek	Normal	4.23	mg/L
WEL-07-0019	6/24/2020	0123	01234008	Crooked Creek	Normal	2.33	mg/L
WEL-07-0019	7/21/2020	0123	01234008	Crooked Creek	Normal	2.12	mg/L
WEL-07-0019	8/27/2020	0123	01234008	Crooked Creek	Normal	1.82	mg/L
WEL-07-0019	9/24/2020	0123	01234008	Crooked Creek	Normal		mg/L
WEL-07-0019	10/22/2020	0123	01234008	Crooked Creek	Normal		mg/L
WEL-07-0019	11/19/2020	0123	01234008	Crooked Creek	Normal	1.57	mg/L
WEL-07-0019	12/16/2020	0123	01234008	Crooked Creek	Normal	1.89	mg/L
WEL-07-0019	1/25/2021	0123	01234008	Crooked Creek	Normal	2.01	mg/L
WEL-07-0019	2/25/2021	0123	01234008	Crooked Creek	Normal	3.65	mg/L
WEL-07-0019	3/18/2021	0123	01234008	Crooked Creek	Normal	3.99	mg/L
WEL-07-0020	5/26/2020	2831	28311015	Monroe Center Epi	Normal	12.1	mg/L
WEL-07-0020	5/26/2020	2831	28311115	Monroe Center Epi (Duplicate)	Duplicate		mg/L
WEL-07-0020	5/26/2020	2831	28312015	Monroe Center Hypo	Normal	9.9	mg/L
WEL-07-0020	5/26/2020	2831	28312115	Monroe Center Hypo (Duplicate)	Duplicate	3.15	mg/L
WEL-07-0020	6/25/2020	2856	28561015	Monroe Center Epi	Normal	3.85	mg/L
WEL-07-0020	6/25/2020	2856	28561115	Monroe Center Epi (Duplicate)	Duplicate		mg/L
WEL-07-0020	6/25/2020	2856	28562015	Monroe Center Hypo	Normal	*	mg/L
WEL-07-0020	6/25/2020	2856	28562115	Monroe Center Hypo (Duplicate)	Duplicate	3.54	mg/L
WEL-07-0020	7/27/2020	2918	29181015	Monroe Center Epi	Normal	3.37	mg/L
WEL-07-0020	7/27/2020	2918	29181115	Monroe Center Epi (Duplicate)	Duplicate		mg/L
WEL-07-0020	7/27/2020	2918	29182015	Monroe Center Hypo	Normal	3.54	mg/L
WEL-07-0020	7/27/2020	2918	29182115	Monroe Center Hypo (Duplicate)	Duplicate		mg/L
WEL-07-0020	8/28/2020	2940	29401015	Monroe Center Epi	Normal	3.54	mg/L
WEL-07-0020	8/28/2020	2940	29401115	Monroe Center Epi (Duplicate)	Duplicate		mg/L
WEL-07-0020	8/28/2020	2940	29402015	Monroe Center Hypo	Normal	3.86	mg/L
WEL-07-0020	8/28/2020	2940	29402115	Monroe Center Hypo (Duplicate)	Duplicate	4.28	mg/L
WEL-07-0020	9/23/2020	2943	29431015	Monroe Center Epi	Normal	4	mg/L
WEL-07-0020	9/23/2020	2943	29431115	Monroe Center Epi (Duplicate)	Duplicate		mg/L
WEL-07-0020	9/23/2020	2943	29432015	Monroe Center Hypo	Normal		mg/L
WEL-07-0020	9/23/2020	2943	29432115	Monroe Center Hypo (Duplicate)	Duplicate		mg/L
WEL-07-0020	10/26/2020	2945	29451015	Monroe Center Epi	Normal	3.83	mg/L
WEL-07-0020	10/26/2020	2945	29451115	Monroe Center Epi (Duplicate)	Duplicate		mg/L
WEL-07-0020	10/26/2020	2945	29452015	Monroe Center Hypo	Normal		mg/L
WEL-07-0020	10/26/2020	2945	29452115	Monroe Center Hypo (Duplicate)	Duplicate		mg/L
WEL-07-0021	5/26/2020	2832	28321015	Monroe Lower Epi	Normal	3.3	mg/L
WEL-07-0021	5/26/2020	2832	28322015	Monroe Lower Hypo	Normal	3.86	mg/L
WEL-07-0021	5/26/2020	2832	28320015	Monroe Lower Blank	Field Blank	2.07	mg/L
WEL-07-0021	6/25/2020	2857	28571015	Monroe Lower Epi	Normal	3.73	mg/L
WEL-07-0021	6/25/2020	2857	28572015	Monroe Lower Hypo	Normal	3.32	mg/L
WEL-07-0021	6/25/2020	2857	28570015	Monroe Lower Blank	Field Blank	0.524	mg/L

Total Organic Carbon Data Lake Monroe and Tributaries

Number	Sample Date	EventID	Sample_ID	SampleName	Type	Concentration	Unit
WEL-07-0021	7/27/2020	2919	29191015	Monroe Lower Epi	Normal	3.77	mg/L
WEL-07-0021	7/27/2020	2919	29192015	Monroe Lower Hypo	Normal	5.07	mg/L
WEL-07-0021	8/28/2020	2941	29411015	Monroe Lower Epi	Normal	3.66	mg/L
WEL-07-0021	8/28/2020	2941	29412015	Monroe Lower Hypo	Normal	5.02	mg/L
WEL-07-0021	8/28/2020	2941	29410015	Monroe Lower Blank	Field Blank	0.006	mg/L
WEL-07-0021	9/23/2020	2944	29441015	Monroe Lower Epi	Normal	3.67	mg/L
WEL-07-0021	9/23/2020	2944	29442015	Monroe Lower Hypo	Normal	5.22	mg/L
WEL-07-0021	9/23/2020	2944	29440015	Monroe Lower Blank	Field Blank	0.007	mg/L
WEL-07-0021	10/26/2020	2946	29461015	Monroe Lower Epi	Normal	3.48	mg/L
WEL-07-0021	10/26/2020	2946	29462015	Monroe Lower Hypo	Normal		mg/L
WEL-07-0021	10/26/2020	2946	29460015	Monroe Lower Blank	Field Blank	1.05	mg/L
WEL-08-0036	4/22/2020	0111	01114008	Lake Monroe Outlet	Normal	3.4	mg/L
WEL-08-0036	4/22/2020	0111	01110008	Lake Monroe Outlet Blank	Field Blank	2.03	mg/L
WEL-08-0036	5/27/2020	0111	01114008	Lake Monroe Outlet	Normal	3.45	mg/L
WEL-08-0036	5/27/2020	0111	01110008	Lake Monroe Outlet Blank	Field Blank	1.02	mg/L
WEL-08-0036	6/24/2020	0111	01114008	Lake Monroe Outlet	Normal	4.75	mg/L
WEL-08-0036	6/24/2020	0111	01110008	Lake Monroe Outlet Blank	Field Blank		mg/L
WEL-08-0036	7/21/2020	0111	01114008	Lake Monroe Outlet	Normal	4.42	mg/L
WEL-08-0036	7/21/2020	0111	01110008	Lake Monroe Outlet Blank	Field Blank	0.861	mg/L
WEL-08-0036	8/27/2020	0111	01114008	Lake Monroe Outlet	Normal	3.79	mg/L
WEL-08-0036	8/27/2020	0111	01110008	Lake Monroe Outlet Blank	Field Blank	1.4	mg/L
WEL-08-0036	9/24/2020	0111	01114008	Lake Monroe Outlet	Normal	3.83	mg/L
WEL-08-0036	9/24/2020	0111	01110008	Lake Monroe Outlet Blank	Field Blank	1.32	mg/L
WEL-08-0036	10/22/2020	0111	01114008	Lake Monroe Outlet	Normal	3.88	mg/L
WEL-08-0036	10/22/2020	0111	01110008	Lake Monroe Outlet Blank	Field Blank	0.406	mg/L
WEL-08-0036	11/19/2020	0111	01114008	Lake Monroe Outlet	Normal	3.86	mg/L
WEL-08-0036	11/19/2020	0111	01110008	Lake Monroe Outlet Blank	Field Blank	0.646	mg/L
WEL-08-0036	12/16/2020	0111	01114008	Lake Monroe Outlet	Normal	4.45	mg/L
WEL-08-0036	12/16/2020	0111	01110008	Lake Monroe Outlet Blank	Field Blank	0.558	mg/L
WEL-08-0036	1/25/2021	0111	01114008	Lake Monroe Outlet	Normal	3.17	mg/L
WEL-08-0036	1/25/2021	0111	01110008	Lake Monroe Outlet Blank	Field Blank	1.28	mg/L
WEL-08-0036	2/25/2021	0111	01114008	Lake Monroe Outlet	Normal	4.51	mg/L
WEL-08-0036	2/25/2021	0111	01110008	Lake Monroe Outlet Blank	Field Blank	1.71	mg/L
WEL-08-0036	3/18/2021	0111	01114008	Lake Monroe Outlet	Normal	5.05	mg/L
WEL-08-0036	3/18/2021	0111	01110008	Lake Monroe Outlet Blank	Field Blank		mg/L

UV254 Data for Lake Monroe and its Tributaries

Number	Sample Date	EventID	Sample_ID	SampleName	Type	Concentration	Unit
WEL-04-0004	4/22/2020	0914	09144008	South Fork Salt Creek	Normal	0.107	UVA at cm^-1
WEL-04-0004	5/27/2020	0914	09144008	South Fork Salt Creek	Normal	0.18	UVA at cm^-1
WEL-04-0004	6/24/2020	0914	09144008	South Fork Salt Creek	Normal	0.411	UVA at cm^-1
WEL-04-0004	7/21/2020	0914	09144008	South Fork Salt Creek	Normal	0.265	UVA at cm^-1
WEL-04-0004	8/27/2020	0914	09144008	South Fork Salt Creek	Normal	0.183	UVA at cm^-1
WEL-04-0004	9/24/2020	0914	09144008	South Fork Salt Creek	Normal	0.183	UVA at cm^-1
WEL-04-0004	10/22/2020	0914	09144008	South Fork Salt Creek	Normal	0.283	UVA at cm^-1
WEL-04-0004	11/19/2020	0914	09144008	South Fork Salt Creek	Normal	0.157	UVA at cm^-1
WEL-04-0004	12/16/2020	0914	09144008	South Fork Salt Creek	Normal	0.109	UVA at cm^-1
WEL-04-0004	1/25/2021	0914	09144008	South Fork Salt Creek	Normal	0.09	UVA at cm^-1
WEL-04-0004	2/25/2021	0914	09144008	South Fork Salt Creek	Normal	0.21	UVA at cm^-1
WEL-04-0004	3/18/2021	0914	09144008	South Fork Salt Creek	Normal	0.125	UVA at cm^-1
WEL-05-0001	4/22/2020	0668	06684008	Middle Fork Salt Creek	Normal	0.072	UVA at cm^-1
WEL-05-0001	4/22/2020	0668	06684108	Middle Fork Salt Creek (Duplicates)	Duplicate	0.067	UVA at cm^-1
WEL-05-0001	5/27/2020	0668	06684008	Middle Fork Salt Creek	Normal	0.113	UVA at cm^-1
WEL-05-0001	5/27/2020	0668	06684108	Middle Fork Salt Creek (Duplicates)	Duplicate	0.114	UVA at cm^-1
WEL-05-0001	6/24/2020	0668	06684008	Middle Fork Salt Creek	Normal	0.139	UVA at cm^-1
WEL-05-0001	6/24/2020	0668	06684108	Middle Fork Salt Creek (Duplicates)	Duplicate	0.137	UVA at cm^-1
WEL-05-0001	7/21/2020	0668	06684008	Middle Fork Salt Creek	Normal	0.178	UVA at cm^-1
WEL-05-0001	7/21/2020	0668	06684108	Middle Fork Salt Creek (Duplicates)	Duplicate	0.178	UVA at cm^-1
WEL-05-0001	8/27/2020	0668	06684008	Middle Fork Salt Creek	Normal	0.116	UVA at cm^-1
WEL-05-0001	8/27/2020	0668	06684108	Middle Fork Salt Creek (Duplicates)	Duplicate	0.115	UVA at cm^-1
WEL-05-0001	9/24/2020	0668	06684008	Middle Fork Salt Creek	Normal	0.153	UVA at cm^-1
WEL-05-0001	9/24/2020	0668	06684108	Middle Fork Salt Creek (Duplicates)	Duplicate	0.125	UVA at cm^-1
WEL-05-0001	10/22/2020	0668	06684008	Middle Fork Salt Creek	Normal	0.265	UVA at cm^-1
WEL-05-0001	10/22/2020	0668	06684108	Middle Fork Salt Creek (Duplicates)	Duplicate	0.199	UVA at cm^-1
WEL-05-0001	11/19/2020	0668	06684008	Middle Fork Salt Creek	Normal	0.129	UVA at cm^-1
WEL-05-0001	11/19/2020	0668	06684108	Middle Fork Salt Creek (Duplicates)	Duplicate	0.124	UVA at cm^-1
WEL-05-0001	12/16/2020	0668	06684008	Middle Fork Salt Creek	Normal	0.086	UVA at cm^-1
WEL-05-0001	12/16/2020	0668	06684108	Middle Fork Salt Creek (Duplicates)	Duplicate	0.087	UVA at cm^-1
WEL-05-0001	1/25/2021	0668	06684008	Middle Fork Salt Creek	Normal	0.062	UVA at cm^-1
WEL-05-0001	1/25/2021	0668	06684108	Middle Fork Salt Creek (Duplicates)	Duplicate	0.063	UVA at cm^-1
WEL-05-0001	2/25/2021	0668	06684008	Middle Fork Salt Creek	Normal	0.192	UVA at cm^-1
WEL-05-0001	2/25/2021	0668	06684108	Middle Fork Salt Creek (Duplicates)	Duplicate	0.198	UVA at cm^-1
WEL-05-0001	3/18/2021	0668	06684008	Middle Fork Salt Creek	Normal	0.181	UVA at cm^-1
WEL-05-0001	3/18/2021	0668	06684108	Middle Fork Salt Creek (Duplicates)	Duplicate	0.206	UVA at cm^-1
WEL-06-0008	4/22/2020	0256	02564008	North Fork Salt Creek	Normal	0.098	UVA at cm^-1
WEL-06-0008	5/27/2020	0256	02564008	North Fork Salt Creek	Normal	0.163	UVA at cm^-1
WEL-06-0008	6/24/2020	0256	02564008	North Fork Salt Creek	Normal	0.154	UVA at cm^-1
WEL-06-0008	7/21/2020	0256	02564008	North Fork Salt Creek	Normal	0.203	UVA at cm^-1
WEL-06-0008	8/27/2020	0256	02564008	North Fork Salt Creek	Normal	0.113	UVA at cm^-1
WEL-06-0008	9/24/2020	0256	02564008	North Fork Salt Creek	Normal	0.13	UVA at cm^-1
WEL-06-0008	10/22/2020	0256	02564008	North Fork Salt Creek	Normal	0.216	UVA at cm^-1
WEL-06-0008	11/19/2020	0256	02564008	North Fork Salt Creek	Normal	0.162	UVA at cm^-1
WEL-06-0008	12/16/2020	0256	02564008	North Fork Salt Creek	Normal	0.106	UVA at cm^-1
WEL-06-0008	1/25/2021	0256	02564008	North Fork Salt Creek	Normal	0.104	UVA at cm^-1
WEL-06-0008	2/25/2021	0256	02564008	North Fork Salt Creek	Normal	0.313	UVA at cm^-1
WEL-06-0008	3/18/2021	0256	02564008	North Fork Salt Creek	Normal	0.235	UVA at cm^-1
WEL-07-0018	5/26/2020	2830	28301016	Monroe Upper Epi	Normal	0.14	UVA at cm^-1
WEL-07-0018	5/26/2020	2830	28302016	Monroe Upper Hypo	Normal		UVA at cm^-1
WEL-07-0018	6/25/2020	2855	28551016	Monroe Upper Epi	Normal	0.11	UVA at cm^-1
WEL-07-0018	6/25/2020	2855	28552016	Monroe Upper Hypo	Normal	0.214	UVA at cm^-1
WEL-07-0018	7/27/2020	2917	29171016	Monroe Upper Epi	Normal	0.102	UVA at cm^-1
WEL-07-0018	7/27/2020	2917	29172016	Monroe Upper Hypo	Normal	0.265	UVA at cm^-1

Number	Sample Date	EventID	Sample_ID	SampleName	Type	Concentration	Unit
WEL-07-0018	8/28/2020	2939	29391016	Monroe Upper Epi	Normal	0.116	UVA at cm^-1
WEL-07-0018	8/28/2020	2939	29392016	Monroe Upper Hypo	Normal	0.228	UVA at cm^-1
WEL-07-0018	9/23/2020	2942	29421016	Monroe Upper Epi	Normal	0.135	UVA at cm^-1
WEL-07-0018	9/23/2020	2942	29422016	Monroe Upper Hypo	Normal		UVA at cm^-1
WEL-07-0018	10/26/2020	2947	29471016	Monroe Upper Epi	Normal	0.112	UVA at cm^-1
WEL-07-0018	10/26/2020	2947	29472016	Monroe Upper Hypo	Normal		UVA at cm^-1
WEL-07-0019	4/22/2020	0123	01234008	Crooked Creek	Normal	0.066	UVA at cm^-1
WEL-07-0019	5/27/2020	0123	01234008	Crooked Creek	Normal	0.04	UVA at cm^-1
WEL-07-0019	6/24/2020	0123	01234008	Crooked Creek	Normal	0.028	UVA at cm^-1
WEL-07-0019	7/21/2020	0123	01234008	Crooked Creek	Normal	0.025	UVA at cm^-1
WEL-07-0019	8/27/2020	0123	01234008	Crooked Creek	Normal	0.032	UVA at cm^-1
WEL-07-0019	9/24/2020	0123	01234008	Crooked Creek	Normal		UVA at cm^-1
WEL-07-0019	10/22/2020	0123	01234008	Crooked Creek	Normal		UVA at cm^-1
WEL-07-0019	11/19/2020	0123	01234008	Crooked Creek	Normal	0.27	UVA at cm^-1
WEL-07-0019	12/16/2020	0123	01234008	Crooked Creek	Normal	0.031	UVA at cm^-1
WEL-07-0019	1/25/2021	0123	01234008	Crooked Creek	Normal	0.038	UVA at cm^-1
WEL-07-0019	2/25/2021	0123	01234008	Crooked Creek	Normal	0.174	UVA at cm^-1
WEL-07-0019	3/18/2021	0123	01234008	Crooked Creek	Normal	0.115	UVA at cm^-1
WEL-07-0020	5/26/2020	2831	28311016	Monroe Center Epi	Normal	0.097	UVA at cm^-1
WEL-07-0020	5/26/2020	2831	28311116	Monroe Center Epi (Duplicate)	Duplicate		UVA at cm^-1
WEL-07-0020	5/26/2020	2831	28312016	Monroe Center Hypo	Normal	0.099	UVA at cm^-1
WEL-07-0020	5/26/2020	2831	28312116	Monroe Center Hypo (Duplicate)	Duplicate	0.096	UVA at cm^-1
WEL-07-0020	6/25/2020	2856	28561016	Monroe Center Epi	Normal	0.074	UVA at cm^-1
WEL-07-0020	6/25/2020	2856	28561116	Monroe Center Epi (Duplicate)	Duplicate		UVA at cm^-1
WEL-07-0020	6/25/2020	2856	28562016	Monroe Center Hypo	Normal	0.102	UVA at cm^-1
WEL-07-0020	6/25/2020	2856	28562116	Monroe Center Hypo (Duplicate)	Duplicate	0.097	UVA at cm^-1
WEL-07-0020	7/27/2020	2918	29181016	Monroe Center Epi	Normal	0.073	UVA at cm^-1
WEL-07-0020	7/27/2020	2918	29181116	Monroe Center Epi (Duplicate)	Duplicate		UVA at cm^-1
WEL-07-0020	7/27/2020	2918	29182016	Monroe Center Hypo	Normal	0.096	UVA at cm^-1
WEL-07-0020	7/27/2020	2918	29182116	Monroe Center Hypo (Duplicate)	Duplicate	0.109	UVA at cm^-1
WEL-07-0020	8/28/2020	2940	29401016	Monroe Center Epi	Normal	0.072	UVA at cm^-1
WEL-07-0020	8/28/2020	2940	29401116	Monroe Center Epi (Duplicate)	Duplicate		UVA at cm^-1
WEL-07-0020	8/28/2020	2940	29402016	Monroe Center Hypo	Normal	0.096	UVA at cm^-1
WEL-07-0020	8/28/2020	2940	29402116	Monroe Center Hypo (Duplicate)	Duplicate	0.096	UVA at cm^-1
WEL-07-0020	9/23/2020	2943	29431016	Monroe Center Epi	Normal		UVA at cm^-1
WEL-07-0020	9/23/2020	2943	29431116	Monroe Center Epi (Duplicate)	Duplicate		UVA at cm^-1
WEL-07-0020	9/23/2020	2943	29432016	Monroe Center Hypo	Normal		UVA at cm^-1
WEL-07-0020	9/23/2020	2943	29432116	Monroe Center Hypo (Duplicate)	Duplicate		UVA at cm^-1
WEL-07-0020	10/26/2020	2945	29451016	Monroe Center Epi	Normal	0.096	UVA at cm^-1
WEL-07-0020	10/26/2020	2945	29451116	Monroe Center Epi (Duplicate)	Duplicate		UVA at cm^-1
WEL-07-0020	10/26/2020	2945	29452016	Monroe Center Hypo	Normal		UVA at cm^-1
WEL-07-0020	10/26/2020	2945	29452116	Monroe Center Hypo (Duplicate)	Duplicate		UVA at cm^-1
WEL-07-0021	5/26/2020	2832	28321016	Monroe Lower Epi	Normal	0.088	UVA at cm^-1
WEL-07-0021	5/26/2020	2832	28322016	Monroe Lower Hypo	Normal	0.139	UVA at cm^-1
WEL-07-0021	5/26/2020	2832	28320016	Monroe Lower Blank	Field Blank	-0.001	UVA at cm^-1
WEL-07-0021	6/25/2020	2857	28571016	Monroe Lower Epi	Normal	0.07	UVA at cm^-1
WEL-07-0021	6/25/2020	2857	28572016	Monroe Lower Hypo	Normal	0.097	UVA at cm^-1
WEL-07-0021	6/25/2020	2857	28570016	Monroe Lower Blank	Field Blank	0.001	UVA at cm^-1
WEL-07-0021	7/27/2020	2919	29191016	Monroe Lower Epi	Normal	0.063	UVA at cm^-1
WEL-07-0021	7/27/2020	2919	29192016	Monroe Lower Hypo	Normal	0.33	UVA at cm^-1
WEL-07-0021	8/28/2020	2941	29411016	Monroe Lower Epi	Normal	0.069	UVA at cm^-1
WEL-07-0021	8/28/2020	2941	29412016	Monroe Lower Hypo	Normal	0.494	UVA at cm^-1
WEL-07-0021	8/28/2020	2941	29410016	Monroe Lower Blank	Field Blank	0	UVA at cm^-1
WEL-07-0021	9/23/2020	2944	29441016	Monroe Lower Epi	Normal	0.075	UVA at cm^-1

UV254 Data for Lake Monroe and its Tributaries

Number	Sample Date	EventID	Sample_ID	SampleName	Type	Concentration	Unit
WEL-07-0021	9/23/2020	2944	29442016	Monroe Lower Hypo	Normal		UVA at cm^-1
WEL-07-0021	9/23/2020	2944	29440016	Monroe Lower Blank	Field Blank	0.004	UVA at cm^-1
WEL-07-0021	10/26/2020	2946	29461016	Monroe Lower Epi	Normal	0.089	UVA at cm^-1
WEL-07-0021	10/26/2020	2946	29462016	Monroe Lower Hypo	Normal		UVA at cm^-1
WEL-07-0021	10/26/2020	2946	29460016	Monroe Lower Blank	Field Blank	0.01	UVA at cm^-1
WEL-08-0036	4/22/2020	0111	01114008	Lake Monroe Outlet	Normal	0.131	UVA at cm^-1
WEL-08-0036	4/22/2020	0111	01110008	Lake Monroe Outlet Blank	Field Blank	0.002	UVA at cm^-1
WEL-08-0036	5/27/2020	0111	01114008	Lake Monroe Outlet	Normal	0.108	UVA at cm^-1
WEL-08-0036	5/27/2020	0111	01110008	Lake Monroe Outlet Blank	Field Blank	-0.001	UVA at cm^-1
WEL-08-0036	6/24/2020	0111	01114008	Lake Monroe Outlet	Normal	0.103	UVA at cm^-1
WEL-08-0036	6/24/2020	0111	01110008	Lake Monroe Outlet Blank	Field Blank	0.021	UVA at cm^-1
WEL-08-0036	7/21/2020	0111	01114008	Lake Monroe Outlet	Normal	0.133	UVA at cm^-1
WEL-08-0036	7/21/2020	0111	01110008	Lake Monroe Outlet Blank	Field Blank	-0.003	UVA at cm^-1
WEL-08-0036	8/27/2020	0111	01114008	Lake Monroe Outlet	Normal	0.146	UVA at cm^-1
WEL-08-0036	8/27/2020	0111	01110008	Lake Monroe Outlet Blank	Field Blank	0	UVA at cm^-1
WEL-08-0036	9/24/2020	0111	01114008	Lake Monroe Outlet	Normal	0.125	UVA at cm^-1
WEL-08-0036	9/24/2020	0111	01110008	Lake Monroe Outlet Blank	Field Blank	0.02	UVA at cm^-1
WEL-08-0036	10/22/2020	0111	01114008	Lake Monroe Outlet	Normal	0.089	UVA at cm^-1
WEL-08-0036	10/22/2020	0111	01110008	Lake Monroe Outlet Blank	Field Blank	0.004	UVA at cm^-1
WEL-08-0036	11/19/2020	0111	01114008	Lake Monroe Outlet	Normal	0.082	UVA at cm^-1
WEL-08-0036	11/19/2020	0111	01110008	Lake Monroe Outlet Blank	Field Blank	0	UVA at cm^-1
WEL-08-0036	12/16/2020	0111	01114008	Lake Monroe Outlet	Normal	0.066	UVA at cm^-1
WEL-08-0036	12/16/2020	0111	01110008	Lake Monroe Outlet Blank	Field Blank	0.001	UVA at cm^-1
WEL-08-0036	1/25/2021	0111	01114008	Lake Monroe Outlet	Normal	0.08	UVA at cm^-1
WEL-08-0036	1/25/2021	0111	01110008	Lake Monroe Outlet Blank	Field Blank	0.004	UVA at cm^-1
WEL-08-0036	2/25/2021	0111	01114008	Lake Monroe Outlet	Normal	0.09	UVA at cm^-1
WEL-08-0036	2/25/2021	0111	01110008	Lake Monroe Outlet Blank	Field Blank	0	UVA at cm^-1
WEL-08-0036	3/18/2021	0111	01114008	Lake Monroe Outlet	Normal	0.101	UVA at cm^-1
WEL-08-0036	3/18/2021	0111	01110008	Lake Monroe Outlet Blank	Field Blank	0.001	UVA at cm^-1

Acid Neutralizing Capacity (ANC) Data for Lake Monroe and its Tributaries

IDEM Site Number	Sample Date	EventID	Sample_ID	Sample Name	Sample Type	Concentration	Unit	QA Flags
WEL-04-0004	4/22/2020	0914	09144001	South Fork Salt Creek	Normal	29	mg/L	
WEL-04-0004	5/27/2020	0914	09144001	South Fork Salt Creek	Normal	31	mg/L	
WEL-04-0004	6/24/2020	0914	09144001	South Fork Salt Creek	Normal	33	mg/L	
WEL-04-0004	7/21/2020	0914	09144001	South Fork Salt Creek	Normal	55	mg/L	
WEL-04-0004	8/27/2020	0914	09144001	South Fork Salt Creek	Normal	59	mg/L	
WEL-04-0004	9/24/2020	0914	09144001	South Fork Salt Creek	Normal	81.0	mg/L	
WEL-04-0004	10/22/2020	0914	09144001	South Fork Salt Creek	Normal	81.0	mg/L	
WEL-04-0004	11/19/2020	0914	09144001	South Fork Salt Creek	Normal	50.0	mg/L	
WEL-04-0004	12/16/2020	0914	09144001	South Fork Salt Creek	Normal	34.0	mg/L	
WEL-04-0004	1/25/2021	0914	09144001	South Fork Salt Creek	Normal	34.0	mg/L	
WEL-04-0004	2/25/2021	0914	09144001	South Fork Salt Creek	Normal	14.0	mg/L	
WEL-04-0004	3/18/2021	0914	09144001	South Fork Salt Creek	Normal	21.0	mg/L	
WEL-05-0001	4/22/2020	0668	06684001	Middle Fork Salt Creek	Normal	36	mg/L	
WEL-05-0001	4/22/2020	0668	06684101	Middle Fork Salt Creek	Duplicate	36	mg/L	
WEL-05-0001	5/27/2020	0668	06684001	Middle Fork Salt Creek	Normal	33.7	mg/L	
WEL-05-0001	5/27/2020	0668	06684101	Middle Fork Salt Creek	Duplicate	33.8	mg/L	
WEL-05-0001	6/24/2020	0668	06684001	Middle Fork Salt Creek	Normal	38.9	mg/L	
WEL-05-0001	6/24/2020	0668	06684101	Middle Fork Salt Creek	Duplicate	45.8	mg/L	
WEL-05-0001	7/21/2020	0668	06684001	Middle Fork Salt Creek	Normal	63	mg/L	
WEL-05-0001	7/21/2020	0668	06684101	Middle Fork Salt Creek	Duplicate	64	mg/L	
WEL-05-0001	8/27/2020	0668	06684001	Middle Fork Salt Creek	Normal	63	mg/L	
WEL-05-0001	8/27/2020	0668	06684101	Middle Fork Salt Creek	Duplicate	63	mg/L	
WEL-05-0001	9/24/2020	0668	06684001	Middle Fork Salt Creek	Normal	88.0	mg/L	
WEL-05-0001	9/24/2020	0668	06684101	Middle Fork Salt Creek	Duplicate	89.0	mg/L	
WEL-05-0001	10/22/2020	0668	06684001	Middle Fork Salt Creek	Normal	87.0	mg/L	
WEL-05-0001	10/22/2020	0668	06684101	Middle Fork Salt Creek	Duplicate	88.0	mg/L	
WEL-05-0001	11/19/2020	0668	06684001	Middle Fork Salt Creek	Normal	58.0	mg/L	
WEL-05-0001	11/19/2020	0668	06684101	Middle Fork Salt Creek	Duplicate	60.0	mg/L	
WEL-05-0001	12/16/2020	0668	06684001	Middle Fork Salt Creek	Normal	47.0	mg/L	
WEL-05-0001	12/16/2020	0668	06684101	Middle Fork Salt Creek	Duplicate	46.0	mg/L	
WEL-05-0001	1/25/2021	0668	06684001	Middle Fork Salt Creek	Normal	43.0	mg/L	
WEL-05-0001	1/25/2021	0668	06684101	Middle Fork Salt Creek	Duplicate	43.0	mg/L	
WEL-05-0001	2/25/2021	0668	06684001	Middle Fork Salt Creek	Normal	18.0	mg/L	
WEL-05-0001	2/25/2021	0668	06684101	Middle Fork Salt Creek	Duplicate	18.0	mg/L	
WEL-05-0001	3/18/2021	0668	06684001	Middle Fork Salt Creek	Normal	31.0	mg/L	
WEL-05-0001	3/18/2021	0668	06684101	Middle Fork Salt Creek	Duplicate	31.0	mg/L	
WEL-06-0008	4/22/2020	0256	02564001	North Fork Salt Creek	Normal	47	mg/L	
WEL-06-0008	5/27/2020	0256	02564001	North Fork Salt Creek	Normal	42.2	mg/L	
WEL-06-0008	6/24/2020	0256	02564001	North Fork Salt Creek	Normal	83.3	mg/L	
WEL-06-0008	7/21/2020	0256	02564001	North Fork Salt Creek	Normal	86	mg/L	
WEL-06-0008	8/27/2020	0256	02564001	North Fork Salt Creek	Normal	89	mg/L	
WEL-06-0008	9/24/2020	0256	02564001	North Fork Salt Creek	Normal	110.0	mg/L	
WEL-06-0008	10/22/2020	0256	02564001	North Fork Salt Creek	Normal	100.0	mg/L	
WEL-06-0008	11/19/2020	0256	02564001	North Fork Salt Creek	Normal	88.0	mg/L	
WEL-06-0008	12/16/2020	0256	02564001	North Fork Salt Creek	Normal	68.0	mg/L	
WEL-06-0008	1/25/2021	0256	02564001	North Fork Salt Creek	Normal	63.0	mg/L	
WEL-06-0008	2/25/2021	0256	02564001	North Fork Salt Creek	Normal	20.0	mg/L	
WEL-06-0008	3/18/2021	0256	02564001	North Fork Salt Creek	Normal	24.0	mg/L	
WEL-07-0018	5/26/2020	2830	28301001	Monroe Upper Epi	Normal	30.5	mg/L	
WEL-07-0018	6/25/2020	2855	28551001	Monroe Upper Epi	Normal	32.8	mg/L	
WEL-07-0018	6/25/2020	2855	28552001	Monroe Upper Hypo	Normal	25	mg/L	
WEL-07-0018	7/27/2020	2917	29171001	Monroe Upper Epi	Normal	41	mg/L	
WEL-07-0018	7/27/2020	2917	29172001	Monroe Upper Hypo	Normal	52	mg/L	
WEL-07-0018	8/28/2020	2939	29391001	Monroe Upper Epi	Normal	40	mg/L	
WEL-07-0018	8/28/2020	2939	29392001	Monroe Upper Hypo	Normal	49	mg/L	

Acid Neutralizing Capacity (ANC) Data for Lake Monroe and its Tributaries

IDEM Site Number	Sample Date	EventID	Sample_ID	Sample Name	Sample Type	Concentr ation	Unit	QA Flags
WEL-07-0018	9/23/2020	2942	29421001	Monroe Upper Epi	Normal	44.0	mg/L	
WEL-07-0018	10/26/2020	2947	29471001	Monroe Upper Epi	Normal	39.0	mg/L	
WEL-07-0019	4/22/2020	0123	01234001	Crooked Creek	Normal	35	mg/L	
WEL-07-0019	5/27/2020	0123	01234001	Crooked Creek	Normal	49.2	mg/L	
WEL-07-0019	6/24/2020	0123	01234001	Crooked Creek	Normal	62	mg/L	
WEL-07-0019	7/21/2020	0123	01234001	Crooked Creek	Normal	68	mg/L	
WEL-07-0019	8/27/2020	0123	01234001	Crooked Creek	Normal	76	mg/L	
WEL-07-0019	11/19/2020	0123	01234001	Crooked Creek	Normal	64.0	mg/L	
WEL-07-0019	12/16/2020	0123	01234001	Crooked Creek	Normal	59.0	mg/L	
WEL-07-0019	1/25/2021	0123	01234001	Crooked Creek	Normal	47.0	mg/L	
WEL-07-0019	2/25/2021	0123	01234001	Crooked Creek	Normal	23.0	mg/L	
WEL-07-0019	3/18/2021	0123	01234001	Crooked Creek	Normal	32.0	mg/L	
WEL-07-0020	5/26/2020	2831	28311001	Monroe Center Epi	Normal	28	mg/L	
WEL-07-0020	5/26/2020	2831	28311101	Monroe Center Epi	Duplicate	28.8	mg/L	
WEL-07-0020	5/26/2020	2831	28312001	Monroe Center Hypo	Normal	28.3	mg/L	
WEL-07-0020	6/25/2020	2856	28561001	Monroe Center Epi	Normal	26	mg/L	
WEL-07-0020	6/25/2020	2856	28561101	Monroe Center Epi	Duplicate	32	mg/L	
WEL-07-0020	6/25/2020	2856	28562001	Monroe Center Hypo	Normal	33	mg/L	
WEL-07-0020	7/27/2020	2918	29181001	Monroe Center Epi	Normal	25	mg/L	
WEL-07-0020	7/27/2020	2918	29181101	Monroe Center Epi	Duplicate	29	mg/L	
WEL-07-0020	7/27/2020	2918	29182001	Monroe Center Hypo	Normal	39	mg/L	
WEL-07-0020	8/28/2020	2940	29401001	Monroe Center Epi	Normal	37	mg/L	
WEL-07-0020	8/28/2020	2940	29401101	Monroe Center Epi	Duplicate	38	mg/L	
WEL-07-0020	8/28/2020	2940	29402001	Monroe Center Hypo	Normal	41	mg/L	
WEL-07-0020	9/23/2020	2943	29431001	Monroe Center Epi	Normal	39.0	mg/L	
WEL-07-0020	9/23/2020	2943	29431101	Monroe Center Epi	Duplicate	42.0	mg/L	
WEL-07-0020	10/26/2020	2945	29451001	Monroe Center Epi	Normal	29.0	mg/L	
WEL-07-0020	10/26/2020	2945	29451101	Monroe Center Epi	Duplicate	30.0	mg/L	
WEL-07-0021	5/26/2020	2832	28321001	Monroe Lower Epi	Normal	27.4	mg/L	
WEL-07-0021	5/26/2020	2832	28322001	Monroe Lower Hypo	Normal	29.1	mg/L	
WEL-07-0021	6/25/2020	2857	28571001	Monroe Lower Epi	Normal	32	mg/L	
WEL-07-0021	6/25/2020	2857	28572001	Monroe Lower Hypo	Normal	31	mg/L	
WEL-07-0021	7/27/2020	2919	29191001	Monroe Lower Epi	Normal	46	mg/L	
WEL-07-0021	7/27/2020	2919	29192001	Monroe Lower Hypo	Normal	40	mg/L	
WEL-07-0021	8/28/2020	2941	29411001	Monroe Lower Epi	Normal	35	mg/L	
WEL-07-0021	8/28/2020	2941	29412001	Monroe Lower Hypo	Normal	60	mg/L	
WEL-07-0021	9/23/2020	2944	29441001	Monroe Lower Epi	Normal	40.0	mg/L	
WEL-07-0021	9/23/2020	2944	29442001	Monroe Lower Hypo	Normal	64.0	mg/L	
WEL-07-0021	10/26/2020	2946	29461001	Monroe Lower Epi	Normal	40.0	mg/L	
WEL-08-0036	4/22/2020	0111	01114001	Lake Monroe Outlet	Normal	38	mg/L	
WEL-08-0036	5/27/2020	0111	01114001	Lake Monroe Outlet	Normal	27.3	mg/L	
WEL-08-0036	6/24/2020	0111	01114001	Lake Monroe Outlet	Normal	32.7	mg/L	
WEL-08-0036	7/21/2020	0111	01114001	Lake Monroe Outlet	Normal	38	mg/L	
WEL-08-0036	8/27/2020	0111	01114001	Lake Monroe Outlet	Normal	41	mg/L	
WEL-08-0036	9/24/2020	0111	01114001	Lake Monroe Outlet	Normal	45.0	mg/L	
WEL-08-0036	10/22/2020	0111	01114001	Lake Monroe Outlet	Normal	40.0	mg/L	
WEL-08-0036	11/19/2020	0111	01114001	Lake Monroe Outlet	Normal	38.0	mg/L	
WEL-08-0036	12/16/2020	0111	01114001	Lake Monroe Outlet	Normal	35.0	mg/L	
WEL-08-0036	1/25/2021	0111	01114001	Lake Monroe Outlet	Normal	22.0	mg/L	
WEL-08-0036	2/25/2021	0111	01114001	Lake Monroe Outlet	Normal	36.0	mg/L	
WEL-08-0036	3/18/2021	0111	01114001	Lake Monroe Outlet	Normal	33.0	mg/L	

Total Suspended Solids (TSS) Data for Lake Monroe and its Tributaries

IDEM Site Number	Sample Date	EventID	Sample_ID	Sample Name	Sample Type	Concentration	Unit	QA Flags
WEL-04-0004	4/22/2020	0914	09144012	South Fork Salt Creek	Normal	5.2	mg/L	
WEL-04-0004	5/27/2020	0914	09144012	South Fork Salt Creek	Normal	31.3	mg/L	
WEL-04-0004	6/24/2020	0914	09144012	South Fork Salt Creek	Normal	16.8	mg/L	
WEL-04-0004	7/21/2020	0914	09144012	South Fork Salt Creek	Normal	2.4	mg/L	
WEL-04-0004	8/27/2020	0914	09144012	South Fork Salt Creek	Normal	2.3	mg/L	
WEL-04-0004	9/24/2020	0914	09144012	South Fork Salt Creek	Normal	7.5	mg/L	
WEL-04-0004	10/22/2020	0914	09144012	South Fork Salt Creek	Normal	9.5	mg/L	
WEL-04-0004	11/19/2020	0914	09144012	South Fork Salt Creek	Normal	4.3	mg/L	
WEL-04-0004	12/16/2020	0914	09142012	South Fork Salt Creek	Normal	1.75	mg/L	
WEL-04-0004	1/25/2021	0914	09144012	South Fork Salt Creek	Normal	2.8	mg/L	
WEL-04-0004	2/25/2021	0914	09144012	South Fork Salt Creek	Normal	25.3	mg/L	
WEL-04-0004	3/18/2021	0914	09144012	South Fork Salt Creek	Normal	14.8	mg/L	
WEL-05-0001	4/22/2020	0668	06684012	Middle Fork Salt Creek	Normal	3	mg/L	
WEL-05-0001	4/22/2020	0668	06684112	Middle Fork Salt Creek	Duplicate	3	mg/L	
WEL-05-0001	5/27/2020	0668	06684012	Middle Fork Salt Creek	Normal	15.2	mg/L	
WEL-05-0001	5/27/2020	0668	06684112	Middle Fork Salt Creek	Duplicate	15.8	mg/L	
WEL-05-0001	6/24/2020	0668	06684012	Middle Fork Salt Creek	Normal	3.6	mg/L	
WEL-05-0001	6/24/2020	0668	06684112	Middle Fork Salt Creek	Duplicate	3.2	mg/L	
WEL-05-0001	7/21/2020	0668	06684012	Middle Fork Salt Creek	Normal	3.6	mg/L	
WEL-05-0001	7/21/2020	0668	06684112	Middle Fork Salt Creek	Duplicate	3.2	mg/L	
WEL-05-0001	8/27/2020	0668	06684112	Middle Fork Salt Creek	Duplicate	2	mg/L	
WEL-05-0001	8/27/2020	0668	06684012	Middle Fork Salt Creek	Normal	2	mg/L	
WEL-05-0001	9/24/2020	0668	06684012	Middle Fork Salt Creek	Normal	3	mg/L	
WEL-05-0001	9/24/2020	0668	06684112	Middle Fork Salt Creek	Duplicate	2.5	mg/L	
WEL-05-0001	10/22/2020	0668	06684112	Middle Fork Salt Creek	Duplicate	5.5	mg/L	
WEL-05-0001	10/22/2020	0668	06684012	Middle Fork Salt Creek	Normal	5.8	mg/L	
WEL-05-0001	11/19/2020	0668	06684012	Middle Fork Salt Creek	Normal	2.3	mg/L	
WEL-05-0001	11/19/2020	0668	06684112	Middle Fork Salt Creek	Duplicate	2.8	mg/L	
WEL-05-0001	12/16/2020	0668	06684112	Middle Fork Salt Creek	Duplicate	0.8	mg/L	
WEL-05-0001	12/16/2020	0668	06684012	Middle Fork Salt Creek	Normal	1.4	mg/L	
WEL-05-0001	1/25/2021	0668	06684012	Middle Fork Salt Creek	Normal	6.0	mg/L	
WEL-05-0001	1/25/2021	0668	06684112	Middle Fork Salt Creek	Duplicate	3.3	mg/L	
WEL-05-0001	2/25/2021	0668	06684012	Middle Fork Salt Creek	Normal	24.8	mg/L	
WEL-05-0001	2/25/2021	0668	06684112	Middle Fork Salt Creek	Duplicate	27.6	mg/L	
WEL-05-0001	3/18/2021	0668	06684012	Middle Fork Salt Creek	Normal	39.4	mg/L	
WEL-05-0001	3/18/2021	0668	06684112	Middle Fork Salt Creek	Duplicate	36.2	mg/L	
WEL-06-0008	4/22/2020	0256	02564012	North Fork Salt Creek	Normal	7.6	mg/L	
WEL-06-0008	5/27/2020	0256	02564012	North Fork Salt Creek	Normal	30.8	mg/L	
WEL-06-0008	6/24/2020	0256	02564012	North Fork Salt Creek	Normal	2.8	mg/L	
WEL-06-0008	7/21/2020	0256	02564012	North Fork Salt Creek	Normal	<0.5	mg/L	U
WEL-06-0008	8/27/2020	0256	02564012	North Fork Salt Creek	Normal	2.5	mg/L	
WEL-06-0008	9/24/2020	0256	02564012	North Fork Salt Creek	Normal	5.5	mg/L	
WEL-06-0008	10/22/2020	0256	02564012	North Fork Salt Creek	Normal	4.8	mg/L	
WEL-06-0008	11/19/2020	0256	02564012	North Fork Salt Creek	Normal	1.8	mg/L	
WEL-06-0008	12/16/2020	0236	02564012	North Fork Salt Creek	Normal	2	mg/L	
WEL-06-0008	1/25/2021	0256	02564012	North Fork Salt Creek	Normal	1.6	mg/L	
WEL-06-0008	2/25/2021	0256	02564012	North Fork Salt Creek	Normal	101.3	mg/L	
WEL-06-0008	3/18/2021	0256	02564012	North Fork Salt Creek	Normal	148.6	mg/L	
WEL-07-0018	5/26/2020	2830	28301012	Monroe Upper EPI	Normal	4.6	mg/L	
WEL-07-0018	6/25/2020	2855	28551012	Monroe Upper EPI	Normal	5.6	mg/L	
WEL-07-0018	6/25/2020	2855	28552012	Monroe Upper Hypo	Normal	36.4	mg/L	
WEL-07-0018	7/27/2020	2917	29171012	Monroe Upper EPI	Normal	6.7	mg/L	
WEL-07-0018	7/27/2020	2917	29172012	Monroe Upper Hypo	Normal	4.4	mg/L	
WEL-07-0018	8/26/2020	2939	29391012	Monroe Upper EPI	Normal	4.5	mg/L	
WEL-07-0018	9/23/2020	2942	29421012	Monroe Upper EPI	Normal	16.5	mg/L	

Total Suspended Solids (TSS) Data for Lake Monroe and its Tributaries

IDEM Site Number	Sample Date	EventID	Sample_ID	Sample Name	Sample Type	Concentration	Unit	QA Flags
WEL-07-0018	10/26/2020	2947	29471012	Monroe Upper EPI	Normal	15.6	mg/L	
WEL-07-0019	4/22/2020	0123	01234012	Crooked Creek	Normal	1.3	mg/L	
WEL-07-0019	5/27/2020	0123	01234012	Crooked Creek	Normal	1.6	mg/L	
WEL-07-0019	6/24/2020	0123	01234012	Crooked Creek	Normal	1	mg/L	
WEL-07-0019	7/21/2020	0123	01234012	Crooked Creek	Normal	<0.5	mg/L	U
WEL-07-0019	8/27/2020	0123	01234012	Crooked Creek	Normal	0.7	mg/L	
WEL-07-0019	11/19/2020	0123	01234012	Crooked Creek	Normal	<0.5	mg/L	U
WEL-07-0019	12/16/2020	0123	01234012	Crooked Creek	Normal	<0.5	mg/L	U
WEL-07-0019	1/25/2021	0123	01234012	Crooked Creek	Normal	0.2	mg/L	
WEL-07-0019	2/25/2021	0123	01234012	Crooked Creek	Normal	3.2	mg/L	
WEL-07-0019	3/18/2021	0123	01234012	Crooked Creek	Normal	3.8	mg/L	
WEL-07-0020	5/26/2020	2831	28311012	Monroe Center EPI	Normal	4	mg/L	
WEL-07-0020	5/26/2020	2831	28312012	Monroe Center Hypo	Normal	5.2	mg/L	
WEL-07-0020	5/26/2020	2831	28312112	Monroe Center Hypo	Duplicate	4.8	mg/L	
WEL-07-0020	6/25/2020	2856	28561012	Monroe Center EPI	Normal	2.8	mg/L	
WEL-07-0020	6/25/2020	2856	28562012	Monroe Center Hypo	Normal	6	mg/L	
WEL-07-0020	6/25/2020	2856	28562112	Monroe Center Hypo	Duplicate	5.2	mg/L	
WEL-07-0020	7/27/2020	2918	29181012	Monroe Center EPI	Normal	4	mg/L	
WEL-07-0020	7/27/2020	2918	29182012	Monroe Center Hypo	Normal	4.5	mg/L	
WEL-07-0020	7/27/2020	2918	29182112	Monroe Center Hypo	Duplicate	3.8	mg/L	
WEL-07-0020	8/26/2020	2940	29402012	Monroe Center Hypo	Normal	3.3	mg/L	
WEL-07-0020	8/26/2020	2940	29401012	Monroe Center EPI	Normal	1.5	mg/L	
WEL-07-0020	9/23/2020	2943	29431012	Monroe Center EPI	Normal	4.3	mg/L	
WEL-07-0020	10/26/2020	2945	29451012	Monroe Center EPI	Normal	10.8	mg/L	
WEL-07-0021	5/26/2020	2832	28320012	Monroe Lower	Field Blank	<0.5	mg/L	U
WEL-07-0021	5/26/2020	2832	28321012	Monroe Lower EPI	Normal	3	mg/L	
WEL-07-0021	5/26/2020	2832	28322012	Monroe Lower Hypo	Normal	10.9	mg/L	
WEL-07-0021	6/25/2020	2857	28570012	Monroe Lower	Field Blank	<0.5	mg/L	U
WEL-07-0021	6/25/2020	2857	28571012	Monroe Lower EPI	Normal	1.6	mg/L	
WEL-07-0021	6/25/2020	2857	28572012	Monroe Lower Hypo	Normal	3.8	mg/L	
WEL-07-0021	7/27/2020	2919	29190012	Monroe Lower	Field Blank	<0.5	mg/L	U
WEL-07-0021	7/27/2020	2919	29191012	Monroe Lower EPI	Normal	1.7	mg/L	
WEL-07-0021	7/27/2020	2919	29192012	Monroe Lower Hypo	Normal	28.4	mg/L	
WEL-07-0021	8/26/2020	2941	29410012	Monroe Lower	Field Blank	<0.5	mg/L	U
WEL-07-0021	8/26/2020	2941	29412012	Monroe Lower Hypo	Normal	6.5	mg/L	
WEL-07-0021	8/26/2020	2941	29411012	Monroe Lower EPI	Normal	1.7	mg/L	
WEL-07-0021	9/23/2020	2944	29442012	Monroe Lower Hypo	Normal	26.7	mg/L	
WEL-07-0021	9/23/2020	2944	29440012	Monroe Lower	Field Blank	<0.5	mg/L	U
WEL-07-0021	9/23/2020	2944	29441012	Monroe Lower EPI	Normal	2.5	mg/L	
WEL-07-0021	10/26/2020	2946	29461012	Monroe Lower EPI	Normal	5.2	mg/L	
WEL-07-0021	10/26/2020	2946	29460012	Monroe Lower	Field Blank	<0.5	mg/L	U
WEL-08-0036	4/22/2020	0111	01114012	Lake Monroe Outlet	Normal	4.8	mg/L	
WEL-08-0036	4/22/2020	0111	01114012	Lake Monroe Outlet	Field Blank	<0.5	mg/L	U
WEL-08-0036	5/27/2020	0111	01114012	Lake Monroe Outlet	Normal	4.4	mg/L	
WEL-08-0036	5/27/2020	0111	01114012	Lake Monroe Outlet	Field Blank	<0.5	mg/L	U
WEL-08-0036	6/24/2020	0111	01114012	Lake Monroe Outlet	Normal	3.2	mg/L	
WEL-08-0036	6/24/2020	0111	01114012	Lake Monroe Outlet	Field Blank	<0.5	mg/L	U
WEL-08-0036	7/21/2020	0111	01114012	Lake Monroe Outlet	Field Blank	<0.5	mg/L	U
WEL-08-0036	7/21/2020	0111	01114012	Lake Monroe Outlet	Normal	6.8	mg/L	
WEL-08-0036	8/27/2020	0111	01114012	Lake Monroe Outlet	Field Blank	<0.5	mg/L	U
WEL-08-0036	8/27/2020	0111	01114012	Lake Monroe Outlet	Normal	9.5	mg/L	
WEL-08-0036	9/24/2020	0111	01114012	Lake Monroe Outlet	Normal	10	mg/L	
WEL-08-0036	9/24/2020	0111	01114012	Lake Monroe Outlet	Field Blank	<0.5	mg/L	U

Total Suspended Solids (TSS) Data for Lake Monroe and its Tributaries

IDEM Site Number	Sample Date	EventID	Sample_ID	Sample Name	Sample Type	Concentration	Unit	QA Flags
WEL-08-0036	10/22/2020	0111	01110012	Lake Monroe Outlet	Field Blank	<0.5	mg/L	U
WEL-08-0036	10/22/2020	0111	01114012	Lake Monroe Outlet	Normal	6.2	mg/L	
WEL-08-0036	11/19/2020	0111	01110012	Lake Monroe Outlet	Field Blank	<0.5	mg/L	U
WEL-08-0036	11/19/2020	0111	01114012	Lake Monroe Outlet	Normal	11.0	mg/L	
WEL-08-0036	12/16/2020	0111	01114013	Lake Monroe Outlet	Normal	10.4	mg/L	
WEL-08-0036	12/16/2020	0111	01110012	Lake Monroe Outlet	Field Blank	<0.5	mg/L	U
WEL-08-0036	1/25/2021	0111	01110012	Lake Monroe Outlet	Field Blank	<0.5	mg/L	U
WEL-08-0036	1/25/2021	0111	01114012	Lake Monroe Outlet	Normal	6.0	mg/L	
WEL-08-0036	2/25/2021	0111	01114012	Lake Monroe Outlet	Normal	6.2	mg/L	
WEL-08-0036	2/25/2021	0111	01110012	Lake Monroe Outlet	Field Blank	<0.5	mg/L	U
WEL-08-0036	3/18/2021	0111	01114012	Lake Monroe Outlet	Normal	6.5	mg/L	
WEL-08-0036	3/18/2021	0111	01110012	Lake Monroe Outlet	Field Blank	<0.5	mg/L	U

Soluble Reactive Phosphorus (SRP) Data for Lake Monroe and its Tributaries

IDEM Site Number	Sample Date	EventID	Sample_ID	SampleName	Sample Type	Concentration	Unit	QA Flags
WEL-04-0004	4/22/2020	0914	09144004	0914 SForkStCk 4.22	Normal	0.012	mg/L	
WEL-04-0004	5/27/2020	0914	09144004	0914 SForkStCk 5.27	Normal	0.011	mg/L	
WEL-04-0004	6/24/2020	0914	09144004	0914 SForkStCk 6.24	Normal	0.036	mg/L	
WEL-04-0004	6/24/2020	0914	09144004	0914 SForkStCk SPL 6.24	Duplicate	0.035	mg/L	
WEL-04-0004	7/21/2020	0914	09144004	0914 SForkStCk 7.21	Normal	0.009	mg/L	
WEL-04-0004	8/27/2020	0914	09144004	0914 SForkStCk 8.27	Normal	0.009	mg/L	
WEL-04-0004	9/24/2020	0914	09144004	0914 SForkStCk 9.24	Normal	0.005	mg/L	
WEL-04-0004	10/22/2020	0914	09144004	0914 SForkStCk 10.22	Normal	0.008	mg/L	
WEL-04-0004	10/22/2020	0914	09144004	0914 SForkStCk 10.22 SPL	Duplicate	0.007	mg/L	
WEL-04-0004	11/19/2020	0914	09144004	0914 SForkStCk 11.19	Normal	0.01	mg/L	
WEL-04-0004	12/16/2020	0914	09144004	0914 SForkStCk	Normal	0.005	mg/L	
WEL-04-0004	1/25/2021	0914	09144004	0914 SForkStCk	Normal	0.004	mg/L	
WEL-04-0004	2/25/2021	0914	09144004	0914 SForkStCk	Normal	0.011	mg/L	
WEL-04-0004	2/25/2021	0914	09144004	0914 SForkStCk	Duplicate	0.014	mg/L	
WEL-04-0004	3/18/2021	0914	09144004	0914 SForkStCk	Normal	0.007	mg/L	
WEL-05-0001	4/22/2020	0668	06684104	0668 MForkStCk 4.22 Dup	Duplicate	0.003	mg/L	
WEL-05-0001	4/22/2020	0668	06684004	0668 MForkStCk 4.22	Normal	0.003	mg/L	
WEL-05-0001	5/27/2020	0668	06684004	0668 MForkStCk 5.27	Normal	0.035	mg/L	
WEL-05-0001	5/27/2020	0668	06684104	0668 MForkStCk 5.27 Dup	Duplicate	0.006	mg/L	
WEL-05-0001	6/24/2020	0668	06684004	0668 MForkStCk 6.24	Normal	0.006	mg/L	
WEL-05-0001	6/24/2020	0668	06684104	0668 MForkStCk Dup 6.24	Duplicate	0.006	mg/L	
WEL-05-0001	7/21/2020	0668	06684004	0668 MForkStCk 7.21	Normal	0.003	mg/L	
WEL-05-0001	7/21/2020	0668	06684104	0668 MForkStCk DUP 7.21	Duplicate	0.004	mg/L	
WEL-05-0001	8/27/2020	0668	06684004	0668 MForkStCk 8.27	Normal	0.005	mg/L	
WEL-05-0001	8/27/2020	0668	06684104	0668 MForkStCk DUP 8.27	Duplicate	0.005	mg/L	
WEL-05-0001	9/24/2020	0668	06684004	0668 MForkStCk 9.24	Normal	0.003	mg/L	
WEL-05-0001	9/24/2020	0668	06684104	0668 MForkStCk DUP 9.24	Duplicate	0.004	mg/L	
WEL-05-0001	10/22/2020	0668	06684004	0668 MForkStCk 10.22	Normal	0.003	mg/L	
WEL-05-0001	10/22/2020	0668	06684104	0668 MForkStCk DUP 10.22	Duplicate	0.005	mg/L	
WEL-05-0001	11/19/2020	0668	06684004	0668 MForkStCk 11.19	Normal	0.005	mg/L	
WEL-05-0001	11/19/2020	0668	06684104	0668 MForkStCk DUP 11.19	Duplicate	0.004	mg/L	
WEL-05-0001	12/16/2020	0668	06684004	0668 MForkStCk	Normal	0.003	mg/L	
WEL-05-0001	12/16/2020	0668	06684104	0668 MForkStCk- DUP	Duplicate	0.004	mg/L	
WEL-05-0001	1/25/2021	0668	06684004	0668 MForkStCk	Normal	0.003	mg/L	
WEL-05-0001	1/25/2021	0668	06684104	0668 MForkStCk	Duplicate	0.003	mg/L	
WEL-05-0001	2/25/2021	0668	06684004	0668 MForkStCk	Normal	0.008	mg/L	
WEL-05-0001	2/25/2021	0668	06684104	0668 MForkStCk	Duplicate	0.009	mg/L	
WEL-05-0001	3/18/2021	0668	06684004	0668 MForkStCk	Normal	0.006	mg/L	
WEL-05-0001	3/18/2021	0668	06684104	0668 MForkStCk	Duplicate	0.007	mg/L	
WEL-06-0008	4/22/2020	0256	02564004	0256 NForkStCk 4.22	Normal	0.006	mg/L	
WEL-06-0008	5/27/2020	0256	02564004	0256 NForkStCk 5.27	Normal	0.008	mg/L	
WEL-06-0008	5/27/2020	0256	02564004	0256 NForkStCk 5.27 SPL	Duplicate	0.008	mg/L	
WEL-06-0008	6/24/2020	0256	02564004	0256 NForkStCk 6.24	Normal	0.006	mg/L	
WEL-06-0008	7/21/2020	0256	02564004	0256 NForkStCk 7.21	Normal	0.005	mg/L	
WEL-06-0008	8/27/2020	0256	02564004	0256 NForkStCk 8.27	Normal	0.004	mg/L	
WEL-06-0008	9/24/2020	0256	02564004	0256 NForkStCk 9.24	Normal	0.003	mg/L	
WEL-06-0008	10/22/2020	0256	02564004	0256 NForkStCk 10.22	Normal	0.012	mg/L	
WEL-06-0008	11/19/2020	0256	02564004	0256 NForkStCk 11.19	Normal	0.01	mg/L	
WEL-06-0008	12/16/2020	0256	02564004	0256 NForkStCk	Normal	0.005	mg/L	
WEL-06-0008	1/25/2021	0256	02564004	0256 NForkStCk	Normal	0.003	mg/L	
WEL-06-0008	1/25/2021	0256	02564004	0256 NForkStCk	Duplicate	0.003	mg/L	
WEL-06-0008	2/25/2021	0256	02564004	0256 NForkStCk	Normal	0.01	mg/L	
WEL-06-0008	3/18/2021	0256	02564004	0256 NForkStCk	Normal	0.009	mg/L	
WEL-07-0018	5/26/2020	2830	28301004	2830 MonUpp epi	Normal	0.034	mg/L	
WEL-07-0018	5/26/2020	2830	28302004	2830 MonUpp epi SPL	Duplicate	0.032	mg/L	

Soluble Reactive Phosphorus (SRP) Data for Lake Monroe and its Tributaries

IDEM Site Number	Sample Date	EventID	Sample_ID	SampleName	Sample Type	Concentration	Unit	QA Flags
WEL-07-0018	6/25/2020	2855	28551004	2855 MonUpp epi	Normal	0.013	mg/L	
WEL-07-0018	6/25/2020	2855	28552004	2855 MonUpp hypo	Normal	0.013	mg/L	
WEL-07-0018	7/27/2020	2917	29171004	2917 MonUpp epi	Normal	0.003	mg/L	
WEL-07-0018	7/27/2020	2917	29172004	2917 MonUpp hypo	Normal	0.055	mg/L	
WEL-07-0018	8/28/2020	2939	29391004	2939 MonUpp epi	Normal	0.008	mg/L	
WEL-07-0018	8/28/2020	2939	29392004	2939 MonUpp hypo	Normal	0.018	mg/L	
WEL-07-0018	9/23/2020	2942	29421004	2942 MonUpp EPI	Normal	0.049	mg/L	
WEL-07-0018	10/26/2020	2947	29471004	2947 MonUpp epi	Normal	0.004	mg/L	
WEL-07-0019	4/22/2020	0123	01234004	0123 CrookedCk 4.22	Normal	0.002	mg/L	
WEL-07-0019	5/27/2020	0123	01234004	0123 CrookedCk 5.27	Normal	0.002	mg/L	
WEL-07-0019	6/24/2020	0123	01234004	0123 CrookedCk 6.24	Normal	0.007	mg/L	
WEL-07-0019	7/21/2020	0123	01234004	0123 CrookedCk 7.21	Normal	0.003	mg/L	
WEL-07-0019	8/27/2020	0123	01234004	0123 CrookedCk 8.27	Normal	0.005	mg/L	
WEL-07-0019	11/19/2020	0123	01234004	0123 CrookedCk 11.19	Normal	0.004	mg/L	
WEL-07-0019	12/16/2020	0123	01234004	0123 CrookedCk	Normal	0.004	mg/L	
WEL-07-0019	1/25/2021	0123	01234004	0123 CrookedCk	Normal	0.003	mg/L	
WEL-07-0019	2/25/2021	0123	01234004	0123 CrookedCk	Normal	0.008	mg/L	
WEL-07-0019	3/18/2021	0123	01234004	0123 CrookedCk	Normal	0.006	mg/L	
WEL-07-0020	5/26/2020	2831	28311004	2831 MonCen epi	Normal	0.019	mg/L	
WEL-07-0020	5/26/2020	2831	28312004	2831 MonCen hypo	Normal	0.003	mg/L	
WEL-07-0020	5/26/2020	2831	28312104	2831 MonCen hypo Dup	Duplicate	0.004	mg/L	
WEL-07-0020	6/25/2020	2856	28561004	2856 MonCen epi	Normal	0.009	mg/L	
WEL-07-0020	6/25/2020	2856	28562004	2856 MonCen hypo	Normal	0.004	mg/L	
WEL-07-0020	6/25/2020	2856	28562104	2856 MonCen hypo DUP	Duplicate	0.003	mg/L	
WEL-07-0020	7/27/2020	2918	29181004	2918 MonCen epi	Normal	0.002	mg/L	
WEL-07-0020	7/27/2020	2918	29182004	2918 MonCen hypo	Normal	0.002	mg/L	
WEL-07-0020	7/27/2020	2918	29182104	2918 MonCen hypo DUP	Duplicate	0.003	mg/L	
WEL-07-0020	8/28/2020	2940	29401004	2940 MonCen epi	Normal	0.005	mg/L	
WEL-07-0020	8/28/2020	2940	29402004	2940 MonCen hypo	Normal	0.006	mg/L	
WEL-07-0020	8/28/2020	2940	29402104	2940 MonCen hypo DUP	Duplicate	0.005	mg/L	
WEL-07-0020	9/23/2020	2943	29431004	2943 MonCen EPI	Normal	0.004	mg/L	
WEL-07-0020	10/26/2020	2945	29451004	2945 MonCen epi	Normal	0.004	mg/L	
WEL-07-0020	10/26/2020	2945	29451004	2945 MonCen epi SPL	Duplicate	0.004	mg/L	
WEL-07-0021	5/26/2020	2832	28320004	2832 MonLow Blnk	Field Blank	<0.002	mg/L	U
WEL-07-0021	5/26/2020	2832	28321004	2832 MonLow epi	Normal	0.003	mg/L	
WEL-07-0021	5/26/2020	2832	28322004	2832 MonLow hypo	Normal	0.007	mg/L	
WEL-07-0021	6/25/2020	2857	28570004	2857 MonLow blank	Field Blank	0.002	mg/L	
WEL-07-0021	6/25/2020	2857	28571004	2857 MonLow epi	Normal	0.002	mg/L	
WEL-07-0021	6/25/2020	2857	28572004	2857 MonLow hypo	Normal	0.004	mg/L	
WEL-07-0021	7/27/2020	2919	29191004	2919 MonLow epi	Normal	0.002	mg/L	
WEL-07-0021	7/27/2020	2919	29192004	2919 MonLow hypo	Normal	0.12	mg/L	
WEL-07-0021	7/27/2020	2919	29192004	2919 MonLow hypo SPL	Duplicate	0.122	mg/L	
WEL-07-0021	8/28/2020	2941	29410004	2941 MonLow blank	Field Blank	0.003	mg/L	
WEL-07-0021	8/28/2020	2941	29411004	2941 MonLow epi	Normal	0.004	mg/L	
WEL-07-0021	8/28/2020	2941	29412004	2941 MonLow hypo	Normal	0.062	mg/L	
WEL-07-0021	9/23/2020	2944	29440004	2944 MonLow BLNK	Field Blank	<0.002	mg/L	U
WEL-07-0021	9/23/2020	2944	29441004	2944 MonLow EPI	Normal	0.003	mg/L	
WEL-07-0021	9/23/2020	2944	29442004	2944 MonLow hypo	Normal	0.007	mg/L	
WEL-07-0021	10/26/2020	2946	29460004	2946 MonLow blank	Field Blank	<0.002	mg/L	U
WEL-07-0021	10/26/2020	2946	29461004	2946 MonLow epi	Normal	0.003	mg/L	
WEL-08-0036	4/22/2020	0111	01110004	0111 LMOut blnk 4.22	Field Blank	<0.002	mg/L	U
WEL-08-0036	4/22/2020	0111	01114004	0111 LMOut 4.22	Normal	0.01	mg/L	
WEL-08-0036	5/27/2020	0111	01110004	0111 LMOut Blnk 5.27	Field Blank	<0.002	mg/L	U

Soluble Reactive Phosphorus (SRP) Data for Lake Monroe and its Tributaries

IDEM Site Number	Sample Date	EventID	Sample_ID	SampleName	Sample Type	Concentration	Unit	QA Flags
WEL-08-0036	5/27/2020	0111	01114004	0111 LMOut 5.27	Normal	0.004	mg/L	
WEL-08-0036	6/24/2020	0111	01110004	0111 MonOut Blnk 6.24	Field Blank	0.003	mg/L	
WEL-08-0036	6/24/2020	0111	01114004	0111 MonOut 6.24	Normal	0.005	mg/L	
WEL-08-0036	7/21/2020	0111	01110004	0111 MonOut blank 7.21	Field Blank	0.002	mg/L	
WEL-08-0036	7/21/2020	0111	01114004	0111 MonOut 7.21	Normal	0.011	mg/L	
WEL-08-0036	8/27/2020	0111	01110004	0111 MonOut blank 8.27	Field Blank	0.002	mg/L	
WEL-08-0036	8/27/2020	0111	01114004	0111 MonOut 8.27	Normal	0.016	mg/L	
WEL-08-0036	9/24/2020	0111	01110004	0111 MonOut Blnk 9.24	Field Blank	0.002	mg/L	
WEL-08-0036	9/24/2020	0111	01114004	0111 MonOut 9.24	Normal	0.01	mg/L	
WEL-08-0036	10/22/2020	0111	01110004	0111 MonOut blank 10.22	Field Blank	0.002	mg/L	
WEL-08-0036	10/22/2020	0111	01114004	0111 MonOut 10.22	Normal	0.006	mg/L	
WEL-08-0036	11/19/2020	0111	01110004	0111 MonOut blank 11.19	Field Blank	0.002	mg/L	
WEL-08-0036	11/19/2020	0111	01114004	0111 MonOut 11.19	Normal	0.004	mg/L	
WEL-08-0036	12/16/2020	0111	01114004	0111 MonOut	Normal	0.002	mg/L	
WEL-08-0036	12/16/2020	0111	01110004	0111 MonOut blank	Field Blank	<0.002	mg/L	U
WEL-08-0036	1/25/2021	0111	01114004	0111 MonOut	Normal	0.003	mg/L	
WEL-08-0036	1/25/2021	0111	01110004	0111 MonOut blank	Field Blank	0.002	mg/L	
WEL-08-0036	2/25/2021	0111	01114004	0111 MonOut	Normal	0.004	mg/L	
WEL-08-0036	2/25/2021	0111	01110004	0111 MonOut blank	Field Blank	0.003	mg/L	
WEL-08-0036	3/18/2021	0111	01114004	0111 MonOut	Normal	0.003	mg/L	
WEL-08-0036	3/18/2021	0111	01110004	0111 MonOut blank	Field Blank	0.002	mg/L	

IDEM Site Numb	Sample Date	EventID	Sample_ID	SampleName	Sample Type	Concentration	Unit	QA Flags
WEL-04-0004	4/22/2020	0914	09144003	0914 SForkStCk 4.22	Normal	0.185	mg/L	
WEL-04-0004	5/27/2020	0914	09144003	0914 SForkStCk 5.27	Normal	0.377	mg/L	
WEL-04-0004	6/24/2020	0914	09144003	0914 SForkStCk 6.24	Normal	2.11	mg/L	
WEL-04-0004	6/24/2020	0914	09144003	0914 SForkStCk SPL 6.24	Split	2.119	mg/L	
WEL-04-0004	7/21/2020	0914	09144003	0914 SForkStCk 7.21	Normal	0.205	mg/L	
WEL-04-0004	8/27/2020	0914	09144003	0914 SForkStCk 8.27	Normal	0.092	mg/L	
WEL-04-0004	9/24/2020	0914	09144003	0914 SForkStCk 9.24	Normal	<0.008	mg/L	U
WEL-04-0004	10/22/2020	0914	09144003	0914 SForkStCk 10.22	Normal	0.011	mg/L	
WEL-04-0004	11/19/2020	0914	09144003	0914 SForkStCk 11.19	Normal	0.228	mg/L	
WEL-04-0004	12/16/2020	0914	09144003	0914 SForkStCk 12.16	Normal	0.554	mg/L	
WEL-04-0004	12/16/2020	0914	09144003	0914 SForkStCk spl 12.16	Split	0.447	mg/L	
WEL-04-0004	1/25/2021	0914	09144003	0914 SForkStCk 01.25	Normal	0.669	mg/L	
WEL-04-0004	1/25/2021	0914	09144003	0914 SForkStCk spl 01.25	Split	0.71	mg/L	
WEL-04-0004	2/25/2021	0914	09144003	0914 SForkStCk	Normal	0.546	mg/L	
WEL-04-0004	2/25/2021	0914	09144003	0914 SForkStCk	Split	0.553	mg/L	
WEL-04-0004	3/18/2021	0914	09144003	0914 SForkStCk	Normal	0.493	mg/L	
WEL-05-0001	4/22/2020	0668	06684003	0668 MForkStCk 4.22	Normal	0.16	mg/L	
WEL-05-0001	4/22/2020	0668	06684103	0668 MForkStCk DUP 4.22	Duplicate	0.154	mg/L	
WEL-05-0001	5/27/2020	0668	06684003	0668 MForkStCk 5.27	Normal	0.228	mg/L	
WEL-05-0001	5/27/2020	0668	06684103	0668 MForkStCk DUP 5.27	Duplicate	0.26	mg/L	
WEL-05-0001	6/24/2020	0668	06684003	0668 MForkStCk 6.24	Normal	0.18	mg/L	
WEL-05-0001	6/24/2020	0668	06684103	0668 MForkStCk DUP 6.24	Duplicate	0.166	mg/L	
WEL-05-0001	7/21/2020	0668	06684003	0668 MForkStCk 7.21	Normal	0.087	mg/L	
WEL-05-0001	7/21/2020	0668	06684103	0668 MForkStCk DUP 7.21	Duplicate	0.101	mg/L	
WEL-05-0001	8/27/2020	0668	06684003	0668 MForkStCk 8.27	Normal	0.134	mg/L	
WEL-05-0001	8/27/2020	0668	06684103	0668 MForkStCk DUP 8.27	Duplicate	0.131	mg/L	
WEL-05-0001	9/24/2020	0668	06684003	0668 MForkStCk 9.24	Normal	<0.008	mg/L	U
WEL-05-0001	9/24/2020	0668	06684103	0668 MForkStCk DUP 9.24	Duplicate	<0.008	mg/L	U
WEL-05-0001	10/22/2020	0668	06684003	0668 MForkStCk 10.22	Normal	<0.008	mg/L	U
WEL-05-0001	10/22/2020	0668	06684103	0668 MForkStCk DUP 10.22	Duplicate	<0.008	mg/L	U
WEL-05-0001	11/19/2020	0668	06684003	0668 MForkStCk 11.19	Normal	0.098	mg/L	
WEL-05-0001	11/19/2020	0668	06684103	0668 MForkStCk DUP 11.19	Duplicate	0.098	mg/L	
WEL-05-0001	12/16/2020	0668	06684003	0668 MForkStCk 12.16	Normal	0.475	mg/L	
WEL-05-0001	12/16/2020	0668	06684103	0668 MForkStCk DUP 12.16	Duplicate	0.516	mg/L	
WEL-05-0001	1/25/2021	0668	06684003	0668 MForkStCk 01.25	Normal	0.519	mg/L	
WEL-05-0001	1/25/2021	0668	06684103	0668 MForkStCk DUP 01.25	Duplicate	0.521	mg/L	
WEL-05-0001	2/25/2021	0668	06684003	0668 MForkStCk	Normal	0.608	mg/L	
WEL-05-0001	2/25/2021	0668	06684103	0668 MForkStCk	Duplicate	0.638	mg/L	
WEL-05-0001	3/18/2021	0668	06684003	0668 MForkStCk	Normal	0.415	mg/L	
WEL-05-0001	3/18/2021	0668	06684103	0668 MForkStCk	Duplicate	0.411	mg/L	
WEL-06-0008	4/22/2020	0256	02564003	0256 NForkStCk 4.22	Normal	0.123	mg/L	
WEL-06-0008	5/27/2020	0256	02564003	0256 NForkStCk 5.27	Normal	0.268	mg/L	
WEL-06-0008	6/24/2020	0256	02564003	0256 NForkStCk 6.24	Normal	0.104	mg/L	
WEL-06-0008	7/21/2020	0256	02564003	0256 NForkStCk 7.21	Normal	0.117	mg/L	
WEL-06-0008	8/27/2020	0256	02564003	0256 NForkStCk 8.27	Normal	0.14	mg/L	
WEL-06-0008	9/24/2020	0256	02564003	0256 NForkStCk 9.24	Normal	<0.008	mg/L	U
WEL-06-0008	10/22/2020	0256	02564003	0256 NForkStCk 10.22	Normal	<0.008	mg/L	U
WEL-06-0008	10/22/2020	0256	02564003	0256 NForkStCk SPL 10.22	Duplicate	<0.008	mg/L	U
WEL-06-0008	11/19/2020	0256	02564003	0256 NForkStCk 11.19	Normal	0.455	mg/L	
WEL-06-0008	11/19/2020	0256	02564003	0256 NForkStCk SPL 11.19	Split	0.444	mg/L	
WEL-06-0008	12/16/2020	0256	02564003	0256 NForkStCk 12.16	Normal	0.7	mg/L	
WEL-06-0008	1/25/2021	0256	02564003	0256 NForkStCk 01.25	Normal	0.645	mg/L	
WEL-06-0008	2/25/2021	0256	02564003	0256 NForkStCk	Normal	0.478	mg/L	
WEL-06-0008	3/18/2021	0256	02564003	0256 NForkStCk	Normal	0.249	mg/L	
WEL-07-0018	5/26/2020	2830	28301003	2830 MonUpp epi	Normal	<0.008	mg/L	U

Nitrate (NO3) Data for Lake Monroe and its Tributaries

IDEM Site Numb	Sample Date	EventID	Sample_ID	SampleName	Sample Type	Concentration	Unit	QA Flags
WEL-07-0018	6/25/2020	2855	28551003	2855 MonUpp epi	Normal	0.021	mg/L	
WEL-07-0018	6/25/2020	2855	28552003	2855 MonUpp hypo	Normal	0.024	mg/L	
WEL-07-0018	7/27/2020	2917	29171003	2917 MonUpp epi	Normal	<0.008	mg/L	U
WEL-07-0018	7/27/2020	2917	29172003	2917 MonUpp hypo	Normal	0.135	mg/L	
WEL-07-0018	8/28/2020	2939	29391003	2939 MonUpp epi	Normal	<0.008	mg/L	U
WEL-07-0018	8/28/2020	2939	29392003	2939 MonUpp hypo	Normal	0.009	mg/L	
WEL-07-0018	9/23/2020	2942	29421003	2942 MonUpp epi	Normal	0.011	mg/L	
WEL-07-0018	10/26/2020	2947	29471003	2947 MonUpp epi	Normal	0.019	mg/L	
WEL-07-0019	4/22/2020	0123	01234003	0123 CrookedCk 4.22	Normal	0.067	mg/L	
WEL-07-0019	5/27/2020	0123	01234003	0123 CrookedCk 5.27	Normal	0.145	mg/L	
WEL-07-0019	5/27/2020	0123	01234003	0123 CrookedCk SPL 5.27	Split	0.139	mg/L	
WEL-07-0019	6/24/2020	0123	01234003	0123 CrookedCk 6.24	Normal	0.2	mg/L	
WEL-07-0019	7/21/2020	0123	01234003	0123 CrookedCk 7.21	Normal	0.175	mg/L	
WEL-07-0019	8/27/2020	0123	01234003	0123 CrookedCk 8.27	Normal	0.136	mg/L	
WEL-07-0019	11/19/2020	0123	01234003	0123 CrookedCk 11.19	Normal	0.01	mg/L	
WEL-07-0019	12/16/2020	0123	01234003	0123 Crkd Ck 12.16	Normal	0.043	mg/L	
WEL-07-0019	1/25/2021	0123	01234003	0123 Crkd Ck 01.25	Normal	0.066	mg/L	
WEL-07-0019	2/25/2021	0123	01234003	0123 CrookedCk	Normal	0.241	mg/L	
WEL-07-0019	3/18/2021	0123	01234003	0123 CrookedCk	Normal	0.105	mg/L	
WEL-07-0020	5/26/2020	2831	28311003	2831 MonCen epi	Normal	0.038	mg/L	
WEL-07-0020	5/26/2020	2831	28312003	2831 MonCen hypo	Normal	0.13	mg/L	
WEL-07-0020	5/26/2020	2831	28312103	2831 MonCen hypo DUP	Duplicate	0.12	mg/L	
WEL-07-0020	6/25/2020	2856	28561003	2856 MonCen epi	Normal	0.024	mg/L	
WEL-07-0020	6/25/2020	2856	28562003	2856 MonCen hypo	Normal	0.025	mg/L	
WEL-07-0020	6/25/2020	2856	28562103	2856 MonCen hypo DUP	Duplicate	0.026	mg/L	
WEL-07-0020	7/27/2020	2918	29181003	2918 MonCen epi	Normal	<0.008	mg/L	U
WEL-07-0020	7/27/2020	2918	29182003	2918 MonCen hypo	Normal	<0.008	mg/L	U
WEL-07-0020	7/27/2020	2918	29182103	2918 MonCen hypo DUP	Duplicate	<0.008	mg/L	U
WEL-07-0020	8/28/2020	2940	29401003	2940 MonCen epi	Normal	<0.008	mg/L	U
WEL-07-0020	8/28/2020	2940	29402003	2940 MonCen hypo	Normal	<0.008	mg/L	U
WEL-07-0020	8/28/2020	2940	29402103	2940 MonCen hypo DUP	Duplicate	0.011	mg/L	
WEL-07-0020	9/23/2020	2943	29431003	2943 MonCen epi	Normal	<0.008	mg/L	U
WEL-07-0020	10/26/2020	2945	29451003	2945 MonCen epi	Normal	0.034	mg/L	
WEL-07-0021	5/26/2020	2832	28320003	2832 MonLow blank	Field Blank	<0.008	mg/L	U
WEL-07-0021	5/26/2020	2832	28321003	2832 MonLow epi	Normal	0.12	mg/L	
WEL-07-0021	5/26/2020	2832	28322003	2832 MonLow hypo	Normal	0.295	mg/L	
WEL-07-0021	5/26/2020	2832	28322003	2832 MonLow hypo SPL	Split	0.254	mg/L	
WEL-07-0021	6/25/2020	2857	28570003	2857 MonLow blank	Field Blank	0.02	mg/L	
WEL-07-0021	6/25/2020	2857	28571003	2857 MonLow epi	Normal	0.019	mg/L	
WEL-07-0021	6/25/2020	2857	28572003	2857 MonLow hypo	Normal	0.034	mg/L	
WEL-07-0021	6/25/2020	2857	28572003	2857 MonLow hypo SPL	Split	0.032	mg/L	
WEL-07-0021	7/27/2020	2919	29191003	2919 MonLow epi	Normal	<0.008	mg/L	U
WEL-07-0021	7/27/2020	2919	29192003	2919 MonLow hypo	Normal	0.016	mg/L	
WEL-07-0021	7/27/2020	2919	29192003	2919 MonLow hypo SPL	Split	0.017	mg/L	
WEL-07-0021	8/28/2020	2941	29410003	2941 MonLow blank	Field Blank	0.011	mg/L	
WEL-07-0021	8/28/2020	2941	29411003	2941 MonLow epi	Normal	<0.008	mg/L	U
WEL-07-0021	8/28/2020	2941	29412003	2941 MonLow hypo	Normal	<0.008	mg/L	U
WEL-07-0021	8/28/2020	2941	29412003	2941 MonLow hypo SPL	Split	0.008	mg/L	
WEL-07-0021	9/23/2020	2944	29440003	2944 MonLow BLNK RR	Field Blank	<0.008	mg/L	U
WEL-07-0021	9/23/2020	2944	29441003	2944 MonLow EPI RR	Normal	<0.008	mg/L	U
WEL-07-0021	9/23/2020	2944	29442003	2944 MonLow HYPO RR	Normal	<0.008	mg/L	U
WEL-07-0021	10/26/2020	2946	29460003	2946 MonLow blank	Field Blank	<0.008	mg/L	U
WEL-07-0021	10/26/2020	2946	29461003	2946 MonLow epi	Normal	0.093	mg/L	

Nitrate (NO3) Data for Lake Monroe and its Tributaries

IDEM Site Numb	Sample Date	EventID	Sample_ID	SampleName	Sample Type	Concentration	Unit	QA Flags
WEL-08-0036	4/22/2020	0111	01110003	0111 MonOut blank 4.22	Field Blank	0.024	mg/L	
WEL-08-0036	4/22/2020	0111	01114003	0111 MonOut 4.22	Normal	0.308	mg/L	
WEL-08-0036	5/27/2020	0111	01110003	0111 MonOut blank 5.27	Field Blank	0.024	mg/L	
WEL-08-0036	5/27/2020	0111	01114003	0111 MonOut 5.27	Normal	0.201	mg/L	
WEL-08-0036	6/24/2020	0111	01110003	0111 MonOut blank 6.24	Field Blank	0.028	mg/L	
WEL-08-0036	6/24/2020	0111	01114003	0111 MonOut 6.24	Normal	0.052	mg/L	
WEL-08-0036	7/21/2020	0111	01110003	0111 MonOut blank 7.21	Field Blank	<0.008	mg/L	U
WEL-08-0036	7/21/2020	0111	01114003	0111 MonOut epi 7.21	Normal	<0.008	mg/L	U
WEL-08-0036	8/27/2020	0111	01110003	0111 MonOut blank 8.27	Field Blank	<0.008	mg/L	U
WEL-08-0036	8/27/2020	0111	01114003	0111 MonOut 8.27	Normal	0.015	mg/L	
WEL-08-0036	9/24/2020	0111	01110003	0111 MonOut 9.24	Normal	<0.009	mg/L	U
WEL-08-0036	9/24/2020	0111	01110003	0111 MonOut blank 9.24	Field Blank	<0.008	mg/L	U
WEL-08-0036	9/24/2020	0111	01110003	0111 MonOut SPL 9.24	Split	<0.010	mg/L	U
WEL-08-0036	10/22/2020	0111	01110003	0111 MonOut 10.22	Normal	0.081	mg/L	
WEL-08-0036	10/22/2020	0111	01114003	0111 MonOut blank 10.22	Field Blank	<0.008	mg/L	U
WEL-08-0036	11/19/2020	0111	01110003	0111 MonOut blank 11.19	Field Blank	<0.008	mg/L	U
WEL-08-0036	11/19/2020	0111	01114003	0111 MonOut 11.19	Normal	0.087	mg/L	
WEL-08-0036	12/16/2020	0111	01114003	0111 MonOut 12.16	Normal	0.071	mg/L	
WEL-08-0036	12/16/2020	0111	01110003	0111 MonOut BLNK 12.16	Field Blank	<0.008	mg/L	U
WEL-08-0036	1/25/2021	0111	01114003	0111 MonOut 01.25	Normal	0.071	mg/L	
WEL-08-0036	1/25/2021	0111	01110003	0111 MonOut BLNK 01.25	Field Blank	<0.008	mg/L	U
WEL-08-0036	2/25/2021	0111	01114003	0111 MonOut	Normal	0.153	mg/L	
WEL-08-0036	2/25/2021	0111	01110003	0111 MonOut blank	Field Blank	<0.008	mg/L	U
WEL-08-0036	3/18/2021	0111	01114003	0111 MonOut	Normal	0.175	mg/L	
WEL-08-0036	3/18/2021	0111	01110003	0111 MonOut blank	Field Blank	0.013	mg/L	

Ammonia (NH3) Data for Lake Monroe and its Tributaries

IDEM Site Number	Sample Date	EventID	Sample_ID	SampleName	Sample Type	Concentration	Unit	QA Flags
WEL-04-0004	4/22/2020	0914	09144003	0914 SForkStCk 4.22	Normal	<0.014	mg/L	U
WEL-04-0004	5/27/2020	0914	09144003	0914 SForkStCk 5.27	Normal	0.044	mg/L	
WEL-04-0004	6/24/2020	0914	09144003	0914 SForkStCk 6.24	Normal	0.419	mg/L	
WEL-04-0004	6/24/2020	0914	09144003	0914 SForkStCk SPL 6.24	Split	0.405	mg/L	
WEL-04-0004	7/21/2020	0914	09144003	0914 SForkStCk 7.21	Normal	0.1	mg/L	
WEL-04-0004	8/27/2020	0914	09144003	0914 SForkStCk 8.27	Normal	0.075	mg/L	
WEL-04-0004	9/24/2020	0914	09144003	0914 SForkStCk 9.24	Normal	0.093	mg/L	
WEL-04-0004	10/22/2020	0914	09144003	0914 SForkStCk 10.22	Normal	0.034	mg/L	
WEL-04-0004	11/19/2020	0914	09144003	0914 SForkStCk 11.19	Normal	0.027	mg/L	
WEL-04-0004	12/16/2020	0914	09144003	0914 SForkStCk 12.16	Normal	0.032	mg/L	
WEL-04-0004	12/16/2020	0914	09144003	0914 SForkStCk spl 12.16	Split	0.033	mg/L	
WEL-04-0004	1/25/2021	0914	09144003	0914 SForkStCk 01.25	Normal	0.049	mg/L	
WEL-04-0004	1/25/2021	0914	09144003	0914 SForkStCk spl 01.25	Split	0.048	mg/L	
WEL-04-0004	2/25/2021	0914	09144003	0914 SForkStCk	Normal	<0.014	mg/L	U
WEL-04-0004	2/25/2021	0914	09144003	0914 SForkStCk	Split	0.014	mg/L	
WEL-04-0004	3/18/2021	0914	09144003	0914 SForkStCk	Normal	0.024	mg/L	
WEL-05-0001	4/22/2020	0668	06684003	0668 MForkStCk 4.22	Normal	<0.014	mg/L	U
WEL-05-0001	4/22/2020	0668	06684103	0668 MForkStCk DUP 4.22	Duplicate	<0.014	mg/L	U
WEL-05-0001	5/27/2020	0668	06684003	0668 MForkStCk 5.27	Normal	<0.014	mg/L	U
WEL-05-0001	5/27/2020	0668	06684103	0668 MForkStCk DUP 5.27	Duplicate	<0.014	mg/L	U
WEL-05-0001	6/24/2020	0668	06684003	0668 MForkStCk 6.24	Normal	0.115	mg/L	
WEL-05-0001	6/24/2020	0668	06684103	0668 MForkStCk DUP 6.24	Duplicate	0.1	mg/L	
WEL-05-0001	7/21/2020	0668	06684003	0668 MForkStCk 7.21	Normal	0.086	mg/L	
WEL-05-0001	7/21/2020	0668	06684103	0668 MForkStCk DUP 7.21	Duplicate	0.125	mg/L	
WEL-05-0001	8/27/2020	0668	06684003	0668 MForkStCk 8.27	Normal	0.095	mg/L	
WEL-05-0001	8/27/2020	0668	06684103	0668 MForkStCk DUP 8.27	Duplicate	0.061	mg/L	
WEL-05-0001	9/24/2020	0668	06684003	0668 MForkStCk 9.24	Normal	0.062	mg/L	
WEL-05-0001	9/24/2020	0668	06684103	0668 MForkStCk DUP 9.24	Duplicate	0.058	mg/L	
WEL-05-0001	10/22/2020	0668	06684003	0668 MForkStCk 10.22	Normal	0.014	mg/L	
WEL-05-0001	10/22/2020	0668	06684103	0668 MForkStCk DUP 10.22	Duplicate	<0.014	mg/L	U
WEL-05-0001	11/19/2020	0668	06684003	0668 MForkStCk 11.19	Normal	0.014	mg/L	
WEL-05-0001	11/19/2020	0668	06684103	0668 MForkStCk DUP 11.19	Duplicate	<0.014	mg/L	U
WEL-05-0001	12/16/2020	0668	06684003	0668 MForkStCk 12.16	Normal	0.017	mg/L	
WEL-05-0001	12/16/2020	0668	06684103	0668 MForkStCk DUP 12.16	Duplicate	0.021	mg/L	
WEL-05-0001	1/25/2021	0668	06684003	0668 MForkStCk 01.25	Normal	0.03	mg/L	
WEL-05-0001	1/25/2021	0668	06684103	0668 MForkStCk DUP 01.25	Duplicate	0.03	mg/L	
WEL-05-0001	2/25/2021	0668	06684003	0668 MForkStCk	Normal	0.045	mg/L	
WEL-05-0001	2/25/2021	0668	06684103	0668 MForkStCk	Duplicate	0.047	mg/L	
WEL-05-0001	3/18/2021	0668	06684003	0668 MForkStCk	Normal	0.017	mg/L	
WEL-05-0001	3/18/2021	0668	06684103	0668 MForkStCk	Duplicate	0.025	mg/L	
WEL-06-0008	4/22/2020	0256	02564003	0256 NForkStCk 4.22	Normal	<0.014	mg/L	U
WEL-06-0008	5/27/2020	0256	02564003	0256 NForkStCk 5.27	Normal	<0.014	mg/L	U
WEL-06-0008	6/24/2020	0256	02564003	0256 NForkStCk 6.24	Normal	0.125	mg/L	
WEL-06-0008	7/21/2020	0256	02564003	0256 NForkStCk 7.21	Normal	0.036	mg/L	
WEL-06-0008	8/27/2020	0256	02564003	0256 NForkStCk 8.27	Normal	0.034	mg/L	
WEL-06-0008	9/24/2020	0256	02564003	0256 NForkStCk 9.24	Normal	<0.014	mg/L	U
WEL-06-0008	10/22/2020	0256	02564003	0256 NForkStCk 10.22	Normal	<0.014	mg/L	U
WEL-06-0008	10/22/2020	0256	02564003	0256 NForkStCk SPL 10.22	Split	<0.014	mg/L	U
WEL-06-0008	11/19/2020	0256	02564003	0256 NForkStCk 11.19	Normal	<0.014	mg/L	U
WEL-06-0008	11/19/2020	0256	02564003	0256 NForkStCk SPL 11.19	Split	<0.014	mg/L	U
WEL-06-0008	12/16/2020	0256	02564003	0256 NForkStCk 12.16	Normal	<0.014	mg/L	U
WEL-06-0008	1/25/2021	0256	02564003	0256 NForkStCk 01.25	Normal	0.067	mg/L	
WEL-06-0008	2/25/2021	0256	02564003	0256 NForkStCk	Normal	0.084	mg/L	
WEL-06-0008	3/18/2021	0256	02564003	0256 NForkStCk	Normal	0.048	mg/L	
WEL-07-0018	5/26/2020	2830	28301003	2830 MonUpp epi	Normal	0.024	mg/L	

Ammonia (NH3) Data for Lake Monroe and its Tributaries

IDEM Site Number	Sample Date	EventID	Sample_ID	SampleName	Sample Type	Concentration	Unit	QA Flags
WEL-07-0018	6/25/2020	2855	28551003	2855 MonUpp epi	Normal	0.052	mg/L	
WEL-07-0018	6/25/2020	2855	28552003	2855 MonUpp hypo	Normal	0.112	mg/L	
WEL-07-0018	7/27/2020	2917	29171003	2917 MonUpp epi	Normal	<0.014	mg/L	U
WEL-07-0018	7/27/2020	2917	29172003	2917 MonUpp hypo	Normal	0.346	mg/L	
WEL-07-0018	8/28/2020	2939	29391003	2939 MonUpp epi	Normal	<0.014	mg/L	U
WEL-07-0018	8/28/2020	2939	29392003	2939 MonUpp hypo	Normal	0.298	mg/L	
WEL-07-0018	9/23/2020	2942	29421003	2942 MonUpp epi	Normal	<0.014	mg/L	U
WEL-07-0018	10/26/2020	2947	29471003	2947 MonUpp epi	Normal	0.023	mg/L	
WEL-07-0019	4/22/2020	0123	01234003	0123 CrookedCk 4.22	Normal	<0.014	mg/L	U
WEL-07-0019	5/27/2020	0123	01234003	0123 CrookedCk 5.27	Normal	<0.014	mg/L	U
WEL-07-0019	5/27/2020	0123	01234003	0123 CrookedCk SPL 5.27	Split	<0.014	mg/L	U
WEL-07-0019	6/24/2020	0123	01234003	0123 CrookedCk 6.24	Normal	0.04	mg/L	
WEL-07-0019	7/21/2020	0123	01234003	0123 CrookedCk 7.21	Normal	<0.014	mg/L	U
WEL-07-0019	8/27/2020	0123	01234003	0123 CrookedCk 8.27	Normal	<0.014	mg/L	U
WEL-07-0019	11/19/2020	0123	01234003	0123 CrookedCk 11.19	Normal	<0.014	mg/L	U
WEL-07-0019	12/16/2020	0123	01234003	0123 Crkd Ck 12.16	Normal	<0.014	mg/L	U
WEL-07-0019	1/25/2021	0123	01234003	0123 Crkd Ck 01.25	Normal	<0.014	mg/L	U
WEL-07-0019	2/25/2021	0123	01234003	0123 CrookedCk	Normal	0.024	mg/L	
WEL-07-0019	3/18/2021	0123	01234003	0123 CrookedCk	Normal	<0.014	mg/L	U
WEL-07-0020	5/26/2020	2831	28311003	2831 MonCen epi	Normal	0.022	mg/L	
WEL-07-0020	5/26/2020	2831	28312003	2831 MonCen hypo	Normal	0.036	mg/L	
WEL-07-0020	5/26/2020	2831	28312103	2831 MonCen hypo DUP	Duplicate	0.029	mg/L	
WEL-07-0020	6/25/2020	2856	28561003	2856 MonCen epi	Normal	<0.014	mg/L	U
WEL-07-0020	6/25/2020	2856	28562003	2856 MonCen hypo	Normal	<0.014	mg/L	U
WEL-07-0020	6/25/2020	2856	28562103	2856 MonCen hypo DUP	Duplicate	<0.014	mg/L	U
WEL-07-0020	7/27/2020	2918	29181003	2918 MonCen epi	Normal	0.017	mg/L	
WEL-07-0020	7/27/2020	2918	29182003	2918 MonCen hypo	Normal	<0.014	mg/L	U
WEL-07-0020	7/27/2020	2918	29182103	2918 MonCen hypo DUP	Duplicate	<0.014	mg/L	U
WEL-07-0020	8/28/2020	2940	29401003	2940 MonCen epi	Normal	0.018	mg/L	
WEL-07-0020	8/28/2020	2940	29402003	2940 MonCen hypo	Normal	0.03	mg/L	
WEL-07-0020	8/28/2020	2940	29402103	2940 MonCen hypo DUP	Duplicate	0.061	mg/L	
WEL-07-0020	9/23/2020	2943	29431003	2943 MonCen epi	Normal	<0.014	mg/L	U
WEL-07-0020	10/26/2020	2945	29451003	2945 MonCen epi	Normal	0.029	mg/L	
WEL-07-0021	5/26/2020	2832	28320003	2832 MonLow blank	Field Blank	0.02	mg/L	
WEL-07-0021	5/26/2020	2832	28321003	2832 MonLow epi	Normal	0.032	mg/L	
WEL-07-0021	5/26/2020	2832	28322003	2832 MonLow hypo	Normal	0.08	mg/L	
WEL-07-0021	5/26/2020	2832	28322003	2832 MonLow hypo SPL	Split	0.083	mg/L	
WEL-07-0021	6/25/2020	2857	28570003	2857 MonLow blank	Field Blank	<0.014	mg/L	U
WEL-07-0021	6/25/2020	2857	28571003	2857 MonLow epi	Normal	<0.014	mg/L	U
WEL-07-0021	6/25/2020	2857	28572003	2857 MonLow hypo	Normal	<0.014	mg/L	U
WEL-07-0021	6/25/2020	2857	28572003	2857 MonLow hypo SPL	Split	<0.014	mg/L	U
WEL-07-0021	7/27/2020	2919	29191003	2919 MonLow epi	Normal	<0.014	mg/L	U
WEL-07-0021	7/27/2020	2919	29192003	2919 MonLow hypo	Normal	0.342	mg/L	
WEL-07-0021	7/27/2020	2919	29192003	2919 MonLow hypo SPL	Split	0.338	mg/L	
WEL-07-0021	8/28/2020	2941	29410003	2941 MonLow blank	Field Blank	0.015	mg/L	
WEL-07-0021	8/28/2020	2941	29411003	2941 MonLow epi	Normal	<0.014	mg/L	U
WEL-07-0021	8/28/2020	2941	29412003	2941 MonLow hypo	Normal	0.564	mg/L	
WEL-07-0021	8/28/2020	2941	29412003	2941 MonLow hypo SPL	Split	0.571	mg/L	
WEL-07-0021	9/23/2020	2944	29440003	2944 MonLow BLNK RR	Field Blank	<0.014	mg/L	U
WEL-07-0021	9/23/2020	2944	29441003	2944 MonLow EPI RR	Normal	0.044	mg/L	
WEL-07-0021	9/23/2020	2944	29442003	2944 MonLow HYPO RR	Normal	0.8	mg/L	
WEL-07-0021	10/26/2020	2946	29460003	2946 MonLow blank	Field Blank	<0.014	mg/L	U
WEL-07-0021	10/26/2020	2946	29461003	2946 MonLow epi	Normal	0.034	mg/L	

Ammonia (NH3) Data for Lake Monroe and its Tributaries

IDEM Site Number	Sample Date	EventID	Sample_ID	SampleName	Sample Type	Concentration	Unit	QA Flags
WEL-08-0036	4/22/2020	0111	01110003	0111 MonOut blank 4.22	Field Blank	<0.014	mg/L	U
WEL-08-0036	4/22/2020	0111	01114003	0111 MonOut 4.22	Normal	<0.014	mg/L	U
WEL-08-0036	5/27/2020	0111	01110003	0111 MonOut blank 5.27	Field Blank	<0.014	mg/L	U
WEL-08-0036	5/27/2020	0111	01114003	0111 MonOut 5.27	Normal	<0.014	mg/L	U
WEL-08-0036	6/24/2020	0111	01110003	0111 MonOut blank 6.24	Field Blank	<0.014	mg/L	U
WEL-08-0036	6/24/2020	0111	01114003	0111 MonOut 6.24	Normal	0.066	mg/L	
WEL-08-0036	7/21/2020	0111	01110003	0111 MonOut blank 7.21	Field Blank	<0.014	mg/L	U
WEL-08-0036	7/21/2020	0111	01114003	0111 MonOut epi 7.21	Normal	0.035	mg/L	
WEL-08-0036	8/27/2020	0111	01110003	0111 MonOut blank 8.27	Field Blank	<0.014	mg/L	U
WEL-08-0036	8/27/2020	0111	01114003	0111 MonOut 8.27	Normal	0.09	mg/L	
WEL-08-0036	9/24/2020	0111	01110003	0111 MonOut 9.24	Normal	0.016	mg/L	
WEL-08-0036	9/24/2020	0111	01110003	0111 MonOut blank 9.24	Field Blank	<0.014	mg/L	U
WEL-08-0036	9/24/2020	0111	01110003	0111 MonOut SPL 9.24	Split	0.016	mg/L	
WEL-08-0036	10/22/2020	0111	01110003	0111 MonOut 10.22	Normal	0.046	mg/L	
WEL-08-0036	10/22/2020	0111	01114003	0111 MonOut blank 10.22	Field Blank	<0.014	mg/L	U
WEL-08-0036	11/19/2020	0111	01110003	0111 MonOut blank 11.19	Field Blank	<0.014	mg/L	U
WEL-08-0036	11/19/2020	0111	01114003	0111 MonOut 11.19	Normal	<0.014	mg/L	U
WEL-08-0036	12/16/2020	0111	01114003	0111 MonOut 12.16	Normal	0.038	mg/L	
WEL-08-0036	12/16/2020	0111	01110003	0111 MonOut BLNK 12.16	Field Blank	<0.014	mg/L	U
WEL-08-0036	1/25/2021	0111	01114003	0111 MonOut 01.25	Normal	0.019	mg/L	
WEL-08-0036	1/25/2021	0111	01110003	0111 MonOut BLNK 01.25	Field Blank	<0.014	mg/L	U
WEL-08-0036	2/25/2021	0111	01114003	0111 MonOut	Normal	<0.014	mg/L	U
WEL-08-0036	2/25/2021	0111	01110003	0111 MonOut blank	Field Blank	<0.014	mg/L	U
WEL-08-0036	3/18/2021	0111	01114003	0111 MonOut	Normal	<0.014	mg/L	U
WEL-08-0036	3/18/2021	0111	01110003	0111 MonOut blank	Field Blank	<0.014	mg/L	U

