Louisville District
Water Quality
Program Management Plan

FY 2020

Prepared by the Louisville District Water Quality Team

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Table of Contents

Tables and Figures 2
Executive Summary 3
Introduction 4
Authorities 10
Mission and Objectives 11
Overview of the District's Water Quality Characteristics 13
Current and Emerging Water Quality Issues 13
Eutrophication 13
Climate Change 14
General Watershed Disturbances and Sedimentation 14
Harmful Algal Blooms (HABs) 14
Invasive Species 15
State Classified Impaired Waters 17
Reservoir Operations, Hydropower Monitoring and Water Quality 22
Hydropower Monitoring 22
Impacts of Limited Selective Withdrawal Capabilities 24
Water Quality Criteria Exceedances 25
Water Quality Program Implementation Strategy 25
Monitoring and Studies 25
Project Profiles 27
Ambient Surveys 27
Intensive Surveys 27
Emergency and Situational Response 28
Special Studies 28
Partnerships 29
Technical Assistance 30
Data Management and Analysis 30
Planning and Reporting 31
Risks, Challenges and Prioritization 33
Future Outlook 35
Signature Page 36

Tables and Figures

List of Tables

Table 1: Louisville District lake facts. Lakes are listed alphabetically. 5
Table 2: Louisville District Ohio River locks and dams information, listed upstream to downstream. 7
Table 3: Hydropower development on the Ohio River in the Louisville District. 9
Table 4: Select invasive species documented in District watersheds. 16
Table 5: District reservoir project watersheds with Clean Water Act Section 303(d) listed waters. 18
Table 6: District Ohio River project watersheds with Clean Water Act Section 303(d) listed waters. 20
Table 7: Description and status of Water Quality Program plan and report documents. 31
Table 8: Prioritized Water Quality Program Activities. Activities are listed from highest to lowest priority. 34

List of Figures

Figure 1: Louisville District Water Quality Program jurisdiction. 4
Figure 2: Lock and Dam 52 on the Ohio River. 6
Figure 3: Louisville District Ohio River Dams and Hydropower. 8
Figure 4: Cave Run Lake tower construction photograph showing selective withdrawal capabilities. 11
Figure 5: Fish are collected as part of biological assessments. 12
Figure 6: Harsha Lake HAB in 2017. 14
Figure 7: Goldfish found in the C.J. Brown Lake watershed during intensive surveys. 15
Figure 8: Original turbine installation at Markland. 23

Executive Summary

- The purpose of this document is to comply with ER 1110-2-8154 which stipulates, "Water managers in each district must develop district-specific Water Quality Program Management Plans (WQMPs)".
- The activities of the District's Water Quality Program are driven by the guidance and requirements set forth in ER 1110-2-8154, titled "Water Quality and Environmental Management for Corps Civil Works Projects".
- Water quality issues associated with the operation of water control projects led to the development of the water quality discipline within the Corps. The impacts of impounding a free-flowing waterbody can be detrimental, extensive and enduring. It is the policy of the Corps that the environment be given equal weight, not simply consideration, in all aspects of project management and the operational decision-making process.
- The Corps' water quality management authority is founded on the Federal Water Pollution Control Act of 1948 and its amendments. Several Corps policies support operating Corps projects in an environmentally responsible manner. These include Engineer Regulations, Engineer Manuals and the Environmental Operating Principles.
- ER 1110-2-8154 states, "The Corps operates a water quality management program to ensure that all applicable state and federal water quality standards are met, water quality degradation of Corps resources is avoided or minimized, and project responsibilities are attained."
- The District's Water Quality Program's area of responsibility includes 20 flood control reservoirs and 542 miles of the Ohio River.
- The District's Water Quality Program provides technical support on water quality issues to all District activities as requested. Routine technical assistance is provided to the District Hydropower Coordinator, Water Management, Planning and Operations.
- While water quality in the District is generally good, several water quality issues exist and need to be monitored. It is important to note that these water quality issues are similar to what is experienced in other non-Corps waterbodies in the area.
- It is Corps policy that a district's Water Quality Team and Water Management Team work closely together. Incredible strides have been made in increasing the coordination between both teams within the past year. Activities to this end include water quality directives, regular meetings between respective Team leaders, increased communication, partnerships on projects and input on plans and reports.
- The future looks fair for the District's Water Quality Program. The Water Quality Team is a small but capable team experienced at finding and implementing efficient solutions to challenges that arise. However, funding for the Water Quality Program has been sporadic in the past few years.
- Questions regarding this document should be directed to Jade L. Young.

Introduction

The U.S. Army Corps of Engineers (Corps) Louisville District (hereinafter, District) Water Quality Program's (WQP) area of responsibility includes 20 flood control reservoirs and 542 miles of the Ohio River (Figure 1). Along the Ohio River, nine locks and dams currently exist for navigation. The District drains waters of Illinois, Indiana, Kentucky, Ohio and Tennessee.