Total Nitrogen (TN) Data for Lake Monroe and its Tributaries

IDEM Site Num	Sample Date	EventID	Sample_ID	SampleName	Sample Type	Concentration	Unit	QA Flags
WEL-04-0004	4/22/2020	0914	09144005	0914 SForkStCk	Normal	0.319	mg/L	
WEL-04-0004	5/27/2020	0914	09144005	0914 SForkStCk	Normal	0.719	mg/L	
WEL-04-0004	6/24/2020	0914	09144005	0914 SForkStCk 6.24	Normal	3.379	mg/L	
WEL-04-0004	7/21/2020	0914	09144005	0914 SForkStCk 7.21	Normal	0.604	mg/L	
WEL-04-0004	8/27/2020	0914	09144005	0914 SForkStCk 8.27	Normal	0.429	mg/L	
WEL-04-0004	8/27/2020	0914	09144005	0914 SForkStCk DGSPL 8.27	Duplicate	0.393	mg/L	
WEL-04-0004	9/24/2020	0914	09144005	0914 SForkStCk 9.24	Normal	0.459	mg/L	
WEL-04-0004	9/24/2020	0914	09144005	0914 SForkStCk 9.24 SPL	Split	0.464	mg/L	
WEL-04-0004	10/22/2020	0914	09144005	0914 SForkStCk	Normal	0.513	mg/L	
WEL-04-0004	11/19/2020	0914	09144005	0914 SForkStCk	Normal	0.257	mg/L	
WEL-04-0004	11/19/2020	0914	09144005	0914 SForkStCk	DigSplit	0.264	mg/L	
WEL-04-0004	12/16/2020	0914	09144005	0914 SForkStCk	Normal	0.599	mg/L	
WEL-04-0004	12/16/2020	0914	09144005	0914 SForkStCk	Split	0.592	mg/L	
WEL-04-0004	1/25/2021	0914	09144005	0914 SForkStCk	Normal	0.749	mg/L	
WEL-04-0004	2/25/2021	0914	09144005	0914 SForkStCk	Normal	0.865	mg/L	
WEL-04-0004	3/18/2021	0914	09144005	0914 SForkStCk	Normal	0.64	mg/L	
WEL-05-0001	4/22/2020	0668	06684005	0668 MForkStCk	Normal	0.237	mg/L	
WEL-05-0001	4/22/2020	0668	06684105	0668 MForkStCk	Duplicate	0.224	mg/L	
WEL-05-0001	5/27/2020	0668	06684005	0668 MForkStCk	Normal	0.396	mg/L	
WEL-05-0001	5/27/2020	0668	06684105	0668 MForkStCk	Duplicate	0.422	mg/L	
WEL-05-0001	6/24/2020	0668	06684005	0668 MForkStCk 6.24	Normal	0.449	mg/L	
WEL-05-0001	6/24/2020	0668	06684105	0668 MForkStCk DUP 6.24	Duplicate	0.438	mg/L	
WEL-05-0001	7/21/2020	0668	06684005	0668 MForkStCk 7.21	Normal	0.443	mg/L	
WEL-05-0001	7/21/2020	0668	06684105	0668 MForkStCk DUP 7.21	Duplicate	0.407	mg/L	
WEL-05-0001	8/27/2020	0668	06684005	0668 MForkStCk 8.27	Normal	0.363	mg/L	
WEL-05-0001	8/27/2020	0668	06684105	0668 MForkStCk DUP 8.27	Duplicate	0.317	mg/L	
WEL-05-0001	9/24/2020	0668	06684005	0668 MForkStCk 9.24	Normal	0.263	mg/L	
WEL-05-0001	9/24/2020	0668	06684105	0668 MForkStCk 9.24 DUP	Duplicate	0.247	mg/L	
WEL-05-0001	10/22/2020	0668	06684105	0668 MForkStCk	Duplicate	0.473	mg/L	
WEL-05-0001	10/22/2020	0668	06684005	0668 MForkStCk	Normal	0.428	mg/L	
WEL-05-0001	11/19/2020	0668	06684005	0668 MForkStCk	Normal	0.19	mg/L	
WEL-05-0001	11/19/2020	0668	06684105	0668 MForkStCk	Duplicate	0.105	mg/L	
WEL-05-0001	12/16/2020	0668	06684005	0668 MForkStCk	Normal	0.554	mg/L	
WEL-05-0001	12/16/2020	0668	06684105	0668 MForkStCk	Duplicate	0.568	mg/L	
WEL-05-0001	1/25/2021	0668	06684005	0668 MForkStCk	Normal	0.402	mg/L	
WEL-05-0001	1/25/2021	0668	06684105	0668 MForkStCk	Duplicate	0.531	mg/L	
WEL-05-0001	2/25/2021	0668	06684005	0668 MForkStCk	Normal	0.789	mg/L	
WEL-05-0001	2/25/2021	0668	06684105	0668 MForkStCk	Duplicate	0.771	mg/L	
WEL-05-0001	3/18/2021	0668	06684005	0668 MForkStCk	Normal	0.554	mg/L	
WEL-05-0001	3/18/2021	0668	06684105	0668 MForkStCk	Duplicate	0.572	mg/L	
WEL-06-0008	4/22/2020	0256	02564005	0256 NForkStCk	Normal	0.194	mg/L	
WEL-06-0008	5/27/2020	0256	02564005	0256 NForkStCk	Normal	0.399	mg/L	
WEL-06-0008	5/27/2020	0256	02564005	0256 NForkStCk	Duplicate	0.393	mg/L	
WEL-06-0008	6/24/2020	0256	02564005	0256 NForkStCk 6.24	Normal	0.554	mg/L	
WEL-06-0008	7/21/2020	0256	02564005	0256 NForkStCk 7.21	Normal	0.436	mg/L	
WEL-06-0008	7/21/2020	0256	02564005	0256 NForkStCk DGSPL 7.21	Duplicate	0.407	mg/L	
WEL-06-0008	8/27/2020	0256	02564005	0256 NForkStCk 8.27	Normal	0.376	mg/L	
WEL-06-0008	8/27/2020	0256	02564005	0256 NForkStCk 8.27 SPL	Split	0.361	mg/L	
WEL-06-0008	9/24/2020	0256	02564005	0256 NForkStCk 9.24	Normal	0.251	mg/L	
WEL-06-0008	10/22/2020	0256	02564005	0256 NForkStCk	Normal	0.358	mg/L	
WEL-06-0008	10/22/2020	0256	02564005	0256 NForkStCk	Split	0.356	mg/L	
WEL-06-0008	11/19/2020	0256	02564005	0256 NForkStCk	Normal	0.331	mg/L	
WEL-06-0008	11/19/2020	0256	02564005	0256 NForkStCk	Split	0.331	mg/L	
WEL-06-0008	12/16/2020	0256	02564005	0256 NForkStCk	Normal	0.693	mg/L	
WEL-06-0008	1/25/2021	0256	02564005	0256 NForkStCk	Normal	0.603	mg/L	

Total Nitrogen (TN) Data for Lake Monroe and its Tributaries

IDEM Site Num	Sample Date	EventID	Sample_ID	SampleName	Sample Type	Concentration	Unit	QA Flags
WEL-06-0008	2/25/2021	0256	02564005	0256 NForkStCk	Normal	0.679	mg/L	
WEL-06-0008	2/25/2021	0256	02564005	0256 NForkStCk	Split	0.687	mg/L	
WEL-06-0008	3/18/2021	0256	02564005	0256 NForkStCk	Normal	0.522	mg/L	
WEL-06-0008	3/18/2021	0256	02564005	0256 NForkStCk	Split	0.543	mg/L	
WEL-07-0018	5/26/2020	2830	28301005	2830 MonUpp epi	Normal	0.377	mg/L	
WEL-07-0018	6/25/2020	2855	28552005	2855 MonUpp hypo	Normal	0.437	mg/L	
WEL-07-0018	6/25/2020	2855	28552005	2855 MonUpp hypo DGSPL	DigSplit	0.456	mg/L	
WEL-07-0018	6/25/2020	2855	28551005	2855 MonUpp epi	Normal	0.431	mg/L	
WEL-07-0018	7/27/2020	2917	29171005	2917 MonUpp epi	Normal	0.349	mg/L	
WEL-07-0018	7/27/2020	2917	29172005	2917 MonUpp hypo	Normal	0.936	mg/L	
WEL-07-0018	8/28/2020	2939	29391005	2939 MonUpp epi	Normal	0.649	mg/L	
WEL-07-0018	8/28/2020	2939	29392005	2939 MonUpp hypo	Normal	0.784	mg/L	
WEL-07-0018	9/23/2020	2942	29421005	2942 MonUpp epi	Normal	0.7	mg/L	
WEL-07-0018	10/26/2020	2947	29471005	2947 MonUpp epi	Normal	0.51	mg/L	
WEL-07-0019	4/22/2020	0123	01234005	0123 CrookedCk	Normal	<0.1	mg/L	U
WEL-07-0019	5/27/2020	0123	01234005	0123 CrookedCk	Normal	0.171	mg/L	
WEL-07-0019	5/27/2020	0123	01234005	0123 CrookedCk	Split	0.172	mg/L	
WEL-07-0019	6/24/2020	0123	01234005	0123 CrookedCk 6.24	Normal	0.328	mg/L	
WEL-07-0019	7/21/2020	0123	01234005	0123 CrookedCk 7.21	Normal	0.301	mg/L	
WEL-07-0019	7/21/2020	0123	01234005	0123 CrookedCk SPL 7.21	Split	0.302	mg/L	
WEL-07-0019	8/27/2020	0123	01234005	0123 CrookedCk 8.27	Normal	0.252	mg/L	
WEL-07-0019	11/19/2020	0123	01234005	0123 CrookedCk	Normal	<0.1	mg/L	U
WEL-07-0019	12/16/2020	0123	01234005	0123 CrookedCk	Normal	<0.1	mg/L	U
WEL-07-0019	1/25/2021	0123	01234005	0123 CrookedCk	Normal	<0.1	mg/L	U
WEL-07-0019	1/25/2021	0123	01234005	0123 CrookedCk	DigSplit	<0.1	mg/L	U
WEL-07-0019	2/25/2021	0123	01234005	0123 CrookedCk	Normal	0.407	mg/L	
WEL-07-0019	3/18/2021	0123	01234005	0123 CrookedCk	Normal	0.201	mg/L	
WEL-07-0019	3/18/2021	0123	01234005	0123 CrookedCk	DigSplit	0.203	mg/L	
WEL-07-0020	5/26/2020	2831	28311005	2831 MonCen epi	Normal	0.352	mg/L	
WEL-07-0020	5/26/2020	2831	28312005	2831 MonCen hypo	Normal	0.394	mg/L	
WEL-07-0020	5/26/2020	2831	28312105	2831 MonCen hypo	Duplicate	0.381	mg/L	
WEL-07-0020	6/25/2020	2856	28561005	2856 MonCen epi	Normal	0.394	mg/L	
WEL-07-0020	6/25/2020	2856	28562005	2856 MonCen hypo	Normal	0.288	mg/L	
WEL-07-0020	6/25/2020	2856	28562105	2856 MonCen hypo DUP	Duplicate	0.296	mg/L	
WEL-07-0020	7/27/2020	2918	29182005	2918 MonCen hypo	Normal	0.226	mg/L	
WEL-07-0020	7/27/2020	2918	29182105	2918 MonCen hypo	Duplicate	0.216	mg/L	
WEL-07-0020	7/27/2020	2918	29181005	2918 MonCen epi	Normal	0.267	mg/L	
WEL-07-0020	7/27/2020	2918	29181005	2918 MonCen epi	Split	0.272	mg/L	
WEL-07-0020	8/28/2020	2940	29401005	2940 MonCen epi	Normal	0.32	mg/L	
WEL-07-0020	8/28/2020	2940	29402005	2940 MonCen hypo	Normal	0.281	mg/L	
WEL-07-0020	8/28/2020	2940	29402105	2940 MonCen hypo	Duplicate	0.208	mg/L	
WEL-07-0020	9/23/2020	2943	29431005	2943 MonCen epi	Normal	0.334	mg/L	
WEL-07-0020	10/26/2020	2945	29451005	2945 MonCen epi	Normal	0.422	mg/L	
WEL-07-0021	5/26/2020	2832	28320005	2832 MonLow blank	Field Blank	<0.1	mg/L	U
WEL-07-0021	5/26/2020	2832	28321005	2832 MonLow epi	Normal	0.417	mg/L	
WEL-07-0021	5/26/2020	2832	28322005	2832 MonLow hypo	Normal	0.551	mg/L	
WEL-07-0021	5/26/2020	2832	28322005	2832 MonLow hypo	DigSplit	0.545	mg/L	
WEL-07-0021	6/25/2020	2857	28570005	2857 MonLow blank	Field Blank	<0.100	mg/L	U
WEL-07-0021	6/25/2020	2857	28571005	2857 MonLow epi	Normal	0.314	mg/L	
WEL-07-0021	6/25/2020	2857	28572005	2857 MonLow hypo	Normal	0.263	mg/L	
WEL-07-0021	7/27/2020	2919	29191005	2919 MonLow epi	Normal	0.238	mg/L	
WEL-07-0021	7/27/2020	2919	29192005	2919 MonLow hypo	Normal	0.646	mg/L	
WEL-07-0021	7/27/2020	2919	29192005	2919 MonLow hypo	DigSplit	0.631	mg/L	

Total Nitrogen (TN) Data for Lake Monroe and its Tributaries

IDEM Site Num	Sample Date	EventID	Sample_ID	SampleName	Sample Type	Concentration	Unit	QA Flags
WEL-07-0021	8/28/2020	2941	29410005	2941 MonLow blank	Field Blank	<0.1	mg/L	U
WEL-07-0021	8/28/2020	2941	29411005	2941 MonLow epi	Normal	0.235	mg/L	
WEL-07-0021	8/28/2020	2941	29412005	2941 MonLow hypo	Normal	0.765	mg/L	
WEL-07-0021	8/28/2020	2941	29412005	2941 MonLow hypo	Split	0.748	mg/L	
WEL-07-0021	9/23/2020	2944	29440005	2944 MonLow blank	Field Blank	<0.100	mg/L	U
WEL-07-0021	9/23/2020	2944	29440005	2944 MonLow epi	Normal	0.292	mg/L	
WEL-07-0021	9/23/2020	2944	29440005	2944 MonLow hypo	Normal	1.14	mg/L	
WEL-07-0021	10/26/2020	2946	29460005	2946 MonLow blank	Field Blank	<0.1	mg/L	U
WEL-07-0021	10/26/2020	2946	29461005	2946 MonLow epi	Normal	0.439	mg/L	
WEL-07-0021	10/26/2020	2946	29461005	2946 MonLow epi	Split	0.436	mg/L	
WEL-08-0036	4/22/2020	0111	01110005	0111 MonOut blank	Field Blank	<0.1	mg/L	U
WEL-08-0036	4/22/2020	0111	01114005	0111 MonOut	Normal	0.508	mg/L	
WEL-08-0036	5/27/2020	0111	01110005	0111 MonOut blank	Field Blank	<0.1	mg/L	U
WEL-08-0036	5/27/2020	0111	01114005	0111 MonOut	Normal	0.429	mg/L	
WEL-08-0036	6/24/2020	0111	01110005	0111 MonOut blank 6.24	Field Blank	<0.100	mg/L	U
WEL-08-0036	6/24/2020	0111	01114005	0111 MonOut 6.24	Normal	0.286	mg/L	
WEL-08-0036	7/21/2020	0111	01110005	0111 MonOut blank 7.21	Field Blank	<0.100	mg/L	U
WEL-08-0036	7/21/2020	0111	01114005	0111 MonOut 7.21	Normal	0.326	mg/L	
WEL-08-0036	8/27/2020	0111	01110005	0111 MonOut blank 8.27	Field Blank	<0.100	mg/L	U
WEL-08-0036	8/27/2020	0111	01114005	0111 MonOut 8.27	Normal	0.34	mg/L	
WEL-08-0036	9/24/2020	0111	01110005	0111 MonOut blank 9.24	Field Blank	<0.100	mg/L	U
WEL-08-0036	9/24/2020	0111	01114005	0111 MonOut 9.24	Normal	0.43	mg/L	
WEL-08-0036	9/24/2020	0111	01114005	0111 MonOut DGSPL 9.24	DigSplit	0.44	mg/L	
WEL-08-0036	10/22/2020	0111	01110005	0111 MonOut blank	Field Blank	<0.1	mg/L	U
WEL-08-0036	10/22/2020	0111	01114005	0111 MonOut	Normal	0.384	mg/L	
WEL-08-0036	11/19/2020	0111	01110005	0111 MonOut blank	Field Blank	<0.1	mg/L	U
WEL-08-0036	11/19/2020	0111	01114005	0111 MonOut	Normal	0.181	mg/L	
WEL-08-0036	12/16/2020	0111	01110005	0111 MonOut blank	Field Blank	<0.1	mg/L	U
WEL-08-0036	12/16/2020	0111	01114005	0111 MonOut	Normal	0.317	mg/L	
WEL-08-0036	1/25/2021	0111	01110005	0111 MonOut blank	Field Blank	<0.1	mg/L	U
WEL-08-0036	1/25/2021	0111	01114005	0111 MonOut	Normal	0.3	mg/L	
WEL-08-0036	2/25/2021	0111	01110005	0111 MonOut blank	Field Blank	<0.1	mg/L	U
WEL-08-0036	2/25/2021	0111	01114005	0111 MonOut	Normal	0.408	mg/L	
WEL-08-0036	3/18/2021	0111	01110005	0111 MonOut blank	Field Blank	<0.1	mg/L	U
WEL-08-0036	3/18/2021	0111	01114005	0111 MonOut	Normal	0.489	mg/L	

Total Phosphorus (TP) Data for Lake Monroe and its Tributaries

IDEM Site Num	Sample Date	EventID	Sample_ID	SampleName	Sample Type	Concentration	Unit	QA Flags
WEL-04-0004	4/22/2020	0914	09144005	0914 SForkStCk	Normal	0.037	mg/L	
WEL-04-0004	5/27/2020	0914	09144005	0914 SForkStCk	Normal	0.041	mg/L	
WEL-04-0004	6/24/2020	0914	09144005	0914 SForkStCk 6.24	Normal	0.116	mg/L	
WEL-04-0004	7/21/2020	0914	09144005	0914 SForkStCk 7.21	Normal	0.051	mg/L	
WEL-04-0004	8/27/2020	0914	09144005	0914 SForkStCk 8.27	Normal	0.042	mg/L	
WEL-04-0004	8/27/2020	0914	09144005	0914 SForkStCk DGSPL 8.27	DigSplit	0.041	mg/L	
WEL-04-0004	9/24/2020	0914	09144005	0914 SForkStCk 9.24	Normal	0.05	mg/L	
WEL-04-0004	9/24/2020	0914	09144005	0914 SForkStCk 9.24 SPL	Split	0.046	mg/L	
WEL-04-0004	10/22/2020	0914	09144005	0914 SForkStCk	Normal	0.05	mg/L	
WEL-04-0004	11/19/2020	0914	09144005	0914 SForkStCk	Normal	0.022	mg/L	
WEL-04-0004	11/19/2020	0914	09144005	0914 SForkStCk	DigSplit	0.022	mg/L	
WEL-04-0004	12/16/2020	0914	09144005	0914 SForkStCk	Normal	0.016	mg/L	
WEL-04-0004	12/16/2020	0914	09144005	0914 SForkStCk	Split	0.017	mg/L	
WEL-04-0004	1/25/2021	0914	09144005	0914 SForkStCk	Normal	0.017	mg/L	
WEL-04-0004	2/25/2021	0914	09144005	0914 SForkStCk	Normal	0.035	mg/L	
WEL-04-0004	3/18/2021	0914	09144005	0914 SForkStCk	Normal	0.028	mg/L	
WEL-05-0001	4/22/2020	0668	06684005	0668 MForkStCk	Normal	0.012	mg/L	
WEL-05-0001	4/22/2020	0668	06684105	0668 MForkStCk	Duplicate	0.013	mg/L	
WEL-05-0001	5/27/2020	0668	06684005	0668 MForkStCk	Normal	0.024	mg/L	
WEL-05-0001	5/27/2020	0668	06684105	0668 MForkStCk	Duplicate	0.019	mg/L	
WEL-05-0001	6/24/2020	0668	06684005	0668 MForkStCk 6.24	Normal	0.05	mg/L	
WEL-05-0001	6/24/2020	0668	06684105	0668 MForkStCk DUP 6.24	Duplicate	0.03	mg/L	
WEL-05-0001	7/21/2020	0668	06684005	0668 MForkStCk 7.21	Normal	0.025	mg/L	
WEL-05-0001	7/21/2020	0668	06684105	0668 MForkStCk DUP 7.21	Duplicate	0.022	mg/L	
WEL-05-0001	8/27/2020	0668	06684005	0668 MForkStCk 8.27	Normal	0.029	mg/L	
WEL-05-0001	8/27/2020	0668	06684105	0668 MForkStCk DUP 8.27	Duplicate	0.021	mg/L	
WEL-05-0001	9/24/2020	0668	06684005	0668 MForkStCk 9.24	Normal	0.013	mg/L	
WEL-05-0001	9/24/2020	0668	06684105	0668 MForkStCk 9.24 DUP	Duplicate	0.012	mg/L	
WEL-05-0001	10/22/2020	0668	06684105	0668 MForkStCk	Duplicate	0.042	mg/L	
WEL-05-0001	10/22/2020	0668	06684005	0668 MForkStCk	Normal	0.048	mg/L	
WEL-05-0001	11/19/2020	0668	06684005	0668 MForkStCk	Normal	0.017	mg/L	
WEL-05-0001	11/19/2020	0668	06684105	0668 MForkStCk	Duplicate	0.014	mg/L	
WEL-05-0001	12/16/2020	0668	06684005	0668 MForkStCk	Normal	0.01	mg/L	
WEL-05-0001	12/16/2020	0668	06684105	0668 MForkStCk	Duplicate	0.01	mg/L	
WEL-05-0001	1/25/2021	0668	06684005	0668 MForkStCk	Normal	0.02	mg/L	
WEL-05-0001	1/25/2021	0668	06684105	0668 MForkStCk	Duplicate	0.008	mg/L	
WEL-05-0001	2/25/2021	0668	06684005	0668 MForkStCk	Normal	0.028	mg/L	
WEL-05-0001	2/25/2021	0668	06684105	0668 MForkStCk	Duplicate	0.025	mg/L	
WEL-05-0001	3/18/2021	0668	06684005	0668 MForkStCk	Normal	0.036	mg/L	
WEL-05-0001	3/18/2021	0668	06684105	0668 MForkStCk	Duplicate	0.04	mg/L	
WEL-06-0008	4/22/2020	0256	02564005	0256 NForkStCk	Normal	0.018	mg/L	
WEL-06-0008	5/27/2020	0256	02564005	0256 NForkStCk	Normal	0.021	mg/L	
WEL-06-0008	5/27/2020	0256	02564005	0256 NForkStCk	DigSplit	0.023	mg/L	
WEL-06-0008	6/24/2020	0256	02564005	0256 NForkStCk 6.24	Normal	0.028	mg/L	
WEL-06-0008	7/21/2020	0256	02564005	0256 NForkStCk 7.21	Normal	0.037	mg/L	
WEL-06-0008	7/21/2020	0256	02564005	0256 NForkStCk DGSPL 7.21	DigSplit	0.036	mg/L	
WEL-06-0008	8/27/2020	0256	02564005	0256 NForkStCk 8.27	Normal	0.022	mg/L	
WEL-06-0008	8/27/2020	0256	02564005	0256 NForkStCk 8.27 SPL	Split	0.022	mg/L	
WEL-06-0008	9/24/2020	0256	02564005	0256 NForkStCk 9.24	Normal	0.016	mg/L	
WEL-06-0008	10/22/2020	0256	02564005	0256 NForkStCk	Normal	0.036	mg/L	
WEL-06-0008	10/22/2020	0256	02564005	0256 NForkStCk	Split	0.036	mg/L	
WEL-06-0008	11/19/2020	0256	02564005	0256 NForkStCk	Normal	0.021	mg/L	
WEL-06-0008	11/19/2020	0256	02564005	0256 NForkStCk	Split	0.021	mg/L	
WEL-06-0008	12/16/2020	0256	02564005	0256 NForkStCk	Normal	0.016	mg/L	
WEL-06-0008	1/25/2021	0256	02564005	0256 NForkStCk	Normal	0.015	mg/L	

Total Phosphorus (TP) Data for Lake Monroe and its Tributaries

IDEM Site Num	Sample Date	EventID	Sample_ID	SampleName	Sample Type	Concentration	Unit	QA Flags
WEL-06-0008	2/25/2021	0256	02564005	0256 NForkStCk	Normal	0.048	mg/L	
WEL-06-0008	2/25/2021	0256	02564005	0256 NForkStCk	Split	0.048	mg/L	
WEL-06-0008	3/18/2021	0256	02564005	0256 NForkStCk	Normal	0.04	mg/L	
WEL-06-0008	3/18/2021	0256	02564005	0256 NForkStCk	Split	0.04	mg/L	
WEL-07-0018	5/26/2020	2830	28301005	2830 MonUpp epi	Normal	0.02	mg/L	
WEL-07-0018	6/25/2020	2855	28551005	2855 MonUpp epi	Normal	0.029	mg/L	
WEL-07-0018	6/25/2020	2855	28552005	2855 MonUpp hypo	Normal	0.037	mg/L	
WEL-07-0018	6/25/2020	2855	28552005	2855 MonUpp hypo DGSPL	DigSplit	0.038	mg/L	
WEL-07-0018	7/27/2020	2917	29171005	2917 MonUpp epi	Normal	0.022	mg/L	
WEL-07-0018	7/27/2020	2917	29172005	2917 MonUpp hypo	Normal	0.051	mg/L	
WEL-07-0018	8/28/2020	2939	29392005	2939 MonUpp epi	Normal	0.022	mg/L	
WEL-07-0018	8/28/2020	2940	29401005	2939 MonUpp hypo	Normal	0.061	mg/L	
WEL-07-0018	9/23/2020	2942	29421005	2942 MonUpp epi	Normal	0.062	mg/L	
WEL-07-0018	10/26/2020	2947	29471005	2947 MonUpp epi	Normal	0.015	mg/L	
WEL-07-0019	4/22/2020	0123	01234005	0123 CrookedCk	Normal	0.01	mg/L	
WEL-07-0019	5/27/2020	0123	01234005	0123 CrookedCk	Normal	0.009	mg/L	
WEL-07-0019	5/27/2020	0123	01234005	0123 CrookedCk	Split	0.008	mg/L	
WEL-07-0019	6/24/2020	0123	01234005	0123 CrookedCk 6.24	Normal	0.014	mg/L	
WEL-07-0019	7/21/2020	0123	01234005	0123 CrookedCk 7.21	Normal	0.004	mg/L	
WEL-07-0019	7/21/2020	0123	01234005	0123 CrookedCk SPL 7.21	Split	0.004	mg/L	
WEL-07-0019	8/27/2020	0123	01234005	0123 CrookedCk 8.27	Normal	0.005	mg/L	
WEL-07-0019	11/19/2020	0123	01234005	0123 CrookedCk	Normal	0.007	mg/L	
WEL-07-0019	12/16/2020	0123	01234005	0123 CrookedCk	Normal	0.005	mg/L	
WEL-07-0019	1/25/2021	0123	01234005	0123 CrookedCk	Normal	0.005	mg/L	
WEL-07-0019	1/25/2021	0123	01234005	0123 CrookedCk	DigSplit	0.005	mg/L	
WEL-07-0019	2/25/2021	0123	01234005	0123 CrookedCk	Normal	0.016	mg/L	
WEL-07-0019	3/18/2021	0123	01234005	0123 CrookedCk	Normal	0.012	mg/L	
WEL-07-0019	3/18/2021	0123	01234005	0123 CrookedCk	DigSplit	0.011	mg/L	
WEL-07-0020	5/26/2020	2831	28311005	2831 MonCen epi	Normal	0.012	mg/L	
WEL-07-0020	5/26/2020	2831	28312005	2831 MonCen hypo	Normal	0.015	mg/L	
WEL-07-0020	5/26/2020	2831	28312105	2831 MonCen hypo	Duplicate	0.015	mg/L	
WEL-07-0020	6/25/2020	2856	28561005	2856 MonCen epi	Normal	0.017	mg/L	
WEL-07-0020	6/25/2020	2856	28562005	2856 MonCen hypo	Normal	0.025	mg/L	
WEL-07-0020	6/25/2020	2856	28562105	2856 MonCen hypo DUP	Duplicate	0.028	mg/L	
WEL-07-0020	7/27/2020	2918	29182005	2918 MonCen hypo	Normal	0.025	mg/L	
WEL-07-0020	7/27/2020	2918	29182105	2918 MonCen hypo	Duplicate	0.021	mg/L	
WEL-07-0020	7/27/2020	2918	29181005	2918 MonCen epi	Normal	0.017	mg/L	
WEL-07-0020	7/27/2020	2918	29181005	2918 MonCen epi	Split	0.017	mg/L	
WEL-07-0020	8/28/2020	2940	29402005	2940 MonCen epi	Normal	0.005	mg/L	
WEL-07-0020	8/28/2020	2940	29402105	2940 MonCen hypo	Normal	0.01	mg/L	
WEL-07-0020	8/28/2020	2940	29402105	2940 MonCen hypo	Duplicate	0.004	mg/L	
WEL-07-0020	9/23/2020	2943	29431005	2943 MonCen epi	Normal	0.015	mg/L	
WEL-07-0020	10/26/2020	2945	29451005	2945 MonCen epi	Normal	0.005	mg/L	
WEL-07-0021	5/26/2020	2832	28320005	2832 MonLow blank	Field Blank	0.002	mg/L	
WEL-07-0021	5/26/2020	2832	28321005	2832 MonLow epi	Normal	0.012	mg/L	
WEL-07-0021	5/26/2020	2832	28322005	2832 MonLow hypo	Normal	0.02	mg/L	
WEL-07-0021	5/26/2020	2832	28322005	2832 MonLow hypo	DigSplit	0.02	mg/L	
WEL-07-0021	6/25/2020	2857	28570005	2857 MonLow blank	Field Blank	<0.002	mg/L	U
WEL-07-0021	6/25/2020	2857	28571005	2857 MonLow epi	Normal	0.016	mg/L	
WEL-07-0021	6/25/2020	2857	28572005	2857 MonLow hypo	Normal	0.017	mg/L	
WEL-07-0021	7/27/2020	2919	29191005	2919 MonLow epi	Normal	0.009	mg/L	
WEL-07-0021	7/27/2020	2919	29192005	2919 MonLow hypo	Normal	0.163	mg/L	
WEL-07-0021	7/27/2020	2919	29192005	2919 MonLow hypo	DigSplit	0.156	mg/L	

Total Phosphorus (TP) Data for Lake Monroe and its Tributaries

IDEM Site Num	Sample Date	EventID	Sample_ID	SampleName	Sample Type	Concentration	Unit	QA Flags
WEL-07-0021	8/28/2020	2941	29410005	2941 MonLow blank	Field Blank	<0.002	mg/L	U
WEL-07-0021	8/28/2020	2941	29411005	2941 MonLow epi	Normal	<0.002	mg/L	U
WEL-07-0021	8/28/2020	2941	29412005	2941 MonLow hypo	Normal	0.176	mg/L	
WEL-07-0021	8/28/2020	2941	29412005	2941 MonLow hypo	Split	0.176	mg/L	
WEL-07-0021	9/23/2020	2944	29440005	2944 MonLow blank	Field Blank	<0.002	mg/L	U
WEL-07-0021	9/23/2020	2944	29440005	2944 MonLow epi	Normal	0.008	mg/L	
WEL-07-0021	9/23/2020	2944	29440005	2944 MonLow hypo	Normal	0.229	mg/L	
WEL-07-0021	10/26/2020	2946	29460005	2946 MonLow blank	Field Blank	<0.002	mg/L	U
WEL-07-0021	10/26/2020	2946	29461005	2946 MonLow epi	Normal	0.012	mg/L	
WEL-07-0021	10/26/2020	2946	29461005	2946 MonLow epi	Split	0.012	mg/L	
WEL-08-0036	4/22/2020	0111	01110005	0111 MonOut blank	Field Blank	0.009	mg/L	
WEL-08-0036	4/22/2020	0111	01114005	0111 MonOut	Normal	0.024	mg/L	
WEL-08-0036	5/27/2020	0111	01110005	0111 MonOut blank	Field Blank	0.005	mg/L	
WEL-08-0036	5/27/2020	0111	01114005	0111 MonOut	Normal	0.016	mg/L	
WEL-08-0036	6/24/2020	0111	01110005	0111 MonOut blank 6.24	Field Blank	<0.002	mg/L	U
WEL-08-0036	6/24/2020	0111	01114005	0111 MonOut 6.24	Normal	0.027	mg/L	
WEL-08-0036	7/21/2020	0111	01110005	0111 MonOut blank 7.21	Field Blank	<0.002	mg/L	U
WEL-08-0036	7/21/2020	0111	01114005	0111 MonOut 7.21	Normal	0.037	mg/L	
WEL-08-0036	8/27/2020	0111	01110005	0111 MonOut blank 8.27	Field Blank	0.002	mg/L	
WEL-08-0036	8/27/2020	0111	01114005	0111 MonOut 8.27	Normal	0.056	mg/L	
WEL-08-0036	9/24/2020	0111	01110005	0111 MonOut blank 9.24	Field Blank	<0.002	mg/L	U
WEL-08-0036	9/24/2020	0111	01114005	0111 MonOut 9.24	Normal	0.026	mg/L	
WEL-08-0036	9/24/2020	0111	01114005	0111 MonOut DGSPL 9.24	DigSplit	0.028	mg/L	
WEL-08-0036	10/22/2020	0111	01110005	0111 MonOut blank	Field Blank	<0.002	mg/L	U
WEL-08-0036	10/22/2020	0111	01114005	0111 MonOut	Normal	0.011	mg/L	
WEL-08-0036	11/19/2020	0111	01110005	0111 MonOut blank	Field Blank	0.003	mg/L	
WEL-08-0036	11/19/2020	0111	01114005	0111 MonOut	Normal	0.015	mg/L	
WEL-08-0036	12/16/2020	0111	01110005	0111 MonOut blank	Field Blank	0.003	mg/L	
WEL-08-0036	12/16/2020	0111	01114005	0111 MonOut	Normal	0.023	mg/L	
WEL-08-0036	1/25/2021	0111	01110005	0111 MonOut blank	Field Blank	0.004	mg/L	
WEL-08-0036	1/25/2021	0111	01114005	0111 MonOut	Normal	0.018	mg/L	
WEL-08-0036	2/25/2021	0111	01110005	0111 MonOut blank	Field Blank	0.003	mg/L	
WEL-08-0036	2/25/2021	0111	01114005	0111 MonOut	Normal	0.017	mg/L	
WEL-08-0036	3/18/2021	0111	01110005	0111 MonOut blank	Field Blank	0.003	mg/L	
WEL-08-0036	3/18/2021	0111	01114005	0111 MonOut	Normal	0.024	mg/L	

Sites Information Table

IDEM Site Number	Latitude (Decimal Degree)	Longitude (Decimal Degree)	Short Description	Project Site Number	Waterbody
WEL-07-0019	39.107955	-86.313718	Crooked Creek Rd	Stream1	Crooked Creek
WEL-06-0008	39.173369	-86.319094	Yellowwood Rd	Stream2	North Fork Salt Creek
WEL-05-0001	39.089564	-86.220924	Kirks Ford Rd	Stream3	Middle Fork Salt Creek
WEL-04-0004	39.021974	-86.260526	1190 W, 1000 N	Stream4	South Fork Salt Creek
WEL-08-0036	39.004734	-86.508396	E Monroe Dam Ct Park Rds	Stream5	Monroe Lake
WEL-07-0018	39.072457	-86.40544	North Causway	Lake1	Monroe Lake
WEL-07-0020	39.030813	-86.472697	Center	Lake2	Monroe Lake
WEL-07-0021	39.00885	-86.516267	Dam	Lake3	Monroe Lake

Table 3:	Flags and their Application for Biological Results
ALT	Alternate Method
CON	Value Confirmed
EFAI	Equipment Failure
FEQ	Field Equipment Questionable
FQC	Quality Control, failed
HIB	Likely Biased High
ISP	Improper Sample Preservation
JCW	Sample Container Damaged, Sample Lost
LAC	No Result Reported, Lab Accident
OTHER	Other, explain in Comments
R	Rejected
RPO	%RPD outside of acceptable limits
SCF	Suspected contamination, field
SCP	Suspected contamination, lab preparation
SCX	Suspected contamination, unknown
SUS	Result value is defined as suspect by data owner.
UNC	Value Not Confirmed

tripId	eventId	sampleId	lakeName	sampleDate	parameterInfo
20200526	2830	28301001	Monroe Upper	5/26/20	ANC EPI
20200526	2830	28302001	Monroe Upper	5/26/20	ANC HYPO
20200526	2830	28301002	Monroe Upper	5/26/20	Chla EPI
20200526	2830	28301003	Monroe Upper	5/26/20	NO3/NH3 EPI
20200526	2830	28302003	Monroe Upper	5/26/20	NO3/NH3 HYPO
20200526	2830	28301004	Monroe Upper	5/26/20	SRP EPI
20200526	2830	28302004	Monroe Upper	5/26/20	SRP HYPO
20200526	2830	28301005	Monroe Upper	5/26/20	TN/TP EPI
20200526	2830	28302005	Monroe Upper	5/26/20	TN/TP HYPO
20200526	2830	28301012	Monroe Upper	5/26/20	TSS epi
20200526	2830	28302012	Monroe Upper	5/26/20	TSS hypo
20200526	2831	28311001	Monroe Center	5/26/20	ANC EPI
20200526	2831	28311101	Monroe Center	5/26/20	ANC EPI DUP
20200526	2831	28312001	Monroe Center	5/26/20	ANC HYPO
20200526	2831	28311002	Monroe Center	5/26/20	Chla EPI
20200526	2831	28311102	Monroe Center	5/26/20	Chla EPI DUP
20200526	2831	28311003	Monroe Center	5/26/20	NO3/NH3 EPI
20200526	2831	28312003	Monroe Center	5/26/20	NO3/NH3 HYPO
20200526	2831	28312103	Monroe Center	5/26/20	NO3/NH3 HYPO DUP
20200526	2831	28311004	Monroe Center	5/26/20	SRP EPI
20200526	2831	28312004	Monroe Center	5/26/20	SRP HYPO
20200526	2831	28312104	Monroe Center	5/26/20	SRP HYPO DUP
20200526	2831	28311005	Monroe Center	5/26/20	TN/TP EPI
20200526	2831	28312005	Monroe Center	5/26/20	TN/TP HYPO
20200526	2831	28312105	Monroe Center	5/26/20	TN/TP HYPO DUP
20200526	2831	28311012	Monroe Center	5/26/20	TSS epi
20200526	2831	28312012	Monroe Center	5/26/20	TSS hypo
20200526	2831	28312112	Monroe Center	5/26/20	TSS hypo DUP
20200526	2832	28321001	Monroe Lower	5/26/20	ANC EPI
20200526	2832	28322001	Monroe Lower	5/26/20	ANC HYPO
20200526	2832	28321002	Monroe Lower	5/26/20	Chla EPI
20200526	2832	28320003	Monroe Lower	5/26/20	NO3/NH3 BLANK
20200526	2832	28321003	Monroe Lower	5/26/20	NO3/NH3 EPI
20200526	2832	28322003	Monroe Lower	5/26/20	NO3/NH3 HYPO
20200526	2832	28320004	Monroe Lower	5/26/20	SRP BLANK
20200526	2832	28321004	Monroe Lower	5/26/20	SRP EPI
20200526	2832	28322004	Monroe Lower	5/26/20	SRP HYPO
20200526	2832	28321005	Monroe Lower	5/26/20	TN/TP EPI
20200526	2832	28320005	Monroe Lower	5/26/20	TN/TP EPI BLANK
20200526	2832	28322005	Monroe Lower	5/26/20	TN/TP HYPO
20200526	2832	28320012	Monroe Lower	5/26/20	TSS BLANK
20200526	2832	28321012	Monroe Lower	5/26/20	TSS epi
20200526	2832	28322012	Monroe Lower	5/26/20	TSS hypo
20200625	2855	28551001	Monroe Upper	6/25/20	ANC EPI
20200625	2855	28552001	Monroe Upper	6/25/20	ANC HYPO
20200625	2855	28551002	Monroe Upper	6/25/20	Chla EPI
20200625	2855	28551003	Monroe Upper	6/25/20	NO3/NH3 EPI
20200625	2855	28552003	Monroe Upper	6/25/20	NO3/NH3 HYPO
20200625	2855	28551004	Monroe Upper	6/25/20	SRP EPI
20200625	2855	28552004	Monroe Upper	6/25/20	SRP HYPO
20200625	2855	28551005	Monroe Upper	6/25/20	TN/TP EPI
20200625	2855	28552005	Monroe Upper	6/25/20	TN/TP HYPO
20200625	2855	28551012	Monroe Upper	6/25/20	TSS epi
20200625	2855	28552012	Monroe Upper	6/25/20	TSS hypo
20200625	2856	28561001	Monroe Center	6/25/20	ANC EPI
20200625	2856	28561101	Monroe Center	6/25/20	ANC EPI DUP
20200625	2856	28562001	Monroe Center	6/25/20	ANC HYPO

tripId	eventId	sampleId	lakeName	sampleDate	parameterInfo
20200625	2856	28561002	Monroe Center	6/25/20	Chla EPI
20200625	2856	28561102	Monroe Center	6/25/20	Chla EPI DUP
20200625	2856	28561003	Monroe Center	6/25/20	NO3/NH3 EPI
20200625	2856	28562003	Monroe Center	6/25/20	NO3/NH3 HYPO
20200625	2856	28562103	Monroe Center	6/25/20	NO3/NH3 HYPO DUP
20200625	2856	28561004	Monroe Center	6/25/20	SRP EPI
20200625	2856	28562004	Monroe Center	6/25/20	SRP HYPO
20200625	2856	28562104	Monroe Center	6/25/20	SRP HYPO DUP
20200625	2856	28561005	Monroe Center	6/25/20	TN/TP EPI
20200625	2856	28562005	Monroe Center	6/25/20	TN/TP HYPO
20200625	2856	28562105	Monroe Center	6/25/20	TN/TP HYPO DUP
20200625	2856	28561012	Monroe Center	6/25/20	TSS epi
20200625	2856	28562012	Monroe Center	6/25/20	TSS hypo
20200625	2856	28562112	Monroe Center	6/25/20	TSS hypo DUP
20200625	2857	28571001	Monroe Lower	6/25/20	ANC EPI
20200625	2857	28572001	Monroe Lower	6/25/20	ANC HYPO
20200625	2857	28571002	Monroe Lower	6/25/20	Chla EPI
20200625	2857	28570003	Monroe Lower	6/25/20	NO3/NH3 BLANK
20200625	2857	28571003	Monroe Lower	6/25/20	NO3/NH3 EPI
20200625	2857	28572003	Monroe Lower	6/25/20	NO3/NH3 HYPO
20200625	2857	28570004	Monroe Lower	6/25/20	SRP BLANK
20200625	2857	28571004	Monroe Lower	6/25/20	SRP EPI
20200625	2857	28572004	Monroe Lower	6/25/20	SRP HYPO
20200625	2857	28571005	Monroe Lower	6/25/20	TN/TP EPI
20200625	2857	28570005	Monroe Lower	6/25/20	TN/TP EPI BLANK
20200625	2857	28572005	Monroe Lower	6/25/20	TN/TP HYPO
20200625	2857	28570012	Monroe Lower	6/25/20	TSS BLANK
20200625	2857	28571012	Monroe Lower	6/25/20	TSS epi
20200625	2857	28572012	Monroe Lower	6/25/20	TSS hypo
20200727	2917	29171001	Monroe Upper	7/27/20	ANC EPI
20200727	2917	29172001	Monroe Upper	7/27/20	ANC HYPO
20200727	2917	29171002	Monroe Upper	7/27/20	Chla EPI
20200727	2917	29171003	Monroe Upper	7/27/20	NO3/NH3 EPI
20200727	2917	29172003	Monroe Upper	7/27/20	NO3/NH3 HYPO
20200727	2917	29171004	Monroe Upper	7/27/20	SRP EPI
20200727	2917	29172004	Monroe Upper	7/27/20	SRP HYPO
20200727	2917	29171005	Monroe Upper	7/27/20	TN/TP EPI
20200727	2917	29172005	Monroe Upper	7/27/20	TN/TP HYPO
20200727	2917	29171012	Monroe Upper	7/27/20	TSS epi
20200727	2917	29172012	Monroe Upper	7/27/20	TSS hypo
20200727	2918	29181001	Monroe Center	7/27/20	ANC EPI
20200727	2918	29181101	Monroe Center	7/27/20	ANC EPI DUP
20200727	2918	29182001	Monroe Center	7/27/20	ANC HYPO
20200727	2918	29181002	Monroe Center	7/27/20	Chla EPI
20200727	2918	29181102	Monroe Center	7/27/20	Chla EPI DUP
20200727	2918	29181003	Monroe Center	7/27/20	NO3/NH3 EPI
20200727	2918	29182003	Monroe Center	7/27/20	NO3/NH3 HYPO
20200727	2918	29182103	Monroe Center	7/27/20	NO3/NH3 HYPO DUP
20200727	2918	29181004	Monroe Center	7/27/20	SRP EPI
20200727	2918	29182004	Monroe Center	7/27/20	SRP HYPO
20200727	2918	29182104	Monroe Center	7/27/20	SRP HYPO DUP
20200727	2918	29181005	Monroe Center	7/27/20	TN/TP EPI
20200727	2918	29182005	Monroe Center	7/27/20	TN/TP HYPO
20200727	2918	29182105	Monroe Center	7/27/20	TN/TP HYPO DUP
20200727	2918	29181012	Monroe Center	7/27/20	TSS epi
20200727	2918	29182012	Monroe Center	7/27/20	TSS hypo
20200727	2918	29182112	Monroe Center	7/27/20	TSS hypo DUP

tripId	eventId	sampleId	lakeName	sampleDate	parameterInfo
20200727	2919	29191001	Monroe Lower	7/27/20	ANC EPI
20200727	2919	29192001	Monroe Lower	7/27/20	ANC HYPO
20200727	2919	29191002	Monroe Lower	7/27/20	Chla EPI
20200727	2919	29190003	Monroe Lower	7/27/20	NO3/NH3 BLANK
20200727	2919	29191003	Monroe Lower	7/27/20	NO3/NH3 EPI
20200727	2919	29192003	Monroe Lower	7/27/20	NO3/NH3 HYPO
20200727	2919	29190004	Monroe Lower	7/27/20	SRP BLANK
20200727	2919	29191004	Monroe Lower	7/27/20	SRP EPI
20200727	2919	29192004	Monroe Lower	7/27/20	SRP HYPO
20200727	2919	29191005	Monroe Lower	7/27/20	TN/TP EPI
20200727	2919	29190005	Monroe Lower	7/27/20	TN/TP EPI BLANK
20200727	2919	29192005	Monroe Lower	7/27/20	TN/TP HYPO
20200727	2919	29190012	Monroe Lower	7/27/20	TSS BLANK
20200727	2919	29191012	Monroe Lower	7/27/20	TSS epi
20200727	2919	29192012	Monroe Lower	7/27/20	TSS hypo
20200828	2939	29391001	Monroe Upper	8/28/20	ANC EPI
20200828	2939	29392001	Monroe Upper	8/28/20	ANC HYPO
20200828	2939	29391002	Monroe Upper	8/28/20	Chla EPI
20200828	2939	29391003	Monroe Upper	8/28/20	NO3/NH3 EPI
20200828	2939	29392003	Monroe Upper	8/28/20	NO3/NH3 HYPO
20200828	2939	29391004	Monroe Upper	8/28/20	SRP EPI
20200828	2939	29392004	Monroe Upper	8/28/20	SRP HYPO
20200828	2939	29391005	Monroe Upper	8/28/20	TN/TP EPI
20200828	2939	29392005	Monroe Upper	8/28/20	TN/TP HYPO
20200828	2939	29391012	Monroe Upper	8/28/20	TSS epi
20200828	2939	29392012	Monroe Upper	8/28/20	TSS hypo
20200828	2940	29401001	Monroe Center	8/28/20	ANC EPI
20200828	2940	29401101	Monroe Center	8/28/20	ANC EPI DUP
20200828	2940	29402001	Monroe Center	8/28/20	ANC HYPO
20200828	2940	29401002	Monroe Center	8/28/20	Chla EPI
20200828	2940	29401102	Monroe Center	8/28/20	Chla EPI DUP
20200828	2940	29401003	Monroe Center	8/28/20	NO3/NH3 EPI
20200828	2940	29402003	Monroe Center	8/28/20	NO3/NH3 HYPO
20200828	2940	29402103	Monroe Center	8/28/20	NO3/NH3 HYPO DUP
20200828	2940	29401004	Monroe Center	8/28/20	SRP EPI
20200828	2940	29402004	Monroe Center	8/28/20	SRP HYPO
20200828	2940	29402104	Monroe Center	8/28/20	SRP HYPO DUP
20200828	2940	29401005	Monroe Center	8/28/20	TN/TP EPI
20200828	2940	29402005	Monroe Center	8/28/20	TN/TP HYPO
20200828	2940	29402105	Monroe Center	8/28/20	TN/TP HYPO DUP
20200828	2940	29401012	Monroe Center	8/28/20	TSS epi
20200828	2940	29402012	Monroe Center	8/28/20	TSS hypo
20200828	2940	29402112	Monroe Center	8/28/20	TSS hypo DUP
20200828	2941	29411001	Monroe Lower	8/28/20	ANC EPI
20200828	2941	29412001	Monroe Lower	8/28/20	ANC HYPO
20200828	2941	29411002	Monroe Lower	8/28/20	Chla EPI
20200828	2941	29410003	Monroe Lower	8/28/20	NO3/NH3 BLANK
20200828	2941	29411003	Monroe Lower	8/28/20	NO3/NH3 EPI
20200828	2941	29412003	Monroe Lower	8/28/20	NO3/NH3 HYPO
20200828	2941	29410004	Monroe Lower	8/28/20	SRP BLANK
20200828	2941	29411004	Monroe Lower	8/28/20	SRP EPI
20200828	2941	29412004	Monroe Lower	8/28/20	SRP HYPO
20200828	2941	29411005	Monroe Lower	8/28/20	TN/TP EPI
20200828	2941	29410005	Monroe Lower	8/28/20	TN/TP BLANK
20200828	2941	29412005	Monroe Lower	8/28/20	TN/TP HYPO
20200828	2941	29410012	Monroe Lower	8/28/20	TSS BLANK
20200828	2941	29411012	Monroe Lower	8/28/20	TSS epi

tripId	eventId	sampleId	lakeName	sampleDate	parameterInfo
20200828	2941	29412012	Monroe Lower	8/28/20	TSS hypo
20200923	2943	29431001	Monroe Center	9/23/20	ANC EPI
20200923	2943	29431101	Monroe Center	9/23/20	ANC EPI DUP
20200923	2943	29432001	Monroe Center	9/23/20	ANC HYPO
20200923	2943	29431002	Monroe Center	9/23/20	Chla EPI
20200923	2943	29431102	Monroe Center	9/23/20	Chla EPI DUP
20200923	2943	29431003	Monroe Center	9/23/20	NO3/NH3 EPI
20200923	2943	29432003	Monroe Center	9/23/20	NO3/NH3 HYPO
20200923	2943	29432103	Monroe Center	9/23/20	NO3/NH3 HYPO DUP
20200923	2943	29431004	Monroe Center	9/23/20	SRP EPI
20200923	2943	29432004	Monroe Center	9/23/20	SRP HYPO
20200923	2943	29432104	Monroe Center	9/23/20	SRP HYPO DUP
20200923	2943	29431005	Monroe Center	9/23/20	TN/TP EPI
20200923	2943	29432005	Monroe Center	9/23/20	TN/TP HYPO
20200923	2943	29432105	Monroe Center	9/23/20	TN/TP HYPO DUP
20200923	2943	29431012	Monroe Center	9/23/20	TSS epi
20200923	2943	29432012	Monroe Center	9/23/20	TSS hypo
20200923	2943	29432112	Monroe Center	9/23/20	TSS hypo DUP
20200923	2944	29441001	Monroe Lower	9/23/20	ANC EPI
20200923	2944	29442001	Monroe Lower	9/23/20	ANC HYPO
20200923	2944	29441002	Monroe Lower	9/23/20	Chla EPI
20200923	2944	29440003	Monroe Lower	9/23/20	NO3/NH3 BLANK
20200923	2944	29441003	Monroe Lower	9/23/20	NO3/NH3 EPI
20200923	2944	29442003	Monroe Lower	9/23/20	NO3/NH3 HYPO
20200923	2944	29440004	Monroe Lower	9/23/20	SRP BLANK
20200923	2944	29441004	Monroe Lower	9/23/20	SRP EPI
20200923	2944	29442004	Monroe Lower	9/23/20	SRP HYPO
20200923	2944	29441005	Monroe Lower	9/23/20	TN/TP EPI
20200923	2944	29440005	Monroe Lower	9/23/20	TN/TP EPI BLANK
20200923	2944	29442005	Monroe Lower	9/23/20	TN/TP HYPO
20200923	2944	29440012	Monroe Lower	9/23/20	TSS BLANK
20200923	2944	29441012	Monroe Lower	9/23/20	TSS epi
20200923	2944	29442012	Monroe Lower	9/23/20	TSS hypo
20200923	2942	29421001	Monroe Upper	9/23/20	ANC EPI
20200923	2942	29422001	Monroe Upper	9/23/20	ANC HYPO
20200923	2942	29421002	Monroe Upper	9/23/20	Chla EPI
20200923	2942	29421003	Monroe Upper	9/23/20	NO3/NH3 EPI
20200923	2942	29422003	Monroe Upper	9/23/20	NO3/NH3 HYPO
20200923	2942	29421004	Monroe Upper	9/23/20	SRP EPI
20200923	2942	29422004	Monroe Upper	9/23/20	SRP HYPO
20200923	2942	29421005	Monroe Upper	9/23/20	TN/TP EPI
20200923	2942	29422005	Monroe Upper	9/23/20	TN/TP HYPO
20200923	2942	29421012	Monroe Upper	9/23/20	TSS epi
20200923	2942	29422012	Monroe Upper	9/23/20	TSS hypo
20201026	2945	29451001	Monroe Center	10/26/2020	ANC EPI
20201026	2945	29451101	Monroe Center	10/26/2020	ANC EPI DUP
20201026	2945	29452001	Monroe Center	10/26/2020	ANC HYPO
20201026	2945	29451002	Monroe Center	10/26/2020	Chla EPI
20201026	2945	29451102	Monroe Center	10/26/2020	Chla EPI DUP
20201026	2945	29451003	Monroe Center	10/26/2020	NO3/NH3 EPI
20201026	2945	29452003	Monroe Center	10/26/2020	NO3/NH3 HYPO
20201026	2945	29452103	Monroe Center	10/26/2020	NO3/NH3 HYPO DUP
20201026	2945	29451004	Monroe Center	10/26/2020	SRP EPI
20201026	2945	29452004	Monroe Center	10/26/2020	SRP HYPO
20201026	2945	29452104	Monroe Center	10/26/2020	SRP HYPO DUP
20201026	2945	29451005	Monroe Center	10/26/2020	TN/TP EPI
20201026	2945	29452005	Monroe Center	10/26/2020	TN/TP HYPO

tripId	eventId	sampleId	lakeName	sampleDate	parameterInfo
20201026	2945	29452105	Monroe Center	10/26/2020	TN/TP HYPO DUP
20201026	2945	29451012	Monroe Center	10/26/2020	TSS epi
20201026	2945	29452012	Monroe Center	10/26/2020	TSS hypo
20201026	2945	29452112	Monroe Center	10/26/2020	TSS hypo DUP
20201026	2946	29461001	Monroe Lower	10/26/2020	ANC EPI
20201026	2946	29462001	Monroe Lower	10/26/2020	ANC HYPO
20201026	2946	29461002	Monroe Lower	10/26/2020	Chla EPI
20201026	2946	29460003	Monroe Lower	10/26/2020	NO3/NH3 BLANK
20201026	2946	29461003	Monroe Lower	10/26/2020	NO3/NH3 EPI
20201026	2946	29462003	Monroe Lower	10/26/2020	NO3/NH3 HYPO
20201026	2946	29460004	Monroe Lower	10/26/2020	SRP BLANK
20201026	2946	29461004	Monroe Lower	10/26/2020	SRP EPI
20201026	2946	29462004	Monroe Lower	10/26/2020	SRP HYPO
20201026	2946	29461005	Monroe Lower	10/26/2020	TN/TP EPI
20201026	2946	29460005	Monroe Lower	10/26/2020	TN/TP EPI BLANK
20201026	2946	29462005	Monroe Lower	10/26/2020	TN/TP HYPO
20201026	2946	29460012	Monroe Lower	10/26/2020	TSS BLANK
20201026	2946	29461012	Monroe Lower	10/26/2020	TSS epi
20201026	2946	29462012	Monroe Lower	10/26/2020	TSS hypo
20201026	2947	29471001	Monroe Upper	10/26/2020	ANC EPI
20201026	2947	29472001	Monroe Upper	10/26/2020	ANC HYPO
20201026	2947	29471002	Monroe Upper	10/26/2020	Chla EPI
20201026	2947	29471003	Monroe Upper	10/26/2020	NO3/NH3 EPI
20201026	2947	29472003	Monroe Upper	10/26/2020	NO3/NH3 HYPO
20201026	2947	29471004	Monroe Upper	10/26/2020	SRP EPI
20201026	2947	29472004	Monroe Upper	10/26/2020	SRP HYPO
20201026	2947	29471005	Monroe Upper	10/26/2020	TN/TP EPI
20201026	2947	29472005	Monroe Upper	10/26/2020	TN/TP HYPO
20201026	2947	29471012	Monroe Upper	10/26/2020	TSS epi
20201026	2947	29472012	Monroe Upper	10/26/2020	TSS hypo
20200422	0111	01114001	Lake Monroe Outlet	4/22/2020	ANC
20200422	0111	01114003	Lake Monroe Outlet	4/22/2020	NO3/NH3
20200422	0111	01110003	Lake Monroe Outlet	4/22/2020	NO3/NH3 BLANK
20200422	0111	01114004	Lake Monroe Outlet	4/22/2020	SRP
20200422	0111	01110004	Lake Monroe Outlet	4/22/2020	SRP BLANK
20200422	0111	01114005	Lake Monroe Outlet	4/22/2020	TN/TP
20200422	0111	01110005	Lake Monroe Outlet	4/22/2020	TN/TP BLANK
20200422	0111	01114012	Lake Monroe Outlet	4/22/2020	TSS
20200422	0111	01110012	Lake Monroe Outlet	4/22/2020	TSS BLANK
20200422	0123	01234001	Crooked Creek	4/22/2020	ANC
20200422	0123	01234003	Crooked Creek	4/22/2020	NO3/NH3
20200422	0123	01234004	Crooked Creek	4/22/2020	SRP
20200422	0123	01234005	Crooked Creek	4/22/2020	TN/TP
20200422	0123	01234012	Crooked Creek	4/22/2020	TSS
20200422	0256	02564001	North Fork Salt Creek	4/22/2020	ANC
20200422	0256	02564003	North Fork Salt Creek	4/22/2020	NO3/NH3
20200422	0256	02564004	North Fork Salt Creek	4/22/2020	SRP
20200422	0256	02564005	North Fork Salt Creek	4/22/2020	TN/TP
20200422	0256	02564012	North Fork Salt Creek	4/22/2020	TSS
20200422	0668	06684001	Middle Fork Salt Creek	4/22/2020	ANC
20200422	0668	06684101	Middle Fork Salt Creek	4/22/2020	ANC DUP
20200422	0668	06684003	Middle Fork Salt Creek	4/22/2020	NO3/NH3
20200422	0668	06684103	Middle Fork Salt Creek	4/22/2020	NO3/NH3 DUP
20200422	0668	06684004	Middle Fork Salt Creek	4/22/2020	SRP
20200422	0668	06684104	Middle Fork Salt Creek	4/22/2020	SRP DUP

tripId	eventId	sampleId	lakeName	sampleDate	parameterInfo
20200422	0668	06684005	Middle Fork Salt Creek	4/22/2020	TN/TP
20200422	0668	06684105	Middle Fork Salt Creek	4/22/2020	TN/TP DUP
20200422	0668	06684012	Middle Fork Salt Creek	4/22/2020	TSS
20200422	0668	06684112	Middle Fork Salt Creek	4/22/2020	TSS DUP
20200422	0914	09144001	South Fork Salt Creek	4/22/2020	ANC
20200422	0914	09144003	South Fork Salt Creek	4/22/2020	NO3/NH3
20200422	0914	09144004	South Fork Salt Creek	4/22/2020	SRP
20200422	0914	09144005	South Fork Salt Creek	4/22/2020	TN/TP
20200422	0914	09144012	South Fork Salt Creek	4/22/2020	TSS
20200527	0111	01114001	Lake Monroe Outlet	5/27/2020	ANC
20200527	0111	01114003	Lake Monroe Outlet	5/27/2020	NO3/NH3
20200527	0111	01110003	Lake Monroe Outlet	5/27/2020	NO3/NH3 BLANK
20200527	0111	01114004	Lake Monroe Outlet	5/27/2020	SRP
20200527	0111	01110004	Lake Monroe Outlet	5/27/2020	SRP BLANK
20200527	0111	01114005	Lake Monroe Outlet	5/27/2020	TN/TP
20200527	0111	01110005	Lake Monroe Outlet	5/27/2020	TN/TP BLANK
20200527	0111	01114012	Lake Monroe Outlet	5/27/2020	TSS
20200527	0111	01110012	Lake Monroe Outlet	5/27/2020	TSS BLANK
20200527	0123	01234001	Crooked Creek	5/27/2020	ANC
20200527	0123	01234003	Crooked Creek	5/27/2020	NO3/NH3
20200527	0123	01234004	Crooked Creek	5/27/2020	SRP
20200527	0123	01234005	Crooked Creek	5/27/2020	TN/TP
20200527	0123	01234012	Crooked Creek	5/27/2020	TSS
20200527	0256	02564001	North Fork Salt Creek	5/27/2020	ANC
20200527	0256	02564003	North Fork Salt Creek	5/27/2020	NO3/NH3
20200527	0256	02564004	North Fork Salt Creek	5/27/2020	SRP
20200527	0256	02564005	North Fork Salt Creek	5/27/2020	TN/TP
20200527	0256	02564012	North Fork Salt Creek	5/27/2020	TSS
20200527	0668	06684001	Middle Fork Salt Creek	5/27/2020	ANC
20200527	0668	06684101	Middle Fork Salt Creek	5/27/2020	ANC DUP
20200527	0668	06684003	Middle Fork Salt Creek	5/27/2020	NO3/NH3
20200527	0668	06684103	Middle Fork Salt Creek	5/27/2020	NO3/NH3 DUP
20200527	0668	06684004	Middle Fork Salt Creek	5/27/2020	SRP
20200527	0668	06684104	Middle Fork Salt Creek	5/27/2020	SRP DUP
20200527	0668	06684005	Middle Fork Salt Creek	5/27/2020	TN/TP
20200527	0668	06684105	Middle Fork Salt Creek	5/27/2020	TN/TP DUP
20200527	0668	06684012	Middle Fork Salt Creek	5/27/2020	TSS
20200527	0668	06684112	Middle Fork Salt Creek	5/27/2020	TSS DUP
20200527	0914	09144001	South Fork Salt Creek	5/27/2020	ANC
20200527	0914	09144003	South Fork Salt Creek	5/27/2020	NO3/NH3
20200527	0914	09144004	South Fork Salt Creek	5/27/2020	SRP
20200527	0914	09144005	South Fork Salt Creek	5/27/2020	TN/TP
20200527	0914	09144012	South Fork Salt Creek	5/27/2020	TSS
20200624	0111	01114001	Lake Monroe Outlet	6/24/2020	ANC
20200624	0111	01114003	Lake Monroe Outlet	6/24/2020	NO3/NH3
20200624	0111	01110003	Lake Monroe Outlet	6/24/2020	NO3/NH3 BLANK
20200624	0111	01114004	Lake Monroe Outlet	6/24/2020	SRP
20200624	0111	01110004	Lake Monroe Outlet	6/24/2020	SRP BLANK
20200624	0111	01114005	Lake Monroe Outlet	6/24/2020	TN/TP
20200624	0111	01110005	Lake Monroe Outlet	6/24/2020	TN/TP BLANK
20200624	0111	01114012	Lake Monroe Outlet	6/24/2020	TSS
20200624	0111	01110012	Lake Monroe Outlet	6/24/2020	TSS BLANK
20200624	0123	01234001	Crooked Creek	6/24/2020	ANC

tripId	eventId	sampleId	lakeName	sampleDate	parameterInfo
20200624	0123	01234003	Crooked Creek	6/24/2020	NO3/NH3
20200624	0123	01234004	Crooked Creek	6/24/2020	SRP
20200624	0123	01234005	Crooked Creek	6/24/2020	TN/TP
20200624	0123	01234012	Crooked Creek	6/24/2020	TSS
20200624	0256	02564001	North Fork Salt Creek	6/24/2020	ANC
20200624	0256	02564003	North Fork Salt Creek	6/24/2020	NO3/NH3
20200624	0256	02564004	North Fork Salt Creek	6/24/2020	SRP
20200624	0256	02564005	North Fork Salt Creek	6/24/2020	TN/TP
20200624	0256	02564012	North Fork Salt Creek	6/24/2020	TSS
20200624	0668	06684001	Middle Fork Salt Creek	6/24/2020	ANC
20200624	0668	06684101	Middle Fork Salt Creek	6/24/2020	ANC DUP
20200624	0668	06684003	Middle Fork Salt Creek	6/24/2020	NO3/NH3
20200624	0668	06684103	Middle Fork Salt Creek	6/24/2020	NO3/NH3 DUP
20200624	0668	06684004	Middle Fork Salt Creek	6/24/2020	SRP
20200624	0668	06684104	Middle Fork Salt Creek	6/24/2020	SRP DUP
20200624	0668	06684005	Middle Fork Salt Creek	6/24/2020	TN/TP
20200624	0668	06684105	Middle Fork Salt Creek	6/24/2020	TN/TP DUP
20200624	0668	06684012	Middle Fork Salt Creek	6/24/2020	TSS
20200624	0668	06684112	Middle Fork Salt Creek	6/24/2020	TSS DUP
20200624	0914	09144001	South Fork Salt Creek	6/24/2020	ANC
20200624	0914	09144003	South Fork Salt Creek	6/24/2020	NO3/NH3
20200624	0914	09144004	South Fork Salt Creek	6/24/2020	SRP
20200624	0914	09144005	South Fork Salt Creek	6/24/2020	TN/TP
20200624	0914	09144012	South Fork Salt Creek	6/24/2020	TSS
20200721	0111	01114001	Lake Monroe Outlet	7/21/2020	ANC
20200721	0111	01114017	Lake Monroe Outlet	7/21/2020	MACROS
20200721	0111	01114003	Lake Monroe Outlet	7/21/2020	NO3/NH3
20200721	0111	01110003	Lake Monroe Outlet	7/21/2020	NO3/NH3 BLANK
20200721	0111	01114004	Lake Monroe Outlet	7/21/2020	SRP
20200721	0111	01110004	Lake Monroe Outlet	7/21/2020	SRP BLANK
20200721	0111	01114005	Lake Monroe Outlet	7/21/2020	TN/TP
20200721	0111	01110005	Lake Monroe Outlet	7/21/2020	TN/TP BLANK
20200721	0111	01114012	Lake Monroe Outlet	7/21/2020	TSS
20200721	0111	01110012	Lake Monroe Outlet	7/21/2020	TSS BLANK
20200721	0123	01234001	Crooked Creek	7/21/2020	ANC
20200721	0123	01234017	Crooked Creek	7/21/2020	MACROS
20200721	0123	01234003	Crooked Creek	7/21/2020	NO3/NH3
20200721	0123	01234004	Crooked Creek	7/21/2020	SRP
20200721	0123	01234005	Crooked Creek	7/21/2020	TN/TP
20200721	0123	01234012	Crooked Creek	7/21/2020	TSS
20200721	0256	02564001	North Fork Salt Creek	7/21/2020	ANC
20200721	0256	02564017	North Fork Salt Creek	7/21/2020	MACROS
20200721	0256	02564003	North Fork Salt Creek	7/21/2020	NO3/NH3
20200721	0256	02564004	North Fork Salt Creek	7/21/2020	SRP
20200721	0256	02564005	North Fork Salt Creek	7/21/2020	TN/TP
20200721	0256	02564012	North Fork Salt Creek	7/21/2020	TSS
20200721	0668	06684001	Middle Fork Salt Creek	7/21/2020	ANC
20200721	0668	06684101	Middle Fork Salt Creek	7/21/2020	ANC DUP
20200721	0668	06684017	Middle Fork Salt Creek	7/21/2020	MACROS
20200721	0668	06684003	Middle Fork Salt Creek	7/21/2020	NO3/NH3
20200721	0668	06684103	Middle Fork Salt Creek	7/21/2020	NO3/NH3 DUP
20200721	0668	06684004	Middle Fork Salt Creek	7/21/2020	SRP
20200721	0668	06684104	Middle Fork Salt Creek	7/21/2020	SRP DUP

tripId	eventId	sampleId	lakeName	sampleDate	parameterInfo
20200721	0668	06684005	Middle Fork Salt Creek	7/21/2020	TN/TP
20200721	0668	06684105	Middle Fork Salt Creek	7/21/2020	TN/TP DUP
20200721	0668	06684012	Middle Fork Salt Creek	7/21/2020	TSS
20200721	0668	06684112	Middle Fork Salt Creek	7/21/2020	TSS DUP
20200721	0914	09144001	South Fork Salt Creek	7/21/2020	ANC
20200721	0914	09144003	South Fork Salt Creek	7/21/2020	NO3/NH3
20200721	0914	09144004	South Fork Salt Creek	7/21/2020	SRP
20200721	0914	09144005	South Fork Salt Creek	7/21/2020	TN/TP
20200721	0914	09144012	South Fork Salt Creek	7/21/2020	TSS
20200827	0111	01114001	Lake Monroe Outlet	8/27/2020	ANC
20200827	0111	01114003	Lake Monroe Outlet	8/27/2020	NO3/NH3
20200827	0111	01110003	Lake Monroe Outlet	8/27/2020	NO3/NH3 BLANK
20200827	0111	01114004	Lake Monroe Outlet	8/27/2020	SRP
20200827	0111	01110004	Lake Monroe Outlet	8/27/2020	SRP BLANK
20200827	0111	01114005	Lake Monroe Outlet	8/27/2020	TN/TP
20200827	0111	01110005	Lake Monroe Outlet	8/27/2020	TN/TP BLANK
20200827	0111	01114012	Lake Monroe Outlet	8/27/2020	TSS
20200827	0111	01110012	Lake Monroe Outlet	8/27/2020	TSS BLANK
20200827	0123	01234001	Crooked Creek	8/27/2020	ANC
20200827	0123	01234003	Crooked Creek	8/27/2020	NO3/NH3
20200827	0123	01234004	Crooked Creek	8/27/2020	SRP
20200827	0123	01234005	Crooked Creek	8/27/2020	TN/TP
20200827	0123	01234012	Crooked Creek	8/27/2020	TSS
20200827	0256	02564001	North Fork Salt Creek	8/27/2020	ANC
20200827	0256	02564003	North Fork Salt Creek	8/27/2020	NO3/NH3
20200827	0256	02564004	North Fork Salt Creek	8/27/2020	SRP
20200827	0256	02564005	North Fork Salt Creek	8/27/2020	TN/TP
20200827	0256	02564012	North Fork Salt Creek	8/27/2020	TSS
20200827	0668	06684001	Middle Fork Salt Creek	8/27/2020	ANC
20200827	0668	06684101	Middle Fork Salt Creek	8/27/2020	ANC DUP
20200827	0668	06684003	Middle Fork Salt Creek	8/27/2020	NO3/NH3
20200827	0668	06684103	Middle Fork Salt Creek	8/27/2020	NO3/NH3 DUP
20200827	0668	06684004	Middle Fork Salt Creek	8/27/2020	SRP
20200827	0668	06684104	Middle Fork Salt Creek	8/27/2020	SRP DUP
20200827	0668	06684005	Middle Fork Salt Creek	8/27/2020	TN/TP
20200827	0668	06684105	Middle Fork Salt Creek	8/27/2020	TN/TP DUP
20200827	0668	06684012	Middle Fork Salt Creek	8/27/2020	TSS
20200827	0668	06684112	Middle Fork Salt Creek	8/27/2020	TSS DUP
20200827	0914	09144001	South Fork Salt Creek	8/27/2020	ANC
20200827	0914	09144003	South Fork Salt Creek	8/27/2020	NO3/NH3
20200827	0914	09144004	South Fork Salt Creek	8/27/2020	SRP
20200827	0914	09144005	South Fork Salt Creek	8/27/2020	TN/TP
20200827	0914	09144012	South Fork Salt Creek	8/27/2020	TSS
20200924	0111	01114001	Lake Monroe Outlet	9/24/2020	ANC
20200924	0111	01114003	Lake Monroe Outlet	9/24/2020	NO3/NH3
20200924	0111	01110003	Lake Monroe Outlet	9/24/2020	NO3/NH3 BLANK
20200924	0111	01114004	Lake Monroe Outlet	9/24/2020	SRP
20200924	0111	01110004	Lake Monroe Outlet	9/24/2020	SRP BLANK
20200924	0111	01114005	Lake Monroe Outlet	9/24/2020	TN/TP
20200924	0111	01110005	Lake Monroe Outlet	9/24/2020	TN/TP BLANK
20200924	0111	01114012	Lake Monroe Outlet	9/24/2020	TSS
20200924	0111	01110012	Lake Monroe Outlet	9/24/2020	TSS BLANK
20200924	0123	01234001	Crooked Creek	9/24/2020	ANC

tripId	eventId	sampleId	lakeName	sampleDate	parameterInfo
20200924	0123	01234003	Crooked Creek	9/24/2020	NO3/NH3
20200924	0123	01234004	Crooked Creek	9/24/2020	SRP
20200924	0123	01234005	Crooked Creek	9/24/2020	TN/TP
20200924	0123	01234012	Crooked Creek	9/24/2020	TSS
20200924	0256	02564001	North Fork Salt Creek	9/24/2020	ANC
20200924	0256	02564003	North Fork Salt Creek	9/24/2020	NO3/NH3
20200924	0256	02564004	North Fork Salt Creek	9/24/2020	SRP
20200924	0256	02564005	North Fork Salt Creek	9/24/2020	TN/TP
20200924	0256	02564012	North Fork Salt Creek	9/24/2020	TSS
20200924	0668	06684001	Middle Fork Salt Creek	9/24/2020	ANC
20200924	0668	06684101	Middle Fork Salt Creek	9/24/2020	ANC DUP
20200924	0668	06684003	Middle Fork Salt Creek	9/24/2020	NO3/NH3
20200924	0668	06684103	Middle Fork Salt Creek	9/24/2020	NO3/NH3 DUP
20200924	0668	06684004	Middle Fork Salt Creek	9/24/2020	SRP
20200924	0668	06684104	Middle Fork Salt Creek	9/24/2020	SRP DUP
20200924	0668	06684005	Middle Fork Salt Creek	9/24/2020	TN/TP
20200924	0668	06684105	Middle Fork Salt Creek	9/24/2020	TN/TP DUP
20200924	0668	06684012	Middle Fork Salt Creek	9/24/2020	TSS
20200924	0668	06684112	Middle Fork Salt Creek	9/24/2020	TSS DUP
20200924	0914	09144001	South Fork Salt Creek	9/24/2020	ANC
20200924	0914	09144003	South Fork Salt Creek	9/24/2020	NO3/NH3
20200924	0914	09144004	South Fork Salt Creek	9/24/2020	SRP
20200924	0914	09144005	South Fork Salt Creek	9/24/2020	TN/TP
20200924	0914	09144012	South Fork Salt Creek	9/24/2020	TSS
20201022	0111	01114001	Lake Monroe Outlet	10/22/2020	ANC
20201022	0111	01114003	Lake Monroe Outlet	10/22/2020	NO3/NH3
20201022	0111	01110003	Lake Monroe Outlet	10/22/2020	NO3/NH3 BLANK
20201022	0111	01114004	Lake Monroe Outlet	10/22/2020	SRP
20201022	0111	01110004	Lake Monroe Outlet	10/22/2020	SRP BLANK
20201022	0111	01114005	Lake Monroe Outlet	10/22/2020	TN/TP
20201022	0111	01110005	Lake Monroe Outlet	10/22/2020	TN/TP BLANK
20201022	0111	01114012	Lake Monroe Outlet	10/22/2020	TSS
20201022	0111	01110012	Lake Monroe Outlet	10/22/2020	TSS BLANK
20201022	0123	01234001	Crooked Creek	10/22/2020	ANC
20201022	0123	01234003	Crooked Creek	10/22/2020	NO3/NH3
20201022	0123	01234004	Crooked Creek	10/22/2020	SRP
20201022	0123	01234005	Crooked Creek	10/22/2020	TN/TP
20201022	0123	01234012	Crooked Creek	10/22/2020	TSS
20201022	0256	02564001	North Fork Salt Creek	10/22/2020	ANC
20201022	0256	02564003	North Fork Salt Creek	10/22/2020	NO3/NH3
20201022	0668	06684004	Middle Fork Salt Creek	10/22/2020	SRP
20201022	0256	02564005	North Fork Salt Creek	10/22/2020	TN/TP
20201022	0256	02564012	North Fork Salt Creek	10/22/2020	TSS
20201022	0668	06684001	Middle Fork Salt Creek	10/22/2020	ANC
20201022	0668	06684101	Middle Fork Salt Creek	10/22/2020	ANC DUP
20201022	0668	06684003	Middle Fork Salt Creek	10/22/2020	NO3/NH3
20201022	0668	06684103	Middle Fork Salt Creek	10/22/2020	NO3/NH3 DUP
20201022	0668	06684104	Middle Fork Salt Creek	10/22/2020	SRP DUP
20201022	0256	02564004	North Fork Salt Creek	10/22/2020	SRP
20201022	0668	06684005	Middle Fork Salt Creek	10/22/2020	TN/TP
20201022	0668	06684105	Middle Fork Salt Creek	10/22/2020	TN/TP DUP
20201022	0668	06684012	Middle Fork Salt Creek	10/22/2020	TSS
20201022	0668	06684112	Middle Fork Salt Creek	10/22/2020	TSS DUP

tripId	eventId	sampleId	lakeName	sampleDate	parameterInfo
20201022	0914	09144001	South Fork Salt Creek	10/22/2020	ANC
20201022	0914	09144003	South Fork Salt Creek	10/22/2020	NO3/NH3
20201022	0914	09144004	South Fork Salt Creek	10/22/2020	SRP
20201022	0914	09144005	South Fork Salt Creek	10/22/2020	TN/TP
20201022	0914	09144012	South Fork Salt Creek	10/22/2020	TSS
20201119	0111	01114001	Lake Monroe Outlet	11/19/2020	ANC
20201119	0111	01114003	Lake Monroe Outlet	11/19/2020	NO3/NH3
20201119	0111	01110003	Lake Monroe Outlet	11/19/2020	NO3/NH3 BLANK
20201119	0111	01114004	Lake Monroe Outlet	11/19/2020	SRP
20201119	0111	01110004	Lake Monroe Outlet	11/19/2020	SRP BLANK
20201119	0111	01114005	Lake Monroe Outlet	11/19/2020	TN/TP
20201119	0111	01110005	Lake Monroe Outlet	11/19/2020	TN/TP BLANK
20201119	0111	01114012	Lake Monroe Outlet	11/19/2020	TSS
20201119	0111	01110012	Lake Monroe Outlet	11/19/2020	TSS BLANK
20201119	0123	01234001	Crooked Creek	11/19/2020	ANC
20201119	0123	01234003	Crooked Creek	11/19/2020	NO3/NH3
20201119	0123	01234004	Crooked Creek	11/19/2020	SRP
20201119	0123	01234005	Crooked Creek	11/19/2020	TN/TP
20201119	0123	01234012	Crooked Creek	11/19/2020	TSS
20201119	0256	02564001	North Fork Salt Creek	11/19/2020	ANC
20201119	0256	02564003	North Fork Salt Creek	11/19/2020	NO3/NH3
20201119	0256	02564004	North Fork Salt Creek	11/19/2020	SRP
20201119	0256	02564005	North Fork Salt Creek	11/19/2020	TN/TP
20201119	0256	02564012	North Fork Salt Creek	11/19/2020	TSS
20201119	0668	06684001	Middle Fork Salt Creek	11/19/2020	ANC
20201119	0668	06684101	Middle Fork Salt Creek	11/19/2020	ANC DUP
20201119	0668	06684003	Middle Fork Salt Creek	11/19/2020	NO3/NH3
20201119	0668	06684103	Middle Fork Salt Creek	11/19/2020	NO3/NH3 DUP
20201119	0668	06684004	Middle Fork Salt Creek	11/19/2020	SRP
20201119	0668	06684104	Middle Fork Salt Creek	11/19/2020	SRP DUP
20201119	0668	06684005	Middle Fork Salt Creek	11/19/2020	TN/TP
20201119	0668	06684105	Middle Fork Salt Creek	11/19/2020	TN/TP DUP
20201119	0668	06684012	Middle Fork Salt Creek	11/19/2020	TSS
20201119	0668	06684112	Middle Fork Salt Creek	11/19/2020	TSS DUP
20201119	0914	09144001	South Fork Salt Creek	11/19/2020	ANC
20201119	0914	09144003	South Fork Salt Creek	11/19/2020	NO3/NH3
20201119	0914	09144004	South Fork Salt Creek	11/19/2020	SRP
20201119	0914	09144005	South Fork Salt Creek	11/19/2020	TN/TP
20201119	0914	09144012	South Fork Salt Creek	11/19/2020	TSS
20201216	0111	01114001	Lake Monroe Outlet	12/16/2020	ANC
20201216	0111	01114003	Lake Monroe Outlet	12/16/2020	NO3/NH3
20201216	0111	01110003	Lake Monroe Outlet	12/16/2020	NO3/NH3 BLANK
20201216	0111	01114004	Lake Monroe Outlet	12/16/2020	SRP
20201216	0111	01110004	Lake Monroe Outlet	12/16/2020	SRP BLANK
20201216	0111	01114005	Lake Monroe Outlet	12/16/2020	TN/TP
20201216	0111	01110005	Lake Monroe Outlet	12/16/2020	TN/TP BLANK
20201216	0111	01114012	Lake Monroe Outlet	12/16/2020	TSS
20201216	0111	01110012	Lake Monroe Outlet	12/16/2020	TSS BLANK
20201216	0123	01234001	Crooked Creek	12/16/2020	ANC
20201216	0123	01234003	Crooked Creek	12/16/2020	NO3/NH3
20201216	0123	01234004	Crooked Creek	12/16/2020	SRP
20201216	0123	01234005	Crooked Creek	12/16/2020	TN/TP
20201216	0123	01234012	Crooked Creek	12/16/2020	TSS

tripId	eventId	sampleId	lakeName	sampleDate	parameterInfo
20201216	0256	02564001	North Fork Salt Creek	12/16/2020	ANC
20201216	0256	02564003	North Fork Salt Creek	12/16/2020	NO3/NH3
20201216	0256	02564004	North Fork Salt Creek	12/16/2020	SRP
20201216	0256	02564005	North Fork Salt Creek	12/16/2020	TN/TP
20201216	0256	02564012	North Fork Salt Creek	12/16/2020	TSS
20201216	0668	06684001	Middle Fork Salt Creek	12/16/2020	ANC
20201216	0668	06684101	Middle Fork Salt Creek	12/16/2020	ANC DUP
20201216	0668	06684003	Middle Fork Salt Creek	12/16/2020	NO3/NH3
20201216	0668	06684103	Middle Fork Salt Creek	12/16/2020	NO3/NH3 DUP
20201216	0668	06684004	Middle Fork Salt Creek	12/16/2020	SRP
20201216	0668	06684104	Middle Fork Salt Creek	12/16/2020	SRP DUP
20201216	0668	06684005	Middle Fork Salt Creek	12/16/2020	TN/TP
20201216	0668	06684105	Middle Fork Salt Creek	12/16/2020	TN/TP DUP
20201216	0668	06684012	Middle Fork Salt Creek	12/16/2020	TSS
20201216	0668	06684112	Middle Fork Salt Creek	12/16/2020	TSS DUP
20201216	0914	09144001	South Fork Salt Creek	12/16/2020	ANC
20201216	0914	09144003	South Fork Salt Creek	12/16/2020	NO3/NH3
20201216	0914	09144004	South Fork Salt Creek	12/16/2020	SRP
20201216	0914	09144005	South Fork Salt Creek	12/16/2020	TN/TP
20201216	0914	09144012	South Fork Salt Creek	12/16/2020	TSS

comments
no hypo samples were collected
no hypo samples were collected
no hypo samples were collected
no hypo samples were collected
no hypo samples were collected

comments

comments
na
na
na

comments
no hypo samples were collected
no hypo samples were collected
no hypo samples were collected
no hypo samples were collected
no hypo samples were collected
no hypo samples were collected
no hypo samples were collected
no hypo samples were collected
no hypo samples were collected
no hypo samples were collected
no hypo samples were collected
no hypo samples were collected
no hypo samples were collected
no hypo samples were collected
Not collected
no hypo samples were collected
no hypo samples were collected
no hypo samples were collected
no hypo samples were collected
no hypo samples were collected

comments
no hypo samples were collected
no hypo samples were collected
no hypo samples were collected
no hypo samples were collected
no hypo samples were collected
no hypo samples were collected
no hypo samples were collected
no hypo samples were collected
no hypo samples were collected
no hypo samples were collected
no hypo samples were collected
no hypo samples were collected
no hypo samples were collected

comments

comments

comments
No samples-stream dry

comments
No samples-stream dry
No samples-stream dry
No samples-stream dry
No samples-stream dry
No samples-stream dry
No samples-stream dry
No samples-stream dry
No samples-stream dry
No samples-stream dry

comments

comments

IDEM Site Number	Sample Date	EventID	Sample Name	Depth	Depth Unit	Temp	Unit
WEL-07-0018	5/26/2020 8:44	2830	Monroe Upper	0	meters	23.9	°C
WEL-07-0018	5/26/2020 8:44	2830	Monroe Upper	1	meters	23.9	°C
WEL-07-0018	5/26/2020 8:44	2830	Monroe Upper	2	meters	21.3	°C
WEL-07-0018	5/26/2020 8:44	2830	Monroe Upper	3	meters	18.4	°C
WEL-07-0018	5/26/2020 8:44	2830	Monroe Upper	4	meters	16.8	°C
WEL-07-0018	5/26/2020 8:44	2830	Monroe Upper	5	meters	16.5	°C
WEL-07-0018	5/26/2020 8:44	2830	Monroe Upper	6	meters	16.2	°C
WEL-07-0018	5/26/2020 8:44	2830	Monroe Upper	7	meters	16	°C
WEL-07-0018	5/26/2020 8:44	2830	Monroe Upper	8	meters	15.9	°C
WEL-07-0018	5/26/2020 8:44	2830	Monroe Upper	9	meters	15.9	°C
WEL-07-0018	5/26/2020 8:44	2830	Monroe Upper	10	meters	15.7	°C
WEL-07-0020	5/26/2020 11:00	2831	Monroe Center	0	meters	23.14	°C
WEL-07-0020	5/26/2020 11:00	2831	Monroe Center	1	meters	23.08	°C
WEL-07-0020	5/26/2020 11:00	2831	Monroe Center	2	meters	22.73	°C
WEL-07-0020	5/26/2020 11:00	2831	Monroe Center	3	meters	19.76	°C
WEL-07-0020	5/26/2020 11:00	2831	Monroe Center	4	meters	17.93	°C
WEL-07-0020	5/26/2020 11:00	2831	Monroe Center	5	meters	17.25	°C
WEL-07-0020	5/26/2020 11:00	2831	Monroe Center	6	meters	16.02	°C
WEL-07-0020	5/26/2020 11:00	2831	Monroe Center	7	meters	15.67	°C
WEL-07-0020	5/26/2020 11:00	2831	Monroe Center	7.5	meters	15.34	°C
WEL-07-0021	5/26/2020 12:47	2832	Monroe Lower	0	meters	24.5	°C
WEL-07-0021	5/26/2020 12:47	2832	Monroe Lower	1	meters	23.4	°C
WEL-07-0021	5/26/2020 12:47	2832	Monroe Lower	2	meters	21.3	°C
WEL-07-0021	5/26/2020 12:47	2832	Monroe Lower	3	meters	18.3	°C
WEL-07-0021	5/26/2020 12:47	2832	Monroe Lower	4	meters	17.2	°C
WEL-07-0021	5/26/2020 12:47	2832	Monroe Lower	5	meters	16.7	°C
WEL-07-0021	5/26/2020 12:47	2832	Monroe Lower	6	meters	16.6	°C
WEL-07-0021	5/26/2020 12:47	2832	Monroe Lower	7	meters	16.2	°C
WEL-07-0021	5/26/2020 12:47	2832	Monroe Lower	8	meters	15.9	°C
WEL-07-0021	5/26/2020 12:47	2832	Monroe Lower	9	meters	14.8	°C
WEL-07-0021	5/26/2020 12:47	2832	Monroe Lower	10	meters	14.4	°C
WEL-07-0021	5/26/2020 12:47	2832	Monroe Lower	11	meters	14.2	°C
WEL-07-0021	5/26/2020 12:47	2832	Monroe Lower	12	meters	14	°C
WEL-07-0021	5/26/2020 12:47	2832	Monroe Lower	13	meters	13.8	°C
WEL-07-0021	5/26/2020 12:47	2832	Monroe Lower	14	meters	13.8	°C
WEL-07-0021	5/26/2020 12:47	2832	Monroe Lower	15	meters	13.6	°C
WEL-07-0021	5/26/2020 12:47	2832	Monroe Lower	16	meters	13.2	°C
WEL-07-0018	6/25/2020 8:30	2855	Monroe Upper	0	meters	26.05	°C
WEL-07-0018	6/25/2020 8:30	2855	Monroe Upper	1	meters	26.19	°C
WEL-07-0018	6/25/2020 8:30	2855	Monroe Upper	2	meters	26.14	°C
WEL-07-0018	6/25/2020 8:30	2855	Monroe Upper	3	meters	26.08	°C
WEL-07-0018	6/25/2020 8:30	2855	Monroe Upper	4	meters	26	°C
WEL-07-0018	6/25/2020 8:30	2855	Monroe Upper	5	meters	25.63	°C
WEL-07-0018	6/25/2020 8:30	2855	Monroe Upper	6	meters	23.8	°C
WEL-07-0018	6/25/2020 8:30	2855	Monroe Upper	7	meters	20.89	°C
WEL-07-0018	6/25/2020 8:30	2855	Monroe Upper	8	meters	18.5	°C
WEL-07-0020	6/25/2020 10:00	2856	Monroe Center	0	meters	25.94	°C
WEL-07-0020	6/25/2020 10:00	2856	Monroe Center	1	meters	26.01	°C
WEL-07-0020	6/25/2020 10:00	2856	Monroe Center	2	meters	25.94	°C
WEL-07-0020	6/25/2020 10:00	2856	Monroe Center	3	meters	25.93	°C
WEL-07-0020	6/25/2020 10:00	2856	Monroe Center	4	meters	25.87	°C
WEL-07-0020	6/25/2020 10:00	2856	Monroe Center	5	meters	25.14	°C
WEL-07-0020	6/25/2020 10:00	2856	Monroe Center	6	meters	22.31	°C
WEL-07-0020	6/25/2020 10:00	2856	Monroe Center	6.5	meters	20.53	°C
WEL-07-0021	6/25/2020 11:37	2857	Monroe Lower	0	meters	26.08	°C
WEL-07-0021	6/25/2020 11:37	2857	Monroe Lower	1	meters	25.56	°C

IDEM Site Number	Sample Date	EventID	Sample Name	Depth	Depth Unit	Temp	Unit
WEL-07-0021	6/25/2020 11:37	2857	Monroe Lower	2	meters	25.21	°C
WEL-07-0021	6/25/2020 11:37	2857	Monroe Lower	3	meters	25.09	°C
WEL-07-0021	6/25/2020 11:37	2857	Monroe Lower	4	meters	24.98	°C
WEL-07-0021	6/25/2020 11:37	2857	Monroe Lower	5	meters	24.69	°C
WEL-07-0021	6/25/2020 11:37	2857	Monroe Lower	6	meters	21.97	°C
WEL-07-0021	6/25/2020 11:37	2857	Monroe Lower	7	meters	20.51	°C
WEL-07-0021	6/25/2020 11:37	2857	Monroe Lower	8	meters	18.37	°C
WEL-07-0021	6/25/2020 11:37	2857	Monroe Lower	9	meters	17	°C
WEL-07-0021	6/25/2020 11:37	2857	Monroe Lower	10	meters	15.78	°C
WEL-07-0021	6/25/2020 11:37	2857	Monroe Lower	11	meters	15.42	°C
WEL-07-0021	6/25/2020 11:37	2857	Monroe Lower	12	meters	15.11	°C
WEL-07-0021	6/25/2020 11:37	2857	Monroe Lower	13	meters	14.96	°C
WEL-07-0021	6/25/2020 11:37	2857	Monroe Lower	14	meters	14.84	°C
WEL-07-0021	6/25/2020 11:37	2857	Monroe Lower	15	meters	14.7	°C
WEL-07-0018	7/27/2020 6:57	2917	Monroe Upper	0	meters	29.03	°C
WEL-07-0018	7/27/2020 6:57	2917	Monroe Upper	1	meters	29.13	°C
WEL-07-0018	7/27/2020 6:57	2917	Monroe Upper	2	meters	29.15	°C
WEL-07-0018	7/27/2020 6:57	2917	Monroe Upper	3	meters	28.47	°C
WEL-07-0018	7/27/2020 6:57	2917	Monroe Upper	4	meters	27.72	°C
WEL-07-0018	7/27/2020 6:57	2917	Monroe Upper	5	meters	27.27	°C
WEL-07-0018	7/27/2020 6:57	2917	Monroe Upper	6	meters	26.26	°C
WEL-07-0018	7/27/2020 6:57	2917	Monroe Upper	7	meters	25.38	°C
WEL-07-0018	7/27/2020 6:57	2917	Monroe Upper	8	meters	25.11	°C
WEL-07-0020	7/27/2020 8:57	2918	Monroe Center	0	meters	29.21	°C
WEL-07-0020	7/27/2020 8:57	2918	Monroe Center	1	meters	29.21	°C
WEL-07-0020	7/27/2020 8:57	2918	Monroe Center	2	meters	29.17	°C
WEL-07-0020	7/27/2020 8:57	2918	Monroe Center	3	meters	29.18	°C
WEL-07-0020	7/27/2020 8:57	2918	Monroe Center	4	meters	29.16	°C
WEL-07-0020	7/27/2020 8:57	2918	Monroe Center	5	meters	27.5	°C
WEL-07-0020	7/27/2020 8:57	2918	Monroe Center	6	meters	25.74	°C
WEL-07-0021	7/27/2020 10:40	2919	Monroe Lower	0	meters	29.74	°C
WEL-07-0021	7/27/2020 10:40	2919	Monroe Lower	1	meters	29.64	°C
WEL-07-0021	7/27/2020 10:40	2919	Monroe Lower	2	meters	29.39	°C
WEL-07-0021	7/27/2020 10:40	2919	Monroe Lower	3	meters	28.9	°C
WEL-07-0021	7/27/2020 10:40	2919	Monroe Lower	4	meters	28.46	°C
WEL-07-0021	7/27/2020 10:40	2919	Monroe Lower	5	meters	26.56	°C
WEL-07-0021	7/27/2020 10:40	2919	Monroe Lower	6	meters	25.35	°C
WEL-07-0021	7/27/2020 10:40	2919	Monroe Lower	7	meters	22.32	°C
WEL-07-0021	7/27/2020 10:40	2919	Monroe Lower	8	meters	20.8	°C
WEL-07-0021	7/27/2020 10:40	2919	Monroe Lower	9	meters	18.57	°C
WEL-07-0021	7/27/2020 10:40	2919	Monroe Lower	10	meters	16.8	°C
WEL-07-0021	7/27/2020 10:40	2919	Monroe Lower	11	meters	16.16	°C
WEL-07-0021	7/27/2020 10:40	2919	Monroe Lower	12	meters	16.02	°C
WEL-07-0021	7/27/2020 10:40	2919	Monroe Lower	13	meters	15.85	°C
WEL-07-0021	7/27/2020 10:40	2919	Monroe Lower	14	meters	15.81	°C
WEL-07-0018	8/28/2020 8:26	2939	Monroe Upper	0	meters	28.23	°C
WEL-07-0018	8/28/2020 8:26	2939	Monroe Upper	1	meters	28.33	°C
WEL-07-0018	8/28/2020 8:26	2939	Monroe Upper	2	meters	28.39	°C
WEL-07-0018	8/28/2020 8:26	2939	Monroe Upper	3	meters	27.63	°C
WEL-07-0018	8/28/2020 8:26	2939	Monroe Upper	4	meters	26.96	°C
WEL-07-0018	8/28/2020 8:26	2939	Monroe Upper	5	meters	26.74	°C
WEL-07-0018	8/28/2020 8:26	2939	Monroe Upper	6	meters	26.28	°C
WEL-07-0018	8/28/2020 8:26	2939	Monroe Upper	7	meters	25.75	°C
WEL-07-0018	8/28/2020 8:26	2939	Monroe Upper	8	meters	25.11	°C
WEL-07-0021	9/23/2020 17:00	2944	Monroe Lower	0	meters	22.78	°C
WEL-07-0021	9/23/2020 17:00	2944	Monroe Lower	1	meters	22.97	°C

IDEM Site Number	Sample Date	EventID	Sample Name	Depth	Depth Unit	Temp	Unit
WEL-07-0021	9/23/2020 17:00	2944	Monroe Lower	2	meters	22.92	°C
WEL-07-0021	9/23/2020 17:00	2944	Monroe Lower	3	meters	22.79	°C
WEL-07-0021	9/23/2020 17:00	2944	Monroe Lower	4	meters	22.73	°C
WEL-07-0021	9/23/2020 17:00	2944	Monroe Lower	5	meters	22.71	°C
WEL-07-0021	9/23/2020 17:00	2944	Monroe Lower	6	meters	22.69	°C
WEL-07-0021	9/23/2020 17:00	2944	Monroe Lower	7	meters	22.64	°C
WEL-07-0021	9/23/2020 17:00	2944	Monroe Lower	8	meters	22.61	°C
WEL-07-0021	9/23/2020 17:00	2944	Monroe Lower	9	meters	22.3	°C
WEL-07-0021	9/23/2020 17:00	2944	Monroe Lower	10	meters	20.59	°C
WEL-07-0021	9/23/2020 17:00	2944	Monroe Lower	11	meters	19.59	°C
WEL-07-0021	9/23/2020 17:00	2944	Monroe Lower	12	meters	19.02	°C
WEL-07-0021	9/23/2020 17:00	2944	Monroe Lower	13	meters	18.39	°C
WEL-07-0021	9/23/2020 17:00	2944	Monroe Lower	14	meters	17.67	°C
WEL-07-0021	9/23/2020 17:00	2944	Monroe Lower	15	meters	16.98	°C
WEL-07-0020	9/23/2020 17:52	2943	Monroe Center	0	meters	22.72	°C
WEL-07-0020	9/23/2020 17:52	2943	Monroe Center	1	meters	22.72	°C
WEL-07-0020	9/23/2020 17:52	2943	Monroe Center	2	meters	22.61	°C
WEL-07-0020	9/23/2020 17:52	2943	Monroe Center	3	meters	22.34	°C
WEL-07-0020	9/23/2020 17:52	2943	Monroe Center	4	meters	22.19	°C
WEL-07-0020	9/23/2020 17:52	2943	Monroe Center	5	meters	21.96	°C
WEL-07-0020	9/23/2020 17:52	2943	Monroe Center	6	meters	21.72	°C
WEL-07-0018	9/23/2020 14:39	2942	Monroe Upper	0	meters	22.72	°C
WEL-07-0018	9/23/2020 14:39	2942	Monroe Upper	1	meters	21.38	°C
WEL-07-0018	9/23/2020 14:39	2942	Monroe Upper	2	meters	20.95	°C
WEL-07-0018	9/23/2020 14:39	2942	Monroe Upper	3	meters	20.76	°C
WEL-07-0018	9/23/2020 14:39	2942	Monroe Upper	4	meters	20.58	°C
WEL-07-0018	9/23/2020 14:39	2942	Monroe Upper	5	meters	20.48	°C
WEL-07-0018	9/23/2020 14:39	2942	Monroe Upper	6	meters	20.42	°C
WEL-07-0018	9/23/2020 14:39	2942	Monroe Upper	7	meters	20.36	°C
WEL-07-0018	9/23/2020 14:39	2942	Monroe Upper	8	meters	20.33	°C
WEL-07-0020	10/26/2020 15:45	2945	Monroe Center	0	meters	15.19	°C
WEL-07-0020	10/26/2020 15:45	2945	Monroe Center	1	meters	15.41	°C
WEL-07-0020	10/26/2020 15:45	2945	Monroe Center	2	meters	15.45	°C
WEL-07-0020	10/26/2020 15:45	2945	Monroe Center	3	meters	15.44	°C
WEL-07-0020	10/26/2020 15:45	2945	Monroe Center	4	meters	15.45	°C
WEL-07-0020	10/26/2020 15:45	2945	Monroe Center	5	meters	15.44	°C
WEL-07-0020	10/26/2020 15:45	2945	Monroe Center	6	meters	15.44	°C
WEL-07-0021	10/26/2020 16:50	2946	Monroe Lower	0	meters	15.46	°C
WEL-07-0021	10/26/2020 16:50	2946	Monroe Lower	1	meters	15.92	°C
WEL-07-0021	10/26/2020 16:50	2946	Monroe Lower	2	meters	15.96	°C
WEL-07-0021	10/26/2020 16:50	2946	Monroe Lower	3	meters	15.99	°C
WEL-07-0021	10/26/2020 16:50	2946	Monroe Lower	4	meters	16	°C
WEL-07-0021	10/26/2020 16:50	2946	Monroe Lower	5	meters	15.98	°C
WEL-07-0021	10/26/2020 16:50	2946	Monroe Lower	6	meters	15.97	°C
WEL-07-0021	10/26/2020 16:50	2946	Monroe Lower	7	meters	15.96	°C
WEL-07-0021	10/26/2020 16:50	2946	Monroe Lower	8	meters	15.97	°C
WEL-07-0021	10/26/2020 16:50	2946	Monroe Lower	9	meters	15.96	°C
WEL-07-0021	10/26/2020 16:50	2946	Monroe Lower	10	meters	15.95	°C
WEL-07-0021	10/26/2020 16:50	2946	Monroe Lower	11	meters	15.94	°C
WEL-07-0021	10/26/2020 16:50	2946	Monroe Lower	12	meters	15.93	°C
WEL-07-0021	10/26/2020 16:50	2946	Monroe Lower	13	meters	15.72	°C
WEL-07-0021	10/26/2020 16:50	2946	Monroe Lower	14	meters	15.87	°C
WEL-07-0021	10/26/2020 16:50	2946	Monroe Lower	15	meters	15.87	°C
WEL-07-0018	10/26/2020 14:30	2947	Monroe Upper	0	meters	14.45	°C
WEL-07-0018	10/26/2020 14:30	2947	Monroe Upper	1	meters	14.32	°C
WEL-07-0018	10/26/2020 14:30	2947	Monroe Upper	2	meters	14.34	°C

IDEM Site Number	Sample Date	EventID	Sample Name	Depth	Depth Unit	Temp	Unit
WEL-07-0018	10/26/2020 14:30	2947	Monroe Upper	3	meters	14.34	°C
WEL-07-0018	10/26/2020 14:30	2947	Monroe Upper	4	meters	14.33	°C
WEL-07-0018	10/26/2020 14:30	2947	Monroe Upper	5	meters	14.36	°C
WEL-07-0018	10/26/2020 14:30	2947	Monroe Upper	6	meters	14.34	°C
WEL-07-0018	10/26/2020 14:30	2947	Monroe Upper	7	meters	14.34	°C
WEL-07-0018	10/26/2020 14:30	2947	Monroe Upper	8	meters	14.32	°C
WEL-07-0020	8/28/2020 9:49	2940	Monroe Center	0	meters	27.86	°C
WEL-07-0020	8/28/2020 9:49	2940	Monroe Center	1	meters	27.88	°C
WEL-07-0020	8/28/2020 9:49	2940	Monroe Center	2	meters	27.88	°C
WEL-07-0020	8/28/2020 9:49	2940	Monroe Center	3	meters	27.84	°C
WEL-07-0020	8/28/2020 9:49	2940	Monroe Center	4	meters	27.67	°C
WEL-07-0020	8/28/2020 9:49	2940	Monroe Center	5	meters	26.58	°C
WEL-07-0020	8/28/2020 9:49	2940	Monroe Center	6	meters	25.88	°C
WEL-07-0021	8/28/2020 11:02	2941	Monroe Lower	0	meters	27.99	°C
WEL-07-0021	8/28/2020 11:02	2941	Monroe Lower	1	meters	27.89	°C
WEL-07-0021	8/28/2020 11:02	2941	Monroe Lower	2	meters	27.61	°C
WEL-07-0021	8/28/2020 11:02	2941	Monroe Lower	3	meters	26.83	°C
WEL-07-0021	8/28/2020 11:02	2941	Monroe Lower	4	meters	26.31	°C
WEL-07-0021	8/28/2020 11:02	2941	Monroe Lower	5	meters	26.07	°C
WEL-07-0021	8/28/2020 11:02	2941	Monroe Lower	6	meters	25.79	°C
WEL-07-0021	8/28/2020 11:02	2941	Monroe Lower	7	meters	25.4	°C
WEL-07-0021	8/28/2020 11:02	2941	Monroe Lower	8	meters	24.09	°C
WEL-07-0021	8/28/2020 11:02	2941	Monroe Lower	9	meters	21.19	°C
WEL-07-0021	8/28/2020 11:02	2941	Monroe Lower	10	meters	20.11	°C
WEL-07-0021	8/28/2020 11:02	2941	Monroe Lower	11	meters	19.34	°C
WEL-07-0021	8/28/2020 11:02	2941	Monroe Lower	12	meters	18.04	°C
WEL-07-0021	8/28/2020 11:02	2941	Monroe Lower	13	meters	17.24	°C
WEL-07-0021	8/28/2020 11:02	2941	Monroe Lower	14	meters	16.96	°C
WEL-07-0019	5/27/2020 7:50	0123	Crooked Creek			17.6	°C
WEL-06-0008	5/27/2020 9:20	0256	North Fork Salt Creek			20.47	°C
WEL-05-0001	5/27/2020 10:25	0668	Middle Fork Salt Creek			19.93	°C
WEL-04-0004	5/27/2020 11:21	0914	South Fork Salt Creek			21.31	°C
WEL-08-0036	5/27/2020 13:07	0111	Lake Monroe Outlet			16.02	°C
WEL-07-0019	6/24/2020 9:15	0123	Crooked Creek			18.5	°C
WEL-05-0001	6/24/2020 10:25	0668	Middle Fork Salt Creek			22	°C
WEL-04-0004	6/24/2020 11:45	0914	South Fork Salt Creek			22.9	°C
WEL-06-0008	6/24/2020 8:15	0256	North Fork Salt Creek			23.3	°C
WEL-08-0036	6/24/2020 13:55	0111	Lake Monroe Outlet			23	°C
WEL-07-0019	7/21/2020 8:30	0123	Crooked Creek			23.32	°C
WEL-05-0001	7/21/2020 9:20	0668	Middle Fork Salt Creek			24.76	°C
WEL-04-0004	7/21/2020 10:40	0914	South Fork Salt Creek			25.28	°C
WEL-06-0008	7/21/2020 11:50	0256	North Fork Salt Creek			25.83	°C
WEL-08-0036	7/21/2020 13:45	0111	Lake Monroe Outlet			25.8	°C
WEL-07-0019	8/27/2020 9:05	0123	Crooked Creek			21.74	°C
WEL-05-0001	8/27/2020 9:45	0668	Middle Fork Salt Creek			23.59	°C
WEL-04-0004	8/27/2020 11:15	0914	South Fork Salt Creek			24.5	°C
WEL-06-0008	8/27/2020 12:51	0256	North Fork Salt Creek			25.37	°C
WEL-08-0036	8/27/2020 14:09	0111	Lake Monroe Outlet			25.08	°C
WEL-05-0001	9/24/2020 8:30	0668	Middle Fork Salt Creek			14.92	°C
WEL-04-0004	9/24/2020 9:25	0914	South Fork Salt Creek			15.33	°C
WEL-06-0008	9/24/2020 10:35	0256	North Fork Salt Creek			15.87	°C
WEL-08-0036	9/24/2020 12:10	0111	Lake Monroe Outlet			21.89	°C
WEL-05-0001	10/22/2020 9:30	0668	Middle Fork Salt Creek			13	°C
WEL-04-0004	10/22/2020 10:40	0914	South Fork Salt Creek			14.23	°C
WEL-06-0008	10/22/2020 11:45	0256	North Fork Salt Creek			12.4	°C
WEL-08-0036	10/22/2020 1:15	0111	Lake Monroe Outlet			17.62	°C