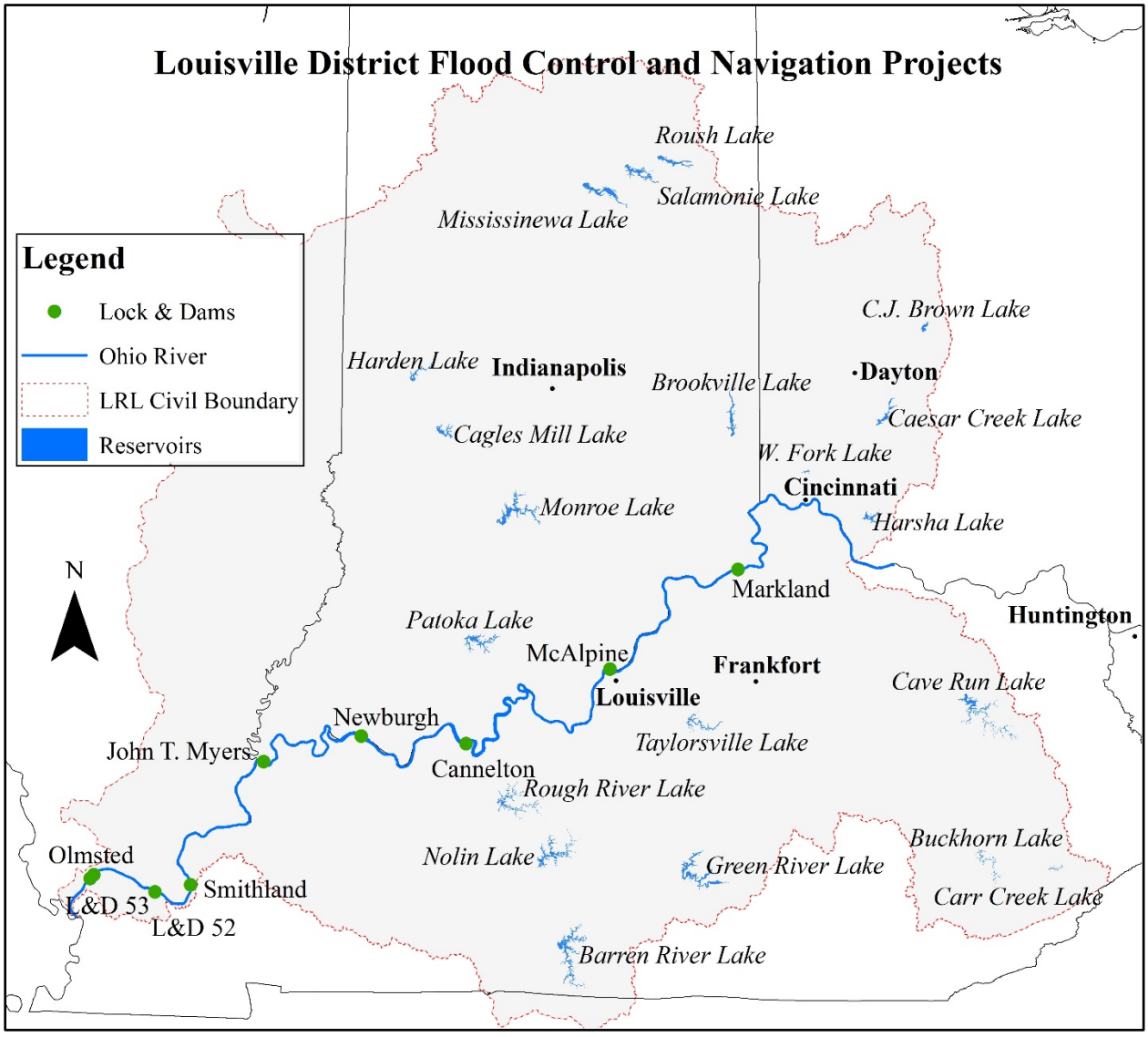

Figure 1: Louisville District Water Quality Program jurisdiction.

The District's twenty reservoirs exist in three states and are diverse in characteristics (Table 1). The landuse surrounding these reservoirs is mostly agricultural, some residential and some resource extraction. The District includes watersheds with amazing biodiversity and beautiful scenery. Great recreational opportunities exist and the District's projects host more than 28 million visitors annually.

Table 1: Louisville District lake facts. Lakes are listed alphabetically.

Lake	State	Began Operation	Surface Area of Seasonal Pool (Acres)	Flood Control	Recreation	Water Quality	Water Supply	Fish and Wildlife
Barren River Lake	KY	1964	10,000	X	X	X	X	
Buckhorn Lake	KY	1961	1,202	X	X			X
Brookville Lake	IN	1974	5,260	X	X	X	X	X
C.J. Brown Lake	OH	1974	2,120	X	X	X		
Caesar Creek Lake	OH	1978	2,830	X	X	X	X	X
Cagles Mill Lake	IN	1953	1,464	X	X	X	X	X
Carr Fork Lake	KY	1973	707	X	X	X	X	
Cave Run Lake	KY	1974	8,270	X	X	X		
Green River Lake	KY	1968	8,210	X	X	X	X	
Harden, Cecil M. Lake	IN	1960	2,110	X	X	X	X	
Harsha, William H. Lake	OH	1978	2,120	X	X	X	X	
Mississinewa Lake	IN	1967	3,180	X	X	X		X
Monroe Lake	IN	1965	10,750	X	X	X	X	X
Nolin River Lake	KY	1963	5,790	X	X	X	X	
Patoka Lake	IN	1979	8,750	X	X	X	X	X
Rough River Lake	KY	1960	5,100	X	X	X	X	
Roush, J. Edward Lake	IN	1969	900	X	X	X	X	
Salamonie Lake	IN	1966	2,665	X	X	X		X

Lake	State	Began Operation	Surface Area of Seasonal Pool (Acres)	Flood Control	Recreation	Water Quality	Water Supply	Fish and Wildlife
Taylorsville Lake	KY	1983	3,050	X	X	X		X
West Fork Lake	OH	1952	557	X	X			

The Ohio River is 981 miles long and drains 205,000 square miles (roughly 5% of the U.S. mainland). Its watershed contains approximately 25 million people (10% of the US population) and it serves American commerce as an efficient means of transporting products. The major causes of pollution to the Ohio River are urban runoff, agricultural activities and abandoned mines. Additional interesting facts about the Ohio River are listed below.

- The widest point along the Ohio River is one mile, at Smithland dam.
- The average depth of the Ohio River is around 24 feet.
- Around 160 species of fish have been collected from the Ohio River.
- The Ohio River is a source of drinking water for more than five million people.
- The Ohio River flows through or borders six states: Illinois, Indiana, Kentucky, Ohio, Pennsylvania and West Virginia.
- There are 20 locks and dams on the Ohio River for navigation.
- Thirty-eight electric power generating facilities exist on the Ohio River.
- More than 184 million tons of cargo are transported on the Ohio River each year, with coal being the most commonly transported product.

Figure 2: Lock and Dam 52 on the Ohio River.

The portion of the Ohio River within the District's area of responsibility starts immediately below Meldahl Lock and Dam and extends downstream to the river's mouth where it empties into the Mississippi River (Figure 1). The District oversees approximately 542 miles of the Ohio River for navigation. This currently includes nine locks and dams (Table 2). It should be noted that, as of today's date, Olmsted is

operational and it is planned that it will replace locks and dams 52 (Figure 2) and 53. The plan for replacement includes complete demolition of locks and dams 52 and 53, however this could change due to funding constraints. At least partial demolition is underway at both projects.

Table 2: Louisville District Ohio River locks and dams information, listed upstream to downstream.

Lock & Dam	Completion Date	River Mile	Upper Pool Distance (mi)	Dam Type	Lock Location	Hydropower
Markland	1964	531.5	95.3	Tainter gate	KY	YES
McAlpine	1830	606.8	75	Concrete fixed weir with tainter gate	KY	YES
Cannelton	1974	720.7	114	Concrete fixed weir with tainter gate	IN	YES
Newburgh	1975	776.1	55.4	Concrete fixed weir with tainter gate	IN	NO
J.T. Myers	1977	846.0	69.9	Concrete fixed weir with tainter gate	IN	NO
Smithland	1980	918.5	72.5	Concrete fixed weir with tainter gate	IL	YES
L&D 52	1928	939.0	-	Wicket	IL	NO
L&D 53	1929	962.0	-	Wicket	IL	NO
Olmsted	2018	964.4	45.9	Wicket and fixed weir with tainter gate	IL	NO

Navigation was the first civil works mission of the Corps and it is still of the utmost importance today. Several activities associated with navigation can have detrimental impacts to the Ohio River water quality and biological communities. This includes dredging, invasive species dispersal and hydropower.

The District does not own or operate any hydropower projects; however, four non-federal hydropower facilities exist at navigation dams in the District (Figure 3;Table 3). These hydropower generation stations are owned and operated by private entities and operate as run-of-the-river projects. They have been retrofitted to existing District locks and dams and the potential exists for the development of additional hydropower facilities at other District projects.

If improperly operated, hydropower facilities can have harmful impacts to water quality and biological communities in the Ohio River; most notably on dissolved oxygen concentration. Since these are Corps dams, we play a key role in assuring adequate controls on hydropower impacts. Corps policies requiring a "Memorandum of Understanding" (MOU) with hydropower licensees which include provisions on operating for and monitoring water quality conditions and require licensees to maintain water quality standards as appropriate. For the Ohio River, state water quality authorities typically refer to the water quality standards set by the Ohio River Valley Water Sanitation Commission (ORSANCO) and the District coordinates with these agencies regarding hydropower activities.

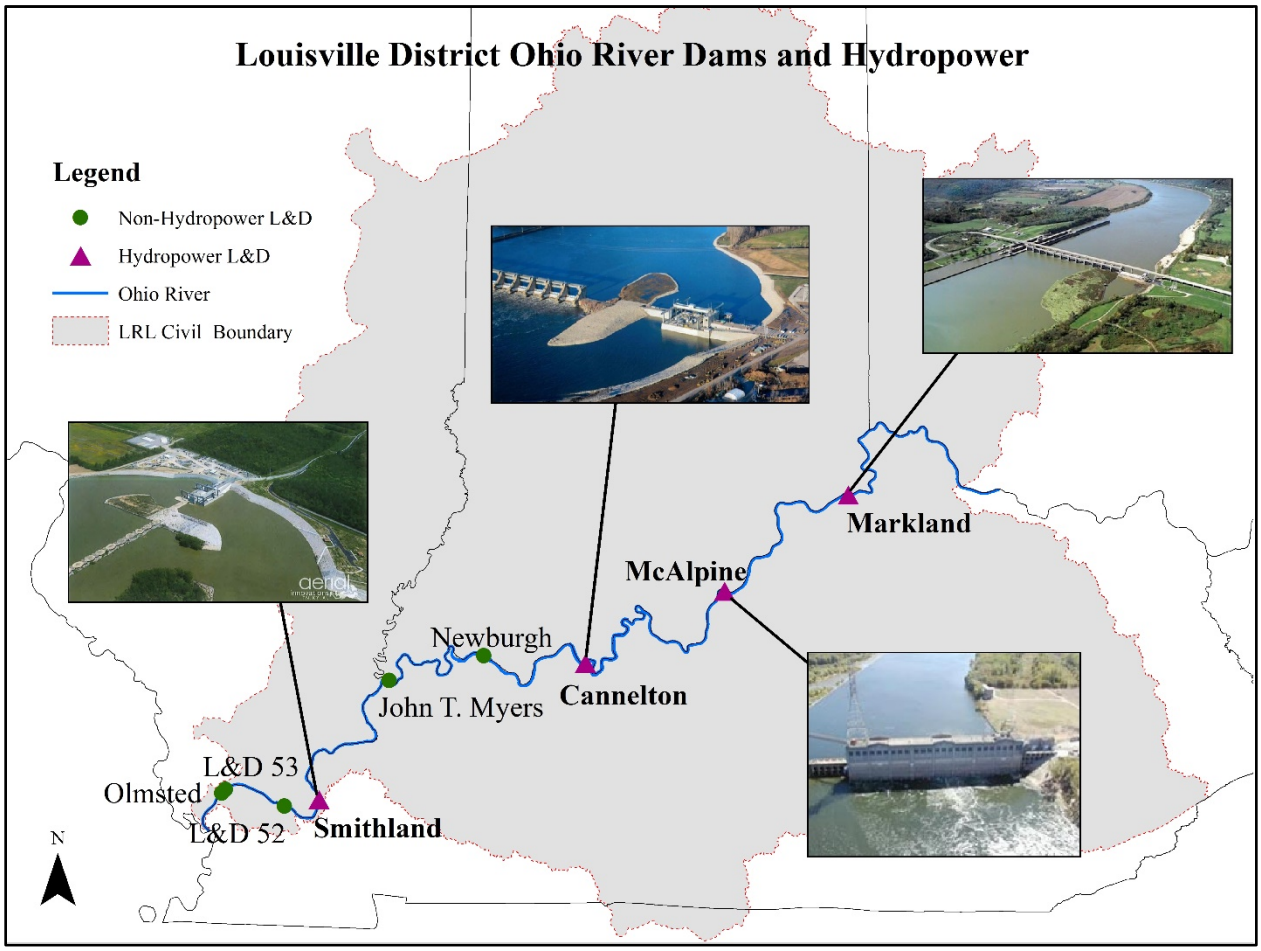

Figure 3: Louisville District Ohio River Dams and Hydropower.

Table 3: Hydropower development on the Ohio River in the Louisville District.

Lock & Dam	Current Hydropower	Hydropower Development Interest	Licensee	Capacity (megawatts)
Markland	YES	-	Duke Energy	64.8
McAlpine	YES	-	Louisville Gas & Electric	100.6
Cannelton	YES	-	American Municipal Power	88.8
Newburgh	NO	Preliminary License	Symbiotics	-
J.T. Myers	NO	Preliminary License	Symbiotics	-
Smithland	YES	-	American Municipal Power	72
L&D 52	NO	NO	-	-
L&D 53	NO	NO	-	-
Olmsted	NO	NO	-	-

The District's WQP is responsible for water quality issues related to all waters within the District's jurisdiction. Construction of a flood control reservoir or activities associated with navigation structures have major impacts to a watershed and the surrounding ecosystem. The flow of water through an impoundment continuously influences the physical, chemical and biological conditions both upstream and downstream, which ultimately determines the ecological integrity of the aquatic environment. Due to these influences, water quality must be an integral component of all Corps civil works missions. The Corps is mandated to meet all applicable Federal and State water quality standards and stewardship responsibilities at such projects as described in Engineer Regulation (ER) 1110-2-8154. In managing the operation of flood control and navigation projects, the Corps' decisions impact whether the projects have a positive or negative impact on the environment. As stewards of the environment, the Corps has a responsibility to conserve, protect and, where necessary, restore that portion of the environment influenced by Corps projects.