IDEM Site Number	Sample Date	EventID	Sample Name	Depth	Depth Unit	Temp	Unit
WEL-07-0019	11/19/2020 9:00	0123	Crooked Creek			6.49	°C
WEL-06-0008	11/19/2020 9:30	0256	North Fork Salt Creek			5.87	°C
WEL-05-0001	11/19/2020 10:20	0668	Middle Fork Salt Creek			6.21	°C
WEL-04-0004	11/19/2020 11:15	0914	South Fork Salt Creek			6.33	°C
WEL-08-0036	11/19/2020 12:35	0111	Lake Monroe Outlet			12.27	°C
WEL-06-0008	4/22/2020 9:30	0256	North Fork Salt Creek			12.06	°C
WEL-07-0019	4/22/2020 11:30	0123	Crooked Creek			11.2	°C
WEL-05-0001	4/22/2020 13:25	0668	Middle Fork Salt Creek			13.93	°C
WEL-04-0004	4/22/2020 15:00	0914	South Fork Salt Creek			14.31	°C
WEL-08-0036	4/22/2020 16:50	0111	Lake Monroe Outlet			12.19	°C
WEL-07-0019	12/16/20 9:05 AM	0123	Crooked Creek			3.83	°C
WEL-06-0008	12/16/2020 9:30	0256	North Fork Salt Creek			2.83	°C
WEL-05-0001	12/16/2020 10:35	0668	Middle Fork Salt Creek			3.77	°C
WEL-04-0004	12/16/2020 11:26	0914	South Fork Salt Creek			3.87	°C
WEL-08-0036	12/16/2020 12:45	0111	Lake Monroe Outlet			7.25	°C

IDEM Site Number	Sample Date	EventID	Sample Name	Depth	Depth Unit	Concentration	Unit
WEL-07-0018	5/26/2020 8:44	2830	Monroe Upper	0	meters	9.62	mg/L
WEL-07-0018	5/26/2020 8:44	2830	Monroe Upper	1	meters	9.63	mg/L
WEL-07-0018	5/26/2020 8:44	2830	Monroe Upper	2	meters	9.72	mg/L
WEL-07-0018	5/26/2020 8:44	2830	Monroe Upper	3	meters	8.7	mg/L
WEL-07-0018	5/26/2020 8:44	2830	Monroe Upper	4	meters	8.2	mg/L
WEL-07-0018	5/26/2020 8:44	2830	Monroe Upper	5	meters	4.32	mg/L
WEL-07-0018	5/26/2020 8:44	2830	Monroe Upper	6	meters	4.26	mg/L
WEL-07-0018	5/26/2020 8:44	2830	Monroe Upper	7	meters	4.33	mg/L
WEL-07-0018	5/26/2020 8:44	2830	Monroe Upper	8	meters	4.35	mg/L
WEL-07-0018	5/26/2020 8:44	2830	Monroe Upper	9	meters	4.33	mg/L
WEL-07-0018	5/26/2020 8:44	2830	Monroe Upper	10	meters	4.15	mg/L
WEL-07-0020	5/26/2020 11:00	2831	Monroe Center	0	meters	9.75	mg/L
WEL-07-0020	5/26/2020 11:00	2831	Monroe Center	1	meters	9.83	mg/L
WEL-07-0020	5/26/2020 11:00	2831	Monroe Center	2	meters	9.98	mg/L
WEL-07-0020	5/26/2020 11:00	2831	Monroe Center	3	meters	10.21	mg/L
WEL-07-0020	5/26/2020 11:00	2831	Monroe Center	4	meters	9.7	mg/L
WEL-07-0020	5/26/2020 11:00	2831	Monroe Center	5	meters	8.82	mg/L
WEL-07-0020	5/26/2020 11:00	2831	Monroe Center	6	meters	7.21	mg/L
WEL-07-0020	5/26/2020 11:00	2831	Monroe Center	7	meters	5.73	mg/L
WEL-07-0020	5/26/2020 11:00	2831	Monroe Center	7.5	meters	4.82	mg/L
WEL-07-0021	5/26/2020 12:47	2832	Monroe Lower	0	meters	9.67	mg/L
WEL-07-0021	5/26/2020 12:47	2832	Monroe Lower	1	meters	10.13	mg/L
WEL-07-0021	5/26/2020 12:47	2832	Monroe Lower	2	meters	10.29	mg/L
WEL-07-0021	5/26/2020 12:47	2832	Monroe Lower	3	meters	10.57	mg/L
WEL-07-0021	5/26/2020 12:47	2832	Monroe Lower	4	meters	9.56	mg/L
WEL-07-0021	5/26/2020 12:47	2832	Monroe Lower	5	meters	8.85	mg/L
WEL-07-0021	5/26/2020 12:47	2832	Monroe Lower	6	meters	8.1	mg/L
WEL-07-0021	5/26/2020 12:47	2832	Monroe Lower	7	meters	7.73	mg/L
WEL-07-0021	5/26/2020 12:47	2832	Monroe Lower	8	meters	7.57	mg/L
WEL-07-0021	5/26/2020 12:47	2832	Monroe Lower	9	meters	6.87	mg/L
WEL-07-0021	5/26/2020 12:47	2832	Monroe Lower	10	meters	5.86	mg/L
WEL-07-0021	5/26/2020 12:47	2832	Monroe Lower	11	meters	4.88	mg/L
WEL-07-0021	5/26/2020 12:47	2832	Monroe Lower	12	meters	4.19	mg/L
WEL-07-0021	5/26/2020 12:47	2832	Monroe Lower	13	meters	3.57	mg/L
WEL-07-0021	5/26/2020 12:47	2832	Monroe Lower	14	meters	3.21	mg/L
WEL-07-0021	5/26/2020 12:47	2832	Monroe Lower	15	meters	3.05	mg/L
WEL-07-0021	5/26/2020 12:47	2832	Monroe Lower	16	meters	1.75	mg/L
WEL-07-0018	6/25/2020 8:30	2855	Monroe Upper	0	meters	6.91	mg/L
WEL-07-0018	6/25/2020 8:30	2855	Monroe Upper	1	meters	6.83	mg/L
WEL-07-0018	6/25/2020 8:30	2855	Monroe Upper	2	meters	6.83	mg/L
WEL-07-0018	6/25/2020 8:30	2855	Monroe Upper	3	meters	6.62	mg/L
WEL-07-0018	6/25/2020 8:30	2855	Monroe Upper	4	meters	6.34	mg/L
WEL-07-0018	6/25/2020 8:30	2855	Monroe Upper	5	meters	4.9	mg/L
WEL-07-0018	6/25/2020 8:30	2855	Monroe Upper	6	meters	0.21	mg/L
WEL-07-0018	6/25/2020 8:30	2855	Monroe Upper	7	meters	0.08	mg/L
WEL-07-0018	6/25/2020 8:30	2855	Monroe Upper	8	meters	0.06	mg/L
WEL-07-0020	6/25/2020 10:00	2856	Monroe Center	0	meters	7.91	mg/L
WEL-07-0020	6/25/2020 10:00	2856	Monroe Center	1	meters	7.86	mg/L
WEL-07-0020	6/25/2020 10:00	2856	Monroe Center	2	meters	7.86	mg/L
WEL-07-0020	6/25/2020 10:00	2856	Monroe Center	3	meters	7.86	mg/L
WEL-07-0020	6/25/2020 10:00	2856	Monroe Center	4	meters	7.82	mg/L
WEL-07-0020	6/25/2020 10:00	2856	Monroe Center	5	meters	5.59	mg/L
WEL-07-0020	6/25/2020 10:00	2856	Monroe Center	6	meters	2.18	mg/L
WEL-07-0020	6/25/2020 10:00	2856	Monroe Center	6.5	meters	0.09	mg/L
WEL-07-0021	6/25/2020 11:37	2857	Monroe Lower	0	meters	7.31	mg/L
WEL-07-0021	6/25/2020 11:37	2857	Monroe Lower	1	meters	7.3	mg/L

IDEM Site Number	Sample Date	EventID	Sample Name	Depth	Depth Unit	Concentration	Unit
WEL-07-0021	6/25/2020 11:37	2857	Monroe Lower	2	meters	7.09	mg/L
WEL-07-0021	6/25/2020 11:37	2857	Monroe Lower	3	meters	6.9	mg/L
WEL-07-0021	6/25/2020 11:37	2857	Monroe Lower	4	meters	6.57	mg/L
WEL-07-0021	6/25/2020 11:37	2857	Monroe Lower	5	meters	5.55	mg/L
WEL-07-0021	6/25/2020 11:37	2857	Monroe Lower	6	meters	1.48	mg/L
WEL-07-0021	6/25/2020 11:37	2857	Monroe Lower	7	meters	0.5	mg/L
WEL-07-0021	6/25/2020 11:37	2857	Monroe Lower	8	meters	0.19	mg/L
WEL-07-0021	6/25/2020 11:37	2857	Monroe Lower	9	meters	0.09	mg/L
WEL-07-0021	6/25/2020 11:37	2857	Monroe Lower	10	meters	0.06	mg/L
WEL-07-0021	6/25/2020 11:37	2857	Monroe Lower	11	meters	0.05	mg/L
WEL-07-0021	6/25/2020 11:37	2857	Monroe Lower	12	meters	0.04	mg/L
WEL-07-0021	6/25/2020 11:37	2857	Monroe Lower	13	meters	0.04	mg/L
WEL-07-0021	6/25/2020 11:37	2857	Monroe Lower	14	meters	0.04	mg/L
WEL-07-0021	6/25/2020 11:37	2857	Monroe Lower	15	meters	0.03	mg/L
WEL-07-0018	7/27/2020 6:57	2917	Monroe Upper	0	meters	7.42	mg/L
WEL-07-0018	7/27/2020 6:57	2917	Monroe Upper	1	meters	7.41	mg/L
WEL-07-0018	7/27/2020 6:57	2917	Monroe Upper	2	meters	7.43	mg/L
WEL-07-0018	7/27/2020 6:57	2917	Monroe Upper	3	meters	6.47	mg/L
WEL-07-0018	7/27/2020 6:57	2917	Monroe Upper	4	meters	1.81	mg/L
WEL-07-0018	7/27/2020 6:57	2917	Monroe Upper	5	meters	0.6	mg/L
WEL-07-0018	7/27/2020 6:57	2917	Monroe Upper	6	meters	0.09	mg/L
WEL-07-0018	7/27/2020 6:57	2917	Monroe Upper	7	meters	0.06	mg/L
WEL-07-0018	7/27/2020 6:57	2917	Monroe Upper	8	meters	0.05	mg/L
WEL-07-0020	7/27/2020 8:57	2918	Monroe Center	0	meters	7.61	mg/L
WEL-07-0020	7/27/2020 8:57	2918	Monroe Center	1	meters	7.62	mg/L
WEL-07-0020	7/27/2020 8:57	2918	Monroe Center	2	meters	7.6	mg/L
WEL-07-0020	7/27/2020 8:57	2918	Monroe Center	3	meters	7.61	mg/L
WEL-07-0020	7/27/2020 8:57	2918	Monroe Center	4	meters	7.6	mg/L
WEL-07-0020	7/27/2020 8:57	2918	Monroe Center	5	meters	3.9	mg/L
WEL-07-0020	7/27/2020 8:57	2918	Monroe Center	6	meters	0.69	mg/L
WEL-07-0021	7/27/2020 10:40	2919	Monroe Lower	0	meters	7.52	mg/L
WEL-07-0021	7/27/2020 10:40	2919	Monroe Lower	1	meters	7.53	mg/L
WEL-07-0021	7/27/2020 10:40	2919	Monroe Lower	2	meters	7.53	mg/L
WEL-07-0021	7/27/2020 10:40	2919	Monroe Lower	3	meters	7.41	mg/L
WEL-07-0021	7/27/2020 10:40	2919	Monroe Lower	4	meters	6.99	mg/L
WEL-07-0021	7/27/2020 10:40	2919	Monroe Lower	5	meters	4.41	mg/L
WEL-07-0021	7/27/2020 10:40	2919	Monroe Lower	6	meters	2.63	mg/L
WEL-07-0021	7/27/2020 10:40	2919	Monroe Lower	7	meters	0.71	mg/L
WEL-07-0021	7/27/2020 10:40	2919	Monroe Lower	8	meters	0.28	mg/L
WEL-07-0021	7/27/2020 10:40	2919	Monroe Lower	9	meters	0.09	mg/L
WEL-07-0021	7/27/2020 10:40	2919	Monroe Lower	10	meters	0.05	mg/L
WEL-07-0021	7/27/2020 10:40	2919	Monroe Lower	11	meters	0.04	mg/L
WEL-07-0021	7/27/2020 10:40	2919	Monroe Lower	12	meters	0.04	mg/L
WEL-07-0021	7/27/2020 10:40	2919	Monroe Lower	13	meters	0.04	mg/L
WEL-07-0021	7/27/2020 10:40	2919	Monroe Lower	14	meters	0.02	mg/L
WEL-07-0018	9/23/2020 14:39	2942	Monroe Upper	0	meters	10.11	mg/L
WEL-07-0018	9/23/2020 14:39	2942	Monroe Upper	1	meters	7.32	mg/L
WEL-07-0018	9/23/2020 14:39	2942	Monroe Upper	2	meters	5.44	mg/L
WEL-07-0018	9/23/2020 14:39	2942	Monroe Upper	3	meters	5.09	mg/L
WEL-07-0018	9/23/2020 14:39	2942	Monroe Upper	4	meters	4.41	mg/L
WEL-07-0018	9/23/2020 14:39	2942	Monroe Upper	5	meters	4.04	mg/L
WEL-07-0018	9/23/2020 14:39	2942	Monroe Upper	6	meters	3.89	mg/L
WEL-07-0018	9/23/2020 14:39	2942	Monroe Upper	7	meters	3.72	mg/L
WEL-07-0018	9/23/2020 14:39	2942	Monroe Upper	8	meters	3.07	mg/L
WEL-07-0021	9/23/2020 17:00	2944	Monroe Lower	0	meters	7.34	mg/L
WEL-07-0021	9/23/2020 17:00	2944	Monroe Lower	1	meters	6.87	mg/L

IDEM Site Number	Sample Date	EventID	Sample Name	Depth	Depth Unit	Concentration	Unit
WEL-07-0021	9/23/2020 17:00	2944	Monroe Lower	2	meters	6.71	mg/L
WEL-07-0021	9/23/2020 17:00	2944	Monroe Lower	3	meters	6.26	mg/L
WEL-07-0021	9/23/2020 17:00	2944	Monroe Lower	4	meters	6.08	mg/L
WEL-07-0021	9/23/2020 17:00	2944	Monroe Lower	5	meters	6	mg/L
WEL-07-0021	9/23/2020 17:00	2944	Monroe Lower	6	meters	5.91	mg/L
WEL-07-0021	9/23/2020 17:00	2944	Monroe Lower	7	meters	5.77	mg/L
WEL-07-0021	9/23/2020 17:00	2944	Monroe Lower	8	meters	5.36	mg/L
WEL-07-0021	9/23/2020 17:00	2944	Monroe Lower	9	meters	3.77	mg/L
WEL-07-0021	9/23/2020 17:00	2944	Monroe Lower	10	meters	1.58	mg/L
WEL-07-0021	9/23/2020 17:00	2944	Monroe Lower	11	meters	0.36	mg/L
WEL-07-0021	9/23/2020 17:00	2944	Monroe Lower	12	meters	0.13	mg/L
WEL-07-0021	9/23/2020 17:00	2944	Monroe Lower	13	meters	0.1	mg/L
WEL-07-0021	9/23/2020 17:00	2944	Monroe Lower	14	meters	0.07	mg/L
WEL-07-0021	9/23/2020 17:00	2944	Monroe Lower	15	meters	0.06	mg/L
WEL-07-0020	9/23/2020 17:52	2943	Monroe Center	0	meters	9.12	mg/L
WEL-07-0020	9/23/2020 17:52	2943	Monroe Center	1	meters	9.13	mg/L
WEL-07-0020	9/23/2020 17:52	2943	Monroe Center	2	meters	8.93	mg/L
WEL-07-0020	9/23/2020 17:52	2943	Monroe Center	3	meters	8.35	mg/L
WEL-07-0020	9/23/2020 17:52	2943	Monroe Center	4	meters	7.82	mg/L
WEL-07-0020	9/23/2020 17:52	2943	Monroe Center	5	meters	7.42	mg/L
WEL-07-0020	9/23/2020 17:52	2943	Monroe Center	6	meters	6.69	mg/L
WEL-07-0018	10/26/2020 14:30	2947	Monroe Upper	0	meters	8.2	mg/L
WEL-07-0018	10/26/2020 14:30	2947	Monroe Upper	1	meters	8.13	mg/L
WEL-07-0018	10/26/2020 14:30	2947	Monroe Upper	2	meters	8.09	mg/L
WEL-07-0018	10/26/2020 14:30	2947	Monroe Upper	3	meters	8.08	mg/L
WEL-07-0018	10/26/2020 14:30	2947	Monroe Upper	4	meters	8.05	mg/L
WEL-07-0018	10/26/2020 14:30	2947	Monroe Upper	5	meters	8.04	mg/L
WEL-07-0018	10/26/2020 14:30	2947	Monroe Upper	6	meters	8.05	mg/L
WEL-07-0018	10/26/2020 14:30	2947	Monroe Upper	7	meters	8.05	mg/L
WEL-07-0018	10/26/2020 14:30	2947	Monroe Upper	8	meters	8.05	mg/L
WEL-07-0020	10/26/2020 15:45	2945	Monroe Center	0	meters	8.34	mg/L
WEL-07-0020	10/26/2020 15:45	2945	Monroe Center	1	meters	7.81	mg/L
WEL-07-0020	10/26/2020 15:45	2945	Monroe Center	2	meters	7.75	mg/L
WEL-07-0020	10/26/2020 15:45	2945	Monroe Center	3	meters	7.71	mg/L
WEL-07-0020	10/26/2020 15:45	2945	Monroe Center	4	meters	7.7	mg/L
WEL-07-0020	10/26/2020 15:45	2945	Monroe Center	5	meters	7.68	mg/L
WEL-07-0020	10/26/2020 15:45	2945	Monroe Center	6	meters	7.67	mg/L
WEL-07-0021	10/26/2020 16:50	2946	Monroe Lower	0	meters	8.07	mg/L
WEL-07-0021	10/26/2020 16:50	2946	Monroe Lower	1	meters	7.08	mg/L
WEL-07-0021	10/26/2020 16:50	2946	Monroe Lower	2	meters	6.85	mg/L
WEL-07-0021	10/26/2020 16:50	2946	Monroe Lower	3	meters	6.8	mg/L
WEL-07-0021	10/26/2020 16:50	2946	Monroe Lower	4	meters	6.78	mg/L
WEL-07-0021	10/26/2020 16:50	2946	Monroe Lower	5	meters	6.76	mg/L
WEL-07-0021	10/26/2020 16:50	2946	Monroe Lower	6	meters	6.76	mg/L
WEL-07-0021	10/26/2020 16:50	2946	Monroe Lower	7	meters	6.75	mg/L
WEL-07-0021	10/26/2020 16:50	2946	Monroe Lower	8	meters	6.75	mg/L
WEL-07-0021	10/26/2020 16:50	2946	Monroe Lower	9	meters	6.74	mg/L
WEL-07-0021	10/26/2020 16:50	2946	Monroe Lower	10	meters	6.74	mg/L
WEL-07-0021	10/26/2020 16:50	2946	Monroe Lower	11	meters	6.74	mg/L
WEL-07-0021	10/26/2020 16:50	2946	Monroe Lower	12	meters	6.75	mg/L
WEL-07-0021	10/26/2020 16:50	2946	Monroe Lower	13	meters	6.74	mg/L
WEL-07-0021	10/26/2020 16:50	2946	Monroe Lower	14	meters	6.77	mg/L
WEL-07-0021	10/26/2020 16:50	2946	Monroe Lower	15	meters	6.82	mg/L
WEL-07-0018	8/28/2020 8:26	2939	Monroe Upper	0	meters	8.39	mg/L
WEL-07-0018	8/28/2020 8:26	2939	Monroe Upper	1	meters	8.37	mg/L
WEL-07-0018	8/28/2020 8:26	2939	Monroe Upper	2	meters	8.34	mg/L

IDEM Site Number	Sample Date	EventID	Sample Name	Depth	Depth Unit	Concentration	Unit
WEL-07-0018	8/28/2020 8:26	2939	Monroe Upper	3	meters	4.58	mg/L
WEL-07-0018	8/28/2020 8:26	2939	Monroe Upper	4	meters	2.02	mg/L
WEL-07-0018	8/28/2020 8:26	2939	Monroe Upper	5	meters	0.52	mg/L
WEL-07-0018	8/28/2020 8:26	2939	Monroe Upper	6	meters	0.17	mg/L
WEL-07-0018	8/28/2020 8:26	2939	Monroe Upper	7	meters	0.08	mg/L
WEL-07-0018	8/28/2020 8:26	2939	Monroe Upper	8	meters	0.06	mg/L
WEL-07-0020	8/28/2020 9:49	2940	Monroe Center	0	meters	8.01	mg/L
WEL-07-0020	8/28/2020 9:49	2940	Monroe Center	1	meters	8	mg/L
WEL-07-0020	8/28/2020 9:49	2940	Monroe Center	2	meters	7.93	mg/L
WEL-07-0020	8/28/2020 9:49	2940	Monroe Center	3	meters	7.8	mg/L
WEL-07-0020	8/28/2020 9:49	2940	Monroe Center	4	meters	7.34	mg/L
WEL-07-0020	8/28/2020 9:49	2940	Monroe Center	5	meters	2.59	mg/L
WEL-07-0020	8/28/2020 9:49	2940	Monroe Center	6	meters	0.75	mg/L
WEL-07-0021	8/28/2020 11:02	2941	Monroe Lower	0	meters	7.98	mg/L
WEL-07-0021	8/28/2020 11:02	2941	Monroe Lower	1	meters	8.06	mg/L
WEL-07-0021	8/28/2020 11:02	2941	Monroe Lower	2	meters	7.74	mg/L
WEL-07-0021	8/28/2020 11:02	2941	Monroe Lower	3	meters	5.49	mg/L
WEL-07-0021	8/28/2020 11:02	2941	Monroe Lower	4	meters	2.27	mg/L
WEL-07-0021	8/28/2020 11:02	2941	Monroe Lower	5	meters	1.89	mg/L
WEL-07-0021	8/28/2020 11:02	2941	Monroe Lower	6	meters	0.8	mg/L
WEL-07-0021	8/28/2020 11:02	2941	Monroe Lower	7	meters	0.26	mg/L
WEL-07-0021	8/28/2020 11:02	2941	Monroe Lower	8	meters	0.09	mg/L
WEL-07-0021	8/28/2020 11:02	2941	Monroe Lower	9	meters	0.08	mg/L
WEL-07-0021	8/28/2020 11:02	2941	Monroe Lower	10	meters	0.05	mg/L
WEL-07-0021	8/28/2020 11:02	2941	Monroe Lower	11	meters	0.05	mg/L
WEL-07-0021	8/28/2020 11:02	2941	Monroe Lower	12	meters	0.04	mg/L
WEL-07-0021	8/28/2020 11:02	2941	Monroe Lower	13	meters	0.05	mg/L
WEL-07-0021	8/28/2020 11:02	2941	Monroe Lower	14	meters	0.04	mg/L
WEL-07-0019	5/27/2020 7:50	0123	Crooked Creek			8.27	mg/L
WEL-06-0008	5/27/2020 9:20	0256	North Fork Salt Creek			7.78	mg/L
WEL-05-0001	5/27/2020 10:25	0668	Middle Fork Salt Creek			7.62	mg/L
WEL-04-0004	5/27/2020 11:21	0914	South Fork Salt Creek			6.85	mg/L
WEL-08-0036	5/27/2020 13:07	0111	Lake Monroe Outlet			9.38	mg/L
WEL-07-0019	6/24/2020 9:15	0123	Crooked Creek			8.5	mg/L
WEL-05-0001	6/24/2020 10:25	0668	Middle Fork Salt Creek			5	mg/L
WEL-04-0004	6/24/2020 11:45	0914	South Fork Salt Creek			5.3	mg/L
WEL-06-0008	6/24/2020 8:15	0256	North Fork Salt Creek			2.4	mg/L
WEL-08-0036	6/24/2020 13:55	0111	Lake Monroe Outlet			7.6	mg/L
WEL-07-0019	7/21/2020 8:30	0123	Crooked Creek			7.43	mg/L
WEL-05-0001	7/21/2020 9:20	0668	Middle Fork Salt Creek			2.95	mg/L
WEL-04-0004	7/21/2020 10:40	0914	South Fork Salt Creek			3.86	mg/L
WEL-06-0008	7/21/2020 11:50	0256	North Fork Salt Creek			2.55	mg/L
WEL-08-0036	7/21/2020 13:45	0111	Lake Monroe Outlet			7.55	mg/L
WEL-07-0019	8/27/2020 9:05	0123	Crooked Creek			7.42	mg/L
WEL-05-0001	8/27/2020 9:45	0668	Middle Fork Salt Creek			3.77	mg/L
WEL-04-0004	8/27/2020 11:15	0914	South Fork Salt Creek			2.51	mg/L
WEL-06-0008	8/27/2020 12:51	0256	North Fork Salt Creek			2.07	mg/L
WEL-08-0036	8/27/2020 14:09	0111	Lake Monroe Outlet			7.57	mg/L
WEL-05-0001	9/24/2020 8:30	0668	Middle Fork Salt Creek			3.99	mg/L
WEL-04-0004	9/24/2020 9:25	0914	South Fork Salt Creek			2.85	mg/L
WEL-06-0008	9/24/2020 10:35	0256	North Fork Salt Creek			6	mg/L
WEL-08-0036	9/24/2020 12:10	0111	Lake Monroe Outlet			8.14	mg/L
WEL-05-0001	10/22/2020 9:30	0668	Middle Fork Salt Creek			2.43	mg/L
WEL-04-0004	10/22/2020 10:40	0914	South Fork Salt Creek			3.73	mg/L
WEL-06-0008	10/22/2020 11:45	0256	North Fork Salt Creek			2.3	mg/L
WEL-08-0036	10/22/2020 1:15	0111	Lake Monroe Outlet			8.57	mg/L

IDEM Site Number	Sample Date	EventID	Sample Name	Depth	Depth Unit	Concentration	Unit
WEL-07-0019	11/19/2020 9:00	0123	Crooked Creek			15.11	mg/L
WEL-06-0008	11/19/2020 9:30	0256	North Fork Salt Creek			6.57	mg/L
WEL-05-0001	11/19/2020 10:20	0668	Middle Fork Salt Creek			12.3	mg/L
WEL-04-0004	11/19/2020 11:15	0914	South Fork Salt Creek			9.57	mg/L
WEL-08-0036	11/19/2020 12:35	0111	Lake Monroe Outlet			15.84	mg/L
WEL-07-0018	5/26/2020 8:44	2830	Monroe Upper	0	meters	115.9	%
WEL-07-0018	5/26/2020 8:44	2830	Monroe Upper	1	meters	115.9	%
WEL-07-0018	5/26/2020 8:44	2830	Monroe Upper	2	meters	110.5	%
WEL-07-0018	5/26/2020 8:44	2830	Monroe Upper	3	meters	92.6	%
WEL-07-0018	5/26/2020 8:44	2830	Monroe Upper	4	meters	53.4	%
WEL-07-0018	5/26/2020 8:44	2830	Monroe Upper	5	meters	44.6	%
WEL-07-0018	5/26/2020 8:44	2830	Monroe Upper	6	meters	44	%
WEL-07-0018	5/26/2020 8:44	2830	Monroe Upper	7	meters	44.7	%
WEL-07-0018	5/26/2020 8:44	2830	Monroe Upper	8	meters	44.7	%
WEL-07-0018	5/26/2020 8:44	2830	Monroe Upper	9	meters	44.4	%
WEL-07-0018	5/26/2020 8:44	2830	Monroe Upper	10	meters	42.4	%
WEL-07-0020	5/26/2020 11:00	2831	Monroe Center	0	meters	115.9	%
WEL-07-0020	5/26/2020 11:00	2831	Monroe Center	1	meters	116.5	%
WEL-07-0020	5/26/2020 11:00	2831	Monroe Center	2	meters	117.5	%
WEL-07-0020	5/26/2020 11:00	2831	Monroe Center	3	meters	113.8	%
WEL-07-0020	5/26/2020 11:00	2831	Monroe Center	4	meters	102.9	%
WEL-07-0020	5/26/2020 11:00	2831	Monroe Center	5	meters	92.6	%
WEL-07-0020	5/26/2020 11:00	2831	Monroe Center	6	meters	72.46	%
WEL-07-0020	5/26/2020 11:00	2831	Monroe Center	7	meters	57.7	%
WEL-07-0020	5/26/2020 11:00	2831	Monroe Center	7.5	meters	47.71	%
WEL-07-0021	5/26/2020 12:47	2832	Monroe Lower	0	meters	118.03	%
WEL-07-0021	5/26/2020 12:47	2832	Monroe Lower	1	meters	121.3	%
WEL-07-0021	5/26/2020 12:47	2832	Monroe Lower	2	meters	118.2	%
WEL-07-0021	5/26/2020 12:47	2832	Monroe Lower	3	meters	113.7	%
WEL-07-0021	5/26/2020 12:47	2832	Monroe Lower	4	meters	100.4	%
WEL-07-0021	5/26/2020 12:47	2832	Monroe Lower	5	meters	90.9	%
WEL-07-0021	5/26/2020 12:47	2832	Monroe Lower	6	meters	84.2	%
WEL-07-0021	5/26/2020 12:47	2832	Monroe Lower	7	meters	79.8	%
WEL-07-0021	5/26/2020 12:47	2832	Monroe Lower	8	meters	76.8	%
WEL-07-0021	5/26/2020 12:47	2832	Monroe Lower	9	meters	67.7	%
WEL-07-0021	5/26/2020 12:47	2832	Monroe Lower	10	meters	58.1	%
WEL-07-0021	5/26/2020 12:47	2832	Monroe Lower	11	meters	47.5	%
WEL-07-0021	5/26/2020 12:47	2832	Monroe Lower	12	meters	40.9	%
WEL-07-0021	5/26/2020 12:47	2832	Monroe Lower	13	meters	34.4	%
WEL-07-0021	5/26/2020 12:47	2832	Monroe Lower	14	meters	31.3	%
WEL-07-0021	5/26/2020 12:47	2832	Monroe Lower	15	meters	29.6	%
WEL-07-0021	5/26/2020 12:47	2832	Monroe Lower	16	meters	16.8	%
WEL-07-0018	6/25/2020 8:30	2855	Monroe Upper	0	meters	86.37	%
WEL-07-0018	6/25/2020 8:30	2855	Monroe Upper	1	meters	85.86	%
WEL-07-0018	6/25/2020 8:30	2855	Monroe Upper	2	meters	85.72	%
WEL-07-0018	6/25/2020 8:30	2855	Monroe Upper	3	meters	82.89	%
WEL-07-0018	6/25/2020 8:30	2855	Monroe Upper	4	meters	79	%
WEL-07-0018	6/25/2020 8:30	2855	Monroe Upper	5	meters	56.65	%
WEL-07-0018	6/25/2020 8:30	2855	Monroe Upper	6	meters	2.44	%
WEL-07-0018	6/25/2020 8:30	2855	Monroe Upper	7	meters	0.84	%
WEL-07-0018	6/25/2020 8:30	2855	Monroe Upper	8	meters	0.59	%
WEL-07-0020	6/25/2020 10:00	2856	Monroe Center	0	meters	98.82	%
WEL-07-0020	6/25/2020 10:00	2856	Monroe Center	1	meters	98.29	%
WEL-07-0020	6/25/2020 10:00	2856	Monroe Center	2	meters	98.19	%
WEL-07-0020	6/25/2020 10:00	2856	Monroe Center	3	meters	98.22	%
WEL-07-0020	6/25/2020 10:00	2856	Monroe Center	4	meters	97.67	%

IDEM Site Number	Sample Date	EventID	Sample Name	Depth	Depth Unit	Concentration	Unit
WEL-07-0020	6/25/2020 10:00	2856	Monroe Center	5	meters	67.18	%
WEL-07-0020	6/25/2020 10:00	2856	Monroe Center	6	meters	18.46	%
WEL-07-0020	6/25/2020 10:00	2856	Monroe Center	6.5	meters	0.96	%
WEL-07-0021	6/25/2020 11:37	2857	Monroe Lower	0	meters	91.59	%
WEL-07-0021	6/25/2020 11:37	2857	Monroe Lower	1	meters	90.74	%
WEL-07-0021	6/25/2020 11:37	2857	Monroe Lower	2	meters	87.13	%
WEL-07-0021	6/25/2020 11:37	2857	Monroe Lower	3	meters	84.64	%
WEL-07-0021	6/25/2020 11:37	2857	Monroe Lower	4	meters	80.52	%
WEL-07-0021	6/25/2020 11:37	2857	Monroe Lower	5	meters	67.03	%
WEL-07-0021	6/25/2020 11:37	2857	Monroe Lower	6	meters	16.11	%
WEL-07-0021	6/25/2020 11:37	2857	Monroe Lower	7	meters	5.61	%
WEL-07-0021	6/25/2020 11:37	2857	Monroe Lower	8	meters	2.02	%
WEL-07-0021	6/25/2020 11:37	2857	Monroe Lower	9	meters	0.93	%
WEL-07-0021	6/25/2020 11:37	2857	Monroe Lower	10	meters	0.55	%
WEL-07-0021	6/25/2020 11:37	2857	Monroe Lower	11	meters	0.48	%
WEL-07-0021	6/25/2020 11:37	2857	Monroe Lower	12	meters	0.42	%
WEL-07-0021	6/25/2020 11:37	2857	Monroe Lower	13	meters	0.36	%
WEL-07-0021	6/25/2020 11:37	2857	Monroe Lower	14	meters	0.35	%
WEL-07-0021	6/25/2020 11:37	2857	Monroe Lower	15	meters	0.32	%
WEL-07-0018	7/27/2020 6:57	2917	Monroe Upper	0	meters	98.12	%
WEL-07-0018	7/27/2020 6:57	2917	Monroe Upper	1	meters	98.11	%
WEL-07-0018	7/27/2020 6:57	2917	Monroe Upper	2	meters	98.52	%
WEL-07-0018	7/27/2020 6:57	2917	Monroe Upper	3	meters	84.07	%
WEL-07-0018	7/27/2020 6:57	2917	Monroe Upper	4	meters	22.79	%
WEL-07-0018	7/27/2020 6:57	2917	Monroe Upper	5	meters	2.35	%
WEL-07-0018	7/27/2020 6:57	2917	Monroe Upper	6	meters	1.13	%
WEL-07-0018	7/27/2020 6:57	2917	Monroe Upper	7	meters	0.79	%
WEL-07-0018	7/27/2020 6:57	2917	Monroe Upper	8	meters	0.63	%
WEL-07-0020	7/27/2020 8:57	2918	Monroe Center	0	meters	100.93	%
WEL-07-0020	7/27/2020 8:57	2918	Monroe Center	1	meters	100.88	%
WEL-07-0020	7/27/2020 8:57	2918	Monroe Center	2	meters	100.73	%
WEL-07-0020	7/27/2020 8:57	2918	Monroe Center	3	meters	100.85	%
WEL-07-0020	7/27/2020 8:57	2918	Monroe Center	4	meters	100.73	%
WEL-07-0020	7/27/2020 8:57	2918	Monroe Center	5	meters	50.02	%
WEL-07-0020	7/27/2020 8:57	2918	Monroe Center	6	meters	17.78	%
WEL-07-0021	7/27/2020 10:40	2919	Monroe Lower	0	meters	100.75	%
WEL-07-0021	7/27/2020 10:40	2919	Monroe Lower	1	meters	100.49	%
WEL-07-0021	7/27/2020 10:40	2919	Monroe Lower	2	meters	100.2	%
WEL-07-0021	7/27/2020 10:40	2919	Monroe Lower	3	meters	97.53	%
WEL-07-0021	7/27/2020 10:40	2919	Monroe Lower	4	meters	90.46	%
WEL-07-0021	7/27/2020 10:40	2919	Monroe Lower	5	meters	53.98	%
WEL-07-0021	7/27/2020 10:40	2919	Monroe Lower	6	meters	32.73	%
WEL-07-0021	7/27/2020 10:40	2919	Monroe Lower	7	meters	8.06	%
WEL-07-0021	7/27/2020 10:40	2919	Monroe Lower	8	meters	2.83	%
WEL-07-0021	7/27/2020 10:40	2919	Monroe Lower	9	meters	0.93	%
WEL-07-0021	7/27/2020 10:40	2919	Monroe Lower	10	meters	0.53	%
WEL-07-0021	7/27/2020 10:40	2919	Monroe Lower	11	meters	0.44	%
WEL-07-0021	7/27/2020 10:40	2919	Monroe Lower	12	meters	0.41	%
WEL-07-0021	7/27/2020 10:40	2919	Monroe Lower	13	meters	0.38	%
WEL-07-0021	7/27/2020 10:40	2919	Monroe Lower	14	meters	0.23	%
WEL-07-0018	9/23/2020 14:39	2942	Monroe Upper	0	meters	116.28	%
WEL-07-0018	9/23/2020 14:39	2942	Monroe Upper	1	meters	81.11	%
WEL-07-0018	9/23/2020 14:39	2942	Monroe Upper	2	meters	61.85	%
WEL-07-0018	9/23/2020 14:39	2942	Monroe Upper	3	meters	55.97	%
WEL-07-0018	9/23/2020 14:39	2942	Monroe Upper	4	meters	49.14	%
WEL-07-0018	9/23/2020 14:39	2942	Monroe Upper	5	meters	45.09	%

IDEM Site Number	Sample Date	EventID	Sample Name	Depth	Depth Unit	Concentration	Unit
WEL-07-0018	9/23/2020 14:39	2942	Monroe Upper	6	meters	43.67	%
WEL-07-0018	9/23/2020 14:39	2942	Monroe Upper	7	meters	41.43	%
WEL-07-0018	9/23/2020 14:39	2942	Monroe Upper	8	meters	34.62	%
WEL-07-0021	9/23/2020 17:00	2944	Monroe Lower	0	meters	85.87	%
WEL-07-0021	9/23/2020 17:00	2944	Monroe Lower	1	meters	81.01	%
WEL-07-0021	9/23/2020 17:00	2944	Monroe Lower	2	meters	77.99	%
WEL-07-0021	9/23/2020 17:00	2944	Monroe Lower	3	meters	73.52	%
WEL-07-0021	9/23/2020 17:00	2944	Monroe Lower	4	meters	71.32	%
WEL-07-0021	9/23/2020 17:00	2944	Monroe Lower	5	meters	70.3	%
WEL-07-0021	9/23/2020 17:00	2944	Monroe Lower	6	meters	69.28	%
WEL-07-0021	9/23/2020 17:00	2944	Monroe Lower	7	meters	67.38	%
WEL-07-0021	9/23/2020 17:00	2944	Monroe Lower	8	meters	63.3	%
WEL-07-0021	9/23/2020 17:00	2944	Monroe Lower	9	meters	41.95	%
WEL-07-0021	9/23/2020 17:00	2944	Monroe Lower	10	meters	16.06	%
WEL-07-0021	9/23/2020 17:00	2944	Monroe Lower	11	meters	3.49	%
WEL-07-0021	9/23/2020 17:00	2944	Monroe Lower	12	meters	1.42	%
WEL-07-0021	9/23/2020 17:00	2944	Monroe Lower	13	meters	1.04	%
WEL-07-0021	9/23/2020 17:00	2944	Monroe Lower	14	meters	0.7	%
WEL-07-0021	9/23/2020 17:00	2944	Monroe Lower	15	meters	0.58	%
WEL-07-0020	9/23/2020 17:52	2943	Monroe Center	0	meters	107.45	%
WEL-07-0020	9/23/2020 17:52	2943	Monroe Center	1	meters	107.31	%
WEL-07-0020	9/23/2020 17:52	2943	Monroe Center	2	meters	105.05	%
WEL-07-0020	9/23/2020 17:52	2943	Monroe Center	3	meters	96.22	%
WEL-07-0020	9/23/2020 17:52	2943	Monroe Center	4	meters	91.16	%
WEL-07-0020	9/23/2020 17:52	2943	Monroe Center	5	meters	85.91	%
WEL-07-0020	9/23/2020 17:52	2943	Monroe Center	6	meters	75.01	%
WEL-07-0018	10/26/2020 14:30	2947	Monroe Upper	0	meters	80.98	%
WEL-07-0018	10/26/2020 14:30	2947	Monroe Upper	1	meters	80.25	%
WEL-07-0018	10/26/2020 14:30	2947	Monroe Upper	2	meters	79.86	%
WEL-07-0018	10/26/2020 14:30	2947	Monroe Upper	3	meters	79.6	%
WEL-07-0018	10/26/2020 14:30	2947	Monroe Upper	4	meters	79.39	%
WEL-07-0018	10/26/2020 14:30	2947	Monroe Upper	5	meters	79.35	%
WEL-07-0018	10/26/2020 14:30	2947	Monroe Upper	6	meters	79.48	%
WEL-07-0018	10/26/2020 14:30	2947	Monroe Upper	7	meters	79.13	%
WEL-07-0018	10/26/2020 14:30	2947	Monroe Upper	8	meters	79.61	%
WEL-07-0020	10/26/2020 15:45	2945	Monroe Center	0	meters	83.33	%
WEL-07-0020	10/26/2020 15:45	2945	Monroe Center	1	meters	78.88	%
WEL-07-0020	10/26/2020 15:45	2945	Monroe Center	2	meters	78.25	%
WEL-07-0020	10/26/2020 15:45	2945	Monroe Center	3	meters	78	%
WEL-07-0020	10/26/2020 15:45	2945	Monroe Center	4	meters	77.78	%
WEL-07-0020	10/26/2020 15:45	2945	Monroe Center	5	meters	77.7	%
WEL-07-0020	10/26/2020 15:45	2945	Monroe Center	6	meters	77.47	%
WEL-07-0021	10/26/2020 16:50	2946	Monroe Lower	0	meters	81	%
WEL-07-0021	10/26/2020 16:50	2946	Monroe Lower	1	meters	71.75	%
WEL-07-0021	10/26/2020 16:50	2946	Monroe Lower	2	meters	69.97	%
WEL-07-0021	10/26/2020 16:50	2946	Monroe Lower	3	meters	69.41	%
WEL-07-0021	10/26/2020 16:50	2946	Monroe Lower	4	meters	69.22	%
WEL-07-0021	10/26/2020 16:50	2946	Monroe Lower	5	meters	69.13	%
WEL-07-0021	10/26/2020 16:50	2946	Monroe Lower	6	meters	69.03	%
WEL-07-0021	10/26/2020 16:50	2946	Monroe Lower	7	meters	69.03	%
WEL-07-0021	10/26/2020 16:50	2946	Monroe Lower	8	meters	68.9	%
WEL-07-0021	10/26/2020 16:50	2946	Monroe Lower	9	meters	68.91	%
WEL-07-0021	10/26/2020 16:50	2946	Monroe Lower	10	meters	68.9	%
WEL-07-0021	10/26/2020 16:50	2946	Monroe Lower	11	meters	68.84	%
WEL-07-0021	10/26/2020 16:50	2946	Monroe Lower	12	meters	68.76	%
WEL-07-0021	10/26/2020 16:50	2946	Monroe Lower	13	meters	68.78	%

IDEM Site Number	Sample Date	EventID	Sample Name	Depth	Depth Unit	Concentration	Unit
WEL-07-0021	10/26/2020 16:50	2946	Monroe Lower	14	meters	69.1	%
WEL-07-0021	10/26/2020 16:50	2946	Monroe Lower	15	meters	69.48	%
WEL-07-0018	8/28/2020 8:26	2939	Monroe Upper	0	meters	109.7	%
WEL-07-0018	8/28/2020 8:26	2939	Monroe Upper	1	meters	109.7	%
WEL-07-0018	8/28/2020 8:26	2939	Monroe Upper	2	meters	109.5	%
WEL-07-0018	8/28/2020 8:26	2939	Monroe Upper	3	meters	66.53	%
WEL-07-0018	8/28/2020 8:26	2939	Monroe Upper	4	meters	23.65	%
WEL-07-0018	8/28/2020 8:26	2939	Monroe Upper	5	meters	6.48	%
WEL-07-0018	8/28/2020 8:26	2939	Monroe Upper	6	meters	2	%
WEL-07-0018	8/28/2020 8:26	2939	Monroe Upper	7	meters	1	%
WEL-07-0018	8/28/2020 8:26	2939	Monroe Upper	8	meters	0.76	%
WEL-07-0021	8/28/2020 11:02	2941	Monroe Lower	0	meters	104.19	%
WEL-07-0021	8/28/2020 11:02	2941	Monroe Lower	1	meters	104.98	%
WEL-07-0021	8/28/2020 11:02	2941	Monroe Lower	2	meters	100.08	%
WEL-07-0021	8/28/2020 11:02	2941	Monroe Lower	3	meters	68.24	%
WEL-07-0021	8/28/2020 11:02	2941	Monroe Lower	4	meters	34.48	%
WEL-07-0021	8/28/2020 11:02	2941	Monroe Lower	5	meters	22.18	%
WEL-07-0021	8/28/2020 11:02	2941	Monroe Lower	6	meters	0.17	%
WEL-07-0021	8/28/2020 11:02	2941	Monroe Lower	7	meters	3.07	%
WEL-07-0021	8/28/2020 11:02	2941	Monroe Lower	8	meters	1.13	%
WEL-07-0021	8/28/2020 11:02	2941	Monroe Lower	9	meters	0.88	%
WEL-07-0021	8/28/2020 11:02	2941	Monroe Lower	10	meters	0.6	%
WEL-07-0021	8/28/2020 11:02	2941	Monroe Lower	11	meters	0.53	%
WEL-07-0021	8/28/2020 11:02	2941	Monroe Lower	12	meters	0.47	%
WEL-07-0021	8/28/2020 11:02	2941	Monroe Lower	13	meters	0.48	%
WEL-07-0021	8/28/2020 11:02	2941	Monroe Lower	14	meters	0.4	%
WEL-07-0019	5/27/2020 7:50	0123	Crooked Creek			88.12	%
WEL-06-0008	5/27/2020 9:20	0256	North Fork Salt Creek			85.87	%
WEL-05-0001	5/27/2020 10:25	0668	Middle Fork Salt Creek			85.11	%
WEL-04-0004	5/27/2020 11:21	0914	South Fork Salt Creek			78.67	%
WEL-08-0036	5/27/2020 13:07	0111	Lake Monroe Outlet			96.54	%
WEL-07-0019	6/24/2020 9:15	0123	Crooked Creek			88	%
WEL-05-0001	6/24/2020 10:25	0668	Middle Fork Salt Creek			57	%
WEL-04-0004	6/24/2020 11:45	0914	South Fork Salt Creek			60	%
WEL-06-0008	6/24/2020 8:15	0256	North Fork Salt Creek			30	%
WEL-08-0036	6/24/2020 13:55	0111	Lake Monroe Outlet			87	%
WEL-07-0019	7/21/2020 8:30	0123	Crooked Creek			88.3	%
WEL-05-0001	7/21/2020 9:20	0668	Middle Fork Salt Creek			36.2	%
WEL-04-0004	7/21/2020 10:40	0914	South Fork Salt Creek			47.6	%
WEL-06-0008	7/21/2020 11:50	0256	North Fork Salt Creek			31.9	%
WEL-08-0036	7/21/2020 13:45	0111	Lake Monroe Outlet			94.3	%
WEL-07-0019	8/27/2020 9:05	0123	Crooked Creek			85.85	%
WEL-05-0001	8/27/2020 9:45	0668	Middle Fork Salt Creek			45.23	%
WEL-04-0004	8/27/2020 11:15	0914	South Fork Salt Creek			30.44	%
WEL-06-0008	8/27/2020 12:51	0256	North Fork Salt Creek			25.71	%
WEL-08-0036	8/27/2020 14:09	0111	Lake Monroe Outlet			93.02	%
WEL-05-0001	9/24/2020 8:30	0668	Middle Fork Salt Creek			39.82	%
WEL-04-0004	9/24/2020 9:25	0914	South Fork Salt Creek			28.68	%
WEL-06-0008	9/24/2020 10:35	0256	North Fork Salt Creek			54.19	%
WEL-08-0036	9/24/2020 12:10	0111	Lake Monroe Outlet			94.13	%
WEL-05-0001	10/22/2020 9:30	0668	Middle Fork Salt Creek			23.7	%
WEL-04-0004	10/22/2020 10:40	0914	South Fork Salt Creek			36.2	%
WEL-06-0008	10/22/2020 11:45	0256	North Fork Salt Creek			21.84	%
WEL-08-0036	10/22/2020 1:15	0111	Lake Monroe Outlet			90.88	%
WEL-07-0019	11/19/2020 9:00	0123	Crooked Creek			127.83	%
WEL-06-0008	11/19/2020 9:30	0256	North Fork Salt Creek			52.96	%

IDEM Site Number	Sample Date	EventID	Sample Name	Depth	Depth Unit	Concentration	Unit
WEL-05-0001	11/19/2020 10:20	0668	Middle Fork Salt Creek			101.24	%
WEL-04-0004	11/19/2020 11:15	0914	South Fork Salt Creek			78.08	%
WEL-08-0036	11/19/2020 12:35	0111	Lake Monroe Outlet			149.77	%
WEL-06-0008	4/22/2020 9:30	0256	North Fork Salt Creek			90.74	%
WEL-07-0019	4/22/2020 11:30	0123	Crooked Creek			98.55	%
WEL-05-0001	4/22/2020 13:25	0668	Middle Fork Salt Creek			98.35	%
WEL-04-0004	4/22/2020 15:00	0914	South Fork Salt Creek			91.69	%
WEL-08-0036	4/22/2020 16:50	0111	Lake Monroe Outlet			99.41	%
WEL-06-0008	4/22/2020 9:30	0256	North Fork Salt Creek			9.72	mg/L
WEL-07-0019	4/22/2020 11:30	0123	Crooked Creek			10.65	mg/L
WEL-05-0001	4/22/2020 13:25	0668	Middle Fork Salt Creek			9.95	mg/L
WEL-04-0004	4/22/2020 15:00	0914	South Fork Salt Creek			9.18	mg/L
WEL-08-0036	4/22/2020 16:50	0111	Lake Monroe Outlet			10.24	mg/L
WEL-07-0019	12/16/20 9:05 AM	0123	Crooked Creek			19.46	mg/L
WEL-07-0019	12/16/20 9:05 AM	0123	Crooked Creek			150.21	%
WEL-06-0008	12/16/2020 9:30	0256	North Fork Salt Creek			17.94	mg/L
WEL-06-0008	12/16/2020 9:30	0256	North Fork Salt Creek			134.87	%
WEL-05-0001	12/16/2020 10:35	0668	Middle Fork Salt Creek			16.12	mg/L
WEL-05-0001	12/16/2020 10:35	0668	Middle Fork Salt Creek			124.08	%
WEL-04-0004	12/16/2020 11:26	0914	South Fork Salt Creek			16.25	mg/L
WEL-04-0004	12/16/2020 11:26	0914	South Fork Salt Creek			125.89	%
WEL-08-0036	12/16/2020 12:45	0111	Lake Monroe Outlet			17.94	mg/L
WEL-08-0036	12/16/2020 12:45	0111	Lake Monroe Outlet			151.53	%
WEL-07-0020	8/28/2020 9:49	2918	Monroe Center	0	meters	104.33	%
WEL-07-0020	8/28/2020 9:49	2918	Monroe Center	1	meters	104.06	%
WEL-07-0020	8/28/2020 9:49	2918	Monroe Center	2	meters	103.17	%
WEL-07-0020	8/28/2020 9:49	2918	Monroe Center	3	meters	101.49	%
WEL-07-0020	8/28/2020 9:49	2918	Monroe Center	4	meters	95.17	%
WEL-07-0020	8/28/2020 9:49	2918	Monroe Center	5	meters	29.56	%
WEL-07-0020	8/28/2020 9:49	2918	Monroe Center	6	meters	7.58	%

IDEM Site Number	Sample Date	EventID	Sample Name	Depth	Depth Unit	Concentration	Unit
WEL-07-0018	5/26/2020 8:44	2830	Monroe Upper	0	meters	132.9	umho/cm
WEL-07-0018	5/26/2020 8:44	2830	Monroe Upper	1	meters	132.8	umho/cm
WEL-07-0018	5/26/2020 8:44	2830	Monroe Upper	2	meters	132.1	umho/cm
WEL-07-0018	5/26/2020 8:44	2830	Monroe Upper	3	meters	126.9	umho/cm
WEL-07-0018	5/26/2020 8:44	2830	Monroe Upper	4	meters	116.4	umho/cm
WEL-07-0018	5/26/2020 8:44	2830	Monroe Upper	5	meters	116.9	umho/cm
WEL-07-0018	5/26/2020 8:44	2830	Monroe Upper	6	meters	116.8	umho/cm
WEL-07-0018	5/26/2020 8:44	2830	Monroe Upper	7	meters	118.1	umho/cm
WEL-07-0018	5/26/2020 8:44	2830	Monroe Upper	8	meters	119.5	umho/cm
WEL-07-0018	5/26/2020 8:44	2830	Monroe Upper	9	meters	121.3	umho/cm
WEL-07-0018	5/26/2020 8:44	2830	Monroe Upper	10	meters	124.9	umho/cm
WEL-07-0020	5/26/2020 11:00	2831	Monroe Center	0	meters	120.9	umho/cm
WEL-07-0020	5/26/2020 11:00	2831	Monroe Center	1	meters	120.6	umho/cm
WEL-07-0020	5/26/2020 11:00	2831	Monroe Center	2	meters	120.5	umho/cm
WEL-07-0020	5/26/2020 11:00	2831	Monroe Center	3	meters	118.5	umho/cm
WEL-07-0020	5/26/2020 11:00	2831	Monroe Center	4	meters	122.1	umho/cm
WEL-07-0020	5/26/2020 11:00	2831	Monroe Center	5	meters	120.9	umho/cm
WEL-07-0020	5/26/2020 11:00	2831	Monroe Center	6	meters	113.2	umho/cm
WEL-07-0020	5/26/2020 11:00	2831	Monroe Center	7	meters	116.2	umho/cm
WEL-07-0020	5/26/2020 11:00	2831	Monroe Center	7.5	meters	115.8	umho/cm
WEL-07-0021	5/26/2020 12:47	2832	Monroe Lower	0	meters	114.4	umho/cm
WEL-07-0021	5/26/2020 12:47	2832	Monroe Lower	1	meters	115.9	umho/cm
WEL-07-0021	5/26/2020 12:47	2832	Monroe Lower	2	meters	115.4	umho/cm
WEL-07-0021	5/26/2020 12:47	2832	Monroe Lower	3	meters	113.4	umho/cm
WEL-07-0021	5/26/2020 12:47	2832	Monroe Lower	4	meters	113.7	umho/cm
WEL-07-0021	5/26/2020 12:47	2832	Monroe Lower	5	meters	115.9	umho/cm
WEL-07-0021	5/26/2020 12:47	2832	Monroe Lower	6	meters	114	umho/cm
WEL-07-0021	5/26/2020 12:47	2832	Monroe Lower	7	meters	116.6	umho/cm
WEL-07-0021	5/26/2020 12:47	2832	Monroe Lower	8	meters	113.3	umho/cm
WEL-07-0021	5/26/2020 12:47	2832	Monroe Lower	9	meters	112.3	umho/cm
WEL-07-0021	5/26/2020 12:47	2832	Monroe Lower	10	meters	113.3	umho/cm
WEL-07-0021	5/26/2020 12:47	2832	Monroe Lower	11	meters	114.4	umho/cm
WEL-07-0021	5/26/2020 12:47	2832	Monroe Lower	12	meters	115.7	umho/cm
WEL-07-0021	5/26/2020 12:47	2832	Monroe Lower	13	meters	116.5	umho/cm
WEL-07-0021	5/26/2020 12:47	2832	Monroe Lower	14	meters	117	umho/cm
WEL-07-0021	5/26/2020 12:47	2832	Monroe Lower	15	meters	117.7	umho/cm
WEL-07-0021	5/26/2020 12:47	2832	Monroe Lower	16	meters	122	umho/cm
WEL-07-0018	6/25/2020 8:30	2855	Monroe Upper	0	meters	136.12	umho/cm
WEL-07-0018	6/25/2020 8:30	2855	Monroe Upper	1	meters	136.17	umho/cm
WEL-07-0018	6/25/2020 8:30	2855	Monroe Upper	2	meters	136.11	umho/cm
WEL-07-0018	6/25/2020 8:30	2855	Monroe Upper	3	meters	136.43	umho/cm
WEL-07-0018	6/25/2020 8:30	2855	Monroe Upper	4	meters	136.87	umho/cm
WEL-07-0018	6/25/2020 8:30	2855	Monroe Upper	5	meters	141.35	umho/cm
WEL-07-0018	6/25/2020 8:30	2855	Monroe Upper	6	meters	152.18	umho/cm
WEL-07-0018	6/25/2020 8:30	2855	Monroe Upper	7	meters	157.88	umho/cm
WEL-07-0018	6/25/2020 8:30	2855	Monroe Upper	8	meters	149.79	umho/cm
WEL-07-0020	6/25/2020 10:00	2856	Monroe Center	0	meters	128.93	umho/cm
WEL-07-0020	6/25/2020 10:00	2856	Monroe Center	1	meters	128.84	umho/cm
WEL-07-0020	6/25/2020 10:00	2856	Monroe Center	2	meters	128.82	umho/cm
WEL-07-0020	6/25/2020 10:00	2856	Monroe Center	3	meters	128.81	umho/cm
WEL-07-0020	6/25/2020 10:00	2856	Monroe Center	4	meters	128.8	umho/cm
WEL-07-0020	6/25/2020 10:00	2856	Monroe Center	5	meters	128.7	umho/cm
WEL-07-0020	6/25/2020 10:00	2856	Monroe Center	6	meters	135.19	umho/cm
WEL-07-0020	6/25/2020 10:00	2856	Monroe Center	6.5	meters	135.88	umho/cm
WEL-07-0021	6/25/2020 11:37	2857	Monroe Lower	0	meters	127.31	umho/cm
WEL-07-0021	6/25/2020 11:37	2857	Monroe Lower	1	meters	127.35	umho/cm

IDEM Site Number	Sample Date	EventID	Sample Name	Depth	Depth Unit	Concentration	Unit
WEL-07-0021	6/25/2020 11:37	2857	Monroe Lower	2	meters	127.48	umho/cm
WEL-07-0021	6/25/2020 11:37	2857	Monroe Lower	3	meters	127.43	umho/cm
WEL-07-0021	6/25/2020 11:37	2857	Monroe Lower	4	meters	127.46	umho/cm
WEL-07-0021	6/25/2020 11:37	2857	Monroe Lower	5	meters	127.19	umho/cm
WEL-07-0021	6/25/2020 11:37	2857	Monroe Lower	6	meters	125.45	umho/cm
WEL-07-0021	6/25/2020 11:37	2857	Monroe Lower	7	meters	124.71	umho/cm
WEL-07-0021	6/25/2020 11:37	2857	Monroe Lower	8	meters	123.16	umho/cm
WEL-07-0021	6/25/2020 11:37	2857	Monroe Lower	9	meters	125.37	umho/cm
WEL-07-0021	6/25/2020 11:37	2857	Monroe Lower	10	meters	131.25	umho/cm
WEL-07-0021	6/25/2020 11:37	2857	Monroe Lower	11	meters	136.69	umho/cm
WEL-07-0021	6/25/2020 11:37	2857	Monroe Lower	12	meters	138.5	umho/cm
WEL-07-0021	6/25/2020 11:37	2857	Monroe Lower	13	meters	142.21	umho/cm
WEL-07-0021	6/25/2020 11:37	2857	Monroe Lower	14	meters	142.63	umho/cm
WEL-07-0021	6/25/2020 11:37	2857	Monroe Lower	15	meters	145.68	umho/cm
WEL-07-0018	7/27/2020 6:57	2917	Monroe Upper	0	meters	142.6	umho/cm
WEL-07-0018	7/27/2020 6:57	2917	Monroe Upper	1	meters	142.7	umho/cm
WEL-07-0018	7/27/2020 6:57	2917	Monroe Upper	2	meters	143.03	umho/cm
WEL-07-0018	7/27/2020 6:57	2917	Monroe Upper	3	meters	146.16	umho/cm
WEL-07-0018	7/27/2020 6:57	2917	Monroe Upper	4	meters	152.39	umho/cm
WEL-07-0018	7/27/2020 6:57	2917	Monroe Upper	5	meters	156.13	umho/cm
WEL-07-0018	7/27/2020 6:57	2917	Monroe Upper	6	meters	163.02	umho/cm
WEL-07-0018	7/27/2020 6:57	2917	Monroe Upper	7	meters	156.2	umho/cm
WEL-07-0018	7/27/2020 6:57	2917	Monroe Upper	8	meters	154.99	umho/cm
WEL-07-0020	7/27/2020 8:57	2918	Monroe Center	0	meters	132.78	umho/cm
WEL-07-0020	7/27/2020 8:57	2918	Monroe Center	1	meters	132.83	umho/cm
WEL-07-0020	7/27/2020 8:57	2918	Monroe Center	2	meters	133.99	umho/cm
WEL-07-0020	7/27/2020 8:57	2918	Monroe Center	3	meters	133.04	umho/cm
WEL-07-0020	7/27/2020 8:57	2918	Monroe Center	4	meters	133.25	umho/cm
WEL-07-0020	7/27/2020 8:57	2918	Monroe Center	5	meters	135.69	umho/cm
WEL-07-0020	7/27/2020 8:57	2918	Monroe Center	6	meters	139.01	umho/cm
WEL-07-0021	7/27/2020 10:40	2919	Monroe Lower	0	meters	152.15	umho/cm
WEL-07-0021	7/27/2020 10:40	2919	Monroe Lower	1	meters	131.92	umho/cm
WEL-07-0021	7/27/2020 10:40	2919	Monroe Lower	2	meters	131.86	umho/cm
WEL-07-0021	7/27/2020 10:40	2919	Monroe Lower	3	meters	131.72	umho/cm
WEL-07-0021	7/27/2020 10:40	2919	Monroe Lower	4	meters	131.62	umho/cm
WEL-07-0021	7/27/2020 10:40	2919	Monroe Lower	5	meters	131.77	umho/cm
WEL-07-0021	7/27/2020 10:40	2919	Monroe Lower	6	meters	129.91	umho/cm
WEL-07-0021	7/27/2020 10:40	2919	Monroe Lower	7	meters	129.26	umho/cm
WEL-07-0021	7/27/2020 10:40	2919	Monroe Lower	8	meters	135.17	umho/cm
WEL-07-0021	7/27/2020 10:40	2919	Monroe Lower	9	meters	142.81	umho/cm
WEL-07-0021	7/27/2020 10:40	2919	Monroe Lower	10	meters	153.5	umho/cm
WEL-07-0021	7/27/2020 10:40	2919	Monroe Lower	11	meters	154.05	umho/cm
WEL-07-0021	7/27/2020 10:40	2919	Monroe Lower	12	meters	154.82	umho/cm
WEL-07-0021	7/27/2020 10:40	2919	Monroe Lower	13	meters	156.24	umho/cm
WEL-07-0021	7/27/2020 10:40	2919	Monroe Lower	14	meters	156.38	umho/cm
WEL-07-0018	9/23/2020 14:39	2942	Monroe Upper	0	meters	150.22	umho/cm
WEL-07-0018	9/23/2020 14:39	2942	Monroe Upper	1	meters	153.7	umho/cm
WEL-07-0018	9/23/2020 14:39	2942	Monroe Upper	2	meters	154.08	umho/cm
WEL-07-0018	9/23/2020 14:39	2942	Monroe Upper	3	meters	155.19	umho/cm
WEL-07-0018	9/23/2020 14:39	2942	Monroe Upper	4	meters	155.26	umho/cm
WEL-07-0018	9/23/2020 14:39	2942	Monroe Upper	5	meters	155.44	umho/cm
WEL-07-0018	9/23/2020 14:39	2942	Monroe Upper	6	meters	156.23	umho/cm
WEL-07-0018	9/23/2020 14:39	2942	Monroe Upper	7	meters	157.4	umho/cm
WEL-07-0018	9/23/2020 14:39	2942	Monroe Upper	8	meters	159.13	umho/cm
WEL-07-0021	9/23/2020 17:00	2944	Monroe Lower	0	meters	143.62	umho/cm
WEL-07-0021	9/23/2020 17:00	2944	Monroe Lower	1	meters	143.27	umho/cm

IDEM Site Number	Sample Date	EventID	Sample Name	Depth	Depth Unit	Concentration	Unit
WEL-07-0021	9/23/2020 17:00	2944	Monroe Lower	2	meters	143.13	umho/cm
WEL-07-0021	9/23/2020 17:00	2944	Monroe Lower	3	meters	143.22	umho/cm
WEL-07-0021	9/23/2020 17:00	2944	Monroe Lower	4	meters	143.27	umho/cm
WEL-07-0021	9/23/2020 17:00	2944	Monroe Lower	5	meters	143.28	umho/cm
WEL-07-0021	9/23/2020 17:00	2944	Monroe Lower	6	meters	143.27	umho/cm
WEL-07-0021	9/23/2020 17:00	2944	Monroe Lower	7	meters	143.54	umho/cm
WEL-07-0021	9/23/2020 17:00	2944	Monroe Lower	8	meters	143.55	umho/cm
WEL-07-0021	9/23/2020 17:00	2944	Monroe Lower	9	meters	150.01	umho/cm
WEL-07-0021	9/23/2020 17:00	2944	Monroe Lower	10	meters	199.21	umho/cm
WEL-07-0021	9/23/2020 17:00	2944	Monroe Lower	11	meters	204.86	umho/cm
WEL-07-0021	9/23/2020 17:00	2944	Monroe Lower	12	meters	202.95	umho/cm
WEL-07-0021	9/23/2020 17:00	2944	Monroe Lower	13	meters	200.06	umho/cm
WEL-07-0021	9/23/2020 17:00	2944	Monroe Lower	14	meters	201.61	umho/cm
WEL-07-0021	9/23/2020 17:00	2944	Monroe Lower	15	meters	217.04	umho/cm
WEL-07-0020	9/23/2020 17:52	2943	Monroe Center	0	meters	143.29	umho/cm
WEL-07-0020	9/23/2020 17:52	2943	Monroe Center	1	meters	143.33	umho/cm
WEL-07-0020	9/23/2020 17:52	2943	Monroe Center	2	meters	143.4	umho/cm
WEL-07-0020	9/23/2020 17:52	2943	Monroe Center	3	meters	143.67	umho/cm
WEL-07-0020	9/23/2020 17:52	2943	Monroe Center	4	meters	143.89	umho/cm
WEL-07-0020	9/23/2020 17:52	2943	Monroe Center	5	meters	144.02	umho/cm
WEL-07-0020	9/23/2020 17:52	2943	Monroe Center	6	meters	144.97	umho/cm
WEL-07-0018	10/26/2020 14:30	2947	Monroe Upper	0	meters	146.78	umho/cm
WEL-07-0018	10/26/2020 14:30	2947	Monroe Upper	1	meters	146.25	umho/cm
WEL-07-0018	10/26/2020 14:30	2947	Monroe Upper	2	meters	145.85	umho/cm
WEL-07-0018	10/26/2020 14:30	2947	Monroe Upper	3	meters	145.85	umho/cm
WEL-07-0018	10/26/2020 14:30	2947	Monroe Upper	4	meters	145.66	umho/cm
WEL-07-0018	10/26/2020 14:30	2947	Monroe Upper	5	meters	145.7	umho/cm
WEL-07-0018	10/26/2020 14:30	2947	Monroe Upper	6	meters	145.61	umho/cm
WEL-07-0018	10/26/2020 14:30	2947	Monroe Upper	7	meters	145.66	umho/cm
WEL-07-0018	10/26/2020 14:30	2947	Monroe Upper	8	meters	145.73	umho/cm
WEL-07-0020	10/26/2020 15:45	2945	Monroe Center	0	meters	142.11	umho/cm
WEL-07-0020	10/26/2020 15:45	2945	Monroe Center	1	meters	141.57	umho/cm
WEL-07-0020	10/26/2020 15:45	2945	Monroe Center	2	meters	141.48	umho/cm
WEL-07-0020	10/26/2020 15:45	2945	Monroe Center	3	meters	141.34	umho/cm
WEL-07-0020	10/26/2020 15:45	2945	Monroe Center	4	meters	141.34	umho/cm
WEL-07-0020	10/26/2020 15:45	2945	Monroe Center	5	meters	141.3	umho/cm
WEL-07-0020	10/26/2020 15:45	2945	Monroe Center	6	meters	141.25	umho/cm
WEL-07-0021	10/26/2020 16:50	2946	Monroe Lower	0	meters	140.97	umho/cm
WEL-07-0021	10/26/2020 16:50	2946	Monroe Lower	1	meters	144.43	umho/cm
WEL-07-0021	10/26/2020 16:50	2946	Monroe Lower	2	meters	144.21	umho/cm
WEL-07-0021	10/26/2020 16:50	2946	Monroe Lower	3	meters	144.25	umho/cm
WEL-07-0021	10/26/2020 16:50	2946	Monroe Lower	4	meters	144.43	umho/cm
WEL-07-0021	10/26/2020 16:50	2946	Monroe Lower	5	meters	144.12	umho/cm
WEL-07-0021	10/26/2020 16:50	2946	Monroe Lower	6	meters	144.12	umho/cm
WEL-07-0021	10/26/2020 16:50	2946	Monroe Lower	7	meters	144.06	umho/cm
WEL-07-0021	10/26/2020 16:50	2946	Monroe Lower	8	meters	144.1	umho/cm
WEL-07-0021	10/26/2020 16:50	2946	Monroe Lower	9	meters	144.11	umho/cm
WEL-07-0021	10/26/2020 16:50	2946	Monroe Lower	10	meters	144.13	umho/cm
WEL-07-0021	10/26/2020 16:50	2946	Monroe Lower	11	meters	144.12	umho/cm
WEL-07-0021	10/26/2020 16:50	2946	Monroe Lower	12	meters	144.15	umho/cm
WEL-07-0021	10/26/2020 16:50	2946	Monroe Lower	13	meters	144.23	umho/cm
WEL-07-0021	10/26/2020 16:50	2946	Monroe Lower	14	meters	144.18	umho/cm
WEL-07-0021	10/26/2020 16:50	2946	Monroe Lower	15	meters	144.43	umho/cm
WEL-07-0018	8/28/2020 8:26	2939	Monroe Upper	0	meters	148.47	umho/cm
WEL-07-0018	8/28/2020 8:26	2939	Monroe Upper	1	meters	148.4	umho/cm
WEL-07-0018	8/28/2020 8:26	2939	Monroe Upper	2	meters	148.41	umho/cm

IDEM Site Number	Sample Date	EventID	Sample Name	Depth	Depth Unit	Concentration	Unit
WEL-07-0018	8/28/2020 8:26	2939	Monroe Upper	3	meters	155.39	umho/cm
WEL-07-0018	8/28/2020 8:26	2939	Monroe Upper	4	meters	157.76	umho/cm
WEL-07-0018	8/28/2020 8:26	2939	Monroe Upper	5	meters	159.44	umho/cm
WEL-07-0018	8/28/2020 8:26	2939	Monroe Upper	6	meters	163.1	umho/cm
WEL-07-0018	8/28/2020 8:26	2939	Monroe Upper	7	meters	164.49	umho/cm
WEL-07-0018	8/28/2020 8:26	2939	Monroe Upper	8	meters	176.08	umho/cm
WEL-07-0020	8/28/2020 9:49	2940	Monroe Center	0	meters	140.76	umho/cm
WEL-07-0020	8/28/2020 9:49	2940	Monroe Center	1	meters	137.92	umho/cm
WEL-07-0020	8/28/2020 9:49	2940	Monroe Center	2	meters	140.76	umho/cm
WEL-07-0020	8/28/2020 9:49	2940	Monroe Center	3	meters	140.86	umho/cm
WEL-07-0020	8/28/2020 9:49	2940	Monroe Center	4	meters	141.13	umho/cm
WEL-07-0020	8/28/2020 9:49	2940	Monroe Center	5	meters	145.14	umho/cm
WEL-07-0020	8/28/2020 9:49	2940	Monroe Center	6	meters	145.14	umho/cm
WEL-07-0021	8/28/2020 11:02	2941	Monroe Lower	0	meters	139.33	umho/cm
WEL-07-0021	8/28/2020 11:02	2941	Monroe Lower	1	meters	139.27	umho/cm
WEL-07-0021	8/28/2020 11:02	2941	Monroe Lower	2	meters	138.89	umho/cm
WEL-07-0021	8/28/2020 11:02	2941	Monroe Lower	3	meters	138.92	umho/cm
WEL-07-0021	8/28/2020 11:02	2941	Monroe Lower	4	meters	139.68	umho/cm
WEL-07-0021	8/28/2020 11:02	2941	Monroe Lower	5	meters	138.78	umho/cm
WEL-07-0021	8/28/2020 11:02	2941	Monroe Lower	6	meters	138.77	umho/cm
WEL-07-0021	8/28/2020 11:02	2941	Monroe Lower	7	meters	137.84	umho/cm
WEL-07-0021	8/28/2020 11:02	2941	Monroe Lower	8	meters	143.77	umho/cm
WEL-07-0021	8/28/2020 11:02	2941	Monroe Lower	9	meters	170.09	umho/cm
WEL-07-0021	8/28/2020 11:02	2941	Monroe Lower	10	meters	179.42	umho/cm
WEL-07-0021	8/28/2020 11:02	2941	Monroe Lower	11	meters	183.91	umho/cm
WEL-07-0021	8/28/2020 11:02	2941	Monroe Lower	12	meters	183.75	umho/cm
WEL-07-0021	8/28/2020 11:02	2941	Monroe Lower	13	meters	185.76	umho/cm
WEL-07-0021	8/28/2020 11:02	2941	Monroe Lower	14	meters	186.51	umho/cm
WEL-07-0019	5/27/2020 7:50	0123	Crooked Creek			178.8	umho/cm
WEL-06-0008	5/27/2020 9:20	0256	North Fork Salt Creek			152.93	umho/cm
WEL-05-0001	5/27/2020 10:25	0668	Middle Fork Salt Creek			157.71	umho/cm
WEL-04-0004	5/27/2020 11:21	0914	South Fork Salt Creek			146.46	umho/cm
WEL-08-0036	5/27/2020 13:07	0111	Lake Monroe Outlet			115.29	umho/cm
WEL-07-0019	6/24/2020 9:15	0123	Crooked Creek			157	umho/cm
WEL-05-0001	6/24/2020 10:25	0668	Middle Fork Salt Creek			166	umho/cm
WEL-04-0004	6/24/2020 11:45	0914	South Fork Salt Creek			176.8	umho/cm
WEL-06-0008	6/24/2020 8:15	0256	North Fork Salt Creek			234.5	umho/cm
WEL-08-0036	6/24/2020 13:55	0111	Lake Monroe Outlet			118	umho/cm
WEL-07-0019	7/21/2020 8:30	0123	Crooked Creek			176.5	umho/cm
WEL-05-0001	7/21/2020 9:20	0668	Middle Fork Salt Creek			175.9	umho/cm
WEL-04-0004	7/21/2020 10:40	0914	South Fork Salt Creek			170.1	umho/cm
WEL-06-0008	7/21/2020 11:50	0256	North Fork Salt Creek			310.3	umho/cm
WEL-08-0036	7/21/2020 13:45	0111	Lake Monroe Outlet			119	umho/cm
WEL-07-0019	8/27/2020 9:05	0123	Crooked Creek			247.01	umho/cm
WEL-05-0001	8/27/2020 9:45	0668	Middle Fork Salt Creek			235.86	umho/cm
WEL-04-0004	8/27/2020 11:15	0914	South Fork Salt Creek			203.43	umho/cm
WEL-06-0008	8/27/2020 12:51	0256	North Fork Salt Creek			296.54	umho/cm
WEL-08-0036	8/27/2020 14:09	0111	Lake Monroe Outlet			149.51	umho/cm
WEL-05-0001	9/24/2020 8:30	0668	Middle Fork Salt Creek			257.49	umho/cm
WEL-04-0004	9/24/2020 9:25	0914	South Fork Salt Creek			221.96	umho/cm
WEL-06-0008	9/24/2020 10:35	0256	North Fork Salt Creek			390.68	umho/cm
WEL-08-0036	9/24/2020 12:10	0111	Lake Monroe Outlet			154.96	umho/cm
WEL-05-0001	10/22/2020 9:30	0668	Middle Fork Salt Creek			257.85	umho/cm
WEL-04-0004	10/22/2020 10:40	0914	South Fork Salt Creek			233.17	umho/cm
WEL-06-0008	10/22/2020 11:45	0256	North Fork Salt Creek			375.68	umho/cm
WEL-08-0036	10/22/2020 1:15	0111	Lake Monroe Outlet			146.97	umho/cm

IDEM Site Number	Sample Date	EventID	Sample Name	Depth	Depth Unit	Concentration	Unit
WEL-07-0019	11/19/2020 9:00	0123	Crooked Creek			219.03	umho/cm
WEL-06-0008	11/19/2020 9:30	0256	North Fork Salt Creek			345.09	umho/cm
WEL-05-0001	11/19/2020 10:20	0668	Middle Fork Salt Creek			229.81	umho/cm
WEL-04-0004	11/19/2020 11:15	0914	South Fork Salt Creek			221.66	umho/cm
WEL-08-0036	11/19/2020 12:35	0111	Lake Monroe Outlet			143.65	umho/cm
WEL-07-0020	8/28/2020 9:49	2940	Monroe Center	0	meters	104.33	umho/cm
WEL-07-0020	8/28/2020 9:49	2940	Monroe Center	1	meters	104.06	umho/cm
WEL-07-0020	8/28/2020 9:49	2940	Monroe Center	2	meters	103.17	umho/cm
WEL-07-0020	8/28/2020 9:49	2940	Monroe Center	3	meters	101.49	umho/cm
WEL-07-0020	8/28/2020 9:49	2940	Monroe Center	4	meters	95.17	umho/cm
WEL-07-0020	8/28/2020 9:49	2940	Monroe Center	5	meters	29.56	umho/cm
WEL-07-0020	8/28/2020 9:49	2940	Monroe Center	6	meters	7.58	umho/cm
WEL-06-0008	4/22/2020 9:30	0256	North Fork Salt Creek			174.01	umho/cm
WEL-07-0019	4/22/2020 11:30	0123	Crooked Creek			163.67	umho/cm
WEL-05-0001	4/22/2020 13:25	0668	Middle Fork Salt Creek			187.58	umho/cm
WEL-04-0004	4/22/2020 15:00	0914	South Fork Salt Creek			152.27	umho/cm
WEL-08-0036	4/22/2020 16:50	0111	Lake Monroe Outlet			115.04	umho/cm
WEL-07-0019	12/16/20 9:05 AM	0123	Crooked Creek			195.26	umho/cm
WEL-06-0008	12/16/2020 9:30	0256	North Fork Salt Creek			275.54	umho/cm
WEL-05-0001	12/16/2020 10:35	0668	Middle Fork Salt Creek			230.3	umho/cm
WEL-04-0004	12/16/2020 11:26	0914	South Fork Salt Creek			166.03	umho/cm
WEL-08-0036	12/16/2020 12:45	0111	Lake Monroe Outlet			138.75	umho/cm

IDEM Site Number	Sample Date	EventID	Sample Name	Depth	Depth Unit	Concentration	QA Flags
WEL-07-0018	5/26/2020 8:44	2830	Monroe Upper	0	meters	7.59	
WEL-07-0018	5/26/2020 8:44	2830	Monroe Upper	1	meters	7.7	
WEL-07-0018	5/26/2020 8:44	2830	Monroe Upper	2	meters	7.75	
WEL-07-0018	5/26/2020 8:44	2830	Monroe Upper	3	meters	7.49	
WEL-07-0018	5/26/2020 8:44	2830	Monroe Upper	4	meters	6.71	
WEL-07-0018	5/26/2020 8:44	2830	Monroe Upper	5	meters	6.54	
WEL-07-0018	5/26/2020 8:44	2830	Monroe Upper	6	meters	6.42	
WEL-07-0018	5/26/2020 8:44	2830	Monroe Upper	7	meters	6.37	
WEL-07-0018	5/26/2020 8:44	2830	Monroe Upper	8	meters	6.35	
WEL-07-0018	5/26/2020 8:44	2830	Monroe Upper	9	meters	6.34	
WEL-07-0018	5/26/2020 8:44	2830	Monroe Upper	10	meters	6.33	
WEL-07-0020	5/26/2020 11:00	2831	Monroe Center	0	meters	7.76	
WEL-07-0020	5/26/2020 11:00	2831	Monroe Center	1	meters	7.83	
WEL-07-0020	5/26/2020 11:00	2831	Monroe Center	2	meters	7.82	
WEL-07-0020	5/26/2020 11:00	2831	Monroe Center	3	meters	7.72	
WEL-07-0020	5/26/2020 11:00	2831	Monroe Center	4	meters	7.58	
WEL-07-0020	5/26/2020 11:00	2831	Monroe Center	5	meters	7.29	
WEL-07-0020	5/26/2020 11:00	2831	Monroe Center	6	meters	7.13	
WEL-07-0020	5/26/2020 11:00	2831	Monroe Center	7	meters	6.92	
WEL-07-0020	5/26/2020 11:00	2831	Monroe Center	7.5	meters	6.78	
WEL-07-0021	5/26/2020 12:47	2832	Monroe Lower	0	meters	7.94	
WEL-07-0021	5/26/2020 12:47	2832	Monroe Lower	1	meters	7.96	
WEL-07-0021	5/26/2020 12:47	2832	Monroe Lower	2	meters	8.12	
WEL-07-0021	5/26/2020 12:47	2832	Monroe Lower	3	meters	7.91	
WEL-07-0021	5/26/2020 12:47	2832	Monroe Lower	4	meters	7.48	
WEL-07-0021	5/26/2020 12:47	2832	Monroe Lower	5	meters	7.26	
WEL-07-0021	5/26/2020 12:47	2832	Monroe Lower	6	meters	7.07	
WEL-07-0021	5/26/2020 12:47	2832	Monroe Lower	7	meters	6.97	
WEL-07-0021	5/26/2020 12:47	2832	Monroe Lower	8	meters	6.92	
WEL-07-0021	5/26/2020 12:47	2832	Monroe Lower	9	meters	6.85	
WEL-07-0021	5/26/2020 12:47	2832	Monroe Lower	10	meters	6.77	
WEL-07-0021	5/26/2020 12:47	2832	Monroe Lower	11	meters	6.69	
WEL-07-0021	5/26/2020 12:47	2832	Monroe Lower	12	meters	6.62	
WEL-07-0021	5/26/2020 12:47	2832	Monroe Lower	13	meters	6.56	
WEL-07-0021	5/26/2020 12:47	2832	Monroe Lower	14	meters	6.52	
WEL-07-0021	5/26/2020 12:47	2832	Monroe Lower	15	meters	6.49	
WEL-07-0021	5/26/2020 12:47	2832	Monroe Lower	16	meters	6.41	
WEL-07-0018	6/25/2020 8:30	2855	Monroe Upper	0	meters	8.05	
WEL-07-0018	6/25/2020 8:30	2855	Monroe Upper	1	meters	7.78	
WEL-07-0018	6/25/2020 8:30	2855	Monroe Upper	2	meters	7.63	
WEL-07-0018	6/25/2020 8:30	2855	Monroe Upper	3	meters	7.52	
WEL-07-0018	6/25/2020 8:30	2855	Monroe Upper	4	meters	7.46	
WEL-07-0018	6/25/2020 8:30	2855	Monroe Upper	5	meters	7.38	
WEL-07-0018	6/25/2020 8:30	2855	Monroe Upper	6	meters	7.46	
WEL-07-0018	6/25/2020 8:30	2855	Monroe Upper	7	meters	7.58	
WEL-07-0018	6/25/2020 8:30	2855	Monroe Upper	8	meters	7.75	
WEL-07-0020	6/25/2020 10:00	2856	Monroe Center	0	meters	8.56	
WEL-07-0020	6/25/2020 10:00	2856	Monroe Center	1	meters	8.63	
WEL-07-0020	6/25/2020 10:00	2856	Monroe Center	2	meters	8.57	
WEL-07-0020	6/25/2020 10:00	2856	Monroe Center	3	meters	8.38	
WEL-07-0020	6/25/2020 10:00	2856	Monroe Center	4	meters	8.4	
WEL-07-0020	6/25/2020 10:00	2856	Monroe Center	5	meters	8.15	
WEL-07-0020	6/25/2020 10:00	2856	Monroe Center	6	meters	8.01	
WEL-07-0020	6/25/2020 10:00	2856	Monroe Center	6.5	meters	7.93	
WEL-07-0021	6/25/2020 11:37	2857	Monroe Lower	0	meters	8.34	
WEL-07-0021	6/25/2020 11:37	2857	Monroe Lower	1	meters	8.48	

IDEM Site Number	Sample Date	EventID	Sample Name	Depth	Depth Unit	Concentration	QA Flags
WEL-07-0021	6/25/2020 11:37	2857	Monroe Lower	2	meters	8.46	
WEL-07-0021	6/25/2020 11:37	2857	Monroe Lower	3	meters	8.31	
WEL-07-0021	6/25/2020 11:37	2857	Monroe Lower	4	meters	8.17	
WEL-07-0021	6/25/2020 11:37	2857	Monroe Lower	5	meters	8.06	
WEL-07-0021	6/25/2020 11:37	2857	Monroe Lower	6	meters	8.02	
WEL-07-0021	6/25/2020 11:37	2857	Monroe Lower	7	meters	8.08	
WEL-07-0021	6/25/2020 11:37	2857	Monroe Lower	8	meters	8.06	
WEL-07-0021	6/25/2020 11:37	2857	Monroe Lower	9	meters	8.27	
WEL-07-0021	6/25/2020 11:37	2857	Monroe Lower	10	meters	8.38	
WEL-07-0021	6/25/2020 11:37	2857	Monroe Lower	11	meters	8.5	
WEL-07-0021	6/25/2020 11:37	2857	Monroe Lower	12	meters	8.61	
WEL-07-0021	6/25/2020 11:37	2857	Monroe Lower	13	meters	8.71	
WEL-07-0021	6/25/2020 11:37	2857	Monroe Lower	14	meters	8.83	
WEL-07-0021	6/25/2020 11:37	2857	Monroe Lower	15	meters	8.9	
WEL-07-0018	7/27/2020 6:57	2917	Monroe Upper	0	meters	9.67	FEQ
WEL-07-0018	7/27/2020 6:57	2917	Monroe Upper	1	meters	9.68	FEQ
WEL-07-0018	7/27/2020 6:57	2917	Monroe Upper	2	meters	9.74	FEQ
WEL-07-0018	7/27/2020 6:57	2917	Monroe Upper	3	meters	9.45	FEQ
WEL-07-0018	7/27/2020 6:57	2917	Monroe Upper	4	meters	9.1	FEQ
WEL-07-0018	7/27/2020 6:57	2917	Monroe Upper	5	meters	8.98	FEQ
WEL-07-0018	7/27/2020 6:57	2917	Monroe Upper	6	meters	8.86	FEQ
WEL-07-0018	7/27/2020 6:57	2917	Monroe Upper	7	meters	8.93	FEQ
WEL-07-0018	7/27/2020 6:57	2917	Monroe Upper	8	meters	8.98	FEQ
WEL-07-0020	7/27/2020 8:57	2918	Monroe Center	0	meters	10.2	FEQ
WEL-07-0020	7/27/2020 8:57	2918	Monroe Center	1	meters	10.3	FEQ
WEL-07-0020	7/27/2020 8:57	2918	Monroe Center	2	meters	10.38	FEQ
WEL-07-0020	7/27/2020 8:57	2918	Monroe Center	3	meters	10.45	FEQ
WEL-07-0020	7/27/2020 8:57	2918	Monroe Center	4	meters	10.51	FEQ
WEL-07-0020	7/27/2020 8:57	2918	Monroe Center	5	meters	10.17	FEQ
WEL-07-0020	7/27/2020 8:57	2918	Monroe Center	6	meters	10	FEQ
WEL-07-0021	7/27/2020 10:40	2919	Monroe Lower	0	meters	9.99	FEQ
WEL-07-0021	7/27/2020 10:40	2919	Monroe Lower	1	meters	10.07	FEQ
WEL-07-0021	7/27/2020 10:40	2919	Monroe Lower	2	meters	10.13	FEQ
WEL-07-0021	7/27/2020 10:40	2919	Monroe Lower	3	meters	10.14	FEQ
WEL-07-0021	7/27/2020 10:40	2919	Monroe Lower	4	meters	10.12	FEQ
WEL-07-0021	7/27/2020 10:40	2919	Monroe Lower	5	meters	9.86	FEQ
WEL-07-0021	7/27/2020 10:40	2919	Monroe Lower	6	meters	9.78	FEQ
WEL-07-0021	7/27/2020 10:40	2919	Monroe Lower	7	meters	9.65	FEQ
WEL-07-0021	7/27/2020 10:40	2919	Monroe Lower	8	meters	9.66	FEQ
WEL-07-0021	7/27/2020 10:40	2919	Monroe Lower	9	meters	9.72	FEQ
WEL-07-0021	7/27/2020 10:40	2919	Monroe Lower	10	meters	9.81	FEQ
WEL-07-0021	7/27/2020 10:40	2919	Monroe Lower	11	meters	9.96	FEQ
WEL-07-0021	7/27/2020 10:40	2919	Monroe Lower	12	meters	10.08	FEQ
WEL-07-0021	7/27/2020 10:40	2919	Monroe Lower	13	meters	10.25	FEQ
WEL-07-0021	7/27/2020 10:40	2919	Monroe Lower	14	meters	11.3	FEQ
WEL-07-0018	9/23/2020 14:39	2942	Monroe Upper	0	meters	8.51	
WEL-07-0018	9/23/2020 14:39	2942	Monroe Upper	1	meters	8.04	
WEL-07-0018	9/23/2020 14:39	2942	Monroe Upper	2	meters	7.42	
WEL-07-0018	9/23/2020 14:39	2942	Monroe Upper	3	meters	7.29	
WEL-07-0018	9/23/2020 14:39	2942	Monroe Upper	4	meters	7.19	
WEL-07-0018	9/23/2020 14:39	2942	Monroe Upper	5	meters	7.09	
WEL-07-0018	9/23/2020 14:39	2942	Monroe Upper	6	meters	7.04	
WEL-07-0018	9/23/2020 14:39	2942	Monroe Upper	7	meters	7.02	
WEL-07-0018	9/23/2020 14:39	2942	Monroe Upper	8	meters	6.95	
WEL-07-0021	9/23/2020 17:00	2944	Monroe Lower	0	meters	7.66	
WEL-07-0021	9/23/2020 17:00	2944	Monroe Lower	1	meters	7.77	

IDEM Site Number	Sample Date	EventID	Sample Name	Depth	Depth Unit	Concentration	QA Flags
WEL-07-0021	9/23/2020 17:00	2944	Monroe Lower	2	meters	7.74	
WEL-07-0021	9/23/2020 17:00	2944	Monroe Lower	3	meters	7.69	
WEL-07-0021	9/23/2020 17:00	2944	Monroe Lower	4	meters	7.63	
WEL-07-0021	9/23/2020 17:00	2944	Monroe Lower	5	meters	7.6	
WEL-07-0021	9/23/2020 17:00	2944	Monroe Lower	6	meters	7.45	
WEL-07-0021	9/23/2020 17:00	2944	Monroe Lower	7	meters	6.99	
WEL-07-0021	9/23/2020 17:00	2944	Monroe Lower	8	meters	6.97	
WEL-07-0021	9/23/2020 17:00	2944	Monroe Lower	9	meters	6.9	
WEL-07-0021	9/23/2020 17:00	2944	Monroe Lower	10	meters	6.77	
WEL-07-0021	9/23/2020 17:00	2944	Monroe Lower	11	meters	6.78	
WEL-07-0021	9/23/2020 17:00	2944	Monroe Lower	12	meters	6.78	
WEL-07-0021	9/23/2020 17:00	2944	Monroe Lower	13	meters	6.81	
WEL-07-0021	9/23/2020 17:00	2944	Monroe Lower	14	meters	6.83	
WEL-07-0021	9/23/2020 17:00	2944	Monroe Lower	15	meters	6.84	
WEL-07-0020	9/23/2020 17:52	2943	Monroe Center	0	meters	8.5	
WEL-07-0020	9/23/2020 17:52	2943	Monroe Center	1	meters	8.49	
WEL-07-0020	9/23/2020 17:52	2943	Monroe Center	2	meters	8.45	
WEL-07-0020	9/23/2020 17:52	2943	Monroe Center	3	meters	8.23	
WEL-07-0020	9/23/2020 17:52	2943	Monroe Center	4	meters	7.69	
WEL-07-0020	9/23/2020 17:52	2943	Monroe Center	5	meters	7.4	
WEL-07-0020	9/23/2020 17:52	2943	Monroe Center	6	meters	7.28	
WEL-07-0018	10/26/2020 14:30	2947	Monroe Upper	0	meters	6.98	
WEL-07-0018	10/26/2020 14:30	2947	Monroe Upper	1	meters	6.88	
WEL-07-0018	10/26/2020 14:30	2947	Monroe Upper	2	meters	6.8	
WEL-07-0018	10/26/2020 14:30	2947	Monroe Upper	3	meters	6.8	
WEL-07-0018	10/26/2020 14:30	2947	Monroe Upper	4	meters	6.77	
WEL-07-0018	10/26/2020 14:30	2947	Monroe Upper	5	meters	6.75	
WEL-07-0018	10/26/2020 14:30	2947	Monroe Upper	6	meters	6.76	
WEL-07-0018	10/26/2020 14:30	2947	Monroe Upper	7	meters	6.78	
WEL-07-0018	10/26/2020 14:30	2947	Monroe Upper	8	meters	6.77	
WEL-07-0020	10/26/2020 15:45	2945	Monroe Center	0	meters	7.18	
WEL-07-0020	10/26/2020 15:45	2945	Monroe Center	1	meters	7.15	
WEL-07-0020	10/26/2020 15:45	2945	Monroe Center	2	meters	7.14	
WEL-07-0020	10/26/2020 15:45	2945	Monroe Center	3	meters	7.09	
WEL-07-0020	10/26/2020 15:45	2945	Monroe Center	4	meters	7.06	
WEL-07-0020	10/26/2020 15:45	2945	Monroe Center	5	meters	7.06	
WEL-07-0020	10/26/2020 15:45	2945	Monroe Center	6	meters	7.05	
WEL-07-0021	10/26/2020 16:50	2946	Monroe Lower	0	meters	7.39	
WEL-07-0021	10/26/2020 16:50	2946	Monroe Lower	1	meters	7.34	
WEL-07-0021	10/26/2020 16:50	2946	Monroe Lower	2	meters	7.24	
WEL-07-0021	10/26/2020 16:50	2946	Monroe Lower	3	meters	7.17	
WEL-07-0021	10/26/2020 16:50	2946	Monroe Lower	4	meters	7.14	
WEL-07-0021	10/26/2020 16:50	2946	Monroe Lower	5	meters	7.12	
WEL-07-0021	10/26/2020 16:50	2946	Monroe Lower	6	meters	7.09	
WEL-07-0021	10/26/2020 16:50	2946	Monroe Lower	7	meters	7.08	
WEL-07-0021	10/26/2020 16:50	2946	Monroe Lower	8	meters	7.08	
WEL-07-0021	10/26/2020 16:50	2946	Monroe Lower	9	meters	7.1	
WEL-07-0021	10/26/2020 16:50	2946	Monroe Lower	10	meters	7.1	
WEL-07-0021	10/26/2020 16:50	2946	Monroe Lower	11	meters	7.09	
WEL-07-0021	10/26/2020 16:50	2946	Monroe Lower	12	meters	7.13	
WEL-07-0021	10/26/2020 16:50	2946	Monroe Lower	13	meters	7.17	
WEL-07-0021	10/26/2020 16:50	2946	Monroe Lower	14	meters	7.18	
WEL-07-0021	10/26/2020 16:50	2946	Monroe Lower	15	meters	7.19	
WEL-07-0018	8/28/2020 8:26	2939	Monroe Upper	0	meters	8.64	
WEL-07-0018	8/28/2020 8:26	2939	Monroe Upper	1	meters	8.76	
WEL-07-0018	8/28/2020 8:26	2939	Monroe Upper	2	meters	8.74	

IDEM Site Number	Sample Date	EventID	Sample Name	Depth	Depth Unit	Concentration	QA Flags
WEL-07-0018	8/28/2020 8:26	2939	Monroe Upper	3	meters	8.24	
WEL-07-0018	8/28/2020 8:26	2939	Monroe Upper	4	meters	7.91	
WEL-07-0018	8/28/2020 8:26	2939	Monroe Upper	5	meters	7.58	
WEL-07-0018	8/28/2020 8:26	2939	Monroe Upper	6	meters	7.36	
WEL-07-0018	8/28/2020 8:26	2939	Monroe Upper	7	meters	7.13	
WEL-07-0018	8/28/2020 8:26	2939	Monroe Upper	8	meters	7.05	
WEL-07-0020	8/28/2020 9:49	2940	Monroe Center	0	meters	8.21	
WEL-07-0020	8/28/2020 9:49	2940	Monroe Center	1	meters	8.2	
WEL-07-0020	8/28/2020 9:49	2940	Monroe Center	2	meters	8.03	
WEL-07-0020	8/28/2020 9:49	2940	Monroe Center	3	meters	8.04	
WEL-07-0020	8/28/2020 9:49	2940	Monroe Center	4	meters	7.89	
WEL-07-0020	8/28/2020 9:49	2940	Monroe Center	5	meters	7.61	
WEL-07-0020	8/28/2020 9:49	2940	Monroe Center	6	meters	7.22	
WEL-07-0021	8/28/2020 11:02	2941	Monroe Lower	0	meters	8.22	
WEL-07-0021	8/28/2020 11:02	2941	Monroe Lower	1	meters	8.14	
WEL-07-0021	8/28/2020 11:02	2941	Monroe Lower	2	meters	8.03	
WEL-07-0021	8/28/2020 11:02	2941	Monroe Lower	3	meters	7.81	
WEL-07-0021	8/28/2020 11:02	2941	Monroe Lower	4	meters	7.43	
WEL-07-0021	8/28/2020 11:02	2941	Monroe Lower	5	meters	7.29	
WEL-07-0021	8/28/2020 11:02	2941	Monroe Lower	6	meters	7.1	
WEL-07-0021	8/28/2020 11:02	2941	Monroe Lower	7	meters	6.97	
WEL-07-0021	8/28/2020 11:02	2941	Monroe Lower	8	meters	6.84	
WEL-07-0021	8/28/2020 11:02	2941	Monroe Lower	9	meters	6.73	
WEL-07-0021	8/28/2020 11:02	2941	Monroe Lower	10	meters	6.68	
WEL-07-0021	8/28/2020 11:02	2941	Monroe Lower	11	meters	6.65	
WEL-07-0021	8/28/2020 11:02	2941	Monroe Lower	12	meters	6.64	
WEL-07-0021	8/28/2020 11:02	2941	Monroe Lower	13	meters	6.64	
WEL-07-0021	8/28/2020 11:02	2941	Monroe Lower	14	meters	6.64	
WEL-07-0019	5/27/2020 7:50	0123	Crooked Creek			7.16	
WEL-06-0008	5/27/2020 9:20	0256	North Fork Salt Creek			7.37	
WEL-05-0001	5/27/2020 10:25	0668	Middle Fork Salt Creek			7.14	
WEL-04-0004	5/27/2020 11:21	0914	South Fork Salt Creek			7.27	
WEL-08-0036	5/27/2020 13:07	0111	Lake Monroe Outlet			6.84	
WEL-07-0019	6/24/2020 9:15	0123	Crooked Creek			6.94	
WEL-05-0001	6/24/2020 10:25	0668	Middle Fork Salt Creek			7.01	
WEL-04-0004	6/24/2020 11:45	0914	South Fork Salt Creek			6.85	
WEL-06-0008	6/24/2020 8:15	0256	North Fork Salt Creek			6.9	
WEL-08-0036	6/24/2020 13:55	0111	Lake Monroe Outlet			7.05	
WEL-07-0019	7/21/2020 8:30	0123	Crooked Creek			8.48	
WEL-05-0001	7/21/2020 9:20	0668	Middle Fork Salt Creek			8.5	
WEL-04-0004	7/21/2020 10:40	0914	South Fork Salt Creek			8.25	
WEL-06-0008	7/21/2020 11:50	0256	North Fork Salt Creek			8.68	
WEL-08-0036	7/21/2020 13:45	0111	Lake Monroe Outlet			8.01	
WEL-07-0019	8/27/2020 9:05	0123	Crooked Creek			7.2	
WEL-05-0001	8/27/2020 9:45	0668	Middle Fork Salt Creek			7.06	
WEL-04-0004	8/27/2020 11:15	0914	South Fork Salt Creek			6.97	
WEL-06-0008	8/27/2020 12:51	0256	North Fork Salt Creek			7.09	
WEL-08-0036	8/27/2020 14:09	0111	Lake Monroe Outlet			7.17	
WEL-05-0001	9/24/2020 8:30	0668	Middle Fork Salt Creek			7.28	
WEL-04-0004	9/24/2020 9:25	0914	South Fork Salt Creek			7.07	
WEL-06-0008	9/24/2020 10:35	0256	North Fork Salt Creek			7.58	
WEL-08-0036	9/24/2020 12:10	0111	Lake Monroe Outlet			6.75	
WEL-05-0001	10/22/2020 9:30	0668	Middle Fork Salt Creek			7.38	
WEL-04-0004	10/22/2020 10:40	0914	South Fork Salt Creek			7.12	
WEL-06-0008	10/22/2020 11:45	0256	North Fork Salt Creek			7.45	
WEL-08-0036	10/22/2020 1:15	0111	Lake Monroe Outlet			7.41	

IDEM Site Number	Sample Date	EventID	Sample Name	Depth	Depth Unit	Concentration	QA Flags
WEL-07-0019	11/19/2020 9:00	0123	Crooked Creek			7.51	
WEL-06-0008	11/19/2020 9:30	0256	North Fork Salt Creek			7.47	
WEL-05-0001	11/19/2020 10:20	0668	Middle Fork Salt Creek			7.79	
WEL-04-0004	11/19/2020 11:15	0914	South Fork Salt Creek			7.46	
WEL-08-0036	11/19/2020 12:35	0111	Lake Monroe Outlet			7.66	
WEL-06-0008	4/22/2020 9:30	0256	North Fork Salt Creek			6.79	
WEL-07-0019	4/22/2020 11:30	0123	Crooked Creek			6.55	
WEL-05-0001	4/22/2020 13:25	0668	Middle Fork Salt Creek			6.47	
WEL-04-0004	4/22/2020 15:00	0914	South Fork Salt Creek			7.21	
WEL-08-0036	4/22/2020 16:50	0111	Lake Monroe Outlet			6.95	
WEL-07-0019	12/16/2020 9:05	0123	Crooked Creek			7.72	
WEL-06-0008	12/16/2020 9:30	0256	North Fork Salt Creek			7.4	
WEL-05-0001	12/16/2020 10:35	0668	Middle Fork Salt Creek			7.48	
WEL-04-0004	12/16/2020 11:26	0914	South Fork Salt Creek			7.3	
WEL-08-0036	12/16/2020 12:45	0111	Lake Monroe Outlet			7.4	