Water quality standards are provisions of law that describe the desired condition of a water body. Water quality standards form a legal basis for controlling pollutants entering the waters of the United States.

Authorities

The Corps' water quality management authority is founded on the Federal Water Pollution Control Act (FWPCA) of 1948 and its amendments including the Clean Water Act of 1977 and the Water Quality Act of 1987. Executive Order 12088, Federal Compliance with Pollution Control Standards (1978), requires Federal facilities to comply with applicable pollution control standards in the same manner as any non-Federal entity. ER 1110-2-8154 stipulates that it is Corps policy to develop and implement a holistic, environmentally sound water quality management strategy for all projects. Furthermore, it is a Corps goal to responsibly manage our projects to maximize environmental compliance. The Corps is also mandated to comply with native State regulations and standards as follows.

- Indiana Administrative Code Title 327, Article 2 – Water Quality Standards
- Kentucky Administrative Regulations Title 401, Chapter 10:031 – Surface Water Standards
- Ohio Administrative Code Chapter 3745-1 – Water Quality Standards

Key Supporting Publications

Several Corps policies support operating Corps projects in an environmentally responsible manner. These include ERs, Engineer Manuals (EMs) and the Environmental Operating Principles. Division and District documents are also important as they provide more specific goals and applications of these policies. Key documents are listed below.

- ER 1110-2-8154; Water Quality Management; 31 MAY 2018
- EM 1110-2-3600; Management of Water Control Systems; 10 OCT 2017
- ER 1110-2-240; Water Control Management; 30 MAY 2016
- ER 1110-2-1462; Water Quality and Water Control Considerations for Non-Federal Hydropower Development at Corps of Engineers Projects; 20 FEB 1991
- ER 1110-2-1454; Corps Responsibilities for Non-Federal Hydroelectric Power Development Under the Federal Power Act; 15 JUL 1983
- LRD Operation Order 2012-075; Regional Strategy for Improved Water Quality Monitoring on the Ohio River
- The Corps' Environmental Operating Principles
- U.S. Army Corps of Engineers Great Lakes and Ohio River Division (LRD) Water Quality Program Strategic Plan; October 2015
- Great Lakes and Ohio River Division Water Quality Program Strategic Plan Implementation Record for the Louisville District Water Quality Program; 16 MAR 2018

Mission and Objectives

Water quality issues associated with the operation of water control projects led to the development of the water quality discipline within the Corps. The impacts of impounding a free-flowing waterbody can be detrimental, extensive and enduring. It is the policy of the Corps that the environment be given equal weight, not simply consideration, in all aspects of project management and the operational decision-making process. The District's WQP satisfies this need by following the general objectives listed in ER 1110-2-8154:

1. Ensure that water quality affected by district activities and projects and their operations, are suitable for designated purposes, existing water uses and public health and safety and comply with applicable Federal, state, tribal and local laws and regulations, while meeting the purpose and objectives of the water resource development project.

Figure 4: Cave Run Lake tower construction photograph showing selective withdrawal capabilities.

2. Establish and maintain a water quality monitoring and data evaluation program that ensures the achievement of water quality management objectives, the evaluation of project performance, an understanding of water quality and associated trends and data essential for real-time modeling systems is available.

3. In a watershed context, identify existing and potential water quality problems, develop and implement effective operational strategies per applicable Corps authority and initiate management actions that offset or mitigate those problems.

4. Integrate water quality considerations into all water control management decisions.

5. Maintain coordination and communication among division and district elements involved in water quality matters.

6. Maintain close coordination and, where possible, collaboration with all interested governmental and non-governmental entities about activities that may affect (or be affected) by water quality or water control decisions associated with the Corps projects.

7. Use an interdisciplinary team approach to develop objectives, establish priorities and execute water quality management programs and activities.

8. Develop an understanding and continuing awareness of the water quality factors and processes in the project, its watershed and in the area influenced by project operation.

9. Where degraded conditions exist, explore appropriate Corps authority or legal requirements to address the conditions and develop plans to restore or improve water quality conditions as appropriate and feasible. These plans should be coordinated with appropriate Federal, state, tribal, local and other stakeholders.

10. Ensure that all Corps water resource activities result in the lowest potential negative impact to the aquatic environment and that they are managed to accentuate their potential to improve conservation and preservation of natural and cultural resources.

11. Document the water quality management activities of the Civil Works Programs and individual projects to record trends, identify problems and accomplishments and provide information and guidance.

12. Recognize that some problems and opportunities demand rapid, timely response. Per applicable emergency delegation authorities, district water managers may be empowered in some instances to react in a time frame commensurate with the event and with best available information and judgment. Long-term situations allow for more comprehensive study and refined response.

Figure 5: Fish are collected as part of biological assessments.

13. Promote and develop cost-sharing partnerships for water quality monitoring and data collection activities.

14. To the greatest extent possible, incorporate ecological sustainability and consider system response in all water resource activities.

15. In a watershed context, pursue collaboration with stakeholders and support education and communication.

16. Apply, as appropriate, water quality models and/or watershed-based management tools capable of predicting changes in water quality conditions in response to project operations and other water resource management activities. Water quality models and/or watershed-based management tools must be capable of evaluating changes in water quality within an acceptable level of uncertainty.

It should be noted that budget and personnel constraints will impact the pace and level at which the general objectives listed above can be met and maintained. A robust WQP is required to adequately meet district needs and policy requirements.

> "The water quality management program provides one of the greatest opportunities for the Corps to demonstrate its commitment to environmental leadership, conservation, restoration, and stewardship." **ER 1110-2-8154**

Overview of the District's Water Quality Characteristics

While water quality in the District is generally good, several water quality issues are known and ought to be monitored. It is important to note that these water quality issues of concern are similar to what is experienced in other non-Corps waterbodies in the area. Although it is the case that several of these issues are similar to other nearby waterbodies, increased awareness, attention and evaluation is typically required to understand lake dynamics and impacts to our operations and authorized purposes. This monitoring is supported by the objectives listed in ER 1110-2-8154. Examples of water quality issues include environmental flow management, mineral and resource extraction techniques, Harmful Algal Blooms (HABs), climate change, invasive species and non-Federal hydropower development.

Current and Emerging Water Quality Issues

Eutrophication

Eutrophication is the excessive presence of nutrients in a waterbody. Streams, rivers and reservoirs need nutrients to support primary productivity, and ultimately, all life in the waterbody. However, an excess of nutrients is detrimental to water quality and can cause harmful and excessive algal blooms, low dissolved oxygen and fish kills. Eutrophication is a natural phenomenon that occurs as a lake ages. However, human disturbances (e.g. agricultural runoff, residential fertilizers, sewage, etc.) greatly accelerate the process.