IDEM Site Number	Sample Date	EventID	Sample Name	Depth	Depth Unit	Concentration	Unit	Instrument	QA Flags
WEL-07-0018	5/26/2020 8:44	2830	Monroe Upper	0	meters	137.3	ug/L	InSitu	
WEL-07-0018	5/26/2020 8:44	2830	Monroe Upper	1	meters	137	ug/L	InSitu	
WEL-07-0018	5/26/2020 8:44	2830	Monroe Upper	2	meters	152.9	ug/L	InSitu	
WEL-07-0018	5/26/2020 8:44	2830	Monroe Upper	3	meters	168.5	ug/L	InSitu	
WEL-07-0018	5/26/2020 8:44	2830	Monroe Upper	4	meters	161.5	ug/L	InSitu	
WEL-07-0018	5/26/2020 8:44	2830	Monroe Upper	5	meters	155.3	ug/L	InSitu	
WEL-07-0018	5/26/2020 8:44	2830	Monroe Upper	6	meters	145.6	ug/L	InSitu	
WEL-07-0018	5/26/2020 8:44	2830	Monroe Upper	7	meters	135.1	ug/L	InSitu	
WEL-07-0018	5/26/2020 8:44	2830	Monroe Upper	8	meters	127.6	ug/L	InSitu	
WEL-07-0018	5/26/2020 8:44	2830	Monroe Upper	9	meters	126.5	ug/L	InSitu	
WEL-07-0018	5/26/2020 8:44	2830	Monroe Upper	10	meters	128.1	ug/L	InSitu	
WEL-07-0020	5/26/2020 11:00	2831	Monroe Center	0	meters	147.8	ug/L	InSitu	
WEL-07-0020	5/26/2020 11:00	2831	Monroe Center	1	meters	140.8	ug/L	InSitu	
WEL-07-0020	5/26/2020 11:00	2831	Monroe Center	2	meters	141.7	ug/L	InSitu	
WEL-07-0020	5/26/2020 11:00	2831	Monroe Center	3	meters	154.1	ug/L	InSitu	
WEL-07-0020	5/26/2020 11:00	2831	Monroe Center	4	meters	144.4	ug/L	InSitu	
WEL-07-0020	5/26/2020 11:00	2831	Monroe Center	5	meters	140.7	ug/L	InSitu	
WEL-07-0020	5/26/2020 11:00	2831	Monroe Center	6	meters	134	ug/L	InSitu	
WEL-07-0020	5/26/2020 11:00	2831	Monroe Center	7	meters	127.7	ug/L	InSitu	
WEL-07-0020	5/26/2020 11:00	2831	Monroe Center	7.5	meters	118.7	ug/L	InSitu	
WEL-07-0021	5/26/2020 12:47	2832	Monroe Lower	0	meters	92.4	ug/L	InSitu	
WEL-07-0021	5/26/2020 12:47	2832	Monroe Lower	1	meters	79.5	ug/L	InSitu	
WEL-07-0021	5/26/2020 12:47	2832	Monroe Lower	2	meters	103.8	ug/L	InSitu	
WEL-07-0021	5/26/2020 12:47	2832	Monroe Lower	3	meters	105.3	ug/L	InSitu	
WEL-07-0021	5/26/2020 12:47	2832	Monroe Lower	4	meters	97.4	ug/L	InSitu	
WEL-07-0021	5/26/2020 12:47	2832	Monroe Lower	5	meters	89.9	ug/L	InSitu	
WEL-07-0021	5/26/2020 12:47	2832	Monroe Lower	6	meters	81.2	ug/L	InSitu	
WEL-07-0021	5/26/2020 12:47	2832	Monroe Lower	7	meters	77.6	ug/L	InSitu	
WEL-07-0021	5/26/2020 12:47	2832	Monroe Lower	8	meters	83.5	ug/L	InSitu	
WEL-07-0021	5/26/2020 12:47	2832	Monroe Lower	9	meters	88.5	ug/L	InSitu	
WEL-07-0021	5/26/2020 12:47	2832	Monroe Lower	10	meters	92.2	ug/L	InSitu	
WEL-07-0021	5/26/2020 12:47	2832	Monroe Lower	11	meters	91	ug/L	InSitu	
WEL-07-0021	5/26/2020 12:47	2832	Monroe Lower	12	meters	94.7	ug/L	InSitu	
WEL-07-0021	5/26/2020 12:47	2832	Monroe Lower	13	meters	89.3	ug/L	InSitu	
WEL-07-0021	5/26/2020 12:47	2832	Monroe Lower	14	meters	91.8	ug/L	InSitu	
WEL-07-0021	5/26/2020 12:47	2832	Monroe Lower	15	meters	88.9	ug/L	InSitu	
WEL-07-0021	5/26/2020 12:47	2832	Monroe Lower	16	meters	84.7	ug/L	InSitu	
WEL-07-0018	6/25/2020 8:30	2855	Monroe Upper	0	meters	191.94	ug/L	InSitu	confirm InSitu
WEL-07-0018	6/25/2020 8:30	2855	Monroe Upper	1	meters	183.92	ug/L	InSitu	confirm InSitu
WEL-07-0018	6/25/2020 8:30	2855	Monroe Upper	2	meters	176.8	ug/L	InSitu	confirm InSitu
WEL-07-0018	6/25/2020 8:30	2855	Monroe Upper	3	meters	175.29	ug/L	InSitu	confirm InSitu
WEL-07-0018	6/25/2020 8:30	2855	Monroe Upper	4	meters	172.93	ug/L	InSitu	confirm InSitu
WEL-07-0018	6/25/2020 8:30	2855	Monroe Upper	5	meters	168.41	ug/L	InSitu	confirm InSitu
WEL-07-0018	6/25/2020 8:30	2855	Monroe Upper	6	meters	181.44	ug/L	InSitu	confirm InSitu
WEL-07-0018	6/25/2020 8:30	2855	Monroe Upper	7	meters	208.4	ug/L	InSitu	confirm InSitu
WEL-07-0018	6/25/2020 8:30	2855	Monroe Upper	8	meters	207.49	ug/L	InSitu	confirm InSitu
WEL-07-0020	6/25/2020 10:00	2856	Monroe Center	0	meters	42.53	ug/L	InSitu	
WEL-07-0020	6/25/2020 10:00	2856	Monroe Center	1	meters	40.34	ug/L	InSitu	
WEL-07-0020	6/25/2020 10:00	2856	Monroe Center	2	meters	40.86	ug/L	InSitu	
WEL-07-0020	6/25/2020 10:00	2856	Monroe Center	3	meters	40.72	ug/L	InSitu	
WEL-07-0020	6/25/2020 10:00	2856	Monroe Center	4	meters	40.01	ug/L	InSitu	
WEL-07-0020	6/25/2020 10:00	2856	Monroe Center	5	meters	50.91	ug/L	InSitu	
WEL-07-0020	6/25/2020 10:00	2856	Monroe Center	6	meters	51.86	ug/L	InSitu	
WEL-07-0020	6/25/2020 10:00	2856	Monroe Center	6.5	meters	55.17	ug/L	InSitu	
WEL-07-0021	6/25/2020 11:37	2857	Monroe Lower	0	meters	81.85	ug/L	InSitu	
WEL-07-0021	6/25/2020 11:37	2857	Monroe Lower	1	meters	76.75	ug/L	InSitu	

IDEM Site Number	Sample Date	EventID	Sample Name	Depth	Depth Unit	Concentration	Unit	Instrument	QA Flags
WEL-07-0021	6/25/2020 11:37	2857	Monroe Lower	2	meters	84.15	ug/L	InSitu	
WEL-07-0021	6/25/2020 11:37	2857	Monroe Lower	3	meters	86.67	ug/L	InSitu	
WEL-07-0021	6/25/2020 11:37	2857	Monroe Lower	4	meters	91.05	ug/L	InSitu	
WEL-07-0021	6/25/2020 11:37	2857	Monroe Lower	5	meters	95.21	ug/L	InSitu	
WEL-07-0021	6/25/2020 11:37	2857	Monroe Lower	6	meters	124.25	ug/L	InSitu	
WEL-07-0021	6/25/2020 11:37	2857	Monroe Lower	7	meters	127.31	ug/L	InSitu	
WEL-07-0021	6/25/2020 11:37	2857	Monroe Lower	8	meters	136.66	ug/L	InSitu	
WEL-07-0021	6/25/2020 11:37	2857	Monroe Lower	9	meters	140.06	ug/L	InSitu	
WEL-07-0021	6/25/2020 11:37	2857	Monroe Lower	10	meters	142.22	ug/L	InSitu	
WEL-07-0021	6/25/2020 11:37	2857	Monroe Lower	11	meters	143.55	ug/L	InSitu	
WEL-07-0021	6/25/2020 11:37	2857	Monroe Lower	12	meters	145.53	ug/L	InSitu	
WEL-07-0021	6/25/2020 11:37	2857	Monroe Lower	13	meters	143.7	ug/L	InSitu	
WEL-07-0021	6/25/2020 11:37	2857	Monroe Lower	14	meters	142.77	ug/L	InSitu	
WEL-07-0021	6/25/2020 11:37	2857	Monroe Lower	15	meters	131.57	ug/L	InSitu	
WEL-07-0018	7/27/2020 6:57	2917	Monroe Upper	0	meters	72.69	ug/L	InSitu	
WEL-07-0018	7/27/2020 6:57	2917	Monroe Upper	1	meters	61.77	ug/L	InSitu	
WEL-07-0018	7/27/2020 6:57	2917	Monroe Upper	2	meters	63.68	ug/L	InSitu	
WEL-07-0018	7/27/2020 6:57	2917	Monroe Upper	3	meters	73.51	ug/L	InSitu	
WEL-07-0018	7/27/2020 6:57	2917	Monroe Upper	4	meters	75.07	ug/L	InSitu	
WEL-07-0018	7/27/2020 6:57	2917	Monroe Upper	5	meters	73.71	ug/L	InSitu	
WEL-07-0018	7/27/2020 6:57	2917	Monroe Upper	6	meters	77.76	ug/L	InSitu	
WEL-07-0018	7/27/2020 6:57	2917	Monroe Upper	7	meters	82.52	ug/L	InSitu	
WEL-07-0018	7/27/2020 6:57	2917	Monroe Upper	8	meters	93.92	ug/L	InSitu	
WEL-07-0020	7/27/2020 8:57	2918	Monroe Center	0	meters	54.99	ug/L	InSitu	
WEL-07-0020	7/27/2020 8:57	2918	Monroe Center	1	meters	48.76	ug/L	InSitu	
WEL-07-0020	7/27/2020 8:57	2918	Monroe Center	2	meters	43.73	ug/L	InSitu	
WEL-07-0020	7/27/2020 8:57	2918	Monroe Center	3	meters	50.07	ug/L	InSitu	
WEL-07-0020	7/27/2020 8:57	2918	Monroe Center	4	meters	55.03	ug/L	InSitu	
WEL-07-0020	7/27/2020 8:57	2918	Monroe Center	5	meters	53.61	ug/L	InSitu	
WEL-07-0020	7/27/2020 8:57	2918	Monroe Center	6	meters	68.48	ug/L	InSitu	
WEL-07-0021	7/27/2020 10:40	2919	Monroe Lower	0	meters	46.88	ug/L	InSitu	
WEL-07-0021	7/27/2020 10:40	2919	Monroe Lower	1	meters	35.35	ug/L	InSitu	
WEL-07-0021	7/27/2020 10:40	2919	Monroe Lower	2	meters	42.32	ug/L	InSitu	
WEL-07-0021	7/27/2020 10:40	2919	Monroe Lower	3	meters	49.46	ug/L	InSitu	
WEL-07-0021	7/27/2020 10:40	2919	Monroe Lower	4	meters	54.84	ug/L	InSitu	
WEL-07-0021	7/27/2020 10:40	2919	Monroe Lower	5	meters	78.55	ug/L	InSitu	
WEL-07-0021	7/27/2020 10:40	2919	Monroe Lower	6	meters	95.99	ug/L	InSitu	
WEL-07-0021	7/27/2020 10:40	2919	Monroe Lower	7	meters	114.26	ug/L	InSitu	
WEL-07-0021	7/27/2020 10:40	2919	Monroe Lower	8	meters	134.38	ug/L	InSitu	
WEL-07-0021	7/27/2020 10:40	2919	Monroe Lower	9	meters	167.21	ug/L	InSitu	
WEL-07-0021	7/27/2020 10:40	2919	Monroe Lower	10	meters	176.35	ug/L	InSitu	
WEL-07-0021	7/27/2020 10:40	2919	Monroe Lower	11	meters	161.96	ug/L	InSitu	
WEL-07-0021	7/27/2020 10:40	2919	Monroe Lower	12	meters	154.1	ug/L	InSitu	
WEL-07-0021	7/27/2020 10:40	2919	Monroe Lower	13	meters	152.73	ug/L	InSitu	
WEL-07-0021	7/27/2020 10:40	2919	Monroe Lower	14	meters	133.83	ug/L	InSitu	
WEL-07-0018	9/23/2020 14:39	2942	Monroe Upper	0	meters	538.65	ug/L	InSitu	
WEL-07-0018	9/23/2020 14:39	2942	Monroe Upper	1	meters	547.73	ug/L	InSitu	
WEL-07-0018	9/23/2020 14:39	2942	Monroe Upper	2	meters	469.28	ug/L	InSitu	
WEL-07-0018	9/23/2020 14:39	2942	Monroe Upper	3	meters	501.06	ug/L	InSitu	
WEL-07-0018	9/23/2020 14:39	2942	Monroe Upper	4	meters	455.1	ug/L	InSitu	
WEL-07-0018	9/23/2020 14:39	2942	Monroe Upper	5	meters	595.26	ug/L	InSitu	
WEL-07-0018	9/23/2020 14:39	2942	Monroe Upper	6	meters	614.32	ug/L	InSitu	
WEL-07-0018	9/23/2020 14:39	2942	Monroe Upper	7	meters	556.85	ug/L	InSitu	
WEL-07-0018	9/23/2020 14:39	2942	Monroe Upper	8	meters	602.1	ug/L	InSitu	
WEL-07-0021	9/23/2020 17:00	2944	Monroe Lower	0	meters	394.8	ug/L	InSitu	
WEL-07-0021	9/23/2020 17:00	2944	Monroe Lower	1	meters	329.49	ug/L	InSitu	

IDEM Site Number	Sample Date	EventID	Sample Name	Depth	Depth Unit	Concentration	Unit	Instrument	QA Flags
WEL-07-0021	9/23/2020 17:00	2944	Monroe Lower	2	meters	326.54	ug/L	InSitu	
WEL-07-0021	9/23/2020 17:00	2944	Monroe Lower	3	meters	333.8	ug/L	InSitu	
WEL-07-0021	9/23/2020 17:00	2944	Monroe Lower	4	meters	365.26	ug/L	InSitu	
WEL-07-0021	9/23/2020 17:00	2944	Monroe Lower	5	meters	370.47	ug/L	InSitu	
WEL-07-0021	9/23/2020 17:00	2944	Monroe Lower	6	meters	369.29	ug/L	InSitu	
WEL-07-0021	9/23/2020 17:00	2944	Monroe Lower	7	meters	339.75	ug/L	InSitu	
WEL-07-0021	9/23/2020 17:00	2944	Monroe Lower	8	meters	350.58	ug/L	InSitu	
WEL-07-0021	9/23/2020 17:00	2944	Monroe Lower	9	meters	414.07	ug/L	InSitu	
WEL-07-0021	9/23/2020 17:00	2944	Monroe Lower	10	meters	442.1	ug/L	InSitu	
WEL-07-0021	9/23/2020 17:00	2944	Monroe Lower	11	meters	617.08	ug/L	InSitu	
WEL-07-0021	9/23/2020 17:00	2944	Monroe Lower	12	meters	639.09	ug/L	InSitu	
WEL-07-0021	9/23/2020 17:00	2944	Monroe Lower	13	meters	725.03	ug/L	InSitu	
WEL-07-0021	9/23/2020 17:00	2944	Monroe Lower	14	meters	689.13	ug/L	InSitu	
WEL-07-0021	9/23/2020 17:00	2944	Monroe Lower	15	meters	741.32	ug/L	InSitu	
WEL-07-0020	9/23/2020 17:52	2943	Monroe Center	0	meters	426.44	ug/L	InSitu	
WEL-07-0020	9/23/2020 17:52	2943	Monroe Center	1	meters	407.05	ug/L	InSitu	
WEL-07-0020	9/23/2020 17:52	2943	Monroe Center	2	meters	415.35	ug/L	InSitu	
WEL-07-0020	9/23/2020 17:52	2943	Monroe Center	3	meters	416.11	ug/L	InSitu	
WEL-07-0020	9/23/2020 17:52	2943	Monroe Center	4	meters	411.65	ug/L	InSitu	
WEL-07-0020	9/23/2020 17:52	2943	Monroe Center	5	meters	433.5	ug/L	InSitu	
WEL-07-0020	9/23/2020 17:52	2943	Monroe Center	6	meters	414.02	ug/L	InSitu	
WEL-07-0018	10/26/2020 14:30	2947	Monroe Upper	0	meters	449.68	ug/L	InSitu	
WEL-07-0018	10/26/2020 14:30	2947	Monroe Upper	1	meters	416.22	ug/L	InSitu	
WEL-07-0018	10/26/2020 14:30	2947	Monroe Upper	2	meters	374.47	ug/L	InSitu	
WEL-07-0018	10/26/2020 14:30	2947	Monroe Upper	3	meters	394.87	ug/L	InSitu	
WEL-07-0018	10/26/2020 14:30	2947	Monroe Upper	4	meters	387.97	ug/L	InSitu	
WEL-07-0018	10/26/2020 14:30	2947	Monroe Upper	5	meters	400.06	ug/L	InSitu	
WEL-07-0018	10/26/2020 14:30	2947	Monroe Upper	6	meters	421.21	ug/L	InSitu	
WEL-07-0018	10/26/2020 14:30	2947	Monroe Upper	7	meters	487.06	ug/L	InSitu	
WEL-07-0018	10/26/2020 14:30	2947	Monroe Upper	8	meters	403.77	ug/L	InSitu	
WEL-07-0020	10/26/2020 15:45	2945	Monroe Center	0	meters	387.72	ug/L	InSitu	
WEL-07-0020	10/26/2020 15:45	2945	Monroe Center	1	meters	422.44	ug/L	InSitu	
WEL-07-0020	10/26/2020 15:45	2945	Monroe Center	2	meters	426.01	ug/L	InSitu	
WEL-07-0020	10/26/2020 15:45	2945	Monroe Center	3	meters	455.72	ug/L	InSitu	
WEL-07-0020	10/26/2020 15:45	2945	Monroe Center	4	meters	429.43	ug/L	InSitu	
WEL-07-0020	10/26/2020 15:45	2945	Monroe Center	5	meters	436.25	ug/L	InSitu	
WEL-07-0020	10/26/2020 15:45	2945	Monroe Center	6	meters	434.91	ug/L	InSitu	
WEL-07-0021	10/26/2020 16:50	2946	Monroe Lower	0	meters	453.96	ug/L	InSitu	
WEL-07-0021	10/26/2020 16:50	2946	Monroe Lower	1	meters	428.86	ug/L	InSitu	
WEL-07-0021	10/26/2020 16:50	2946	Monroe Lower	2	meters	466.23	ug/L	InSitu	
WEL-07-0021	10/26/2020 16:50	2946	Monroe Lower	3	meters	393.98	ug/L	InSitu	
WEL-07-0021	10/26/2020 16:50	2946	Monroe Lower	4	meters	407.42	ug/L	InSitu	
WEL-07-0021	10/26/2020 16:50	2946	Monroe Lower	5	meters	437.6	ug/L	InSitu	
WEL-07-0021	10/26/2020 16:50	2946	Monroe Lower	6	meters	411.54	ug/L	InSitu	
WEL-07-0021	10/26/2020 16:50	2946	Monroe Lower	7	meters	427.59	ug/L	InSitu	
WEL-07-0021	10/26/2020 16:50	2946	Monroe Lower	8	meters	427.5	ug/L	InSitu	
WEL-07-0021	10/26/2020 16:50	2946	Monroe Lower	9	meters	402.93	ug/L	InSitu	
WEL-07-0021	10/26/2020 16:50	2946	Monroe Lower	10	meters	407.51	ug/L	InSitu	
WEL-07-0021	10/26/2020 16:50	2946	Monroe Lower	11	meters	438.29	ug/L	InSitu	
WEL-07-0021	10/26/2020 16:50	2946	Monroe Lower	12	meters	429.69	ug/L	InSitu	
WEL-07-0021	10/26/2020 16:50	2946	Monroe Lower	13	meters	422.34	ug/L	InSitu	
WEL-07-0021	10/26/2020 16:50	2946	Monroe Lower	14	meters	415.8	ug/L	InSitu	
WEL-07-0021	10/26/2020 16:50	2946	Monroe Lower	15	meters	404.06	ug/L	InSitu	
WEL-07-0018	8/28/2020 8:26	2939	Monroe Upper	0	meters	490.24	ug/L	InSitu	
WEL-07-0018	8/28/2020 8:26	2939	Monroe Upper	1	meters	399.02	ug/L	InSitu	
WEL-07-0018	8/28/2020 8:26	2939	Monroe Upper	2	meters	400.96	ug/L	InSitu	

IDEM Site Number	Sample Date	EventID	Sample Name	Depth	Depth Unit	Concentration	Unit	Instrument	QA Flags
WEL-07-0018	8/28/2020 8:26	2939	Monroe Upper	3	meters	422	ug/L	InSitu	
WEL-07-0018	8/28/2020 8:26	2939	Monroe Upper	4	meters	385.69	ug/L	InSitu	
WEL-07-0018	8/28/2020 8:26	2939	Monroe Upper	5	meters	438.43	ug/L	InSitu	
WEL-07-0018	8/28/2020 8:26	2939	Monroe Upper	6	meters	464.84	ug/L	InSitu	
WEL-07-0018	8/28/2020 8:26	2939	Monroe Upper	7	meters	549.87	ug/L	InSitu	
WEL-07-0018	8/28/2020 8:26	2939	Monroe Upper	8	meters	551.79	ug/L	InSitu	
WEL-07-0020	8/28/2020 9:49	2940	Monroe Center	0	meters	449.2	ug/L	InSitu	
WEL-07-0020	8/28/2020 9:49	2940	Monroe Center	1	meters	336.63	ug/L	InSitu	
WEL-07-0020	8/28/2020 9:49	2940	Monroe Center	2	meters	327.18	ug/L	InSitu	
WEL-07-0020	8/28/2020 9:49	2940	Monroe Center	3	meters	329.02	ug/L	InSitu	
WEL-07-0020	8/28/2020 9:49	2940	Monroe Center	4	meters	281.91	ug/L	InSitu	
WEL-07-0020	8/28/2020 9:49	2940	Monroe Center	5	meters	318.37	ug/L	InSitu	
WEL-07-0020	8/28/2020 9:49	2940	Monroe Center	6	meters	345.87	ug/L	InSitu	
WEL-07-0021	8/28/2020 11:02	2941	Monroe Lower	0	meters	404.02	ug/L	InSitu	
WEL-07-0021	8/28/2020 11:02	2941	Monroe Lower	1	meters	310.77	ug/L	InSitu	
WEL-07-0021	8/28/2020 11:02	2941	Monroe Lower	2	meters	326.84	ug/L	InSitu	
WEL-07-0021	8/28/2020 11:02	2941	Monroe Lower	3	meters	342.49	ug/L	InSitu	
WEL-07-0021	8/28/2020 11:02	2941	Monroe Lower	4	meters	274.24	ug/L	InSitu	
WEL-07-0021	8/28/2020 11:02	2941	Monroe Lower	5	meters	263.46	ug/L	InSitu	
WEL-07-0021	8/28/2020 11:02	2941	Monroe Lower	6	meters	281.73	ug/L	InSitu	
WEL-07-0021	8/28/2020 11:02	2941	Monroe Lower	7	meters	326.69	ug/L	InSitu	
WEL-07-0021	8/28/2020 11:02	2941	Monroe Lower	8	meters	367.23	ug/L	InSitu	
WEL-07-0021	8/28/2020 11:02	2941	Monroe Lower	9	meters	442.68	ug/L	InSitu	
WEL-07-0021	8/28/2020 11:02	2941	Monroe Lower	10	meters	406.22	ug/L	InSitu	
WEL-07-0021	8/28/2020 11:02	2941	Monroe Lower	11	meters	495.35	ug/L	InSitu	
WEL-07-0021	8/28/2020 11:02	2941	Monroe Lower	12	meters	482.78	ug/L	InSitu	
WEL-07-0021	8/28/2020 11:02	2941	Monroe Lower	13	meters	413.18	ug/L	InSitu	
WEL-07-0021	8/28/2020 11:02	2941	Monroe Lower	14	meters	413.19	ug/L	InSitu	
WEL-07-0020	5/26/2020 11:00	2831	Monroe Center			6.62	ug/L	Lab	
WEL-07-0020	5/26/2020 11:00	2831	Monroe Center			6.99	ug/L	Lab	
WEL-07-0018	5/26/2020 8:44	2830	Monroe Upper			8.59	ug/L	Lab	
WEL-07-0021	5/26/2020 12:47	2832	Monroe Lower			6.76	ug/L	Lab	
WEL-07-0020	6/25/2020 10:00	2856	Monroe Center			4.77	ug/L	Lab	
WEL-07-0020	6/25/2020 10:00	2856	Monroe Center			4.07	ug/L	Lab	
WEL-07-0018	6/25/2020 8:30	2855	Monroe Upper			6.19	ug/L	Lab	
WEL-07-0021	6/25/2020 11:37	2857	Monroe Lower			2.97	ug/L	Lab	
WEL-07-0021	7/27/2020 10:40	2919	Monroe Lower			2.50	ug/L	Lab	
WEL-07-0020	7/27/2020 8:57	2918	Monroe Center			4.14	ug/L	Lab	
WEL-07-0020	7/27/2020 8:57	2918	Monroe Center			7.99	ug/L	Lab	
WEL-07-0018	7/27/2020 6:57	2917	Monroe Upper			19.32	ug/L	Lab	
WEL-07-0018	8/28/2020 8:26	2939	Monroe Upper			26.49	ug/L	Lab	
WEL-07-0021	8/28/2020 11:02	2941	Monroe Lower			7.96	ug/L	Lab	
WEL-07-0020	8/28/2020 9:49	2940	Monroe Center			11.53	ug/L	Lab	
WEL-07-0020	8/28/2020 9:49	2940	Monroe Center			11.14	ug/L	Lab	
WEL-07-0021	9/23/2020 17:00	2944	Monroe Lower			6.15	ug/L	Lab	
WEL-07-0020	9/23/2020 17:52	2943	Monroe Center			19.32	ug/L	Lab	
WEL-07-0020	9/23/2020 17:52	2943	Monroe Center			14.61	ug/L	Lab	
WEL-07-0018	9/23/2020 14:39	2942	Monroe Upper			31.00	ug/L	Lab	
WEL-07-0021	10/26/2020 16:50	2946	Monroe Lower			7.73	ug/L	Lab	
WEL-07-0020	10/26/2020 15:45	2945	Monroe Center			13.78	ug/L	Lab	
WEL-07-0018	10/26/2020 14:30	2947	Monroe Upper			18.57	ug/L	Lab	

IDEM Site Number	Sample Date	EventID	Sample Name	Depth	Depth Unit	Concentration
WEL-07-0018	5/26/2020 8:44	2830	Monroe Upper	0	meters	583.7
WEL-07-0018	5/26/2020 8:44	2830	Monroe Upper	1	meters	218.4
WEL-07-0018	5/26/2020 8:44	2830	Monroe Upper	2	meters	75.4
WEL-07-0018	5/26/2020 8:44	2830	Monroe Upper	3	meters	24.4
WEL-07-0018	5/26/2020 8:44	2830	Monroe Upper	4	meters	4.6
WEL-07-0018	5/26/2020 8:44	2830	Monroe Upper	5	meters	0.51
WEL-07-0018	5/26/2020 8:44	2830	Monroe Upper	6	meters	0.05
WEL-07-0018	5/26/2020 8:44	2830	Monroe Upper	7	meters	0
WEL-07-0018	5/26/2020 8:44	2830	Monroe Upper	8	meters	0
WEL-07-0018	5/26/2020 8:44	2830	Monroe Upper	9	meters	0
WEL-07-0018	5/26/2020 8:44	2830	Monroe Upper	10	meters	0
WEL-07-0020	5/26/2020 11:00	2831	Monroe Center	0	meters	1443
WEL-07-0020	5/26/2020 11:00	2831	Monroe Center	1	meters	204.3
WEL-07-0020	5/26/2020 11:00	2831	Monroe Center	2	meters	240.7
WEL-07-0020	5/26/2020 11:00	2831	Monroe Center	3	meters	171.8
WEL-07-0020	5/26/2020 11:00	2831	Monroe Center	4	meters	78.3
WEL-07-0020	5/26/2020 11:00	2831	Monroe Center	5	meters	31.8
WEL-07-0020	5/26/2020 11:00	2831	Monroe Center	6	meters	18.4
WEL-07-0020	5/26/2020 11:00	2831	Monroe Center	7	meters	7.3
WEL-07-0020	5/26/2020 11:00	2831	Monroe Center	7.5	meters	4.1
WEL-07-0021	5/26/2020 12:47	2832	Monroe Lower	0	meters	2170
WEL-07-0021	5/26/2020 12:47	2832	Monroe Lower	1	meters	1392
WEL-07-0021	5/26/2020 12:47	2832	Monroe Lower	2	meters	667.5
WEL-07-0021	5/26/2020 12:47	2832	Monroe Lower	3	meters	316.7
WEL-07-0021	5/26/2020 12:47	2832	Monroe Lower	4	meters	135.9
WEL-07-0021	5/26/2020 12:47	2832	Monroe Lower	5	meters	42.4
WEL-07-0021	5/26/2020 12:47	2832	Monroe Lower	6	meters	30.1
WEL-07-0021	5/26/2020 12:47	2832	Monroe Lower	7	meters	14.4
WEL-07-0021	5/26/2020 12:47	2832	Monroe Lower	8	meters	7.06
WEL-07-0021	5/26/2020 12:47	2832	Monroe Lower	9	meters	3.03
WEL-07-0021	5/26/2020 12:47	2832	Monroe Lower	10	meters	0.53
WEL-07-0021	5/26/2020 12:47	2832	Monroe Lower	11	meters	0
WEL-07-0021	5/26/2020 12:47	2832	Monroe Lower	12	meters	0
WEL-07-0021	5/26/2020 12:47	2832	Monroe Lower	13	meters	0
WEL-07-0021	5/26/2020 12:47	2832	Monroe Lower	14	meters	0
WEL-07-0021	5/26/2020 12:47	2832	Monroe Lower	15	meters	0
WEL-07-0021	5/26/2020 12:47	2832	Monroe Lower	16	meters	0
WEL-07-0018	6/25/2020 8:30	2855	Monroe Upper	0	meters	3856
WEL-07-0018	6/25/2020 8:30	2855	Monroe Upper	1	meters	266.3
WEL-07-0018	6/25/2020 8:30	2855	Monroe Upper	2	meters	45.81
WEL-07-0018	6/25/2020 8:30	2855	Monroe Upper	3	meters	10.8
WEL-07-0018	6/25/2020 8:30	2855	Monroe Upper	4	meters	1.99
WEL-07-0018	6/25/2020 8:30	2855	Monroe Upper	5	meters	0.23
WEL-07-0018	6/25/2020 8:30	2855	Monroe Upper	6	meters	0.01
WEL-07-0018	6/25/2020 8:30	2855	Monroe Upper	7	meters	0
WEL-07-0018	6/25/2020 8:30	2855	Monroe Upper	8	meters	0
WEL-07-0020	6/25/2020 10:00	2856	Monroe Center	0	meters	3567
WEL-07-0020	6/25/2020 10:00	2856	Monroe Center	1	meters	575.8
WEL-07-0020	6/25/2020 10:00	2856	Monroe Center	2	meters	453.9
WEL-07-0020	6/25/2020 10:00	2856	Monroe Center	3	meters	220.7
WEL-07-0020	6/25/2020 10:00	2856	Monroe Center	4	meters	105.4
WEL-07-0020	6/25/2020 10:00	2856	Monroe Center	5	meters	56.45
WEL-07-0020	6/25/2020 10:00	2856	Monroe Center	6	meters	16.95
WEL-07-0020	6/25/2020 10:00	2856	Monroe Center	6.5	meters	2.68
WEL-07-0021	6/25/2020 11:37	2857	Monroe Lower	0	meters	4018
WEL-07-0021	6/25/2020 11:37	2857	Monroe Lower	1	meters	1016.7

IDEM Site Number	Sample Date	EventID	Sample Name	Depth	Depth Unit	Concentration
WEL-07-0021	6/25/2020 11:37	2857	Monroe Lower	2	meters	827.5
WEL-07-0021	6/25/2020 11:37	2857	Monroe Lower	3	meters	439.7
WEL-07-0021	6/25/2020 11:37	2857	Monroe Lower	4	meters	243.3
WEL-07-0021	6/25/2020 11:37	2857	Monroe Lower	5	meters	127.1
WEL-07-0021	6/25/2020 11:37	2857	Monroe Lower	6	meters	62.53
WEL-07-0021	6/25/2020 11:37	2857	Monroe Lower	7	meters	34.51
WEL-07-0021	6/25/2020 11:37	2857	Monroe Lower	8	meters	20.07
WEL-07-0021	6/25/2020 11:37	2857	Monroe Lower	9	meters	18.7
WEL-07-0021	6/25/2020 11:37	2857	Monroe Lower	10	meters	2.49
WEL-07-0021	6/25/2020 11:37	2857	Monroe Lower	11	meters	0.26
WEL-07-0021	6/25/2020 11:37	2857	Monroe Lower	12	meters	0.02
WEL-07-0021	6/25/2020 11:37	2857	Monroe Lower	13	meters	0
WEL-07-0021	6/25/2020 11:37	2857	Monroe Lower	14	meters	0
WEL-07-0021	6/25/2020 11:37	2857	Monroe Lower	15	meters	0
WEL-07-0018	7/27/2020 6:57	2917	Monroe Upper	0	meters	2177
WEL-07-0018	7/27/2020 6:57	2917	Monroe Upper	1	meters	75.58
WEL-07-0018	7/27/2020 6:57	2917	Monroe Upper	2	meters	14.64
WEL-07-0018	7/27/2020 6:57	2917	Monroe Upper	3	meters	2.38
WEL-07-0018	7/27/2020 6:57	2917	Monroe Upper	4	meters	0.13
WEL-07-0018	7/27/2020 6:57	2917	Monroe Upper	5	meters	0
WEL-07-0018	7/27/2020 6:57	2917	Monroe Upper	6	meters	0
WEL-07-0018	7/27/2020 6:57	2917	Monroe Upper	7	meters	0
WEL-07-0018	7/27/2020 6:57	2917	Monroe Upper	8	meters	0
WEL-07-0020	7/27/2020 8:57	2918	Monroe Center	0	meters	3593
WEL-07-0020	7/27/2020 8:57	2918	Monroe Center	1	meters	573.2
WEL-07-0020	7/27/2020 8:57	2918	Monroe Center	2	meters	236.5
WEL-07-0020	7/27/2020 8:57	2918	Monroe Center	3	meters	114.6
WEL-07-0020	7/27/2020 8:57	2918	Monroe Center	4	meters	52.7
WEL-07-0020	7/27/2020 8:57	2918	Monroe Center	5	meters	19.21
WEL-07-0020	7/27/2020 8:57	2918	Monroe Center	6	meters	6.18
WEL-07-0021	7/27/2020 10:40	2919	Monroe Lower	0	meters	1544.9
WEL-07-0021	7/27/2020 10:40	2919	Monroe Lower	1	meters	353.1
WEL-07-0021	7/27/2020 10:40	2919	Monroe Lower	2	meters	212
WEL-07-0021	7/27/2020 10:40	2919	Monroe Lower	3	meters	125.9
WEL-07-0021	7/27/2020 10:40	2919	Monroe Lower	4	meters	77.78
WEL-07-0021	7/27/2020 10:40	2919	Monroe Lower	5	meters	43.89
WEL-07-0021	7/27/2020 10:40	2919	Monroe Lower	6	meters	17.64
WEL-07-0021	7/27/2020 10:40	2919	Monroe Lower	7	meters	3.77
WEL-07-0021	7/27/2020 10:40	2919	Monroe Lower	8	meters	1.34
WEL-07-0021	7/27/2020 10:40	2919	Monroe Lower	9	meters	0.46
WEL-07-0021	7/27/2020 10:40	2919	Monroe Lower	10	meters	0.05
WEL-07-0021	7/27/2020 10:40	2919	Monroe Lower	11	meters	0
WEL-07-0021	7/27/2020 10:40	2919	Monroe Lower	12	meters	0
WEL-07-0021	7/27/2020 10:40	2919	Monroe Lower	13	meters	0
WEL-07-0021	7/27/2020 10:40	2919	Monroe Lower	14	meters	0
WEL-07-0018	9/23/2020 14:39	2942	Monroe Upper	0	meters	926.4
WEL-07-0018	9/23/2020 14:39	2942	Monroe Upper	1	meters	63.74
WEL-07-0018	9/23/2020 14:39	2942	Monroe Upper	2	meters	5.95
WEL-07-0018	9/23/2020 14:39	2942	Monroe Upper	3	meters	0.38
WEL-07-0018	9/23/2020 14:39	2942	Monroe Upper	4	meters	0.02
WEL-07-0018	9/23/2020 14:39	2942	Monroe Upper	5	meters	0
WEL-07-0018	9/23/2020 14:39	2942	Monroe Upper	6	meters	0
WEL-07-0018	9/23/2020 14:39	2942	Monroe Upper	7	meters	0
WEL-07-0018	9/23/2020 14:39	2942	Monroe Upper	8	meters	0
WEL-07-0021	9/23/2020 17:00	2944	Monroe Lower	0	meters	521
WEL-07-0021	9/23/2020 17:00	2944	Monroe Lower	1	meters	46.42

IDEM Site Number	Sample Date	EventID	Sample Name	Depth	Depth Unit	Concentration
WEL-07-0021	9/23/2020 17:00	2944	Monroe Lower	2	meters	18.81
WEL-07-0021	9/23/2020 17:00	2944	Monroe Lower	3	meters	7.35
WEL-07-0021	9/23/2020 17:00	2944	Monroe Lower	4	meters	2.6
WEL-07-0021	9/23/2020 17:00	2944	Monroe Lower	5	meters	0.93
WEL-07-0021	9/23/2020 17:00	2944	Monroe Lower	6	meters	0.35
WEL-07-0021	9/23/2020 17:00	2944	Monroe Lower	7	meters	0.11
WEL-07-0021	9/23/2020 17:00	2944	Monroe Lower	8	meters	0.02
WEL-07-0021	9/23/2020 17:00	2944	Monroe Lower	9	meters	0
WEL-07-0021	9/23/2020 17:00	2944	Monroe Lower	10	meters	0
WEL-07-0021	9/23/2020 17:00	2944	Monroe Lower	11	meters	0
WEL-07-0021	9/23/2020 17:00	2944	Monroe Lower	12	meters	0
WEL-07-0021	9/23/2020 17:00	2944	Monroe Lower	13	meters	0
WEL-07-0021	9/23/2020 17:00	2944	Monroe Lower	14	meters	0
WEL-07-0021	9/23/2020 17:00	2944	Monroe Lower	15	meters	0
WEL-07-0020	9/23/2020 17:52	2943	Monroe Center	0	meters	1520.5
WEL-07-0020	9/23/2020 17:52	2943	Monroe Center	1	meters	209.5
WEL-07-0020	9/23/2020 17:52	2943	Monroe Center	2	meters	73.05
WEL-07-0020	9/23/2020 17:52	2943	Monroe Center	3	meters	27.6
WEL-07-0020	9/23/2020 17:52	2943	Monroe Center	4	meters	10
WEL-07-0020	9/23/2020 17:52	2943	Monroe Center	5	meters	3.66
WEL-07-0020	9/23/2020 17:52	2943	Monroe Center	6	meters	1.07
WEL-07-0018	10/26/2020 14:30	2947	Monroe Upper	0	meters	529.6
WEL-07-0018	10/26/2020 14:30	2947	Monroe Upper	1	meters	29.76
WEL-07-0018	10/26/2020 14:30	2947	Monroe Upper	2	meters	5.22
WEL-07-0018	10/26/2020 14:30	2947	Monroe Upper	3	meters	0.99
WEL-07-0018	10/26/2020 14:30	2947	Monroe Upper	4	meters	0.18
WEL-07-0018	10/26/2020 14:30	2947	Monroe Upper	5	meters	0.63
WEL-07-0018	10/26/2020 14:30	2947	Monroe Upper	6	meters	0
WEL-07-0018	10/26/2020 14:30	2947	Monroe Upper	7	meters	0
WEL-07-0018	10/26/2020 14:30	2947	Monroe Upper	8	meters	0
WEL-07-0020	10/26/2020 15:45	2945	Monroe Center	0	meters	432.9
WEL-07-0020	10/26/2020 15:45	2945	Monroe Center	1	meters	53.64
WEL-07-0020	10/26/2020 15:45	2945	Monroe Center	2	meters	13.73
WEL-07-0020	10/26/2020 15:45	2945	Monroe Center	3	meters	3.74
WEL-07-0020	10/26/2020 15:45	2945	Monroe Center	4	meters	1.03
WEL-07-0020	10/26/2020 15:45	2945	Monroe Center	5	meters	0.3
WEL-07-0020	10/26/2020 15:45	2945	Monroe Center	6	meters	0.07
WEL-07-0021	10/26/2020 16:50	2946	Monroe Lower	0	meters	177.6
WEL-07-0021	10/26/2020 16:50	2946	Monroe Lower	1	meters	15.31
WEL-07-0021	10/26/2020 16:50	2946	Monroe Lower	2	meters	4.88
WEL-07-0021	10/26/2020 16:50	2946	Monroe Lower	3	meters	1.39
WEL-07-0021	10/26/2020 16:50	2946	Monroe Lower	4	meters	0.46
WEL-07-0021	10/26/2020 16:50	2946	Monroe Lower	5	meters	0.15
WEL-07-0021	10/26/2020 16:50	2946	Monroe Lower	6	meters	0.03
WEL-07-0021	10/26/2020 16:50	2946	Monroe Lower	7	meters	0
WEL-07-0021	10/26/2020 16:50	2946	Monroe Lower	8	meters	0
WEL-07-0021	10/26/2020 16:50	2946	Monroe Lower	9	meters	0
WEL-07-0021	10/26/2020 16:50	2946	Monroe Lower	10	meters	0
WEL-07-0021	10/26/2020 16:50	2946	Monroe Lower	11	meters	0
WEL-07-0021	10/26/2020 16:50	2946	Monroe Lower	12	meters	0
WEL-07-0021	10/26/2020 16:50	2946	Monroe Lower	13	meters	0
WEL-07-0021	10/26/2020 16:50	2946	Monroe Lower	14	meters	0
WEL-07-0021	10/26/2020 16:50	2946	Monroe Lower	15	meters	0
WEL-07-0018	8/28/2020 8:26	2939	Monroe Upper	0	meters	651.3
WEL-07-0018	8/28/2020 8:26	2939	Monroe Upper	1	meters	48.22
WEL-07-0018	8/28/2020 8:26	2939	Monroe Upper	2	meters	9.35

IDEM Site Number	Sample Date	EventID	Sample Name	Depth	Depth Unit	Concentration
WEL-07-0018	8/28/2020 8:26	2939	Monroe Upper	3	meters	1.36
WEL-07-0018	8/28/2020 8:26	2939	Monroe Upper	4	meters	0.11
WEL-07-0018	8/28/2020 8:26	2939	Monroe Upper	5	meters	0
WEL-07-0018	8/28/2020 8:26	2939	Monroe Upper	6	meters	0
WEL-07-0018	8/28/2020 8:26	2939	Monroe Upper	7	meters	0
WEL-07-0018	8/28/2020 8:26	2939	Monroe Upper	8	meters	0
WEL-07-0020	8/28/2020 9:49	2940	Monroe Center	0	meters	3817
WEL-07-0020	8/28/2020 9:49	2940	Monroe Center	1	meters	601.1
WEL-07-0020	8/28/2020 9:49	2940	Monroe Center	2	meters	229.9
WEL-07-0020	8/28/2020 9:49	2940	Monroe Center	3	meters	95.96
WEL-07-0020	8/28/2020 9:49	2940	Monroe Center	4	meters	40.5
WEL-07-0020	8/28/2020 9:49	2940	Monroe Center	5	meters	11.91
WEL-07-0020	8/28/2020 9:49	2940	Monroe Center	6	meters	3.02
WEL-07-0021	8/28/2020 11:02	2941	Monroe Lower	0	meters	593.2
WEL-07-0021	8/28/2020 11:02	2941	Monroe Lower	1	meters	90.15
WEL-07-0021	8/28/2020 11:02	2941	Monroe Lower	2	meters	54.88
WEL-07-0021	8/28/2020 11:02	2941	Monroe Lower	3	meters	25.11
WEL-07-0021	8/28/2020 11:02	2941	Monroe Lower	4	meters	13.14
WEL-07-0021	8/28/2020 11:02	2941	Monroe Lower	5	meters	5.99
WEL-07-0021	8/28/2020 11:02	2941	Monroe Lower	6	meters	2.77
WEL-07-0021	8/28/2020 11:02	2941	Monroe Lower	7	meters	1.42
WEL-07-0021	8/28/2020 11:02	2941	Monroe Lower	8	meters	0.82
WEL-07-0021	8/28/2020 11:02	2941	Monroe Lower	9	meters	0.48
WEL-07-0021	8/28/2020 11:02	2941	Monroe Lower	10	meters	0.08
WEL-07-0021	8/28/2020 11:02	2941	Monroe Lower	11	meters	0
WEL-07-0021	8/28/2020 11:02	2941	Monroe Lower	12	meters	0
WEL-07-0021	8/28/2020 11:02	2941	Monroe Lower	13	meters	0
WEL-07-0021	8/28/2020 11:02	2941	Monroe Lower	14	meters	0

IDEM Site Number	Sample Date	EventID	Sample Name	Depth	Unit	QA Flags
WEL-07-0018	5/26/2020 8:44	2830	Monroe Upper	1.3	meters	
WEL-07-0020	5/26/2020 11:00	2831	Monroe Center	1.2	meters	
WEL-07-0021	5/26/2020 12:47	2832	Monroe Lower	1.95	meters	
WEL-07-0018	6/25/2020 8:30	2855	Monroe Upper	0.7	meters	
WEL-07-0020	6/25/2020 10:00	2856	Monroe Center	1.05	meters	
WEL-07-0021	6/25/2020 11:37	2857	Monroe Lower	1.8	meters	
WEL-07-0018	7/27/2020 6:57	2917	Monroe Upper	0.95	meters	
WEL-07-0020	7/27/2020 8:57	2918	Monroe Center	2.15	meters	
WEL-07-0021	7/27/2020 10:40	2919	Monroe Lower	3.45	meters	
WEL-07-0018	8/28/2020 8:26	2939	Monroe Upper	0.8	meters	
WEL-07-0020	8/28/2020 9:49	2940	Monroe Center	1.65	meters	
WEL-07-0021	8/28/2020 11:02	2941	Monroe Lower	2.05	meters	
WEL-07-0018	9/23/2020 14:39	2942	Monroe Upper	0.35	meters	
WEL-07-0021	9/23/2020 17:00	2944	Monroe Lower	1.55	meters	
WEL-07-0020	9/23/2020 17:52	2943	Monroe Center	1	meters	
WEL-07-0018	10/26/2020 14:30	2947	Monroe Upper	0.45	meters	
WEL-07-0020	10/26/2020 15:45	2945	Monroe Center	0.75	meters	

IDEM Site Number	Sample Date	EventID	Sample Name	Concentration	Unit	QA Flags
WEL-07-0019	5/27/2020 7:50	0123	Crooked Creek	0.81	cfs	
WEL-06-0008	5/27/2020 9:20	0256	North Fork Salt Creek	171.29	cfs	
WEL-05-0001	5/27/2020 10:25	0668	Middle Fork Salt Creek	44.68	cfs	
WEL-04-0004	5/27/2020 11:21	0914	South Fork Salt Creek	9.56	cfs	Comment 1
WEL-07-0019	6/24/2020 9:15	0123	Crooked Creek	0.06	cfs	
WEL-05-0001	6/24/2020 10:25	0668	Middle Fork Salt Creek	5.70	cfs	
WEL-04-0004	6/24/2020 11:45	0914	South Fork Salt Creek	2.65	cfs	
WEL-06-0008	6/24/2020 8:15	0256	North Fork Salt Creek	9.26	cfs	
WEL-07-0019	7/21/2020 8:30	0123	Crooked Creek	0.05	cfs	
WEL-05-0001	7/21/2020 9:20	0668	Middle Fork Salt Creek	2.42	cfs	
WEL-04-0004	7/21/2020 10:40	0914	South Fork Salt Creek	0.38	cfs	
WEL-06-0008	7/21/2020 11:50	0256	North Fork Salt Creek	22.03	cfs	
WEL-07-0019	8/27/2020 9:05	0123	Crooked Creek	0.01	cfs	
WEL-05-0001	8/27/2020 9:45	0668	Middle Fork Salt Creek	1.10	cfs	
WEL-04-0004	8/27/2020 11:15	0914	South Fork Salt Creek	0.61	cfs	
WEL-06-0008	8/27/2020 12:51	0256	North Fork Salt Creek	5.38	cfs	
WEL-05-0001	9/24/2020 8:30	0668	Middle Fork Salt Creek	0.10	cfs	
WEL-04-0004	9/24/2020 9:25	0914	South Fork Salt Creek	0.89	cfs	
WEL-06-0008	9/24/2020 10:35	0256	North Fork Salt Creek	0.27	cfs	
WEL-05-0001	10/22/2020 9:30	0668	Middle Fork Salt Creek	0.38	cfs	
WEL-04-0004	10/22/2020 10:40	0914	South Fork Salt Creek	2.34	cfs	
WEL-06-0008	10/22/2020 11:45	0256	North Fork Salt Creek	1.96	cfs	
WEL-07-0019	11/19/2020 9:00	0123	Crooked Creek	1.72	cfs	
WEL-06-0008	11/19/2020 9:30	0256	North Fork Salt Creek	8.50	cfs	
WEL-05-0001	11/19/2020 10:20	0668	Middle Fork Salt Creek	2.24	cfs	
WEL-04-0004	11/19/2020 11:15	0914	South Fork Salt Creek	4.18	cfs	
WEL-07-0019	4/22/2020 0:00	0123	Crooked Creek	4.74	cfs	
WEL-06-0008	4/22/2020 0:00	0256	North Fork Salt Creek	65.82	cfs	
WEL-05-0001	4/22/2020 0:00	0668	Middle Fork Salt Creek	18.37	cfs	
WEL-04-0004	4/22/2020 0:00	0914	South Fork Salt Creek		cfs	Comment 2
WEL-07-0019	12/16/2020 9:05	0123	Crooked Creek	0.11	cfs	
WEL-06-0008	12/16/2020 9:30	0256	North Fork Salt Creek	13.54	cfs	
WEL-05-0001	12/16/2020 10:35	0668	Middle Fork Salt Creek	3.50	cfs	
WEL-04-0004	12/16/2020 11:26	0914	South Fork Salt Creek	22.95	cfs	

Comment 1 This number seems low relative to other values for this day; however, water too deep to wade at site.

Comment 2 Discharge not collected, first event, not prepared for bridge sample, too deep to wade.

IDEM Site Number	Site Name	Site	Substrate	Instream cover	Channel Morphology	Bank Erosion & Riparian Zone	Pool/glide and Riffle/run quality	Riffle	Gradient	QHEI TOTAL
WEL-07-0019	Crooked Creek	1	13	4	16	10	2	0	4	49
WEL-06-0008	North Fork	2	8.5	16	15	5.5	8	3	4	60
WEL-05-0001	Middle Fork	3	2	8	11	6.5	9	0	4	40.5
WEL-04-0004	South Fork	4	1	6	9	7	7	0	4	34
WEL-08-0036	Outlet	5	0	6	6	6	9	0	4	31

IDEM Site Number	Sample Date	EventID	Sample Name	Depth	Depth Unit	Instrument	Concentration	Unit
WEL-07-0018	5/26/2020 8:44	2830	Monroe Upper	0	meters	InSitu	2.53	NTU
WEL-07-0018	5/26/2020 8:44	2830	Monroe Upper	1	meters	InSitu	2.6	NTU
WEL-07-0018	5/26/2020 8:44	2830	Monroe Upper	2	meters	InSitu	4.48	NTU
WEL-07-0018	5/26/2020 8:44	2830	Monroe Upper	3	meters	InSitu	7.24	NTU
WEL-07-0018	5/26/2020 8:44	2830	Monroe Upper	4	meters	InSitu	21.7	NTU
WEL-07-0018	5/26/2020 8:44	2830	Monroe Upper	5	meters	InSitu	27.5	NTU
WEL-07-0018	5/26/2020 8:44	2830	Monroe Upper	6	meters	InSitu	22.9	NTU
WEL-07-0018	5/26/2020 8:44	2830	Monroe Upper	7	meters	InSitu	23.1	NTU
WEL-07-0018	5/26/2020 8:44	2830	Monroe Upper	8	meters	InSitu	22.2	NTU
WEL-07-0018	5/26/2020 8:44	2830	Monroe Upper	9	meters	InSitu	23.1	NTU
WEL-07-0018	5/26/2020 8:44	2830	Monroe Upper	10	meters	InSitu	22.6	NTU
WEL-07-0020	5/26/2020 11:00	2831	Monroe Center	0	meters	InSitu	2.25	NTU
WEL-07-0020	5/26/2020 11:00	2831	Monroe Center	1	meters	InSitu	2.05	NTU
WEL-07-0020	5/26/2020 11:00	2831	Monroe Center	2	meters	InSitu	2.35	NTU
WEL-07-0020	5/26/2020 11:00	2831	Monroe Center	3	meters	InSitu	2.16	NTU
WEL-07-0020	5/26/2020 11:00	2831	Monroe Center	4	meters	InSitu	2.24	NTU
WEL-07-0020	5/26/2020 11:00	2831	Monroe Center	5	meters	InSitu	1.54	NTU
WEL-07-0020	5/26/2020 11:00	2831	Monroe Center	6	meters	InSitu	3.78	NTU
WEL-07-0020	5/26/2020 11:00	2831	Monroe Center	7	meters	InSitu	5.33	NTU
WEL-07-0020	5/26/2020 11:00	2831	Monroe Center	7.5	meters	InSitu	5.98	NTU
WEL-07-0021	5/26/2020 12:47	2832	Monroe Lower	0	meters	InSitu	1.21	ntu
WEL-07-0021	5/26/2020 12:47	2832	Monroe Lower	1	meters	InSitu	1.56	ntu
WEL-07-0021	5/26/2020 12:47	2832	Monroe Lower	2	meters	InSitu	1.84	ntu
WEL-07-0021	5/26/2020 12:47	2832	Monroe Lower	3	meters	InSitu	2.01	ntu
WEL-07-0021	5/26/2020 12:47	2832	Monroe Lower	4	meters	InSitu	1.74	ntu
WEL-07-0021	5/26/2020 12:47	2832	Monroe Lower	5	meters	InSitu	1.88	ntu
WEL-07-0021	5/26/2020 12:47	2832	Monroe Lower	6	meters	InSitu	1.78	ntu
WEL-07-0021	5/26/2020 12:47	2832	Monroe Lower	7	meters	InSitu	1.92	ntu
WEL-07-0021	5/26/2020 12:47	2832	Monroe Lower	8	meters	InSitu	1.91	ntu
WEL-07-0021	5/26/2020 12:47	2832	Monroe Lower	9	meters	InSitu	3.82	ntu
WEL-07-0021	5/26/2020 12:47	2832	Monroe Lower	10	meters	InSitu	7.78	ntu
WEL-07-0021	5/26/2020 12:47	2832	Monroe Lower	11	meters	InSitu	9.53	ntu
WEL-07-0021	5/26/2020 12:47	2832	Monroe Lower	12	meters	InSitu	11.85	ntu
WEL-07-0021	5/26/2020 12:47	2832	Monroe Lower	13	meters	InSitu	12.13	ntu
WEL-07-0021	5/26/2020 12:47	2832	Monroe Lower	14	meters	InSitu	12.11	ntu
WEL-07-0021	5/26/2020 12:47	2832	Monroe Lower	15	meters	InSitu	12.62	ntu
WEL-07-0021	5/26/2020 12:47	2832	Monroe Lower	16	meters	InSitu	20.2	ntu
WEL-07-0018	6/25/2020 8:30	2855	Monroe Upper	0	meters	InSitu	8.3	ntu
WEL-07-0018	6/25/2020 8:30	2855	Monroe Upper	1	meters	InSitu	9.05	ntu
WEL-07-0018	6/25/2020 8:30	2855	Monroe Upper	2	meters	InSitu	8.14	ntu
WEL-07-0018	6/25/2020 8:30	2855	Monroe Upper	3	meters	InSitu	13.44	ntu
WEL-07-0018	6/25/2020 8:30	2855	Monroe Upper	4	meters	InSitu	16.88	ntu
WEL-07-0018	6/25/2020 8:30	2855	Monroe Upper	5	meters	InSitu	20.46	ntu
WEL-07-0018	6/25/2020 8:30	2855	Monroe Upper	6	meters	InSitu	20.13	ntu
WEL-07-0018	6/25/2020 8:30	2855	Monroe Upper	7	meters	InSitu	26.41	ntu
WEL-07-0018	6/25/2020 8:30	2855	Monroe Upper	8	meters	InSitu	22.75	ntu
WEL-07-0020	6/25/2020 10:00	2856	Monroe Center	0	meters	InSitu	1.3	ntu
WEL-07-0020	6/25/2020 10:00	2856	Monroe Center	1	meters	InSitu	1.63	ntu
WEL-07-0020	6/25/2020 10:00	2856	Monroe Center	2	meters	InSitu	1.64	ntu
WEL-07-0020	6/25/2020 10:00	2856	Monroe Center	3	meters	InSitu	1.64	ntu
WEL-07-0020	6/25/2020 10:00	2856	Monroe Center	4	meters	InSitu	1.74	ntu
WEL-07-0020	6/25/2020 10:00	2856	Monroe Center	5	meters	InSitu	2.29	ntu
WEL-07-0020	6/25/2020 10:00	2856	Monroe Center	6	meters	InSitu	11.97	ntu
WEL-07-0020	6/25/2020 10:00	2856	Monroe Center	6.5	meters	InSitu	26.18	ntu
WEL-07-0021	6/25/2020 11:37	2857	Monroe Lower	0	meters	InSitu	1.01	ntu
WEL-07-0021	6/25/2020 11:37	2857	Monroe Lower	1	meters	InSitu	1.21	ntu

IDEM Site Number	Sample Date	EventID	Sample Name	Depth	Depth Unit	Instrument	Concentration	Unit
WEL-07-0021	6/25/2020 11:37	2857	Monroe Lower	2	meters	InSitu	1.74	ntu
WEL-07-0021	6/25/2020 11:37	2857	Monroe Lower	3	meters	InSitu	1.35	ntu
WEL-07-0021	6/25/2020 11:37	2857	Monroe Lower	4	meters	InSitu	1.8	ntu
WEL-07-0021	6/25/2020 11:37	2857	Monroe Lower	5	meters	InSitu	1.49	ntu
WEL-07-0021	6/25/2020 11:37	2857	Monroe Lower	6	meters	InSitu	2.36	ntu
WEL-07-0021	6/25/2020 11:37	2857	Monroe Lower	7	meters	InSitu	2.47	ntu
WEL-07-0021	6/25/2020 11:37	2857	Monroe Lower	8	meters	InSitu	2.61	ntu
WEL-07-0021	6/25/2020 11:37	2857	Monroe Lower	9	meters	InSitu	6.75	ntu
WEL-07-0021	6/25/2020 11:37	2857	Monroe Lower	10	meters	InSitu	19.43	ntu
WEL-07-0021	6/25/2020 11:37	2857	Monroe Lower	11	meters	InSitu	32.92	ntu
WEL-07-0021	6/25/2020 11:37	2857	Monroe Lower	12	meters	InSitu	38.98	ntu
WEL-07-0021	6/25/2020 11:37	2857	Monroe Lower	13	meters	InSitu	63.33	ntu
WEL-07-0021	6/25/2020 11:37	2857	Monroe Lower	14	meters	InSitu	41.23	ntu
WEL-07-0021	6/25/2020 11:37	2857	Monroe Lower	15	meters	InSitu	44.66	ntu
WEL-07-0018	7/27/2020 6:57	2917	Monroe Upper	0	meters	InSitu	5.65	NTU
WEL-07-0018	7/27/2020 6:57	2917	Monroe Upper	1	meters	InSitu	5.3	NTU
WEL-07-0018	7/27/2020 6:57	2917	Monroe Upper	2	meters	InSitu	6.48	NTU
WEL-07-0018	7/27/2020 6:57	2917	Monroe Upper	3	meters	InSitu	18.96	NTU
WEL-07-0018	7/27/2020 6:57	2917	Monroe Upper	4	meters	InSitu	41.76	NTU
WEL-07-0018	7/27/2020 6:57	2917	Monroe Upper	5	meters	InSitu	33.44	NTU
WEL-07-0018	7/27/2020 6:57	2917	Monroe Upper	6	meters	InSitu	40.82	NTU
WEL-07-0018	7/27/2020 6:57	2917	Monroe Upper	7	meters	InSitu	31.25	NTU
WEL-07-0018	7/27/2020 6:57	2917	Monroe Upper	8	meters	InSitu	30.58	NTU
WEL-07-0020	7/27/2020 8:57	2918	Monroe Center	0	meters	InSitu	2.29	ntu
WEL-07-0020	7/27/2020 8:57	2918	Monroe Center	1	meters	InSitu	2.62	ntu
WEL-07-0020	7/27/2020 8:57	2918	Monroe Center	2	meters	InSitu	2.52	ntu
WEL-07-0020	7/27/2020 8:57	2918	Monroe Center	3	meters	InSitu	2.59	ntu
WEL-07-0020	7/27/2020 8:57	2918	Monroe Center	4	meters	InSitu	3.2	ntu
WEL-07-0020	7/27/2020 8:57	2918	Monroe Center	5	meters	InSitu	3.45	ntu
WEL-07-0020	7/27/2020 8:57	2918	Monroe Center	6	meters	InSitu	5.76	ntu
WEL-07-0021	7/27/2020 10:40	2919	Monroe Lower	0	meters	InSitu	1.7	ntu
WEL-07-0021	7/27/2020 10:40	2919	Monroe Lower	1	meters	InSitu	1.83	ntu
WEL-07-0021	7/27/2020 10:40	2919	Monroe Lower	2	meters	InSitu	2.2	ntu
WEL-07-0021	7/27/2020 10:40	2919	Monroe Lower	3	meters	InSitu	2.13	ntu
WEL-07-0021	7/27/2020 10:40	2919	Monroe Lower	4	meters	InSitu	2.61	ntu
WEL-07-0021	7/27/2020 10:40	2919	Monroe Lower	5	meters	InSitu	3.31	ntu
WEL-07-0021	7/27/2020 10:40	2919	Monroe Lower	6	meters	InSitu	3.13	ntu
WEL-07-0021	7/27/2020 10:40	2919	Monroe Lower	7	meters	InSitu	7.89	ntu
WEL-07-0021	7/27/2020 10:40	2919	Monroe Lower	8	meters	InSitu	13.53	ntu
WEL-07-0021	7/27/2020 10:40	2919	Monroe Lower	9	meters	InSitu	10.82	ntu
WEL-07-0021	7/27/2020 10:40	2919	Monroe Lower	10	meters	InSitu	33.41	ntu
WEL-07-0021	7/27/2020 10:40	2919	Monroe Lower	11	meters	InSitu	36.78	ntu
WEL-07-0021	7/27/2020 10:40	2919	Monroe Lower	12	meters	InSitu	32.04	ntu
WEL-07-0021	7/27/2020 10:40	2919	Monroe Lower	13	meters	InSitu	34.46	ntu
WEL-07-0021	7/27/2020 10:40	2919	Monroe Lower	14	meters	InSitu	33.43	ntu
WEL-07-0018	9/23/2020 14:39	2942	Monroe Upper	0	meters	InSitu	13.72	NTU
WEL-07-0018	9/23/2020 14:39	2942	Monroe Upper	1	meters	InSitu	27.81	NTU
WEL-07-0018	9/23/2020 14:39	2942	Monroe Upper	2	meters	InSitu	28.96	NTU
WEL-07-0018	9/23/2020 14:39	2942	Monroe Upper	3	meters	InSitu	48.64	NTU
WEL-07-0018	9/23/2020 14:39	2942	Monroe Upper	4	meters	InSitu	41.72	NTU
WEL-07-0018	9/23/2020 14:39	2942	Monroe Upper	5	meters	InSitu	51.71	NTU
WEL-07-0018	9/23/2020 14:39	2942	Monroe Upper	6	meters	InSitu	44.31	NTU
WEL-07-0018	9/23/2020 14:39	2942	Monroe Upper	7	meters	InSitu	48.97	NTU
WEL-07-0018	9/23/2020 14:39	2942	Monroe Upper	8	meters	InSitu	51.58	NTU
WEL-07-0021	9/23/2020 17:00	2944	Monroe Lower	0	meters	InSitu	2.43	NTU
WEL-07-0021	9/23/2020 17:00	2944	Monroe Lower	1	meters	InSitu	2.32	NTU

IDEM Site Number	Sample Date	EventID	Sample Name	Depth	Depth Unit	Instrument	Concentration	Unit
WEL-07-0021	9/23/2020 17:00	2944	Monroe Lower	2	meters	InSitu	2.74	NTU
WEL-07-0021	9/23/2020 17:00	2944	Monroe Lower	3	meters	InSitu	3.34	NTU
WEL-07-0021	9/23/2020 17:00	2944	Monroe Lower	4	meters	InSitu	2.72	NTU
WEL-07-0021	9/23/2020 17:00	2944	Monroe Lower	5	meters	InSitu	3.18	NTU
WEL-07-0021	9/23/2020 17:00	2944	Monroe Lower	6	meters	InSitu	2.9	NTU
WEL-07-0021	9/23/2020 17:00	2944	Monroe Lower	7	meters	InSitu	3.99	NTU
WEL-07-0021	9/23/2020 17:00	2944	Monroe Lower	8	meters	InSitu	2.26	NTU
WEL-07-0021	9/23/2020 17:00	2944	Monroe Lower	9	meters	InSitu	5.36	NTU
WEL-07-0021	9/23/2020 17:00	2944	Monroe Lower	10	meters	InSitu	37.86	NTU
WEL-07-0021	9/23/2020 17:00	2944	Monroe Lower	11	meters	InSitu	52.56	NTU
WEL-07-0021	9/23/2020 17:00	2944	Monroe Lower	12	meters	InSitu	45.02	NTU
WEL-07-0021	9/23/2020 17:00	2944	Monroe Lower	13	meters	InSitu	29.02	NTU
WEL-07-0021	9/23/2020 17:00	2944	Monroe Lower	14	meters	InSitu	21.56	NTU
WEL-07-0021	9/23/2020 17:00	2944	Monroe Lower	15	meters	InSitu	46.1	NTU
WEL-07-0020	9/23/2020 17:52	2943	Monroe Center	0	meters	InSitu	3.17	NTU
WEL-07-0020	9/23/2020 17:52	2943	Monroe Center	1	meters	InSitu	4.03	NTU
WEL-07-0020	9/23/2020 17:52	2943	Monroe Center	2	meters	InSitu	3.87	NTU
WEL-07-0020	9/23/2020 17:52	2943	Monroe Center	3	meters	InSitu	4.11	NTU
WEL-07-0020	9/23/2020 17:52	2943	Monroe Center	4	meters	InSitu	4.73	NTU
WEL-07-0020	9/23/2020 17:52	2943	Monroe Center	5	meters	InSitu	6.09	NTU
WEL-07-0020	9/23/2020 17:52	2943	Monroe Center	6	meters	InSitu	19.8	NTU
WEL-07-0018	10/26/2020 14:30	2947	Monroe Upper	0	meters	InSitu	17.87	NTU
WEL-07-0018	10/26/2020 14:30	2947	Monroe Upper	1	meters	InSitu	22.49	NTU
WEL-07-0018	10/26/2020 14:30	2947	Monroe Upper	2	meters	InSitu	17.22	NTU
WEL-07-0018	10/26/2020 14:30	2947	Monroe Upper	3	meters	InSitu	22.17	NTU
WEL-07-0018	10/26/2020 14:30	2947	Monroe Upper	4	meters	InSitu	17.27	NTU
WEL-07-0018	10/26/2020 14:30	2947	Monroe Upper	5	meters	InSitu	18.38	NTU
WEL-07-0018	10/26/2020 14:30	2947	Monroe Upper	6	meters	InSitu	16.85	NTU
WEL-07-0018	10/26/2020 14:30	2947	Monroe Upper	7	meters	InSitu	31.37	NTU
WEL-07-0018	10/26/2020 14:30	2947	Monroe Upper	8	meters	InSitu	38.02	NTU
WEL-07-0020	10/26/2020 15:45	2945	Monroe Center	0	meters	InSitu	9	NTU
WEL-07-0020	10/26/2020 15:45	2945	Monroe Center	1	meters	InSitu	8.62	NTU
WEL-07-0020	10/26/2020 15:45	2945	Monroe Center	2	meters	InSitu	7.62	NTU
WEL-07-0020	10/26/2020 15:45	2945	Monroe Center	3	meters	InSitu	9.22	NTU
WEL-07-0020	10/26/2020 15:45	2945	Monroe Center	4	meters	InSitu	8.9	NTU
WEL-07-0020	10/26/2020 15:45	2945	Monroe Center	5	meters	InSitu	8.51	NTU
WEL-07-0020	10/26/2020 15:45	2945	Monroe Center	6	meters	InSitu	9.36	NTU
WEL-07-0021	10/26/2020 16:50	2946	Monroe Lower	0	meters	InSitu	3.67	NTU
WEL-07-0021	10/26/2020 16:50	2946	Monroe Lower	1	meters	InSitu	4.12	NTU
WEL-07-0021	10/26/2020 16:50	2946	Monroe Lower	2	meters	InSitu	3.97	NTU
WEL-07-0021	10/26/2020 16:50	2946	Monroe Lower	3	meters	InSitu	3.37	NTU
WEL-07-0021	10/26/2020 16:50	2946	Monroe Lower	4	meters	InSitu	3.35	NTU
WEL-07-0021	10/26/2020 16:50	2946	Monroe Lower	5	meters	InSitu	3.36	NTU
WEL-07-0021	10/26/2020 16:50	2946	Monroe Lower	6	meters	InSitu	3.18	NTU
WEL-07-0021	10/26/2020 16:50	2946	Monroe Lower	7	meters	InSitu	3.52	NTU
WEL-07-0021	10/26/2020 16:50	2946	Monroe Lower	8	meters	InSitu	3.38	NTU
WEL-07-0021	10/26/2020 16:50	2946	Monroe Lower	9	meters	InSitu	3.25	NTU
WEL-07-0021	10/26/2020 16:50	2946	Monroe Lower	10	meters	InSitu	3.13	NTU
WEL-07-0021	10/26/2020 16:50	2946	Monroe Lower	11	meters	InSitu	3.32	NTU
WEL-07-0021	10/26/2020 16:50	2946	Monroe Lower	12	meters	InSitu	3.55	NTU
WEL-07-0021	10/26/2020 16:50	2946	Monroe Lower	13	meters	InSitu	9.16	NTU
WEL-07-0021	10/26/2020 16:50	2946	Monroe Lower	14	meters	InSitu	4.15	NTU
WEL-07-0021	10/26/2020 16:50	2946	Monroe Lower	15	meters	InSitu	8.95	NTU
WEL-07-0018	8/28/2020 8:26	2939	Monroe Upper	0	meters	InSitu	7.33	NTU
WEL-07-0018	8/28/2020 8:26	2939	Monroe Upper	1	meters	InSitu	8.15	NTU
WEL-07-0018	8/28/2020 8:26	2939	Monroe Upper	2	meters	InSitu	8.74	NTU

IDEM Site Number	Sample Date	EventID	Sample Name	Depth	Depth Unit	Instrument	Concentration	Unit
WEL-07-0018	8/28/2020 8:26	2939	Monroe Upper	3	meters	InSitu	16.48	NTU
WEL-07-0018	8/28/2020 8:26	2939	Monroe Upper	4	meters	InSitu	20.02	NTU
WEL-07-0018	8/28/2020 8:26	2939	Monroe Upper	5	meters	InSitu	27.89	NTU
WEL-07-0018	8/28/2020 8:26	2939	Monroe Upper	6	meters	InSitu	46.79	NTU
WEL-07-0018	8/28/2020 8:26	2939	Monroe Upper	7	meters	InSitu	51.27	NTU
WEL-07-0018	8/28/2020 8:26	2939	Monroe Upper	8	meters	InSitu	34.62	NTU
WEL-07-0020	8/28/2020 9:49	2940	Monroe Center	0	meters	InSitu	2.2	NTU
WEL-07-0020	8/28/2020 9:49	2940	Monroe Center	1	meters	InSitu	2.34	NTU
WEL-07-0020	8/28/2020 9:49	2940	Monroe Center	2	meters	InSitu	2.56	NTU
WEL-07-0020	8/28/2020 9:49	2940	Monroe Center	3	meters	InSitu	2.45	NTU
WEL-07-0020	8/28/2020 9:49	2940	Monroe Center	4	meters	InSitu	3.05	NTU
WEL-07-0020	8/28/2020 9:49	2940	Monroe Center	5	meters	InSitu	5.07	NTU
WEL-07-0020	8/28/2020 9:49	2940	Monroe Center	6	meters	InSitu	6.45	NTU
WEL-07-0021	8/28/2020 11:02	2941	Monroe Lower	0	meters	InSitu	1.73	NTU
WEL-07-0021	8/28/2020 11:02	2941	Monroe Lower	1	meters	InSitu	2.06	NTU
WEL-07-0021	8/28/2020 11:02	2941	Monroe Lower	2	meters	InSitu	2.06	NTU
WEL-07-0021	8/28/2020 11:02	2941	Monroe Lower	3	meters	InSitu	2.11	NTU
WEL-07-0021	8/28/2020 11:02	2941	Monroe Lower	4	meters	InSitu	2.02	NTU
WEL-07-0021	8/28/2020 11:02	2941	Monroe Lower	5	meters	InSitu	2.18	NTU
WEL-07-0021	8/28/2020 11:02	2941	Monroe Lower	6	meters	InSitu	2.44	NTU
WEL-07-0021	8/28/2020 11:02	2941	Monroe Lower	7	meters	InSitu	2.24	NTU
WEL-07-0021	8/28/2020 11:02	2941	Monroe Lower	8	meters	InSitu	2.16	NTU
WEL-07-0021	8/28/2020 11:02	2941	Monroe Lower	9	meters	InSitu	10.96	NTU
WEL-07-0021	8/28/2020 11:02	2941	Monroe Lower	10	meters	InSitu	21.58	NTU
WEL-07-0021	8/28/2020 11:02	2941	Monroe Lower	11	meters	InSitu	20.51	NTU
WEL-07-0021	8/28/2020 11:02	2941	Monroe Lower	12	meters	InSitu	13.22	NTU
WEL-07-0021	8/28/2020 11:02	2941	Monroe Lower	13	meters	InSitu	11.71	NTU
WEL-07-0021	8/28/2020 11:02	2941	Monroe Lower	14	meters	InSitu	12.55	NTU
WEL-07-0019	5/27/2020 7:50	0123	Crooked Creek			InSitu	0.79	NTU
WEL-06-0008	5/27/2020 9:20	0256	North Fork Salt Creek			InSitu	36.53	NTU
WEL-05-0001	5/27/2020 10:25	0668	Middle Fork Salt Creek			InSitu	21.75	NTU
WEL-04-0004	5/27/2020 11:21	0914	South Fork Salt Creek			InSitu	28.85	NTU
WEL-08-0036	5/27/2020 13:07	0111	Lake Monroe Outlet			InSitu	4.25	NTU
WEL-07-0019	6/24/2020 9:15	0123	Crooked Creek			InSitu	1.09	NTU
WEL-05-0001	6/24/2020 10:25	0668	Middle Fork Salt Creek			InSitu	13.2	NTU
WEL-04-0004	6/24/2020 11:45	0914	South Fork Salt Creek			InSitu	47.7	NTU
WEL-06-0008	6/24/2020 8:15	0256	North Fork Salt Creek			InSitu	65.3	NTU
WEL-08-0036	6/24/2020 13:55	0111	Lake Monroe Outlet			InSitu	14.2	NTU
WEL-07-0019	7/21/2020 8:30	0123	Crooked Creek			InSitu	4.31	NTU
WEL-05-0001	7/21/2020 9:20	0668	Middle Fork Salt Creek			InSitu	32.3	NTU
WEL-04-0004	7/21/2020 10:40	0914	South Fork Salt Creek			InSitu	47.5	NTU
WEL-06-0008	7/21/2020 11:50	0256	North Fork Salt Creek			InSitu	51	NTU
WEL-08-0036	7/21/2020 13:45	0111	Lake Monroe Outlet			InSitu	13.1	NTU
WEL-07-0019	8/27/2020 9:05	0123	Crooked Creek			InSitu	1.06	NTU
WEL-05-0001	8/27/2020 9:45	0668	Middle Fork Salt Creek			InSitu	4.05	NTU
WEL-04-0004	8/27/2020 11:15	0914	South Fork Salt Creek			InSitu	28.13	NTU
WEL-06-0008	8/27/2020 12:51	0256	North Fork Salt Creek			InSitu	19.98	NTU
WEL-08-0036	8/27/2020 14:09	0111	Lake Monroe Outlet			InSitu	11.14	NTU
WEL-05-0001	9/24/2020 8:30	0668	Middle Fork Salt Creek			InSitu	6.97	NTU
WEL-04-0004	9/24/2020 9:25	0914	South Fork Salt Creek			InSitu	15.32	NTU
WEL-06-0008	9/24/2020 10:35	0256	North Fork Salt Creek			InSitu	61.01	NTU
WEL-08-0036	9/24/2020 12:10	0111	Lake Monroe Outlet			InSitu	486.6	NTU
WEL-05-0001	10/22/2020 9:30	0668	Middle Fork Salt Creek			InSitu	4.57	NTU
WEL-04-0004	10/22/2020 10:40	0914	South Fork Salt Creek			InSitu	26.19	NTU
WEL-06-0008	10/22/2020 11:45	0256	North Fork Salt Creek			InSitu	16.24	NTU
WEL-08-0036	10/22/2020 1:15	0111	Lake Monroe Outlet			InSitu	8.08	NTU

IDEM Site Number	Sample Date	EventID	Sample Name	Depth	Depth Unit	Instrument	Concentration	Unit
WEL-07-0019	11/19/2020 9:00	0123	Crooked Creek			InSitu	0.53	NTU
WEL-06-0008	11/19/2020 9:30	0256	North Fork Salt Creek			InSitu	2.67	NTU
WEL-05-0001	11/19/2020 10:20	0668	Middle Fork Salt Creek			InSitu	86.35	NTU
WEL-04-0004	11/19/2020 11:15	0914	South Fork Salt Creek			InSitu	111.54	NTU
WEL-08-0036	11/19/2020 12:35	0111	Lake Monroe Outlet			InSitu	15.86	NTU
WEL-06-0008	4/22/2020 9:30	0256	North Fork Salt Creek			InSitu	5.67	NTU
WEL-07-0019	4/22/2020 11:30	0123	Crooked Creek			InSitu	0.36	NTU
WEL-05-0001	4/22/2020 13:25	0668	Middle Fork Salt Creek			InSitu	2.95	NTU
WEL-04-0004	4/22/2020 15:00	0914	South Fork Salt Creek			InSitu	5.19	NTU
WEL-08-0036	4/22/2020 16:50	0111	Lake Monroe Outlet			InSitu	7.85	NTU
WEL-06-0008	12/16/2020 9:30	0256	North Fork Salt Creek			InSitu	6.5	NTU
WEL-07-0019	12/16/2020 9:05	0123	Crooked Creek			InSitu	2.63	NTU
WEL-05-0001	12/16/2020 10:35	0668	Middle Fork Salt Creek			InSitu	45.09	NTU
WEL-04-0004	12/16/2020 11:26	0914	South Fork Salt Creek			InSitu	3.33	NTU
WEL-08-0036	12/16/2020 12:45	0111	Lake Monroe Outlet			InSitu	1.92	NTU

Macroinvertebrate Analysis

Stream Site	Crooked Creek
Analyst	Lynnette Murphy
Date Collected	8/27/2020
Date Counted	9/15/2020

mIBI Metric		**Metric Score**
HBI	#DIV/0!	#DIV/0!
No. Taxa (family)	3	1
Total Count (# individuals)	8	1
EPT Index (# families)	1	1
Diptera Index (# families)	1	1
EPT Count (# individuals)	3	0
% Chironomidae	0.0	1
% Non-insect (minus crayfish)	37.5	5
% Intolerant	0.0	1
% Tolerant	37.5	5
% Predators	0.00	1
% Shredders + Scrappers	25.00	5
% Collector-Filters	0.00	5
% Sprawlers	0.00	1
mIBI Score		28.0
		Impaired

Macro Taxa	**Number of Individuals**
Heptageniidae	3
Oniscidea	3
Curculionidea	2

Macroinvertebrate Analysis

Stream Site	North Fork Middle Creek
Analyst	Lynnette Murphy
Date Collected	8/27/2020
Date Counted	9/15/2020

mIBI Metric		Metric Score
HBI	#REF!	#REF!
No. Taxa (family)	12	1
Total Count (# individuals)	26	1
EPT Index (# families)	2	3
Diptera Index (# families)	2	1
EPT Count (# individuals)	4	0
% Chironomidae	0.2	1
% Non-insect (minus crayfish)	23.1	1
% Intolerant	23.1	3
% Tolerant	0.0	1
% Predators	26.92	3
% Shredders + Scrappers	7.69	1
% Collector-Filters	19.23	3
% Sprawlers	0.00	1
mIBI Score		20.0
		Impaired

Macro Taxa	Number of Individuals
Cheumatopsyche	1
Ancyronyx	1
Ephemerella	1
Stenelmis	2
Dineutus	2
Pisidium	4
Chironomidae	4
Metrobates	1
Macronychus	4
Dineutus	1
Mesovelia	3
Pseudosuccinea	1
Strophitus undulatus	1

Macroinvertebrate Analysis

Stream Site	Middle Fork Middle Creek
Analyst	Lynnette Murphy
Date Collected	8/27/2020
Date Counted	9/15/2020

mIBI Metric		Metric Score
HBI	#REF!	#REF!
No. Taxa (family)	7	1
Total Count (# individuals)	27	1
EPT Index (# families)	2	3
Diptera Index (# families)	3	1
EPT Count (# individuals)	10	0
% Chironomidae	0.0	1
% Non-insect (minus crayfish)	7.4	1
% Intolerant	14.8	1
% Tolerant	3.7	1
% Predators	33.33	3
% Shredders + Scrappers	22.22	5
% Collector-Filters	0.00	5
% Sprawlers	0.00	1
mIBI Score		24.0
		Impaired

Macro Taxa	Number of Individuals
Anthopotamus	1
Dubiraphia	11
Calopteryx	6
Stenonema	4
Physa vernalis	1
Helisoma anceps	1
Metrobates	3

Macroinvertebrate Analysis

Stream Site	South Fork Middle Creek
Analyst	Lynnette Murphy
Date Collected	8/27/2020
Date Counted	9/15/2020

mIBI Metric		Metric Score
HBI	#REF!	#REF!
No. Taxa (family)	8	1
Total Count (# individuals)	25	1
EPT Index (# families)	0	1
Diptera Index (# families)	3	1
EPT Count (# individuals)	0	0
% Chironomidae	0.1	1
% Non-insect (minus crayfish)	4.0	1
% Intolerant	0.0	1
% Tolerant	4.0	1
% Predators	56.00	5
% Shredders + Scrappers	4.00	1
% Collector-Filters	8.00	5
% Sprawlers	0.00	1
mIBI Score		20.0
		Impaired

Macro Taxa	Number of Individuals
Dubiraphia	4
Anopheles	2
Sialis	1
Physidae	1
Argia	12
Chironomidae	3
Rheumatobates	1
Suphisellus	1
P. picta	1

Macroinvertebrate Analysis

Stream Site	Lake Monroe Outlet
Analyst	Lynnette Murphy
Date Collected	8/27/2020
Date Counted	9/15/2020

mIBI Metric		Metric Score
HBI	#REF!	#REF!
No. Taxa (family)	4	1
Total Count (# individuals)	4	1
EPT Index (# families)	0	1
Diptera Index (# families)	2	1
EPT Count (# individuals)	0	0
% Chironomidae	0.3	1
% Non-insect (minus crayfish)	0.0	1
% Intolerant	0.0	1
% Tolerant	0.0	1
% Predators	50.00	5
% Shredders + Scrappers	0.00	1
% Collector-Filters	0.00	5
% Sprawlers	0.00	1
mIBI Score		20.0
		Impaired

Macro Taxa	Number of Individuals
Pelocoris	1
Sialis	1
Chironomidae	1

SampleList	CustomerID	System	Site	Station	SampleInfo	Sample Level	DateSampled	NU_per_mL	Cells_per_mL
D20200323T155136	377	Monroe Reservoir	Lower	786	27271006	Epi	6/18/2019	1,152	3,425
D20201022T160437	377	Monroe Reservoir	Upper	786	28301006	Epi	5/26/2020	904	11,752
D20201022T162333	377	Monroe Reservoir	Center	786	28311006	Epi	5/26/2020	653	14,040
D20201022T164352	377	Monroe Reservoir	Lower	786	28321006	Epi	5/26/2020	566	11,057
D20201022T170333	377	Monroe Reservoir	Upper	786	28551006	Epi	6/25/2020	1,658	14,058
D20201022T172321	377	Monroe Reservoir	Center	786	28561006	Epi	6/25/2020	495	4,576
D20201022T174054	377	Monroe Reservoir	Lower	786	28571006	Epi	6/25/2020	1,212	9,816
D20201022T180454	377	Monroe Reservoir	Upper	786	29171006	Epi	7/27/2020	564	14,048
D20201022T182310	377	Monroe Reservoir	Center	786	29181006	Epi	7/27/2020	335	683
D20201023T141328	377	Monroe Reservoir	Lower	786	29191006	Epi	7/27/2020	132	257
D20201023T143827	377	Monroe Reservoir	Upper	786	29171006	Epi	8/28/2020	24,171	163,731
D20201023T181147	377	Monroe Reservoir	Center	786	29181006	Epi	8/28/2020	7,174	58,266
D20201023T183119	377	Monroe Reservoir	Lower	786	29191006	Epi	8/28/2020	2,197	19,435
D20201023T184602	377	Monroe Reservoir	Center	786	29181006	Epi	9/23/2020	3,195	39,192
D20201023T190212	377	Monroe Reservoir	Lower	786	29191006	Epi	9/23/2020	1,353	12,835
D20201023T191642	377	Monroe Reservoir	Upper	786	29171006	Epi	9/23/2020	14,188	129,725
D20201201T164441	377	Monroe Reservoir	Center	786	29451006	Epi	10/26/2020	1,667	11,869
D20201201T181850	377	Monroe Reservoir	Lower	786	29461006	Epi	10/26/2020	1,453	9,676
D20201201T184417	377	Monroe Reservoir	Upper	786	29471006	Epi	10/26/2020	4,956	47,276

SampleList	CustomerID	System	Site	IFCB Biovolume um3/mL	HAB_cell_per_mL	HAB_cell_per_mL_percent	HAB_Biovolume_um3_per_mL	Biovolume_percent_HAB
D20200323T155136	377	Monroe Reservoir	Lower	2,160,351				
D20201022T160437	377	Monroe Reservoir	Upper	1,649,039	115	1	39510	2
D20201022T162333	377	Monroe Reservoir	Center	1,857,230	24	0	3356	0
D20201022T164352	377	Monroe Reservoir	Lower	1,845,465	51	0	21760	1
D20201022T170333	377	Monroe Reservoir	Upper	1,939,425	843	6	85861	4
D20201022T172321	377	Monroe Reservoir	Center	938,464	23	1	3268	0
D20201022T174054	377	Monroe Reservoir	Lower	1,073,657	33	0	3602	0
D20201022T180454	377	Monroe Reservoir	Upper	2,279,735	0	0	0	0
D20201022T182310	377	Monroe Reservoir	Center	391,093	1	0	348	0
D20201023T141328	377	Monroe Reservoir	Lower	118,704	5	2	488	0
D20201023T143827	377	Monroe Reservoir	Upper	9,950,520	121107	74	7615603	77
D20201023T181147	377	Monroe Reservoir	Center	3,864,027	34948	60	2244996	58
D20201023T183119	377	Monroe Reservoir	Lower	2,154,918	15557	80	1081696	50
D20201023T184602	377	Monroe Reservoir	Center	4,707,953	8932	23	1418226	30
D20201023T190212	377	Monroe Reservoir	Lower	1,805,114	4019	31	558175	31
D20201023T191642	377	Monroe Reservoir	Upper	11,677,402	24558	19	3534409	30
D20201201T164441	377	Monroe Reservoir	Center	2,532,779	346	3	46633	2
D20201201T181850	377	Monroe Reservoir	Lower	2,573,563	408	4	64472	3
D20201201T184417	377	Monroe Reservoir	Upper	5,431,830	1102	2	125291	2

Blitz_ID	Creek_Name	Cross_Street	Lat	Long	HUC_12_Name	HUC_10_Name	HUC_12_Num
107	Allens Creek	ROBERTS RD	39.0272	-86.4371	Allens	Lake Monroe	51202080703
111	Lake Monroe Outlet	Monroe Dam Rd	39.0072	-86.5117	Allens	Lake Monroe	51202080703
112	Crooked Creek	Crooked Creek Road	39.1206	-86.3028	Jacobs	Lake Monroe	51202080701
114	Moore Creek	STIPP RD	39.1023	-86.4633	Moore	Lake Monroe	51202080702
115	Butcher Branch	STIPP RD	39.0993	-86.4710	Moore	Lake Monroe	51202080702
123	Crooked Creek	CROOKED CREEK RD	39.1081	-86.3138	Jacobs	Lake Monroe	51202080701
128	Moores Creek	Moores Creek Rd	39.1146	-86.4696	Moore	Lake Monroe	51202080702
141	Unnamed tributary of Lake Monroe	T C STEELE RD	39.1071	-86.3369	Jacobs	Lake Monroe	51202080701
201	Mount Liberty Creek	VALLEY BRANCH RD	39.1868	-86.1469	Gnaw Bone	North Fork	51202080603
202	Gnaw Bone Creek	VALLEY BRANCH RD	39.1920	-86.1479	Gnaw Bone	North Fork	51202080603
208	Lick Creek	Oak Grove Rd	39.2138	-86.2971	Clay Lick	North Fork	51202080604
210	Owl Creek	Oak Grove rd	39.2137	-86.2741	Clay Lick	North Fork	51202080604
225	North Fork Salt Creek	GOLD POINT RD	39.3238	-86.1744	Sweetwater	North Fork	51202080601
226	Unnamed tributary of NF Salt	GOLD POINT RD	39.3166	-86.1675	Sweetwater	North Fork	51202080601
231	Brummett Creek	BRUMMETTS CREEK	39.1671	-86.3987	Brummett	North Fork	51202080605
232	Unnamed tributary of Sweetwater Creel	SWEETWATER TR	39.2702	-86.1422	Sweetwater	North Fork	51202080601
239	East Fork Salt Creek	HOOVER RD	39.2429	-86.0945	East Fork Salt	North Fork	51202080602
250	Clay Lick Creek	OLD SR 46	39.2027	-86.2207	Clay Lick	North Fork	51202080604
251	North Fork Salt Creek	KENT RD	39.1513	-86.3985	Brummett	North Fork	51202080605
256	North Fork Salt Creek	DUBOIS RIDGE RD	39.1732	-86.3194	Clay Lick	North Fork	51202080604
258	Stephens Creek	FRIENDSHIP RD	39.1477	-86.4074	Stephens	North Fork	51202080606
262	Jackson (Yellowwood) Creek		39.1766	-86.3398	Clay Lick	North Fork	51202080604
273	Jackson (Yellowwood) Creek	YELLOWWOOD LAKE RD	39.2144	-86.3445	Clay Lick	North Fork	51202080604
277	Lick Creek	Green Valley Rd	39.1960	-86.2971	Clay Lick	North Fork	51202080604
280	Goodley Branch	MCGOWAN	39.1278	-86.3852	Stephens	North Fork	51202080606
282	Clay Lick Creek	WALLOW HOLLOW RD	39.2218	-86.2041	Clay Lick	North Fork	51202080604
297	Clay Lick Creek	CLAY LICK RD	39.2333	-86.1954	Clay Lick	North Fork	51202080604
303	North Fork Salt Creek	Petro Rd	39.2688	-86.1654	Sweetwater	North Fork	51202080601
305	Unnamed tributary of Greasy Creek	Bear Wallow Hill Rd	39.2396	-86.2303	Clay Lick	North Fork	51202080604
306	Greasy Creek	Bear Hollow RD	39.2333	-86.2359	Clay Lick	North Fork	51202080604
309	Greasy Creek	Memorial Road	39.2073	-86.2402	Clay Lick	North Fork	51202080604
317	East Branch Sweetwater Creek	LUNAPET RD	39.2803	-86.1342	Sweetwater	North Fork	51202080601
321	Mount Liberty Creek	MOUNT LIBERTY RD	39.1776	-86.1029	Gnaw Bone	North Fork	51202080603
325	Unnamed tributary of EF Salt	OGALA HORSE CAMP RD	39.2476	-86.0989	East Fork Salt	North Fork	51202080602
326	Sweetwater Creek	OGALA HORSE CAMP RD	39.2618	-86.1434	Sweetwater	North Fork	51202080601
327	Unnamed tributary of EF Salt	OGALA HORSE CAMP RD	39.2621	-86.1247	East Fork Salt	North Fork	51202080602
332	North Fork Salt Creek	OGALA HORSE CAMP RD	39.2619	-86.1454	Sweetwater	North Fork	51202080601
334	Unnamed tributary of Gnaw Bone	LUCAS HOLLOW RD	39.2124	-86.1251	Gnaw Bone	North Fork	51202080603
338	Stephens Creek	KERR CREEK RD	39.1719	-86.4184	Stephens	North Fork	51202080606
341	Kerr Creek	KERR CREEK RD	39.1755	-86.4328	Stephens	North Fork	51202080606
343	Gnaw Bone Creek	Georgetown Rd	39.2124	-86.1198	Gnaw Bone	North Fork	51202080603
348	North Fork Salt Creek	Brown Hill Rd	39.2108	-86.1699	East Fork Salt	North Fork	51202080602
355	Unnamed tributary of NF Salt	SALT CREEK RD	39.2015	-86.1918	East Fork Salt	North Fork	51202080602
368	Sciscoe Branch	Oak Grove Rd	39.1980	-86.3004	Clay Lick	North Fork	51202080604
369	Upper Schooner Creek	Shipley Hollow	39.1571	-86.2887	Brummett	North Fork	51202080605
373	Green Valley Creek	Green Valley Church Rd	39.1900	-86.2579	Clay Lick	North Fork	51202080604
377	Unnamed tributary of Gnaw Bone	Camp Moneto Rd	39.2030	-86.1414	Gnaw Bone	North Fork	51202080603
385	North Fork Salt Creek	Deer Run Lane	39.1993	-86.2544	Clay Lick	North Fork	51202080604
388	Unnamed tributary of Gnaw Bone	Daugherty Rd	39.1949	-86.1471	Gnaw Bone	North Fork	51202080603
389	North Fork Salt Creek	Salt Creek Trail	39.1997	-86.2452	Clay Lick	North Fork	51202080604
398	North Fork Salt Creek	Salt Creek Golf Course	39.1935	-86.2041	Clay Lick	North Fork	51202080604
404	Henderson Creek	Jordan Lane	39.1997	-86.1206	Gnaw Bone	North Fork	51202080603
409	David Branch	Beech Dr	39.1869	-86.1945	Gnaw Bone	North Fork	51202080603
412	Unnamed tributary of David Branch	SR 135	39.1806	-86.1936	Gnaw Bone	North Fork	51202080603
413	Gnaw Bone Creek	SR 135	39.1903	-86.1922	Gnaw Bone	North Fork	51202080603
419	North Fork Salt Creek	ANNIE SMITH RD	39.2207	-86.1606	East Fork Salt	North Fork	51202080602
425	Stephens Creek	MOUNT GILEAD RD	39.1932	-86.4348	Stephens	North Fork	51202080606
434	Lower Schooner Creek	CROOKED CREEK RD	39.1548	-86.3054	Brummett	North Fork	51202080605
436	North Fork Salt Creek	T C STEELE RD	39.1487	-86.3468	Brummett	North Fork	51202080605
440	Owl Creek	Owl Creek RD	39.2195	-86.2738	Clay Lick	North Fork	51202080604
450	Brummett Creek	BRUMMETTS CREEK RD	39.2035	-86.4022	Brummett	North Fork	51202080605
452	North Fork Salt Creek	VAUGHT RD	39.2911	-86.1664	Sweetwater	North Fork	51202080601
464	Baby Creek	BABY CREEK RD	39.2068	-86.3974	Brummett	North Fork	51202080605
485	Davis Branch	Stevens	39.1449	-86.3404	Brummett	North Fork	51202080605
488	Unnamed tributary of NF Salt	Borders RD	39.2149	-86.1682	East Fork Salt	North Fork	51202080602
492	David Branch	Gnaw Bone Camp Rd	39.1683	-86.1831	Gnaw Bone	North Fork	51202080603

Blitz_ID	Creek_Name	Cross_Street	Lat	Long	HUC_12_Name	HUC_10_Name	HUC_12_Num
495	Conrad Branch	BROCK RD	39.1847	-86.3912	Brummett	North Fork	51202080605
498	Unnamed tributary of NF Salt	Friendship Rd	39.1411	-86.4035	Stephens	North Fork	51202080606
499	North Fork Salt Creek	McGowan	39.1328	-86.3892	Stephens	North Fork	51202080606
608	Pleasant Valley Creek	VALLEY BRANCH RD	39.1502	-86.1545	Pleasant Valley	Middle Fork	51202080502
613	Middle Fork Salt Creek	ORCHARD RD	39.1157	-86.1896	Pleasant Valley	Middle Fork	51202080502
616	Hamilton Creek	Bob Allen Rd	39.0850	-86.1490	Pleasant Valley	Middle Fork	51202080502
621	Gravel Creek	GRAVEL CREEK RD	39.1074	-86.2264	Gravel	Middle Fork	51202080503
623	Hamilton Creek	MOUNT NEBO RD	39.0879	-86.1916	Pleasant Valley	Middle Fork	51202080502
625	Unnamed trib of South Branch Salt	BELLSVILLE RD	39.1425	-86.0690	Headwaters	Middle Fork	51202080501
631	Middle Fork Salt Creek	ELKINSVILLE RD	39.0845	-86.2493	Gravel	Middle Fork	51202080503
636	Little Blue Creek	BLUE CREEK RD	39.0948	-86.2627	Gravel	Middle Fork	51202080503
642	Unnamed tributary of South Branch Salt	Harrison Ridge Rd	39.1643	-86.0989	Headwaters	Middle Fork	51202080501
644	Unnamed tributary of South Branch Salt	Bellsville Pike	39.1445	-86.1081	Headwaters	Middle Fork	51202080501
647	South Branch Salt Creek	Grandview Road	39.1305	-86.1181	Headwaters	Middle Fork	51202080501
662	Middle Fork Salt Creek	Kirks Ford RD	39.0891	-86.2205	Gravel	Middle Fork	51202080503
668	Middle Fork Salt Creek	SR 135	39.0935	-86.2082	Pleasant Valley	Middle Fork	51202080502
669	Hamilton Creek	SR 135	39.0826	-86.1688	Pleasant Valley	Middle Fork	51202080502
670	Strahl Creek	SR 135	39.1197	-86.1891	Pleasant Valley	Middle Fork	51202080502
679	Pleasant Valley Creek	SR 135	39.1301	-86.1589	Pleasant Valley	Middle Fork	51202080502
680	Unnamed tributary of Pleasant Valley Cr	SR 135	39.1371	-86.1624	Pleasant Valley	Middle Fork	51202080502
685	Middle Fork Salt Creek	HAMILTON CREEK RD	39.1277	-86.1420	Headwaters	Middle Fork	51202080501
692	Unnamed tributary of Hamilton Creek	HAMILTON CREEK RD	39.0972	-86.1338	Pleasant Valley	Middle Fork	51202080502
697	South Branch Salt Creek	Grandview Road	39.1438	-86.1062	Headwaters	Middle Fork	51202080501
700	Spanker Branch	Elkinsville Rd	39.0714	-86.2635	Gravel	Middle Fork	51202080603
702	Pension Branch	Mount Nebo Road	39.0780	-86.1966	Pleasant Valley	Middle Fork	51202080502
805	Lincoln Back Branch	Young-Maumee Rd	39.0319	-86.2736	Negro	South Fork	51202080404
808	Callahan Branch	CR 825 N	38.9939	-86.2411	Tipton	South Fork	51202080403
809	Combs Branch	Young-Maume Road	39.0394	-86.2780	Negro	South Fork	51202080404
814	South Fork Salt Creek	CR825 N	38.9943	-86.2344	Tipton	South Fork	51202080403
816	Little Salt Creek	SR 135	39.0377	-86.1494	Little Salt	South Fork	51202080402
819	Little Salt Creek	SR 135	38.9552	-86.1309	Kiper	South Fork	51202080401
824	Little Salt Creek	Buffalo Pike	39.0150	-86.1864	Little Salt	South Fork	51202080402
831	Unnamed tributary of Little Salt (Kiper) (	CR 675 N	38.9737	-86.1229	Kiper	South Fork	51202080401
836	Tipton Creek	N 980 W	38.9633	-86.2231	Tipton	South Fork	51202080403
843	Little Salt Creek	SR 258 WB	38.9849	-86.0958	Kiper	South Fork	51202080401
844	Runt Run	SR 258 WB	38.9847	-86.1019	Kiper	South Fork	51202080401
846	Little Salt Creek	Garrity Road	39.0755	-86.1030	Little Salt	South Fork	51202080402
853	South Fork Salt Creek	Cleveland St	38.9629	-86.2034	Tipton	South Fork	51202080403
855	Unnamed tributary of SF Salt	Pike Rd	38.9663	-86.2034	Tipton	South Fork	51202080403
857	South Fork Salt Creek	CR 725 N	38.9799	-86.2174	Tipton	South Fork	51202080403
867	Cross Branch	BUFFALO PIKE	39.0341	-86.1678	Little Salt	South Fork	51202080402
869	Unnamed tributary of Runt Run	CR 850 N	39.0006	-86.0980	Kiper	South Fork	51202080401
877	South Fork Salt Creek	SR 58	38.9592	-86.1572	Tipton	South Fork	51202080403
881	Kiper Creek	SR 58	38.9662	-86.1335	Kiper	South Fork	51202080401
882	Bee Creek	SR 58	38.9534	-86.1794	Tipton	South Fork	51202080403
884	Runt Run	SR 58	38.9957	-86.1112	Kiper	South Fork	51202080401
886	Starnes Branch	CR 800N	38.9946	-86.2650	Negro	South Fork	51202080404
895	Little Salt Creek	CR 1075 N	39.0310	-86.1726	Little Salt	South Fork	51202080402
901	Unnamed tributary of Kiper Creek	CR850 N	38.9989	-86.1458	Kiper	South Fork	51202080401
903	Pruitt Branch	BUFFALO PIKE	39.0202	-86.1820	Little Salt	South Fork	51202080402
905	Negro Creek	CR 1200 N	39.0033	-86.2625	Negro	South Fork	51202080404
909	Unnamed tributary of Kiper Creek	CR 680 N	38.9738	-86.1391	Kiper	South Fork	51202080401
912	Kiper Creek	CR 680 N	38.9738	-86.1357	Kiper	South Fork	51202080401
914	South Fork Salt Creek	W 1000 N	39.0219	-86.2607	Negro	South Fork	51202080404
915	Unnamed tributary of Little Salt	W 1000 N	39.0198	-86.2022	Little Salt	South Fork	51202080402
918	Unnamed tributary of Little Salt	W 1000 N	39.0196	-86.2280	Little Salt	South Fork	51202080402
920	Unnamed tributary of Little Salt	CR 940 N	39.0126	-86.2027	Little Salt	South Fork	51202080402
924	Combs Creek	CR 1140	39.0335	-86.2615	Negro	South Fork	51202080404
930	Kiper Creek	SR 135	39.0021	-86.1517	Kiper	South Fork	51202080401