Through a series of biological and chemical processes, eutrophication can result in more extreme lake stratification and greater diurnal fluctuation in dissolved oxygen concentrations.

The result is less dissolved oxygen at depths that reduce the availability of favorable habitat for aquatic organisms. Impacts can extend to reduced recreational use (i.e. fish kills and the decreased perceived aesthetic value of the waterbody) and poorer quality drinking water. Additional negative impacts include diminished biodiversity, new species invasion and algal toxin production.

Climate Change

Climate change is a significant variation in weather patterns occurring over time. Corps policy requires that climate change adaption be mainstreamed into all Corps activities to help enhance the resilience of the Corps built and natural water resource infrastructure and to reduce its potential vulnerabilities to the effects of climate change and variability. One characteristic of climate change is increased temperatures. The USEPA has done an extensive trend analysis on approximately 25 years of District water temperature data. Preliminary results have indicated that reservoir temperatures are increasing.

General Watershed Disturbances and Sedimentation

Resource extraction, land development and farming are examples of watershed disturbances that negatively impact streams. Disturbances are directly correlated with increases in specific conductance, metals, sulfates and sedimentation that threaten biological communities and habitats. While sedimentation is naturally occurring, human activity has accelerated its prevalence, especially in reservoirs and large rivers. Sedimentation can influence nutrient transport, decrease water clarity and alter habitat, which in turn can threaten drinking water quality, biological organisms and recreational use opportunities.

Figure 6: Harsha Lake HAB in 2017.

Harmful Algal Blooms (HABs)

Freshwater HABs are significant and excessive growths of blue-green algae, also known as cyanobacteria. All freshwater lakes are inhabited by native cyanobacteria species that are capable of producing HABs. Several of these species can at times produce toxins (called cyanotoxins) that are harmful to the nervous system (neurotoxins), the liver (hepatotoxins) and the skin (dermatoxins) of humans and other animals. In addition to cyanotoxins, HABs can be harmful to the lake ecosystem and can cause depletion of oxygen levels which can result in large fish kills.

General contributing factors that promote the formation of HABs are:

- Ample sunlight
- Warm temperatures
- Low-water or low-flow conditions
- Excessive nutrients (nitrogen and phosphorus)

Although some HABs occur during the cold seasons, they most frequently occur during the summer when temperatures are high, sunlight is ample and the flow of incoming water is low. Also, one of the most influential factors of HAB growth is the concentration of nutrients such as nitrogen and phosphorus. Most nitrogen and phosphorus pollution (i.e., eutrophication) comes from the runoff of agricultural fertilizer, lawn fertilizer, untreated human sewage (storm overflows) and untreated animal sewage from concentrated animal feeding operations.

In a 29 June 2012 memo from CG Margaret Burcham, LRD Corps Districts were directed to develop HAB Response Plans in order to protect the public from the potential threats posed by HABs. In accordance with the memo, these plans are coordinated with the appropriate state agencies. As states refine and revise their statewide procedures, the Water Quality Team (WQT) continues to coordinate with them in order to have a cohesive approach. The District WQT has created HAB Response Manuals for each reservoir to serve as reference information on HAB response. Additionally, the District WQT coordinates with ORSANCO regarding Ohio River HAB response and provides a communication plan to lockmasters and staff. Also, the District WQT also provides information to the Invasive Species Leadership Team (ISLT) HAB Liaison for vertical communication regarding HAB issues.

Figure 7: Goldfish found in the C.J. Brown Lake watershed during intensive surveys.

Invasive Species

Invasive species are non-native plants, fish and wildlife which, by their introduction, can compete with and threaten the health and existence of native species and their supporting ecosystems. Invasive species often spread and dominate ecosystems due to the absence of natural biological controls that tend to keep native populations in balance. Asian carp, zebra mussels, quagga mussels and Eurasian water milfoil are examples of non-native aquatic species that may need to be managed on Corps project lands and waterways.

The WQT works with the ISLT regularly by providing input to our representative and responding to data calls. The ISLT is an 18 member team that consists of one representative

from each Division office and a representative from one of the District offices within each Division. Corps Headquarters (HQUSACE) proponents include representatives from Natural Resource Management and Navigation along with a technical proponent from the U.S. Army Engineer Research and Development Center (ERDC). The main objectives of the ISLT are:

- To establish a network for the exchange and sharing of information on invasive species challenges, action being taken by others, lessons learned and best management practices.
- To develop and provide strategic recommendations on a range of invasive species issues to Corps leadership.

The District's waters are impacted by invasive species (Table 4). This table is not a comprehensive list of all invasive species.

Table 4: Select invasive species documented in District watersheds.

Lake Watershed	Asiatic Clam	Bighead Carp	Common Carp	Goldfish	Hydrilla	Silver Carp	Water milfoil	Zebra Mussel
Barren River Lake	X		X					
Buckhorn Lake								
Brookville Lake			X					X
C.J. Brown Lake	X		X	X				
Caesar Creek Lake	X		X					X
Cagles Mill Lake	X	X						
Carr Fork Lake	X		X		X			
Cave Run Lake	X				X			
Green River Lake	X					X		
Harden, Cecil M. Lake	X		X					
Harsha, William H. Lake	X		X					
Mississinewa Lake		X	X					
Monroe Lake	X	X	X				X	
Nolin River Lake	X			X				
Patoka Lake	X						X	
Rough River Lake								

Lake Watershed	Asiatic Clam	Bighead Carp	Common Carp	Goldfish	Hydrilla	Silver Carp	Water milfoil	Zebra Mussel
Roush, J. Edward Lake	X	X	X	X		X		
Salamonie Lake			X					
Taylorsville Lake	X							
West Fork Lake	X		X					

In addition to the invasive species found in the District's lakes, the following invasive species have been identified in the Ohio River.

- Common carp
- Silver carp
- Bighead carp
- Asiatic clam
- Zebra mussels
- Marine scuds
- *Hydrilla verticillata*

The District WQP contributes to invasive species assessments through our intensive surveys and partnerships. Fish community assessments are included in these assessments due to the conclusions regarding long-term water quality conditions one can draw from the data. This data, with other District water quality data, is transferred to the state agencies to include in their assessments. This advances the understanding of invasive species habitat and dispersal.

State Classified Impaired Waters

Many streams within the District are listed as impaired waters by their respective states. The National Water Quality Inventory Report to Congress (305(b) report) is the primary means of informing Congress and the public about general water quality conditions in the United States. These reports consist of water quality assessments submitted by states, tribes and others and summarized by the US Environmental Protection Agency (USEPA) for Congress.

In addition to designated uses, the 305(b) report calls for a listing of impaired waters (Section 303(d)). States are required to develop and implement Total Maximum Daily Loads (TMDLs) for water resources listed on their respective 303(d) lists. District projects and major rivers/streams within the District found on current 303(d) lists are shown in Table 5 and Table 6.

"Designated Use" is a description of the use of the water body that is impaired, while the "Cause of Impairment" is a description of the cause of impairment. This information can be found in the Assessment and Total Maximum Daily Load Tracking and Implementation System (ATTAINS) USEPA database. The "Designated Use(s)" are listed by numbers while the "Cause of Impairment(s)" are listed by letters.

The District WQP contributes to this assessment through our partnerships and coordination with state agencies. The District's water quality data is transferred to the appropriate state water quality agency for inclusion in their data framework. From there, data is assessed alongside state (and other) collected water quality data in Clean Water Act (CWA) assessments. The WQT takes special care to ensure that our data is up to the best standards for inclusion in states' CWA assessments and that data is received by the agencies in time and proper format for analysis. This is one way that the District's WQP contributes to improvements in water quality in our watersheds.

Table 5 and Table 6 show the range of impaired designated use and cause of impairment for all waters within District project watersheds, with reservoir projects in Table 5 and Ohio River projects in Table 6. Note that these listings do not necessarily apply to the watershed as a whole, but rather applies to a single or multiple waterbodies within the watershed. These values are reported by the state and information can be found in the ATTAINS USEPA database. More information regarding column interpretations is listed below.

Table 5: District reservoir project watersheds with Clean Water Act Section 303(d) listed waters.

Lake	Year[1]	Impaired Designated Use/ Cause of Impairment[2]
Barren River Lake	2014	Not impaired
Buckhorn Lake	2014	Not impaired
Brookville Lake	2008	1. Fish consumption a) Mercury in fish tissue b) PCB(s) in fish tissue
C.J. Brown Lake	1998	1. Aquatic life a) Organic enrichment/low dissolved oxygen
Caesar Creek Lake	2010	1. Aquatic life a) Nutrients b) Organic enrichment/ low dissolved oxygen c) Siltation 2. Recreation a) *Escherichia coli* (E. coli)

Lake	Year[1]	Impaired Designated Use/ Cause of Impairment[2]
Cagles Mill Lake	2010	Not impaired
Carr Fork Lake	2008	1. Secondary contact recreation water a) Sedimentation/siltation b) Total suspended solids 2. Warm water aquatic habitat a) Dissolved oxygen b) Nutrient/eutrophication biological indicators c) Organic enrichment (sewage) biological indicators
Cave Run Lake	2014	1. Fish consumption a) Methylmercury
Green River Lake	2014	1. Fish consumption a) Mercury in fish tissue b) PCB(s) in fish tissue
Harden, Cecil M. Lake	2010	1. Human health and wildlife a) Mercury in fish tissue b) PCB(s) in fish tissue
Harsha, William H. Lake	NA	1. Aquatic life a) Nutrients b) Pathogens c) Siltation d) Organic enrichment/low dissolved oxygen e) Flow alteration(s) f) Habitat alterations g) Ammonia, unionized
Mississinewa Lake	2010	1. Human health and wildlife a) Mercury in fish tissue b) PCB(s) in fish tissue
Monroe Lake	2010	1. Human health and wildlife a) Mercury in fish tissue 2. Public water supply a) Chlorophyll-a b) Taste and odor
Nolin River Lake	2014	Not impaired
Patoka Lake	2010	1. Human health and wildlife a) Mercury in fish tissue
Rough River Lake	2014	1. Fish consumption a) Mercury in fish tissue
Roush, J. Edward Lake	2008	1. Fish consumption a) Mercury in fish tissue b) PCB(s) in fish tissue
Salamonie Lake	2010	1. Human health and wildlife a) Mercury in fish tissue b) PCB(s) in fish tissue

Lake	Year[1]	Impaired Designated Use/ Cause of Impairment[2]
Taylorsville Lake	2014	1. Fish consumption a) Methylmercury 2. Warm water aquatic habitat a) Dissolved oxygen b) Nutrient/eutrophication biological indicators
West Fork Lake	1998	1. Aquatic life a) Nutrients b) Organic enrichment/ low dissolved oxygen c) Siltation 2. Recreation a) Oil and grease

1. The year of the most recent data from the ATTAINS USEPA database.
2. "Designated Use" is a description of the use of the water body that is impaired, while the "Cause of Impairment" is a description of the cause of impairment. This information can be found in the ATTAINS USEPA database. The "Designated Use(s)" are listed by numbers while the "Cause of Impairment(s)" are listed by letters.

Table 6: District Ohio River project watersheds with Clean Water Act Section 303(d) listed waters.

Lock & Dam Pool	Year[1]	Impaired Designated Use/ Cause of Impairment[2]
Markland	2014	1. Fish consumption a) Dioxin (including 2,3,7,8-TCDD) b) Polychlorinated Biphenyls (PCBs) 2. Primary contact recreation water a) *Escherichia coli* (E. coli)
McAlpine	2014	1. Fish consumption a) Dioxin (including 2,3,7,8-TCDD) b) Polychlorinated Biphenyls (PCBs) 2. Primary contact recreation water a) *Escherichia coli* (E. coli)
Cannelton	2014	1. Fish consumption a) Dioxin (including 2,3,7,8-TCDD) b) Polychlorinated Biphenyls (PCBs) c) Mercury in fish tissue 2. Primary contact recreation water a) *Escherichia coli* (E. coli) 3.Warm water aquatic habitat a) Iron

Lock & Dam Pool	Year[1]	Impaired Designated Use/ Cause of Impairment[2]
Newburgh	2014	1. Fish consumption a) Dioxin (including 2,3,7,8-TCDD) b) Polychlorinated Biphenyls (PCBs) c) Mercury in fish tissue 2. Primary contact recreation water a) *Escherichia coli* (E. coli)
J.T. Myers	2014	1. Fish consumption a) Dioxin (including 2,3,7,8-TCDD) b) Polychlorinated Biphenyls (PCBs) c) Mercury in fish tissue 2.Primary contact recreation water a) *Escherichia coli* (E. coli) b) Fecal coliform 3.Warm water aquatic habitat a) Iron
Smithland	2014	1. Fish consumption a) Dioxin (including 2,3,7,8-TCDD) b) Polychlorinated Biphenyls (PCBs) c) Mercury in fish tissue d) Dioxin 2. Primary contact recreation water a) *Escherichia coli* (E. coli) b) Fecal coliform 3.Warm water aquatic habitat a) Iron
L&D 52	2014	1. Fish consumption a) Dioxin (including 2,3,7,8-TCDD) b) Polychlorinated Biphenyls (PCBs) c) Mercury in fish tissue 2. Primary contact recreation water a) *Escherichia coli* (E. coli) 3.Warm water aquatic habitat a) Iron
L&D 53	2014	1. Fish consumption a) Dioxin (including 2,3,7,8-TCDD) b) Polychlorinated Biphenyls (PCBs) c) Mercury in fish tissue 2. Primary contact recreation water a) *Escherichia coli* (E. coli)