Blitz_ID	Substrate Size	Smother	Silting	Fish Cover	Stream Shape	Alterations	Riparian Width	Land Use	Bank Erosion	Stream Shading	Pool Depth	Flow Types	Riffle Run	Riffle Run Sub	Fall CQHEI Total
107	10	5	5	6	8	12	5	5	4	3	0	0	0	0	**63.0**
111	14	5	5	4	0	0	5	2	4	0	8	5	6	7	**65.0**
112	10	5	5	12	3	9	8	5	4	3	0	0	0	0	**64.0**
114	0	0	0	8	8	9	8	5	2	0	4	1	0	0	**45.0**
115	12	5	5	8	8	9	8	5	2	3	0	0	0	0	**65.0**
123	6	5	5	8	3	9	8	5	4	3	0	0	0	0	**56.0**
128	14	5	5	6	6	9	8	5	2	3	0	0	0	0	**63.0**
141	10	5	5	12	3	9	5	5	4	3	0	0	0	0	**61.0**
201	10	5	5	6	4	9	5	3	2	2	2	1	0	0	**54.0**
202	6	0	0	8	3	9	8	1	4	3	4	1	0	0	**47.0**
208	12	5	5	10	6	9	8	0	2	0	0	0	0	0	**57.0**
210	10	0	0	6	3	6	5	2	4	2	4	1	0	4	**47.0**
225	14	5	5	14	8	12	5	4.5	4	3	0	0	0	0	**74.5**
226	14	5	5	10	8	12	5	4.5	4	3	0	1	4	0	**75.5**
231	10	0	0	10	8	9	5	1	2	2	4	1	0	0	**52.0**
232	6	0	5	10	3	9	8	3	2	3	4	1	0	0	**54.0**
239	10	0	0	10	6	6	5	3.5	2	3	0	0	0	0	**45.5**
250	10	0	0	16	8	9	5	5	2	2	4	1	0	3.7	**65.7**
251	3	0	0	12	8	9	8	4.5	4	2	8	1	0	0	**59.5**
256	5.3	0	0	14	3	0	5	2.5	0	2	8	1	4	4	**48.8**
258	0	0	0	6	3	9	5	5	0	2	6	1	0	0	**37.0**
262	14	5	0	8	6	6	6.5	3.7	2	2	4	2	4	3.5	**66.7**
273	10	5	5	12	3	6	5	3.7	2	2	2	0	0	3.5	**59.2**
277	14	0	0	12	0	9	5	1	2	3	4	1	0	0	**51.0**
280	14	5	0	12	3	9	8	4.5	4	2	4	0	0	0	**65.5**
282	14	0	0	14	8	12	5	5	2	3	4	0	0	3.7	**70.7**
297	14	0	0	6	6	9	5	1.5	2	2	0	0	0	3.7	**49.2**
303	10	0	5	14	8	9	5	3	4	3	0	1	4	4	**70.0**
305	10	5	5	4	3	0	0	1.5	2	2	0	0	4	4	**40.5**
306	10	5	5	8	6	6	5	1	2	2	0	1	4	4	**59.0**
309	10	5	5	8	6	0	0	2	2	0	0	0	4	4	**46.0**
317	10	5	5	6	3	6	5	3	2	3	4	1	0	0	**53.0**
321	14	0	5	4	3	6	0	2	4	3	0	0	0	0	**41.0**
325	10	5	0	10	8	6	5	4	2	3	0	0	0	0	**53.0**
326	0	0	0	10	6	9	5	3	2	3	4	1	4	4	**51.0**
327	10	5	0	8	3	9	5	1	2	3	0	0	0	0	**46.0**
332	10	0	0	10	6	9	8	2	2	2	4	1	0	0	**54.0**
334	14	5	5	12	8	9	8	4.5	2	3	2	0	0	0	**72.5**
338	10	0	0	12	8	6	5	1	2	2	6	2	0	4	**58.0**
341	10	5	5	10	8	12	5	5	4	3	4	1	0	0	**72.0**
343	12	5	5	8	3	6	6.5	2.7	2	3	4	0	0	0	**57.2**
348	6	5	0	8	3	12	8	3	4	3	5	2	4	0	**63.0**
355	10	5	5	2	3	9	8	4.5	2	3	0	0	0	0	**51.5**
368	14	5	5	10	3	9	5	3	2	3	0	0	0	0	**59.0**
369	10	5	0	8	3	9	5	5	2	3	6	1	0	0	**57.0**
373	12	5	5	6	3	12	5	1	2	3	4	0	0	0	**58.0**
377	12	5	5	4	8	9	6.5	3.3	4	3	0	0	0	0	**59.8**
385	12	5	0	14	3	12	8	2	2	3	8	1	0	0	**70.0**
388	10	5	0	2	6	6	5	1	4	3	0	0	0	0	**42.0**
389	14	0	0	10	3	12	5	5	4	2	4	1	0	7	**67.0**
398	6	0	0	8	8	9	8	2	2	2	6	1	4	4	**60.0**
404	10	5	5	8	8	9	5	1	2	3	4	1	0	0	**61.0**
409	14	0	0	6	3	6	8	1	2	3	4	0	0	7	**54.0**
412	14	5	5	4	0	6	5	1	2	2	0	0	0	7	**51.0**
413	14	5	5	10	3	9	8	3	2	3	4	1	0	7	**74.0**
419	10	0	0	8	8	9	8	3.3	4	3	6	1	4	7	**71.3**
425	10	5	5	10	8	9	5	1	2	2	4	1	4	4	**70.0**
434	10	0	0	10	8	9	5	5	4	3	6	1	0	4	**65.0**
436	0	0	0	10	3	6	8	1	4	3	8	1	0	0	**44.0**
440	6	0	0	8	6	6	5	1	2	3	4	1	4	4	**50.0**
450	10	0	0	12	8	9	5	3	2	2	4	1	4	7	**67.0**
452	14	5	5	12	6	9	5	3	4	3	4	0	0	0	**70.0**
464	6	0	0	6	6	9	5	0	2	3	0	0	0	0	**37.0**
485	12	0	0	6	6	9	6.5	1.5	3	2	0	0	0	0	**46.0**
488	10	5	0	4	6	12	5	4	2	2	0	0	0	0	**50.0**
492	10	5	5	8	6	9	5	5	4	3	4	1	0	4	**69.0**
495	14	5	5	12	6	9	5	2	2	3	0	0	0	0	**63.0**
498	14	0	0	14	8	9	5	5	0	3	4	1	4	7	**74.0**

499	0	0	0	6	3	9	5	4.5	4	3	4	0	0	0	**38.5**
608	14	5	5	4	3	12	5	2	4	2	0	0	0	0	**56.0**
613	10	0	0	12	3	9	5	0	2	3	4	1	0	0	**49.0**
616	0	0	0	6	8	0	5	5	2	3	4	1	0	0	**34.0**
621	14	5	5	6	6	9	5	5	4	3	0	0	0	0	**62.0**
623	14	0	5	12	8	9	6.5	5	4	2.5	7	1	0	0	**74.0**
625	10	5	0	10	8	9	8	5	2	3	0	0	0	0	**60.0**
631	0	5	5	10	3	9	5	5	4	2	8	1	0	0	**57.0**
636	10	5	0	10	6	12	5	4	2	2	6	0	0	4	**66.0**
642	14	5	5	4	8	12	5	5	4	3	4	0	0	0	**69.0**
644	10	5	5	6	3	0	8	5	2	3	4	0	0	0	**51.0**
647	10	2.5	0	16	8	12	5	4	2	3	6	1	0	0	**69.5**
662	0	0	0	10	6	9	5	1	0	2	7	1	0	0	**41.0**
668	14	0	0	10	6	9	5	1	2	2	8	0	0	0	**57.0**
669	10	5	0	6	8	9	5	1	2	2	4	1	0	0	**53.0**
670	6	5	0	10	8	9	5	3	4	3	0	0	0	0	**53.0**
679	6	5	5	2	6	12	5	1	2	2	0	0	0	0	**46.0**
680	14	5	5	6	3	12	5	5	4	2	0	1	4	7	**73.0**
685	6	5	0	10	6	9	5	2	2	3	4	1	4	4	**61.0**
692	14	0	0	10	8	9	5	5	4	3	4	1	0	0	**63.0**
697	10	0	2.5	10	8	12	5	2	2	2	4	1	4	4	**66.5**
700	10	5	0	6	6	4.5	5	5	4	3	0	0	0	0	**48.5**
702	12	5	5	4	6	9	5	5	2	3	0	0	0	0	**56.0**
805	12	5	5	6	6	12	5	5	4	3	0	0	0	0	**63.0**
808	10	5	0	8	6	9	5	5	2	3	0	0	0	0	**53.0**
809	10	5	5	2	6	9	5	3	2	3	0	0	0	0	**50.0**
814	10	5	5	6	6	9	8	3	4	2	6	1	0	0	**65.0**
816	12	5	0	10	6	6	8	0	2	3	4	1	0	0	**57.0**
819	10	5	0	6	3	9	5	1	4	3	6	1	0	0	**53.0**
824	12	5	5	14	3	7.5	2.5	2	4	2	6	0.5	4	7	**74.5**
831	10	5	5	6	8	6	8	1.5	2	3	4	1	0	0	**59.5**
836	14	5	5	12	8	12	8	5	4	3	6	2	0	5.5	**89.5**
843	14	0	0	4	8	9	5	1	2	2	4	1	0	0	**50.0**
844	14	0	0	4	3	9	5	1	2	3	4	0	0	0	**45.0**
846	10	5	5	6	8	12	5	5	4	3	0	0	0	0	**63.0**
853	0	0	0	12	3	9	5	1	4	3	8	1	4	7	**57.0**
855	10	5	5	4	0	0	5	1	4	2	4	0	0	4	**44.0**
857	0	0	0	10	3	12	5	1.3	2	3	6	1	4	0	**47.3**
867	14	0	5	12	3	9	5	2	2	3	4	1	0	0	**60.0**
869	10	0	0	6	6	6	6	5	2	3	4	0	0	0	**48.0**
877	14	5	0	8	3	9	8	2	4	3	6	1	0	0	**63.0**
881	10	5	0	6	3	9	5	1	4	2	6	1	0	0	**52.0**
882	14	5	5	4	3	9	5	2	4	3	0	1	0	0	**55.0**
884	3	0	0	10	8	9	5	3	2	3	8	1	4	4	**60.0**
886	14	5	0	8	6	9	8	5	2	3	0	0	0	0	**60.0**
895	10	5	0	10	3	9	8	2	4	3	4	1	0	0	**59.0**
901	6	5	5	8	6	9	5	3	2	3	4	0	0	0	**56.0**
903	6	5	5	14	6	9	5	1	2	3	4	1	0	0	**61.0**
905	10	5	5	4	3	9	6.5	5	4	3	0	0	0	0	**54.5**
909	10	5	5	4	8	9	5	3	4	2	4	0	0	0	**59.0**
912	10	5	0	8	6	9	5	1	2	3	4	1	0	0	**54.0**
914	12	0	0	10	4.5	9	5	5	2	2	4	1	0	0	**54.5**
915	10	5	5	4	3	7.5	5	1	4	2	0	0	0	0	**46.5**
918	10	5	5	14	6	9	8	5	4	3	5	0	0	4	**78.0**
920	10	5	5	12	6	9	8	3	2	3	4	0	0	0	**67.0**
924	8	5	5	6	3	9	5	5	2	3	2	0	0	0	**53.0**
930	14	5	5	4	6	9	5	1	4	3	4	1	0	0	**61.0**

Blitz_ID	Substrate Size	Smother	Silting	Fish Cover	Stream Shape	Alterations	Riparian Width	Land Use	Bank Erosion	Stream Shading	Pool Depth	Flow Types	Riffle Run	Riffle Run Sub	Spring CQHEI Total
107	10	5	5	14	7	9	5	5	4	2	0	5	5	7	**83.0**
111	14	5	5	4	0	0	8	5	4	0	8	5	8	7	**73.0**
112	14	5	5	6	6	6	5	5	2	3	0	2	4	7	**70.0**
114	0	0	0	4	0	9	8	5	0	3	8	0	0	0	**37.0**
115	10	5	5	8	8	9	8	5	2	3	6	4	5	4	**82.0**
123	8	5	5	12	6	9	5	5	2	3	4	2	0	0	**66.0**
128	10	5	0	8	8	9	8	4	2	3	4	5	6	4	**76.0**
141	6	5	5	14	8	9	5	5	2	3	8	1	0	0	**71.0**
201	14	0	0	12	3	9	5	3	2	3	6	1.5	0	4	**62.5**
202	10	0	0	14	0	9	5	0.5	2	3	4	3	6	4	**60.5**
208	14	0	0	6	6	6	0	2.5	2	0	4	2	6	7	**55.5**
210	10	5	5	10	3	9	5	1	2	2	0	4	6	0	**62.0**
225	10	5	5	14	8	9	5	5	2	3	4	4	4	4	**82.0**
226	12	5	5	14	8	9	5	2	2	2	4	4	5	5.5	**82.5**
231	14	0	0	16	3	9	8	4.5	0	2	6	1	6	4	**73.5**
232	10	5	0	4	3	9	5	3	2	2	4	5	4	4	**60.0**
239	10	0	0	10	8	9	5	5	2	3	6	5	6	4	**73.0**
250	10	5	5	18	3	9	8	5	0	2	0	5	6	5.5	**81.5**
251	0	0	0	14	8	12	8	3	2	3	8	1	0	0	**59.0**
256	0	0	0	8	0	9	8	1	2	2	0	1	6	0	**37.0**
258	0	0	0	0	3	9	5	2.5	2	3	8	1	0	0	**33.5**
262	14	0	0	10	6	6	8	2	2	2	4	1	0	7	**62.0**
273	10	0	5	8	3	9	5	2.5	2	2	4	1	4	4	**59.5**
277	10	5	0	6	3	9	5	0.5	2	2	4	2	6	7	**61.5**
280	6	0	0	16	8	12	8	5	4	3	6	0	0	0	**68.0**
282	10	5	5	12	6	9	8	5	4	2	4	5	6	7	**88.0**
297	14	5	5	12	3	9	5	3.5	2	2	4	5	6	7	**82.5**
303	8	5	0	10	3	9	5	5	0	2	4	4	4	4	**63.0**
305	10	5	5	4	3	6	0	5	2	2	0	1	4	4	**51.0**
306	6	5	5	6	6	6	5	5	2	2	4	4	4	4	**64.0**
309	10	5	5	6	8	9	5	2	4	2	4	5	6	7	**78.0**
317	10	5	5	6	6	9	6.5	2	4	2	4	4	6	7	**76.5**
321	10	5	2.5	10	6	9	5	4	2	2	2	5	6	7	**75.5**
325	10	0	0	16	8	9	5	3	2	3	6	4	6	7	**79.0**
326	10	5	0	6	8	7.5	5	3.5	2	2	6	4	6	4	**69.0**
327	10	5	0	10	6	9	5	2	4	2	4	5	6	4	**72.0**
332	10	0	0	12	6	12	6.5	3	4	2	8	4	8	4	**79.5**
334	10	5	5	8	8	6	5	2.3	1	2	6	5	6	7	**76.3**
338	10	0	0	12	3	9	0	5	2	2	8	0	0	0	**51.0**
341	10	5	5	6	3	9	5	5	4	2	4	5	5	5.5	**73.5**
343	8	5	0	4	3	6	5	2	2	2	4	5	4	4	**54.0**
348	10	0	0	12	0	12	5	1	4	2	4	3	8	4	**65.0**
355	10	5	5	0	6	9	5	2	2	2	0	1	4	4	**55.0**
368	10	5	0	8	3	9	5	5	0	2	4	1	4	4	**60.0**
369	12	5	5	16	8	9	5	2	2	2	0	3	6	7	**82.0**
373	14	5	5	12	7	6	5	3.7	2	2	0	3	6	5.5	**76.2**
377	10	5	5	8	8	6	5	3	2	0	4	5	6	5.5	**72.5**
385	6	0	0	8	8	6	5	3	2	2	8	2	0	0	**50.0**
388	10	5	0	10	8	9	5	0	2	2	4	3	6	4	**68.0**
389	10	0	0	14	6	12	5	2	2	3	8	5	6	4	**77.0**
398	14	5	0	10	3	9	0	2	0	2	8	1	0	0	**54.0**
404	10	5	5	8	8	6	5	2.5	2	2	4	5	6	7	**75.5**
409	14	5	5	10	3	9	5	2.5	2	3	8	5	5	7	**83.5**
412	10	5	5	4	3	9	5	1	2	3	2	2	4	4	**59.0**
413	10	5	3	6	3	9	5	0	4	3	4	1	4	4	**61.0**
419	10	5	0	6	0	9	5	0	2	3	8	1	6	7	**62.0**
425	14	0	0	10	3	12	5	5	4	3	4	1	8	7	**76.0**
434	10	5	5	16	8	6	5	3	2	3	8	2	4	4	**81.0**
436	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**-**
440	6	5	5	6	3	6	5	1	2	2	0	2	4	4	**51.0**
450	10	5	0	18	8	9	5	3	2	2	8	1	4	4	**79.0**
452	12	5	5	18	3	9	8	2	4	2	8	5	7	6	**94.0**
464	14	5	5	14	3	9	0	4.5	0	2	0	1	4	4	**65.5**
485	10	5	0	6	3	9	5	2	4	2	0	2	4	7	**59.0**
488	10	5	5	0	3	12	5	5	2	3	4	1	4	4	**63.0**

Blitz_ID	Substrate Size	Smother	Silting	Fish Cover	Stream Shape	Alterations	Riparian Width	Land Use	Bank Erosion	Stream Shading	Pool Depth	Flow Types	Riffle Run	Riffle Run Sub	Spring CQHEI Total
492	14	5	5	4	6	9	5	4	4	2	2	5	6	7	**78.0**
495	14	5	5	14	6	9	5	3	4	3	4	1	4	4	**81.0**
498	14	0	0	12	8	9	5	3	2	3	8	1	0	0	**65.0**
499	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**-**
608	14	5	5	4	3	3	0	2	2	0	0	5	6	7	**56.0**
613	12	5	0	10	6	9	5	3	2	3	4	1	8	6	**74.0**
616	10	5	5	10	8	9	5	0	2	2	4	5	6	4	**75.0**
621	10	5	5	6	6	12	5	5	2	2	0	1	6	4	**69.0**
623	10	5	5	6	8	9	6.5	5	2	2	4	3	4	4	**73.5**
625	10	5	0	14	8	9	5	3	2	2	4	5	6	4	**77.0**
631	0	0	0	10	3	12	8	5	2	2	8	1	0	0	**51.0**
636	10	0	0	4	6	9	5	5	0	2	4	5	6	4	**60.0**
642	14	5	5	10	8	9	2.5	3.5	1	3	2	5	6	7	**81.0**
644	10	0	0	12	8	9	5	1	2	2	6	7	4	6	**72.0**
647	14	0	0	16	8	9	7	2	4	3	6	6	6	4	**85.0**
662	0	0	0	8	6	6	0	3	4	3	8	1	0	0	**39.0**
668	14	5	0	6	6	6	8	3	2	3	4	1	0	0	**58.0**
669	10	5	5	4	8	6	5	1	2	2	4	1	4	4	**61.0**
670	10	5	0	8	3	6	5	3	2	2	4	3	7	4	**62.0**
679	10	5	0	10	6	8	5	1	2	2	0	2	6	4	**61.0**
680	12	5	5	4	6	9	5	5	4	3	4	4	6	7	**79.0**
685	14	5	0	8	6	9	5	2	2	2	4	4	6	7	**74.0**
692	14	5	5	12	8	9	5	2	2	3	4	5	4	7	**85.0**
697	14	0	0	14	8	9	5	2	2	2	4	5	6	7	**78.0**
700	6	5	5	2	6	12	5	5	2	2	4	1	4	4	**63.0**
702	12	5	5	4	6	9	5	3.5	2	3	0	1	4	5.5	**65.0**
805	14	5	0	6	8	9	5	3	2	2	6	1	0	0	**61.0**
808	6	0	5	14	6	11	5	5	0	2	4	2	6	4	**70.0**
809	10	5	5	8	4.5	9	5	1	2	2	4	1	6	5.5	**68.0**
814	0	5	0	4	6	9	0	1	0	2	6	2	8	0	**43.0**
816	8	5	5	12	6	9	5	2	2	2	4	3	8	4	**75.0**
819	10	5	5	4	6	7.5	5	2	2	3	4	1	4	4	**62.5**
824	14	5	5	12	6	9	5	3.5	4	2	4	4	6	7	**86.5**
831	10	0	5	4	8	9	5	2	2	0	0	1	4	4	**54.0**
836	10	0	0	14	8	12	5	3.3	2	3	4	5	6	4	**76.3**
843	14	0	0	10	8	9	8	1	2	3	4	2	4	7	**72.0**
844	6	5	0	16	8	9	5	1	2	3	8	1	6	7	**77.0**
846	10	5	5	12	8	9	5	5	2	3	4	5	6	4	**83.0**
853	0	0	0	10	3	9	5	2	0	0	8	5	6	7	**55.0**
855	10	5	5	0	0	9	0	1	4	0	4	4	4	4	**50.0**
857	0	0	0	14	0	9	5	0.5	2	3	8	1	0	0	**42.5**
867	14	5	5	8	6	9	5	2	2	2	4	4	6	7	**79.0**
869	10	0	0	8	8	9	5	5	2	3	4	1	4	0	**59.0**
877	12	5	5	10	6	9	8	2	4	3	8	1	5	7	**85.0**
881	7	0	0	8	3	6	2.5	2	2	2	6	1	4	3.5	**47.0**
882	12	5	5	6	6	6	5	2	2	2	4	2	5	5.5	**67.5**
884	8	0	0	12	8	6	6.5	2.5	2	2	8	1	4	7	**67.0**
886	14	0	5	8	6	9	0	5	2	2	4	1	6	7	**69.0**
895	8	5	0	4	3	9	5	1.5	2	2	8	4	6	4	**61.5**
901	12	0	2.5	6	6	7.5	0	1.3	2	1	0	1	4	7	**50.3**
903	10	5	5	6	8	9	0	2.5	1	2	4	3	6	7	**68.5**
905	10	5	5	6	6	9	5	5	2	3	4	2	6	4	**72.0**
909	10	0	0	6	8	9	5	1	2	2	4	1	4	4	**56.0**
912	14	5	0	2	8	6	5	2	2	3	4	3	8	7	**69.0**
914	14	5	0	10	8	9	6.5	5	2	2	8	1	0	0	**70.5**
915	10	5	5	16	6	9	5	0.5	2	2	0	5	6	4	**75.5**
918	10	5	5	14	6	9	8	5	4	3	6	5	6	7	**93.0**
920	10	5	5	16	8	9	4	3	2	2	4	4	6	4	**82.0**
924	10	5	5	12	3	9	5	5	2	2	8	4	6	4	**80.0**
930	5	0	0	6	6	9	0	4	2	2	0	4	5	2	**45.0**

Blitz_ID	pre_E.Coli	E. Coli (MPN/100ml)	pre_TSS	TSS (mg/L)	pre_TP	TP (mg/L)	e_SRP	SRP (mg/L)	pre_TN	TN (mg/L)	pre_NO3	NO3 (mg/L)	pre_NH3	NH3 (mg/L)	Unionized NH3 (ug/L)	Hardness (ppm)	Temp (deg C)	pH
107																-		
111		9.7		6.5		0.026		0.014		0.308	<	0.008		0.154	0.080	120	24.0	6.0
112																-		
114		2		7.5		0.011		0.002		0.123	<	0.008		0.036	0.013	120	19.0	6.0
115																-		
123																-		
128																-		
141																-		
201		88.6		1.2	<	0.002		0.003	<	0.100		0.010		0.020	0.006	220	17.0	6.0
202		35		0.5	<	0.002		0.003	<	0.100		0.029		0.014	0.004	175	17.0	6.0
208																-		
210	<	1		1.7	<	0.002	<	0.002		0.108	<	0.008		0.027	0.014	250	24.0	6.0
225																-		
226		4.1	<	0.5	<	0.002		0.008		0.100		0.046		0.017	0.006	120	18.5	6.0
231		18.1		2.5	<	0.002	<	0.002		0.135		0.010		0.038	0.011	220	16.5	6.0
232		4.1		1.8	<	0.002		0.004	<	0.100		0.038	<	0.014	0.011	-	25.0	6.0
239																-		
250		8.6		2.7	<	0.002		0.003	<	0.100	<	0.008		0.021	0.019	185	16.0	6.5
251		9.8		9.0		0.016		0.003		0.420	<	0.008		0.016	n/a	-		
256		4		6.7		0.020		0.003		0.251	<	0.008	<	0.014	0.005	175	17.8	6.0
258		186		7.8		0.024		0.002		0.162	<	0.008		0.029	0.009	120	17.0	6.0
262		4.1		1.2		0.014	<	0.002		0.105	<	0.008		0.021	0.007	175	17.8	6.0
273	<	1		2.2		0.017		0.003	<	0.100		0.013		0.027	0.007	15	14.4	6.0
277		378		0.5		0.016		0.002	<	0.100	<	0.008		0.042	0.014	120	18.0	6.0
280		3		8.3		0.028		0.003		0.380	<	0.008		0.095	n/a	-		
282		214		4.3		0.028		0.004		0.259	<	0.008		0.025	0.007	120	14.5	6.0
297																-		
303		3.1		0.7		0.009		0.006	<	0.100		0.008		0.016	0.010	250	20.0	6.0
305																-		
306		23	<	0.5	<	0.002		0.006	<	0.100		0.028		0.025	0.226	250	15.8	7.5
309		73.3		5.0		0.003		0.003		0.163	<	0.008		0.035	0.392	250	17.4	7.5
317		920.8		2.3	<	0.002		0.004		0.136		0.075		0.035	0.020	-	25.0	6.0
321																-		
325																-		
326		9.8	<	0.5	<	0.002		0.003	<	0.100		0.036		0.023	0.015	-	27.0	6.0
327																-		
332		21.6	<	0.5	<	0.002		0.004	<	0.100		0.022		0.034	0.010	-	16.0	6.0
334																-		
338		920.8		2.2	<	0.002		0.002		0.309		0.253		0.027	0.008	120	16.0	6.0
341		410.6		2.0	<	0.002		0.003	<	0.100	<	0.008		0.025	0.007	250	16.0	6.0
343																-		
348		167		5.5		0.003		0.003		0.115	<	0.008		0.031	0.011	200	18.0	6.0
355																-		
368																-		
369		160.9		0.7	<	0.002		0.006		0.109		0.116		0.027	0.025	185	16.0	6.5
373		27.5		1.2	<	0.002		0.003		0.171		0.052		0.076	0.026	256	18.0	6.0
377																-		
385		9.7		2.8	<	0.002		0.005		6.792		6.605		0.042	0.013	250	17.0	6.0
388																-		
389		16.1		2.5	<	0.002		0.003	<	0.100		0.012		0.033	0.013	120	19.5	6.0
398		1986.3		5.2		0.002		0.003		0.109	<	0.008		0.047	0.016	120	18.0	6.0
404		727	<	0.5	<	0.002		0.004	<	0.100		0.059		0.028	0.008	250	15.0	6.0
409		7.4		2.3	<	0.002		0.004		0.118		0.014		0.053	0.017	220	17.0	6.0
412																-		
413		47.1	<	0.5	<	0.002		0.003		0.100		0.011		0.024	0.007	120	16.0	6.0
419		57.3		15.0		0.008	<	0.002		0.145		1.074		0.032	0.009	120	16.0	6.0
425		1986.3		3.0	<	0.002		0.007		0.269		0.221		0.031	0.009	120	16.0	6.0
434		54.6		0.7	<	0.002	<	0.002	<	0.100		0.019		0.031	0.010	120	17.0	6.0
436		21.3		14.5		0.008	<	0.002		0.174	<	0.008		0.035	n/a	-		
440		298.7		17.2		0.006	<	0.002		0.402		0.204		0.034	0.328	250	15.7	7.5
450	<	1		0.7	<	0.002		0.002	<	0.100		0.063		0.031	0.010	240	17.0	6.0
452																-		
464		57.3		0.5	<	0.002		0.002	<	0.100		0.011		0.030	0.009	240	16.0	6.0
485																-		
488		180.7		639.2		0.235		0.014		2.154	<	0.008		0.083	0.226	425	15.0	7.0
492		14.6		1.0		0.017		0.019	<	0.100		0.043		0.022	0.006	250	15.0	6.0
495																-		
498		1		2.5		0.004		0.002	<	0.100	<	0.008		0.025	0.008	120	16.5	6.0
499	<	1		22.7		0.143		0.009		2.420	<	0.008		1.268	n/a	-		

Blitz_ID	pre_E.Coli	E. Coli (MPN/100ml)	pre_TSS	TSS (mg/L)	pre_TP	TP (mg/L)	pre_SRP	SRP (mg/L)	pre_TN	TN (mg/L)	pre_NO3	NO3 (mg/L)	pre_NH3	NH3 (mg/L)	Unionized NH3 (ug/L)	Hardness (ppm)	Temp (deg C)	pH
608																-		
613		20.4		0.5		0.005		0.002	<	0.100	<	0.008		0.032	0.011	120	18.0	6.0
616		137.4		40.0		0.019		0.002	<	0.100	<	0.008		0.016	0.005	120	16.0	6.0
621		57.3		2.5		0.007		0.004	<	0.100	<	0.008		0.018	0.006	250	17.0	6.0
623		23.1		1.2		0.005		0.002	<	0.100	<	0.008	<	0.014	0.004	120	17.0	6.0
625																-		
631																120		
636		2		1.5		0.002		0.003	<	0.100	<	0.008	<	0.014	0.004	120	16.7	6.0
642																-		
644	>	2419.6		10.0		0.033		0.003		0.446		0.017		0.050	0.015	222	16.0	6.0
647		21.3		5.2		0.010		0.002	<	0.100	<	0.008	<	0.014	0.005	222	17.5	6.0
662	<	1		28.5		0.101		0.005		1.208	<	0.008	<	0.014	0.051	120	19.0	7.0
668		110.6		7.0		0.029		0.003		0.323		0.012		0.052	0.016	120	17.0	6.0
669		20.3		1.2	<	0.002	<	0.002		0.230		0.230	<	0.014	0.005	180	18.0	6.0
670																-		
679																-		
680		43.5		1.0	<	0.002		0.003	<	0.100		0.090	<	0.014	0.005	185	18.0	6.0
685		648.8		1.5		0.006		0.002	<	0.100		0.020	<	0.014	0.004	120	17.0	6.0
692		488.4	<	0.5		0.002		0.005		0.111		0.138	<	0.014	0.004	120	16.0	6.0
697		2419.6		30.7		0.026		0.002	<	0.100		0.012	<	0.014	0.006	205	20.0	6.0
700		6.3		16.5		0.022		0.004		0.169	<	0.008	<	0.014	n/a	-		
702																-		
805																-		
808																-		
809																-		
814		156.5		5.5		0.037		0.009		0.258		0.024		0.080	0.026	120	17.5	6.0
816	>	2419.6		3.5		0.004		0.002		0.219		0.018		0.160	0.055	120	18.0	6.0
819		42	<	0.5		0.021		0.005		0.228	<	0.008	<	0.014	0.003	175	19.0	5.8
824		22.8		1.3		0.003		0.002	<	0.100		0.029	<	0.014	0.005	112	17.9	6.0
831		186	<	0.5		0.003		0.006	<	0.100		0.020	<	0.014	0.005	250	18.0	6.0
836		28.8		0.7		0.005		0.002		0.100		0.020	<	0.014	0.004	186	17.0	6.0
843		5.2		0.5		0.019		0.003		0.186	<	0.008	<	0.014	0.004	154	17.0	6.0
844		38.9	<	0.5		0.009		0.003		0.199		0.083		0.014	0.004	223	17.0	6.0
846																-		
853		64.4		5.2		0.030		0.004		0.268	<	0.008		0.030	0.010	150	17.0	6.0
855	>	2419.6		1.8		0.018		0.007		1.037		0.912		0.052	0.015	220	16.0	6.0
857		21.1		1.5		0.016		0.002		0.271		0.023		0.056	0.018	140	17.0	6.0
867		28.5		0.5	<	0.002		0.003	<	0.100	<	0.008	<	0.014	0.004	120	17.0	6.0
869		18.9		2.2		0.018		0.003		0.183	<	0.008	<	0.014	0.004	205	15.0	6.0
877		38.4		2.8		0.013		0.006		0.170	<	0.008		0.014	0.005	180	18.0	6.0
881		145.5		1.0		0.012		0.009		0.287		0.193		0.029	0.010	225	18.5	6.0
882		143.9		0.5		0.009		0.005		0.111		0.016		0.033	0.004	120	18.5	5.5
884		32.3		0.5		0.010		0.002	<	0.100	<	0.008	<	0.014	0.002	120	19.0	5.5
886																-		
895		29.2		3.0	<	0.002		0.006	<	0.100	<	0.008	<	0.014	0.004	120	17.0	6.0
901		137.4	<	0.5		0.004		0.003	<	0.100	<	0.008	<	0.014	0.000	120	17.5	5.0
903		62.7		0.5		0.003		0.005		1.870		1.848	<	0.014	0.004	120	16.5	6.0
905																-		
909		9.8	<	0.5		0.007		0.011		0.502		0.506	<	0.014	0.004	250	17.0	6.0
912		6.3		0.5		0.010		0.002		0.101	<	0.008	<	0.014	0.004	250	16.5	6.0
914		48		3.0		0.041		0.004		0.368	<	0.008		0.075	n/a	120		6.0
915		613.1		3.5		0.015		0.004		1.172		0.981	<	0.014	0.001	103	17.5	5.5
918		3.1		0.5	<	0.002		0.002	<	0.100		0.012	<	0.014	0.004	103	17.0	6.0
920		12.2		0.5	<	0.002	<	0.002	<	0.100	<	0.008	<	0.014	0.001	111	16.5	5.5
924		3.1		0.7	<	0.002		0.005	<	0.100	<	0.008	<	0.014	n/a	120		6.0
930		435.2	<	0.5	<	0.002		0.005	<	0.100		0.014		0.016	0.001	250	17.0	5.0

Blitz_ID	Spring Ecoli MPN/ 100mL	Spring TSS (mg/L)	Spring TP (mg/L)	Spring SRP (mg/L)	Spring TN (mg/L)	Spring NO3 (mg/L)	Spring NH3 (mg/L)	Spring Unionized NH3 (ug/L)	Spring Hardness (ppm)	Spring Temp (deg C)	Spring pH
930	4.1	<0.5	0.005	<0.002	0.232	0.131	<0.014	0.00020	100	7.0	5.0
924	-	<0.5	0.003	<0.002	<0.1	0.043	<0.014	0.00022	50	8.0	5.0
920	-	<0.5	0.004	<0.002	<0.1	<0.008	<0.014	0.00060	80	6.0	5.5
918	3.0	<0.5	0.009	<0.002	0.154	0.080	<0.014	0.00019	50	6.0	5.0
915	4.0	<0.5	0.009	<0.002	0.311	0.261	<0.014	0.00002	35	5.5	4.0
914	21.1	5.6	0.019	<0.002	0.507	0.388	<0.014	0.00002	120	6.5	4.0
912	6.3	<0.5	0.010	<0.002	0.347	0.296	<0.014	0.00016	120	4.0	5.0
909	3.1	<0.5	0.010	<0.002	0.233	0.160	<0.014	0.00017	120	5.0	5.0
905	-	1.0	0.012	<0.002	0.170	0.085	<0.014	0.00018	120	5.5	5.0
903	3.1	5.0	0.011	<0.002	0.583	0.531	<0.014	0.00017	120	5.0	5.0
901	26.9	<0.5	0.011	<0.002	0.179	0.135	<0.014	0.00019	100	6.0	5.0
895	4.1	<0.5	0.015	<0.002	0.129	0.052	<0.014	0.00017	120	4.4	5.0
886	-	<0.5	0.016	<0.002	<0.1	0.031	<0.014	0.00017	120	4.4	5.0
884	5.2	<0.5	0.033	<0.002	0.130	0.043	<0.014	0.00024	100	9.0	5.0
882	2.0	<0.5	0.021	<0.002	0.384	0.311	<0.014	0.00006	120	6.0	4.5
881	488.4	4.8	0.022	<0.002	0.336	0.254	<0.014	0.00020	120	7.0	5.0
877	139.6	0.6	0.023	<0.002	0.498	0.372	<0.014	0.00006	120	6.5	4.5
869	9.7	<0.5	0.018	<0.002	0.177	0.073	<0.014	0.00001	120	3.0	4.0
867	6.3	<0.5	0.016	<0.002	<0.1	0.022	<0.014	0.00016	120	3.9	5.0
857	35.5	2.2	0.022	<0.002	0.719	0.607	<0.014	0.00022	150	8.0	5.0
855	3.1	<0.5	0.014	0.005	1.169	1.082	<0.014	0.00019	120	6.0	5.0
853	66.3	1.6	0.047	0.018	0.632	0.510	<0.014	0.00002	120	5.4	4.0
846	20.3	<0.5	0.011	0.005	<0.1	0.028	<0.014	0.00002	120	5.0	4.0
844	5.2	<0.5	0.061	0.012	0.456	0.360	<0.014	0.00002	120	4.0	4.0
843	98.7	1.2	0.039	0.003	0.460	0.316	<0.014	0.00002	120	4.0	4.0
836	5.2	1.0	0.033	0.007	0.982	0.888	<0.014	0.00065	150	7.0	5.5
831	1.0	<0.5	0.016	0.003	0.194	0.138	<0.014	0.00017	120	5.0	5.0
824	1.0	<0.5	0.045	0.004	0.267	0.223	<0.014	0.00002	80	4.9	4.0
819	31.8	0.6	0.024	0.004	0.488	0.416	<0.014	0.00061	120	6.3	5.5
816	11.0	<0.5	0.016	0.002	<0.1	0.039	<0.014	0.00017	50	5.0	5.0
814	14.5	3.6	0.026	0.004	0.689	0.600	<0.014	0.00002	120	8.8	4.0
809	-	<0.5	0.019	0.004	0.106	0.095	<0.014	0.00019	120	6.0	5.0
808	3.1	<0.5	0.017	0.004	0.155	0.141	<0.014	0.00002	50	4.4	4.0
805	4.1	3.2	0.026	0.005	0.140	0.064	<0.014	0.00019	120	6.0	5.0
702	6.3	<0.5	0.022	0.006	<0.1	0.031	<0.014	0.00001	50	2.2	4.0
700	-	0.8	0.025	0.007	0.202	0.081	<0.014	0.00022	50	8.0	5.0
697	6.3	1.4	0.009	0.006	0.276	0.218	<0.014	0.00020	120	7.0	5.0
692	-	<0.5	0.013	0.005	0.309	0.236	<0.014	0.00002	120	5.0	4.0
685	18.9	1.0	0.015	0.004	0.298	0.228	<0.014	0.00018	120	5.6	5.0
680	20.9	<0.5	0.019	0.017	0.162	0.107	<0.014	0.00018	120	5.5	5.0
679	7.5	4.6	0.014	0.0055	0.319	0.281	<0.014	0.00002	120	6.7	4.0
670	-	<0.5	0.015	0.004	0.212	0.125	<0.014	0.00021	120	7.2	5.0
669	11.8	0.6	0.018	0.003	0.351	0.311	<0.014	0.00002	120	5.0	4.0
668	18.3	1.4	0.015	0.003	0.343	0.295	<0.014	0.00018	120	5.6	5.0
662	13.5	1.8	0.022	0.003	0.361	0.247	<0.014	0.00002	120	5.6	4.0
647	5.1	1.2	0.018	0.003	0.322	0.252	<0.014	0.00002	50	7.5	4.0
644	-	1.6	0.022	0.004	0.374	0.243	<0.014	0.00002	120	9.5	4.0
642	6.3	0.6	0.019	0.004	0.150	0.103	<0.014	0.00016	50	4.0	5.0
636	1.0	<0.5	0.019	0.0035	0.125	0.095	<0.014	0.00007	25	8.0	4.5
631	22.8	3.4	0.031	0.005	0.356	0.250	<0.014	0.00019	50	6.0	5.0
625	43.9	5.0	0.026	0.004	0.205	0.079	<0.014	0.00017	120	5.0	5.0
623	14.5	1.0	0.019	0.003	0.316	0.251	<0.014	0.00048	120	3.3	5.5
621	2.0	<0.5	0.021	0.004	0.179	0.139	<0.014	0.00006	50	6.0	4.5
616	12.1	<0.5	0.021	0.003	0.283	0.229	<0.014	0.00002	120	4.0	4.0
613	9.8	2.4	0.026	0.004	0.357	0.261	<0.014	0.00002	120	6.1	4.0
608	4.1	<0.5	0.025	0.006	0.240	0.117	<0.014	0.00019	120	6.0	5.0
499		<0.5	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-
498	-	1.8	0.021	0.007	0.374	0.338	<0.014	0.00017	120	5.0	5.0
495	11.9	<0.5	0.020	0.003	0.179	0.114	<0.014	0.00017	120	5.0	5.0
492	70.6	<0.5	0.029	0.007	0.210	0.102	<0.014	0.00002	25	4.0	4.0
488	3.1	<0.5	0.031	0.014	0.152	0.069	<0.014	0.00002	50	6.0	4.0
485	2.0	7.4	0.022	0.005	0.100	0.053	<0.014	0.00016	120	4.3	5.0
464	7.5	<0.5	0.023	0.008	0.114	0.055	<0.014	0.00002	50	5.0	4.0
452	7.5	0.6	0.026	0.003	0.347	0.248	<0.014	0.00019	110	6.0	5.0

Blitz_ID	Spring Ecoli MPN/ 100mL	Spring TSS (mg/L)	Spring TP (mg/L)	Spring SRP (mg/L)	Spring TN (mg/L)	Spring NO3 (mg/L)	Spring NH3 (mg/L)	Spring Unionized NH3 (ug/L)	Spring Hardness (ppm)	Spring Temp (deg C)	Spring pH
450	2.0	<0.5	0.020	0.004	0.201	0.098	<0.014	0.00019	120	6.0	5.0
440	8.6	<0.5	0.032	0.006	0.267	0.164	<0.014	0.00017	120	5.0	5.0
436			n/a	n/a	n/a	n/a	n/a	n/a	-	-	-
434	4.1	1.0	0.024	0.005	0.214	0.114	<0.014	0.00002	50	5.0	4.0
425	5.2	<0.5	0.032	0.005	0.271	0.199	<0.014	0.00017	120	5.0	5.0
419	14.2	1.2	0.024	0.003	0.438	0.369	<0.014	0.00019	50	6.0	5.0
413	193.5	<0.5	0.028	0.006	0.298	0.258	<0.014	-	120	5.0	-
412	-	<0.5	0.021	0.004	0.150	0.113	<0.014	-	25	5.0	-
409	16.0	2.4	0.029	0.013	0.218	0.151	<0.014	-	25	5.0	-
404	14.2	<0.5	0.026	0.004	0.169	0.103	<0.014	0.00017	80	5.0	5.0
398	14.5	1.2	0.026	0.004	0.350	0.278	<0.014	0.00020	120	7.0	5.0
389	17.1	0.6	0.030	0.004	0.389	0.303	<0.014	0.00018	120	5.6	5.0
388	8.6	<0.5	0.079	0.009	0.185	0.142	<0.014	0.00017	50	5.0	5.0
385	27.2	1.6	0.026	0.006	0.406	0.307	<0.014	0.00020	50	7.0	5.0
377	8.6	<0.5	0.026	0.005	<0.1	0.022	<0.014	0.00055	50	5.0	5.5
373	3.1	<0.5	0.022	0.005	0.210	0.103	<0.014	0.00020	25	7.0	5.0
369	3.1	<0.5	0.028	0.009	0.224	0.138	<0.014	0.00017	50	5.0	5.0
368	32.7	<0.5	0.027	0.009	<0.1	0.010	<0.014	0.00000	60	6.0	3.0
355	3.0	0.6	0.038	0.01	0.254	0.072	<0.014	0.00002	50	7.0	4.0
348	5.2	2.2	0.023	0.003	0.412	0.308	<0.014	0.00019	50	6.0	5.0
343	2.0	<0.5	0.025	0.005	0.149	0.081	<0.014	0.00017	100	5.0	5.0
341	4.1	<0.5	0.029	0.008	0.342	0.149	<0.014	0.00197	120	6.5	6.0
338	3.1	<0.5	0.023	0.003	0.457	0.426	<0.014	0.00017	120	5.0	5.0
334	-	<0.5	0.026	0.007	0.170	0.094	<0.014	0.00017	60	5.0	5.0
332	6.2	<0.5	0.021	0.004	0.321	0.233	<0.014	0.00019	50	6.0	5.0
327	1.0	3.6	0.027	0.002	0.238	0.127	<0.014	0.00020	25	7.0	5.0
326	2.0	<0.5	0.021	0.002	0.280	0.197	<0.014	0.00020	70	7.0	5.0
325	3.1	<0.5	0.027	0.004	<0.1	0.031	<0.014	0.00002	50	6.0	4.0
321	6.2	<0.5	0.026	0.005	0.224	0.146	<0.014	0.00016	50	4.0	5.0
317	17.1	1.0	0.024	0.003	0.198	0.059	<0.014	0.00019	120	6.0	5.0
309	21.1	<0.5	0.028	0.005	0.202	0.099	<0.014	0.00002	120	4.0	4.0
306	49.6	<0.5	0.023	0.005	0.197	0.100	<0.014	0.00002	120	4.0	4.0
305	5.2	<0.5	0.022	0.003	<0.1	0.011	<0.014	0.00017	50	5.0	5.0
303	3.0	<0.5	0.028	0.007	0.350	0.291	<0.014	0.00017	200	5.0	5.0
297	3.0	0.6	0.034	0.015	0.169	0.094	<0.014	0.00002	50	5.5	4.0
282	-	<0.5	0.026	0.0045	0.148	0.086	<0.014	0.00002	35	4.0	4.0
280	1.0		0.020	0.004	<0.1	0.012	<0.014	0.00018	120	5.6	5.0
277	20.3	<0.5	0.022	0.004	<0.1	0.024	<0.014	0.00017	80	5.0	5.0
273	1.0	0.6	0.103	0.027	<0.1	0.017	<0.014	0.00019	120	6.0	5.0
262	-	3.4	0.040	0.004	0.349	0.150	<0.014	0.00002	120	9.0	4.0
258	9.3	<0.5	0.027	0.006	0.829	0.279	<0.014	0.00002	120	6.0	4.0
256			n/a	n/a	n/a	n/a	n/a	n/a	-	-	-
251	30.5	8.0	0.037	0.004	0.303	0.169	<0.014	0.00026	120	10.0	5.0
250	10.9	<0.5	0.024	0.004	0.101	0.046	<0.014	0.00006	100	6.5	4.5
239	3.0	4.0	0.038	0.006	0.315	0.126	<0.014	0.00002	50	9.0	4.0
232	9.6	<0.5	0.032	0.013	0.103	0.033	<0.014	0.00019	25	6.0	5.0
231	6.3	2.2	0.023	0.003	0.359	0.192	<0.014	0.00019	120	6.0	5.0
226	9.5	<0.5	0.014	0.004	0.121	0.057	<0.014	0.00017	25	5.0	5.0
225	3.0	2.0	0.049	0.014	0.116	0.058	<0.014	0.00016	37.5	4.0	5.0
210	4.1	<0.5	0.027	0.011	0.255	0.177	<0.014	0.00005	120	4.4	4.5
208	23.1	0.6	0.015	0.005	0.127	0.089	<0.014	0.00022	130	8.0	5.0
202	12.1	<0.5	0.098	0.011	0.263	0.198	<0.014	0.00016	50	4.0	5.0
201	6.2	0.6	0.025	0.002	0.483	0.414	<0.014	0.00015	120	3.5	5.0
141	14.6	<0.5	0.027	0.004	<0.1	0.057	<0.014	0.00017	120	4.7	5.0
128	2.0	<0.5	0.024	0.004	0.442	0.367	<0.014	0.00022	120	8.0	5.0
123	1.0	<0.5	0.027	0.01	0.129	0.054	<0.014	0.00018	120	5.1	5.0
115	18.9	53.0	0.026	0.0045	0.305	0.246	<0.014	0.00167	120	5.0	6.0
114	5.2	4.0	0.048	0.013	0.342	0.195	<0.014	0.00024	120	9.0	5.0
112	2.0	2.6	0.037	0.007	0.322	0.083	0.027	0.00040	120	7.4	5.0
111	-	3.0	0.026	0.008	0.369	0.209	0.014	0.00028	120	11.0	5.0
107	10.8	<0.5	0.012	0.004	<0.1	0.021	<0.014	0.00020	120	7.0	5.0

Appendix F – Brown County Regional Sewer District E. Coli Sampling

Brown County Regional Sewer District retained Lochmueller Group and Arion Consultants to evaluate E. coli levels in Brown County as part of efforts to develop a strategic wastewater management plan. They identified 14 sites in the Bean Blossom watershed and 21 sites in the Lake Monroe (East Fork White River) watershed for evaluation. After an initial round of sampling, 12 sites in the Bean Blossom watershed and 20 sites in the Lake Monroe watershed were sampled weekly over a five-week period (May 5, 2020 – June 2, 2020) and tested for E. coli. This data was used to calculate the geometric mean of the samples to compare to the state geometric mean standard of 125 CFU/100 ml. Results from the Lake Monroe watershed samples are summarized below.

Table 1 E. coli Sampling Results in Lake Monroe Watershed

Site ID	Sub-watershed	Stream	5/5/ 2020	5/12/ 2020	5/19/ 2020	5/26/ 2020	6/2/ 2020	Geo-metric Mean	>State Geo-mean
EF01	Sweetwater (NF)	Sweetwater Creek	115	12	379	365	82	109.2	no
EF02	Sweetwater (NF)	North Fork Salt Creek	338	9	219	61.3	77	79.7	no
EF03	Sweetwater (NF)	Outlet Sweetwater Lake	75	--	--	--	--		no
EF04	Brummett (NF)	North Fork Salt Creek	338	112	1630	365	128	310.4	yes
EF05	Clay Lick (NF)	Outlet Yellowwood Lake	87	33	87	461	13	68.6	no
EF06	Clay Lick (NF)	North Fork Salt Creek	705	310	1170	32.3	126	253.2	yes
EF07	Clay Lick (NF)	Lick Creek	449	22	401	93.3	59	117.2	no
EF08	Clay Lick (NF)	North Fork Salt Creek	1440	58	811	1990	122	439.3	yes
EF09	Clay Lick (NF)	Clay Lick	85	36	171	187	25	75.6	no
EF10	Gnaw Bone (NF)	North Fork Salt Creek	424	195	661	345	96	282.8	yes
EF11	Gnaw Bone (NF)	Gnaw Bone	449	78	620	186	141	224.5	yes
EF12	Gnaw Bone (NF)	Gnaw Bone	338	21	276	172	84	122.4	no
EF13	Gnaw Bone (NF)	Mount Liberty	401	61	449	228	118	196.9	yes

Site ID	Sub-watershed	Stream	5/5/2020	5/12/2020	5/19/2020	5/26/2020	6/2/2020	Geo-metric Mean	>State Geo-mean
EF14	Gravel Creek (MF)	Middle Fork Salt Creek	705	63	1220	548	144	336.1	yes
EF15	Pleasant Valley (MF)	Middle Fork Salt Creek	310	115	925	866	122	322.4	yes
EF16	Pleasant Valley (MF)	Hamilton Creek	1020	43	705	548	166	308.8	yes
EF17	Pleasant Valley (MF)	Middle Fork Salt Creek	755	31	755	861	192	310.4	yes
EF18	Headwaters (MF)	Middle Fork Salt Creek	1440	89	1170	461	122	384.5	yes
EF20	Clay Lick (NF)	Greasy Creek	755	83	276	365	228	270.2	yes
EF21	Little Salt Creek (SF)	Little Salt Creek	136	4	190	461	93	84.6	no

Appendix G – Fecal Contamination Source Assessment Plan

Brown County Regional Sewer District retained Lochmueller Group and Arion Consultants to evaluate E. coli levels in Brown County as part of efforts to develop a strategic wastewater management plan. They identified 14 sites in the Bean Blossom watershed and 21 sites in the Lake Monroe (East Fork White River) watershed for evaluation. After an initial round of sampling, 12 sites in the Bean Blossom watershed and 20 sites in the Lake Monroe watershed were sampled weekly over a five-week period (May 5, 2020 – June 2, 2020) and tested for E. coli. This data was used to calculate the geometric mean of the samples to compare to the state geometric mean standard of 125 CFU/100 ml.

Lochmueller Group and Arion Consultants then used a tiered decision-making approach to select sample sites for *E. coli* source assessment. The tiers are detailed below and note which samples meet the required decision and are thus included in the source assessment phase of the project. Table details the sites where source assessment sampling occurred.

Tier 1 Decision: The geometric mean calculated at that site using 2020 *E. coli* data exceeds the state geometric mean average for the basin. IDEM calculated average geometric mean values for E. coli samples collected during their most recent rotational basin sampling which occurred 2011 to 2019. The average geometric mean value for Beanblossom Creek Watershed is 466 col/100 ml, while the average geometric mean value for the Lake Monroe Watershed is 462 col/100 ml. Six sites in the Beanblossom Creek Watershed exceed the basin geometric mean average concentration, while no sites in the Lake Monroe Watershed exceed the basin geometric mean average concentration.

Sites which exceeded average basin geometric mean concentration include **BB01, BB06, BB07, BB08, BB10, and BB12.**

Tier 2 Decision: There is the potential for human impacts from non-compliant sewer systems or malfunctioning, not maintained or absent septic systems within sample site's subwatershed. The sample site's subwatershed is defined as the area draining to that sample point downstream of any upstream sample site. Lochmueller Group and Arion Consultants used three potential *E. coli* sources to determine if each immediate subwatershed possesses a potential for human impacts. Additional human sources could be present in upstream immediate watersheds and so may be observed in subwatershed where a source was not identified in the immediate drainage.
These sources include:

- There are several NPDES permitted facilities within Brown County. Subwatersheds which contain facilities with documented compliance issues were listed as basins which could have a potential human input.
- The Brown County Health Department residential septic data completed for Jackson Township – these data map residential addresses within Jackson County and detail septic system information for each residential point. The total number of residential facilities with documented septic systems was divided by the total number of residential facilities.

Lochmueller Group and Arion Consultants included any subwatershed where 40% or less of residential facilities possessed septic systems.

- The State of Indiana address point file provided point addresses for all properties within Brown County. For areas outside of Jackson Township, these points were used to simulate residential locations. A simple count was utilized to identify subwatersheds where a human impact could occur. Any subwatershed with more than 300 residences outside of Jackson Township were included.

Sites which have a potential human impact include **BB01, BB03, BB05, BB07, BB08, BB09, BB10, BB12, EF02, EF06, EF08, EF10, EF16, EF18, EF20.**

Tier 3 Decision: There is the potential for animal impacts from livestock on a confined feeding operation, hobby farm or with access to the stream or wildlife. The sample site's subwatershed is defined as the area draining to that sample point downstream of any upstream sample site. Lochmueller Group and Arion Consultants used three potential *E. coli* sources to determine if each immediate subwatershed possesses a potential for animal impacts. Additional animal sources could be present in upstream immediate watersheds and so may be observed in subwatershed where a source was not identified in the immediate drainage.
These sources include:

- The presence of a confined feeding operation.
- The presence of a more than 50 observed livestock on hobby farms throughout the subwatershed.
- A high density of observed wildlife or the land use which would house high densities of wildlife.

Sites which have a potential animal impact include **BB04, BB07, BB08, BB10, BB11, EF18**.

Table *1. Brown County Regional Sewer District Site Analysis and Selection*

Sample Site	Tier 1 (E. Coli Results)	Tier 2 (Human Source)	Tier 3 (Animal Source)
BB01	Yes	Yes	
BB03		Yes	
BB04			Yes
BB05		Yes	Yes
BB06	Yes		
BB07	Yes	Yes	Yes
BB08	Yes	Yes	Yes
BB09		Yes	
BB10	Yes	Yes	Yes
BB11			Yes
BB12	Yes	Yes	

Sample Site	Tier 1 (E. Coli Results)	Tier 2 (Human Source)	Tier 3 (Animal Source)
EF02		Yes	
EF06		Yes	
EF08		Yes	
EF10		Yes	
EF16		Yes	
EF18		Yes	Yes
EF20		Yes	

The Lake Monroe watershed coordinator also used a tiered decision-making approach to select sample sites for fecal contamination source assessment. The tiers are detailed below and note which samples meet the required decision and are thus included in the source assessment phase of the project.

<u>Tier 1 Decision</u>: Samples collected during the Spring Blitz and Fall Blitz were compared to the state E. coli standard of 235 cfu/100 mL. All sites with a sample exceeding the state standard were selected for further investigation. Note that only one sample from the Spring Blitz exceeded the state standard, Site 881.

Sites with at least one sample result which exceeded the state standard are: 277, 317, 338, 341, 398, 404, 425, 440, 644, 685, 692, 697, 816, 855, 881, 915, and 930.

Two additional sites were added based on the monthly stream monitoring results from Middle Fork Salt Creek (668) and the CBU storm team monitoring of South Fork Salt Creek at Kurtz (853).

<u>Tier 2 Decision</u>: There is the potential for human impacts from non-compliant sewer systems or malfunctioning, not maintained or absent septic systems within a sample site's sub-watershed. The sample site's sub-watershed is defined as the area draining to that sample point downstream of any upstream sample site. The watershed coordinator used two potential *E. coli* sources to determine if each immediate sub-watershed possesses a potential for human impacts. One was identifying sub-watersheds which contain NPDES permitted facilities with documented compliance issues (Nashville WWTP and Gnaw Bone WWTP) which could have a potential human input. Only site 398 was identified. The other criterion was estimating the number of unsewered homes per acre. The number of unsewered homes was estimated by counting the number of buildings per sub-watershed shown in the "Building Footprints" 2019 shapefile from Indiana MAP and approximate acreage was measured in GIS. Additional human sources could be present that were not identified by these methods.

Sites identified as having a density of unsewered homes greater than or equal to 0.05 are: 317, 338, 341, 398, 404, 425, 440, 644, 685, 692, 697, 816, and 881.

Tier 3 Decision: There is the potential for animal impacts from livestock within the subwatershed. The watershed coordinator classified sites into three categories based on site observations of livestock and land cover maps. Sites with livestock or fenced pasture observed at the site or immediately upstream were categorized as "high." Sites with no livestock observed but with pasture identified upstream on land cover maps were categorized as "medium." Sites with no livestock observed and no pasture shown on land cover maps upstream were categorized as "low." Additional animal sources could be present that were not identified by these methods.

Sites which have a high or medium potential animal impact are: 277, 338, 341, 398, 425, 440, 685, 692, 697, 816, 855, 881, 915, and 930.

Table 2. Lake Monroe Watershed Coordinator Site Analysis and Selection

Sample Site	Tier 1 (E. Coli Results)	Tier 2 (Human Source)	Tier 3 (Animal Source)	Source Assess-ment?	Reason	Stream
277	Yes	0.02	High	No	Low human source	Lick Creek
317	Yes	0.40	Low	No	Low animal source	East Branch Sweetwater
338	Yes	0.10	Medium	No	Redundant; sample 425 in same stream	Stephens Creek
341	Yes	0.10	High	Yes	Both sources probable	Kerr Creek
398	Yes	0.05	Medium	No	Redundant. BCRSD will sample upstream EF10 and downstream EF08	North Fork Salt (below Gnaw Bone Creek)
404	Yes	0.06	Low	No	Low animal source	Henderson Creek
425	Yes	0.13	Medium	Yes	Both sources probable	Stephens Creek
440	Yes	0.05	Medium	Yes	Relatively low concentration (298.7)	Owl Creek
644	Yes	0.05	Low	No	Low animal source	Unnamed Tributary to South Branch
685	Yes	0.07	Medium	No	Redundant; BCRSD will sample nearby EF18	Middle Fork Salt Creek
692	Yes	0.08	Medium	Yes	Both sources probable	Unnamed Tributary to Hamilton Creek
697	Yes	0.06	High	Yes	Both sources probable	South Branch Salt Creek
816	Yes	0.05	High	Yes	Both sources probable	Little Salt Creek

Sample Site	Tier 1 (E. Coli Results)	Tier 2 (Human Source)	Tier 3 (Animal Source)	Source Assess-ment?	Reason	Stream
855	Yes	0.03	Medium	Yes	Low human source but concentration was very high	Unnamed Tributary to Little Salt Creek
881	Yes	0.05	High	Yes	Both sources probable	Kiper Creek
915	Yes	0.01	Medium	No	Low human source	Unnamed Tributary to Little Salt Creek
930	Yes	0.03	High	No	Redundant; sample 881	Kiper Creek
853	Yes (storm team)	0.04	High	Yes	CBU Storm team sampling had many exceedances; both sources probable	South Fork Salt Creek at Kurtz
668/ E15	Yes (monthly samples)	0.05	Medium	Yes	Monthly stream sampling and BCRSD samples had several exceedances; both sources probable	Middle Fork Salt Creek at SR-135

Final Selection: Ten sites were chosen for source analysis through the Lake Monroe Watershed Management Plan project (LMWMP) in addition to the seven sites previously selected by the Brown County Regional Sewer District (BCRSD). The ten LMWMP sites were: 440, 425, and 341 in the North Fork sub-watershed; 697, 668, and 692 in the Middle Fork sub-watershed; and 816, 853, 855, and 881 in the South Fork sub-watershed.

This meant a total of seventeen sites were evaluated using source analysis at Scientific Methods in Granger, Indiana. The complete list of sites is presented in Table 3.

Table 3. Source Sampling Sites in Lake Monroe Watershed

BC_ID	LM_ID	Sub	Stream	Sampler
EF02	332	NF	North Fork Salt (above Sweetwater Creek)	BCRSD
EF10		NF	North Fork Salt (above Gnaw Bone Creek)	BCRSD
EF08		NF	North Fork Salt (SR 46 below Salt Creek Trail)	BCRSD
EF06	256	NF	North Fork Salt (Yellowwood Rd)	BCRSD
	440	NF	Owl Creek (above West Branch Owl Creek)	LMWMP
EF20		NF	Greasy Creek (downstream @ SR-46)	BCRSD
	425	NF	Stephens Creek (upstream)	LMWMP
	341	NF	Kerr Creek	LMWMP
	697	MF	South Branch Salt Creek (upstream of EF18/685)	LMWMP
EF18		MF	Middle Fork Salt Creek (upstream near Christianburg Rd)	BCRSD
EF15	668	MF	Middle Fork Salt Creek (SR-135, above Hamilton Creek)	LMWMP
	692	MF	unnamed tributary to Hamilton Creek	LMWMP
	816	SF	Little Salt Creek (down from EF21 at SR-135)	LMWMP
	853	SF	South Fork Salt Creek (midstream at Kurtz)	LMWMP
	855	SF	unnamed trib to South Fork (enters below 853)	LMWMP
	881	SF	Kiper Creek (downstream)	LMWMP

SCIENTIFIC METHODS

12441 Beckley Street • Granger, Indiana 46530
574.277.4078 [Phone] • www.scientificmethods.com

Laboratory Report

Client: Kyle Myers
Lochmueller Group
6200 Vogel Rd
Evansville, IN 47715
kmyers@lochgroup.com

Report no.: 31427

Sample collection date: April 27, 2021
Received date: April 27, 2021
Analysis date and time: April 27, 2021 @ 17:59 Samples submitted: 13

Serotyping

Sample ID	Sample Location	pfu/100mL	# of Isolates	I	I / II	II	II/III	III	IV	% Human	% Animal
31427	Stephens Creek (upsteam 0425)	<1	0	NA	NA	NA	NA	NA	NA	NA	NA
31428	Kerr Creek 0341	< 1	0	NA	NA	NA	NA	NA	NA	NA	NA
31429	Owl Creek	< 1	0	NA	NA	NA	NA	NA	NA	NA	NA
31430	Middle Fork Salt Creek 0668	< 1	0	NA	NA	NA	NA	NA	NA	NA	NA
31431	South Fork Salt Creek (mid kurts) 0853	0.1	1	0	1	0	0	0	0	50.5	49.5
31432	Unamed Trib to south fork 0855	< 1	0	NA	NA	NA	NA	NA	NA	NA	NA
31433	Kiper Creek 0881	0.1	1	0	1	0	0	0	0	50.5	49.5
31434	Little Salt Creek 0816	< 1	0	NA	NA	NA	NA	NA	NA	NA	NA
31435	Trib to Hamilton Creek 0692	< 1	0	NA	NA	NA	NA	NA	NA	NA	NA
31436	South Branch Salt Creek 0697	< 1	0	NA	NA	NA	NA	NA	NA	NA	NA
31437	Reed Point-Lemon	< 1	0	NA	NA	NA	NA	NA	NA	NA	NA
31438	Riddle Point-Lemon	< 1	0	NA	NA	NA	NA	NA	NA	NA	NA
31439	Chitwood-Lemon	< 1	0	NA	NA	NA	NA	NA	NA	NA	NA

Note: Not all samples produced plaques. *E.coli* may be present without coliphages in any given sample

Scientific Methods appreciates the opportunity to provide you with this analysis. Please feel free to contact us (574-277-4078) if you have any questions regarding this report.

SCIENTIFIC
METHODS

12441 Beckley Street • Granger, Indiana 46530
574.277.4078 [Phone] • www.scientificmethods.com

Reviewed by: ______________________ Date: May 11, 2021

Miriam Svoboda, Project Manager

Finalized by: ______________________ Date: May 11, 2021

Jordyn Andre, Laboratory Analyst

References and definitions

References:

Easyphage SPL, based on:
EPA Method 1602: Male-specific (F^+) and Somatic Coliphage in Water by Single Agar Layer Procedure (821-R-01-029)
Genotyping Male-specific RNA Coliphages by Hybridization with Oligonucleotide Probes. HSU, F.-C., Y.-S. CAROL SHIEH, J. VAN DUIN, M. J. BEEKWILDER, and M. D. SOBSEY.*Appl. Environ. Microbiol*. 61:3960-3966.
Applying meta-analysis of male-specific RNA coliphages to determine the probable sources of fecal contamination during poultry processing. F.-C. Hsu , Y. C. Shieh, J. Larkin, and M. D. Sobsey. ·2004. The Annual Meeting of the American Society for Microbiology, New Orleans, LA.

Definitions:

MRL: Minimum reporting limit

< = “less than.” It indicates the lowest reportable value by the procedure used for analysis.

pfu/100mL: plaque forming units per 100 mL

Coliphages belong to the group of bacterial viruses that infect and replicate exclusively within the coliform bacteria group.

Coliphages can be further classified as belonging to the “male-specific” or “somatic” groups depending upon their method of attachment to host cells.

Male-specific coliphages, also known as F^+coliphages, specifically infect the coliform bacteria that express physical appendages called sex pili. They are classified into F+DNA and F+RNA coliphages. Only F+RNA coliphages can be serotyped or genotyped.

Meta-analysis is based on a database, compiled of all data available on the published literature.

SCIENTIFIC METHODS

12441 Beckley Street • Granger, Indiana 46530
574.277.4078 [Phone] • www.scientificmethods.com

Laboratory Report

Client: Kyle Myers
Lochmueller Group
6200 Vogel Rd
Evansville, IN 47715
kmyers@lochgroup.com

Report no.: 31409

Sample collection date: April 27, 2021
Received date: April 27, 2021
Analysis date and time: April 27, 2021 @ 17:00

Samples submitted: 18

Serotyping

Sample ID	Sample Location	pfu/100mL	# of Isolates	I	I / II	II	II/III	III	IV	% Human	% Animal
31409*	EF02	0.1	1	0	0	0	0	0	0	NA	NA
31410	BB09	< 1	0	NA	NA	NA	NA	NA	NA	NA	NA
31411	BB10	23	20	0	0	20	0	0	0	94	6
31412	BB11	< 1	0	NA	NA	NA	NA	NA	NA	NA	NA
31413	BB12	15	20	0	6	14	0	0	0	74	26
31414	BB08	< 1	0	NA	NA	NA	NA	NA	NA	NA	NA
31415	BB07	< 1	0	NA	NA	NA	NA	NA	NA	NA	NA
31416	BB06	< 1	0	NA	NA	NA	NA	NA	NA	NA	NA
31417	BB05	< 1	0	NA	NA	NA	NA	NA	NA	NA	NA
31418	BB04	< 1	0	NA	NA	NA	NA	NA	NA	NA	NA
31419	BB01	< 1	0	NA	NA	NA	NA	NA	NA	NA	NA
31420	BB03	< 1	0	NA	NA	NA	NA	NA	NA	NA	NA
31421	EF06	0.6	6	0	5	1	0	0	0	54	46
31422	EF08	< 1	0	NA	NA	NA	NA	NA	NA	NA	NA
31423*	EF20	0.4	4	0	0	1	0	0	0	94	6
31424	EF10	< 1	0	NA	NA	NA	NA	NA	NA	NA	NA
31425*	EF18	0.4	4	0	1	0	0	0	0	50.5	49.5
31426*	EF16	0.3	3	0	0	0	0	0	0	NA	NA

Note: Not all samples produced plaques. *E.coli* may be present without coliphages in any given sample
**These samples contained plaques that did not produce any lysis during the spot testing.*

SCIENTIFIC METHODS

12441 Beckley Street • Granger, Indiana 46530
574.277.4078 [Phone] • www.scientificmethods.com

Scientific Methods appreciates the opportunity to provide you with this analysis. Please feel free to contact us (574-277-4078) if you have any questions regarding this report.

Note: This report may not be reproduced, except in full, without a written approval from Scientific Methods.

Reviewed by: ______________________ Date: May 10, 2021

Alicia Jones, Senior Laboratory Analyst

Finalized by: ______________________ Date: May 10, 2021

Miriam Svoboda, Project Manager

References and definitions

References:

Easyphage SPL, based on:

EPA Method 1602: Male-specific (F^+) and Somatic Coliphage in Water by Single Agar Layer Procedure (821-R-01-029)

Genotyping Male-specific RNA Coliphages by Hybridization with Oligonucleotide Probes. HSU, F.-C., Y.-S. CAROL SHIEH, J. VAN DUIN, M. J. BEEKWILDER, and M. D. SOBSEY.*Appl. Environ. Microbiol*. 61:3960-3966.

Applying meta-analysis of male-specific RNA coliphages to determine the probable sources of fecal contamination during poultry processing. F.-C. Hsu , Y. C. Shieh, J. Larkin, and M. D. Sobsey. ·2004. The Annual Meeting of the American Society for Microbiology, New Orleans, LA.

Definitions:

MRL: Minimum reporting limit

< = "less than." It indicates the lowest reportable value by the procedure used for analysis.

pfu/100mL: plaque forming units per 100 mL

Coliphages belong to the group of bacterial viruses that infect and replicate exclusively within the coliform bacteria group.

Coliphages can be further classified as belonging to the "male-specific" or "somatic" groups depending upon their method of attachment to host cells.

Male-specific coliphages, also known as F^+coliphages, specifically infect the coliform bacteria that express physical appendages called sex pili. They are classified into F+DNA and F+RNA coliphages. Only F+RNA coliphages can be serotyped or genotyped.

Meta-analysis is based on a database, compiled of all data available on the published literature.

Appendix H – List of Contaminants Monitored by City of Bloomington Utilities in 2019

CBU Contaminant Testing 2019

SOCs (Synthetic Organic Compounds) (20 undetected, 1 detected)

Alachlor (Lasso)
Atrazine - detected
Benzo(a)pyrene
Di(2-ethylexyl)adipate
Di(2-ethylexyl)phthalate
Endrin
Heptachlor
Heptachlor Epoxide
Hexachlorobenzene
Hexachlorocyclopentadiene
Lindane
Methoxychlor
Simazine
Aldrin
Butachlor
Carbaryl
Dicamba
Dieldrin
Metolachlor
Metribuzin
Propachlor

IOCs (Inorganic Chemicals) (13 undetected, 5 detected)

Antimony
Arsenic
Barium - detected
Beryllium
Cadmium
Chloramine - detected
Chromium
Copper - detected
Cyanide (Free)
Fluoride – detected
Lead - detected
Mercury

Nickel
Selenium
Thallium
Nitrate
Nitrite
Nitrite and Nitrate

Regulated VOCs (Volatile Organic Compounds) (21)
Benzene
Carbon Tetrachloride
Chlorobenzene
1,2-Dichlorobenzene
1,4-Dichlorobenzene
1,2-Dichloroethane
1,1-Dichloroethylene
1,2-Dichloroethylene, cis
1,1-Dichloroethylene, trans
Dichloromethane
1,2-Dichloropropane
Ethylbenzene
Styrene
Tetrachloroethylene
Toluene
1,2,4-Trichlorobenzene
1,1,1-Trichloroethane
1,1,2-Trichloroethane
Trichloroethylene
Vinyl Chloride
Total Xylenes

Unregulated VOCs (Volatile Organic Compounds) (19)
Bromobenzene
Bromomethane
Chloroethane
Chloromethane
2-Chlorotoluene
4-Chlorotoluene
1,3-Dichlorobenzene
1,1-Dichloroethane
1,3-Dichloropropane
2,2-Dichloropropane
1,1-Dichloropropene

1,3-Dichloropropene (cis and trans)
1,1,1,2-Tetrachloroethane
1,1,2,2-Tetrachloroethane
1,2,3-Trichloropropane
Dibromomethane
Bromoform
Chlorodibromomomethane
Methyl-Tert-Butyl Ether (MTBE)

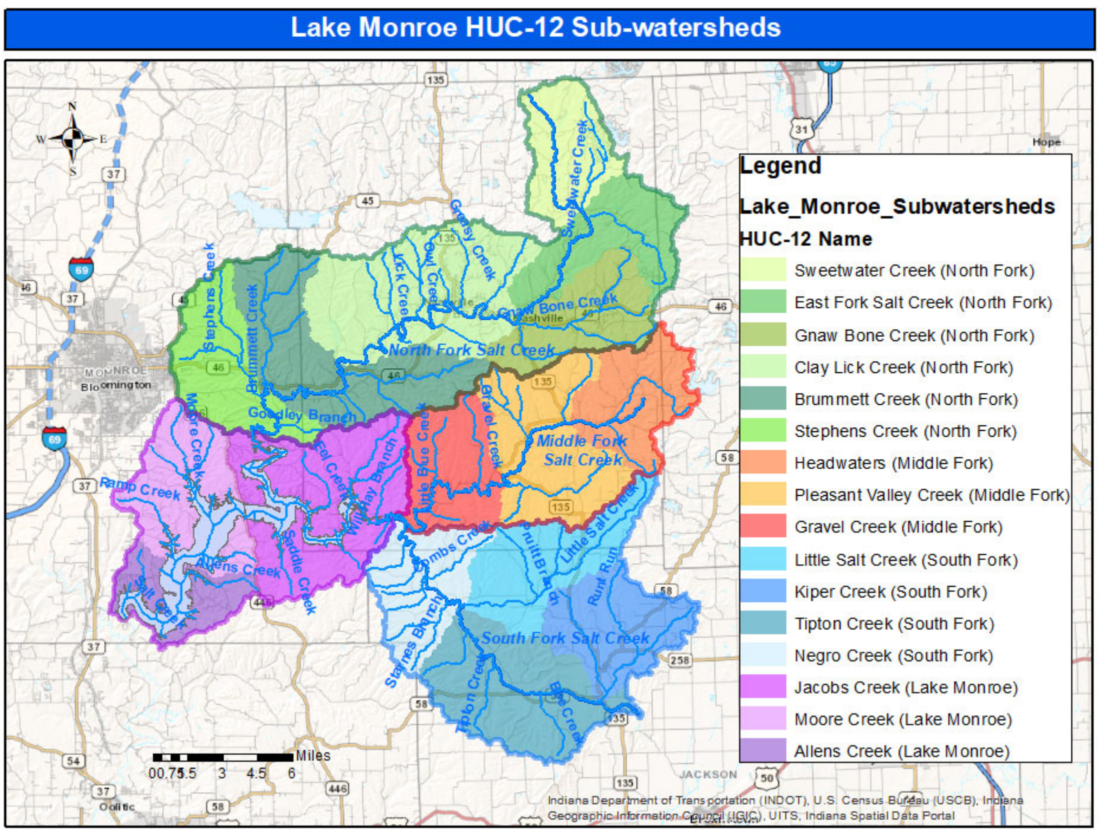
Disinfection Byproducts
Total Trihalomethanes (TTHM) – detected
Haloacetic Acids (HAA5) – detected

Appendix I – HUC12 Subwatershed Ranking Methodology

1 HUC-12 Subwatershed Comparison and Ranking

Data from the desktop survey, windshield survey, monthly tributary sampling, spring sampling blitz, fall sampling blitz, and the Brown County Regional Sewer District E. coli study were compiled by subwatershed in order to make comparisons between the different subwatersheds and identify priority areas. The Lake Monroe watershed was divided into 16 HUC-12 subwatersheds.

Figure 1-1 Lake Monroe HUC-12 Subwatershed Map



In order to make comparisons across variable data sets, a ranking system was used where the highest value represents the highest impact (worst water quality) and the lowest value represents the lowest impact (best water quality).

The following data sets were evaluated:

- IDEM's 303(d) Impaired Waterbodies List
- Point Source Assessment

- Land Cover Assessment
- Nutrient, Suspended Sediment, and E. coli Load Assessment
- Watershed Visual Assessments
    - Streambank Erosion Assessment
    - Adequate Buffer Zone Assessment
    - Livestock Access Assessment
- Fall Sampling Blitz Water Quality Assessment
- Spring Sampling Blitz Water Quality Assessment
- Habitat Assessment
- Brown County RSD E. Coli Assessment

<u>Methodology</u>

For each data set, a value was calculated for each subwatershed in order to evaluate relative prioritization. In some cases, the value was a simple count (e.g. number of impaired waterbodies). For data sets like visual assessments, the value was a percentage of total sites in that subwatershed (e.g. percent of stream sites with severe erosion) in order to account for differences in the number of sites per subwatershed. For water quality data, results were compared to water quality targets in order to determine the percentage of samples in a subwatershed that exceeded the water quality target (e.g. percentage of samples exceeding E. coli target of 235 CFU/100 ml).

In all cases, subwatersheds were compared to evaluate relative prioritization. Each subwatershed was assigned a rank for each parameter with “1” indicating the highest water quality (least exceedances) and “16” indicating the lowest water quality (most exceedances).

Once all subwatersheds were ranked for all parameters, parameters were divided into two major categories:

1. Level of Degradation based on water quality parameters
2. Level of Vulnerability based on land usage assessments

With all parameters equally weighted, the average for each category was calculated and the subwatersheds were ranked according to their Level of Degradation (Category 1) and Vulnerability (Category 2). The ranks of these two categories were then averaged to give an overall Rank Score. As with the individual parameter rankings, the most impacted subwatershed received the highest rank (most concerns) and the least impacted received the lowest rank (least concerns).

1.1 HUC-12 Water Quality Degradation Assessment

Parameters used to calculate Water Quality Degradation Rank were the number of 303(d) impaired water bodies and the percentage of exceedances for E. coli, Total Nitrogen, Nitrates, Total Phosphorus, Soluble Reactive Phosphorus, and Total Suspended Solids from the monthly tributary monitoring, fall blitz monitoring, spring blitz monitoring, and BCRSD monitoring (E. coli only).

Impaired Water Bodies

Impairments listed in the IDEM 303(d) list of impaired water bodies were tabulated for each subwatershed. Based on the 303(d) list of impaired water bodies, Jacobs Creek had the most impairments (4), followed by Moore Creek (3), Allens Creek (3), Negro Creek (2), and Little Salt Creek (1).

Table 1-1 HUC-12 Subwatershed Comparison of 303(d) Impairments

HUC-12-Subwatershed	303(d) Waterbodies and Impairments	# Impairments	303(d) Rank
Kiper Creek (SF)	None	0	1
Little Salt Creek (SF)	Little Salt Creek (E. Coli)	1	12
Tipton Creek (SF)	None	0	1
Negro Creek (SF)	South Fork Salt Creek (Dissolved Oxygen, Biological Integrity)	2	13
Headwaters Middle Fork (MF)	None	0	1
Pleasant Valley Creek (MF)	None	0	1
Gravel Creek (MF)	None	0	1
Sweetwater Creek (NF)	None	0	1
East Fork Salt Creek (NF)	None	0	1
Gnaw Bone Creek (NF)	None	0	1
Clay Lick Creek (NF)	None	0	1
Brummett Creek (NF)	None	0	1
Stephens Creek (NF)	None	0	1
Jacobs Creek (LM)	Crooked Creek (E. Coli), Lake Monroe Upper Basin (Algae, Mercury in Fish, and Taste and Odor)	4	16
Moore Creek (LM)	Lake Monroe Lower Basin (Algae, Mercury in Fish, and Taste and Odor)	3	14
Allens Creek (LM)	Lake Monroe Lower Basin (Algae, Mercury in Fish, and Taste and Odor)	3	14

Fall Blitz Water Quality Assessment

Water quality data collected at 88 sites within the Lake Monroe watershed during the fall sampling blitz on September 18, 2020, were compared against chosen water quality targets. These thresholds were used to discern areas of poor water quality. If the measured parameter did not meet the threshold requirement, the sample was counted as exceeding the threshold. Each of the data sets was analyzed to determine what percentage of samples did not meet the threshold requirement in each HUC-12 subwatershed and therefore how many times poor water quality was indicated for each specific parameter. Table 1-2 summarizes the percentage of exceedances for each parameter in each subwatershed. Table 1-3 assigns a rank for each parameter with "1" indicating the highest water quality (least exceedances) and "16" indicating the lowest water quality (most exceedances).

Table 1-2 HUC-12 Subwatershed Exceedances Using Fall Blitz Data

Subwatershed	# Fall Samples	% Fall Samples E Coli > 235 CFU/ 100ml	% Fall Samples TSS > 30 mg/L	% Fall Samples TP > 0.020 mg/L	% Fall Samples SRP > 0.005 mg/L	% Fall Samples TN > 0.690 mg/L	% Fall Samples NO3 > 0.633 mg/L
Kiper Creek (SF)	11	9%	0%	9%	45%	0%	0%
Little Salt Creek	8	25%	0%	0%	25%	25%	25%
Tipton Creek (SF)	7	14%	0%	29%	57%	14%	14%
Negro Creek (SF)	2	0%	0%	50%	50%	0%	0%
Headwaters	4	75%	25%	50%	0%	0%	0%
Pleasant Valley	7	14%	14%	14%	14%	0%	0%
Gravel Creek (MF)	4	0%	0%	50%	25%	25%	0%
Sweetwater Creek	6	17%	0%	0%	33%	0%	0%
East Fork Salt	3	0%	33%	33%	33%	33%	33%
Gnaw Bone Creek	6	17%	0%	0%	17%	0%	0%
Clay Lick Creek	14	21%	0%	7%	14%	7%	7%
Brummett Creek	7	0%	0%	0%	14%	0%	0%
Stephens Creek	7	43%	0%	43%	29%	14%	0%
Jacobs Creek (LM)	0	0%	0%	0%	0%	0%	0%
Moore Creek (LM)	1	0%	0%	0%	0%	0%	0%
Allens Creek (LM)	1	0%	0%	100%	100%	0%	0%

Table 1-3 HUC-12 Subwatershed Ranking Using Fall Blitz Data

Subwatershed	Fall Blitz E. Coli Rank	Fall Blitz TSS Rank	Fall Blitz TP Rank	Fall Blitz SRP Rank	Fall Blitz TN Rank	Fall Blitz NO3 Rank
Kiper Creek (SF)	8	1	8	13	1	1
Little Salt Creek (SF)	14	1	1	8	14	15
Tipton Creek (SF)	9	1	10	15	12	14
Negro Creek (SF)	1	1	13	14	1	1
Headwaters Middle Fork	16	15	13	1	1	1
Pleasant Valley Creek (MF)	9	14	9	4	1	1
Gravel Creek (MF)	1	1	13	8	14	1
Sweetwater Creek (NF)	11	1	1	11	1	1
East Fork Salt Creek (NF)	1	16	11	11	16	16
Gnaw Bone Creek (NF)	11	1	1	7	1	1
Clay Lick Creek (NF)	13	1	7	4	11	13
Brummett Creek (NF)	1	1	1	4	1	1
Stephens Creek (NF)	15	1	12	10	12	1
Jacobs Creek (LM)	1	1	1	1	1	1
Moore Creek (LM)	1	1	1	1	1	1
Allens Creek (LM)	1	1	16	16	1	1

Based on the percentage of exceedances using the fall blitz data, the HUC-12 subwatershed of greatest concern is East Fork Salt Creek followed by Tipton Creek, Little Salt Creek, and Stephens Creek.

Spring Blitz Water Quality Assessment

Water quality data collected at 122 sites within the Lake Monroe watershed during the spring blitz on April 2, 2021, were compared against chosen water quality targets. These thresholds were used to discern areas of poor water quality. If the measured parameter did not meet the threshold requirement, the sample was counted as exceeding the threshold. Each of the data sets was analyzed to determine what percentage of samples did not meet the threshold requirement in each HUC-12 subwatershed and therefore how many times poor water quality was indicated for each specific parameter. Table 1-4 summarizes the percentage of exceedances for each parameter in each subwatershed. Table 1-5 assigns a rank for each parameter with “1” indicating the highest water quality (least exceedances) and “16” indicating the lowest water quality (most exceedances).

Table 1-4 HUC-12 Subwatershed Ranking Using Spring Blitz Data

HUC-12 Subwatershed	# Spring Samples	% Spring Samples E Coli > 235 CFU/ 100ml	% Spring Samples TSS > 30 mg/L	% Spring Samples TP > 0.020 mg/L	% Spring Samples SRP > 0.005 mg/L	% Spring Samples TN > 0.690 mg/L	% Spring Samples NO3 > 0.633 mg/L
Kiper Creek (SF)	11	9.1%	0%	45%	9%	0%	0%
Little Salt Creek	9	0.0%	0%	11%	0%	0%	0%
Tipton Creek (SF)	8	0.0%	0%	75%	25%	63%	25%
Negro Creek (SF)	6	0.0%	0%	17%	0%	0%	0%
Headwaters	6	0.0%	0%	33%	17%	0%	0%
Pleasant Valley	11	0.0%	0%	36%	36%	0%	0%
Gravel Creek	4	0.0%	0%	75%	0%	0%	0%
Sweetwater	8	0.0%	0%	88%	38%	0%	0%
East Fork Salt	7	0.0%	0%	100%	43%	0%	0%
Gnaw Bone Creek	13	0.0%	0%	100%	54%	0%	0%
Clay Lick Creek	17	0.0%	0%	94%	35%	0%	0%
Brummett Creek	8	0.0%	0%	75%	25%	0%	0%
Stephens Creek	6	0.0%	0%	83%	50%	17%	0%
Jacobs Creek	3	0.0%	0%	100%	67%	0%	0%
Moore Creek	3	0.0%	33%	100%	33%	0%	0%
Allens Creek (LM)	2	0.0%	0%	50%	50%	0%	0%

Table 1-5 HUC-12 Subwatershed Ranking Using Spring Blitz Data

Subwatershed	Spring Blitz E. Coli Rank	Spring Blitz TSS Rank	Spring Blitz TP Rank	Spring Blitz SRP Rank	Spring Blitz TN Rank	Spring Blitz NO3 Rank	Spring Blitz Average Rank
Kiper Creek (SF)	16	1	5	4	1	1	6
Little Salt Creek (SF)	1	1	1	1	1	1	2
Tipton Creek (SF)	1	1	9	6	16	16	8
Negro Creek (SF)	1	1	2	1	1	1	1
Headwaters Middle Fork (MF)	1	1	5	5	1	1	2
Pleasant Valley Creek (MF)	1	1	4	10	1	1	3
Gravel Creek (MF)	1	1	9	1	1	1	3
Sweetwater Creek (NF)	1	1	11	11	1	1	4
East Fork Salt Creek (NF)	1	1	16	12	1	1	5
Gnaw Bone Creek (NF)	1	1	16	15	1	1	4
Clay Lick Creek (NF)	1	1	12	9	1	1	4
Brummett Creek (NF)	1	1	9	6	1	1	3
Stephens Creek (NF)	1	1	10	13	15	1	7
Jacobs Creek (LM)	1	1	16	16	1	1	6
Moore Creek (LM)	1	16	16	8	1	1	7
Allens Creek (LM)	1	1	6	13	1	1	3

Based on the spring blitz data, the highest priority HUC-12 subwatershed is Tipton Creek followed by Moore Creek, Stephens Creek, and Jacobs Creek.

There were noticeable differences between the spring and fall blitz events, potentially due to the dramatically different weather conditions. The Fall Blitz was conducted during a period of low flow when only 88 stream sites could be sampled while the Spring Blitz was conducted during a period of relatively high flow when 123 stream sites were sampled.

Brown County RSD E. Coli Water Quality Assessment

The Brown County Regional Sewer District (BCRSD) collected and analyzed water samples for E. Coli concentration at 19 sites within the Brown County portion of the Lake Monroe watershed on a weekly basis for five weeks. These results were compared to the state standard of 235 CFU/100 ml and compiled by subwatershed. Based on these results, the subwatersheds with the most significant E. coli levels were the three subwatersheds of Middle Fork Salt Creek – Headwaters Middle Fork, Pleasant Valley Creek, and Gravel Creek – along with Brummett Creek in the North Fork subwatershed. E. Coli was also detected above the state water quality target in more than 50% of samples in Gnaw Bone Creek and Clay Lick Creek. It should be noted that there was only one sample site in the South Fork subwatershed and no sample sites in the Lake Monroe Basin subwatershed.

Table 1-6 HUC-12 Subwatershed E. Coli Assessment Using BCRSD Data

HUC-12 Subwatershed	# BCRSD Samples	Average E. Coli Result (CFU/100 ml)	% Samples E Coli > 235 CFU/ 100ml	BCRSD E Coli Rank
Kiper Creek (SF)				
Little Salt Creek (SF)	5	177	20%	9
Tipton Creek (SF)				
Negro Creek (SF)				
Headwaters Middle Fork (MF)	5	656	80%	13
Pleasant Valley Creek (MF)	15	494	80%	13
Gravel Creek (MF)	5	536	80%	13
Sweetwater Creek (NF)	5	166	40%	10
East Fork Salt Creek (NF)				
Gnaw Bone Creek (NF)	15	267	53%	12
Clay Lick Creek (NF)	30	356	50%	11
Brummett Creek (NF)	5	515	80%	13
Stephens Creek (NF)				
Jacobs Creek (LM)				
Moore Creek (LM)				
Allens Creek (LM)				

Water Quality Degradation Summary

Overall, the Tipton Creek subwatershed (South Fork) scored the highest (worst) for water quality degradation, followed by East Fork Salt Creek (North Fork), Stephens Creek (North Fork), Clay Lick Creek (North Fork), and Little Salt Creek (South Fork). This indicates that these five subwatersheds have the poorest water quality.

Jacobs Creek (LM) was expected to have a number of E. coli exceedances due to its listing on the 303(d) impaired water body list but no samples in the subwatershed tested above the state limit of 235 CFU/100 ml.

Table 1-7 HUC-12 Subwatershed Water Quality Degradation Ranking

HUC-12 Subwatershed	Level of Degradation
Kiper Creek (SF)	5
Little Salt Creek (SF)	12 – High
Tipton Creek (SF)	16 – High
Negro Creek (SF)	2
Headwaters Middle Fork (MF)	10 - Medium
Pleasant Valley Creek (MF)	8 - Medium
Gravel Creek (MF)	5
Sweetwater Creek (NF)	3
East Fork Salt Creek (NF)	15 - High
Gnaw Bone Creek (NF)	8
Clay Lick Creek (NF)	13 - High
Brummett Creek (NF)	1
Stephens Creek (NF)	14 - High
Jacobs Creek (LM)	3
Moore Creek (LM)	7 - Medium
Allens Creek (LM)	11 - Medium

0-6 Low, 7-11 Medium, 12-16 High

Table 1-8 HUC-12 Subwatershed Water Quality Degradation Parameters

HUC-12 Sub-watershed	# Parameters	303(d) Rank	Fall Blitz E Coli Rank	Fall Blitz TSS Rank	Fall Blitz TP Rank	Fall Blitz SRP Rank	Fall Blitz TN Rank	Fall Blitz NO3 Rank	Spring Blitz E Coli Rank	Spring Blitz TSS Rank	Spring Blitz TP Rank	Spring Blitz SRP Rank	Spring Blitz TN Rank	Spring Blitz NO3 Rank	BCRSD E Coli Rank
Kiper Creek (SF)	14	1	8	1	8	13	1	1	16	1	5	4	1	1	
Little Salt Creek (SF)	15	12	14	1	1	8	14	15	1	1	1	1	1	1	9
Tipton Creek (SF)	14	1	9	1	10	15	12	14	1	1	9	6	16	16	
Negro Creek (SF)	14	13	1	1	13	14	1	1	1	1	2	1	1	1	
Headwaters Middle Fork (MF)	15	1	16	15	13	1	1	1	1	1	5	5	1	1	13
Pleasant Valley Creek (MF)	15	1	9	14	9	4	1	1	1	1	4	10	1	1	13
Gravel Creek (MF)	15	1	1	1	13	8	14	1	1	1	9	1	1	1	13
Sweetwater Creek (NF)	15	1	11	1	1	11	1	1	1	1	11	11	1	1	10
East Fork Salt Creek (NF)	14	1	1	16	11	11	16	16	1	1	16	12	1	1	
Gnaw Bone Creek (NF)	15	1	11	1	1	7	1	1	1	1	16	15	1	1	12
Clay Lick Creek (NF)	15	1	13	1	7	4	11	13	1	1	12	9	1	1	11
Brummett Creek (NF)	15	1	1	1	1	4	1	1	1	1	9	6	1	1	13
Stephens Creek (NF)	14	1	15	1	12	10	12	1	1	1	10	13	15	1	
Jacobs Creek (LM)	14	16	1	1	1	1	1	1	1	1	16	16	1	1	
Moore Creek (LM)	14	14	1	1	1	1	1	1	1	16	16	8	1	1	
Allens Creek (LM)	14	14	1	1	16	16	1	1	1	1	6	13	1	1	

1.2 HUC-12 Vulnerability Assessment

The level of vulnerability represents observed sources of pollutants in the watershed and utilizes all windshield survey data – erosion, riparian buffer, livestock access – as well as NPDES facilities, land cover, and habitat data. Individual rankings are averaged and compared between watersheds to calculate a degradation rank.

The level of vulnerability represents observed sources of pollutants in the watershed and utilizes all windshield survey data – erosion, riparian buffer, livestock access – as well as NPDES facilities, land cover, and habitat data. Individual rankings are averaged and compared between watersheds to calculate a vulnerability rank.

Point Source Pollution (NPDES)

The number of facilities with point discharge permits (NPDES) was tabulated for each subwatershed to evaluate relative prioritization. Based on NPDES permits, the largest impact is from the Clay Lick Creek subwatershed followed by Moore Creek. Additional areas of concern include the Kiper Creek, Gnaw Bone Creek, Brummett Creek, Allens Creek, and Jacobs Creek subwatersheds.

Table 1-9 HUC-12 Subwatershed Comparison of Point Discharge Facilities

HUC-12-Subwatershed	NPDES Permits	# Permits	Rank
Kiper Creek (SF)	Jackson County Regional Sewer District WWTP, Springhill Camps WWTP	2	11
Little Salt Creek (SF)	None	0	1
Tipton Creek (SF)	None	0	1
Negro Creek (SF)	None	0	1
Headwaters Middle Fork (MF)	None	0	1
Pleasant Valley Creek (MF)	None	0	1
Gravel Creek (MF)	None	0	1
Sweetwater Creek (NF)	None	0	1
East Fork Salt Creek (NF)	None	0	1
Gnaw Bone Creek (NF)	Gnaw Bone WWTP, Camp Moneto WWTP	2	11
Clay Lick Creek (NF)	Nashville WWTP, Greg Rose Properties WWTP, Wrights Auto Parts, Shelby Materials	4	16
Brummett Creek (NF)	Brown County State Park WWTP, Unionville Elementary WWTP	2	11
Stephens Creek (NF)	None	0	1
Jacobs Creek (LM)	Salt Creek Services WWTP	1	10
Moore Creek (LM)	Paynetown SRA WWTP, SCI RSD WWTP, CBU Drinking Water Plant	3	15
Allens Creek (LM)	USFS Hardin Ridge WWTP, Hardin-Monroe WWTP	2	11

Land Cover Assessment

Nonpoint source pollution is most likely to come from agricultural land or developed land (as opposed to forest, water/wetlands, or scrub/shrub). The percentage of agricultural and developed land was tabulated for each subwatershed to evaluate relative prioritization.

The four subwatersheds with the highest percentage of combined agricultural and developed land were Kiper Creek, Tipton Creek, Allens Creek, and Stephens Creek. The five subwatersheds with moderate percentage of combined agricultural and developed land were Little Salt Creek, Pleasant Valley Creek, Sweetwater Creek, Brummett Creek, and Moore Creek.

Table 1-10 HUC-12 Subwatershed Land Cover Assessment

HUC-12 Subwatershed	% Agricultural	% Developed	% Agricultural or Developed	Land Cover Rank
Kiper Creek (SF)	24.6%	4.8%	29.4%	16
Little Salt Creek (SF)	8.0%	1.7%	9.8%	10
Tipton Creek (SF)	21.5%	2.6%	24.1%	15
Negro Creek (SF)	1.8%	1.0%	2.7%	2
Headwaters Middle Fork (MF)	5.8%	1.7%	7.5%	6
Pleasant Valley Creek (MF)	8.7%	1.8%	10.5%	10
Gravel Creek (MF)	2.4%	0.7%	3.0%	2
Sweetwater Creek (NF)	5.8%	2.8%	8.6%	8
East Fork Salt Creek (NF)	5.1%	1.2%	6.3%	4
Gnaw Bone Creek (NF)	4.2%	2.1%	6.4%	4
Clay Lick Creek (NF)	5.2%	2.6%	7.8%	7
Brummett Creek (NF)	6.8%	2.2%	8.9%	8
Stephens Creek (NF)	7.1%	4.1%	11.2%	13
Jacobs Creek (LM)	0.4%	0.8%	1.2%	1
Moore Creek (LM)	7.4%	2.4%	9.8%	10
Allens Creek (LM)	9.4%	2.6%	12.0%	14

Streambank Erosion (Windshield Survey)

Visual assessments of streambank erosion showed the highest percentage of sites with erosion in the Tipton Creek, Gravel Creek, and Stephens Creek subwatersheds followed by Brummett Creek and Gnawbone Creek, Kiper Creek, and Headwaters Middle Fork. One limitation to the data is that fewer sites were evaluated in the Lake Monroe Basin. In that subwatershed, roads tend to run along ridgetops and there are also fewer roads simply because Lake Monroe makes up a large percentage of the watershed (20%). This analysis also does not account for lakeshore erosion which is significant in the Lake Monroe Basin.

Table 1-11 HUC-12 Subwatershed Streambank Erosion Assessment

HUC-12 Subwatershed	Minor Erosion (1-2 ft)	Major Erosion (3+ ft)	Any Erosion (1+ ft)	# Sites Assessed	Erosion Rank
Kiper Creek (SF)	64%	29%	93%	14	**10**
Little Salt Creek (SF)	72%	6%	78%	18	**6**
Tipton Creek (SF)	55%	45%	100%	20	**14**
Negro Creek (SF)	42%	33%	75%	12	**4**
Headwaters Middle Fork (MF)	67%	27%	93%	15	**10**
Pleasant Valley Creek (MF)	52%	30%	83%	23	**8**
Gravel Creek (MF)	54%	46%	100%	13	**14**
Sweetwater Creek (NF)	71%	18%	88%	17	**9**
East Fork Salt Creek (NF)	42%	33%	75%	12	**4**
Gnaw Bone Creek (NF)	65%	29%	94%	17	**12**
Clay Lick Creek (NF)	46%	35%	81%	26	**7**
Brummett Creek (NF)	77%	19%	97%	31	**13**
Stephens Creek (NF)	63%	38%	100%	8	**14**
Jacobs Creek (LM)	33%	17%	50%	6	**2**
Moore Creek (LM)	50%	13%	63%	8	**3**
Allens Creek (LM)	33%	0%	33%	3	**1**

Riparian Buffer (Windshield Survey)

Visual assessment of the width of riparian buffer showed the highest percentage of sites with insufficient buffer (less than 20 feet) in the Pleasant Valley Creek subwatershed followed by Gnaw Bone Creek, Clay Lick Creek, Brummett Creek, and Kiper Creek.

Table 1-12 HUC-12 Subwatershed Riparian Buffer Assessment

HUC-12 Subwatershed	Minimal Riparian Buffer (5-20 ft)	Absent Riparian Buffer (<5 ft)	Insufficient Riparian Buffer (<20 ft)	# Sites Assessed	Riparian Buffer Rank
Kiper Creek (SF)	71%	0%	71%	14	12
Little Salt Creek (SF)	11%	28%	39%	18	5
Tipton Creek (SF)	45%	5%	50%	20	6
Negro Creek (SF)	0%	0%	0%	12	1
Headwaters Middle Fork (MF)	47%	13%	60%	15	8
Pleasant Valley Creek (MF)	57%	35%	91%	23	16
Gravel Creek (MF)	15%	8%	23%	13	3
Sweetwater Creek (NF)	29%	24%	53%	17	7
East Fork Salt Creek (NF)	42%	25%	67%	12	9
Gnaw Bone Creek (NF)	41%	41%	82%	17	15
Clay Lick Creek (NF)	38%	38%	77%	26	13
Brummett Creek (NF)	58%	19%	77%	31	13
Stephens Creek (NF)	38%	0%	38%	8	4
Jacobs Creek (LM)	0%	67%	67%	6	9
Moore Creek (LM)	0%	13%	13%	8	2
Allens Creek (LM)	67%	0%	67%	3	9

Livestock Access (Windshield Survey)
Visual assessment of where livestock had access to streams indicate that the issue is most prevalent in the Tipton Creek and Stephens Creek subwatersheds followed by Little Salt Creek, East Fork Salt Creek, and Clay Lick Creek subwatersheds.

Table 1-13 HUC-12 Subwatershed Livestock Access Assessment

HUC-12 Subwatershed	# Sites with Livestock Access to Streams	# Sites Assessed	% Sites with Livestock Access to Streams	Livestock Access Rank
Kiper Creek (SF)	1	14	7%	**10**
Little Salt Creek (SF)	2	18	11%	**14**
Tipton Creek (SF)	4	20	20%	**15**
Negro Creek (SF)	0	12	0%	**1**
Headwaters Middle Fork (MF)	1	15	7%	**10**
Pleasant Valley Creek (MF)	1	23	4%	**7**
Gravel Creek (MF)	0	13	0%	**1**
Sweetwater Creek (NF)	1	17	6%	**8**
East Fork Salt Creek (NF)	1	12	8%	**12**
Gnaw Bone Creek (NF)	0	17	0%	**1**
Clay Lick Creek (NF)	2	26	8%	**12**
Brummett Creek (NF)	2	31	6%	**8**
Stephens Creek (NF)	2	10	20%	**15**
Jacobs Creek (LM)	1	6	0%	**1**
Moore Creek (LM)	0	8	0%	**1**
Allens Creek (LM)	1	3	0%	**1**

Habitat Assessment

Habitat assessments using the Citizens Quality Habitat Evaluation Index (CQHEI) were completed twice at each blitz sites (once in the fall and once in the spring). Results were compiled and analyzed by subwatershed. Scores were significantly different during the fall and spring blitz, which is partially attributable to the different flow conditions (stream flow was absent or minimal in the fall due to drought conditions while stream flow was moderate in the spring). Based on the fall blitz data, the subwatersheds with the poorest stream habitat were Kiper Creek, Gravel Creek, East Fork Salt Creek, and Brummett Creek. Based on the spring blitz data, the subwatersheds with the poorest stream habitat were Kiper Creek, Tipton Creek, Gravel Creek, and Stephens Creek.

Table 1-14 HUC-12 Subwatershed Habitat Assessment

HUC-12 Subwatershed	Fall Blitz Average CQHEI Score	Spring Blitz Average CQHEI Score	Fall Blitz CQHEI Rank	Spring Blitz CQHEI Rank	Average CQHEI Rank
Kiper Creek (SF)	54.3	59.9	15	15	15
Little Salt Creek (SF)	62.9	78.2	2	1	1.5
Tipton Creek (SF)	59.2	61.2	7	13	10
Negro Creek (SF)	55.8	70.1	11	6	8.5
Headwaters Middle Fork (MF)	62.8	77.8	3	3	3
Pleasant Valley Creek (MF)	55.8	68.1	11	9	10
Gravel Creek (MF)	54.9	54.8	13	16	14.5
Sweetwater Creek (NF)	62.8	75.8	3	4	3.5
East Fork Salt Creek (NF)	54.3	67	15	10	12.5
Gnaw Bone Creek (NF)	56.9	68.4	9	8	8.5
Clay Lick Creek (NF)	56.9	65.5	9	11	10
Brummett Creek (NF)	54.5	72.5	14	5	9.5
Stephens Creek (NF)	59.3	61.2	6	13	9.5
Jacobs Creek (LM)	60.3	69	5	7	6
Moore Creek (LM)	57.7	65	8	12	10
Allens Creek (LM)	64	78	1	2	1.5

Water Quality Vulnerability Summary

The Kiper Creek subwatershed (South Fork) scored the highest (worst) for vulnerability, followed by Clay Lick Creek (North Fork), Brummett Creek (North Fork), Tipton Creek (South Fork), and Stephens Creek (North Fork). This indicates that these five subwatersheds have the highest concentration of documented pollution sources.