Lock & Dam Pool	Year[1]	Impaired Designated Use/ Cause of Impairment[2]
Olmsted	2014	1. Fish consumption a) Dioxin (including 2,3,7,8-TCDD) b) Polychlorinated Biphenyls (PCBs) c) Mercury in fish tissue 2. Primary contact recreation water a) *Escherichia coli* (E. coli)

1. The year of the most recent data from the ATTAINS USEPA database.
2. "Designated Use" is a description of the use of the water body that is impaired, while the "Cause of Impairment" is a description of the cause of impairment. This information can be found in the ATTAINS USEPA database. The "Designated Use(s)" are listed by numbers while the "Cause of Impairment(s)" are listed by letters.

Reservoir Operations, Hydropower Monitoring and Water Quality

Corps projects and water management activities impact natural resources in a variety of ways. Corps projects and their mode of operation influence the quality of the ecosystems, the usefulness of the water resource and the overall benefit derived from a project and/or water resource management activity. The impacts of projects and their operation may be destructive in some cases and have the capacity to affect the environment quite distant from the project. Therefore, efforts to maintain good water quality should be made while operating water resource projects.

Hydropower Monitoring

Although the District does not operate any hydropower projects, there are four non-Federal hydropower projects that have been retrofitted to District locks and dams on the Ohio River. Per Corps policy, non-Federal hydropower is supported at Corps projects so long as it is consistent with authorized project purposes and the objectives of water control and water quality management. The licensing program for non-Federal hydropower at Corps projects is administered by the Federal Energy Regulatory Commission (FERC); however, the Corps is involved throughout the licensing process and a MOU must be agreed upon by the District and the licensee. The MOU shall state Corps authority to change project operating criteria at any time and to order the licensee to cease operation of the hydropower facility if it is deemed to be detrimental to water quality or other Corps objectives.

Hydropower facilities typically have two types of impacts on a river and its resident aquatic life. First, the turbines can cause mortality to fish which pass through the facility. Second, the diversion of river flow through a hydropower facility can prevent the rapid introduction of oxygen, which is more likely to occur if water is passed through the dam. During low flow periods, aeration at dams is the major source of dissolved oxygen to the Ohio River.

Figure 8: Original turbine installation at Markland.

To ensure water quality objectives are met, the District applies directives from the LRD Operation Order 2012-075 to its MOU's, which places the responsibility on the licensee to monitor water quality at hydropower facilities and take action as follows:

- From 1 May through 31 October of each year, the Licensee will continuously measure and record in real time the water temperature and dissolved oxygen (DO) concentration both upstream and downstream of the dam, at locations approved by the District and other appropriate water resources agencies throughout the license term or until such time as the Licensee ceases to operate the hydroelectric project.
- The Licensee will provide to the District, on an electronic and continuous basis (e.g., Internet website) real-time, continuously recorded DO and water temperature data upstream and downstream of the hydroelectric facility from 1 May through 31 October of each year. Additionally, an Annual Report summarizing the data will be submitted to the District and the Division by December 1 of each year. The data provided does not relieve licensees from their obligation to monitor closely and adjust operations in order to meet state minimum WQ criteria or other MOU with the District, i.e. DO instantaneous or averages included in the license requirements; nor does it absolve the licensee from reporting/distributing data to appropriate state water quality agencies as required by other existing agreements.

District hydropower facilities are located in Kentucky and Indiana, in which case both states follow water quality criteria for dissolved oxygen as determined by ORSANCO, which is as follows:

- The minimum DO concentration shall not be less than 4.0 mg/L at any time.
- Average DO concentration shall be at least 5.0 mg/L for each calendar day.
- During the April 15 – June 15 spawning season, a minimum concentration of 5.0 mg/L shall be maintained at all times.

In the event water quality criteria is exceeded, the hydropower facility must immediately notify the District (and later ORSANCO, FERC and the state regulatory authorities) and must coordinate corrective action, which typically includes either "venting" (curtailing the amount of water passing through turbines which may allow some aeration) or shutting down the hydropower facility and passing all water through the dam.

The District WQP supports and provides guidance to the District's Hydropower Coordinator regarding water quality at hydropower facilities, including reviewing licensing documents, reviewing licensee water quality monitoring reports, regularly monitoring real-time water quality conditions at projects and assisting with corrective action coordination or response to emergency events.

Impacts of Limited Selective Withdrawal Capabilities

Selective withdrawal capabilities (i.e. multi-level intakes) describe a reservoir's ability to select and release water from different depths within a reservoir. These capabilities exist and are necessary to properly maintain reservoir and tailwater water quality characteristics during operations. Mimicking a natural temperature regime in the tailwater is critical for wildlife downstream of the reservoir. Additionally, the maintenance of cold water within the reservoir is important as it is a limited resource and can serve to mitigate other water quality problems.

All of these considerations derive from the fact that during the warmer season, most reservoirs undergo a process called thermal stratification. Thermal stratification results in a separation of the lake into three very distinct layers. From top to bottom, these layers are called the epilimnion, metalimnion and hypolimnion. While this process is driven by temperature, each of these layers have unique physical, chemical and biological characteristics.

> "Water quality releases for downstream management have both quantitative and qualitative aspects. One of the most common measures of water quality is flow. At many projects authorized for water quality management, a minimum flow at a downstream control point is the water quality objective. However, flow alone does not ensure a sustainable downstream habitat for aquatic life."
>
> **EM 1110-2-3600**

When a reservoir has limited selective withdrawal capability, an unnatural and harmful temperature regime is created in the tailwater. Limitations in selective withdrawal capabilities will almost always result in too cold tailwater releases in the spring and summer and too warm tailwater releases in the fall. This is due to the fact that if a reservoir's selective withdrawal capabilities are inadequate, water will mostly or only be released from the hypolimnion (i.e. bottom layer) of the reservoir. Over time, this depletes the volume of cold water in the reservoir resulting in tailwaters and reservoirs that are too warm during the fall and early winter.

Inappropriate (too cold or too warm) temperature releases in the tailwater harm aquatic wildlife in many ways. First, unnatural temperature regimes interrupt breeding queues resulting

in diminishing populations. Secondly, temperature impacts an aquatic organism's growth and feeding habits. Additionally, water temperature can increase the harmfulness of certain water quality parameters on aquatic wildlife (e.g. ammonia). Lastly, the solubility of oxygen is decreased as water temperature increases.