Table 1-15 HUC-12 Subwatershed Vulnerability Rank

Sub-watershed	Vulnerability Rank	Average Score	# Parameters	NPDES Rank	Erosion Rank	Riparian Buffer Rank	Livestock Access Rank	Land Cover Rank	Fall Blitz CQHEI Rank	Spring Blitz CQHEI R
Kiper Creek (SF)	16	12.7	7	11	10	12	10	16	15	15
Little Salt Creek (SF)	3	5.6	7	1	6	5	14	10	2	1
Tipton Creek (SF)	13	10.1	7	1	14	6	15	15	7	13
Negro Creek (SF)	1	3.7	7	1	4	1	1	2	11	6
Headwaters Middle Fork (MF)	6	5.9	7	1	10	8	10	6	3	3
Pleasant Valley Creek (MF)	11	8.9	7	1	8	16	7	10	11	9
Gravel Creek (MF)	7	7.1	7	1	14	3	1	2	13	16
Sweetwater Creek (NF)	5	5.7	7	1	9	7	8	8	3	4
East Fork Salt Creek (NF)	9	7.9	7	1	4	9	12	4	15	10
Gnaw Bone Creek (NF)	10	8.6	7	11	12	15	1	4	9	8
Clay Lick Creek (NF)	15	10.7	7	16	7	13	12	7	9	11
Brummett Creek (NF)	14	10.3	7	11	13	13	8	8	14	5
Stephens Creek (NF)	12	9.4	7	1	14	4	15	13	6	13
Jacobs Creek (LM)	2	5.0	7	10	2	9	1	1	5	7
Moore Creek (LM)	8	7.3	7	15	3	2	1	10	8	12
Allens Creek (LM)	3	5.6	7	11	1	9	1	14	1	2

1.3 HUC-12 Overall Assessment

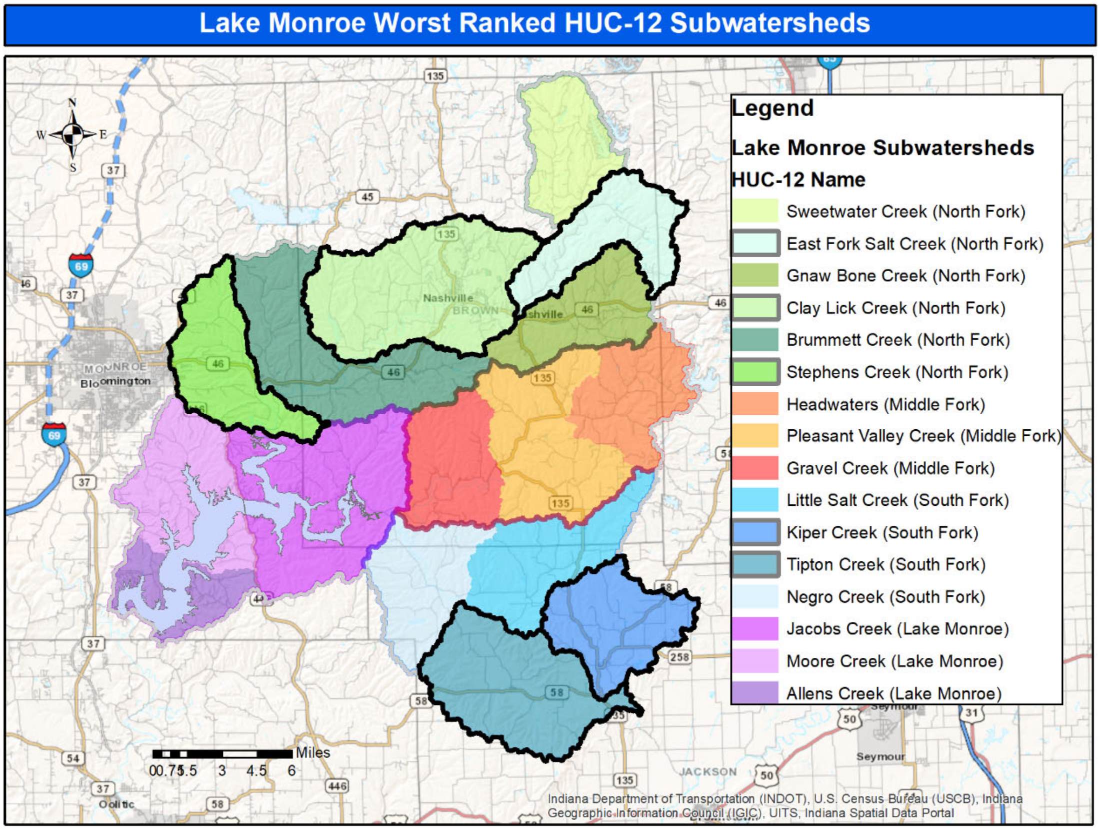
Combining the two sets of rankings, the five highest priority HUC-12 subwatersheds are Kiper Creek and Tipton Creek in the South Fork subwatershed; and East Fork Salt Creek, Clay Lick Creek, and Stephens Creek in the North Fork subwatershed.

Table 1-16 HUC-12 Subwatershed Combined Ranking

HUC-12 Subwatershed	Level of Degradation	Level of Vulnerability	Sum	Overall Rank
Kiper Creek (SF)	5	16 - High	24	12 - High
Little Salt Creek (SF)	12 – High	3	15	6
Tipton Creek (SF)	16 – High	13 - High	29	16 - High
Negro Creek (SF)	2	1	3	1
Headwaters Middle Fork (MF)	10 - Medium	6	16	9 - Medium
Pleasant Valley Creek (MF)	8 - Medium	11 - Medium	19	11 - Medium
Gravel Creek (MF)	5	7 - Medium	12	4
Sweetwater Creek (NF)	3	5	8	3
East Fork Salt Creek (NF)	15 - High	9 - Medium	24	13 - High
Gnaw Bone Creek (NF)	8 - Medium	10 - Medium	18	10 - Medium
Clay Lick Creek (NF)	13 - High	15 - High	28	15 - High
Brummett Creek (NF)	1	14 - High	15	6
Stephens Creek (NF)	14 - High	12 - High	26	14 - High
Jacobs Creek (LM)	3	2	5	2
Moore Creek (LM)	7 - Medium	8 - Medium	15	6
Allens Creek (LM)	11 - Medium	3	14	5

0-6 Low, 7-11 Medium, 12-16 High

Figure 1-2 Lake Monroe Worst Ranked HUC-12 Subwatersheds



Appendix J of Lake Monroe Watershed Management Plan
Detailed HUC-12 Water Quality Analysis by Subwatershed

Contents

1 Water Quality Analysis by Subwatershed (HUC12)

The Lake Monroe watershed consists of sixteen 12-digit Hydrologic Unit Code (HUC) subwatersheds. To better understand localized differences, data was analyzed according to these 12-digit HUC subwatersheds. Each subwatershed reflects a specific tributary drainages. Land uses, point and non-point watershed concern areas, and water quality sampling locations and results are discussed in detail below for each subwatershed based on the following information:

- Monthly Tributary Monitoring (2020-2021)
- Sampling Blitz "Snapshot" Monitoring Events (2020-2021)
- Brown County Regional Sewer District E. Coli Sampling (2020)
- Habitat Evaluation CQHEI Habitat Assessment (2020-2021)
- Land Cover Assessment
- Windshield Survey Visual Assessment (2020)
    - Riparian Buffer
    - Streambank Erosion
    - Livestock Access to Streams
- NPDES Point Source Location Data
- Historical Water Quality Data (where available)

As Lake Monroe straddles three 12-digit HUCs (Allen Creek, Moore Creek, Jacobs Creek), a separate section was added to analyze data collected within the lake.

- Lake Monroe Monitoring (2020-2021)
- Historical Lake Monroe Monitoring Data
    - USACE Annual Lake Monitoring
    - CBU Annual and Periodic Lake Monitoring
    - IDEM/IDNR Annual Beach Blue-Green Algae Monitoring
    - USFS Annual Beach E. Coli Monitoring
    - 1997 Jones Report (1992-1993 Lake Monitoring)

Figure 1-1 Lake Monroe Subwatersheds

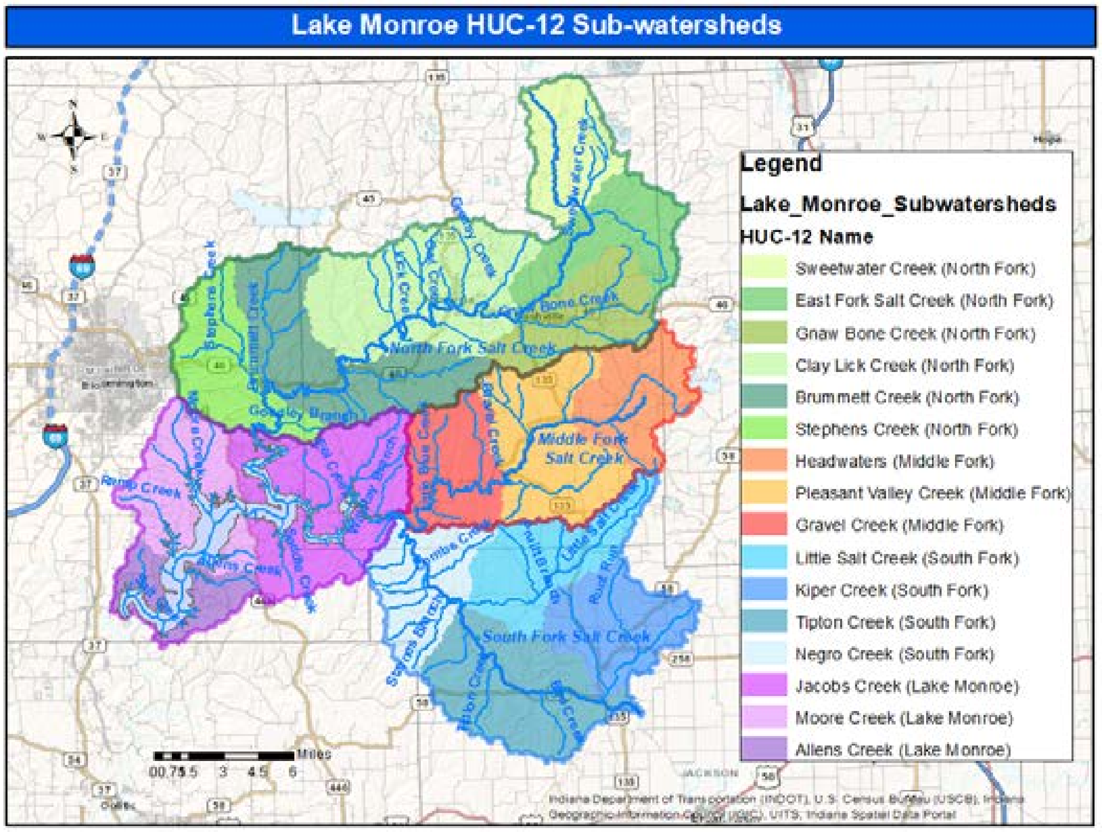


Table 1-1 Lake Monroe 12-Digit Hydrologic Unit Code Subwatersheds

12-Digit HUC	Name	10-Digit HUC Name	Acres	Percentage
051202080401	Kiper Creek (SF)	South Fork Salt Creek	14,531	5%
051202080402	Little Salt Creek (SF)	South Fork Salt Creek	15,681	6%
051202080403	Tipton Creek (SF)	South Fork Salt Creek	21,822	8%
051202080404	Negro Creek (SF)	South Fork Salt Creek	13,548	5%
051202080501	Headwaters Middle Fork (MF)	Middle Fork Salt Creek	13,206	5%
051202080502	Pleasant Valley Creek (MF)	Middle Fork Salt Creek	20,333	7%
051202080503	Gravel Creek (MF)	Middle Fork Salt Creek	13,237	5%
051202080601	Sweetwater Creek (NF)	North Fork Salt Creek	12,239	4%
051202080602	East Fork Salt Creek (NF)	North Fork Salt Creek	13,719	5%
051202080603	Gnaw Bone Creek (NF)	North Fork Salt Creek	13,598	5%
051202080604	Clay Lick Creek (NF)	North Fork Salt Creek	28,572	10%
051202080605	Brummett Creek (NF)	North Fork Salt Creek	23,857	9%
051202080606	Stephens Creek (NF)	North Fork Salt Creek	14,947	5%
051202080701	Jacobs Creek (LM)	Lake Monroe-Salt Creek	28,880	10%
051202080702	Moore Creek (LM)	Lake Monroe-Salt Creek	18,240	7%
051202080703	Allens Creek (LM)	Lake Monroe-Salt Creek	10,273	4%

1.1 Kiper Creek – South Fork (HUC 051202080401)

The Kiper Creek Subwatershed (HUC 12 – 051202080401) is located in the southeastern corner of the watershed as shown in Figure 4-2. The subwatershed encompasses approximately 14,531 acres and represents 5% of the overall watershed. The subwatershed is located entirely within Jackson County and contains Freetown. Kiper Creek, Little Salt (Kiper) Creek – not to be confused with Little Salt Creek in the Little Salt Creek subwatershed – and Runt Run all originate in the subwatershed and combine before discharging into South Fork Salt Creek at the downstream limit of the subwatershed. According to the IDEM 303(d) list, there are no impaired streams within the Kiper Creek Subwatershed.

1.1.1 Land Use

The Kiper Creek Subwatershed has the highest percentage of agricultural land (25%) of the sixteen Lake Monroe subwatersheds. Cropland is most concentrated along Runt Run, Little Salt Creek, and the downstream portion of Kiper Creek. Pasture is located along the headwaters of Little Salt Creek (Spraytown area), along Kiper Creek, and north of Freetown. Kiper Creek Subwatershed also has the highest percentage of developed land (5%) of all sixteen Lake Monroe subwatersheds primarily due to Freetown, a community of roughly 400 residents. (While Nashville in the Clay Lick subwatershed is much larger than Freetown, it makes up a smaller percentage of other overall subwatershed.) Several parcels of land in the northern third of the subwatershed are owned by the United States Forest Service.

1.1.2 Point Source Water Quality Issues

The Kiper Creek Subwatershed contains no confined feeding operations and two NPDES permitted facilities. Springhill Camps maintains a very small (0.0196 MGD) sewage treatment system under NPDES permit IN0044211 that discharges to an unnamed tributary of Little Salt Creek near Freetown. One self-reported violation occurred in July 2018 when sampling revealed E. coli levels above the permit threshold. No other violations were found.

Jackson County Regional Sewer District maintains a wastewater treatment plant under NPDES permit IN0052949 that discharges to Little Salt Creek near Freetown. The facility also has a separate permit for municipal sludge application under Land Application Permit No. INLA000470. The NPDES permit was most recently renewed in 2019. A self-reported violation in nitrogen concentration occurred in 2015 and self-reported violation in TSS occurred in 2016. No other violations were found. However, the plant does appear to be located within the 100-year floodplain of Little Salt Creek.

1.1.3 Non-Point Source Water Quality Issues

In early spring 2020, the watershed coordinator conducted a windshield survey which included 14 stream crossing sites within the Kiper Creek Subwatershed. Observations including streambank erosion, stream buffers, and livestock access were recorded for each site and the results are summarized in Table 4-2 below. Streambank erosion was noted at 13 of the 14 observed sites and lack of sufficient riparian buffer was observed at 10 of the 14 observed sites. Livestock access was documented at 1 of 14 sites but is believed to be more prevalent due to the larger amount of pasture in the subwatershed.

Table 1-2 Kiper Creek Windshield Survey Summary

Parameter	Observations
Streambank Erosion	4/14 sites with erosion >3' 9/14 sites with erosion <3' 1/14 sites with no erosion
Stream Buffers	0/14 sites with no buffers 10/14 sites with buffers <20' 4/14 sites with sufficient buffer
Livestock Access to Streams	1/14 sites with livestock access

Figure 1-2 Kiper Creek (South Fork) Subwatershed

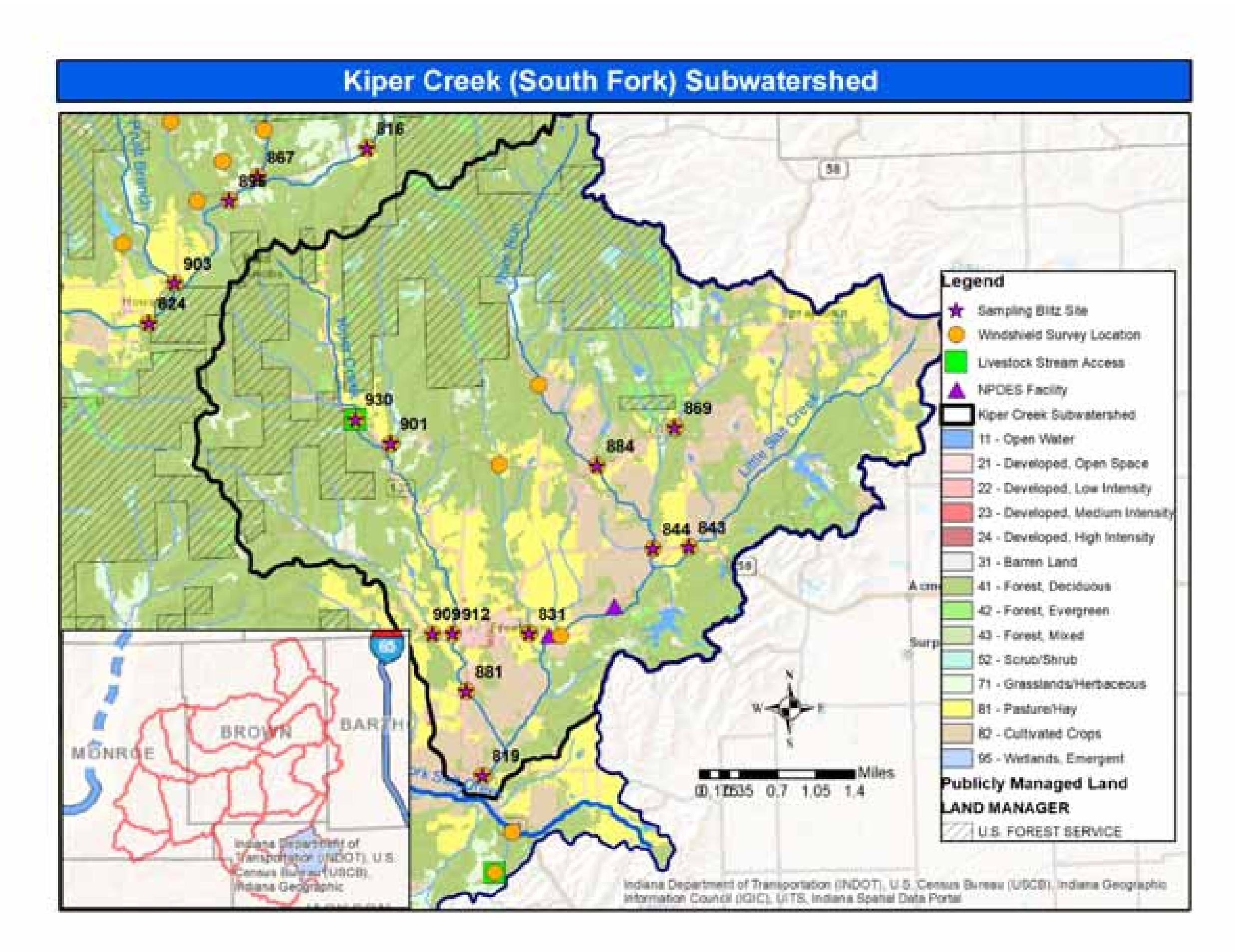


Figure 1-3 Site 881 on Kiper Creek (downstream)

Figure 1-4 Site 930 on Kiper Creek (upstream)

1.1.4 Water Quality Assessment

Eleven stream sites were selected for the spring and fall watershed sampling blitz events. Samples were analyzed for a variety of chemical parameters and E. coli. Habitat was evaluated using CQHEI. Macroinvertebrates and the fish community have not been assessed in this subwatershed. No monthly sampling locations or stream gages are located in this subwatershed.

Water Quality Information

During the two blitz events, no exceedances were reported for total nitrogen, nitrate, or total suspended solids. One sample (of 11) exceeded the total phosphorus target of 0.02 mg/L in the fall and 5 of 11 exceeded the total phosphorus target in the spring. The only site with total phosphorus exceedances during both events was site 819 on Little Salt (Kiper) Creek at the downstream end of the subwatershed. Soluble reactive phosphorus concentrations exceeded the target stream concentration of 0.005 mg/L in 3 of 11 fall samples and 1 of 11 spring samples with very little correlation between elevated total phosphorus levels.

E. coli was measured above the state standard in 1 of 11 samples in each blitz event, at site 930 on Kiper Creek (upstream) in the fall and at site 881 on Kiper Creek (downstream) in the spring. Livestock with access to the stream were observed near site 930 and livestock fenced from the stream were observed at site 881 during the windshield survey.

An additional water sample was collected at site 881 (downstream Kiper Creek) on April 27, 2021 to send for source analysis. The source analysis indicated a 50.5% probability of a human source and a 49.5% probability of an animal source. The E. coli concentration was reported at 1,299.7 CFU/100 ml, significantly exceeding the target of 235 CFU/100 ml.

Table 1-3 Kiper Creek Sampling Blitz Results - Nutrients

Blitz ID	Creek Name	Fall TN (mg/L)	Spring TN (mg/L)	Fall NO3 (mg/L)	Spring NO3 (mg/L)	Fall TP (mg/L)	Spring TP (mg/L)	Fall SRP (mg/L)	Spring SRP (mg/L)
819	Little Salt Creek	0.228	0.488	0.008	0.416	0.021	0.024	0.005	0.004
831	Unnamed tributary of Little Salt (Kiper) Creek	0.100	0.194	0.020	0.138	0.003	0.016	0.006	0.003
843	Little Salt Creek	0.186	0.460	0.008	0.316	0.019	0.039	0.003	0.003
844	Runt Run	0.199	0.456	0.083	0.360	0.009	0.061	0.003	0.012
869	Unnamed tributary of Runt Run	0.183	0.177	0.008	0.073	0.018	0.018	0.003	0.002
881	Kiper Creek	0.287	0.336	0.193	0.254	0.012	0.022	0.009	0.002
884	Runt Run	0.100	0.130	0.008	0.043	0.010	0.033	0.002	0.002
901	Unnamed tributary of Kiper Creek	0.100	0.179	0.008	0.135	0.004	0.011	0.003	0.002
909	Unnamed tributary of Kiper Creek	0.502	0.233	0.506	0.160	0.007	0.010	0.011	0.002
912	Kiper Creek	0.101	0.347	0.008	0.296	0.010	0.010	0.002	0.002
930	Kiper Creek	0.100	0.232	0.014	0.131	0.002	0.005	0.005	0.002

Table 1-4 Kiper Creek Sampling Blitz Results - E. coli and Sediment

Blitz ID	Creek Name	Fall E. Coli (MPN/ 100 mL)	Spring E. coli (MPN/ 100mL)	Fall TSS (mg/L)	Spring TSS (mg/L)
819	Little Salt Creek	42	32	0.5	0.6
831	Unnamed tributary of Little Salt (Kiper) Creek	186	1	0.5	0.5
843	Little Salt Creek	5	99	0.5	1.2
844	Runt Run	39	5	0.5	0.5
869	Unnamed tributary of Runt Run	19	10	2.2	0.5
881	Kiper Creek	146	488	1	4.8
884	Runt Run	32	5	0.5	0.5
901	Unnamed tributary of Kiper Creek	137	27	0.5	0.5
909	Unnamed tributary of Kiper Creek	10	3	0.5	0.5
912	Kiper Creek	6	6	0.5	0.5
930	Kiper Creek	435	4	0.5	0.5

Table 1-5 Kiper Creek Fecal Contamination Source Analysis

BC_ID	LM_ID	Stream	4/27/21 E. Coli	Coliform (PFU/100ml)	% Human	% Animal
N/A	881	Kiper Creek (downstream)	1299.7	0.1	50.5	49.5

1.1.5 Habitat and Biological Assessment

Habitat/Biological Information

Volunteers completed the Citizen Qualitative Habitat Evaluation Index (CQHEI) habitat assessment at all 11 sites during the spring and fall sampling blitz events. Although a comparison scale for the CQHEI has not yet been developed, Hoosier Riverwatch indicates that scores greater than 60 rate as habitat conducive to supporting warm-water biota (IDNR, 2004). CQHEI scores ranged from 45 to 61 during the fall blitz and 45 to 77 during the spring blitz. Only 9% of sites scored above 60 during the fall blitz and only 45% of sites scored above 60 during the spring blitz, indicating poor stream habitat throughout the subwatershed. The lowest scores were in the smallest streams (unnamed tributaries) and in Kiper Creek. In most subwatersheds, CQHEI scores were generally higher in the spring due to higher flow levels. It is unclear why many CQHEI scores were lower in the spring in the Kiper Creek subwatershed and could be due to a difference in volunteers between events.

Table 1-6 Kiper Creek Sampling Blitz Results - Habitat Evaluation (CQHEI)

Blitz ID	Stream Name	Fall 2020 CQHEI	Spring 2021 CQHEI
819	Little Salt (Kiper) Creek	53	62.5
831	Unnamed tributary of Little Salt (Kiper) Creek	59.5	54
843	Little Salt (Kiper) Creek	50	72
844	Runt Run	45	77
869	Unnamed tributary of Runt Run	48	59
881	Kiper Creek	52	47
884	Runt Run	60	67
901	Unnamed tributary of Kiper Creek	56	50.3
909	Unnamed tributary of Kiper Creek	59	56
912	Kiper Creek	54	69
930	Kiper Creek	61	45
	Average CQHEI	54.3	59.9
	% of Sites >60	9%	45%

Table 1-7 Kiper Creek 2017 - 2019 USFS Houston South 3-Year Average of Fish Survey Results

Blitz ID	Stream	Station	# Species	Fish IBI	IBI Rating	QHEI	QHEI Rating
930	Kiper Creek	SR 135	8	27.3	Poor	50.3	Fair

No stream sections in the subwatershed were evaluated using macroinvertebrate Index of Biotic Integrity (mIBI). The USFS sampled fish in Kiper Creek at site 930 from 2017 through 2019 and reported an average fish-based Index of Biotic Integrity (IBI) of 27.3, indicating a poor rating.

The USFS also evaluated habitat using the Qualitative Habitat Evaluation Index (QHEI) at site 930 and reported an average QHEI score indicating fair habitat. This corresponds well with the fall CQHEI score of 61 (generally healthy) but not the spring CQHEI score of 45.

1.1.6 Kiper Creek Subwatershed Summary

The Kiper Creek subwatershed contains the highest concentration of agricultural land in the watershed. Water chemistry data from the Kiper Creek subwatershed suggest that total phosphorus, soluble reactive phosphorus, and E. coli are potential contaminants of concern.

Streambank erosion and insufficient riparian buffer were observed throughout the watershed which may contribute to the poor habitat scores. Kiper Creek appears to be the primary stream of concern due to its E. coli exceedances and low habitat scores compared to the other named streams.

1.2 Little Salt Creek – South Fork (HUC 051202080402)

The Little Salt Creek Subwatershed (HUC 12 – 051202080402) straddles the border between Brown and Jackson Counties as shown in Figure 4-5. The subwatershed encompasses approximately 15,681 acres and represents 6% of the overall watershed. Little Salt Creek (GNIS 00451161) runs through the subwatershed, combining with its tributaries Cross Branch and Pruitt Branch before discharging into South Fork Salt Creek at the downstream limit of the subwatershed. According to the IDEM 303(d) list, Little Salt Creek (GNIS 00451161) is impaired for E. coli, which includes several of its tributaries. This impairment designation is based on samples collected by IDEM in 2013 where Little Salt Creek crosses under Buffalo Pike, corresponding with site 824.

1.2.1 Land Use

The Little Salt Creek Subwatershed has the fifth highest percentage of agricultural land (8%) of the sixteen Lake Monroe subwatersheds. Pasture is primarily located along the northern stretch of State Road 135 and around the community of Houston in the western half of the subwatershed. Cropland is concentrated along the downstream stretch of Little Salt Creek near Houston. Population is sparse and generally located along the main roads (State Road 135, Houston Road, Buffalo Pike). About half the land in the watershed is owned by the United States Forest Service.

1.2.2 Point Source Water Quality Issues

The Little Salt Creek Subwatershed contains no confined feeding operations and no NPDES permitted facilities.

1.2.3 Non-Point Source Water Quality Issues

In early spring 2020, the watershed coordinator conducted a windshield survey which included 18 stream crossing sites within the Little Salt Creek Subwatershed. Observations including streambank erosion, stream buffers, and livestock access were recorded for each site and the results are summarized in Table 4-8 below. Streambank erosion was observed at 14 of 18 sites, nearly all less than three feet in height. Insufficient riparian buffers were observed at 7 of 18 sites. Livestock with free access to streams was noted at 2 of 18 sites.

Table 1-8 Little Salt Creek Windshield Survey Summary

Parameter	Observations
Streambank Erosion	1/18 sites with erosion >3’ 13/18 sites with erosion <3’ 4/18 sites with no erosion
Stream Buffers	5/18 sites with no buffers 2/18 sites with buffers <20’ 11/18 sites with buffers >20’
Livestock Access to Streams	2/18 sites with livestock access

Figure 1-5 Little Salt Creek (South Fork) Subwatershed

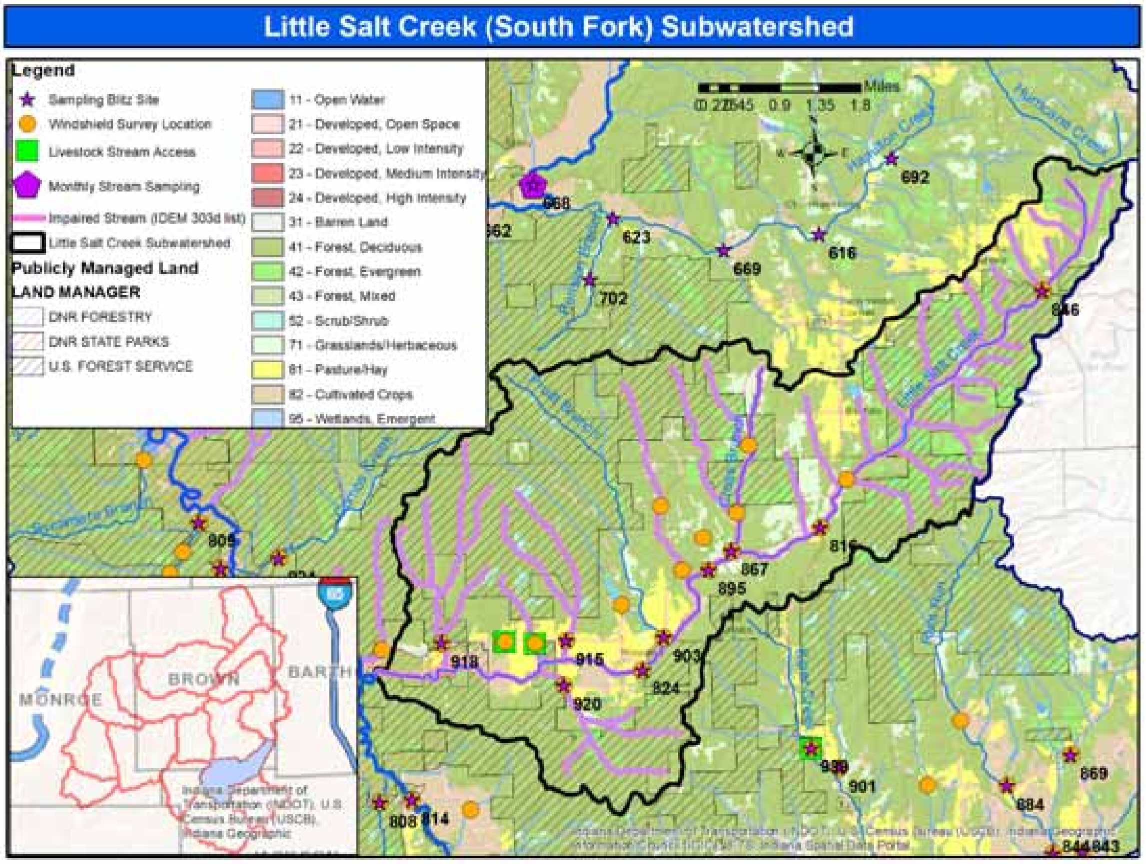


Figure 1-6 Site 903 on Pruitt Branch

Figure 1-7 Site 915 on an unnamed tributary to Little Salt Creek

Figure 1-8   Site 816 on Little Salt Creek

1.2.4 Water Quality Assessment

Nine sites were selected for the spring and fall watershed sampling blitz events though one was dry during the fall blitz. Samples were analyzed for a variety of chemical parameters and E. coli. Habitat was evaluated using CQHEI. No monthly sampling locations or stream gages are located in this subwatershed. Historical fish community assessment data was reviewed.

Water Quality Information

Water chemistry data from the Little Salt Creek subwatershed suggest that nitrogen and phosphorus are potential contaminants of concern. Two sites exceeded both the total nitrogen target and the nitrate target during the fall blitz. Site 903 is located on Pruitt Branch just before it enters Little Salt Creek and site 915 is on a nearby unnamed tributary of Little Salt Creek. Both are bordered by cropland.

There was one exceedance of total phosphorus during the spring blitz at site 824 on Little Salt Creek (just downstream of Pruitt Branch) and one exceedance of soluble reactive phosphorus during the fall blitz at site 895 on Little Salt Creek (upstream of Pruitt Branch).

The E. coli target of 235 CFU/100 ml was exceeded in 2 of 8 samples during the fall blitz, at site 816 on Little Salt Creek and site 915 on an unnamed tributary of Little Salt Creek (which also had nitrogen and nitrate exceedances). Site 816 is located near the midpoint of Little Salt Creek. Samples collected further upstream (846) and downstream (895 and 924) had very low concentrations of E. coli, indicating a localized source that is then diluted further downstream.

BCRSD collected samples from site EF21 just upstream of site 816 on Little Salt Creek for five weeks in spring 2020. Though only one sample exceeded the target concentration of 235 CFU/100 ml and the geometric mean of the samples was well under the state geometric mean target of 125 CFU/100 ml, an additional water sample was collected on April 27, 2021 to send for source analysis. While the results of the source analysis at that site were inconclusive, the E. coli concentration was reported at 344.8 CFU/100 ml, exceeding the target of 235 CFU/100 ml.

Table 1-9 Little Salt Creek Sampling Blitz Results - Nutrients

Blitz ID	Creek Name	Fall TN (mg/L)	Spring TN (mg/L)	Fall NO3 (mg/L)	Spring NO3 (mg/L)	Fall TP (mg/L)	Spring TP (mg/L)	Fall SRP (mg/L)	Spring SRP (mg/L)
816	Little Salt Creek	0.219	0.100	0.018	0.039	0.004	0.016	0.002	0.002
824	Little Salt Creek	0.100	0.267	0.029	0.223	0.003	0.045	0.002	0.004
846	Little Salt Creek		0.100		0.028		0.011		0.005
867	Cross Branch	0.100	0.100	0.008	0.022	0.002	0.016	0.003	0.002
895	Little Salt Creek	0.100	0.129	0.008	0.052	0.002	0.015	0.006	0.002
903	Pruitt Branch	1.870	0.583	1.848	0.531	0.003	0.011	0.005	0.002
915	Unnamed tributary of Little Salt	1.172	0.311	0.981	0.261	0.015	0.009	0.004	0.002
918	Unnamed tributary of Little Salt	0.100	0.154	0.012	0.080	0.002	0.009	0.002	0.002
920	Unnamed tributary of Little Salt	0.100	0.100	0.008	0.008	0.002	0.004	0.002	0.002

Table 1-10 Little Salt Creek Sampling Blitz Results - E. coli and Sediment

Blitz ID	Creek Name	Fall E. Coli (MPN/ 100 mL)	Spring E. coli (MPN/ 100 mL)	Fall TSS (mg/L)	Spring TSS (mg/L)
816	Little Salt Creek	2,420	11	3.5	0.5
824	Little Salt Creek	23	1	1.3	0.5
846	Little Salt Creek		20		0.5
867	Cross Branch	29	6	0.5	0.5
895	Little Salt Creek	29	4	3	0.5
903	Pruitt Branch	63	3	0.5	5
915	Unnamed tributary of Little Salt	613	4	3.5	0.5
918	Unnamed tributary of Little Salt	3	3	0.5	0.5
920	Unnamed tributary of Little Salt	12	-	0.5	0.5

Table 1-11 Little Salt Creek BCRSD E. coli Sampling

BCRSD Site ID	Blitz Site ID	Stream	5/05/20 E. coli	5/12/20 E. coli	5/19/20 E. coli	5/26/20 E. coli	6/02/20 E. coli	Geo. Mean	> State Geomean (125)
EF21	near 816	Little Salt Creek	136	4	190	461	93	85	no

Table 1-12 Little Salt Creek Fecal Contamination Source Analysis

BC_ID	LM_ID	Stream	4/27/21 E. Coli	Coliform (PFU/100ml)	% Human	% Animal
N/A	816	Little Salt Creek	344.8	< 1	NA	NA

1.2.5 Habitat and Biological Assessment

Habitat/Biological Information

Volunteers completed the Citizen Qualitative Habitat Evaluation Index (CQHEI) habitat assessment at all 9 sites during the spring and fall sampling blitz events. Although a comparison scale for the CQHEI has not yet been developed, Hoosier Riverwatch indicates that scores greater than 60 rate as habitat conducive to supporting warm-water biota (IDNR, 2004). CQHEI scores ranged from 46.5 to 78 during the fall blitz and 61.5 to 93 during the spring blitz. While only 56% of sites scored above 60 during the fall blitz, 100% of sites scored above 60 during the spring blitz, indicating good habitat throughout the subwatershed. CQHEI scores were generally higher in the spring due to increased streamflow levels (compared to the drought conditions in the fall).

Table 1-13 Little Salt Creek Sampling Blitz Habitat Assessment (CQHEI)

Blitz ID	Stream Name	Fall 2020 CQHEI	Spring 2021 CQHEI
816	Little Salt Creek	57	75
824	Little Salt Creek	74.5	86.5
846	Little Salt Creek	63	83
867	Cross Branch	60	79
895	Little Salt Creek	59	61.5
903	Pruitt Branch	61	68.5
915	Unnamed tributary of Little Salt	46.5	75.5
918	Unnamed tributary of Little Salt	78	93
920	Unnamed tributary of Little Salt	67	82
	Average CQHEI	62.9	78.2
	% of Sites >60	56%	100%

IDEM assessed the fish and macroinvertebrate communities in Little Salt Creek in 2013 as part of their nine-year rotation to monitor water quality in the East Fork White River basin. The United States Forest Service (USFS) conducted fish surveys and evaluated QHEI in Little Salt Creek and one of its tributaries 2017-2019. The Fish Index of Biotic Integrity (IBI) is based on fish community characteristics and can range from 0 (no fish) to 60 (excellent) with streams expected to score at least 36 (fair) to meet aquatic life use water quality standards.

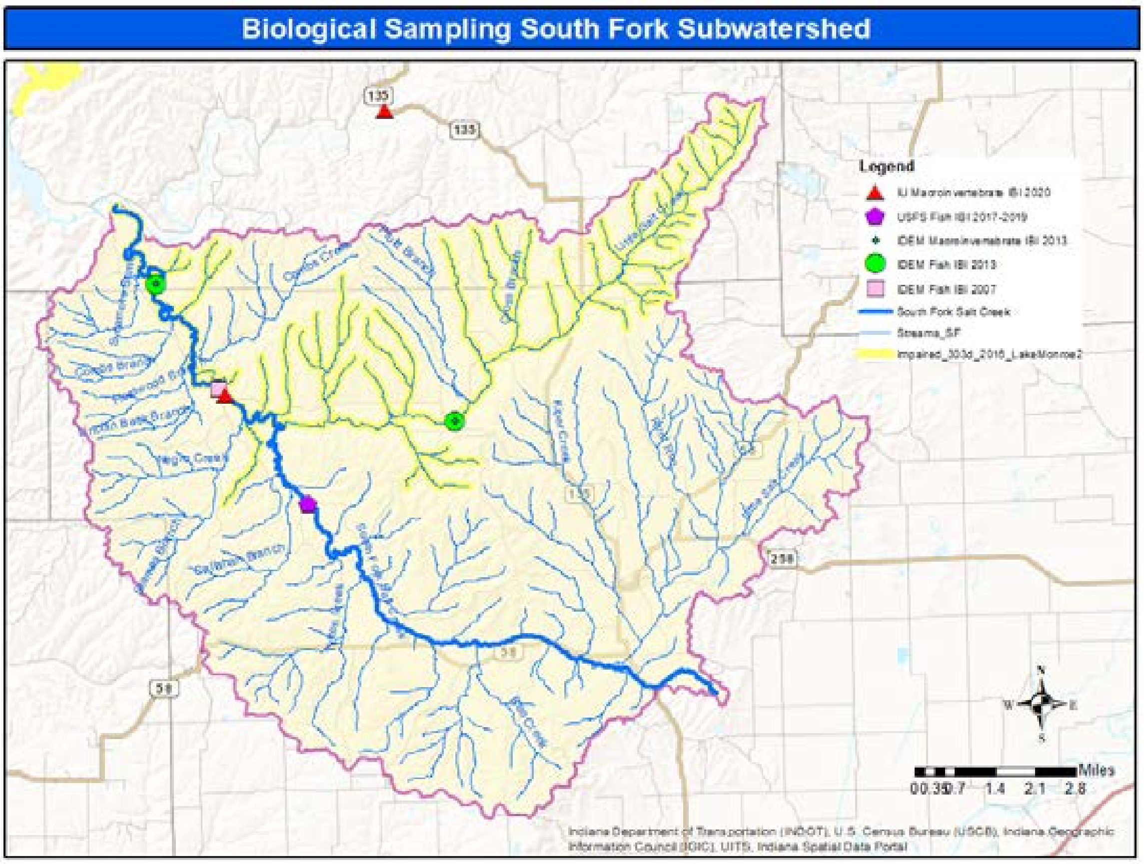
Table 1-14 Little Salt Creek Historical Biological Sampling

Sampler	Date	Site ID	Stream	Station	Fish IBI	Fish IBI Rating	mIBI	mIBI Rating	QHEI	QHEI Rating
IDEM	2013	824	Little Salt Creek	Buffalo Pike	36	Fair	34	Impaired (<36)	--	--
USFS	2017-2019 Average	824	Little Salt Creek	Buffalo Pike	41.3	Fair	--	--	69.5	Excellent
USFS	2017-2019 Average	Near 920	Unnamed tributary of Little Salt Creek	Thompson Cemetery	28	Poor	--	--	56.7	Good

Both surveys indicate that the fish Index of Biotic Integrity at site 824 is “fair” while the IDEM survey indicates that the macroinvertebrate Index of Biotic Integrity is “impaired” with a score of 34. The fish-based IBI for site 920 on an unnamed tributary of Little Salt Creek was “poor” which may be due in part to its small size.

The USFS habitat assessment (QHEI) indicates that habitat at site 824 is "excellent" at 69.5, which corresponds well with the high ratings from the blitz CQHEI assessments – 74.5 in the fall and 86.5 in the spring. The USFS QHEI assessment at site 920 is "good" at 56.7, which corresponds well with the blitz CQHEI assessments of 62.9 and 78.2.

Figure 1-9 Biological Sampling Locations in South Fork Salt Creek Subwatershed



1.2.6 Little Salt Creek Subwatershed Summary

Little Salt Creek and several of its tributaries are designated as impaired for E. coli according to the most recent 303(d) impaired streams list. However, only two E. coli exceedances were reported during the fall blitz and none during the spring blitz. Site 816 on Little Salt Creek had E. coli exceedances during the fall blitz, in one of five samples collected by BCRSD, and in the single sample collected for source analysis. Samples collected further downstream during the fall blitz had low E. coli levels, indicating that the E. coli is diluted to low levels further downstream. However, no samples were collected downstream from site 915 on an unnamed tributary to Little Salt Creek, a site which also had an E. coli exceedance during the fall blitz. The windshield survey also revealed livestock with free access to streams at 4 of 20 stream crossings and there is no sewer system in the subwatershed.

There were a few exceedances for nitrogen and phosphorus, including total phosphorus and soluble reactive phosphorus exceedances in Little Salt Creek. Pruitt Branch (site 903) and an unnamed tributary to Little Salt (915) had exceptionally high nitrogen and nitrate levels. Habitat evaluation through CQHEI was generally good and historical fish surveys showed a “fair” fish biotic integrity in Little Salt Creek. Unstable streambanks and agricultural activity are likely sources of sediment and nutrients to the streams.

1.3 Tipton Creek – South Fork (HUC 051202080403)

The Tipton Creek Subwatershed (HUC 12 – 051202080403) is the southernmost subwatershed and is located in the northwest corner of Jackson County as shown in Figure 4-10. The subwatershed encompasses approximately 21,822 acres and represents 8% of the overall watershed. The headwaters of South Fork Salt Creek are located in this subwatershed along with Tipton Creek, Bee Creek, and Callahan Branch. USGS Stream Gage 03371600 is located in this watershed just north of the town of Kurtz (site 855). This stream gage was installed in January 2020 and the City of Bloomington Utilities Storm Team has collected samples here during storm events since July 2020.

According to the IDEM 303(d) list, there are no impaired streams within the Tipton Creek Subwatershed.

1.3.1 Land Use

Landuse within the Tipton Creek Subwatershed consists primarily of forest but it has the second highest percentage of agricultural land (24%) of all the Lake Monroe subwatersheds. Cropland is most concentrated along South Fork Salt Creek and Tipton Creek. Pasture is located along smaller tributaries to South Fork as well as the ridges along the northern and southern edges of the watershed. Several parcels of land in the northern half of the subwatershed are owned by the United States Forest Service including most of the land around Callahan Branch and west of Tipton Creek.

1.3.2 Point Source Water Quality Issues

The Tipton Creek Subwatershed contains no confined feeding operations and no NPDES permitted facilities.

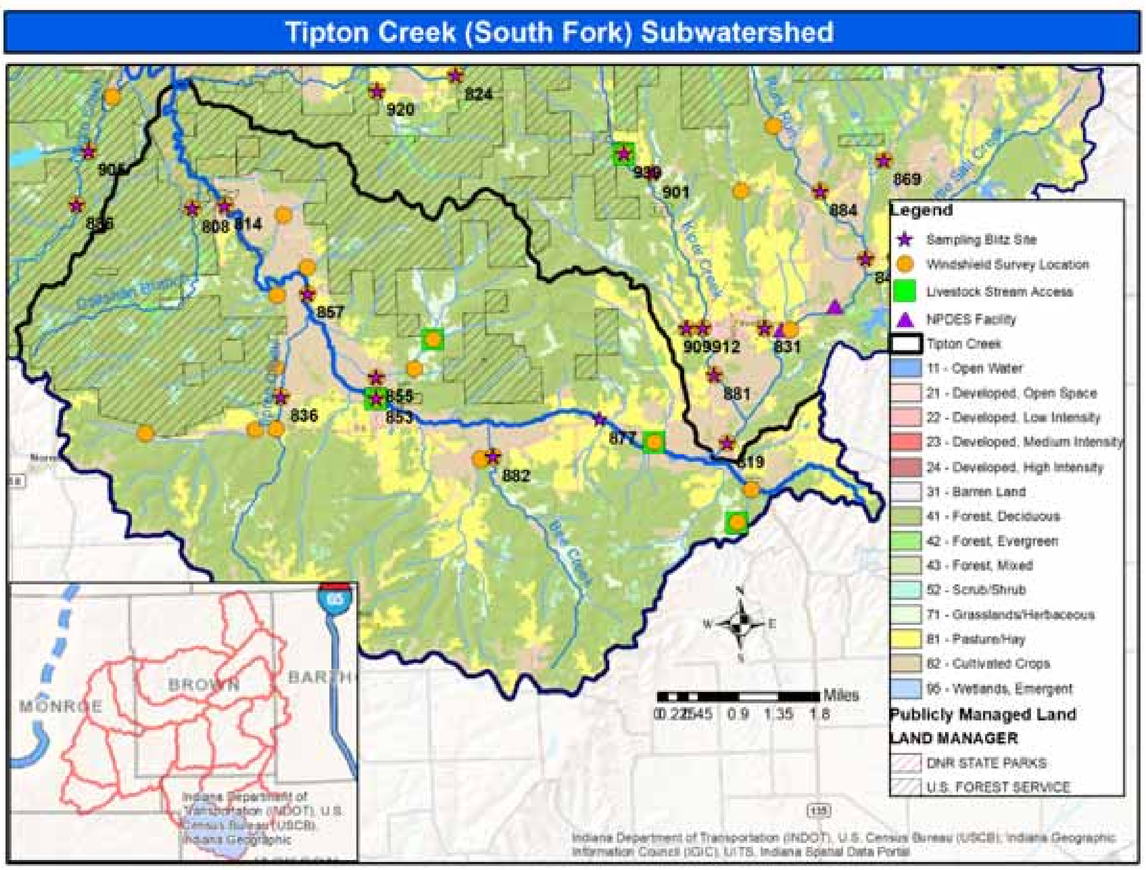
1.3.3 Non-Point Source Water Quality Issues

In early spring 2020, the watershed coordinator conducted a windshield survey which included 20 stream crossing sites within the Tipton Creek Subwatershed. Observations including streambank erosion, stream buffers, and livestock access were recorded for each site and the results are summarized below. Streambank erosion was noted at all 20 observed sites and lack of sufficient riparian buffer was observed at 10 of the 20 observed sites. Livestock access was documented at 4 of 20 sites.

Table 1-15 Tipton Creek Windshield Survey Summary

Parameter	Observations
Streambank Erosion	9/20 sites with erosion >3' 11/20 sites with erosion <3' 0/20 sites with no erosion
Stream Buffers	1/20 sites with no buffers 9/20 sites with buffers <20' 10/20 sites with buffers >20'
Livestock Access to Streams	4/20 sites with livestock access

Figure 1-10 Tipton Creek (South Fork) Subwatershed



1.3.4 Water Quality Assessment

Water Quality Information

Eight sites were selected for the spring and fall watershed sampling blitz events though one was dry during the fall blitz. Results indicate that both nitrogen and phosphorus are constituents of concern. Total phosphorus concentrations exceeded the target concentration of 0.02 mg/L in 2 of 7 samples (29%) during the fall blitz and 6 of 8 samples (75%) during the spring blitz. Soluble reactive phosphorus concentrations exceeded the target stream concentration of 0.005 mg/L in 3 of 7 (43%) fall samples and 2 of 8 (25%) of spring samples. Interestingly, the SRP exceedances were at different sites for each event. The sites with the highest concentrations of total phosphorus were 853 on South Fork Salt Creek, 814 on South Fork Salt Creek, and 836 on Tipton Creek (spring only). Interestingly, the TP levels at 857 on South Fork Salt Creek between 853 (upstream) and 814 (downstream) were below target levels during both blitz events.

Total nitrogen and nitrate concentrations at site 855 on an unnamed tributary to South Fork Salt Creek were significantly higher than any other samples during both the spring and fall blitz events. The second highest total nitrogen and nitrate concentrations were in Tipton Creek at site 836 during the spring blitz. Both these streams enter South Fork Salt Creek between sites 853 (upstream South Fork Salt) and 857 (downstream South Fork Salt. Levels of total nitrogen and nitrates were notably higher at site 857 (downstream) during the spring blitz, likely due to these two tributaries.

The only E. coli exceedance during the blitz events was at site 855 on an unnamed tributary to South Fork Salt Creek during the fall blitz. This site is located downstream from a spot with observed livestock access to the stream.

Table 1-16 Tipton Creek Sampling Blitz Results - Nutrients

Blitz ID	Creek Name	Fall TN (mg/L)	Spring TN (mg/L)	Fall NO3 (mg/L)	Spring NO3 (mg/L)	Fall TP (mg/L)	Spring TP (mg/L)	Fall SRP (mg/L)	Spring SRP (mg/L)
808	Callahan Branch		0.155		0.141		0.017		0.004
814	South Fork Salt Creek	0.258	0.689	0.024	0.600	0.037	0.026	0.009	0.004
836	Tipton Creek	0.100	0.982	0.020	0.888	0.005	0.033	0.002	0.007
853	South Fork Salt Creek	0.268	0.632	0.008	0.510	0.030	0.047	0.004	0.018
855	Unnamed tributary of SF Salt	1.037	1.169	0.912	1.082	0.018	0.014	0.007	0.005
857	South Fork Salt Creek	0.271	0.719	0.023	0.607	0.016	0.022	0.002	0.002
877	South Fork Salt Creek	0.170	0.498	0.008	0.372	0.013	0.023	0.006	0.002
882	Bee Creek	0.111	0.384	0.016	0.311	0.009	0.021	0.005	0.002

Table 1-17 Tipton Creek Sampling Blitz Results - E. coli and Sediment

Blitz ID	Creek Name	Fall E. Coli (MPN/ 100 mL)	Spring E. coli (MPN/ 100 mL)	Fall TSS (mg/L)	Spring TSS (mg/L)
808	Callahan Branch		3		0.5
814	South Fork Salt Creek	157	15	5.5	3.6
836	Tipton Creek	29	5	0.7	1
853	South Fork Salt Creek	64	66	5.2	1.6
855	Unnamed tributary of SF Salt	>2,419	3	1.8	0.5
857	South Fork Salt Creek	21	36	1.5	2.2
877	South Fork Salt Creek	38	140	2.8	0.6
882	Bee Creek	144	2	0.5	0.5

1.3.5 Habitat and Biological Assessment

Habitat/Biological Information

Volunteers completed the Citizen Qualitative Habitat Evaluation Index (CQHEI) habitat assessment at all 8 sites during the spring and fall sampling blitz events. Although a comparison scale for the CQHEI has not yet been developed, Hoosier Riverwatch indicates that scores greater than 60 rate as habitat conducive to supporting warm-water biota (IDNR, 2004). CQHEI scores ranged from 44 to 89.5 during the fall blitz and 42.5 to 85 during the spring blitz. Only 38% of sites scored above 60 during the fall blitz and only 50% of sites scored above 60 during the spring blitz, indicating poor habitat throughout the subwatershed. Higher CQHEI scores in the spring may be partially due to increased streamflow levels (compared to the drought conditions in the fall) but could also be due to differing volunteer interpretation.

Table 1-18 Tipton Creek Sampling Blitz Results - Habitat Evaluation (CQHEI)

Blitz ID	Stream Name	Fall 2020 CQHEI	Spring 2021 CQHEI
808	Callahan Branch	53	70
814	South Fork Salt Creek	65	43
836	Tipton Creek	89.5	76.3
853	South Fork Salt Creek	57	55
855	Unnamed tributary of SF Salt	44	50
857	South Fork Salt Creek	47.3	42.5
877	South Fork Salt Creek	63	85
882	Bee Creek	55	67.5
	Average CQHEI	59.2	61.2
	% of Sites >60	38%	50%

No stream sections in the subwatershed were evaluated using the macroinvertebrate Index of Biotic Integrity (mIBI). Fish studies were conducted by USFS in 2017-2019 to evaluate the fish-based Index of Biotic Integrity (IBI) and habitats were evaluated using the Qualitative Habitat Evaluation Index (QHEI). IBI scores ranged from very poor to good, with the lowest scores appearing to correspond with the smallest streams. Sites 807 and 837 were not selected as sampling blitz sites due to their small size and site 808 was dry during the fall blitz due to its small size. The QHEI scores ranged from fair to good and roughly corresponded with CQHEI ratings. Len Kring of USFS (who conducted the evaluations) mentioned that portions of Tipton Creek appear to be channelized. He also has observed large flooding events in the Houston area that likely increase sediment and E. coli levels significantly in the short term.

Table 1-19 Tipton Creek 2017 - 2019 USFS Houston South 3-Year Average of Fish Survey Results

Blitz ID	Stream	Station	Fish IBI	IBI Rating	QHEI	QHEI Rating
808	Callahan Branch	CR 825 N / Pike	28.7	Poor	68.3	Good
836	Tipton Creek	CR 980 W	35.3	Fair	60.8	Good
814	S Fork Salt Creek	CR 825 N / Pike	46.7	Good	66.7	Good
807	Trib S F Salt Creek	CR 825 N / Pike	22.0	Poor	42.5	Fair
837	Trib Tipton Creek	CR 980 W	19.0	Very Poor	51.3	Fair

1.3.6 Tipton Creek Subwatershed Summary

The Tipton Creek subwatershed contains the second highest percentage of agricultural land. Water monitoring results indicate that phosphorus and nitrogen are both concerns in the subwatershed. Nitrogen was a concern primarily at site 855 on an unnamed tributary to South Fork Salt Creek and at site 836 on Tipton Creek. Phosphorus concerns were more widespread but the three sites with the highest total phosphorus levels were 853 on South Fork Salt Creek, 814 on South Fork Salt Creek, and 836 on Tipton Creek (spring only).

Only one E. coli exceedance was recorded though it was >2,419 CFU/100 ml at site 855 on an unnamed tributary to South Fork Salt Creek, which also had extremely high nitrogen levels. This site is surrounded by cropland and downstream from an area where livestock have direct access to streams.

Poor stream habitat, streambank erosion, and insufficient riparian buffer are prevalent in the subwatershed.

1.4 Negro Creek – South Fork (HUC 051202080404)

The Negro Subwatershed (HUC 12 – 051202080404) is located primarily in the northwest corner of Jackson County plus small portions of Brown, Lawrence, and Monroe Counties as shown in Figure 4-14. The subwatershed encompasses approximately 13,548 acres and represents 5% of the overall watershed. The subwatershed contains the downstream stretch of South Fork Salt Creek until it combines with Middle Fork Salt Creek as well as the tributaries Sycamore Branch, Combs Branch, Fleetwood Branch, Lincoln Branch, Maumee Branch, and Negro Creek. This watershed contains the sampling location used to collect samples monthly from South Fork Salt Creek from May 2020 to April 2021. This location was also used by IDEM in 2013 as part of their basin sampling.

According to the IDEM 303(d) list, the stretch of South Fork Salt Creek that runs through the Negro Creek Subwatershed is impaired for biological integrity.

1.4.1 Land Use

Landuse within the Negro Creek Subwatershed consists primarily of forest and it has the second lowest percentage of agricultural land (2%) of all the Lake Monroe subwatersheds. Approximately 80% of the subwatershed is public land belonging either to the United States Forest Service or the Indiana DNR State Parks Division. Population is extremely sparse. According to the IDEM 303(d) list, the downstream stretch of South Fork Salt Creek is impaired for low dissolved oxygen and low biological integrity, including several of its unnamed tributaries.

1.4.2 Point Source Water Quality Issues

The Negro Creek Subwatershed contains no confined feeding operations and no NPDES permitted facilities.

1.4.3 Non-Point Source Water Quality Issues

In early spring 2020, the watershed coordinator conducted a windshield survey which included included 12 stream crossing sites within the Negro Creek Subwatershed. Observations including streambank erosion, stream buffers, and livestock access were recorded for each site and the results are summarized below. Streambank erosion was noted at 9 of the 12 observed sites. No sites had insufficient riparian buffer and no sites had livestock access to streams.

Table 1-20 Negro Creek Windshield Survey Summary

Parameter	Observations
Streambank Erosion	4/12 sites with erosion >3’ 5/12 sites with erosion <3’
Stream Buffers	0/12 sites with no buffers 0/12 sites with buffers <20’
Livestock Access to Streams	0/12 sites with livestock access

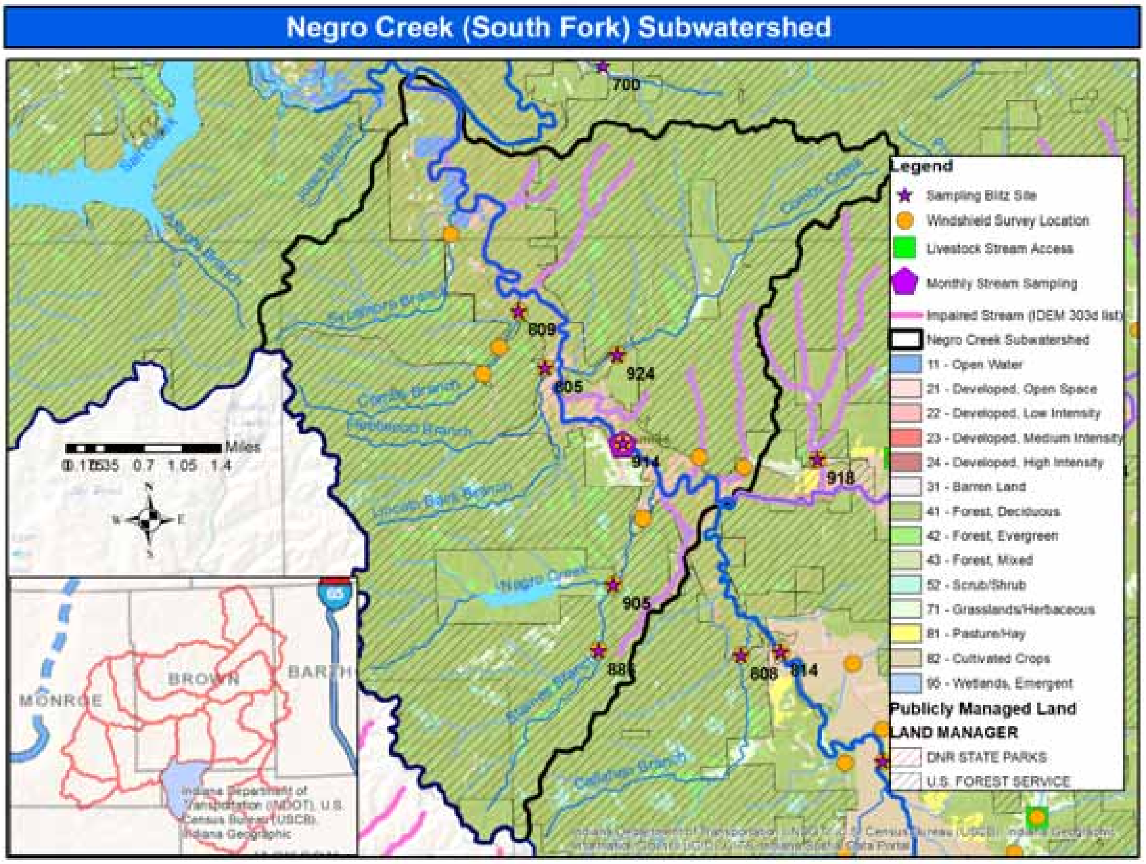
During the windshield survey, we also noted that the United States Forest Service has been replacing some stream crossings to improve both hydrologic flow and stream biology. The two newest crossings were designed so aquatic wildlife could move easily upstream and downstream. This entails leaving the streambed intact and building a bridge with a wide span to preserve the full channel width, rather than putting in a culvert that restricts flow and can cut off the downstream section during periods of low flow. Two other crossings were identified for potential future projects. One is a double culvert that has collected large amounts of sediment. The other is a perched culvert where the culvert itself is an inch above the streambed on the downstream side so that during periods of low flow the stream is disconnected across the culvert. The new crossings are also more resistant to flooding and less likely to become blocked with debris.

Figure 1-11 Windshield Site 905 County Road 1200N at Negro Creek

Figure 1-12 Windshield Site 808 – County Road 825N over Callahan Branch. Double Culvert Slated for Replacement Due to Clogging

Figure 1-13 Windshield Site 936 - Tower Ridge Road at Combs Branch. Perched culvert.

Figure 1-14 Negro Creek (South Fork) Subwatershed



1.4.4 Water Quality Assessment

Six sites were selected for the spring and fall watershed sampling blitz events though four were dry during the fall blitz. Blitz samples were analyzed for a variety of chemical parameters and E. coli. Habitat was evaluated using CQHEI. The South Fork Salt Creek monthly sampling site (914) is also located within this watershed. Monthly samples were analyzed for a variety of chemical parameters and E. coli.   The monthly sampling site was evaluated using the Qualitative Habitat Evaluation Index (QHEI) and macroinvertebrates were assessed. Historical fish assessments were reviewed. No stream gages are located in this subwatershed.

Water Quality Information

Water chemistry data from the blitz indicated good water quality in the Negro Creek subwatershed with the exception of two total phosphorus exceedances. One was at site 914 on South Fork Salt Creek during the fall blitz and the other was at site 805 on Lincoln Back Branch during the spring blitz.

However, monthly samples collected from South Fork Salt Creek at site 914 revealed regular total phosphorus exceedances (83%) and soluble reactive phosphorus exceedances (75%) as well as periodic exceedances for total nitrogen (33%), nitrates (17%), and E. coli (25%).

The sample collected on June had exceptionally high E. coli, total phosphorus, total nitrogen, soluble reactive phosphorus, and nitrate levels. The data point was reviewed to determine if it should be excluded from the data set as an outlier or mismeasurement. A review of flow data revealed that stream flows were elevated at the site in the three days preceding sampling, which could mean that the elevated levels were due to increased runoff from the watershed. Average daily stream flow measured in South Fork Salt Creek at Kurtz was 79.7 cubic feet per second (cfs) the day before sampling, dropping to 19.0 cfs the day of sampling. (Measured flow in North Fork at Nashville remained fairly constant during the same period, dropping from 9.6 to 8.7 cfs)
Data collected from South Fork Salt Creek at Kurtz by the CBU Storm Team during flows between 20 cfs and 100 cfs was reviewed for comparison. This data indicated that the results from the June 24th sampling event conducted by the IU Limnology Lab were within the expected range for elevated flow conditions with the exception of total nitrogen, which was considerably higher than the CBU data range. Ultimately the data point was kept in the report and analysis.

Table 1-21 Negro Creek Sampling Blitz Results - Nutrients

Blitz ID	Creek Name	Fall TN (mg/L)	Spring TN (mg/L)	Fall NO3 (mg/L)	Spring NO3 (mg/L)	Fall TP (mg/L)	Spring TP (mg/L)	Fall SRP (mg/L)	Spring SRP (mg/L)
805	Lincoln Back Branch		0.140		0.064		0.026		0.005
809	Combs Branch		0.106		0.095		0.019		0.004
886	Starnes Branch		0.100		0.031		0.016		0.002
905	Negro Creek		0.170		0.085		0.012		0.002
914	South Fork Salt Creek	0.368	0.507	0.008	0.388	0.041	0.019	0.004	0.002
924	Combs Creek	0.100	0.100	0.008	0.043	0.002	0.003	0.005	0.002

Table 1-22 Negro Creek Sampling Blitz Results - E. coli and Sediment

Blitz ID	Creek Name	Fall E. Coli (MPN/ 100 mL)	Spring E. coli (MPN/ 100 mL)	Fall TSS (mg/L)	Spring TSS (mg/L)
805	Lincoln Back Branch		4		3.2
809	Combs Branch		-		0.5
886	Starnes Branch		-		0.5
905	Negro Creek		-		1
914	South Fork Salt Creek	48	21	3	5.6
924	Combs Creek	3	-	0.7	0.5

Table 1-23 South Fork Salt Creek Monthly Monitoring at Site 914 in Negro Creek Subwatershed

Sample Date	South Fork E. coli (cfu/100 ml)	South Fork TSS (mg/L)	South Fork TN (mg/L)	South Fork NO3 (mg/L)	South Fork TP (mg/L)	South Fork SRP (mg/L)
4/22/2020	70	5.2	0.319	0.185	0.037	0.012
5/27/2020	365	31.3	0.719	0.377	0.041	0.011
6/24/2020	1,414	16.8	3.379	2.115	0.116	0.036
7/21/2020	261	2.4	0.604	0.205	0.051	0.009
8/27/2020	41	2.3	0.411	0.092	0.042	0.009
9/24/2020	13	7.5	0.511	0.008	0.055	0.005
10/22/2020	26	9.5	0.513	0.011	0.050	0.008
11/19/2020	48	4.3	0.261	0.228	0.022	0.010
12/16/2020	26	1.75	0.596	0.501	0.017	0.005
1/25/2021	32	2.8	0.749	0.690	0.017	0.004
2/25/2021	141	25.3	0.865	0.550	0.035	0.013
3/18/2021	326	14.8	0.640	0.493	0.028	0.007

1.4.5 Habitat and Biological Assessment

Habitat/Biological Information

Volunteers completed the Citizen Qualitative Habitat Evaluation Index (CQHEI) habitat assessment at all 11 sites during the spring and fall sampling blitz events. Although a comparison scale for the CQHEI has not yet been developed, Hoosier Riverwatch indicates that scores greater than 60 rate as habitat conducive to supporting warm-water biota (IDNR, 2004). CQHEI scores ranged from 50 to 63 during the fall blitz and 61 to 80 during the spring blitz. While only 17% of sites scored above 60 during the fall blitz, 100% of sites scored above 60 during the spring blitz, indicating good habitat throughout the subwatershed during periods of high flow. Higher CQHEI scores in the spring may be partially due to increased streamflow levels (compared to the drought conditions in the fall) but could also be due to differing volunteer interpretation.

Table 1-24 Negro Creek Sampling Blitz Results - Habitat Assessment (CQHEI)

Blitz ID	Stream Name	Fall 2020 CQHEI	Spring 2021 CQHEI
805	Lincoln Back Branch	63	61
809	Combs Branch	50	68
886	Starnes Branch	60	69
905	Negro Creek	54.5	72
914	South Fork Salt Creek	54.5	70.5
924	Combs Creek	53	80
	Average CQHEI	55.8	70.1
	% of Sites >60	17%	100%

The IU Limnology Lab evaluated site 914 on South Fork Salt Creek at the Maumee Bridge to determine the macroinvertebrate Index of Biotic Integrity (mIBI) and the Qualitative Habitat Evaluation Index (QHEI). The site scored 20 for mIBI, indicating an impaired macroinvertebrate community, and 34 on QHEI, indicating poor habitat. IDEM guidelines state that in streams with a QHEI score less than 51, "habitat is likely having a negative impact on aquatic communities." The low QHEI score is due at least in part to the lack of riffles in this portion of the stream and a substrate that is only sand and silt with no exposed rocks.

IDEM evaluated biotic integrity further downstream in 2013. They calculated the fish-based Index of Biotic Integrity (IBI) to be 42, with a "fair" rating, and calculated mIBI to be 32, with an "impaired" rating.

USFS surveyed fish in 2017-2019 and gave an average IBI score in Negro Creek of 26, with a "poor" rating, and a QHEI score of 57.6 meaning a "good" rating. The low IBI score may be influenced by the relatively small size of Negro Creek.

Table 1-25 Biological Sampling in Negro Creek Subwatershed (Current and Historical)

Sampler and Date	Site ID	Stream	Station	Fish IBI	Fish IBI Rating	mIBI	mIBI Rating	QHEI	QHEI Rating
IU Limno Lab 2021	914	South Fork Salt	Maumee Bridge	--	--	20	Impaired (<36)	34	Poor
IDEM 2013	below 914	South Fork Salt	Young-Maumee	42	Fair	32	Impaired (<36)	--	--
USFS 2017-19 Average	811	Negro Creek	CR 1190 W	26	Poor	--	--	57.6	Good

1.4.6 Negro Creek Subwatershed Summary

The Negro Creek subwatershed contains very little agricultural or developed land. Water quality results from the blitz events showed high water quality with the exception of two total phosphorus exceedances. Habitat scores were generally high. Riparian buffer was largely intact and less than half of observed stream crossings showed signs of severe erosion. However, the macroinvertebrate community in South Fork Salt Creek appears to be impaired.

Monthly sampling of South Fork Salt Creek at site 914 revealed regular total phosphorus exceedances (83%) and soluble reactive phosphorus exceedances (75%) as well as periodic exceedances for total nitrogen (33%), nitrates (17%), and E. coli (25%). Based on blitz data, these exceedances appear to be coming from areas of the watershed further upstream rather than the immediate Negro Creek subwatershed.

1.5 Headwaters Middle Fork – Middle Fork (HUC 51202080501)

The Headwaters Middle Fork Subwatershed (HUC 12 – 51202080501) straddles the Brown County Bartholomew County border as shown in Figure 4-15. The subwatershed encompasses approximately 13,206 acres and represents 5% of the overall watershed. The subwatershed contains the headwaters of Middle Fork Creek along with its tributaries South Branch Salt Creek and Hurricane Creek.

According to the IDEM 303(d) list, there are no impaired streams within the Headwaters Middle Fork Subwatershed.

1.5.1 Land Use

Landuse within the Headwaters Middle Fork Subwatershed consists predominately of forestland and it is ranked 7/16 based on percentage of agricultural land (6%) of all the Lake Monroe subwatersheds. It also has the highest amount of herbaceous cover (7%), some of which may be utilized for pasture. Pasture is primarily located along South Branch Salt Creek while herbaceous land is located more along ridgetops. Cropland is located along South Branch Salt Creek, Middle Fork Salt Creek, and a few ridgetops. Population is sparse and generally located along the main roads (Bellsville Pike, Grandview Road). Density increases on the east end of Bellsville Pike near Grandview Lake (a lakefront residential community located outside the Lake Monroe watershed). All land in the subwatershed is privately owned.

1.5.2 Point Source Water Quality Issues

The Headwaters Middle Fork Subwatershed contains no confined feeding operations and no NPDES permitted facilities.

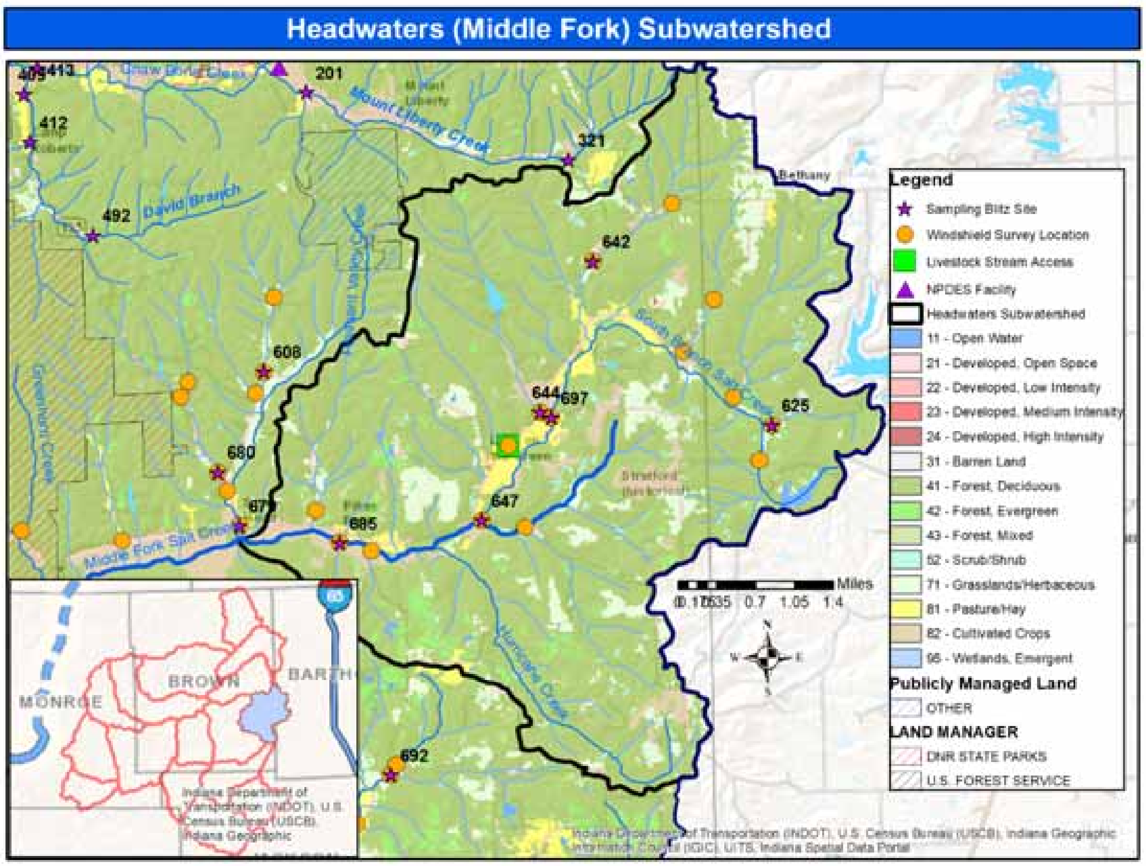
1.5.3 Non-Point Source Water Quality Issues

In early spring 2020, the watershed coordinator conducted a windshield survey which included 15 stream crossing sites within the Headwaters Middle Fork Subwatershed. Observations including streambank erosion, stream buffers, and livestock access were recorded for each site and the results are summarized below. Streambank erosion was noted at 14 of the 15 observed sites and lack of sufficient riparian buffer was observed at 9 of the 15 observed sites. Livestock access was documented at 1 of 15 sites.

Table 1-26 Headwaters Middle Fork Windshield Survey Summary

Parameter	Observations
Streambank Erosion	4/15 sites with erosion >3' 10/15 sites with erosion <3' 1/15 sites with no erosion
Stream Buffers	2/15 sites with no buffers 7/15 sites with buffers <20' 6/15 sites with buffers >20'
Livestock Access to Streams	1/15 sites with livestock access

Figure 1-15 Headwaters (Middle Fork) Subwatershed



1.5.4 Water Quality Assessment

Six sites were selected for the spring and fall watershed sampling blitz although two were dry during the fall sampling event. Samples were analyzed for a variety of chemical parameters and E. coli. Habitat was evaluated using CQHEI. Macroinvertebrates and the fish community have not been assessed in this subwatershed. No monthly sampling locations or stream gages are located in this subwatershed.

Water Quality Information

Water chemistry data from the Headwaters Middle Fork subwatershed suggest that phosphorus and E. coli are the two likely constituents of concern. The two sites of most interest are site 644 on an unnamed tributary of South Branch Salt Creek and 697 located immediately downstream on South Branch Salt Creek. Site 644 had exceedances for E. coli (fall) and total phosphorus (fall and spring) while site 697 had exceedances for E. coli (fall), total suspended solids (fall), total phosphorus (fall), and soluble reactive phosphorus (spring). The sites are in an area with both cropland and pasture though no livestock with direct access to streams were observed.

Fall blitz data suggests that E. coli is a concern in the Headwaters Middle Fork subwatershed, with 3 of 4 fall samples exceeding the water quality target. E. coli concentrations at site 644 on an unnamed tributary of South Branch Salt Creek and the immediately downstream site 697 on South Branch Salt Creek both exceeded 2,419 CFU/100 ml. A sample collected further downstream at site 647 on South Branch Salt Creek had E. coli levels well below the target, indicating that E. coli is diluted as water moves downstream. The other E. coli exceedance was from site 685 on Middle Fork Salt Creek near the downstream edge of the watershed. Site 613 on Middle Fork Salt Creek, located downstream in the next subwatershed (Pleasant Valley), had an E. coli level well below the target, indicating that E. coli is diluted as water moves downstream.

Brown County RSD collected five samples over five weeks at a site near site 685 on Middle Fork Salt Creek and three of the five exceeded the 235 CFU/100 ml, with the geometric mean well above the state geomean standard of 125 CFU/100 ml. Two samples were collected for source testing in April 2021, one from the BCRSD site near 685 on Middle Fork Salt Creek and the other from site 697 on South Branch Salt Creek. Neither had E. coli concentrations above the water quality target. The sample collected near site 685 had enough coliphage residue to generate source testing results, indicating that 50.5% of the identified coliphage were most likely from human sources and 49.5% of the identified coliphage were most likely from animal sources.

Table 1-27 Headwaters Middle Fork Sampling Blitz Results - Nutrients

Blitz ID	Creek Name	Fall TN (mg/L)	Spring TN (mg/L)	Fall NO3 (mg/L)	Spring NO3 (mg/L)	Fall TP (mg/L)	Spring TP (mg/L)	Fall SRP (mg/L)	Spring SRP (mg/L)
625	Unnamed trib of South Branch Salt		0.205		0.079		0.026		0.004
642	Unnamed tributary of South Branch Salt		0.150		0.103		0.019		0.004
644	Unnamed tributary of South Branch Salt	0.446	0.374	0.017	0.243	0.033	0.022	0.003	0.004
647	South Branch Salt Creek	0.100	0.322	0.008	0.252	0.010	0.018	0.002	0.003
685	Middle Fork Salt Creek	0.100	0.298	0.020	0.228	0.006	0.015	0.002	0.004
697	South Branch Salt Creek	0.100	0.276	0.012	0.218	0.026	0.009	0.002	0.006

Table 1-28 Headwaters Middle Fork Sampling Blitz Results - E. coli and Sediment

Blitz ID	Creek Name	Fall E. Coli (MPN/ 100 mL)	Spring E. coli (MPN/ 100 mL)	Fall TSS (mg/L)	Spring TSS (mg/L)
625	Unnamed trib of South Branch Salt		44		5
642	Unnamed tributary of South Branch Salt		6		0.575
644	Unnamed tributary of South Branch Salt	>2,4219	-	10	1.6
647	South Branch Salt Creek	21	5	5.2	1.2
685	Middle Fork Salt Creek	649	19	1.5	1
697	South Branch Salt Creek	>2,419	6	30.7	1.4

Table 1-29 Headwaters Middle Fork BCRSD E. coli Sampling May 2020

BCRSD Site ID	Blitz Site ID	Stream	5-May	12-May	19-May	26-May	2-Jun	Geometric Mean	> State Geomean (125)
EF18	near 685	Middle Fork Salt Creek	1,440	89	1,170	461	122	385	yes

Table 1-30 Headwaters Middle Fork Fecal Source Analysis April 2021

BC_ID	LM_ID	Stream	4/27/21 E. Coli	Coliform (PFU/100ml)	% Human	% Animal
EF18	near 685	Middle Fork Salt Creek	126.0	0.4	50.5	49.5
	697	South Branch Salt Creek	98.5	< 1	NA	NA

1.5.5 Habitat and Biological Assessment

Habitat/Biological Information

Volunteers completed the Citizen Qualitative Habitat Evaluation Index (CQHEI) habitat assessment at all 6 sites during the spring and fall sampling blitz events. Although a comparison scale for the CQHEI has not yet been developed, Hoosier Riverwatch indicates that scores greater than 60 rate as habitat conducive to supporting warm-water biota (IDNR, 2004). CQHEI scores ranged from 51 to 69.5 during the fall blitz and 72 to 85 during the spring blitz. 67% of sites scored above 60 during the fall blitz and 100% of sites scored above 60 during the spring blitz, indicating good habitat throughout the subwatershed. Higher CQHEI scores in the spring may be partially due to increased streamflow levels (compared to the drought conditions in the fall) but could also be due to differing volunteer interpretation.

Table 1-31 Headwaters Middle Fork Sampling Blitz Results - Habitat Assessment (CQHEI)

Blitz ID	Stream Name	Fall 2020 CQHEI	Spring 2021 CQHEI
625	Unnamed trib of South Branch Salt	60	77
642	Unnamed tributary of South Branch Salt	69	81
644	Unnamed tributary of South Branch Salt	51	72
647	South Branch Salt Creek	69.5	85
685	Middle Fork Salt Creek	61	74
697	South Branch Salt Creek	66.5	78
	Average CQHEI	62.8	77.8
	% of Sites >60	67%	100%

No stream sections in the subwatershed were evaluated using the Qualitative Habitat Evaluation Index (QHEI), the fish-based Index of Biotic Integrity (IBI), or the macroinvertebrate Index of Biotic Integrity (mIBI).

1.5.6 Headwaters Middle Fork Subwatershed Summary

The Headwaters Middle Fork subwatershed contains the highest percentage of herbaceous land and moderate levels of agricultural land indicating potential impact from livestock. Water quality monitoring indicates that phosphorus and E. coli are the two constituents of concern. Habitat assessments were good and suggest healthy stream habitat throughout the subwatershed.

1.6 Pleasant Valley – Middle Fork (HUC 51202080502)

The Pleasant Valley Subwatershed (HUC 12 – 51202080502) is located in the southeast corner of Brown County as shown in Figure 4-16. The subwatershed encompasses approximately 20,333 acres and represents 7% of the overall watershed. The subwatershed contains the middle stretch of Middle Fork Salt Creek as well as the tributaries Hamilton Creek, Pleasant Valley Creek, Strahl Creek, Skinner Creek, and Pension Branch. Monthly samples from Middle Fork Salt Creek were collected at the downstream edge of this watershed, site 668.

According to the IDEM 303(d) list, there are no impaired streams in the Pleasant Valley Subwatershed.

1.6.1 Land Use

Landuse within the Pleasant Valley Subwatershed consists primarily of forestland but is tied for the third highest percentage of agricultural land (9%) of all the Lake Monroe subwatersheds. Cropland is primarily located along Middle Fork Salt Creek and Hamilton. Pasture is primarily located on the southern edge of the watershed along the ridge separating Pleasant Valley subwatershed from Little Salt Creek subwatershed. About a quarter of the subwatershed is public land. The northwest portion is part of Brown County State Park and contains its horseman's camp while several parcels in the southwest corner are owned by the United States Forest Service.

1.6.2 Point Source Water Quality Issues

The Pleasant Valley Subwatershed contains no confined feeding operations and no NPDES permitted facilities.

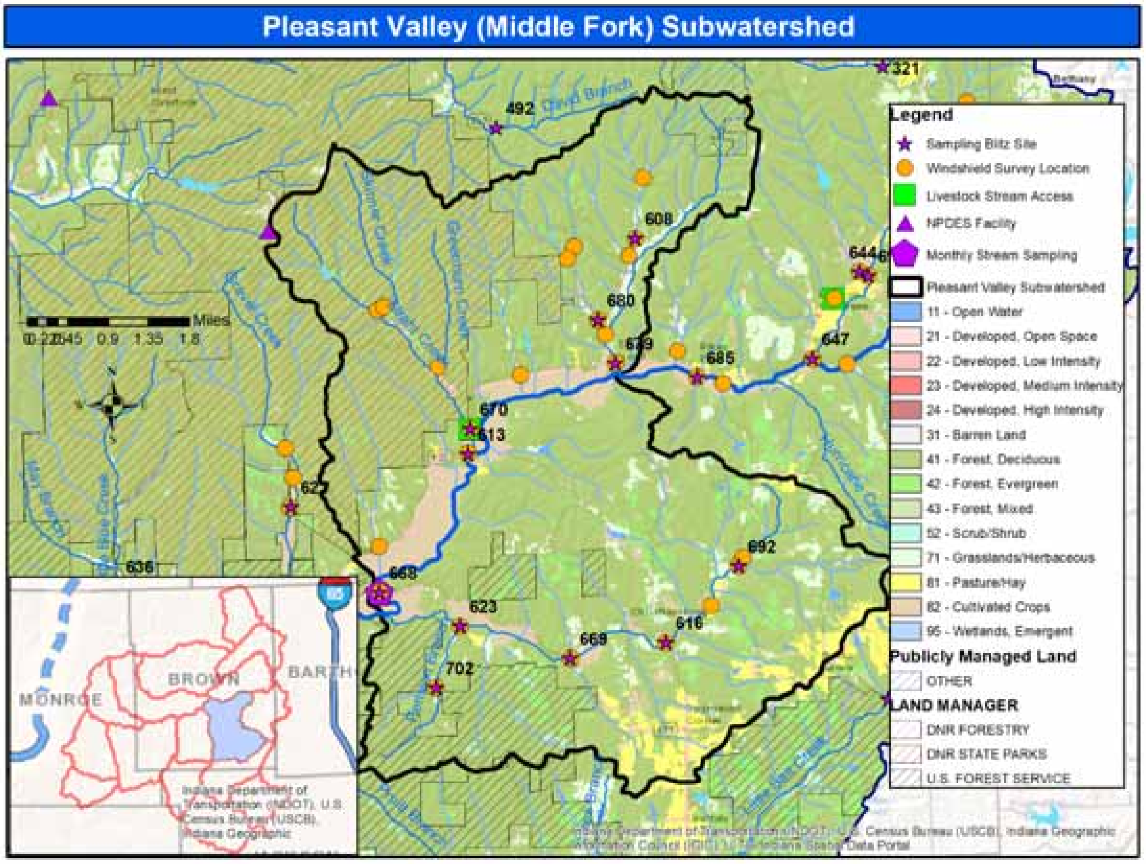
1.6.3 Non-Point Source Water Quality Issues

In early spring 2020, the watershed coordinator conducted a windshield survey which included 23 stream crossing sites within the Pleasant Valley Subwatershed. Observations including streambank erosion, stream buffers, and livestock access were recorded for each site and the results are summarized below. Stream bank erosion was noted at 19/23 observed sites and lack of sufficient riparian buffer was observed at 21 of 23 observed sites. Livestock access was documented at 1 of 23 sites.

Table 1-32 Pleasant Valley Windshield Survey Summary

Parameter	Observations
Streambank Erosion	7/23 sites with erosion >3' 12/23 sites with erosion <3' 4/23 sites with no erosion
Stream Buffers	8/23 sites with no buffers 13/23 sites with buffers <20' 2/23 sites with buffers >20'
Livestock Access to Streams	1/23 sites with livestock access

Figure 1-16 Pleasant Valley (Middle Fork) Subwatershed



1.6.4 Water Quality Assessment

Eleven sites were selected for the spring and fall watershed sampling blitz events though four were dry during the fall blitz. Monthly samples were also collected from Middle Fork Salt Creek at site 668 at the downstream edge of the watershed. Samples were analyzed for a variety of chemical parameters and E. coli. Habitat was evaluated during the blitz events using CQHEI. Macroinvertebrates were surveyed and habitat was evaluated using QHEI once at the monthly sample site 668. The fish community has not been assessed and no stream gages are located in this subwatershed.

Water Quality Information

Water chemistry data from the Pleasant Valley subwatershed suggest that phosphorus and E. coli are the primary constituents of concern. While there was only one total phosphorus exceedance during the fall blitz, it was site 668 on Middle Fork Salt Creek which had exceedances in 7 of 12 monthly sampling events. During the spring blitz, 4 of 11 sites exceeded the total phosphorus target and 4 of 11 sites exceeded the soluble reactive phosphorus target. The two sites to have both TP and SRP exceedances in the spring were 608 on Pleasant Valley Creek and 702 on Pension

Branch. The other two sites to exceed the total phosphorus target were 613 on Middle Fork Salt Creek (near the middle of the watershed) and 616 on Hamilton Creek (near the stream's midsection).

For each site with a TP exceedance in the spring, there was a corresponding site further downstream that had TP levels below the target. For site 608, it's site 679. For site 702, it's site 623. For site 613, it's site 668. For site 616, it's site 669. This appears to indicate that the phosphorus concentrations were diluted as they moved downstream.

One E. coli exceedance was reported during the fall blitz at site 692 on an unnamed tributary of Hamilton Creek. Other sites located further downstream on Hamilton Creek reveal a general decrease in E. coli concentrations moving downstream – 488 at site 692, 137 at site 616, and 20 at site 669.

Brown County Regional Sewer District collected five samples over five weeks at three sites. Furthest upstream was site 613 on Middle Fork Salt Creek near the entrance to the Brown County State Park Horseman's Camp. Next was site 668 on Middle Fork Salt Creek located near the downstream edge of the watershed (and also used as the monthly sampling location). The third was site 623 on Hamilton Creek, which enters Middle Fork Salt Creek downstream from site 668. All three sites had E. coli exceedances in 3 of 5 sampling events and a geometric mean well above the state standard. Monthly samples collected at site 668 on Middle Fork Salt Creek also exceeded the E. coli target in 3 of 12 sampling events although levels were considerably lower than the BCRSD samples.

Table 1-33 Pleasant Valley Sampling Blitz Results - Nutrients

Blitz ID	Creek Name	Fall TN (mg/L)	Spring TN (mg/L)	Fall NO3 (mg/L)	Spring NO3 (mg/L)	Fall TP (mg/L)	Spring TP (mg/L)	Fall SRP (mg/L)	Spring SRP (mg/L)
608	Pleasant Valley Creek		0.240		0.117		0.025		0.006
613	Middle Fork Salt Creek	0.100	0.357	0.008	0.261	0.005	0.026	0.002	0.004
616	Hamilton Creek	0.100	0.283	0.008	0.229	0.019	0.021	0.002	0.003
623	Hamilton Creek	0.100	0.316	0.008	0.251	0.005	0.019	0.002	0.003
668	Middle Fork Salt Creek	0.323	0.343	0.012	0.295	0.029	0.015	0.003	0.003
669	Hamilton Creek	0.230	0.351	0.230	0.311	0.002	0.018	0.002	0.003
670	Strahl Creek		0.212		0.125		0.015		0.004
679	Pleasant Valley Creek		0.319		0.281		0.014		0.006
680	Unnamed tributary of Pleasant Valley Creek	0.100	0.162	0.090	0.107	0.002	0.019	0.003	0.017
692	Unnamed tributary of Hamilton Creek	0.111	0.309	0.138	0.236	0.002	0.013	0.005	0.005
702	Pension Branch		0.100		0.031		0.022		0.006

Table 1-34 Pleasant Valley Sampling Blitz Results - E. coli and Sediment

Blitz ID	Creek Name	Fall E. Coli (MPN/ 100 mL)	Spring E. coli (MPN/ 100 mL)	Fall TSS (mg/L)	Spring TSS (mg/L)
608	Pleasant Valley Creek		4		0.5
613	Middle Fork Salt Creek	20	10	0.5	2.4
616	Hamilton Creek	137	12	40	0.5
623	Hamilton Creek	23	15	1.2	1
668	Middle Fork Salt Creek	111	18	7	1.4
669	Hamilton Creek	20	12	1.2	0.6
670	Strahl Creek		-		0.5
679	Pleasant Valley Creek		8		4.6
680	Unnamed tributary of Pleasant Valley Creek	44	21	1	0.5
692	Unnamed tributary of Hamilton Creek	488	-	0.5	0.5
702	Pension Branch		6		0.5

Table 1-35 Pleasant Valley BCRSD Sampling Results May 2020

BCRSD Site ID	Blitz Site ID	Stream	5-May	12-May	19-May	26-May	2-Jun	Geo. Mean	> State Geomean (125)
EF17	613	Middle Fork Salt Creek (midstream)	755	31	755	861	192	310	yes
EF15	668	Middle Fork Salt Creek (downstream)	310	115	925	866	122	322	yes
EF16	623	Hamilton Creek (joins MF downstream from 668)	1,020	43	705	548	166	309	yes

Table 1-36 Pleasant Valley Fecal Contamination Source Analysis April 2021

BC_ID	LM_ID	Stream	4/27/21 E. Coli	Coliform (PFU/100ml)	% Human	% Animal
EF16	623	Hamilton Creek	22.3	0.3	NA	NA
EF15	668	Middle Fork Salt Creek	26.5	< 1	NA	NA
	692	unnamed tributary to Hamilton Creek	2.0	< 1	NA	NA

Table 1-37 Middle Fork Salt Creek Monthly Sampling at Site 668 in Pleasant Valley Subwatershed

Monthly Sampling Site 668	Middle Fork E. coli (cfu/100 ml)	Middle Fork TSS (mg/L)	Middle Fork TN (mg/L)	Middle Fork NO3 (mg/L)	Middle Fork TP (mg/L)	Middle Fork SRP (mg/L)
4/22/2020	50	3	0.231	0.157	0.013	0.003
5/27/2020	245	15.5	0.409	0.244	0.022	0.021
6/24/2020	158	3.4	0.444	0.173	0.040	0.006
7/21/2020	154	3.4	0.425	0.094	0.024	0.004
8/27/2020	82	2	0.340	0.133	0.025	0.005
9/24/2020	13	2.75	0.289	0.008	0.016	0.004
10/22/2020	131	5.65	0.451	0.008	0.045	0.004
11/19/2020	453	2.6	0.148	0.098	0.016	0.005
12/16/2020	32	1.1	0.561	0.496	0.010	0.004
1/25/2021	16	4.7	0.467	0.520	0.014	0.003
2/25/2021	56	26.2	0.780	0.623	0.027	0.009
3/18/2021	260	37.8	0.563	0.413	0.038	0.007

1.6.5 Habitat and Biological Assessment

Habitat/Biological Information

Volunteers completed the Citizen Qualitative Habitat Evaluation Index (CQHEI) habitat assessment at all 11 sites during the spring and fall sampling blitz events. Although a comparison scale for the CQHEI has not yet been developed, Hoosier Riverwatch indicates that scores greater than 60 rate as habitat conducive to supporting warm-water biota (IDNR, 2004). CQHEI scores ranged from 34 to 74 during the fall blitz and 56 to 85 during the spring blitz. Only 27% of sites scored above 60 during the fall blitz but 82% of sites scored above 60 during the spring blitz, indicating good stream habitat in much of the subwatershed. Higher CQHEI scores in the spring may be partially due to increased streamflow levels (compared to the drought conditions in the fall) but could also be due to differing volunteer interpretation.

Table 1-38 Pleasant Valley Sampling Blitz Results - Habitat Assessment (CQHEI)

Blitz ID	Stream Name	Fall 2020 CQHEI	Spring 2021 CQHEI
608	Pleasant Valley Creek	56	56
613	Middle Fork Salt Creek	49	74
616	Hamilton Creek	34	75
623	Hamilton Creek	74	73.5
668	Middle Fork Salt Creek	57	58
669	Hamilton Creek	53	61
670	Strahl Creek	53	62
679	Pleasant Valley Creek	46	61

680	Unnamed tributary of Pleasant Valley Creek	73	79
692	Unnamed tributary of Hamilton Creek	63	85
702	Pension Branch	56	65
	Average CQHEI	55.8	68.1
	% of Sites >60	27%	82%

Table 1-39 Habitat and Biological Sampling in Pleasant Valley Subwatershed

Sampler and Date	Site ID	Stream	Station	mIBI	mIBI Rating	QHEI	QHEI Rating
IU Limno Lab August 2020	668	Middle Fork Salt	SR-135	24	Impaired (<36)	40.5	Poor

No stream sections in the subwatershed were evaluated using fish-based Index of Biotic Integrity. The IU Limnology Lab evaluated habitat using the Qualitative Habitat Evaluation Index (QHEI) at the monthly sampling site 668 and gave it a score of 40.5, indicating poor habitat. CQHEI scores during the fall and spring blitz events were reported as 57 and 58, respectively, also indicating poor habitat. In August 2020, the IU Limnology Lab collected macroinvertebrates and gave it a mIBI score of 24, indicating impairment.

1.6.6 Pleasant Valley Subwatershed Summary

The Pleasant Valley Subwatershed has significant agricultural land and 21 of 23 observed stream sites lack sufficient riparian buffer. Water quality data indicate that the two main constituents of concern are phosphorus and E. coli. However, there was a site with low phosphorus levels downstream from every phosphorus exceedance during the spring blitz, indicating that dilution is decreasing levels moving downstream. E. coli is more of a concern, particularly based on samples collected by BCRSD though the source sampling was inconclusive. Habitat scores as evaluated by CQHEI and QHEI were generally good. Macroinvertebrate community health in Middle Fork Salt Creek appears to be impaired.

1.7 Gravel Creek – Middle Fork (HUC 51202080503)

The Gravel Creek Subwatershed (HUC 12 – 51202080503) is located in southern Brown County as shown in Figure 4-17. The subwatershed encompasses approximately 13,237 acres and represents 5% of the overall watershed. The subwatershed contains the downstream stretch of Middle Fork Salt Creek until it combines with South Fork Salt Creek as well as the tributaries Gravel Creek, Little Blue Creek, May Creek, and Spanker Branch.

According to the IDEM 303(d) list, there are no impaired streams in the Gravel Creek subwatershed.

1.7.1 Land Use

Landuse within the Gravel Creek Subwatershed consists predominately of forestland and the subwatershed ranks 13/16 for percentage of agricultural land (2%). Cropland is located along Gravel Creek and the eastern (upstream) half of Middle Fork Salt Creek. Herbaceous land was observed to be generally used as hay fields with no livestock present. The vast majority of the subwatershed is public land, split mainly between Brown County State Park and Hoosier National Forest. A small area along Middle Fork Salt Creek is part of the Lake Monroe property managed by the Indiana Department of Natural Resources. There are very few houses in the subwatershed and much of the USFS property is designated as a wilderness area. The subwatershed does contain the small tourist village of Story with a restaurant, hotel, and cabins.

1.7.2 Point Source Water Quality Issues

The Gravel Creek Subwatershed contains no confined feeding operations and no NPDES permitted facilities.

1.7.3 Non-Point Source Water Quality Issues

In early spring 2020, the watershed coordinator conducted a windshield survey which included 13 stream crossing sites within the Gravel Creek Subwatershed. Observations including streambank erosion, stream buffers, and livestock access were recorded for each site and the results are summarized below. Streambank erosion was noted at all sites and lack of sufficient riparian buffer was observed at only 3 of 13 sites. No livestock with access to streams was observed. Several wetland areas were observed, particularly in the western portion of the watershed. Signs of beaver were observed and the chorus of frogs in March was nearly deafening.

Table 1-40 Gravel Creek Windshield Survey Summary

Parameter	Observations
Streambank Erosion	6/13 sites with erosion >3' 7/13 sites with erosion <3' 0/13 sites with no erosion
Stream Buffers	1/13 sites with no buffers 2/13 sites with buffers <20' 10/13 sites with buffers >20'
Livestock Access to Streams	0/13 sites with livestock access

Figure 1-17 Gravel Creek (Middle Fork) Subwatershed

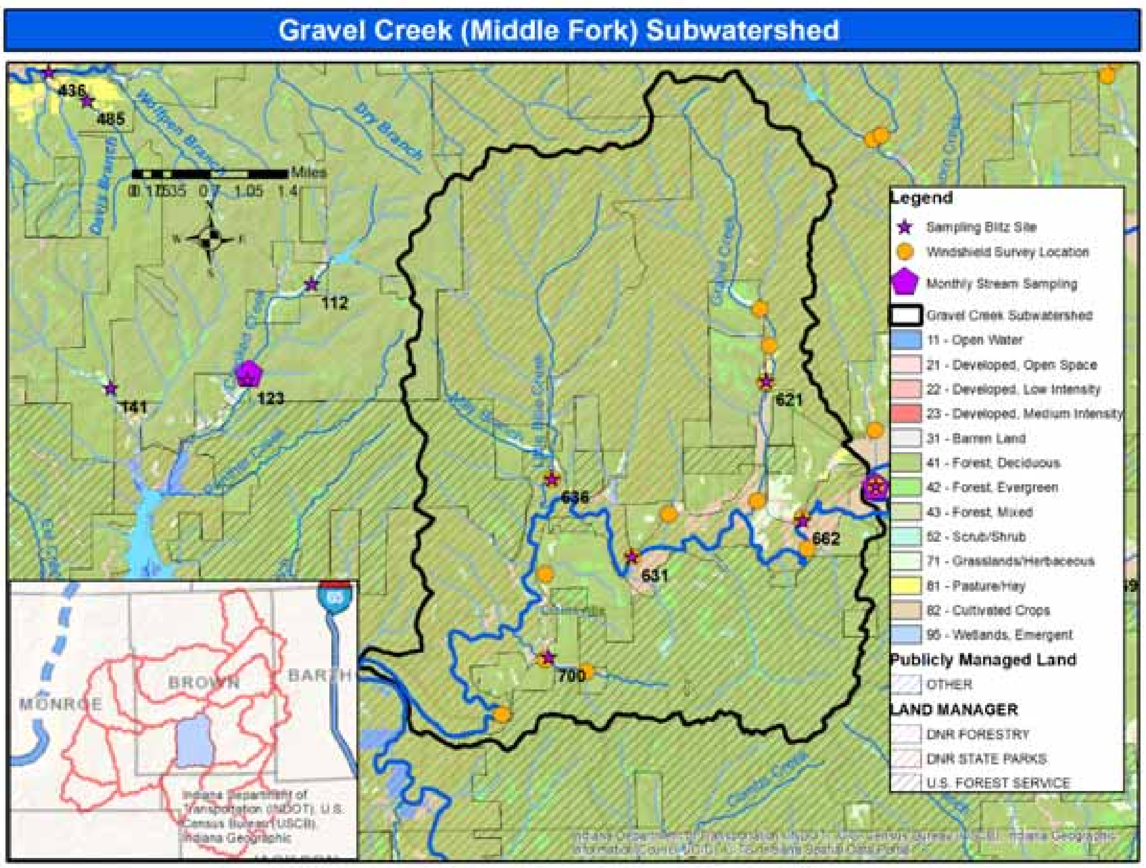


Figure 1-18 Forested wetland near site 636

1.7.4 Water Quality Assessment

Five sites were selected for the spring and fall watershed sampling blitz events though one was dry during the fall blitz. Samples were analyzed for a variety of chemical parameters and E. coli. Habitat was evaluated using CQHEI. Macroinvertebrates and the fish community have not been assessed in this subwatershed. No monthly sampling locations or stream gages are located in this subwatershed.

Water Quality Information
E. coli sampling during the blitz events reported no exceedances. However, samples collected by Brown County Regional Sewer District in Middle Fork Salt Creek near site 662 revealed exceedances in 3 of 5 samples and a geometric mean well above the state standard.

Blitz data suggests total phosphorus may be a concern with 2 of 4 fall samples and 3 of 5 spring samples exceeding the water quality target. All but one of the total phosphorus exceedances ranged from 0.021 to 0.031 mg/L, not too far above the target of 0.020 mg/L. However, the highest reported concentration was 0.101 mg/L at site 662 on Middle Fork Salt Creek during the fall blitz, which is over five times the target concentration of 0.02 mg/L. The total nitrogen concentration at that site during the fall blitz was 1.208, nearly double the total nitrogen target of 0.69 mg/L. It is unclear if this sample is an outlier, particularly since no sample was collected from downstream site 631 on Middle Fork Salt Creek during the fall blitz. A sample collected upstream from site 668 on Middle Fork Salt Creek (in the Pleasant Valley subwatershed) had a total phosphorus concentration of 0.029 mg/L and a total nitrogen concentration of 0.343 mg/L. The samples from Hamilton Creek (which enters Middle Fork Salt Creek upstream from site 662) all had total phosphorus and total nitrogen levels below the water quality targets. This indicates that whatever caused the elevated nutrient levels at site 662 must have entered the stream between the upstream edge of the watershed and the site.

Table 1-41 Gravel Creek Sampling Blitz Results - Nutrients

Blitz ID	Creek Name	Fall TN (mg/L)	Spring TN (mg/L)	Fall NO3 (mg/L)	Spring NO3 (mg/L)	Fall TP (mg/L)	Spring TP (mg/L)	Fall SRP (mg/L)	Spring SRP (mg/L)
621	Gravel Creek	0.100	0.179	0.008	0.139	0.007	0.021	0.004	0.004
631	Middle Fork Salt Creek (midstream)		0.356		0.250		0.031		0.005
636	Little Blue Creek	0.100	0.125	0.008	0.095	0.002	0.019	0.003	0.004
662	Middle Fork Salt Creek (upstream)	1.208	0.361	0.008	0.247	0.101	0.022	0.005	0.003
700	Spanker Branch	0.169	0.202	0.008	0.081	0.022	0.025	0.004	0.007

Table 1-42 Gravel Creek Sampling Blitz Results - E. coli and Sediment

Blitz ID	Creek Name	Fall E. Coli (MPN/ 100 mL)	Spring E. coli (MPN/ 100 mL)	Fall TSS (mg/L)	Spring TSS (mg/L)
621	Gravel Creek	57	2	2.5	0.5
631	Middle Fork Salt Creek		23		3.4
636	Little Blue Creek	2	1	1.5	0.5
662	Middle Fork Salt Creek	1	14	28.5	1.8
700	Spanker Branch	6	-	16.5	0.8

Table 1-43 Gravel Creek BCRSD E. coli Sampling May 2020

BCRSD Site ID	Blitz Site ID	Stream	5-May	12-May	19-May	26-May	2-Jun	Geometric Mean	> State Geomean (125)
EF14	near 662	Middle Fork Salt Creek	705	63	1,220	548	144	336	yes

1.7.5 Habitat and Biological Assessment

Habitat/Biological Information

Volunteers completed the Citizen Qualitative Habitat Evaluation Index (CQHEI) habitat assessment at all 11 sites during the spring and fall sampling blitz events. Although a comparison scale for the CQHEI has not yet been developed, Hoosier Riverwatch indicates that scores greater than 60 rate as habitat conducive to supporting warm-water biota (IDNR, 2004). CQHEI scores ranged from 41 to 66 during the fall blitz and 39 to 69 during the spring blitz. Only 40% of sites scored above 60 during the fall blitz and only 40% of sites scored above 60 during the spring blitz, indicating poor habitat in several streams, particularly Middle Fork Salt Creek (both sites scored below 60 during both blitz events).

Table 1-44 Gravel Creek Sampling Blitz Results - Habitat Assessment (CQHEI)

Blitz ID	Stream Name	Fall 2020 CQHEI	Spring 2021 CQHEI
621	Gravel Creek	62	69
631	Middle Fork Salt Creek (midstream)	57	51
636	Little Blue Creek	66	60
662	Middle Fork Salt Creek (upstream)	41	39
700	Spanker Branch	48.5	63
	Average CQHEI	54.9	56.4
	% of Sites >60	40%	40%

No stream sections in the subwatershed were evaluated using the Qualitative Habitat Evaluation Index (QHEI), the fish-based Index of Biotic Integrity (IBI), or the macroinvertebrate Index of Biotic Integrity (mIBI).

1.7.6 Gravel Creek Subwatershed Summary

The Gravel Creek subwatershed contains a high percentage of public land, is sparsely populated, and has minimal agricultural land. Streambank erosion was present at all observed sites but 10 of 13 had sufficient riparian buffer. The primary water quality issue appears to be phosphorus with exceedances in most blitz samples. The blitz data does not indicate an E. coli issue but the BCRSD data suggests that Middle Fork Salt Creek near site 662 has consistently elevated E. coli levels. Source analysis was not conducted at the site due to lack of livestock and septic systems in the subwatershed.

1.8 Sweetwater Creek - North Fork (HUC 051202080601)

The Sweetwater Creek Subwatershed (HUC 12 – 051202080601) is located in the northeast corner of the watershed and is contained primarily in Brown County with a small portion in Bartholomew County as shown in Figure 4-19. The subwatershed encompasses approximately 12,239 acres and represents 4% of the overall watershed. The headwaters of North Fork Salt Creek are located in this subwatershed as well as the Sweetwater Creek tributary and its reservoir, Sweetwater Lake.

According to the IDEM 303(d) list, there are no impaired streams within the Sweetwater Creek Subwatershed. However, a watershed management plan was developed for Sweetwater Lake in 2006.

1.8.1 Land Use

Landuse within the Sweetwater Creek Subwatershed consists primarily of forestland with 6% of land classified as agricultural and an additional 7% classified as herbaceous. Pasture is primarily located along North Fork Salt Creek and along Fox Ridge Road which runs parallel to North Fork Salt Creek between it and Sweetwater Lake. Cropland is located primarily along the southern sections of North Fork Salt Creek and Sweetwater Creek, near Gatesville. Herbaceous land is located primarily on ridgetops and some of it may be used as pasture. The northeast corner of the subwatershed features Sweetwater Lake, a highly dense residential development built around Sweetwater Lake and its twin Cordry Lake (though the latter lies outside the Lake Monroe watershed). Very little land in the subwatershed is publicly owned.

1.8.2 Point Source Water Quality Issues

The Sweetwater Creek Subwatershed contains no confined feeding operations and no NPDES permitted facilities.

1.8.3 Non-Point Source Water Quality Issues

In early spring 2020, the watershed coordinator conducted a windshield survey which included 17 stream crossing sites within the Sweetwater Creek Subwatershed. Observations including streambank erosion, stream buffers, and livestock access were recorded for each site and the results are summarized below. Streambank erosion was noted at 15 of 17 observed sites and lack of sufficient riparian buffer was observed at 9 of the 17 observed sites. Livestock access was documented at 1 of 17 sites.

Table 1-45 Sweetwater Creek Windshield Survey Summary

Parameter	Observations
Streambank Erosion	3/17 sites with erosion >3' 12/17 sites with erosion <3' 2/17 sites with no erosion
Stream Buffers	4/17 sites with no buffers 5/17 sites with buffers <20' 8/17 sites with buffers >20'
Animal Access to Streams	1/17 sites with animal access

Figure 1-19 Sweetwater Creek (North Fork) Subwatershed

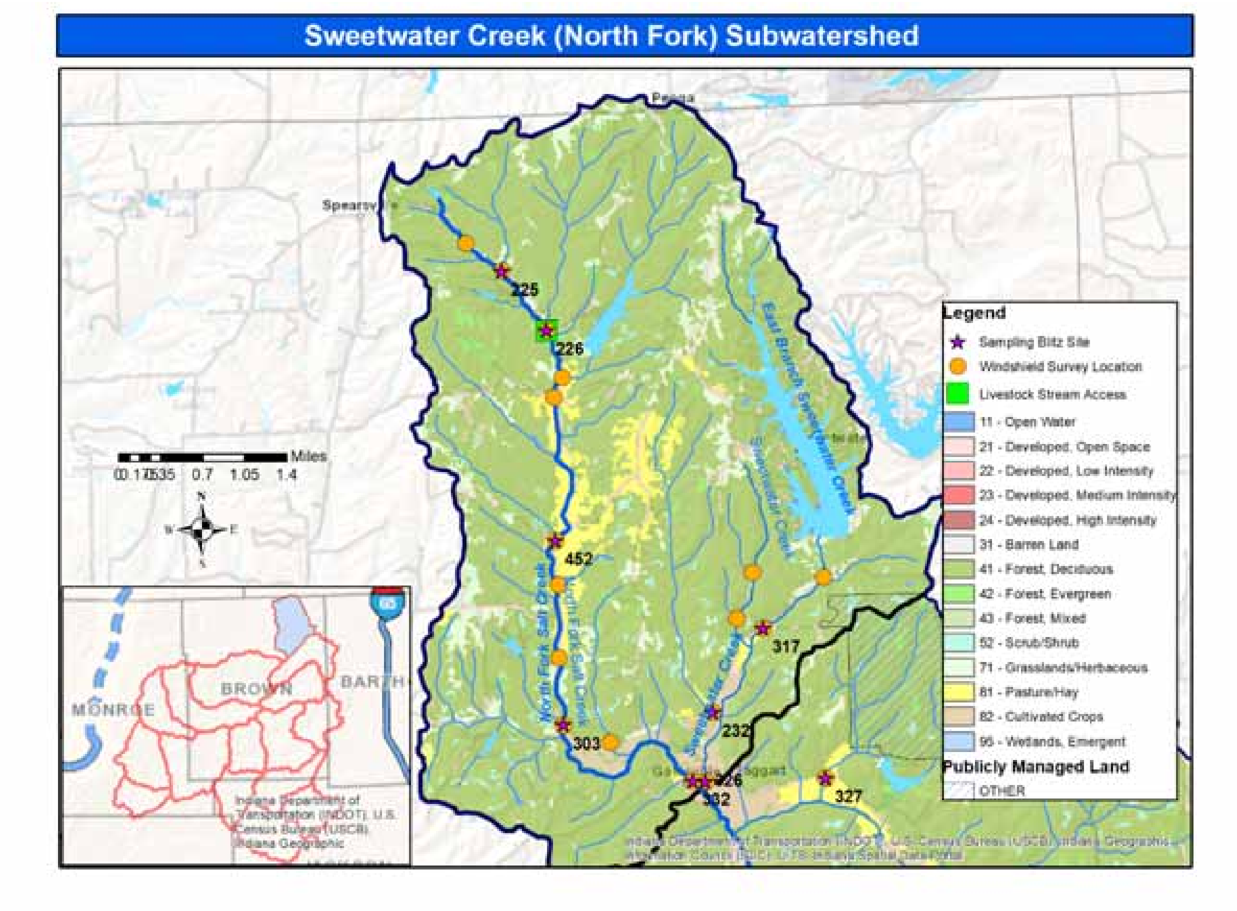


Figure 1-20 Site 232 on unnamed tributary of Sweetwater Creek

1.8.4 Water Quality Assessment

Eight sites were selected for the spring and fall watershed sampling blitz events though two stream sites were dry at the time of the fall sampling blitz. Samples were analyzed for a variety of chemical parameters and E. coli. Habitat was evaluated using CQHEI. Macroinvertebrates and the fish community have not been assessed in this subwatershed. No monthly sampling locations or stream gages are located in this subwatershed. Historical chemistry and bacterial data was reviewed from the 2006 Watershed Management Plan for Sweetwater Lake.

Water Quality Information
Water chemistry data from the blitz events in the Sweetwater Creek subwatershed suggest phosphorus is a contaminant of concern. Total phosphorus levels exceeded the target concentration of 0.02 mg/L in 7 of 8 spring samples. Soluble reactive phosphorus levels exceeded the target concentration of 0.005 mg/L in 3 of 8 spring samples and 2 of 6 fall samples.

There was one E. coli exceedance during the fall blitz at site 317 on East Branch Sweetwater Creek (downstream from Sweetwater Lake) but the spring sample had very low levels of E. coli. Brown County Regional Sewer District also collected one sample from site 317 which was well below the target. BCRSD collected five samples over five weeks from sites 326 on Sweetwater Creek and 332 on North Fork Salt Creek which showed a few exceedances but the geometric mean was below the state standard geometric mean of 125 CFU/100 ml. An additional sample was collected from site 332 on North Fork Salt Creek in April 2021 for fecal coliform source analysis. The sample had very low E. coli levels and the source analysis was inconclusive.

Table 1-46 Sweetwater Creek Sampling Blitz Results - Nutrients

Blitz ID	Creek Name	Fall TN (mg/L)	Spring TN (mg/L)	Fall NO3 (mg/L)	Spring NO3 (mg/L)	Fall TP (mg/L)	Spring TP (mg/L)	Fall SRP (mg/L)	Spring SRP (mg/L)
225	North Fork Salt Creek		0.116		0.058		0.049		0.014
226	Unnamed tributary of NF Salt	0.100	0.121	0.046	0.057	0.002	0.014	0.008	0.004
232	Unnamed tributary of Sweetwater Creek	0.100	0.103	0.038	0.033	0.002	0.032	0.004	0.013
303	North Fork Salt Creek	0.100	0.350	0.008	0.291	0.009	0.028	0.006	0.007
317	East Branch Sweetwater Creek	0.136	0.198	0.075	0.059	0.002	0.024	0.004	0.003
326	Sweetwater Creek	0.100	0.280	0.036	0.197	0.002	0.021	0.003	0.002
332	North Fork Salt Creek	0.100	0.321	0.022	0.233	0.002	0.021	0.004	0.004
452	North Fork Salt Creek		0.347		0.248		0.026		0.003

Table 1-47 Sweetwater Creek Sampling Blitz Results - E. coli and Sediment

Blitz ID	Creek Name	Fall E. Coli (MPN/100 mL)	Spring E. coli (MPN/100mL)	Fall TSS (mg/L)	Spring TSS (mg/L)
225	North Fork Salt Creek		3		2
226	Unnamed tributary of NF Salt	4	10	0.5	0.5
232	Unnamed tributary of Sweetwater Creek	4	10	1.8	0.5
303	North Fork Salt Creek	3	3	0.7	0.5
317	East Branch Sweetwater Creek	921	17	2.3	1
326	Sweetwater Creek	10	2	0.5	0.5
332	North Fork Salt Creek	22	6	0.5	0.5
452	North Fork Salt Creek		8		0.6

Table 1-48 Sweetwater Creek BCRSD E. coli Sampling May 2020

BCRSD Site ID	Blitz Site ID	Stream	5-May	12-May	19-May	26-May	2-Jun	Geo. Mean	> State Geomean (125)
EF01	326	Sweetwater Creek	115	12	379	365	82	109	no
EF02	332	North Fork Salt Creek	338	9	219	61	77	80	no
EF03	near 317	Outlet Sweetwater Lake	75	--	--	--	--	--	no

Table 1-49 Sweetwater Creek Fecal Contamination Source Sampling April 2021

BC_ID	LM_ID	Stream	4/27/21 E. Coli	Coliform (PFU/100ml)	% Human	% Animal
EF02	332	North Fork Salt (above Sweetwater Creek)	10.9	0.1	NA	NA

Looking at historical data, water quality monitoring was conducted in 2005-2006 as part of developing a Watershed Management Plan for Sweetwater Creek based on concerns of the residents of Sweetwater Lake. Phosphorus and chlorophyll-a levels in Sweetwater Lake were well below state averages and in fact, among the lowest in the state. Likewise, no E. coli sample results exceeded the state water quality standards of 235 colonies per 100 mL despite the prevalence of septic systems around the lake. The planners concluded that although water quality was relatively healthy, the top four threats to local water quality were failing septic systems, erosion & sedimentation, geese, and lawn chemicals. The watershed management plan recommended establishing mandatory septic system inspections, educating about erosion, encouraging lakeshore stabilization projects such as riprap or plantings, continuing efforts to discourage geese, and publishing a list of approved fertilizers and rates. These actions have all been carried out by the Sweetwater-Cordry Conservancy since the plan was published.

1.8.5 Habitat and Biological Assessment

Habitat/Biological Information

Volunteers completed the Citizen Qualitative Habitat Evaluation Index (CQHEI) habitat assessment at all 8 sites during the spring and fall sampling blitz events. Although a comparison scale for the CQHEI has not yet been developed, Hoosier Riverwatch indicates that scores greater than 60 rate as habitat conducive to supporting warm-water biota (IDNR, 2004). CQHEI scores ranged from 51 to 75.5 during the fall blitz and 60 to 94 during the spring blitz. While only 50% of sites scored above 60 during the fall blitz, 88% of sites scored above 60 during the spring blitz, indicating generally good stream habitat throughout the subwatershed. Higher CQHEI scores in the spring may be partially due to increased streamflow levels (compared to the drought conditions in the fall) but could also be due to differing volunteer interpretation. The one site with low CQHEI scores during both the spring and fall blitz events was site 232, an unnamed tributary of Sweetwater Creek located just north of Gatesville.

Table 1-50 Sweetwater Creek Sampling Blitz Results - Habitat Assessment (CQHEI)

Blitz ID	Stream Name	Fall 2020 CQHEI	Spring 2021 CQHEI
225	North Fork Salt Creek	74.5	82
226	Unnamed tributary of NF Salt	75.5	82.5
232	Unnamed tributary of Sweetwater Creek	54	60
303	North Fork Salt Creek	70	63
317	East Branch Sweetwater Creek	53	76.5
326	Sweetwater Creek	51	69
332	North Fork Salt Creek	54	79.5
452	North Fork Salt Creek	70	94
	Average CQHEI	62.8	75.8
	% of Sites >60	50%	88%

No stream sections in the subwatershed were evaluated using the Qualitative Habitat Evaluation Index (QHEI), the fish-based Index of Biotic Integrity (IBI), or the macroinvertebrate Index of Biotic Integrity (mIBI).

1.8.6 Sweetwater Creek Subwatershed Summary

The primary constituent of concern in the Sweetwater Creek subwatershed appears to be phosphorus, with 7 of 8 spring blitz samples exceeding the total phosphorus target. One E. coli exceedance was reported out of the 14 blitz samples and 3 E. coli exceedances were reported out of the 12 BCRSD samples. Site 326 on Sweetwater Creek was the only site with multiple E. coli exceedances, with 2 of 8 total samples exceeding the target value of 235 CFU/100 ml.

1.9 East Fork Salt Creek – North Fork (HUC 051202080602)

The East Fork Salt Creek Subwatershed (HUC 12 – 051202080602) is located primarily in Brown County with a portion extending east into Bartholomew County as shown in Figure 4-23. The subwatershed encompasses approximately 13,719 acres and represents 5% of the overall watershed. The headwaters of East Fork Salt Creek are located in this subwatershed as well as a portion of North Fork Salt Creek just below its headwaters.

According to the IDEM 303(d) list, there are no impaired streams within the East Fork Salt Creek Subwatershed.

1.9.1 Land Use

Landuse within the East Fork Salt Creek Subwatershed consists primarily of forestland with the 11th highest percentage of agricultural land at 5%. Cropland is generally located along North Fork Salt Creek and pasture is concentrated along East Fork Salt Creek. Population is sparse and generally located along the main roads (Salt Creek Road, Hoover Road, Georgetown Road). The majority of the subwatershed is private land although there are two state properties – Mountain Tea State Forest and Whippoorwill Nature Preserve.

1.9.2 Point Source Water Quality Issues

The East Fork Salt Creek Subwatershed contains no confined feeding operations and no NPDES permitted facilities.

1.9.3 Non-Point Source Water Quality Issues

In early spring 2020, the watershed coordinator conducted a windshield survey which included 12 stream crossing sites within the East Fork Salt Creek Subwatershed. Observations including streambank erosion, stream buffers, and livestock access were recorded for each site and the results are summarized below. Streambank erosion was noted at 9 of the 12 observed sites and a lack of sufficient riparian buffer was observed at 8 of the 12 observed sites. Livestock access was documented at 1 of 12 sites.

Table 1-51 East Fork Salt Creek Windshield Survey Summary

Parameter	Observations
Streambank Erosion	4/12 sites with erosion >3' 5/12 sites with erosion <3' 3/12 sites with no erosion
Stream Buffers	3/12 sites with no buffers 5/12 sites with buffers <20' 4/12 sites with buffers >20'
Livestock Access to Streams	1/12 sites with livestock access

Figure 1-21 Site 488 on an unnamed tributary to North Fork Salt Creek

Figure 1-22 View from Site 419 on North Fork Salt Creek at Annie Smith Road

Figure 1-23 East Fork Salt (North Fork) Subwatershed

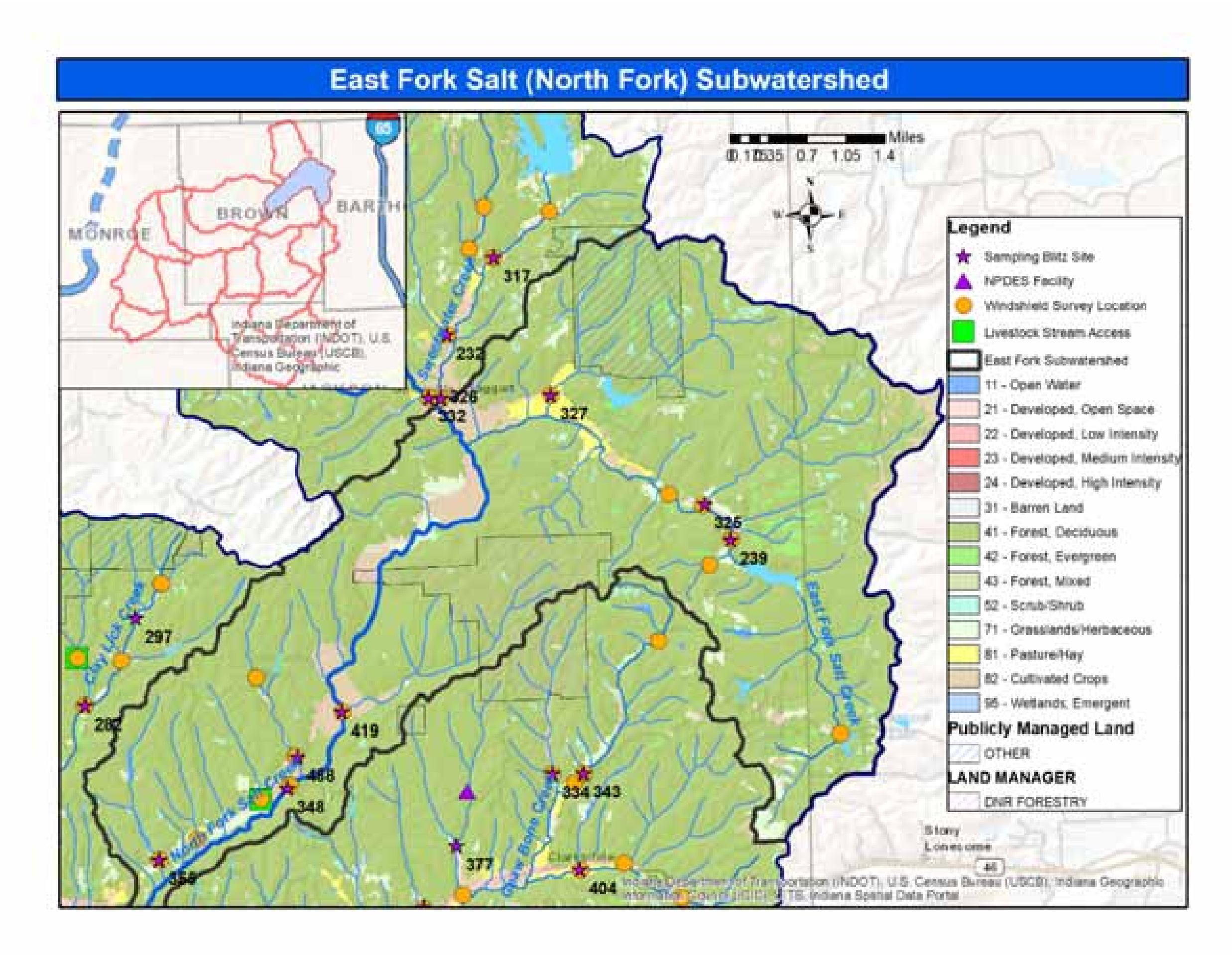


Figure 1-24 Site 355 Unnamed tributary to North Fork Salt Creek – lowest habitat scores

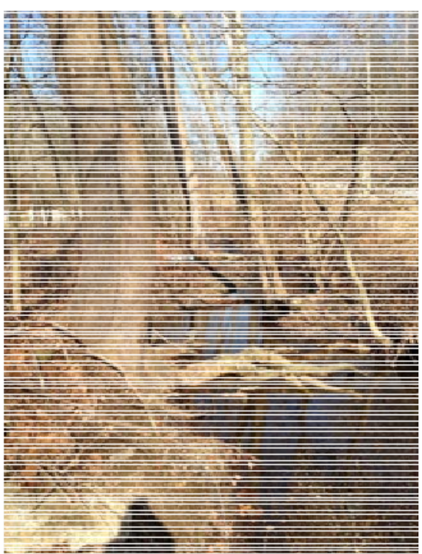


Figure 1-25 Site 488 on unnamed tributary to North Fork Salt Creek - most exceedances

1.9.4 Water Quality Assessment

Seven sites were selected for the spring and fall watershed sampling blitz events though four were dry at the time of the fall sampling blitz. Samples were analyzed for a variety of chemical parameters and E. coli. Habitat was evaluated using CQHEI. Macroinvertebrates and the fish community have not been assessed in this subwatershed. No monthly sampling locations or stream gages are located in this subwatershed.

Water Quality Information
Water chemistry data from the blitz events in the East Fork Salt Creek subwatershed suggest that phosphorus is the primary contaminant of concern with nitrogen also a potential concern. During the spring blitz, all seven sites had total phosphorus concentrations above the water quality target and three of seven sites exceeded the soluble reactive phosphorus water quality target.

The site with the most (and highest) exceedances was 488 on an unnamed tributary to North Fork Salt Creek in the western (downstream) portion of the watershed. During the fall blitz, site 488 had significant exceedances for total suspended solids, total nitrogen, total phosphorus, and soluble reactive phosphorus. Nearby site 419 on North Fork Salt Creek greatly exceeded the water quality target for nitrates with a reported concentration of 1.074 mg/L during the fall blitz. However, that value exceeds the reported total nitrogen concentration of 0.145 mg/L, indicating a potential laboratory error. Sites 488 and 419 are both located adjacent to cropland.

Table 1-52 East Fork Salt Creek Sampling Blitz Results - Nutrients

Blitz ID	Creek Name	Fall TN (mg/L)	Spring TN (mg/L)	Fall NO3 (mg/L)	Spring NO3 (mg/L)	Fall TP (mg/L)	Spring TP (mg/L)	Fall SRP (mg/L)	Spring SRP (mg/L)
239	East Fork Salt Creek		0.315		0.126		0.038		0.006
325	Unnamed tributary of EF Salt		0.100		0.031		0.027		0.004
327	Unnamed tributary of EF Salt		0.238		0.127		0.027		0.002
348	North Fork Salt Creek	0.115	0.412	0.008	0.308	0.003	0.023	0.003	0.003
355	Unnamed tributary of NF Salt		0.254		0.072		0.038		0.010
419	North Fork Salt Creek	0.145	0.438	1.074	0.369	0.008	0.024	0.002	0.003
488	Unnamed tributary of NF Salt	2.154	0.152	0.008	0.069	0.235	0.031	0.014	0.014

Table 1-53 East Fork Salt Sampling Blitz - E. coli and Sediment

Blitz ID	Creek Name	Fall E. Coli (MPN/ 100 mL)	Spring E. coli (MPN/ 100 mL)	Fall TSS (mg/L)	Spring TSS (mg/L)
239	East Fork Salt Creek		3		4
325	Unnamed tributary of EF Salt		3		0.5
327	Unnamed tributary of EF Salt		1		3.6
348	North Fork Salt Creek	167	5	5.5	2.2
355	Unnamed tributary of NF Salt		3		0.6
419	North Fork Salt Creek	57	14	15	1.15
488	Unnamed tributary of NF Salt	181	3	639.2	0.5

1.9.5 Habitat and Biological Assessment

Habitat/Biological Information

Volunteers completed the Citizen Qualitative Habitat Evaluation Index (CQHEI) habitat assessment at all 11 sites during the spring and fall sampling blitz events. Although a comparison scale for the CQHEI has not yet been developed, Hoosier Riverwatch indicates that scores greater than 60 rate as habitat conducive to supporting warm-water biota (IDNR, 2004). CQHEI scores ranged from 45.5 to 71.3 during the fall blitz and 55 to 79 during the spring blitz. While only 29% of sites scored above 60 during the fall blitz, 86% of sites scored above 60 during the spring blitz, indicating good habitat in most streams. The one site with low rankings during both blitz events was 355 on an unnamed tributary of North Fork Salt Creek.

Table 1-54 East Fork Salt Creek Sampling Blitz Results - Habitat Assessment (CQHEI)

Blitz ID	Stream Name	Fall 2020 CQHEI	Spring 2021 CQHEI
239	East Fork Salt Creek	45.5	73
325	Unnamed tributary of EF Salt	53	79
327	Unnamed tributary of EF Salt	46	72
348	North Fork Salt Creek	63	65
355	Unnamed tributary of NF Salt	51.5	55
419	North Fork Salt Creek	71.3	62
488	Unnamed tributary of NF Salt	50	63
	Average CQHEI	54.3	67.0
	% of Sites >60	29%	86%

No stream sections in the subwatershed were evaluated using the Qualitative Habitat Evaluation Index (QHEI), the fish-based Index of Biotic Integrity (IBI), or the macroinvertebrate Index of Biotic Integrity (mIBI).

1.9.6 East Fork Salt Creek Subwatershed Summary

Phosphorus appears to be the largest concern in the subwatershed with 7 of 7 spring blitz samples exceeding the total phosphorus target. Nitrogen and sediment may also be issues at site 488 on an unnamed tributary to North Fork Salt Creek which is directly adjacent to cropland. Erosion and lack of riparian buffers are prevalent throughout the subwatershed.

1.10 Gnaw Bone Creek – North Fork (HUC 051202080603)

The Gnaw Bone Creek Subwatershed (HUC 12 – 051202080603) is located in the eastern half of Brown County as shown in Figure 4-26. The subwatershed encompasses approximately 13,598 acres and represents 5% of the overall watershed. Gnaw Bone Creek, Henderson Creek, Mount Liberty Creek, and David Branch are located within this subwatershed as well as the town of Gnaw Bone. Gnaw Bone Creek discharges into North Fork Salt Creek at the downstream limit of the subwatershed.

According to the IDEM 303(d) list, there are no impaired streams within the Gnaw Bone Creek Subwatershed.

1.10.1 Land Use

Landuse within the Gnaw Bone Creek Subwatershed consists primarily of forestland with the fourth lowest percentage of agricultural land (4%) of the Lake Monroe subwatersheds. Cropland and pasture are both primarily located along Gnaw Bone Creek, Mount Liberty Creek, and the downstream section of Davis Branch. Population is sparse and generally located along the main roads (State Road 46 and State Road 135). The vast majority of the subwatershed is private land though the Laura Hare Nature Preserve is partially located in the subwatershed.

1.10.2 Point Source Water Quality Issues

The Gnaw Bone Creek Subwatershed contains no confined feeding operations and two NPDES permitted facilities. One is the Gnaw Bone Waste Water Treatment Plant and the other is the Camp Moneto Waste Water Treatment Plant. A review of the IDEM Virtual Filing Cabinet found no violations for Camp Moneto WWTP. The Gnaw Bone Regional Sewer District WWTP received a noncompliance letter in September 2020 due to multiple exceedances that were not properly reported. The facility exceeded ammonia-nitrogen limits four times in 2020, TSS twice in 2019, CBOD once in 2019, and E. coli five times in 2019-2020. IDEM expressed particular concern about the ammonia-nitrogen levels and frequency.

1.10.3 Non-Point Source Water Quality Issues

In early spring 2020, the watershed coordinator conducted a windshield survey which included 17 stream crossing sites within the Gnaw Bone Creek Subwatershed. Observations including streambank erosion, stream buffers, and livestock access were recorded for each site and the results are summarized below. Streambank erosion was noted at 8 of the 17 observed sites and lack of sufficient riparian buffer was observed at 14 of the 17 observed sites. Livestock access was not documented at any site.

Table 1-55 Gnaw Bone Creek Windshield Survey Summary

Parameter	Observations
Streambank Erosion	3/17 sites with erosion >3’ 5/17 sites with erosion <3’ 9/17 with no erosion
Stream Buffers	7/17 sites with no buffers 7/17 sites with buffers <20’ 3/17 with buffers >20’
Livestock Access to Streams	0/17 sites with livestock access

Figure 1-26 Gnaw Bone (North Fork) Subwatershed

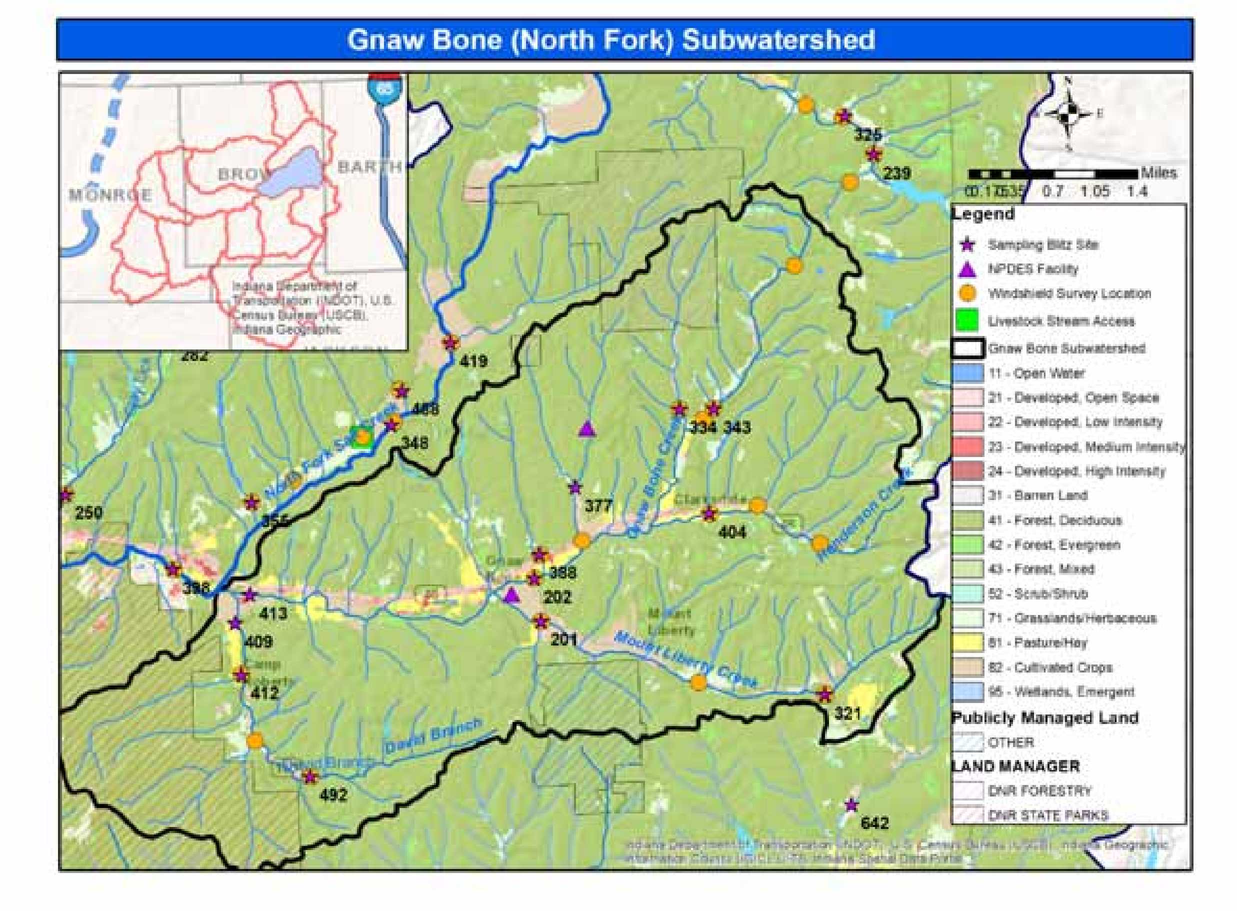


Figure 1-27 Site 388 - Unnamed tributary to Gnaw Bone Creek

Figure 1-28 Site 202 - Gnaw Bone Creek

1.10.4 Water Quality Assessment

Twelve sites were selected for the spring and fall watershed sampling blitz events though six were dry at the time of the fall sampling blitz. Samples were analyzed for a variety of chemical parameters and E. coli. Habitat was evaluated using CQHEI. Macroinvertebrates and the fish community have not been assessed in this subwatershed. No monthly sampling locations or stream gages are located in this subwatershed.

Water Quality Information

Only one blitz sample exceeded the E. coli water quality target – site 404 on Henderson Creek during the fall blitz. However, sampling conducted by the Brown County Regional Sewer District in spring 2020 suggest E. coli issues in two of the three sites sampled – site 413 on Gnaw Bone Creek and site 201 on Mount Liberty Creek.

Phosphorus also appears to be a concern with 12 of 12 spring samples exceeding the total phosphorus target and 6 of 12 spring samples exceeding the soluble reactive phosphorus target. Sites 388 (unnamed tributary of Gnaw Bone Creek) and the immediately downstream site 202 (Gnaw Bone Creek) had the highest concentrations of total phosphorus, both over three times the target concentration of 0.02 mg/L. One site, 492 on David Branch, exceeded the total phosphorus and soluble phosphorus targets during the spring blitz and also exceeded the soluble reactive phosphorus target during the fall blitz.

No exceedances were reported for total suspended solids, total nitrogen, or nitrates.

Table 1-56 Gnaw Bone Creek Sampling Blitz Results - Nutrients

Blitz ID	Creek Name	Fall TN (mg/L)	Spring TN (mg/L)	Fall NO3 (mg/L)	Spring NO3 (mg/L)	Fall TP (mg/L)	Spring TP (mg/L)	Fall SRP (mg/L)	Spring SRP (mg/L)
201	Mount Liberty Creek	0.100	0.483	0.010	0.414	0.002	0.025	0.003	0.002
202	Gnaw Bone Creek	0.100	0.263	0.029	0.198	0.002	0.098	0.003	0.011
321	Mount Liberty Creek		0.224		0.146		0.026		0.005
334	Unnamed tributary of Gnaw Bone		0.170		0.094		0.026		0.007
343	Gnaw Bone Creek		0.149		0.081		0.025		0.005
377	Unnamed tributary of Gnaw Bone		0.100		0.022		0.026		0.005
388	Unnamed tributary of Gnaw Bone		0.185		0.142		0.079		0.009
404	Henderson Creek	0.100	0.169	0.059	0.103	0.002	0.026	0.004	0.004
409	David Branch	0.118	0.218	0.014	0.151	0.002	0.029	0.004	0.013
412	Unnamed tributary of David Branch		0.150		0.113		0.021		0.004
413	Gnaw Bone Creek	0.100	0.298	0.011	0.258	0.002	0.028	0.003	0.006
492	David Branch	0.100	0.210	0.043	0.102	0.017	0.029	0.019	0.007

Table 1-57 Gnaw Bone Creek Sampling Blitz Results - E. coli and Sediment

Blitz ID	Creek Name	Fall E. Coli (MPN/ 100 mL)	Spring E. coli (MPN/ 100 mL)	Fall TSS (mg/L)	Spring TSS (mg/L)
201	Mount Liberty Creek	89	6	1.2	0.625
202	Gnaw Bone Creek	35	12	0.5	0.5
321	Mount Liberty Creek		6		0.5
334	Unnamed tributary of Gnaw Bone		-		0.5
343	Gnaw Bone Creek		2		0.5
377	Unnamed tributary of Gnaw Bone		9		0.5
388	Unnamed tributary of Gnaw Bone		9		0.5
404	Henderson Creek	727	14	0.5	0.5
409	David Branch	7	16	2.3	2.4
412	Unnamed tributary of David Branch		-		0.5
413	Gnaw Bone Creek	47	194	0.5	0.5
492	David Branch	15	71	1	0.5

Table 1-58 Gnaw Bone Creek BCRSD E. coli Sampling Results May 2020

BCRSD Site ID	Blitz Site ID	Stream	5-May	12-May	19-May	26-May	2-Jun	Geo. Mean	> State Geomean (125)
EF11	413	Gnaw Bone	449	78	620	186	141	224	yes
EF12	202	Gnaw Bone	338	21	276	172	84	122	no
EF13	201	Mount Liberty	401	61	449	228	118	197	yes

1.10.5 Habitat and Biological Assessment

Habitat/Biological Information

Volunteers completed the Citizen Qualitative Habitat Evaluation Index (CQHEI) habitat assessment at all 12 sites during the spring and fall sampling blitz events. Although a comparison scale for the CQHEI has not yet been developed, Hoosier Riverwatch indicates that scores greater than 60 rate as habitat conducive to supporting warm-water biota (IDNR, 2004). CQHEI scores ranged from 41 to 74 during the fall blitz and 54 to 83.5 during the spring blitz. While only 33% of sites scored above 60 during the fall blitz, 83% of sites scored above 60 during the spring blitz, indicating good habitat in most streams. The two stream sections with low scores during both blitz events were site 343 on Gnaw Bone Creek and site 412 on an unnamed tributary of David Branch. Higher CQHEI scores in the spring may be partially due to increased streamflow levels (compared to the drought conditions in the fall) but could also be due to differing volunteer interpretation.

Table 1-59 Gnaw Bone Creek Sampling Blitz Results - Habitat Assessment (CQHEI)

Blitz ID	Stream Name	Fall 2020 CQHEI	Spring 2021 CQHEI
201	Mount Liberty Creek	54	62.5
202	Gnaw Bone Creek	47	60.5
321	Mount Liberty Creek	41	75.5
334	Unnamed tributary of Gnaw Bone	72.5	76.3
343	Gnaw Bone Creek	57.2	54
377	Unnamed tributary of Gnaw Bone	59.8	72.5
388	Unnamed tributary of Gnaw Bone	42	68
404	Henderson Creek	61	75.5
409	David Branch	54	83.5
412	Unnamed tributary of David Branch	51	59
413	Gnaw Bone Creek	74	61
492	David Branch	69	78

	Average CQHEI	56.9	68.9
	% of Sites >60	33%	83%

No stream sections in the subwatershed were evaluated using the Qualitative Habitat Evaluation Index (QHEI), the fish-based Index of Biotic Integrity (IBI), or the macroinvertebrate Index of Biotic Integrity (mIBI).

1.10.6 Gnaw Bone Creek Subwatershed Summary

The Gnaw Bone Creek subwatershed has relatively little agricultural and developed land. The main constituents of concern appear to be phosphorus and E. coli. All twelve spring blitz samples had phosphorus levels above the target with sites 388 (unnamed tributary of Gnaw Bone Creek) and the immediately downstream site 202 (Gnaw Bone Creek) having the highest concentrations. While only one blitz sample exceeded the E. coli target, site 404 on Henderson Creek, two sites sampled by BCRSD exceeded the state geomean target, site 413 on Gnaw Bone Creek and site 201 on Mount Liberty Creek. Lack of riparian buffer was observed at 14 of 17 sites and erosion was noted at 8 of 17 sites though CQHEI scores were relatively high.

1.11 Clay Lick Creek – North Fork (HUC 051202080604)

The Clay Lick Creek Subwatershed (HUC 12 – 051202080604) is located in central Brown County as shown in Figure 4-34. The subwatershed is the second largest, encompassing approximately 28,572 acres and representing 10% of the overall watershed. The watershed contains a portion of North Fork Salt Creek as well as tributaries Clay Lick Creek, Greasy Creek, Owl Creek, Lick Creek, and Jackson Creek with its reservoir Yellowwood Lake. The subwatershed also contains the town of Nashville, the North Fork stream gage (near site 389 just south of Nashville), and the monthly North Fork sampling location (site 256 southeast of Yellowwood Lake).

According to the IDEM 303(d) list, there are no impaired streams within the Clay Lick Creek Subwatershed.

1.11.1 Land Use

Landuse within the Clay Lick Creek Subwatershed consists primarily of forestland but it has the sixth highest percentage of agricultural land (5%) of all the Lake Monroe subwatersheds and the largest area of developed land, Nashville. Pasture and cultivated crops are located primarily along North Fork Salt Creek with some pasture and herbaceous land along smaller streams like Clay Lick, Greasy Creek, Owl Creek, and Lick Creek. Portions of the subwatershed have much higher population density than the other subwatersheds, particularly in Nashville and along the main roads (State Road 46, State Road 135, Greasy Creek Road, Clay Lick Road). The town of Nashville is located along the North Fork Salt Creek, has approximately 1,000 residents and is well known as an art colony and tourist destination. About a third of the subwatershed is public land. A portion of Brown County State Park is located in the southern half, a portion of Yellowwood State Forest in the western half, and a handful of smaller parcels managed by other organizations are located in the northeast corner.

1.11.2 Point Source Water Quality Issues

The Clay Lick Creek Subwatershed contains no confined feeding operations and one NPDES permitted facility, the largest in the watershed. The Town of Nashville maintains a 0.60 MGD wastewater treatment plant that discharges into North Fork Salt Creek just west of Nashville. This treatment plant is by far the largest in the area and has been dealing with significant violations. The plant has been operating under an agreed order since 2019. In October 2019, IDEM issued a notice of violation and proposed agreed order for the plant. The letter mentioned an overflow event on February 24, 2019 and alleged there had been additional unreported overflows to North Fork Salt Creek. The letter also mentioned the lack of a preventative maintenance program, insufficient removal of sludge/solids, inadequate staffing, and flooding of the salt stockpile causing salt to enter North Fork Salt Creek.

In response, the town hired a consulting firm to develop a wastewater treatment plant agreed order of response that would include all the necessary elements to bring the plant back into compliance. This plan was approved by IDEM in June 2020 and the town has been working to remedy all the issues. The town has also started work on a sanitary sewer utility master plan to determine how well the plant is currently functioning, investigate options for expansion or reconstruction, and exploring possibilities for expanding service outside town limits. (Brown County Democrat 12/04/19 – "Town Okays Major Study of Sewer Service")

One of the challenges that the treatment plant faces is its location in the floodway of North Fork Salt Creek, meaning it is at high risk for flooding. It was built in the 1960's and expanded several times, most recently around 2010. Some concerns have been raised that the state might not permit expansion of the plant within the floodway and that a relocation could be required. There are also efforts currently underway to consider wastewater treatment at the county level and explore the possibility of a treatment plant that would serve multiple communities. A study was recently published evaluating the feasibility of a Helmsburg Regional

Sewer District and the Brown County Regional Sewer District is working on its own plan for all areas of the county that are not currently served by wastewater treatment plants.

1.11.3 Non-Point Source Water Quality Issues

In early spring 2020, the watershed coordinator conducted a windshield survey which included 26 stream crossing sites within the Clay Lick Creek Subwatershed. Observations including streambank erosion, stream buffers, and livestock access were recorded for each site and the results are summarized below. Streambank erosion was noted at 21 of the 26 observed sites and lack of sufficient riparian buffer was observed at 20 of the 26 observed sites. Many of the sites with no riparian buffer were residential properties where the surrounding area was mowed to the edge of the stream. While lawn is preferable to tilled land, mowed grass provides minimal filtration when stormwater flows into streams. Other sites had streams immediately adjacent to roads with no room for riparian planting. Livestock access was documented at 2 of the 26 observed sites.

Table 1-60 Clay Lick Creek Windshield Survey Summary

Parameter	Observations
Streambank Erosion	9/26 sites with erosion >3' 12/26 sites with erosion <3' 5/26 sites with no erosion
Stream Buffers	10/26 sites with no buffers 10/26 sites with buffers <20' 6/26 sites with buffers>20'
Livestock Access to Streams	2/26 sites with livestock access

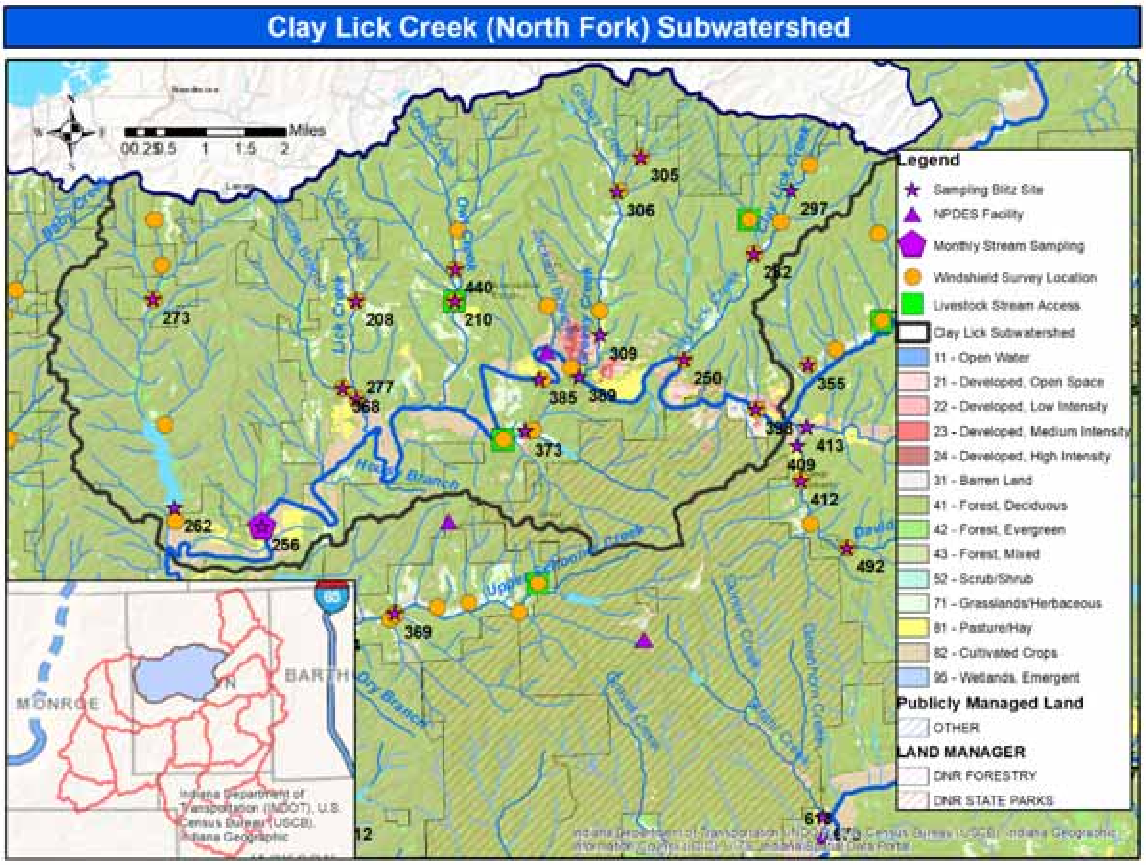
Figure 1-29 Site 482 Showing No Riparian Buffer on Residential Property

Figure 1-30 Stream Gage on North Fork Salt Creek – State Road 46 Bridge Near Site 389

Figure 1-31 Site 277 Showing Insufficient Riparian Buffer on Agricultural Property

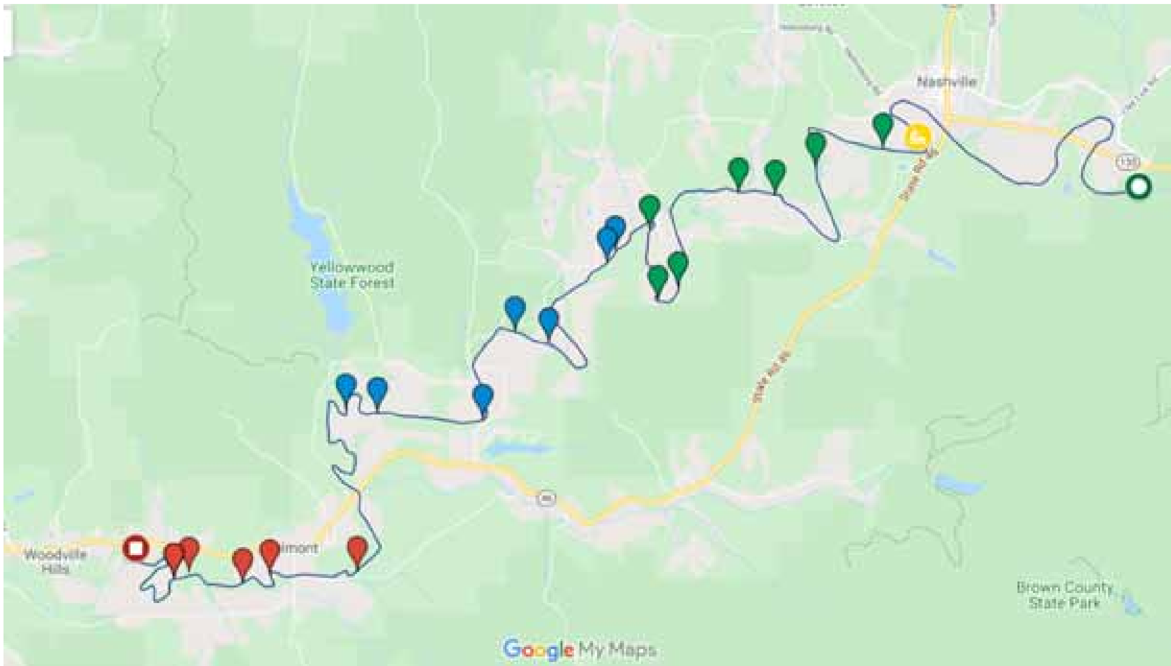
Figure 1-32 Site 306 - Road Immediately Adjacent to Stream

Figure 1-33 Clay Lick Creek (North Fork) Subwatershed



The Brown County Soil and Water District conducted a kayak survey of North Fork Salt Creek in June 2020 within the Clay Lick Creek and Brummett Creek subwatersheds. The stream was surveyed between Brown County State Park (east of Nashville) and the Monroe/Brown County line (about halfway between Bloomington and Nashville). Observations were recorded by section and included log jams, areas of significant erosion, agricultural crossings, invasive terrestrial plant species, and trash. Many of these concerns are not observable from the roads.

Figure 1-34 North Fork Salt Creek Kayak Survey (portions of Clay Lick and Brummetts Creek subwatersheds)



Section 1 (No Markers – Brown County State Park to Deer Run Park) contained no log jams and no notable obstacles to kayaking. Some erosion locations were identified, including a significant area behind the Brown County Music Center and another across from the Deer Run Park boat ramp (site 385).

Section 2 (Green Markers – Deer Run Park to Howard Farms) had a dense section of Japanese Knotweed, one of the newer invasive terrestrial plant species in this area. There were also a couple of very old trash dumps that have become overgrown. Two log jams were noted.

Section 3 (Blue Markers – Howard Farms to Sycamore Land Trust) had several large log jams and unpleasant odors were noted throughout the section.

Section 4 (Red Markers – Sycamore Land Trust to Monroe County Line) had many large log jams and several of the log jams had accumulated trash. This section of the creek (in the Brummett Creek subwatershed) also tended to have narrower and deeper banks.

General observations included several stream crossings for farm equipment that appeared heavily eroded and could benefit from improved management practices. Areas of large erosion tended to occur along agricultural fields and where trees had fallen. The last big logjam removal project was by Salt Creek Preservation Group in 2009.

1.11.4 Water Quality Assessment

Eighteen sites were selected for the spring and fall watershed sampling blitz events though four were dry at the time of the fall sampling blitz and one site was missed during the spring sampling blitz. Additional monthly samples were collected from North Fork Salt Creek at site 256. Samples were analyzed for a variety of chemical parameters and E. coli. Habitat was evaluated during the blitz events using CQHEI. Habitat was evaluated once using QHEI at site 256 and macroinvertebrates were also assessed once at site 256. The fish community have not been assessed in this subwatershed. A stream gage is located on North Fork Salt Creek at site 389 just south of Nashville.

Water Quality Information

Water chemistry data from the blitz sites in the Clay Lick Creek subwatershed suggest E. coli concerns at three sites – 277 on Lick Creek, 398 on North Fork Salt Creek (upstream), and 299 on Owl Creek. Data from the Brown County Regional Sewer District suggest E. coli concerns at site 256 on North Fork Salt Creek (downstream), near site 389 on North Fork Salt Creek (midstream), near site 398 on North Fork Salt Creek (upstream) and near site 309 on Greasy Creek. E. coli was well below target levels in all 12 monthly samples collected at site 256 on North Fork Salt Creek.

Samples were collected for source analysis at five sites in April 2021. All five had levels of E. coli below the state standard. Two of the five samples had sufficient coliphage residue for source analysis. Site EF06/256 on North Fork Salt Creek at Yellowwood Road was reported as having 54% coliphage strains connected to human sources and 46% coliphage strains connected to animal sources. Site EF20 (near 309) on Greasy Creek at State Road 46 was reported as having 94% coliphage strains connected to human sources and 6% coliphage strains connected to animal sources. However, these percentages do not reflect the true source probability as there are species of coliphage that can not be traced to a particular source. The primary conclusion to be drawn from these results is that both human and animal fecal contamination were present in the five samples where results were obtained.

The primary chemical constituent of concern appears to be phosphorus, with 16 of 17 spring samples exceeding the total phosphorus target, six of which also exceeded the soluble reactive phosphorus target. The highest concentration (0.040 mg/L) was reported at site 262 in Jackson Creek at the outlet of Yellowwood Lake.

The only nitrogen and nitrate exceedances were both in the fall at the same site, 385 on North Fork Salt Creek, which had levels of total nitrogen and nitrates one hundred times the target levels. This site is located at the Deer Run Boat Ramp and is surrounded by cropland to the north as well as being located downstream from the Nashville wastewater treatment plant.

Monthly samples collected at site 389 on North Fork Salt Creek also reported multiple total phosphorus and soluble reactive phosphorus exceedances. Nitrogen and nitrate exceedances were minimal (1/12 and 2/12) and were only slightly above the target. The site did experience three total suspended solids exceedances. The two highest TSS levels were reported for 2/25/21 and 3/18/21 when average daily streamflow measured at the North Fork stream gage was over 500 cfs. For comparison, the other ten sampling events were on days with streamflow less than 130 cfs and nine of them were less than 50 cfs.

Table 1-61 Clay Lick Creek Sampling Blitz Results - Nutrients

Blitz ID	Creek Name	Fall TN (mg/L)	Spring TN (mg/L)	Fall NO3 (mg/L)	Spring NO3 (mg/L)	Fall TP (mg/L)	Spring TP (mg/L)	Fall SRP (mg/L)	Spring SRP (mg/L)
208	Lick Creek		0.127		0.089		0.015		0.005
210	Owl Creek	0.108	0.255	0.008	0.177	0.002	0.027	0.002	0.011
250	Clay Lick Creek	0.100	0.101	0.008	0.046	0.002	0.024	0.003	0.004
256	North Fork Salt Creek	0.251		0.008		0.020		0.003	
262	Jackson (Yellowwood) Creek	0.105	0.349	0.008	0.150	0.014	0.040	0.002	0.004
273	Jackson (Yellowwood) Creek	0.100	0.100	0.013	0.017	0.017	0.103	0.003	0.027
277	Lick Creek	0.100	0.100	0.008	0.024	0.016	0.022	0.002	0.004
282	Clay Lick Creek	0.259	0.148	0.008	0.086	0.028	0.026	0.004	0.005
297	Clay Lick Creek		0.169		0.094		0.034		0.015
305	Unnamed tributary of Greasy Creek		0.100		0.011		0.022		0.003
306	Greasy Creek	0.100	0.197	0.028	0.100	0.002	0.023	0.006	0.005
309	Greasy Creek	0.163	0.202	0.008	0.099	0.003	0.028	0.003	0.005
368	Sciscoe Branch		0.100		0.010		0.027		0.009
373	Green Valley Creek	0.171	0.210	0.052	0.103	0.002	0.022	0.003	0.005
385	North Fork Salt Creek	6.792	0.406	6.605	0.307	0.002	0.026	0.005	0.006
389	North Fork Salt Creek	0.100	0.389	0.012	0.303	0.002	0.030	0.003	0.004
398	North Fork Salt Creek	0.109	0.350	0.008	0.278	0.002	0.026	0.003	0.004
440	Owl Creek	0.402	0.267	0.204	0.164	0.006	0.032	0.002	0.006

Table 1-62 Clay Lick Creek Sampling Blitz Results - E. coli and Sediment

Blitz ID	Creek Name	Fall E. Coli (MPN/ 100 mL)	Spring E. coli (MPN/ 100 mL)	Fall TSS (mg/L)	Spring TSS (mg/L)
208	Lick Creek		23		0.6
210	Owl Creek	1	4	1.7	0.5
250	Clay Lick Creek	9	11	2.7	0.5
256	North Fork Salt Creek	4		6.7	
262	Jackson (Yellowwood) Creek	4	-	1.2	3.4
273	Jackson (Yellowwood) Creek	1	1	2.2	0.6
277	Lick Creek	378	20	0.5	0.5
282	Clay Lick Creek	214	-	4.3	0.5
297	Clay Lick Creek		3		0.6
305	Unnamed tributary of Greasy Creek		5		0.5
306	Greasy Creek	23	50	0.5	0.5
309	Greasy Creek	73	21	5	0.5
368	Sciscoe Branch		33		0.5
373	Green Valley Creek	28	3	1.2	0.5
385	North Fork Salt Creek	10	27	2.8	1.6
389	North Fork Salt Creek	16	17	2.5	0.6
398	North Fork Salt Creek	1,986	15	5.2	1.2
440	Owl Creek	299	9	17.2	0.5

Table 1-63 Clay Lick Creek BCRSD E. coli Sampling Results May 2020

BCRSD Site ID	Blitz Site ID	Stream	5-May	12-May	19-May	26-May	2-Jun	Geo. Mean	> State Geomean (125)
EF05	near 262	Outlet Yellowwood Lake	87	33	87	461	13	69	no
EF06	256	North Fork Salt Creek	705	310	1,170	32	126	253	yes
EF07	277	Lick Creek	449	22	401	93	59	117	no
EF08	near 389	North Fork Salt Creek	1,440	58	811	1,990	122	439	yes
EF09	250	Clay Lick	85	36	171	187	25	76	no
EF10	near 398	North Fork Salt Creek	424	195	661	345	96	283	yes
EF20	near 309	Greasy Creek	755	83	276	365	228	270	yes

Table 1-64 Clay Lick Creek Fecal Contamination Source Analysis April 2021

BC_ID	LM_ID	Stream	4/27/21 E. Coli	Coliform (PFU/100ml)	% Human	% Animal
	440	Owl Creek (above West Branch Owl Creek)	48.7	< 1	NA	NA
EF06	256	North Fork Salt (Yellowwood Rd)	56.5	0.6	54	46
EF08	near 389	North Fork Salt (SR 46 below Salt Creek Trail)	167.0	< 1	NA	NA
EF20	near 309	Greasy Creek (downstream @ SR-46)	205.0	0.4	94	6
EF10	near 398	North Fork Salt (above Gnaw Bone Creek)	93.3	< 1	NA	NA

Table 1-65 North Fork Salt Creek Monthly Sampling at Site 256 in Clay Lick Creek Subwatershed

Site 256 Sample Date	North Fork E. coli (cfu/100 ml)	North Fork TSS (mg/L)	North Fork TN (mg/L)	North Fork NO3 (mg/L)	North Fork TP (mg/L)	North Fork SRP (mg/L)
4/22/2020	66	7.6	0.194	0.123	0.018	0.006
5/27/2020	210	30.8	0.396	0.268	0.022	0.008
6/24/2020	70	2.8	0.554	0.104	0.028	0.006
7/21/2020	184	0.5	0.422	0.117	0.037	0.005
8/27/2020	58	2.5	0.369	0.140	0.022	0.004
9/24/2020	15	5.5	0.256	0.008	0.019	0.003
10/22/2020	58	4.8	0.357	0.008	0.036	0.012
11/19/2020	23	1.8	0.331	0.450	0.021	0.01
12/16/2020	41	2	0.693	0.700	0.016	0.005
1/25/2021	15	1.6	0.603	0.645	0.015	0.003
2/25/2021	105	101.3	0.683	0.478	0.048	0.01
3/18/2021	185	148.6	0.533	0.249	0.040	0.009

A review of historical data revealed that sampling was conducted in 2005-2006 as part of developing a Watershed Management Plan for Yellowwood Lake. The lake was on the 2004 list of Impaired Waterbodies as a Category 5B impairment for mercury in Largemouth bass. However, Indiana guidance states that that developing conventional Total Maximum Daily Limits (TMDLs) for mercury is not an appropriate approach as most mercury sources are airborne and therefore managing mercury was limited to education in the plan with no mercury sampling conducted. Water samples were analyzed for sediment, nutrients, and E. coli.

Sampling results indicated moderate levels of phosphorus in Yellowwood Lake with the majority of samples within Carlson's Trophic State Index (TSI) mesotrophic range. Nitrogen levels were relatively low suggesting that the lake is nitrogen limited. Stream sampling in the watershed using Hoosier Riverwatch procedures also suggested that the Yellowwood Lake watershed did not have any significant chemical water quality impairments.

A bathymetric study of Yellowwood Lake in 2006 showed significant sediment accumulation and loss of water depth throughout the lake but with the greatest accumulation concentrated in the north end of the lake and near inlets where up to 5.5 feet had accumulated since 1955. Total sediment accumulation was less than 1% of the 1955 lake basin volume over 65 years. However, the degree of accumulation in the north end of the lake has had a significant impact on aesthetic qualities and usability. The north end of Yellowwood Lake was subsequently dredged 2008-2010. Roughly 6 to 8 feet of sediment was removed from a 17-acre area, totaling 5.2 million cubic feet of sediment. During the project, an underwater ridge was constructed across the north end of the lake in the hopes of creating a sediment trap to keep incoming sediment in the very north end of the lake. Several fish structures were also installed.

E.coli measurements were taken as part of the watershed management plan for Yellowwood Lake in 2004-2006. E. coli sampling for Yellowwood Lake's tributaries was conducted roughly monthly in Jackson Creek and roughly quarterly in John Floyd Hollow between October 2004 and May 2006 by volunteers using the Coliscan Easygel method. Four additional samples were collected from Jackson Creek using a contracted (professional) service. The results from the contracted service were several orders of magnitude less than the volunteers' results, leading the watershed plan steering committee to question the validity of the volunteers' results. One of the four contracted samples had levels of E. coli slightly above the state standard of 235 colonies per 100 mL while fourteen of the seventeen volunteers' samples had E. coli levels above the state standard with six samples exceeding 1,000 colonies per 100 mL. The watershed management plan recommended additional monitoring, education about septic system maintenance, and education about equestrian manure management.

1.11.5 Habitat and Biological Assessment

Habitat/Biological Information
Volunteers completed the Citizen Qualitative Habitat Evaluation Index (CQHEI) habitat assessment at all 18 sites during the fall blitz and 17 sites during the spring blitz. Although a comparison scale for the CQHEI has not yet been developed, Hoosier Riverwatch indicates that scores greater than 60 rate as habitat conducive to supporting warm-water biota (IDNR, 2004). CQHEI scores ranged from 40.5 to 70.7 during the fall blitz and 50 to 88 during the spring blitz. Only 28% of sites scored above

60 during the fall blitz and only 56% of sites scored above 60 during the spring blitz, indicating poor habitat in many streams. The stream sections with consistently low CQHEI scores were site 208 on Lick Creek, site 256 on North Fork Salt Creek (not evaluated in the spring), site 273 on Jackson Creek, site 305 on an unnamed tributary of Greasy Creek, site 368 on Siscoe Branch, site 398 on North Fork Salt Creek, and site 440 on Owl Creek. Most sites scored higher during the spring blitz (likely due to higher water flow) but site 385 on North Fork Salt Creek dropped from a score of 70 to a score of 50.

Table 1-66 Clay Lick Creek Sampling Blitz Results - Habitat Assessment (CQHEI)

Blitz ID	Stream Name	Fall 2020 CQHEI	Spring 2021 CQHEI
208	Lick Creek	57	55.5
210	Owl Creek	47	62
250	Clay Lick Creek	65.7	81.5
256	North Fork Salt Creek	48.8	
262	Jackson (Yellowwood) Creek	66.7	62
273	Jackson (Yellowwood) Creek	59.2	59.5
277	Lick Creek	51	61.5
282	Clay Lick Creek	70.7	88
297	Clay Lick Creek	49.2	82.5
305	Unnamed tributary of Greasy Creek	40.5	51
306	Greasy Creek	59	64
309	Greasy Creek	46	78
368	Sciscoe Branch	59	60
373	Green Valley Creek	58	76.2
385	North Fork Salt Creek	70	50
389	North Fork Salt Creek	67	77
398	North Fork Salt Creek	60	54
440	Owl Creek	50	51
	Average CQHEI	56.9	65.5
	% of Sites >60	28%	56%

Table 1-67 Habitat and Biological Sampling in Clay Lick Subwatershed

Sampler and Date	Site ID	Stream	Station	mIBI	mIBI Rating	QHEI	QHEI Rating
IU Limno Lab August 2020	256	North Fork Salt	Yellowwood Road Bridge	20	Impaired (<36)	60	Good

No stream sections in the subwatershed were evaluated using fish-based Index of Biotic Integrity. The IU Limnology Lab evaluated habitat using the Qualitative Habitat Evaluation Index (QHEI) at the monthly sampling site 256 on North Fork Salt Creek and gave it a score of 60, indicating good habitat. This contrasts with the CQHEI score of 48.8 assigned during the fall blitz, indicating poor habitat, but the site was not re-evaluated during the spring blitz. In August 2020, the IU Limnology Lab collected macroinvertebrates and gave site 256 a mIBI score of 20, indicating impairment.

1.11.6 Clay Lick Creek Subwatershed Summary

The Clay Lick Creek subwatershed is one of the largest and contains significant areas of both agricultural and developed land. Erosion and insufficient riparian buffer were observed throughout the watershed. Phosphorus and E. coli appear to be the main concerns. Sixteen of seventeen spring blitz samples exceeded the total phosphorus standards as did 8 of 12 monthly sampling events collected at site 256 on North Fork Salt Creek at Yellowwood Road. E. coli data collected by BCRSD indicate elevated levels in multiple sites on North Fork Salt Creek as well as Greasy Creek. Source sampling indicates both human and animal sources. Habitat scores evaluated using CQHEI were low at over half the sampling site locations though the QHEI score for site 256 on North Fork Salt Creek was good. Logjams were reported in several sections of North Fork Salt Creek.

1.12 Brummett Creek – North Fork (HUC 051202080605)

The Brummett Creek Subwatershed (HUC 12 – 051202080605) straddles the Monroe-Brown county line with about a third in Monroe County and two thirds in Brown County as shown in Figure 4-35. The subwatershed is the third largest, encompassing approximately 23,857 acres and representing 9% of the overall watershed. The subwatershed contains a lower portion of North Fork Salt Creek as well as its tributaries Brummett Creek, Schooner Creek and Wolfpen Branch.

According to the IDEM 303(d) list, there are no impaired streams within the Brummett Creek Subwatershed.

1.12.1 Land Use

Landuse within the Brummett Creek Subwatershed consists primarily of forestland with approximately 7% agricultural land. Cultivated crops are located primarily along Brummett Creek, North Fork Salt Creek, and the lower section of Schooner Creek. Pasture is primarily located along North Fork Salt Creek and the middle section of Brummett Creek. Additional land that was classified as herbaceous and field verified as pasture is located along upper Schooner Creek, Baby Creek, and the ridge between Brummett Creek and its largest tributary. Population density is low and generally located along the main roads (State Road 46, Upper Schooner Road, Brummetts Creek Road).

About half of the subwatershed is publicly owned. This includes portions of Brown County State Park (in the east), Yellowwood State Forest, Morgan-Monroe State Forest, T.C. Steele State Historic Site, and Lake Monroe State Park. The land managed as part of Lake Monroe State Recreational Area includes the floodplain of North Fork Salt Creek (between Kent Road and State Road 46) as well as the downstream portion of the Brummett Creek floodplain (along Brummetts Creek Road). Much of this land is cropland that the DNR leases to farmers.

1.12.2 Point Source Water Quality Issues

The Brummett Creek Subwatershed contains no confined feeding operations and three NPDES permitted facilities. A review of the IDEM Virtual Filing Cabinet found no violations for Unionville Elementary WWTP (northwest corner of the subwatershed) or Greg Rose Properties WWTP (which is located in the northeast corner of the subwatershed and is not yet operational as the proposed subdivision has not been constructed).

The Brown County State Park WWTP (eastern edge of the subwatershed) has received and responded to a series of compliance letters since 2015. Many of the issues were administrative in nature (late in permit renewal, used the wrong log sheets) but several significant issues were identified. An inspection in October 2015 revealed several areas of inflow/infiltration into the sewage system that the park has subsequently been working to identify and replace. The concern was repeated in March 2016, October 2016, and January 2017 compliance letters from IDEM. The January 2017 letter also referenced an exceedance in E. coli levels in June 2016, which according to the park's response was addressed by cleaning the ultraviolet chamber tank and subsequent readings were within limits. Another violation letter was issued in March 2020 which described a sewer overflow that may have reached North Fork Salt Creek. This concern was repeated in a June 2020 violation letter. The park responded both times that they have increased monitoring frequency and are also investigating if a pump repair or system upgrade may be needed to handle peak flows.

The Brown County State Park treatment plant only handles the central portion of the park (campgrounds, nature center, office) while the Abe Martin Lodge sends its wastewater to the Nashville treatment plant and the horseman's camp has an on-site septic system. As the Nashville treatment plant considers expansion, there has been discussion about closing the Brown County State Park treatment plant and sending wastewater from the central portion of the park to Nashville as well.

1.12.3 Non-Point Source Water Quality Issues

In early spring 2020, the watershed coordinator conducted a windshield survey which included 31 stream crossing sites within the Brummett Creek Subwatershed. Observations including streambank erosion, stream buffers, and livestock access were recorded for each site and the results are summarized below. Streambank erosion was noted at 27 of the 31 observed sites and lack of sufficient riparian buffer was observed at 9 of the 31 observed sites. Livestock access was documented at 2 of 31 sites.

Table 1-68 Brummett Creek Windshield Survey Summary

Parameter	Observations
Streambank Erosion	3/31 sites with erosion >3' 24/31 sites with erosion <3' 4/31 sites with no erosion
Stream Buffers	4/31 sites with no buffers 5/31 sites with buffers <20' 22/31 sites with buffers >20'
Livestock Access to Streams	2/31 sites with livestock access

Figure 1-35 Brummett Creek (North Fork) Subwatershed

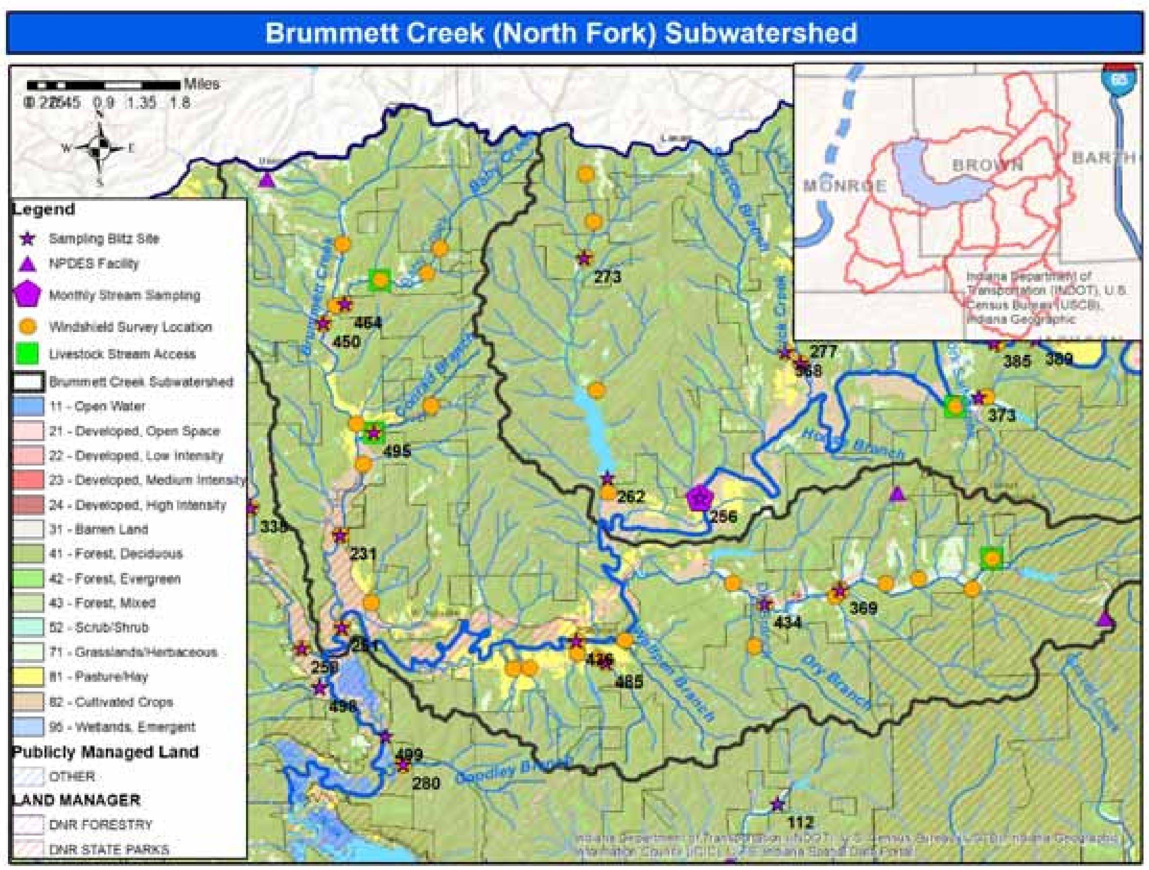


Figure 1-36   Site 467 - Livestock with Access to Baby Creek

1.12.4 Water Quality Assessment

Nine sites were selected for the spring and fall watershed sampling blitz events though two were dry at the time of the fall sampling blitz and one was missed during the spring sampling blitz (site 436 on North Fork Salt Creek). Samples were analyzed for a variety of chemical parameters and E. coli. Habitat was evaluated using CQHEI. Macroinvertebrates and the fish community have not been assessed in this subwatershed. No monthly sampling locations or stream gages are located in this subwatershed.

Water Quality Information
Water chemistry data from the Brummett Creek subwatershed suggest that the primary constituent of concern is phosphorus, with 6 of 8 spring samples exceeding the total phosphorus target of 0.02 mg/L. 1 of 7 fall samples and 1 of 8 spring samples also exceeded the soluble reactive phosphorus target. There were no recorded exceedances for E. coli, total suspended solids, total nitrogen, or nitrates during the blitz events.

However, sampling conducted by the Brown County Regional Sewer District in spring 2020 at site 436 on North Fork Salt Creek at Belmont revealed 3 out of 5 exceedances and a geometric mean exceeding the state standard of 125 CFU/100 ml, indicating an E. coli concern in North Fork Salt Creek within the Brummett Creek subwatershed. BCRSD sampling also identified E. coli as a concern in North Fork Salt Creek upstream in the Clay Lick subwatershed. They did not sample further downstream as North Fork crosses into Monroe County less than two miles downstream from site 436.

Table 1-69 Brummett Creek Sampling Blitz Results - Nutrients

Blitz ID	Creek Name	Fall TN (mg/L)	Spring TN (mg/L)	Fall NO3 (mg/L)	Spring NO3 (mg/L)	Fall TP (mg/L)	Spring TP (mg/L)	Fall SRP (mg/L)	Spring SRP (mg/L)
231	Brummett Creek	0.135	0.359	0.010	0.192	0.002	0.023	0.002	0.003
251	North Fork Salt Creek	0.420	0.303	0.008	0.169	0.016	0.037	0.003	0.004
369	Upper Schooner Creek	0.109	0.224	0.116	0.138	0.002	0.028	0.006	0.009
434	Lower Schooner Creek	0.100	0.214	0.019	0.114	0.002	0.024	0.002	0.005
436	North Fork Salt Creek	0.174		0.008		0.008		0.002	
450	Brummett Creek	0.100	0.201	0.063	0.098	0.002	0.020	0.002	0.004
464	Baby Creek	0.100	0.114	0.011	0.055	0.002	0.023	0.002	0.008
485	Davis Branch		0.100		0.053		0.022		0.005
495	Conrad Branch		0.179		0.114		0.020		0.003

Table 1-70 Brummett Creek Sampling Blitz Results - E. coli and Sediment

Blitz ID	Creek Name	Fall E. Coli (MPN/ 100 mL)	Spring E. coli (MPN/ 100 mL)	Fall TSS (mg/L)	Spring TSS (mg/L)
231	Brummett Creek	18	6	2.5	2.2
251	North Fork Salt Creek	10	31	9	8
369	Upper Schooner Creek	161	3	0.7	0.5
434	Lower Schooner Creek	55	4	0.7	1
436	North Fork Salt Creek	21		14.5	
450	Brummett Creek	1	2	0.7	0.5
464	Baby Creek	57	8	0.5	0.5
485	Davis Branch		2		7.4
495	Conrad Branch		12		0.5

Table 1-71 Brummett Creek BCRSD E. coli Sampling May 2020

BCRSD Site ID	Blitz Site ID	Stream	5-May	12-May	19-May	26-May	2-Jun	Geo. Mean	> State Geomean (125)
EF04	436	North Fork Salt Creek	338	112	1,630	365	128	310	yes

1.12.5 Habitat and Biological Assessment

Habitat/Biological Information
Volunteers completed the Citizen Qualitative Habitat Evaluation Index (CQHEI) habitat assessment at all 11 sites during the spring and fall sampling blitz events. Although a comparison scale for the CQHEI has not yet been developed, Hoosier Riverwatch indicates that scores greater than 60 rate as habitat conducive to supporting warm-water biota (IDNR, 2004). CQHEI scores ranged from 37 to 67 during the fall blitz and 59 to 82 during the spring blitz. While only 33% of sites scored above 60 during the fall blitz, 66% of sites scored above 60 during the spring blitz, indicating good habitat in most streams. The three stream sections that scored poorly during both blitz events were site 251 on North Fork Salt Creek, site 436 on North Fork Salt Creek (not sampled in the spring), and site 485 on Davis Branch.

Blitz ID	Stream Name	Fall 2020 CQHEI	Spring 2021 CQHEI
231	Brummett Creek	52	73.5
251	North Fork Salt Creek	59.5	59
369	Upper Schooner Creek	57	82
434	Lower Schooner Creek	65	81
436	North Fork Salt Creek	44	
450	Brummett Creek	67	79
464	Baby Creek	37	65.5
485	Davis Branch	46	59
495	Conrad Branch	63	81
	Average CQHEI	54.5	72.5
	% of Sites >60	33%	66%

No stream sections in the subwatershed were evaluated using the Qualitative Habitat Evaluation Index (QHEI), the fish-based Index of Biotic Integrity (IBI), or the macroinvertebrate Index of Biotic Integrity (mIBI).

1.12.6 Brummett Creek Subwatershed Summary

Water quality in the Brummett Creek subwatershed as evaluated through the blitz events was generally good. Phosphorus appears to be the primary constituent of concern with 6 of 8 samples exceeding the total phosphorus targets in the spring. However, E. coli sampling done by the Brown County Regional Sewer District indicate that E. coli is a concern in North Fork Salt Creek at site 436 in Belmont. Habitat scores were also low at three sites during both the spring and fall blitz events, including sites 436 and 251 on North Fork Salt Creek and site 485 on Davis Branch. Streambank erosion was observed throughout the Brummett Creek subwatershed (27 of 31 observed sites) though few sites (3 of 31) had severe erosion (> 3 feet).

1.13 Stephens Creek – North Fork (HUC 051202080606)

The Stephens Creek Subwatershed (HUC 12 – 051202080606) is located primarily in the eastern half of Monroe County with the southeast corner located in Brown County as shown in Figure 4-37. The subwatershed encompasses approximately 14,947 acres and represents 5% of the overall watershed. Stephens Creek and its tributary Kerr Creek discharge into North Fork Salt Creek along with Goodley Branch shortly before North Fork Salt Creek enters Lake Monroe. The Kerr Creek portion of the subwatershed has been identified by the Monroe County Highway Department as a critical area due to periodic flash flooding of Kerr Creek Road, which is located directly beside Kerr Creek.

According to the IDEM 303(d) list, there are no impaired streams within the Stephens Creek Subwatershed.

1.13.1 Land Use

Landuse within the Stephens Creek Subwatershed consists primarily of forestland with the fourth highest percentage of agricultural land of the subwatersheds at 7%. Cropland is primarily located along Stephens Creek. Pasture is located primarily on the ridge along the northwestern edge of the watershed (adjacent to State Road 45) and the southwestern edge of the watershed (State Road 446) though land classified as herbaceous is scattered across the watershed and may be in use as pasture or hay fields. Population density is higher than average for the watershed and there are especially dense areas along the western edge of the subwatershed which includes the eastern edge of Bloomington. About a quarter of the land is publicly owned with the largest portion located in the southeastern corner.

1.13.2 Point Source Water Quality Issues

The Stephens Creek Subwatershed contains no confined feeding operations and no NPDES permitted facilities.

1.13.3 Non-Point Source Water Quality Issues

In early spring 2020, the watershed coordinator conducted a windshield survey which included 8 stream crossing sites within the Stephens Creek Subwatershed. Two additional livestock access sites were identified by local citizens. Observations including streambank erosion, stream buffers, and livestock access were recorded for each site and the results are summarized below. Streambank erosion was noted at all 8 of the observed sites and lack of sufficient riparian buffer was observed at 3 of the 8 observed sites. Livestock access was documented at 2 sites identified by local citizens. Several other sites had livestock that were fenced from the stream, including site 338 on Stephens Creek (see photo below).

Table 1-72 Stephens Creek Windshield Survey Summary

Parameter	Observations
Streambank Erosion	3/8 sites with erosion >3' 5/8 sites with erosion <3' 0/8 sites with no erosion
Stream Buffers	0/8 sites with no buffers 3/8 sites with buffers <20' 5/8 sites with buffers >20'
Livestock Access to Streams	2/10 sites with livestock access

Figure 1-37 Stephens Creek (North Fork) Subwatershed

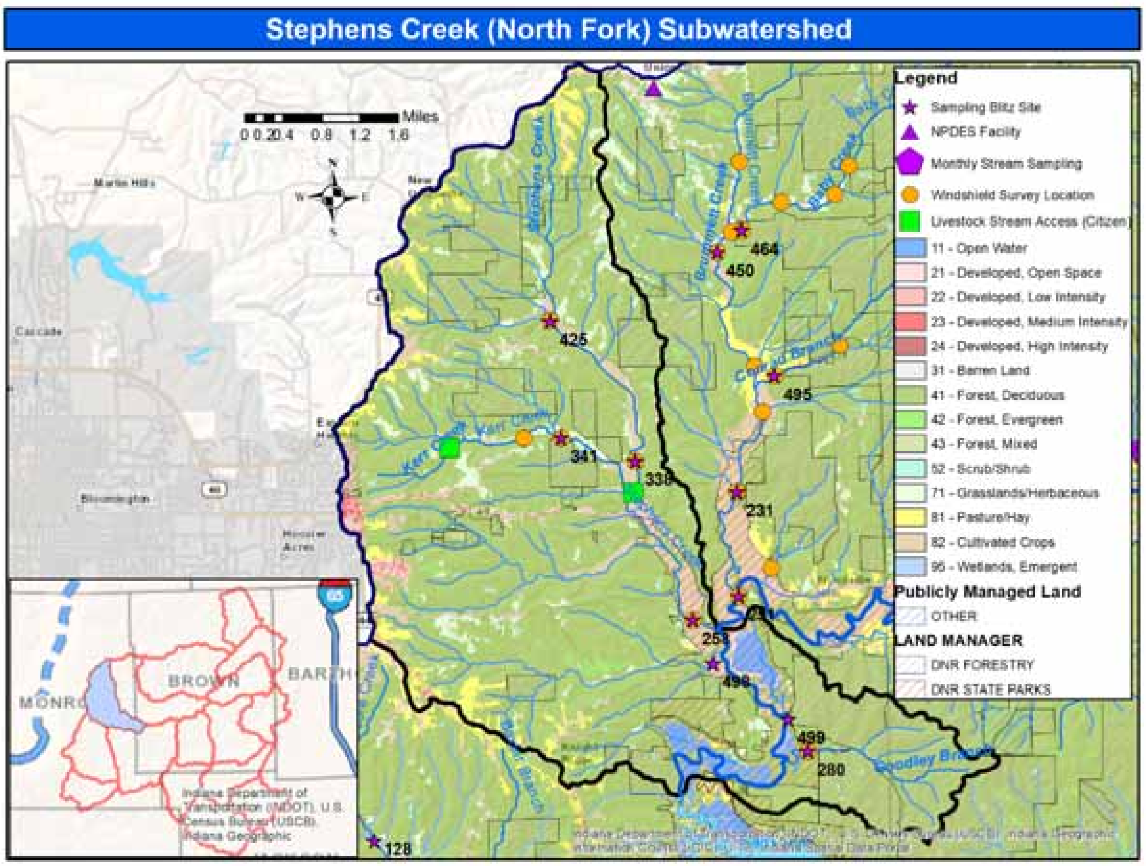


Figure 1-38 Site 338 on Stephens Creek (midstream)

1.13.4 Water Quality Assessment

Seven sites were selected for the spring and fall watershed sampling blitz events. Samples were analyzed for a variety of chemical parameters and E. coli. Habitat was evaluated using CQHEI. Macroinvertebrates and the fish community have not been assessed in this subwatershed. No monthly sampling locations or stream gages are located in this subwatershed.

Water Quality Information

Water chemistry data from the Stephens Creek subwatershed suggest that E. coli is an issue in Kerr Creek (site 341) and the upstream portion of Stephens Creek (sites 425 and 338). E. coli levels were highest in the most upstream site (425), decreasing as the water moves downstream to the midstream site (338), and dropping below the target of 235 CFU/100 ml in lower Stephens Creek (site 258) as well as further downstream in North Fork Salt Creek (site 499) indicating that the bacteria is diluted as additional tributaries enter the stream. Two samples were submitted for source analysis but neither generated results.

E. coli and phosphorus appear to be the primary concerns though there were also two nitrogen exceedances. There was not a visible correlation between elevated E. coli counts and elevated nutrient levels – the two total phosphorus exceedances during the fall blitz were from sites that had low levels of E. coli and the three sites with E. coli exceedances during the fall blitz had low levels of total phosphorus.

There was one total nitrogen exceedance during the fall blitz, at site 499 on North Fork Salt Creek. The reported level of total nitrogen (2.420) was one of the highest recorded during the blitz, as was the reported level of total phosphorus (0.143). The reported soluble reactive phosphorus concentration (0.009) was also above the target. No exceedances were reported during the fall blitz at the upstream site 436 on North Fork Salt Creek (see section 4.12 Brummett Creek subwatershed). Unfortunately, neither site was sampled during the spring blitz due to a volunteer cancellation.

The total nitrogen target was exceeded once during the spring blitz, at site 258 on lower Stephens Creek. This site also had levels of total phosphorus and soluble reactive phosphorus above water quality targets. The total phosphorus target was exceeded at five of six sites during the spring blitz and the soluble reactive phosphorus target was exceeded at three of six sites during the spring blitz.

Total suspended solids levels were below the target in all samples.

Table 1-73 Stephens Creek Sampling Blitz Results - Nutrients

Blitz ID	Creek Name	Fall TN (mg/L)	Spring TN (mg/L)	Fall NO3 (mg/L)	Spring NO3 (mg/L)	Fall TP (mg/L)	Spring TP (mg/L)	Fall SRP (mg/L)	Spring SRP (mg/L)
258	Stephens Creek (downstream)	0.162	0.829	0.008	0.279	0.024	0.027	0.002	0.006
280	Goodley Branch	0.380	0.100	0.008	0.012	0.028	0.020	0.003	0.004
338	Stephens Creek (midstream)	0.309	0.457	0.253	0.426	0.002	0.023	0.002	0.003
341	Kerr Creek	0.100	0.342	0.008	0.149	0.002	0.029	0.003	0.008
425	Stephens Creek (upstream)	0.269	0.271	0.221	0.199	0.002	0.032	0.007	0.005
498	Unnamed tributary of NF Salt	0.100	0.374	0.008	0.338	0.004	0.021	0.002	0.007
499	North Fork Salt Creek	2.420		0.008		0.143		0.009	

Table 1-74 Stephens Creek Sampling Blitz Results - E. coli and Sediment

Blitz ID	Creek Name	Fall E. Coli (MPN/ 100 mL)	Spring E. coli (MPN/ 100 mL)	Fall TSS (mg/L)	Spring TSS (mg/L)
258	Stephens Creek (downstream)	186	9	7.8	0.5
280	Goodley Branch	3	1	8.3	
338	Stephens Creek (midstream)	921	3	2.2	0.5
341	Kerr Creek	411	4	2	0.5
425	Stephens Creek (upstream)	1,986	5	3	0.5
498	Unnamed tributary of NF Salt	1	-	2.5	1.8
499	North Fork Salt Creek	1		22.7	0.5

Table 1-75 Stephens Creek Fecal Contamination Source Analysis April 2021

BC_ID	LM_ID	Subwatershed	Stream	4/27/21 E. Coli	Coliform (PFU/100ml)	% Human	% Animal
	425	Stephens (NF)	Stephens Creek	35.5	< 1	NA	NA
	341	Stephens (NF)	Kerr Creek	142.1	< 1	NA	NA

1.13.5 Habitat and Biological Assessment

Habitat/Biological Information

Volunteers completed the Citizen Qualitative Habitat Evaluation Index (CQHEI) habitat assessment at all 7 sites during the fall blitz and at 6 sites during the spring blitz. Although a comparison scale for the CQHEI has not yet been developed, Hoosier Riverwatch indicates that scores greater than 60 rate as habitat conducive to supporting warm-water biota (IDNR, 2004). CQHEI scores ranged from 37 to 74 during the fall blitz and 33.5 to 76 during the spring blitz. Only 57% of sites scored above 60 during the fall blitz and only 57% of sites scored above 60 during the spring blitz, indicating poor habitat in many streams. The three stream sites with low scores during both blitz events were site 258 on Stephens Creek (downstream), site 338 on Stephens Creek (midstream), and site 499 on North Fork Salt Creek (which was not evaluated in the spring). This indicates that larger and downstream stream sections tended to score worse on CQHEI.

Table 1-76 Stephens Creek Sampling Blitz Results - Habitat Assessment (CQHEI)

Blitz ID	Stream Name	Fall 2020 CQHEI	Spring 2021 CQHEI
258	Stephens Creek (downstream)	37	33.5
280	Goodley Branch	65.5	68
338	Stephens Creek (midstream)	58	51
341	Kerr Creek	72	73.5
425	Stephens Creek (upstream)	70	76
498	Unnamed tributary of NF Salt	74	65
499	North Fork Salt Creek	38.5	
	Average CQHEI	59.3	61.2
	% of Sites >60	57%	57%

No stream sections in the subwatershed were evaluated using the Qualitative Habitat Evaluation Index (QHEI), the fish-based Index of Biotic Integrity (IBI), or the macroinvertebrate Index of Biotic Integrity (mIBI).

1.13.6 Stephens Creek Subwatershed Summary

The Stephens Creek subwatershed appears to have E. coli issues that may be linked to livestock or to failing septic systems, as both livestock and houses on septic systems were observed in the subwatershed. Phosphorus also appears to be a concern with total phosphorus exceedances observed at all sites during at least one blitz event. Total phosphorus and total nitrogen were exceptionally high at site 499 on North Fork Salt Creek during the fall blitz and the site was not sampled during the spring blitz. Habitat scores were low in the middle and downstream sites on Stephens Creek as well as in North Fork Salt Creek (though it was only evaluated during the fall blitz).

1.14 Jacobs Creek – Lake Monroe (HUC 51202080701)

The Jacobs Creek Subwatershed (HUC 12 – 51202080701) straddles the Monroe/Brown County border as shown in Figure 4-40. It is the largest subwatershed, encompassing approximately 28,880 acres and representing 10% of the overall watershed. The subwatershed contains the upper basin of Lake Monroe (upstream/east of the State Road 446 causeway) as well as the tributaries Crooked Creek, Panther Creek, Will Hay Branch, Jones Branch, Axsom Branch, Saddle Creek, and Eel Creek.

According to the IDEM 303(d) list, Crooked Creek is impaired for E. coli, including several of its tributaries. Lake Monroe is also impaired for taste and odor, algal blooms, and mercury in fish.

1.14.1 Land Use

Landuse within the Jacobs Creek Subwatershed consists primarily of forestland with 15% as open water (Lake Monroe) and less than 1% agricultural land, the lowest percentage of the subwatersheds. Over 90% of the subwatershed is public land with the southern portion owned by the United States Forest Service, much of the central portion a part of Lake Monroe State Recreation Area, and the northern portion part of Yellowwood State Forest. The southern portion is designated as a wilderness area with few roads.

1.14.2 Point Source Water Quality Issues

The Jacobs Creek Subwatershed contains no confined feeding operations and one NPDES permitted facility, Salt Creek Services Waste Water Treatment Plant. A review of the IDEM virtual filing cabinet revealed no violations.

1.14.3 Non-Point Source Water Quality Issues

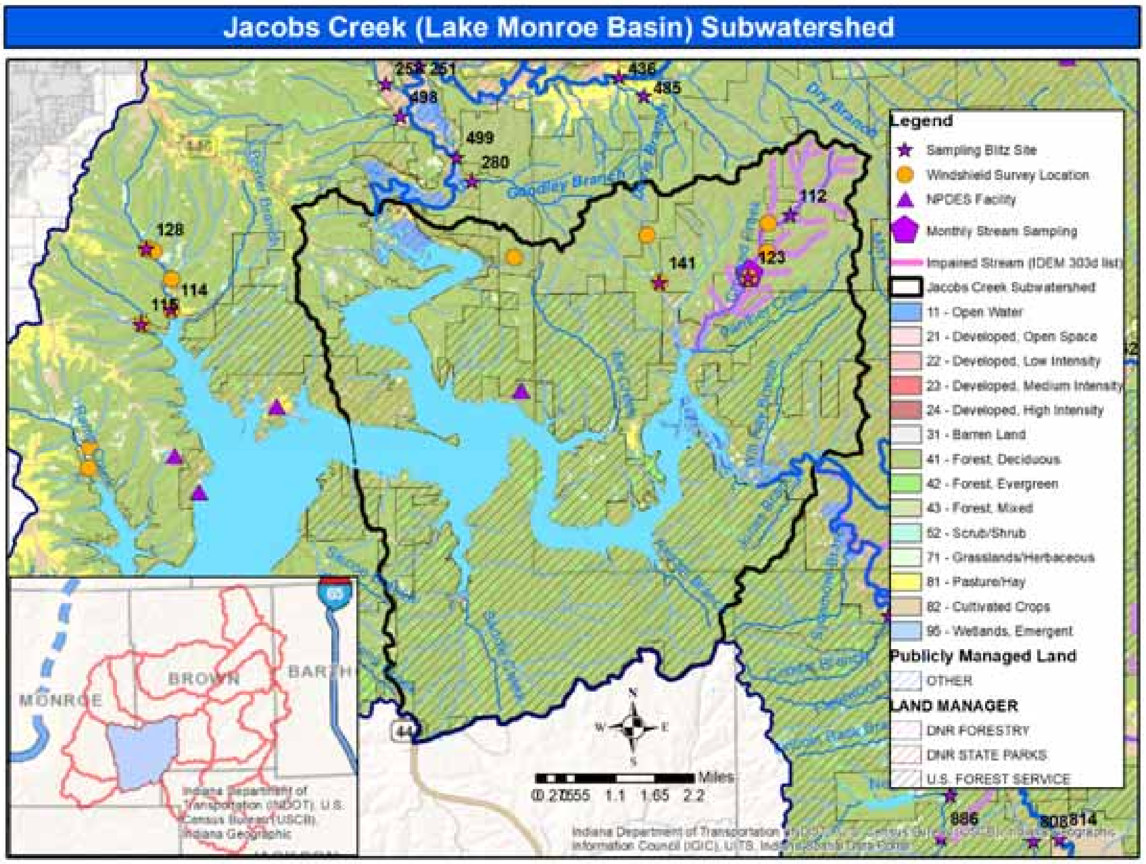
In early spring 2020, the watershed coordinator conducted a windshield survey which included 6 stream crossing sites within the Jacobs Creek Subwatershed. (There are relatively few stream crossings in the watershed due to the extensive amount of park land and open water.) Observations including streambank erosion, stream buffers, and livestock access were recorded for each site and the results are summarized below. Streambank erosion was noted at 3 of the 6 observed sites and lack of riparian buffer was noted at 4 of the 6 sites though all sites had at least some buffer. No sites with livestock access to streams were observed.

Table 1-77 Jacobs Creek Windshield Survey Summary

Parameter	Observations
Streambank Erosion	1/6 sites with erosion >3' 2/6 sites with erosion <3' 3/6 sites with no erosion
Stream Buffers	0/6 sites with no buffers 4/6 sites with buffers <20' 2/6 sites with buffers >20'
Livestock Access to Streams	0/6 sites with livestock access

Figure 1-39 Site 121 Crooked Creek

Figure 1-40 Jacobs Creek (Lake Monroe Basin) Subwatershed



1.14.4 Water Quality Assessment

Three sites were selected for the spring and fall watershed sampling blitz events though all three were dry during the fall blitz.   Samples were also collected monthly from Crooked Creek at site 123 though the creek was dry in September and October. Samples were analyzed for a variety of chemical parameters and E. coli. Habitat was evaluated using CQHEI. Macroinvertebrates were assessed in Crooked Creek during one of the monthly sampling events. No stream gages are located in this subwatershed. Lake sampling results are discussed in section 4.17.

Water Quality Information

Water chemistry data from the Jacobs Creek subwatershed suggest that the only constituent of concern is phosphorus. There were no exceedances for E. coli, total suspended solids, total nitrogen, or nitrates for the blitz samples or the monthly samples in Crooked Creek. However, all three spring blitz samples had total phosphorus levels above the target level of 0.02 mg/L and two of the three spring blitz samples had soluble reactive phosphorus levels above the target level of 0.005 mg/L. Of the ten monthly samples collected in Crooked Creek, the only exceedances were for soluble reactive phosphorus, which was above the target level of 0.005 mg/L in 3 of 10 samples.

Table 1-78 Jacobs Creek Sampling Blitz Results - Nutrients

Blitz ID	Creek Name	Fall TN (mg/L)	Spring TN (mg/L)	Fall NO3 (mg/L)	Spring NO3 (mg/L)	Fall TP (mg/L)	Spring TP (mg/L)	Fall SRP (mg/L)	Spring SRP (mg/L)
112	Crooked Creek		0.322		0.083		0.037		0.007
123	Crooked Creek		0.129		0.054		0.027		0.010
141	Unnamed tributary of Lake Monroe		0.100		0.057		0.027		0.004

Table 1-79 Jacobs Creek Sampling Blitz Results - E. coli and Sediment

Blitz ID	Creek Name	Fall E. Coli (MPN/ 100 mL)	Spring E. coli (MPN/ 100 mL)	Fall TSS (mg/L)	Spring TSS (mg/L)
112	Crooked Creek		2		2.6
123	Crooked Creek		1		0.5
141	Unnamed tributary of Lake Monroe		15		0.5

Table 1-80 Monthly Sampling of Crooked Creek at Site Site 123 in Jacobs Creek Subwatershed

Site 123	Crooked Creek E. coli (cfu/100 ml)	Crooked Creek TSS (mg/L)	Crooked Creek TN (mg/L)	Crooked Creek NO3 (mg/L)	Crooked Creek TP (mg/L)	Crooked Creek SRP (mg/L)
4/22/2020	6	1.3	0.100	0.067	0.010	0.002
5/27/2020	13	1.6	0.172	0.142	0.009	0.002
6/24/2020	60	1	0.328	0.200	0.014	0.007
7/21/2020	65	0.5	0.302	0.175	0.004	0.003
8/27/2020	157	0.7	0.252	0.136	0.005	0.005
9/24/2020	dry	dry	dry	dry	dry	dry
10/22/2020	dry	dry	dry	dry	dry	dry
11/19/2020	2	0.5	0.100	0.010	0.007	0.004
12/16/2020	1	0.5	0.100	0.043	0.005	0.004
1/25/2021	4	0.2	0.100	0.066	0.005	0.003
2/25/2021	7	3.2	0.407	0.241	0.016	0.008
3/18/2021	16	3.8	0.202	0.105	0.011	0.006

1.14.5 Habitat and Biological Assessment

Habitat/Biological Information
Volunteers completed the Citizen Qualitative Habitat Evaluation Index (CQHEI) habitat assessment at all 3 sites during the spring and fall sampling blitz events. Although a comparison scale for the CQHEI has not yet been developed, Hoosier Riverwatch indicates that scores greater than 60 rate as habitat conducive to supporting warm-water biota (IDNR, 2004). CQHEI scores ranged from 56 to 64 during the fall blitz and 66 to 71 during the spring blitz. While 67% of sites scored above 60 during the fall blitz, 100% of sites scored above 60 during the spring blitz, indicating good habitat throughout the subwatershed. Higher CQHEI scores in the spring are likely due to increased streamflow levels.

Table 1-81 Jacobs Creek Sampling Blitz Results - Habitat Assessment (CQHEI)

Blitz ID	Stream Name	Fall 2020 CQHEI	Spring 2021 CQHEI
112	Crooked Creek	64	70
123	Crooked Creek	56	66
141	Unnamed tributary of Lake Monroe	61	71
	Average CQHEI	60.3	69.0
	% of Sites >60	67%	100%

Table 1-82 Habitat and Biological Sampling in Jacobs Creek Subwatershed

Sampler and Date	Site ID	Stream	Station	mIBI	mIBI Rating	QHEI	QHEI Rating
IU Limno Lab August 2020	123	Crooked Creek	Tecumseh Trail	28	Impaired (<36)	49	Fair

No stream sections in the subwatershed were evaluated using fish-based Index of Biotic Integrity. The IU Limnology Lab evaluated habitat using the Qualitative Habitat Evaluation Index (QHEI) at the monthly sampling site 123 and gave it a score of 49, indicating fair habitat for a small stream. CQHEI scores during the fall and spring blitz events were reported as 56 and 66, respectively, indicating poor habitat in the fall and good habitat in the spring (potentially due to dry conditions during the fall blitz). In August 2020, the IU Limnology Lab collected macroinvertebrates and gave it a mIBI score of 28, indicating biological impairment.

1.14.6 Jacobs Creek Subwatershed Summary

Since Crooked Creek is listed on the IDEM 303(d) list as impaired for E. coli, elevated E. coli levels were anticipated in the stream. However, all 12 samples collected from Crooked Creek (11 at site 123 and 1 at upstream site 112) had E. coli concentrations well below the E. coli target of 235

CFU/100 ml, indicating that E. coli is not an issue. Several phosphorus exceedances were recorded (3 of 13 total phosphorus samples and 5 of 13 soluble reactive phosphorus samples) which may indicate a phosphorus concern. Habitat scores in the two evaluated streams were good. Although 4 of the 6 windshield survey sites had insufficient riparian buffer, they do not appear to be representative of the rest of the watershed, which is heavily forested and comprised mainly of public land.

1.15 Moore Creek – Lake Monroe Basin (HUC 51202080702)

The Moore Creek Subwatershed (HUC 12 – 51202080702) is located in southeastern Monroe County as shown in Figure 4-43. The subwatershed encompasses approximately 18,240 acres and represents 7% of the overall watershed. The subwatershed contains the central portion of Lake Monroe (west of the State Road 446 causeway and east of the Allens Creek State Recreation Area) as well as the tributaries Moore Creek, Butcher Branch, Baxter Branch, Ramp Creek, and Siscoe Branch.

According to the IDEM 303(d) list, Lake Monroe is impaired for taste and odor, algal blooms, and mercury in fish. No other impairments were identified in Moore Creek Subwatershed.

1.15.1 Land Use

Landuse within the Moore Creek Subwatershed is 67% forestland, 21% open water (Lake Monroe), and about 7% agriculture. Pasture and cropland are generally located on ridgetops, particularly along the edges of the Lake Monroe watershed and along Handy Ridge Road. Herbaceous land that is likely pasture is located along Moore Creek Road and Ramp Creek Road. Population is concentrated along the northern and western edges of the watershed. Several parcels of land in the eastern portion of the watershed are publicly owned as part of the Morgan Monroe State Forest, the Hoosier National Forest, and the Lake Monroe State Recreational Area.

1.15.2 Point Source Water Quality Issues

The Moore Creek Subwatershed contains no confined feeding operations. There are three NPDES permitted facilities identified in the subwatershed but one, NPDES Permit No. IN0050105 (South Central Regional Sewer District), is incorrectly mapped. The permit belongs to the Lake Monroe RSD Stinesville facility, which is located in Stinesville and discharges to Beanblossom Creek.

The two NPDES permitted facilities actually in the subwatershed are the Paynetown Waste Water Treatment Plant (Paynetown WWTP) and the Bloomington Utilities Monroe Drinking

Water Treatment Plant (Bloomington Water Plant). A review of the IDEM virtual filing cabinet revealed that the Bloomington Water Treatment Plant reported a minor incident in 2019 where a heavy rainfall caused the sludge settling basins to overflow but not reach the receiving waters. The 2018 inspection noted that the lower sludge handling pond was in urgent need of sludge removal. No other issues were found. The Paynetown WWTP received an inspection report in 2018 indicating potential issues with one of the effluent lines and a piece of laboratory equipment. These issues were not mentioned in later inspections.

1.15.3 Non-Point Source Water Quality Issues

In early spring 2020, the watershed coordinator conducted a windshield survey which included 8 stream crossing sites within the Moore Creek Subwatershed. (Most roads in this subwatershed run along ridgetops and do not cross streams.) Observations including streambank erosion, stream buffers, and livestock access were recorded for each site and the results are summarized below. Streambank erosion was noted at 3 of 8 sites and lack of sufficient riparian buffer was observed at 1 of 8 sites. No sites had livestock with access to streams.

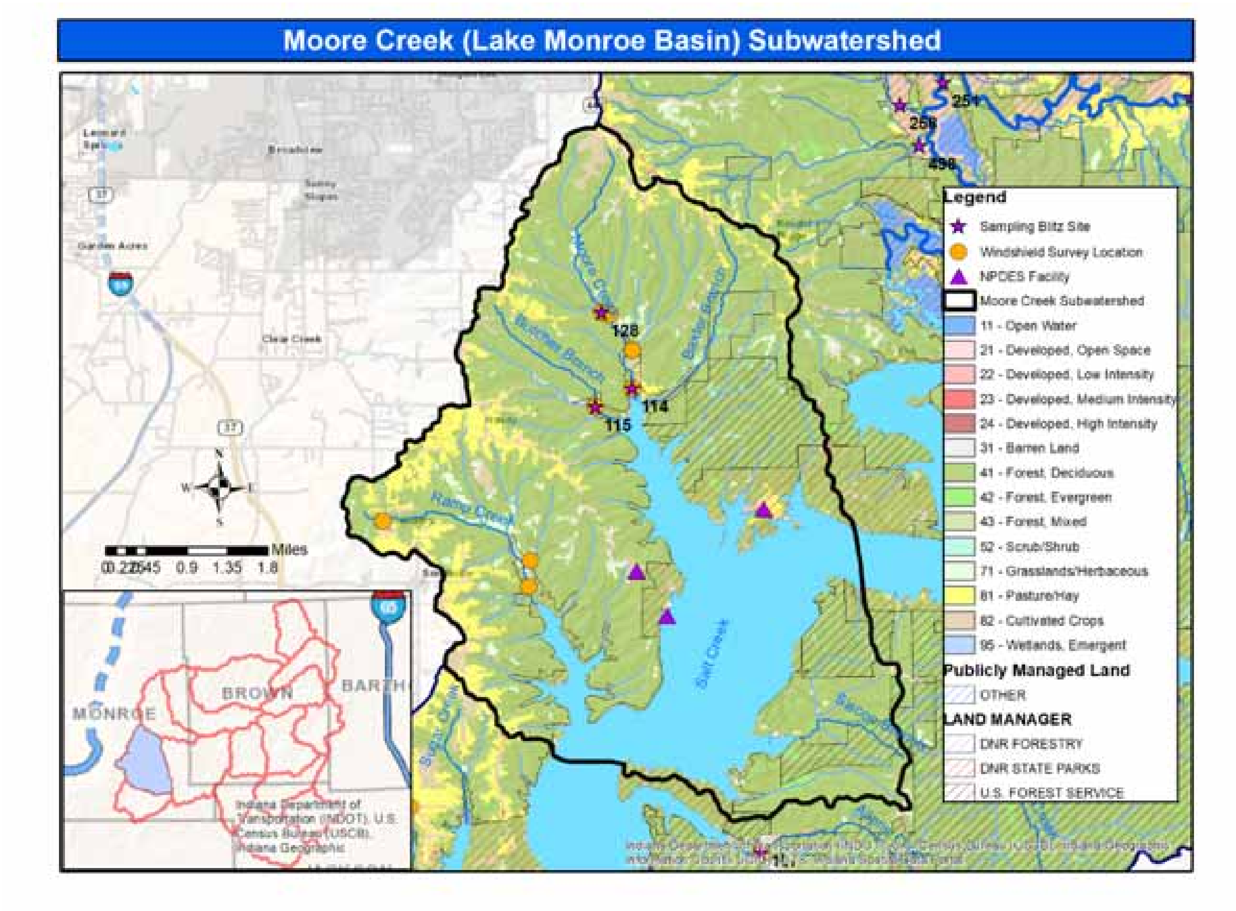
Table 1-83 Moore Creek Windshield Survey Summary

Parameter	Observations
Streambank Erosion	1/8 sites with erosion >3’ 2/8 sites with erosion <3’ 5/8 sites with no erosion
Stream Buffers	0/8 sites with no buffers 1/8 sites with buffers <20’ 7/8 sites with buffers >20’
Livestock Access to Streams	0/8 sites with livestock access

Figure 1-41 Site 114 - Moore Creek entering Lake Monroe

Figure 1-42 Site 115 - Butcher Branch

Figure 1-43 Moore Creek (Lake Monroe Basin) Subwatershed Map



1.15.4 Water Quality Assessment

Three sites were selected for the spring and fall watershed sampling blitz events though two were dry during the fall blitz. Samples were analyzed for a variety of chemical parameters and E. coli. Habitat was evaluated using CQHEI. Macroinvertebrates and the fish community have not been assessed in this subwatershed. No monthly sampling locations or stream gages are located in this subwatershed.

Water Quality Information
Water chemistry data from the Moore Creek subwatershed suggest that phosphorus may be a concern in the subwatershed, with all three spring samples exceeded the total phosphorus target and one (site 114 on downstream Moore Creek) exceeding the soluble reactive phosphorus target. There was also one sediment exceedance at site 115 on Butcher Branch in the spring. Both sites 114 and 115 are located close enough to the lake that they are likely impacted by activities in Lake Monroe, such as elevated water levels and brackish conditions during flood events. This may increase the likelihood of elevated sediment and phosphorus levels.

Table 1-84 Moore Creek Sampling Blitz Results - Nutrients

Blitz ID	Creek Name	Fall TN (mg/L)	Spring TN (mg/L)	Fall NO3 (mg/L)	Spring NO3 (mg/L)	Fall TP (mg/L)	Spring TP (mg/L)	Fall SRP (mg/L)	Spring SRP (mg/L)
114	Moore Creek	0.123	0.342	0.008	0.195	0.011	0.048	0.002	0.013
115	Butcher Branch		0.305		0.246		0.026		0.005
128	Moores Creek		0.442		0.367		0.024		0.004

Table 1-85 Moore Creek Sampling Blitz Results - E. coli and Sediment

Blitz ID	Creek Name	Fall E. Coli (MPN/ 100 mL)	Spring E. coli (MPN/ 100 mL)	Fall TSS (mg/L)	Spring TSS (mg/L)
114	Moore Creek	2	5	7.5	4
115	Butcher Branch		19		53
128	Moores Creek		2		0.5

1.15.5 Habitat and Biological Assessment

Habitat/Biological Information
Volunteers completed the Citizen Qualitative Habitat Evaluation Index (CQHEI) habitat assessment at all 3 sites during the spring and fall sampling blitz events. Although a comparison scale for the CQHEI has not yet been developed, Hoosier Riverwatch indicates that scores greater than 60 rate as habitat conducive to supporting warm-water biota (IDNR, 2004). CQHEI scores ranged from 45 to 65 during the fall blitz and 37 to 82 during the spring blitz. Two of the three sites scored above 60 during both blitz events while site 114 on downstream Moore Creek scored below 60 during both events, indicating poor habitat at that site. It should be noted that site 114 is located where Moore

Creek widens and enters Lake Monroe and experiences regular water level fluctuations due to changing water levels in the lake. The area around the creek is marshy and silty.

Table 1-86 Moore Creek Sampling Blitz Results - Habitat Assessment (CQHEI)

Blitz ID	Stream Name	Fall 2020 CQHEI	Spring 2021 CQHEI
114	Moore Creek	45	37
115	Butcher Branch	65	82
128	Moores Creek	63	76
	Average CQHEI	57.7	65.0
	% of Sites >60	67%	67%

No stream sections in the subwatershed were evaluated using the Qualitative Habitat Evaluation Index (QHEI), the fish-based Index of Biotic Integrity (IBI), or the macroinvertebrate Index of Biotic Integrity (mIBI).

1.15.6 Moore Creek Subwatershed Summary

The Moore Creek subwatershed appears to have some phosphorus concerns, with all three spring samples exceeding the total phosphorus target. One site (114 on Moore Creek) also exceeded the soluble reactive phosphorus target and another (115 on Butcher Branch) also exceeded the total suspended solids target. Both sites 114 and 115 are located very close to Lake Monroe and are likely impacted by water fluctuations in the lake.

1.16 Allens Creek – Lake Monroe Basin (HUC 51202080703)

The Allens Creek Subwatershed (HUC 12 – 51202080703) is located in southern Monroe County and extends just barely into Lawrence County as shown in Figure 4-44. The subwatershed encompasses approximately 10,273 acres and represents 4% of the overall watershed. The subwatershed contains the lower basin of Lake Monroe as well as the tributaries Sugar Creek and Allens Creek and the town of Smithville.

According to the IDEM 303(d) list, Lake Monroe is impaired for taste and odor, algal blooms, and mercury in fish. No other impairments were identified in Allens Creek Subwatershed.

1.16.1 Land Use

The Allens Creek Subwatershed has the third highest percentage of agricultural land (9%), mostly in the form of pasture, as well as the highest percentage of open water (32%) and the lowest percentage of forest (54%). Pasture is concentrated north and west of the lake with an additional concentration along Fairfax Road, east of Sugar Creek. Population is concentrated in the northern and western sections of the watershed and population density is much higher than most of the Lake Monroe watershed, with considerable residential development between Bloomington and the lake. This includes the town of Smithville and the Eagle Pointe Golf Resort. About a third of the subwatershed (excluding the lake) is public land, including the section between the two lobes of Lake Monroe that is part of the Lake Monroe State Recreational Area and the section immediately east of the lake that is part of the Hoosier National Forest.

1.16.2 Point Source Water Quality Issues

The Allens Creek Subwatershed contains no confined feeding operations and two NPDES permitted facilities. The United States Forest Service Hardin Ridge Wastewater Treatment Plant serves a recreational area. This facility had multiple exceedances in 2018 (TSS, Phosphorus, Nitrogen, E. coli) which led to an upgrade in equipment in May 2019. Phosphorus was mentioned as a constituent that is difficult to keep below permitted levels. The Hardin Monroe Wastewater Treatment Plant serves a residential community and was cited for discharging excessive solids and E. coli in June 2017 but it resolved the issue by the end of the year.

1.16.3 Non-Point Source Water Quality Issues

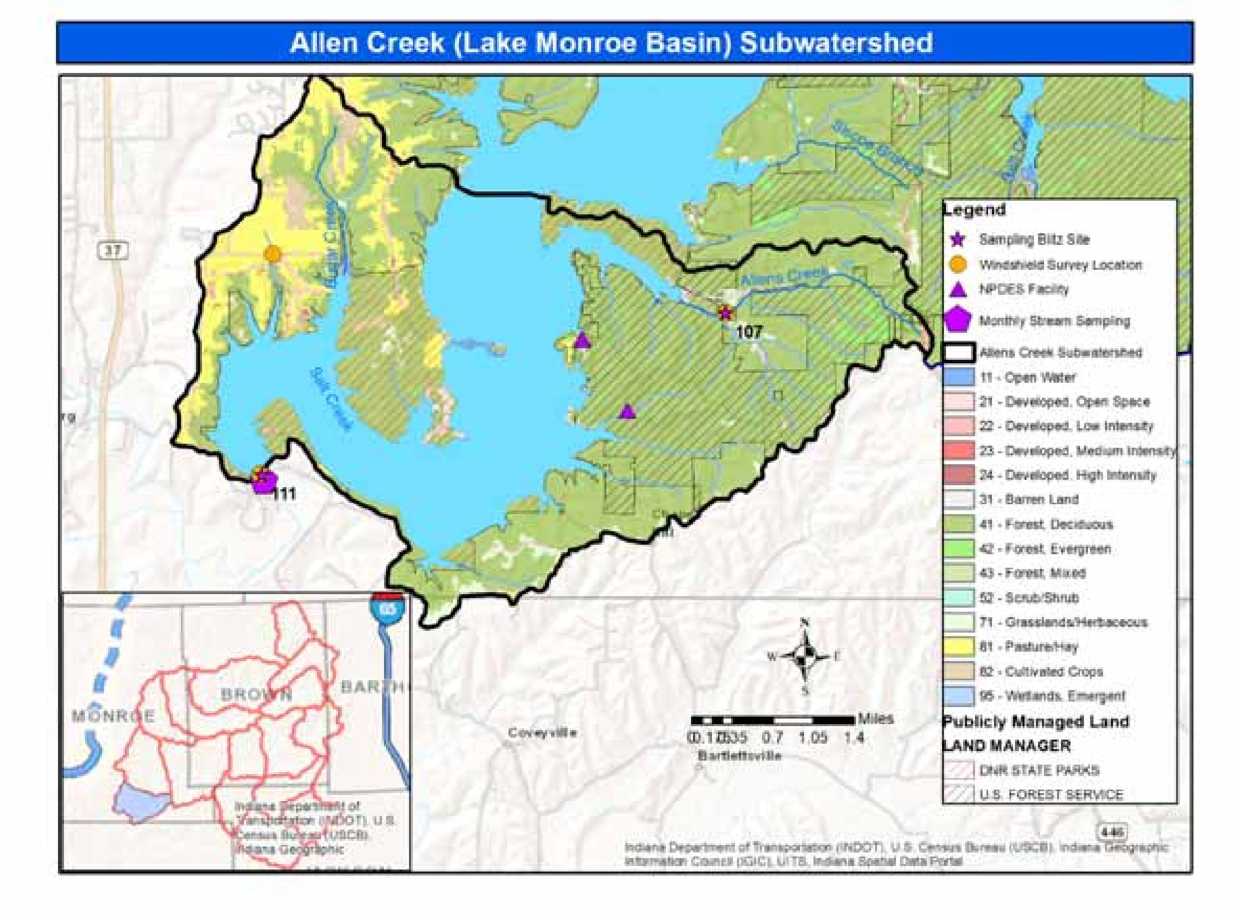
In early spring 2020, the watershed coordinator conducted a windshield survey which included 3 stream crossing sites within the Allens Creek Subwatershed. There are relatively few streams in the subwatershed and roads are generally located along ridgetops. Few roads are present south of the lake as the area is part of the USFS Charles C. Deam Wilderness Area. Observations including streambank erosion, stream buffers, and livestock access were recorded for each site and the results are summarized below. Streambank erosion was noted at 1 of 3 observed sites and lack of sufficient riparian buffer was noted at 1 of 3 observed sites. No sites had livestock with access to streams.

Table 1-87 Allens Creek Windshield Survey Summary

Parameter	Observations
Streambank Erosion	0/3 sites with erosion >3' 1/3 sites with erosion <3' 2/3 sites with no erosion
Stream Buffers	2/3 sites with no buffers 0/3 sites with buffers <20' 1/3 sites with buffers >20'

Livestock Access to Streams	0/3 sites with livestock access

Figure 1-44 Allen Creek (Lake Monroe Basin) Subwatershed Map



1.16.4 Water Quality Assessment

Allens Creek subwatershed had few stream crossings and therefore few sampling locations. This was due largely to a lack of perennial streams and roads being located along ridgetops. Two sites were selected for the spring and fall watershed sampling blitz. Site 107 is located on Allens Creek, which was dry during the fall sampling blitz. Site 111 is located at the outlet of Lake Monroe and therefore is not really representative of the watershed as the water is leaving the lake rather than entering it.

Samples were analyzed for a variety of chemical parameters and E. coli. Habitat was evaluated using CQHEI. Site 111 (Lake Monroe outlet) was sampled monthly from April 2020 through March 2021 and the macroinvertebrate community was assessed once. The fish community has not been assessed in streams in this subwatershed. Flow through the dam is provided by the U.S Army Corps of Engineers.

Water Quality Information

Water chemistry data from the sampling blitz events suggest no concerns in Allens Creek, the single sampling site in this subwatershed entering the lake.

Looking at site 111, the Lake Monroe outlet, total phosphorus and soluble reactive phosphorus appear to be constituents of concern. The spring and fall blitz samples exceeded both the total phosphorus and the soluble reactive phosphorus targets. Monthly sampling also indicated phosphorus concerns with over 58% of samples exceeding the total phosphorus target and 42% exceeding the soluble reactive phosphorus target. No other constituents had exceedances during the blitz or monthly sampling. Additional information about the Lake Monroe outlet is discussed in section 4.17 (Lake Monroe Water Quality Data).

Table 1-88 Allens Creek Sampling Blitz Results - Nutrients

Blitz ID	Creek Name	Fall TN (mg/L)	Spring TN (mg/L)	Fall NO3 (mg/L)	Spring NO3 (mg/L)	Fall TP (mg/L)	Spring TP (mg/L)	Fall SRP (mg/L)	Spring SRP (mg/L)
107	Allens Creek		0.100		0.021		0.012		0.004
111	Lake Monroe Outlet	0.308	0.369	0.008	0.209	0.026	0.026	0.014	0.008

Table 1-89 Allens Creek Sampling Blitz Results - E. coli and Sediment

Blitz ID	Creek Name	Fall E. Coli (MPN/ 100 mL)	Spring E. coli (MPN/ 100 mL)	Fall TSS (mg/L)	Spring TSS (mg/L)
107	Allens Creek		11		0.5
111	Lake Monroe Outlet	10	-	6.5	3

Table 1-90 Monthly Sampling of Lake Monroe Outlet at Site 111 in Allens Creek Subwatershed

Site 111 Sample Date	Lake Monroe Outlet E. coli (cfu/100 ml)	Lake Monroe Outlet TSS (mg/L)	Lake Monroe Outlet TN (mg/L)	Lake Monroe Outlet NO3 (mg/L)	Lake Monroe Outlet TP (mg/L)	Lake Monroe Outlet SRP (mg/L)

4/22/2020	1	4.8	0.508	0.308	0.024	0.01
5/27/2020	6	4.4	0.429	0.201	0.016	0.004
6/24/2020	5	3.2	0.286	0.052	0.027	0.005
7/21/2020	5	6.8	0.326	0.008	0.037	0.011
8/27/2020	4	9.5	0.340	0.015	0.056	0.016
9/24/2020	4	10	0.498	0.010	0.036	0.01
10/22/2020	5	6.2	0.384	0.081	0.011	0.006
11/19/2020	2	11.0	0.181	0.087	0.015	0.004
12/16/2020	1	10.4	0.317	0.071	0.023	0.002
1/25/2021	4	6.0	0.300	0.071	0.018	0.003
2/25/2021	1	6.2	0.408	0.153	0.017	0.004
3/18/2021	55	6.5	0.489	0.175	0.024	0.003

1.16.5 Habitat and Biological Assessment

Habitat/Biological Information
Volunteers completed the Citizen Qualitative Habitat Evaluation Index (CQHEI) habitat assessment at both sites during the spring and fall sampling blitz events. Although a comparison scale for the CQHEI has not yet been developed, Hoosier Riverwatch indicates that scores greater than 60 rate as habitat conducive to supporting warm-water biota (IDNR, 2004).

CQHEI scores at both sites scored above 60 during both blitz events, indicating good habitat. The results were somewhat surprising for site 111 at the Lake Monroe Outlet, as the site is highly modified and lined with riprap. The IU Limnology Lab evaluated QHEI at that site and gave it a score of 31, indicating poor habitat.

Table 1-91 Allens Creek Sampling Blitz Results - Habitat Assessment (CQHEI)

Blitz ID	Stream Name	Fall 2020 CQHEI	Spring 2021 CQHEI
107	Allens Creek	63	83
111	Lake Monroe Outlet	65	73
	Average CQHEI	64	78

	% of Sites >60	100%	100%

Table 1-92 Habitat and Biological Sampling in Allens Creek Subwatershed

Sampler and Date	Site ID	Stream	Station	mIBI	mIBI Rating	QHEI	QHEI Rating
IU Limno Lab August 2020	111	Lake Monroe Outlet	Tailwaters	20	Impaired (<36)	31	Poor

No stream sections in the subwatershed were evaluated using fish-based Index of Biotic Integrity. The IU Limnology Lab evaluated habitat using the Qualitative Habitat Evaluation Index (QHEI) at the monthly sampling site 111 and gave it a score of 31, indicating poor habitat. CQHEI scores during the fall and spring blitz events were reported as 65 and 73, respectively, indicating good habitat. As the dam outlet is highly channelized and covered with riprap, habitat scores would typically be expected to be low. In August 2020, the IU Limnology Lab collected macroinvertebrates and gave it a mIBI score of 20, indicating biological impairment.

1.16.6 Allens Creek Subwatershed Summary

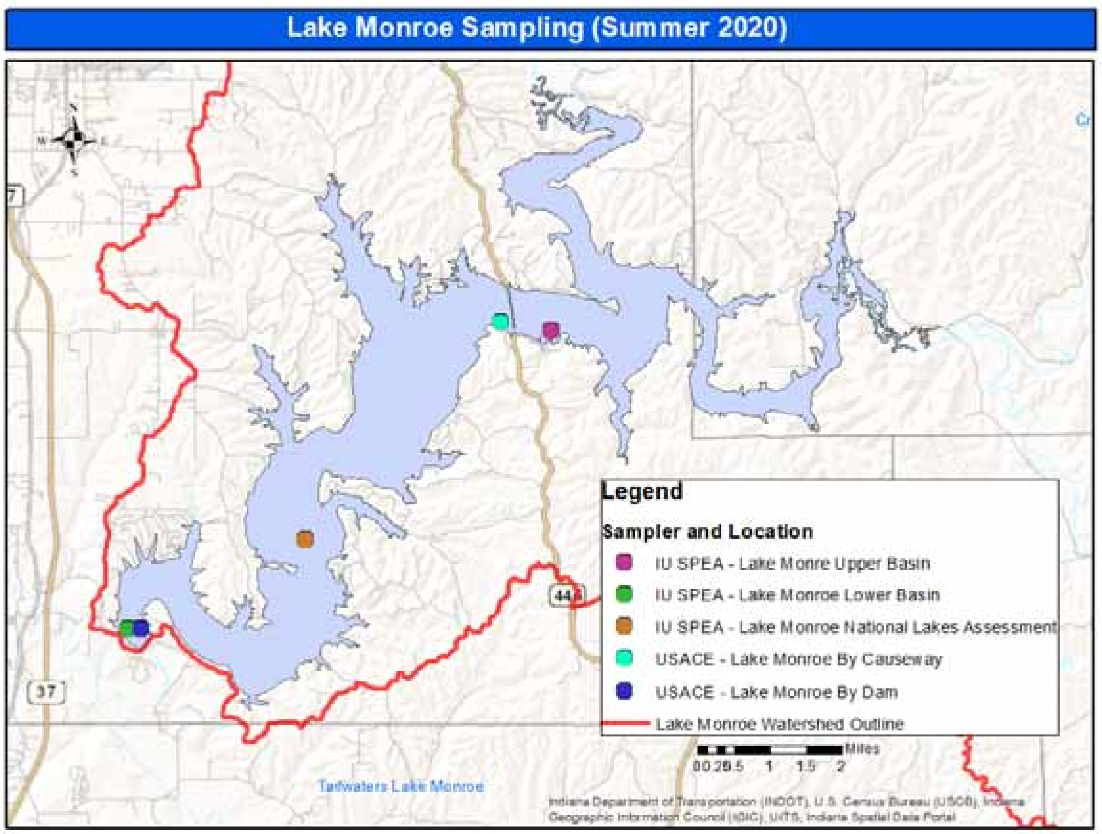
The Allens Creek subwatershed had few data points due to the limited number of stream crossings and the small size of most streams in the watershed. Site 107 on Allens Creek had high CQHEI scores and no monitoring exceedances during the blitz events. Site 111, the Lake Monroe outlet, had levels of total phosphorus and soluble reactive phosphorus above target levels during both blitz events and several of the monthly monitoring events, indicating a phosphorus concern. However, since it is the outlet of the lake, this data is more representative of Lake Monroe than of streams in the watershed. Further discussion of Lake Monroe water quality data is presented below in Section 4.17.

1.17 Lake Monroe Water Quality Data

Lake Monroe spans three HUC-12 subwatersheds – Jacobs, Moores, and Allens. Data was collected by the IU Limnology Lab from April through October 2020 at three different sampling locations, the upper basin, the center basin, and the lower basin. During periods of stratification (which differed between the basins), samples were collected from both the epilimnion and hypolimnion.

Samples have also been collected periodically by the U.S. Army Corps of Engineers, the Indiana Clean Lakes Program, and by City of Bloomington Utilities. Monthly sampling of the three lake basins was conducted for twelve months as part of the Lake Monroe Diagnostics and Feasibility Study (Jones, 1997).

Figure 1-45 Lake Monroe Sampling Map



1.17.1 Water Quality Data – Nutrients and Sediment

As discussed in the Lake Monroe 2020 Monthly Monitoring section (3.4.6), samples collected from Lake Monroe regularly exceeded the water quality targets for total phosphorus, soluble reactive phosphorus, total nitrogen, and chlorophyll-a. Dissolved oxygen profiles show that the hypolimnion becomes anoxic during the summer months, particularly in the lower basin (which is the deepest section of the lake). According to the Redfield ratio of nitrogen to phosphorus, algal growth is phosphorus limited for most of the season but when the hypolimnion is anoxic, phosphorus is released from the bottom sediments and the hypolimnion becomes nitrogen limited. When the lake turns over, this phosphorus becomes accessible to algae in the epilimnion, encouraging further algal growth in the late summer and early fall.

Historical data indicate that phosphorus and organic matter have been at levels of concern for many years as summarized below.

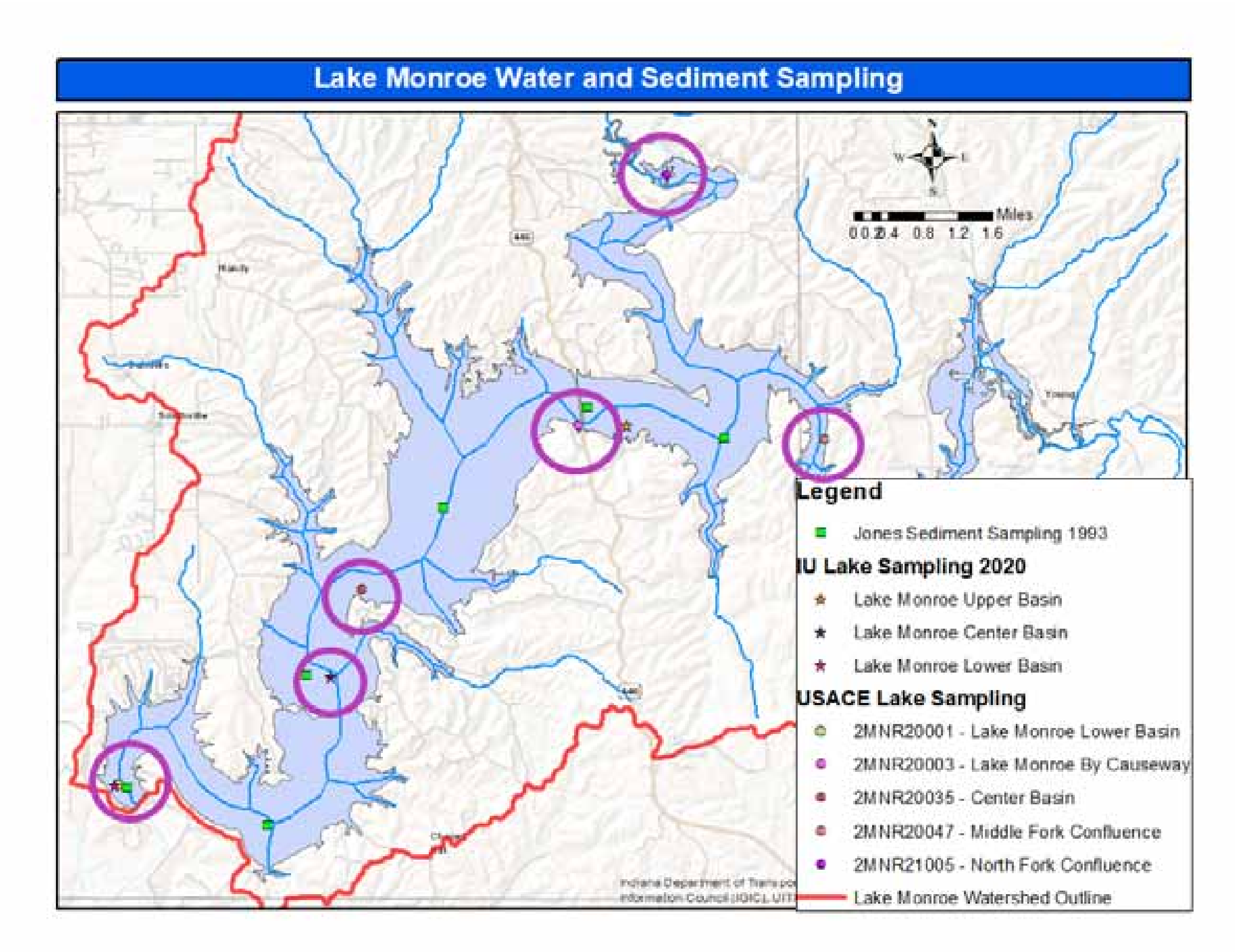
USACE Historic Sampling

A review of data collected annually from 2007-2020 by USACE shows regular total phosphorus exceedances in both the epilimnion and the hypolimnion of all three basins. Note that the sampling locations are slightly different, particularly in the upper basin. Samples were collected every July from the lower basin just above the dam (2MNR20001), the center basin near Allens Creek (2MNR20035), and adjacent to the upper basin just below the causeway (2MNR20003). Phosphorus concentrations were the highest in the lower basin hypolimnion followed by the center basin hypolimnion and the upper basin hypolimnion.

Table 1-93 Historical Phosphorus Levels in Lake Monroe USACE 2007-2020

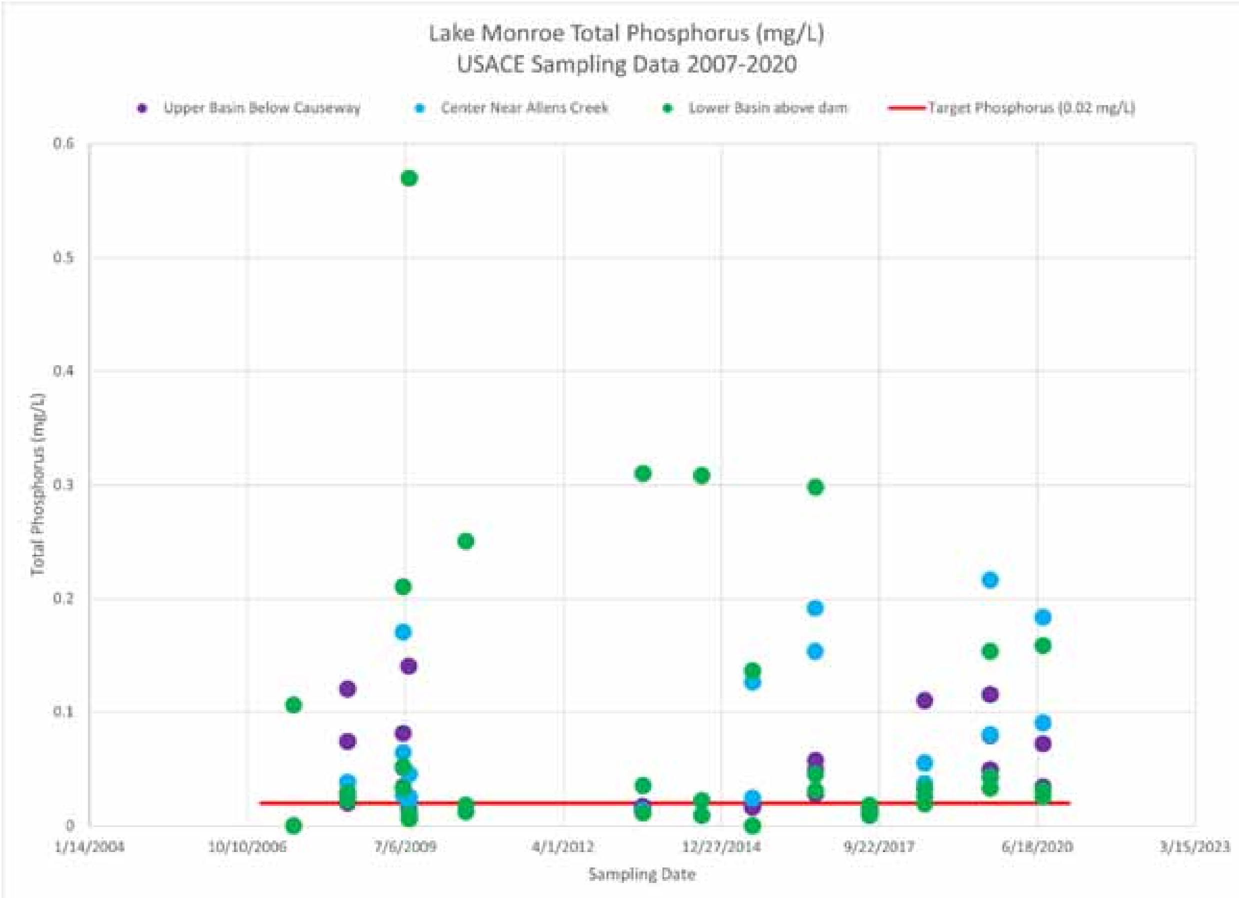
USACE Site	**Average TP (mg/L)**	**Max TP (mg/L)**	**Min TP (mg/L)**	**% Above 0.020 mg/L**
Upper Epilimnion (2MNR20003)	0.024	0.057	0.012	33%
Upper Hypolimnion (2MNR20003)	0.065	0.140	0.016	78%
Center Epilimnion (2MNR20035)	0.025	0.045	0.012	70%
Center Hypolimnion (2MNR20035)	0.082	0.216	0.012	80%
Lower Epilimnion (2MNR20001)	0.020	0.033	0.006	40%
Lower Hypolimnion (2MNR20001)	0.113	0.570	0.010	72%

Figure 1-46 USACE Lake Monroe Water and Sediment Sampling Map



[update and replace map]

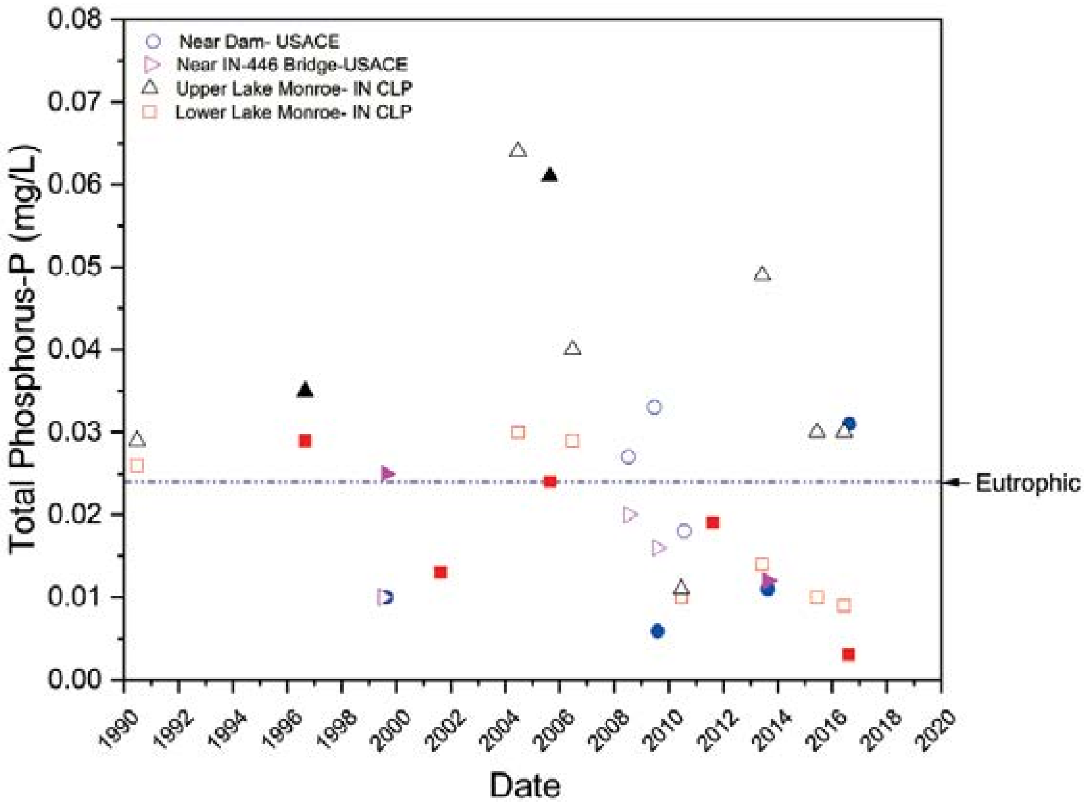
Figure 1-47 Graph of USACE Total Phosphorus Data 2007-2020



Lake Monroe Water Quality Summary 1990-2017 (2018 SPEA)

A portion of the USACE data and Indiana Clean Lakes Program data collected between 1990 and 2017 was summarized by SPEA student Macayla Coleman in the 2018 report "Lake Monroe Water Quality Summary 1990-2017." The study focused on samples collected during the summer stratification period from the three basins. These data were used to calculate the trophic state index (TSI) based on different sampling parameters. Total Phosphorus concentrations ranged widely from approximately 0.004 mg/L to 0.064 mg/L. Using the Carlson (1977) standard of 0.024 mg/L (shown in the diagram), 44% of the measurements meet or exceed the eutrophic threshold.

Figure 1-48 Historical Phosphorus Levels in Lake Monroe 1990-2017 (SPEA 2018)

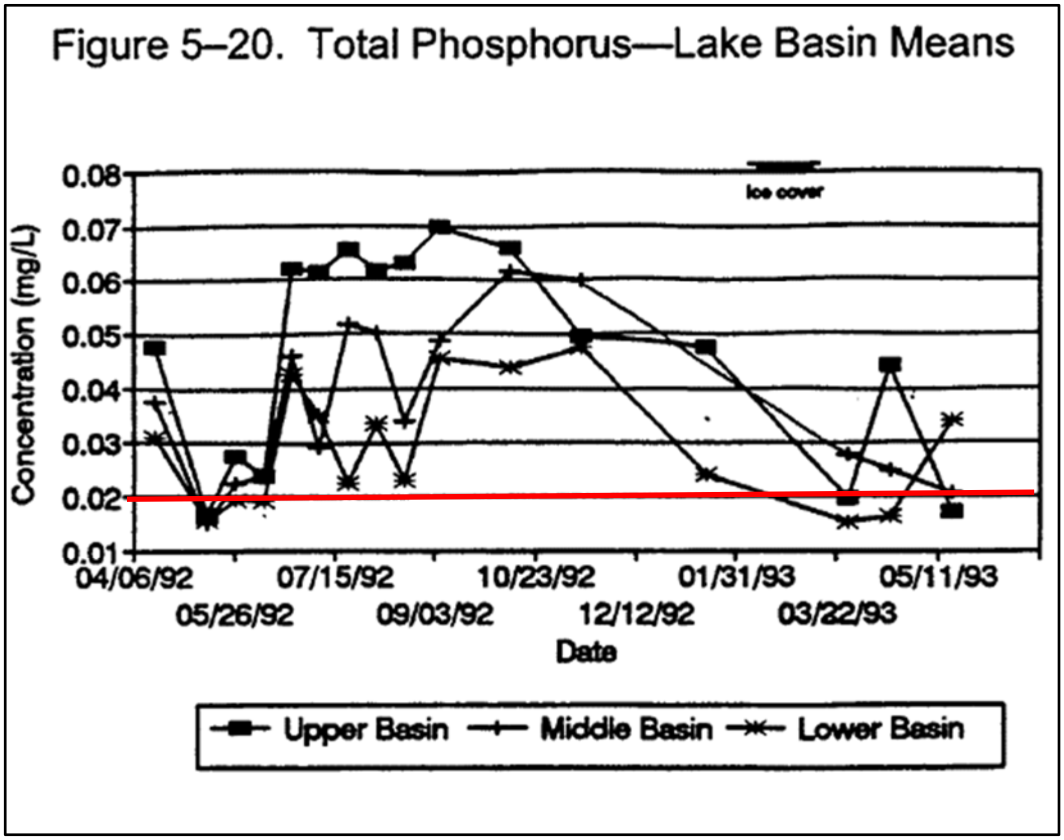


Measurements of Secchi disk transparency and chlorophyll-a also exceeded the eutrophic threshold in about half the samples. The study concluded that Lake Monroe appears to be mildly eutrophic and that algal blooms could be affecting water quality.

<u>Lake Monroe Diagnostic and Feasibility Study (Jones 1997)</u>

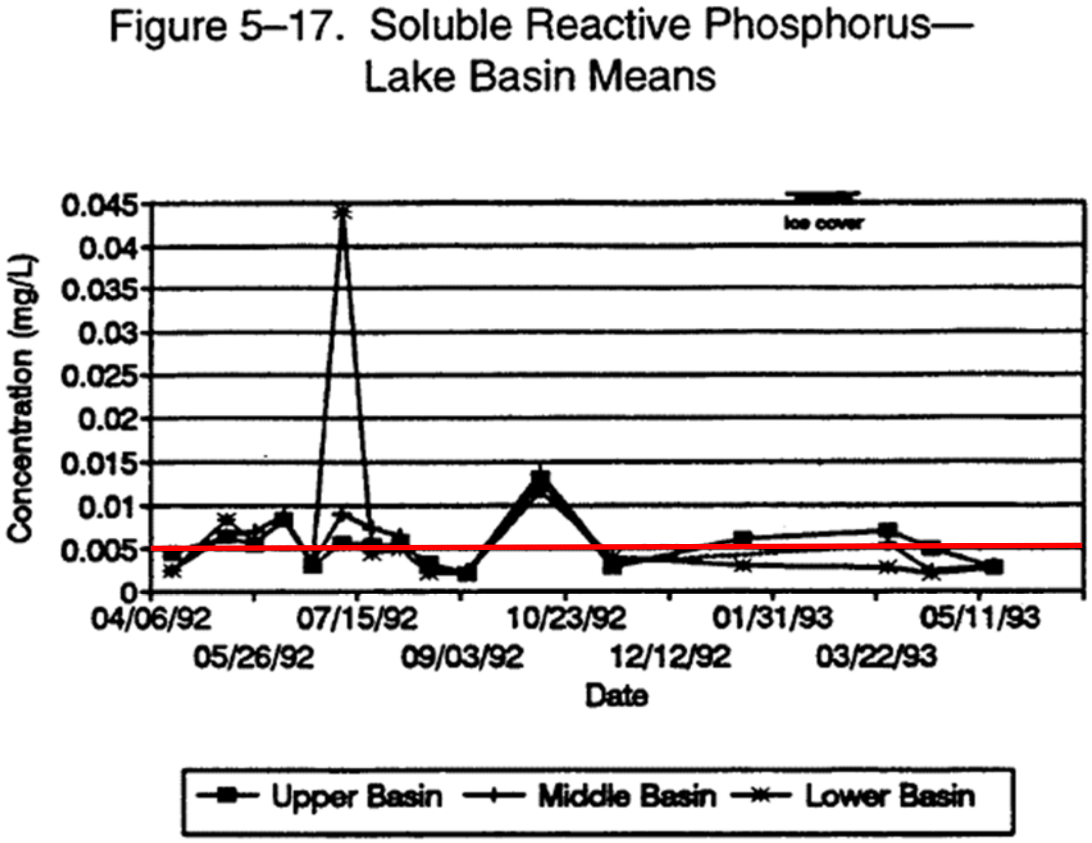
Total phosphorus levels also regularly exceeded the water quality target in samples collected between April 1992 and May 1993 as part of the Jones study. Mean total phosphorus levels in each basin ranged from 0.02 to 0.07 mg/L. TP concentrations were generally low in early summer, rising throughout the summer, and falling throughout the winter months. Levels were highest and most consistently above the threshold in the upper basin which tends to be shallowest.

Figure 1-49 Phosphorus in Lake Monroe (Jones Study 1997: Figure 5-20. Total Phosphorus – Lake Basin Means)



Soluble reactive phosphorus (SRP) concentrations in Lake Monroe also regularly exceeded the water quality target of 0.005 mg/L. Two spikes in particular were noted. One occurred in the October 1992 when all three basins had average SRP concentration around 0.012 mg/L, more than twice the target level. This spike is believed to be result of die-back from Eurasian water milfoil, which released SRP from the decaying plant tissue. The other spike in SRP that was reported for the lower basin in June 1992 is believed to be an analytical error.

Figure 1-50 Historical Soluble Reactive Phosphorus in Lake Monroe (Jones Study 1997: Figure 5-17. Soluble Reactive Phosphorus – Lake Basin Means)



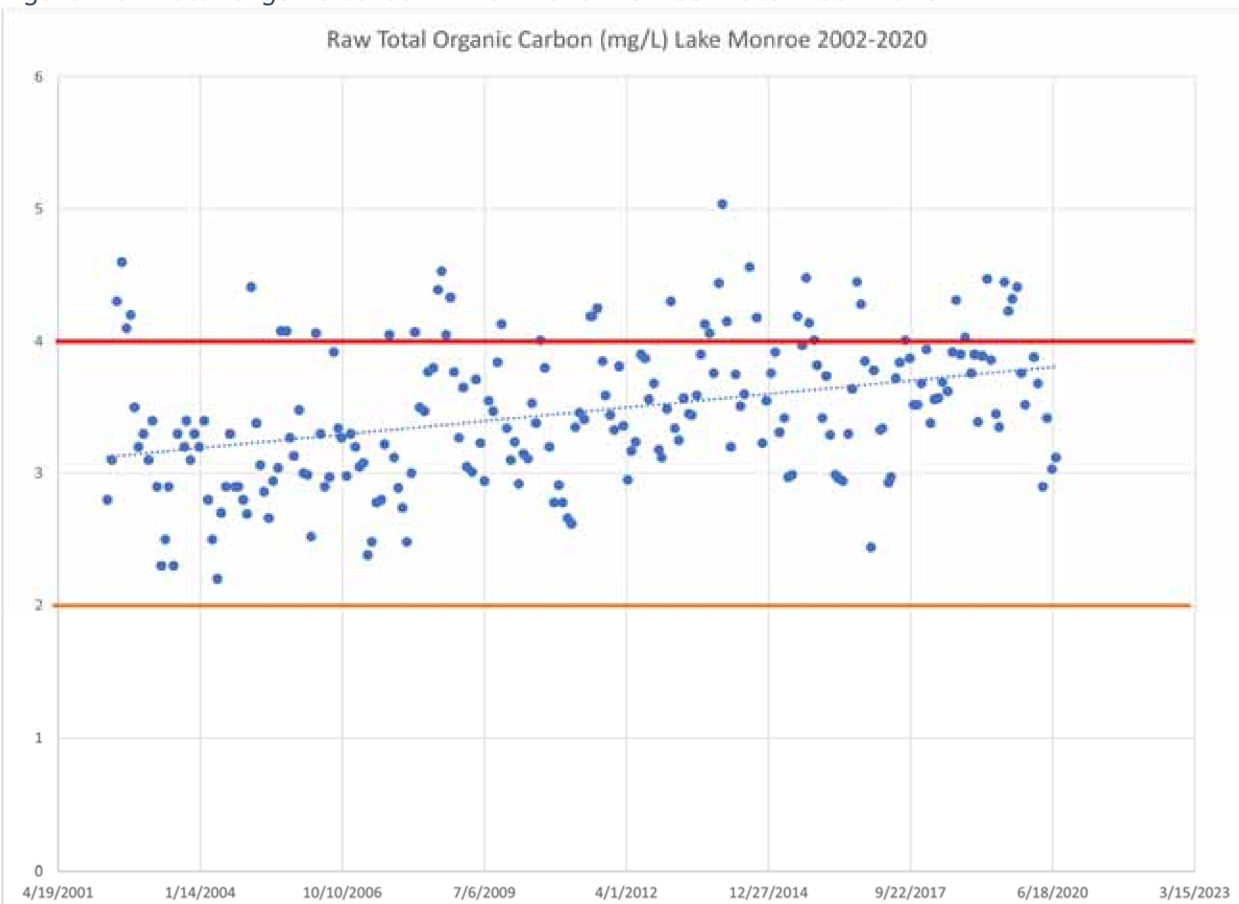
City of Bloomington Utilities (CBU)

CBU conducts a variety of tests on water from Lake Monroe as part of their drinking water treatment program. Three frequently monitored parameters are Total Organic Carbon, Dissolved Organic Carbon, and UV254. These parameters are different ways of measuring organic matter in the water. Increasing organic matter decreases water clarity, turning the water brown. Organic matter can also react with chlorine to create toxic disinfection byproducts, meaning that water with higher concentrations of organic matter requires additional pre-treatment steps before chlorine is added as part of the drinking water treatment process.

Total Organic Carbon (TOC) measures all the organic carbon in a water sample including both the dissolved and the suspended portions. Dissolved Organic Carbon (DOC) measures only the dissolved component. UV254 measures the amount of ultraviolet light at wavelength 254 nm that is absorbed as the light passes through a sample. For all three measurements, increasing values indicate increasing amounts of organic matter.

Based on monthly data collected by CBU between 2002 and 2020, TOC, DOC, and UV254 have all been trending upward. CBU has identified 4 mg/L of TOC as a threshold where additional pre-treatment measures are required in the drinking water treatment process. While this threshold has been exceeded periodically since 2002 and increased removal of TOC was implemented, there have been no incidents where harmful byproducts have exceeded the maximum regulatory threshold.

Figure 1-51 Total Organic Carbon in Raw Lake Monroe Water 2002-2020



1.17.2 Water Quality Data –Metals, Inorganic Compounds, and Other Parameters

While the water quality monitoring for this study focused on nutrients and sediment, historical data was reviewed to evaluate other parameters.

<u>USACE Historic Sampling</u>
USACE evaluates a wide variety of parameters in its annual sampling events includes atrazine, antimony, arsenic, barium, beryllium, cadmium, chromium, copper, lead, manganese, mercury, nickel, selenium, silver, and zinc. Most parameters consistently measure below levels of

concern. However, copper was flagged in the tailwaters sample of the USACE 2019 annual report (based on 2018 sampling) and iron was flagged in the USACE 2020 annual report (based on 2019 sampling).

Reported copper levels in Lake Monroe from 2007-2020 were generally extremely low with almost all samples below 5 ug/L (0.005 mg/L). The exception was the 2018 tailwaters sample with a concentration of 11.4 ug/L which exceeded the acute aquatic criterion of 7.79 ug/L. This is a very conservative threshold. For comparison, the drinking water limit for copper is 1300 ug/L, or 1.3 mg/L. Ultimately copper was not selected as a contaminant of concern for this study.

Reported iron levels in Lake Monroe from 2007-2020 have ranged from below the detection limit to 6.6 mg/L with a median of 1.1 mg/L. Iron cycling in lakes and streams is complex and it is normal for concentrations to vary considerably over both time and space. The EPA acute aquatic criterion is hardness dependent and must be calculated for each sampling event. The 2019 tailwater sample had an iron level of 4.28 mg/L, exceeding the acute aquatic criterion of 2.744 mg/L. While any exceedance is concerning, the concentrations of iron in Lake Monroe appear to be within normal variations for the state. Iron concentrations in samples from all the Louisville District ACOE lakes ranged from below the detection limit to 20.8 mg/L. Due to the limited data availability and the lack of obvious potential sources of iron within the watershed, iron has been excluded from this watershed plan.

<u>City of Bloomington Utilities (CBU)</u>

CBU routinely analyzes drinking water samples for a variety of parameters at different frequencies. Although this is treated drinking water, the presence of a constituent in drinking water would likely indicate its presence in the raw lake water, with the exception of chloramine, disinfection by-products, and fluoride.

- Tests are run quarterly for a list of twenty-one Synthetic Organic Carbons (SOCs) and a much longer parameter list is run every three years.
- Tests are run annually for eighteen Inorganic Compounds (IOCs), twenty-one regulated Volatile Organic Compounds (VOCs), and nineteen unregulated Volatile Organic Compounds.
- Tests are run every six years for radioactive contaminants (most recently in 2015).
- Chloramine, a chemical used for water treatment, is regularly monitored throughout the treatment plant and water distribution system.
- Disinfection By-Products (DBPs), chlorine by-products formed during disinfection, are monitored monthly.
- EPA's Unregulated Contaminant Monitoring Rule program requires sampling for additional parameters every five years (currently underway in 2020).

Based on the 2020 Annual Drinking Water Report (using 2019 data), the two detected constituents that are likely to come from raw lake water are barium and atrazine. Barium was detected at 0.012 ppm, well below EPA's maximum contaminant level of 2 ppm, and is attributed to the erosion of natural deposits. Atrazine was detected at 0.2 ppb, well below EPA's maximum contaminant level of 3.0 ppb, and is attributed to runoff from herbicide used on row crops. Barium has been present at consistent levels for the last ten years. Atrazine was reported at levels between 0.2 and 0.3 ppb in the 2013, 2014, 2015, 2018, 2019, and 2020 annual water quality reports.

Hexachlorocyclopentadiene was detected in 2018, 2016, and 2015 at 0.1 ppb, well below the EPA maximum contaminant level of 50 ppb. Di(2-ethylhexyl)phthalate was detected in 2016 at 1.6 ppb compared to the EPA maximum contaminant level of 6 ppb. Both constituents are associated with chemical manufacturing. Nitrate was detected in 2011 at 0.02 ppm and in 2012 at 3.7 ppb compared to the action level of 15 ppb and was attributed to nonpoint source pollution (fertilizer, septic systems, sewage, or erosion of natural deposits).

Lead and copper were also detected in the drinking water in all years. Copper levels ranged from 0.017 ppm to 0.037 ppm, well below the EPA regulatory limit for drinking water of 1.3 ppm. Lead levels ranged from 4.9 to 7.0 ppb with an EPA action level of 15 ppb and a target of 0 ppb. Lead and copper were both attributed in the annual report to a combination of corrosion of household plumbing and erosion of natural deposits. For comparison, USACE lake sampling data from 2007-2016 show copper levels ranging from under detection limits to 4.4 ug/L (0.0044 mg/L). Lead levels in thirty-five of thirty-seven samples were below 3.0 ppb. The two elevated results were 4.5 and 6.9 ppb, comparable to the CBU samples.

In 2020, samples of raw lake water collected by CBU via a pipe from the raw water intake tower showed elevated copper levels of 0.32 ppm, an order of magnitude higher than the typical drinking water results. The elevated copper levels were due to a new pilot program where copper sulfate is introduced at the intake tower to fight algae. This will likely be adopted as a standard operating procedure during the summer months. CBU will change their sampling point to a spot in the intake tower prior to the copper sulfate addition.

CBU Contaminant Testing 2019

SOCs (Synthetic Organic Compounds) (20 undetected, 1 detected)

Alachlor (Lasso)
Atrazine - detected
Benzo(a)pyrene
Di(2-ethylexyl)adipate
Di(2-ethylexyl)phthalate
Endrin
Heptachlor
Heptachlor Epoxide
Hexachlorobenzene

Hexachlorocyclopentadiene
Lindane
Methoxychlor
Simazine
Aldrin
Butachlor
Carbaryl
Dicamba
Dieldrin
Metolachlor
Metribuzin
Propachlor

IOCs (Inorganic Chemicals) (13 undetected, 5 detected)
Antimony
Arsenic
Barium - detected
Beryllium
Cadmium
Chloramine - detected
Chromium
Copper - detected
Cyanide (Free)
Fluoride – detected
Lead - detected
Mercury
Nickel
Selenium
Thallium
Nitrate
Nitrite
Nitrite & Nitrate

Regulated VOCs (Volatile Organic Compounds) (21)
Benzene
Carbon Tetrachloride
Chlorobenzene
1,2-Dichlorobenzene
1,4-Dichlorobenzene
1,2-Dichloroethane
1,1-Dichloroethylene
1,2-Dichloroethylene, cis
1,1-Dichloroethylene, trans

Dichloromethane
1,2-Dichloropropane
Ethylbenzene
Styrene
Tetrachloroethylene
Toluene
1,2,4-Trichlorobenzene
1,1,1-Trichloroethane
1,1,2-Trichloroethane
Trichloroethylene
Vinyl Chloride
Total Xylenes

Unregulated VOCs (Volatile Organic Compounds) (19)
Bromobenzene
Bromomethane
Chloroethane
Chloromethane
2-Chlorotoluene
4-Chlorotoluene
1,3-Dichlorobenzene
1,1-Dichloroethane
1,3-Dichloropropane
2,2-Dichloropropane
1,1-Dichloropropene
1,3-Dichloropropene (cis & trans)
1,1,1,2-Tetrachloroethane
1,1,2,2-Tetrachloroethane
1,2,3-Trichloropropane
Dibromomethane
Bromoform
Chlorodibromomomethane
Methyl-Tert-Butyl Ether (MTBE)

Disinfection Byproducts
Total Trihalomethanes (TTHM) – detected
Haloacetic Acids (HAA5) – detected

1.17.3 Water Quality Data – Bacteriological and Algal

Blue-Green Algae

The Indiana Department of Natural Resources works with the Indiana Department of Environmental Management and the Indiana State Department of Health to monitor the presence of blue-green algae in lakes during the summer recreation season (Memorial Day-Labor Day). Lake Monroe is sampled approximately twice per month at Paynetown and Fairfax. Beach Advisory Alerts were issued annually 2011-2021 at both beaches based on algal counts over 100,000 cells/ml. These recreational advisories were typically issued in July and stayed in effect through the end of sampling (Labor Day). During a beach advisory alert, swimming and boating is permitted but visitors are advised to avoid contact with algae and take a bath after coming in contact with the water. Cyanotoxins are also measured as part of the monitoring program. However, no cyanotoxins were detected at levels to trigger elevated recreational advisories in Lake Monroe.

Table 1-94 Historical Algal Counts at Paynetown per IDEM/IDNR/ISDH Beach Monitoring Program

Historical Algal Counts (cells/ml) at Paynetown							
	Mid June	Late June	Early/Mid July	Mid/Late July	Early August	Mid August	Late August
2011	—	46,960	—	110,240	604,400	599,160	541,800
2012	—	19,680	—	298,153	—	1,114,200	422,800
2013	—	52,800	—	77,093	—	161,019	148,284
2014	15,952	—	77,763	—	189,919	391,463	—
2015	2,083	—	61,589	—	147,960	87,385	—
2016	—	21,601	—	122,060	798,760	394,318	—
2017	13,078	—	42,699	—	222,759	242,444	—
2018	13,600	—	138,036	235,616	185,624	254,214	—
2019	84,519	—	—	—	508,684	586,131	—
2020	—	30,188	—	—	543,604	656,807	550,698

Chlorophyll-a measurements collected by the Indiana Limnology Lab from April showed peak concentrations during the late September (9/23/2020) sampling event. This indicates that algal counts likely continue to increase in the early fall after the IDEM beach monitoring program ends. Peak algal counts likely occur in September or possibly October. While recreational use decreases significantly after Labor Day, there are still plenty of swimmers and boaters in September and October.

Table 1-95 Chlorophyll-a Levels in Lake Monroe 2020

Sample Date	**Monroe Upper**	**Monroe Center**	**Monroe Lower**

	Chlorophyll-a (ug/L)	Chlorophyll-a (ug/L)	Chlorophyll-a (ug/L)
5/26/2020	8.59	6.81	6.76
6/25/2020	6.19	4.42	2.97
7/27/2020	19.32	6.07	2.50
8/28/2020	26.49	11.34	7.96
9/23/2020	31.00	16.97	6.15
10/26/2020	18.57	13.78	7.73
Average	18.36	9.90	5.68
Max	31.00	16.97	7.96
Min	6.19	4.42	2.50
% > 4.93	100%	83%	67%

Fecal Contamination

The IU Limnology Lab analyzed the monthly 2020 Lake Monroe samples for E. coli. All samples were well below the state E. coli standard of 235 CFU/100 ml. Furthermore, all samples were below 15 CFU/100 ml and 64% were below the detection limit of 1 CFU/ml.
Samples collected by USFS at the Hardin Ridge beach from 2015-2020 revealed four exceedances of the 235 CFU/100 ml standard out of fifty-four total samples. Two occurred in August 2015 (>2,400 and 727), one in July 2016 (>2,400), and one in August 2016 (632). All other samples had reported levels below 50 CFU/100 ml. No exceedances occurred in 2017-2020 and the highest recorded concentration in those years was 28 CFU/100 ml.

Based on these data, E. coli is not considered an active concern at Lake Monroe though it should be addressed elsewhere in the watershed.

1.17.4 Habitat and Biological Assessment

No habitat or biological assessments were conducted in Lake Monroe as part of this project. The lake is a popular fishing destination and is stocked annually with walleye and striped bass. Artificial fish habitat was added to the lake through the IDNR Division of Fish and Wildlife in 2018 and 2019. An estimated 200 habitat structures were installed including Pennsylvania Porcupine Crib Juniors, Georgia Cubes, and Indiana pallet structures. All were installed in the upper basin of Lake Monroe in an area with an approximate depth of 8 to 11 feet where dissolved oxygen levels are expected to be sufficient for fish year-round.

1.17.5 Potential Sources – Lakeshore Observations

The shoreline of Lake Monroe was identified as a potential source of sediment in the 1997 Jones study and was mentioned multiple times as a public concern at the recent community forums. The Jones study conducted a shoreline survey in 1993 that divided the shoreline into 67 sections and documented the type of shoreline substrate (bedrock, talus, soil), the extent of vegetative cover, and bank height for each section. They identified many shoreline sections with erosive characteristics such as less than 100% vegetation, greater than two foot banks, and silt/clay substrates. A class of SPEA students in 2020 digitized the shoreline segments, assigning them geographic locations in a GIS system, and also developed an app designed to have volunteers document current shoreline conditions. Though this fieldwork has not yet been completed, anecdotal information suggests that the lakeshore has eroded considerably since the Jones study. Lake Monroe experienced an unusually extended period of elevated water surface elevation in 2019 with flood conditions in effect from March through August. This appears to have exacerbated lakeshore erosion and eroded soils in areas above existing riprap.

Paynetown State Recreational Area has several stretches of shoreline that are protected by riprap installed in the 1990s. At the time of installation, the record water elevation was 13 feet above normal pool (538 + 13 = 551) and this elevation was used to determine the top of the riprap (per conversation with Jim Roach, DNR). However, in the last five years there have been regular exceedances and some erosion has occurred above the riprap, though the riprap is still holding well.

Sedimentation is a concern around some of the boat ramps. About a decade ago, DNR applied for an 1135 grant through the US Army Corps for almost one million dollars to address sedimentation at the Crooked Creek Boat Ramp (personal conversation with Jim Roach, DNR). The boat ramp was becoming very silted in and they proposed creating a sub-impoundment area to collect sediment during flood events. Large tubular sacks would be filled with silt and stacked in place to create a sort of settling basin, slowing sediment transfer into the boat ramp area and the lake itself. They received a 404 permit for construction in a floodway but were unable to secure a 402 permit that ensures projects are beneficial for fish and wildlife. At that point, the project was tabled and has not been reconsidered.

Appendix K of Lake Monroe Watershed Management Plan

Definitions of Selected Best Management Practices

Boating Restrictions
Lake Monroe has designated several areas of the lake to be no wake zones including any area 200 feet or less away from the shoreline, embayments which are less than 1,500 feet wide at the mouth, and the entire section of lake east of State Road 446. These restrictions help minimize wave action on the Lake Monroe shoreline. Education and enforcement are key strategies to ensuring that the restrictions are followed by boaters.

Cover Crops
Crops which can include grasses, legumes, and forbs are planted after harvest of the main crop for seasonal cover through the winter. Their purpose is to reduce erosion from wind and water while improving soil health. Cover crops increase soil organic matter content, suppress weeds, manage soil moisture, and counter soil compaction. Some cover crops generate or redistribute nutrients in the soil, for example legumes acting as nitrogen fixers. Cover crops are increasingly popular and there are many incentives available for farmers interested in trying them, including reduced premiums for crop insurance in some cases when cover crops are used.

Critical Area Planting
Critical area planting involves establishing permanent vegetation on sites that have, or are expected to have, high erosion rates, and on sites that have physical, chemical or biological conditions that prevent the establishment of vegetation with normal practices. The purpose is to revegetate degraded sites that cannot be stabilized using normal establishment techniques and to stabilize areas with existing or expected high rates of soil erosion by wind or water.

Education
Education is key to achieving behavior change, which is a huge part of watershed management. Different stakeholders will require different forms of education. This could include field days for agricultural producers that showcase agricultural BMPs, forestry field days for foresters and loggers that showcase forestry BMPs, septic education workshops for residents who have septic systems, and general education of the public to increase awareness of water quality issues and result in behavior change to protect water quality.

Exclusion Fencing
Exclusion fencing is constructed to exclude livestock from streams and other critical areas to improve water quality and soil health. Benefits include reduced soil erosion, sedimentation, pathogen (E. coli) contamination and pollution from attached substances.

Field Border

Field borders are small areas or strips of land in permanent ideally native vegetation along the edge of crop fields. Like all conservation buffers, they are designed to intercept soil, fertilizer, and other pollutants before it is washed off-site. Field borders have the advantage of being designed to allow equipment access for turning around at the edge of the field. Field borders are typically a minimum of 15 feet wide.

Flocculation

Flocculation is an in-lake management tool to reduce phosphorus concentrations. One common flocculant is aluminum sulfate, also known as alum. When alum is added to water, it forms aluminum hydroxide, a fluffy precipitate also known as floc. This compound binds with phosphorus and settles to the bottom, effectively trapping the phosphorus. This lowers phosphorus concentrations in the water, decreasing the likelihood of harmful algal blooms. Flocculants are typically most effective in small bodies of water.

Forage and Biomass Planting

Forage and biomass planting are the establishment of adapted and/or compatible species, varieties, or cultivars of herbaceous species suitable for pasture, hay, or biomass production. Its purpose is to improve or maintain livestock nutrition and/or health, provide or increase forage supply during periods of low forage production, reduce soil erosion, improve soil and water quality, produce feedstock for biofuel or energy production.

Heavy Use Area Protection (HUAP)

Heavy Use Area Protection (HUAP) is the stabilization of areas frequently and intensively used by livestock by surfacing with suitable materials, establishing vegetative cover, and/or installing needed structures. Most HUAP practices in the region involve the installation of a stable, non-eroding surface such as a gravel or concrete pad in places like feeding areas that are heavily used in order to avoid soil erosion and simplify manure management.

Land Retirement

Land retirement generally refers to taking agricultural land out of production. It is used most often for marginal farmland that is too wet, too steep, or otherwise difficult to farm consistently. In many cases, the farmer can recover most or all of the loss of production by enrolling the land in the Conservation Reserve Program, which pays a regular stipend for taking sensitive land out of production. Floodplain fields in particular have a high chance of contributing sediment to streams and therefore taking them out of production has a positive impact on water quality. In some watersheds there are similar programs that target owners of non-agricultural land. These programs actively purchase and demolish structures (houses, commercial buildings) that were constructed in a floodplain and flood regularly. The idea is to provide a more natural floodplain (without structures that interrupt flow) and to avoid the hassle and expense of repeatedly repairing flood-damaged buildings. While this sort of program does not yet exist in the Lake Monroe watershed, there may be opportunities to incentivize landowners to protect floodplain land with a conservation easement or other arrangement.

Lake aeration
Aeration is an in-lake management tool to increase the availability of dissolved oxygen, which can counteract eutrophication and reduce the likelihood of harmful algal blooms. The goal is to prevent oxygen depletion in the hypolimnion (the deepest part of the lake) to prevent the release of phosphorus from sediments. This will decrease the likelihood of cyanobacteria blooms. However, aeration does not address the underlying causes of eutrophication and should be viewed as a short-term tool while watershed work addresses the source of excess nutrients.

Lakeshore Stabilization
Lakeshores can erode for a variety of reasons. Fluctuations in water level, heavy usage destroying vegetation, waves caused by wind, waves caused by boats, and soil sloughing due to extreme periods of saturation are all potential causes at Lake Monroe. Lakeshore can be stabilized and protected using a variety of techniques. In the past, “hard” armoring such as riprap and retaining walls were considered the most effective. However, they are expensive, difficult to maintain, and often enhance erosion of the shoreline at the base and sides while providing minimal benefits to wildlife. Current recommendations focus on “soft” armoring (also known as bio-engineering) which involves creating a natural and gentle slope with a combination of natural elements including rocks and vegetation. This armoring is designed to absorb the energy of waves along the shoreline while also preventing erosion, enhancing natural habitats, and filtering nutrients. Lakeshore stabilization can be challenging in reservoirs like Lake Monroe that experience dramatic fluctuations in water level.

Livestock Watering Systems
Livestock watering systems ensure that livestock have clean drinking water from natural sources such streams, ponds, springs or wells. Livestock watering systems are especially important in riparian areas where they provide an alternative to giving livestock access to streams. This reduces sediment and nutrient loading in streams and lakes by preventing bank and shore erosion and limiting the amount of livestock urine and feces deposited directly in the water. Multiple access points can improve water quality and soil health by more evenly spreading manure and urine across a pasture, enhancing grass growth and avoiding runoff of nutrients into surface waters. Multiple watering points also keep livestock from overgrazing the area around any one tank and prevent soil erosion caused by livestock trailing habitually to and from the same spot. Similar conservation benefits are achieved with portable watering systems, which move water to the paddocks where livestock are currently grazing.

Logjam Removal
Logjams occur naturally anywhere there are streams and trees. In the past, woody debris was regularly removed from streams to allow unimpeded streamflow. Current guidance recognizes that woody debris can offer benefits such as cover for fish, redirection of flow to create scour pools, and an increase in groundwater levels. However, woody debris can collect and create hazardous logjams that should be removed. This is generally the case when the logjam threatens to flood a building or road, is likely to cause extreme erosion, or is making a commonly used stream unsafe for recreation. Logjams can be addressed by removing or shifting the material to restore an open channel. Removal permits from DNR are required in many cases.

Modifying Dam Operations
One of the biggest impacts on lakeshore erosion is the change in water levels due to flood control activities at Lake Monroe. The lake is designed with flood capacity above the normal pool level, meaning that the lake level rises above normal pool when there is a large storm event that is held back to prevent downstream flooding. This is different than most other reservoirs in the region, where lakes are drawn down to a lower "winter pool" elevation in the fall and slowly return to "normal pool" during winter and spring rain events. While the U.S. Army Corps of Engineers is charged with utilizing Lake Monroe for flood control, there may be opportunities to modify operations somewhat to reduce the drastic and sometimes prolonged changes in water level that can exacerbate shoreline erosion.

No Till / Conservation Tillage / Crop Residue Management / Equipment Modification
No Till is a conservation practice that leaves the crop residue undisturbed from harvest through planting except for narrow strips that cause minimal soil disturbance. Crop residues are materials left in an agricultural field after the crop has been harvested. These residues include stalks and stubble (stems), leaves and seed pods. Good management of field residues can minimize erosion. No-till can be used for almost any crop in almost any soil and can save producers labor costs and fuel. It also increases the organic matter in the soil, increases earthworm populations that improve soil quality, and increases water infiltration.

Riparian Herbaceous Buffer
Riparian herbaceous buffers are strips of land along a stream that are planted in permanent ideally native herbaceous vegetation (grasses, flowers, sedges, etc.). They are designed to stabilize the streambank and to intercept sediment, nutrients, and pesticides running off an agricultural field before they reach the stream. Riparian herbaceous buffers can also enhance wildlife habitat and protect biodiversity, particularly when planted with native plants that support pollinators and other desirable insects.

Riparian Forested Buffer
Riparian forested buffers are strips of land along a stream that are planted in permanent woody ideally native vegetation (trees and shrubs). They are designed to stabilize the streambank and to intercept sediment, nutrients, and pesticides before they reach the stream. Riparian forested buffers also improve water quality and in-stream habitat by providing shade, which lowers water temperatures and increases available dissolved oxygen. Tree roots provide excellent in-stream habitat and the trees and shrubs enhance terrestrial wildlife habitat, particularly when native species are used.

Sediment Trap
A sediment trap is a shallow basin designed to slow down incoming water and allow particles of sediment to settle out of suspension. Over time, the sediment trap accumulates sediment and needs to be cleaned in order to maintain effectiveness. Sediment traps are commonly used on large construction sites to minimize soil being released into nearby storm drains or waterways. They can also be installed where a stream enters a lake to capture incoming sediment before it reaches the main body of the lake.

Septic System Maintenance, Repairs, and Alternatives
Poorly maintained septic systems can be a major source of bacteria and nutrients entering surface water. Many residents are unaware that their septic systems require regular maintenance and periodic repair. More education is needed to increase the likelihood that septic systems are being maintained and inspected, which will identify systems in need of repairs. Septic system repairs can be expensive and in some cases infeasible, which raises the importance of identifying potential alternatives.

Streambank Stabilization
Streambanks can erode for a variety of reasons. Changes in stream flow, sediment load, and erosion or deposition on the streambanks will cause the stream to seek a new balance. While some streambank erosion is natural, extreme erosion may require bank stabilization. Common techniques include regrading to acquire a gentler slope, adding erosion control materials such as jute blankets or coir logs, re-establishment of thick vegetation, and/or restructuring the stream channel itself. Riprap can also be used to stabilize streambanks but it is generally less desirable as it is unsightly, it provides few habitat benefits, and it often simply pushes the erosion problem further downstream.

Tree/Shrub Establishment
A variety of desired tree species, either seedling or seeds, are planted mechanically or by hand in understocked woodlands or open fields. Tree species are matched with soil types and selected to prevent soil erosion, increase income, or boost productivity of existing woodlands. Trees also provide protection from rill and sheet erosion, protects water quality by filtering excess nutrients and chemicals from surface runoff, increases infiltration rates, and provides long-term wildlife habitat.

Wetland Restoration or Creation

Wetland restoration is the return of a wetland and its functions to a close approximation of its original condition as it existed prior to disturbance on a former or degraded wetland site. Wetland creation is the creation of a wetland area where no wetland previously existed. Both provide the water quality benefit of trapping sediment and nutrients as well as providing storage capacity during flood events and habitat for wildlife. Wetland restoration or creation typically involves regrading an area so that it captures and retains water and adding appropriate water-tolerant vegetation.

Calculation of water budget, nutrient budget, and target loads for Lake Monroe using regression models and other data

1. Flow Models

Flow models were developed for the three main tributaries to Lake Monroe (North Fork, Middle Fork, and South Fork Salt Creek) as well as one smaller tributary (Crooked Creek).

Data utilized:

- Point discharge measurements collected by the IU Limnology Lab monthly in North Fork at Yellowwood Road, Middle Fork at SR-135, and Crooked Creek at Tecumseh Trail from April 2020 through March 2021.
- Point discharge measurements collected by the US Geological Survey periodically in South Fork at Maumee between March 2020 and May 2021.
- Continuous discharge measurements at USGS Gaging Station 03371650 at North Fork Salt Creek near Nashville April 1, 2020 – March 31, 2021
- Continuous discharge measurements at USGS Gaging Station 03371600 at South Fork Salt Creek at Kurtz April 1, 2020 – March 31, 2021

Linear regression models were developed for flow

Q (cfs) = k1 + k2*Qgaged (cfs)

The flow model for South Fork used the USGS point discharge measurements and continuous flow data at the Kurtz (South Fork) gage. The flow models for the other tributaries used the IU point discharge measurements and continuous flow data at the Nashville (North Fork) gage.

Table 1-1 Flow Regression Equations for Lake Monroe Tributaries

Sub-watershed	k1 (intercept)	k2 (slope)	Qgaged	R^2	P	Annual Flow (cubic feet)
South Fork - Maumee	0	2.67	Kurtz	0.99	2.75E-09	3,987,393,636
Middle Fork - Story	2.9	0.21	Nashville	0.62	0.0236	665,491,732
North Fork - Yellowwood	0.33	1.34	Nashville	0.99	1.59E-11	3,673,311,759
Crooked Creek - Tecumseh	0.38	0.017	Nashville	0.81	6.26E-05	57,152,217

Discharge was not measured at North Fork – Yellowwood on 3-18-21. However, data from the Nashville gage indicates similar discharges occurred on 2-25-21 and 3-18-21, indicating that the flow model is representative of both dates. When building the flow model for South Fork, the intercept was forced to zero to avoid negative flow predictions.

2. Water Budget

Water budget calculations provide insight into the balance between water coming into the lake and water leaving the lake. The water budget also helps to evaluate the reliability of the hydrologic measurements used to calculate nutrient and sediment loads. Water budget inputs include streamflow and precipitation while outputs include drinking water withdrawals, evaporation, and outlet flow. Outlet flow is the lake water released to Salt Creek below the dam and recorded by USACE.

As discussed above, annual streamflow into Lake Monroe from the four monitored tributaries (South Fork, Middle Fork, North Fork, and Crooked Creek) was calculated using regression models. This accounts for approximately 55% of the watershed. Streamflow from the remaining unmonitored area was calculated using the following assumptions:

- Calculated the gross unmonitored area by subtracting the monitored acreage from the total Lake Monroe watershed acreage = 125,658 acres
- Excluded the Lake Monroe acreage (10,880 acres), as rain there does not flow through streams.
    - Unmonitored Area Excluding Lake Monroe = 125,658 – 10,880 = 114,778 acres
- Calculated annual flow in Unmonitored Area using areal flow rate for North Fork (53,940 cfs/acre-year) because land cover is most similar
    - Unmonitored Area Annual Flow = 114,778 acres x 53,940 cubic feet/acre-year = 6,191,121,542 cubic feet/year

These flows were combined to get the annual streamflow into Lake Monroe.

Table 2-1 Annual Total and Areal Flow in Tributaries to Lake Monroe

Sub-watershed	Annual Flow From Regression Models 8-17-2021 (cubic feet/yr)	Catchment Area (acres)	Areal Flow (cubic feet/acre-yr)
South Fork - Maumee	3,987,393,636	56,825	70,170
Middle Fork - Story	665,491,732	24,400	27,274
North Fork - Yellowwood	3,673,311,759	68,100	53,940
Crooked Creek - Tecumseh	57,152,217	1,700	33,619
Unmonitored – Excluding Lake Monroe	6,191,121,543	114,778	53,940
Total Inflow Via Tributaries	**14,574,470,887**	**265,803**	**54,832**

The total input of water coming into Lake Monroe is streamflow + precipitation (see monthly data in Table 2-2.) Streamflow accounts for 90% of inputs and precipitation accounts for the remaining 10%. Outputs include drinking water withdrawals, evaporation, and outlet flow through the dam. Outlet flow accounts for 88% of outputs. Drinking water withdrawals by the City of Bloomington account for 5% of outputs, while evaporation from the lake surface accounts for 7% of outputs.

Table 2-2 Monthly Inflow and Outflow for Lake Monroe 4/1/20-3/31/21

Month	Outlet Flow (ft^3)	Withdrawals (ft^3)	Evaporation (ft^3)	Stream Inflow (ft^3)	Precipitation (ft^3)
Apr	4,627,234,845	66,126,325	138,950,191	1,291,902,335	107,672,502
May	2,131,768,890	70,358,256	126,221,220	3,170,956,146	211,535,571
Jun	2,508,705,854	83,216,197	255,969,904	377,328,074	31,727,854
Jul	206,687,375	81,843,549	132,246,007	356,626,472	187,016,875
Aug	891,469,916	80,923,634	195,205,513	399,921,642	180,256,879
Sep	144,181,620	82,309,125	141,384,339	23,659,418	13,445,150
Oct	147,641,297	76,733,444	89,933,842	227,893,719	205,545,571
Nov	323,920,821	69,287,430	78,782,620	836,061,634	124,690,291
Dec	758,986,188	67,791,163	43,753,524	382,278,864	78,449,984
Jan	1,471,355,995	71,562,333	23,516,490	1,537,484,473	94,908,321
Feb	2,174,953,192	70,623,153	36,984,139	3,026,013,062	171,974,211
Mar	1,749,583,223	72,278,358	142,286,661	2,944,345,050	209,408,044
Total	**17,136,489,216**	**893,052,968**	**1,405,234,450**	**14,574,470,888**	**1,616,631,252**

The water budget is balanced when the difference between inflow and outflow is equal to the change in water stored in the lake. By comparing storage to the difference between inflow and outflow we can estimate the accuracy of our calculations. Calculations used to estimate streamflow, precipitation, evaporation and changes in storage are prone to error. The reliability of our calculations can be judged by the relative significance of this error. Error is expressed in the table below as a percentage of the total inputs to the lake.

Table 2-3 Monthly Water Budget for Lake Monroe 4/1/20-3/31/21

Month	Inflow	Outflow	Storage	In-Out-Storage	% Error
Apr-20	1397251288	4693361171	-2861148290	-434961592	-31.13%
May-20	3,377,286,254	2202127146	1032813390	142345718	4.21%
Jun-20	396,007,328	2,591,922,052	-2369099941	173185217	43.73%
Jul-20	448,329,344	288,530,924	224801710	-65003289	-14.50%
Aug-20	556,210,201	972,393,550	-246022649	-170160699	-30.59%
Sep-20	23,659,418	226,490,745	-332202228	1,293,709,00	546.81%
Oct-20	232,975,719	224,374,741	194814936	-186213958	-79.93%
Nov-20	907,889,896	393,208,251	806769218	-292087573	-32.17%
Dec-20	459,973,932	826,777,351	-455838595	89035176	19.36%
Jan-20	1,630,558,036	1,542,918,328	134879501	-47239794	-2.90%
Feb-20	3,195,459,649	2,245,576,345	375909437	573973866	17.96%
Mar-20	3,149,066,163	1,821,861,581	2622607851	-1,295,403,270	-41.14%
Annual Total	**15,774,667,227**	**18,029,542,186**	**-871,715,661**	**-1,383,159,298**	**-8.77%**

On a monthly basis, errors are large, but on an annual basis, the 8.77% error is very good. A cursory comparison of streamflow discharge and reported outflows suggests a tendency to underestimate outflow during periods of small releases to Salt Creek. High errors occurring in September 2020 are likely due to underestimation of outflow. Additionally, the lake level-volume and lake level-area curves most likely originate from the 1960's. No lake-wide bathymetric surveys have been conducted since the lake was constructed in the early 1960's and so the changes in the lake level-volume and lake level-area tables are unknown.

Data Sources

Outlet Flow: USACE https://www.lrl-wc.usace.army.mil/reports/yearly/Monroe%20Lake.html
Withdrawals: City of Bloomington Utilities
Evaporation: Indiana Geological and Water Survey Water Balance Network
Inflow: Calculated from regression equations of monthly stream measurements performed by Indiana University Limnology Lab
Precipitation: USACE https://www.lrl-wc.usace.army.mil/reports/yearly/Monroe%20Lake.html
Storage: Calculated from USACE lake levels https://www.lrl-wc.usace.army.mil/reports/yearly/Monroe%20Lake.html
Using stage volume and stage area tables from USACE Monroe Lake Water Control Plan.

Figure 2-1 Regression Equation Developed to Calculate Lake Surface Area Based on Lake Level

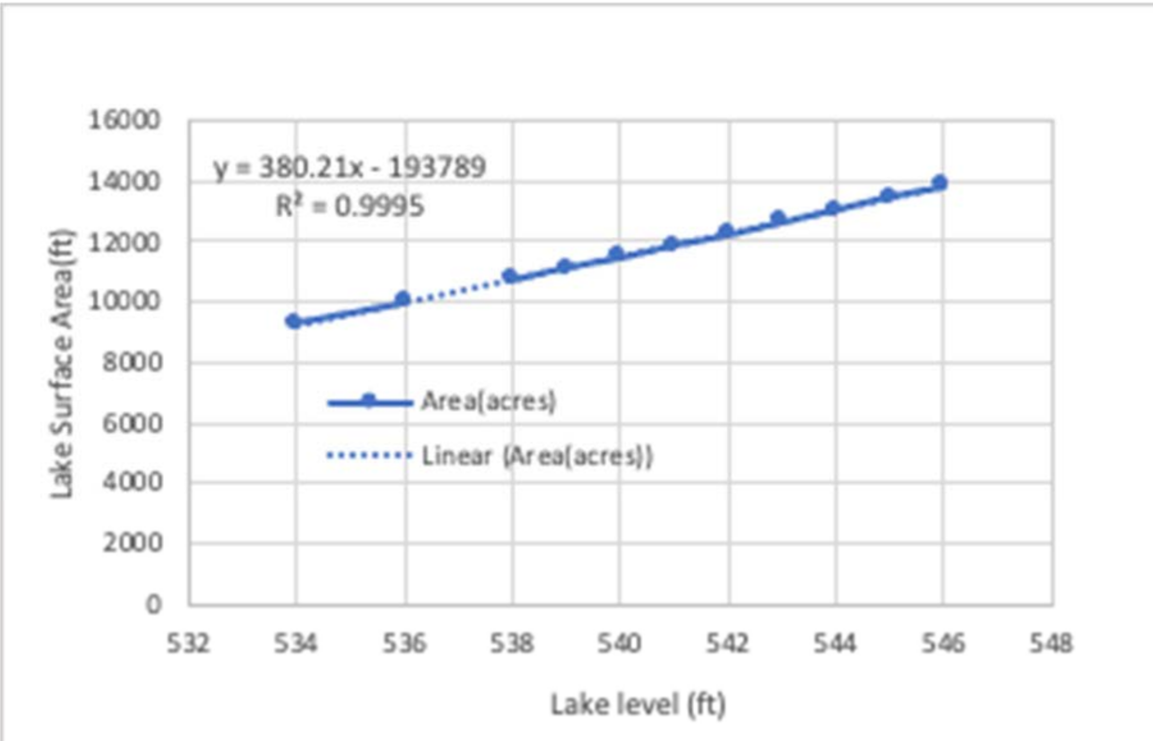
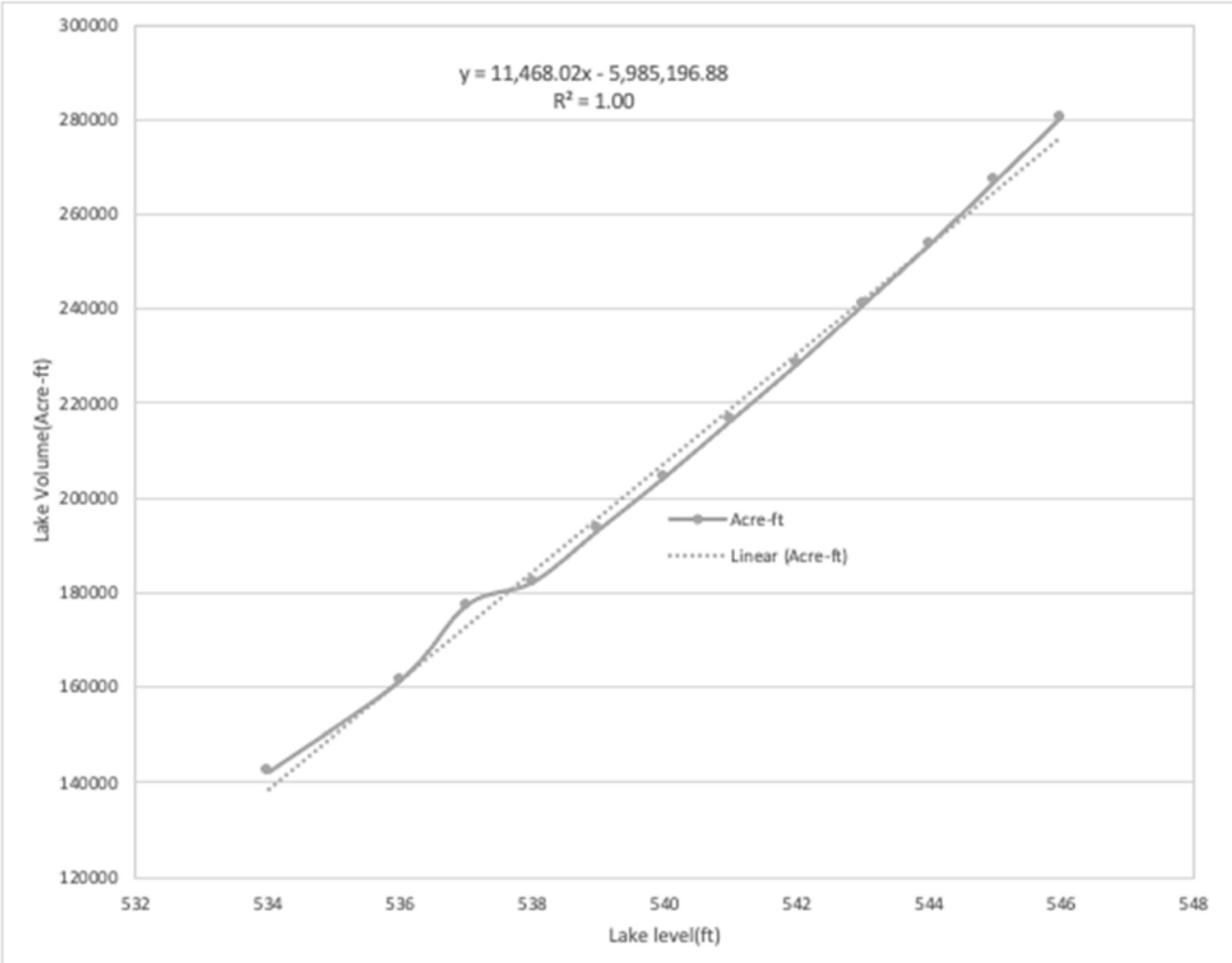


Figure 2-2 Regression Equation Developed to Calculate Lake Volume Based on Lake Level



3. Sediment, Nutrient, and Bacteria Models

Sediment, phosphorus, nitrogen, and E. coli models were developed for the three main tributaries to Lake Monroe (North Fork, Middle Fork, and South Fork Salt Creek) as well as Crooked Creek.

Data utilized:

- Daily loads calculated by multiplying discharge by concentration and using a conversion factor
    - For Middle Fork, North Fork, and Crooked Creek, the measured discharge (field measurements collected by the IU Limnology Lab during sampling) was used.
    - For South Fork, the modeled discharge was used as the measured discharge did not correlate well with discharge measured at the Kurtz gage.
    - Sediment load (tons/day) = Discharge (cfs) * TSS measured (mg/l) * 0.0027
    - Phosphorus load (lbs/day) = Discharge (cfs) * TP measured (mg/l) * 5.39
    - Nitrogen load (lbs/day) = Discharge (cfs) * TN measured (mg/l) * 5.39
    - E. coli load (CFU/day) = Discharge (cfs) * E. coli measured (CFU/100 ml) * 24,468,758
- Daily loads were plotted against gaged flow on the sampling dates
    - For Middle Fork, North Fork, and Crooked Creek, the Nashville (North Fork) stream gage was used
    - For South Fork, the Kurtz (South Fork) stream gage was used
- A linear regression was developed for each parameter.
    - Intercepts were forced to zero to avoid negative loads.
    - For North Fork, a piecewise model was developed to account for the large discrepancy between the low flow loads and the high flow load, as discussed below.

Table 3-1 Regression Equations for South Fork Salt Creek at Maumee

South Fork	k1 (intercept)	k2 (slope)	Qgaged	R^2	Annual Load
Sediment	0	0.131	Kurtz	0.91	2,261
Phosphorus	0	0.443	Kurtz	0.95	7,652
Nitrogen	0	10.515	Kurtz	0.92	181,750
E. coli	0	2E10	Kurtz	0.81	9.21E+14

Table 3-2 Regression Equations for Middle Fork Salt Creek at Story

Middle Fork	k1 (intercept)	k2 (slope)	Qgaged	R^2	Annual Load
Sediment	0	0.0177	Nashville	0.96	560
Phosphorus	0	0.036	Nashville	0.96	1,139
Nitrogen	0	0.759	Nashville	0.97	24,013
E. coli	0	5E+08	Nashville	0.75	1.58E+13

Table 3-3 Regression Equations for Crooked Creek

Crooked Creek	k1 (intercept)	k2 (slope)	Qgaged	R^2	Annual Load
Sediment	0	0.0002	Nashville	0.98	35
Phosphorus	0	0.0013	Nashville	0.97	5
Nitrogen	0	0.028	Nashville	0.90	886
E. coli	0	4E+06	Nashville	0.96	1.27E+11

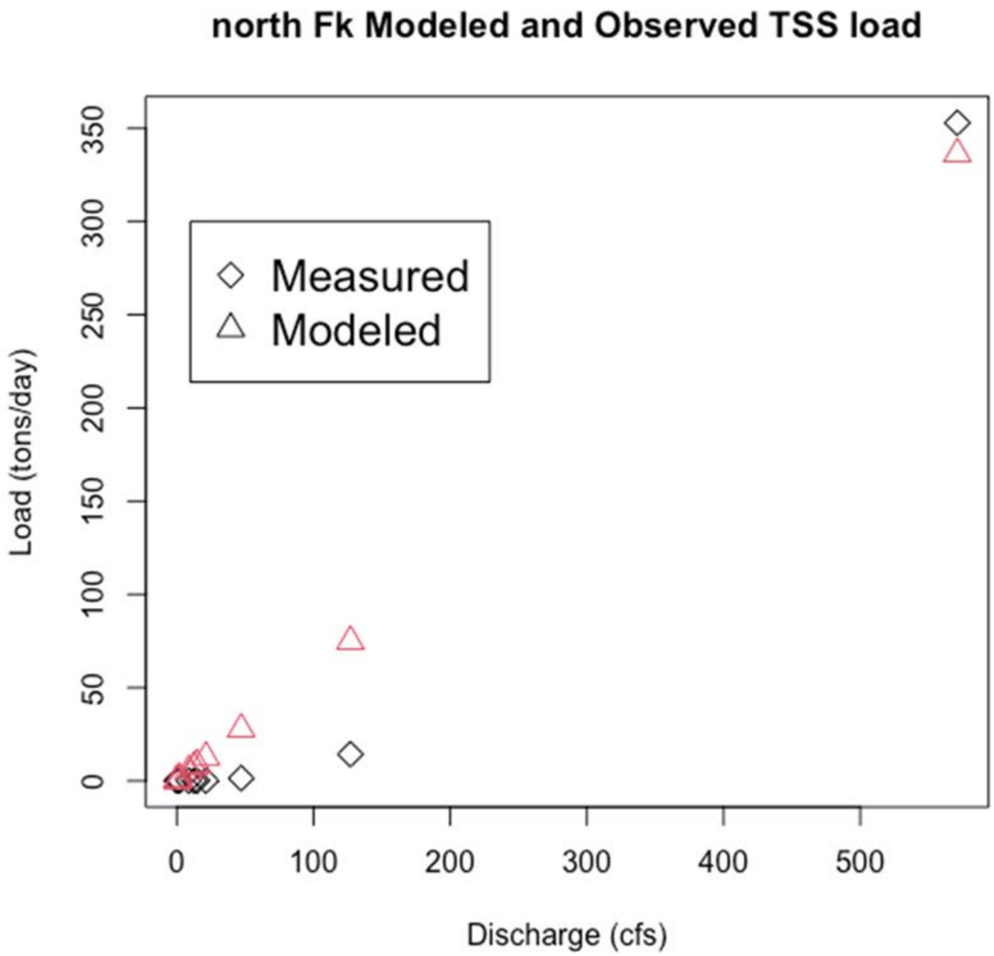
Table 3-4 Regression Equations for North Fork Salt Creek at Yellowwood

North Fork	k1 (intercept)	k2 (slope) Q <150	k2 (slope) Q>=150	Qgaged	R^2	Annual Load
Sediment	0	0.097	0.589	Nashville	0.89/0.96	13,393
Phosphorus	0	0.156	0.561	Nashville	0.97/0.97	13,427
Nitrogen	0	2.740	8.012	Nashville	0.97/0.97	142,929
E. coli	0	6E+09	6E+09	Nashville	0.96/0.91	1.90E+14

For the North Fork, only 11 data points were available because flow was not collected during the 3/18/21 sampling event. Two linear regression models for sediment were explored, one using the full set of measurements and the other eliminating the single high flow measurement (collected 2/25/21). In both cases the intercept was set to zero.

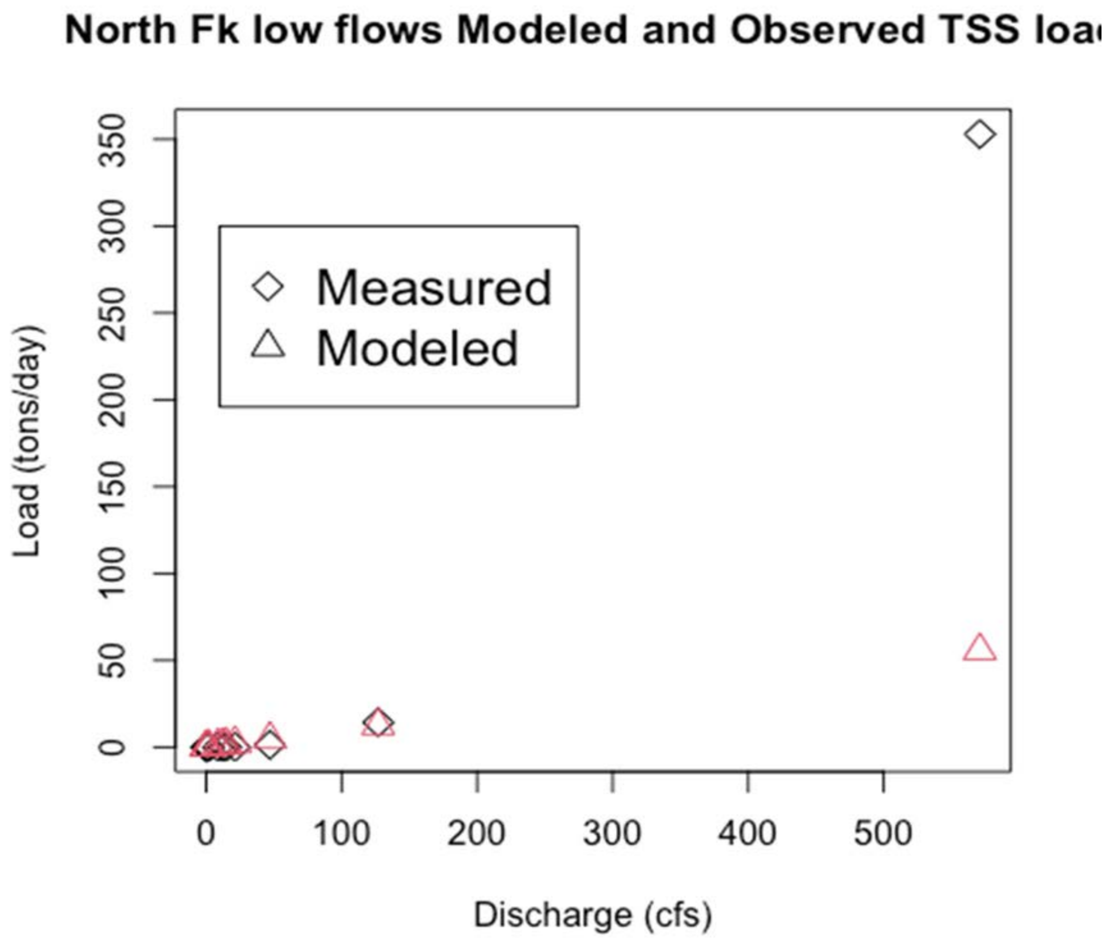
When the full set of measurements were used, the R-square value was 0.96 and the estimated slope was 0.58913. Sediment load was overestimated for all but the single high flow event, which was underestimated (see Figure 3-1). Annual load was estimated at 18,638.81 tons.

Figure 3-1 North Fork Sediment Model with Full Data Set



The second model, which eliminated the high flow measurement, gave an r-square value of 0.89 and a slope of 0.09747. Good agreement was obtained between modeled and observed sediment loads at flows below 150 cfs but the model drastically underestimated the load during the high flow event (see Figure 3-2). Annual sediment load was estimated at 3083.72 tons.

Figure 3-2 North Fork Sediment Model with Low Flow Data



Although plots of flow vs load reveal a curvilinear relationship, regressions using log and loess models in R gave poor results with highly overestimated peak loads. A piecewise model was developed using the regression coefficients from the full measurements and the coefficient using only the low flow measurements. For dates where flows at the Nashville gage was greater than 150 cfs (n=48) the load was calculated using 0.58913, for other dates (n = 317) the slope of 0.09747 was used. For the low flow dates the total sediment load was estimated at 1,040 tons. For the high flow dates the total sediment load was estimated at 12,354 tons. The total annual flow using the piecewise approach was estimated at 13,394 tons.

The same piecewise strategy was used for phosphorus, nitrogen, and E. coli models in North Fork. (The two E. coli models ended up with the same slope after rounding.)

4. Flow Frequency Analysis

When evaluating nutrient and sediment models, it is important to understand if the captured stream flow events are representative of typical stream flow. If the sampling events only captured low flow conditions, the models would likely underestimate nutrient and sediment loads. It is also useful to know if the hydrologic year is typical of the stream over time or if it was an unusually wet or dry year.

Peak discharge for the monitored hydrologic year (4/1/2020-3/31/2021) was compared to historical records of peak discharge for both the Kurtz stream gage and the Nashville stream gage. While the current Kurtz stream gage was just installed in January 2020, peak discharge for the site was available for 1961-1971 from a historical stream gage (USGS National Water Information System site #03371600).

Table 4-1 Historical Peak Discharge at South Fork Kurtz Stream Gage

Date	Peak discharge(cfs)	Rank	% Probability of exceeding in a given year	Return period (years)
5/24/1968	6,400	1	8%	13
2/10/1965	5,500	2	15%	7
3/9/1964	4,960	3	23%	4
5/7/1961	4,690	4	31%	3
2/28/2021	4,680	5	38%	3
3/4/1963	3,930	6	46%	2
4/24/1970	3,860	7	54%	2
2/26/1962	3,510	8	62%	2
5/7/1967	3,070	9	69%	1
1/29/1969	3,000	10	77%	1
2/22/1971	2,510	11	85%	1
4/27/1966	2,250	12	92%	1

Peak discharge in South Fork at Kurtz for the April 2020-March 2021 study year was 4,860 cfs and occurred on 2/28/21. The probability of a peak flow exceeding the study year discharge is 38%, corresponding to a 3-year return period. This indicates that the study year was not unusually wet or dry.

The highest discharge recorded during a monthly sampling event at South Fork Maumee was on 2/25/21. Daily flow at the Kurtz gage on that date was 168 cfs, corresponding to less than a 1-year return period. This indicates that a representative peak flow was not captured and therefore the sediment and nutrient models are likely to underestimate loads.

Peak discharge for the Nashville gage was available from 1962 to 1981 and 2016-2021 (USGS National Water Information System site #03371650).

Table 4-2 Historical Peak Discharge at North Fork Nashville Stream Gage

Date	Peak Discharge (cfs)	Rank	% Probability of exceeding in a given year	Return period (years)
5/24/68	7,200	1	4%	27
3/9/64	7,130	2	7%	14
3/4/63	6,920	3	11%	9
5/24/81	6,620	4	15%	7
2/7/19	6,490	5	19%	5
7/13/79	6,000	6	22%	5
3/20/20	5,670	7	26%	4
6/19/21	5,430	8	30%	3
4/16/72	5,160	9	33%	3
1/30/69	4,950	10	37%	3
4/24/70	4,820	11	41%	2
7/15/62	4,600	12	44%	2
3/14/78	4,460	13	48%	2
2/25/18	4,460	14	52%	2
3/12/75	4,340	15	56%	2
4/2/77	4,310	16	59%	2
2/10/65	4,220	17	63%	2
2/24/16	4,100	18	67%	2
5/5/17	3,830	19	70%	1
12/9/66	3,820	20	74%	1
2/22/71	3,750	21	78%	1
4/8/74	3,430	22	81%	1
3/11/73	3,140	23	85%	1
2/10/66	2,620	24	89%	1
12/24/79	2,560	25	93%	1
12/15/75	2,350	26	96%	1

Peak discharge at the Nashville gage for the April 2020-March 2021 study year was 4,420 cfs and occurred on 2/28/21. The probability of a peak flow exceeding the study year discharge is

53%, corresponding to a 2-year return period. This indicates that the study year was not unusually wet or dry.

The highest discharge recorded during a monthly sampling event at North Fork Yellowwood was on 2/25/21. Daily flow at the Nashville gage on that date was 571 cfs, corresponding to less than a 1-year return period. This indicates that a representative peak flow was not captured and therefore the sediment and nutrient models are likely to underestimate loads.

The daily flow in each stream on 2/25/21 was also compared to daily flow throughout the study year. Daily flow at the South Fork Kurtz gage was 168 cfs, the 20th highest daily flow for the hydrologic year. Daily flow at the North Fork Kurtz gage was 571 cfs, the 10th highest daily flow for the hydrologic year. Since the data set for the North Fork model included a higher flow event, it better predicts loads during larger flow events and therefore generates higher annual load estimates than the South Fork model.

Overall, the flow frequency analysis indicates that the study year was not unusually wet or dry but that our sampling events failed to capture a representative peak flow event. Because our nutrient and sediment load calculations are based on regression models that do not contain representative peak flows, the models likely underestimate the nutrient and sediment load to the lake.