Over the summer, a reservoir with insufficient selective withdrawal capabilities will increase in temperature. Increased temperature in the reservoir promotes algae growth. Eventually, these excessive algae blooms will die and be consumed by bacteria. The bacteria that consumes the algae will deplete oxygen levels in the reservoir potentially causing fish kills within the reservoir body as well as the tailwater. Low reservoir dissolved oxygen is experienced in many District reservoirs. The occasional fish kill is documented due to this dissolved oxygen depletion.

Water Quality Criteria Exceedances

Water quality criteria define acceptable levels of contamination in the environment. The CWA directed the USEPA to develop water quality criteria for the protection of aquatic life. These criteria can be adopted as enforceable standards by states and tribes. Exceedances of water quality criteria are assessed in the District as encouraged in ER 1110-2-8154. Water quality criteria exceedances in the District are not numerous or extreme, however they have been documented within the past couple of years. Exceedances of copper, dissolved oxygen, temperature, mercury, iron, ammonia, zinc and pH have been documented in the District. Any and all exceedances found are reported to the state lead water quality agency as well as other partners. Additionally, any exceedances found within a year will be specified and discussed in the WQP's Annual Report.

Water Quality Program Implementation Strategy

A water quality program designed to monitor status and trend data is essential to understand and effectively manage the District's water resource projects. According to ER 1110-2-240, water control management responsibilities include, "Analyzing water quality parameters necessary to evaluate proposed operations and inform water control management decisions." Therefore, it is crucial that the District's WQP be adequately staffed and funded in order to provide current information as well as track trends (i.e. increases, decreases, or status quo in analyte levels). Such data can be shared with water managers, watershed interests, policy makers and other potential stakeholders.

Monitoring and Studies

Due to the diversity in the District's water quality needs and the quantity of water managed by the District, a strong water quality program is necessary. Water quality data must be collected, analyzed and applied to understand and manage water resources effectively. The

following examples of water quality monitoring and data collection objectives are listed in ER 1110-2-8154.

1. Assess compliance with applicable Federal, state and tribal water quality standards.
2. Provide adequate, publicly available database for understanding current water quality conditions, identifying trends, identifying problems and solutions and facilitating coordination with Federal, state and tribal agencies regarding watershed activities influencing water quality.
3. Investigate special problems [such as harmful algal blooms (HABs), fish kills, radionuclides, or other acute or chronic conditions] and design and implement modifications to improve water management procedures.
4. Provide data to support reservoir regulation and other civil works activities, support effective management, manage water quality and address environmental problems.
5. Provide water quality data required for real-time project operation, which may include regulatory compliance, environmental flow management and ecological sustainability.
6. Evaluate sediment physiochemical interactions with water quality conditions and their effects on overall water quality.
7. Understand, protect and restore aquatic and riparian environments and ecosystems.
8. Through training, Community of Practice lessons learned and close attention to system response, develop and maintain water quality awareness to ensure sound stewardship of environmental resources.
9. Monitor recreational areas and water supplies to ensure public safety and restore integrity.
10. Ensure stormwater, erosion and sediment control best management practices are designed, constructed, maintained and functioning per applicable state and local requirements.
11. Collect water quality data to support studies, evaluations and water resource modeling.
12. Consider spatial watershed relationships or conditions through both short and long-term seasonal, annual and/or multi-annual trends in water quality.
13. Identify/modify water quality data collection requirements to meet evolving management objectives, regulatory requirements and/or Corps policies.

14. Develop a sufficient data record to document water quality impacts or harm to project purposes and/or resources from external sources.

15. Provide timely response to incidents that could impact project operations and/or resources.

In order to meet Corps policy on water quality and environmental protection, a variety of techniques must be used. Several of these approaches are described in EM 1110-2-3600. These methods include a diverse set of water quality surveys and studies. These surveys and studies are accomplished through in-house collection, contracts and partnerships. Stringent quality control procedures are followed on all data collection and sampling activities. At times, the types of surveys, sampling, analyses and frequency of sampling must be altered in response to environmental events, weather, staffing levels and budget constraints. Below is a description of the types of surveys and studies necessary to meet the District's WQP objectives.

Project Profiles

Project profiles monitor the status and progression of thermal and chemical stratification in a reservoir. Project personnel take temperature and dissolved oxygen readings approximately once every two weeks during reservoir stratification. These profiles are collected at all reservoir projects. Data includes the reservoir profile as well as a tailwater reading of temperature and dissolved oxygen. Data collected from these readings are used to manage the quality of the release from the reservoir. Data from the United States Geological Survey (USGS) gages are also used, when available.

Ambient Surveys

The purpose of ambient surveys is to capture the status of water quality in the reservoir during thermal stratification. This effort is conducted through an annual contract. Contractors travel to each of the twenty reservoirs to sample the reservoir body, primary inflows and tailwater. They collect field data and grab samples for various chemical and biological (e.g. phytoplankton, zooplankton and chlorophyll) analyses. Water quality parameters measured and tested are relatively standard, however, customized plans have been and are being developed for many reservoirs. This data is used to evaluate reservoir operations and environmental concerns, both long and short term in nature.

Intensive Surveys

Intensive Surveys are designed to more thoroughly assess water quality parameters within a watershed. These surveys are conducted on a ten year rotation (i.e. two reservoirs per year) at every reservoir. Sample stations are sampled three times – during the spring, summer and fall. Sample sites, additional to what would be included in ambient surveys, are added. Additional biological assessments are conducted (e.g. fish and macroinvertebrates) and

additional water quality parameters may be assessed. This provides a seasonal and more in-depth picture of water quality status of a reservoir.

Emergency and Situational Response

Emergency and situational response surveys are conducted on an as-needed basis. These surveys are typically in response to an unusual environmental event (e.g. fish kills, plankton blooms, chemical spills). However, these surveys can also be in response to a rare change in operations such as periodic inspections which allow access to habitat that is typically too deep and rapid to assess. Data collected during these surveys is reviewed, imported into the LRL WQ database and used in future assessments. Additionally, a special report or public advisory may be issued based upon data results.

E. coli Monitoring

Escherichia coli (E. coli) is a type of bacteria that is used to measure levels of fecal contamination in order to prevent illness. Fecal contamination is monitored at Corps-operated public beaches, which is limited to only Barren River Lake, Green River Lake, Nolin River Lake and Rough River Lake in the District. Historically, each of these lake offices have conducted E. coli monitoring independently of the WQP. However, the WQP developed an SOP to assist District project staff in the collection, monitoring and response of E. coli data. The E. coli SOP was implemented during the 2019 recreation season. It follows state regulations and intends to centralize E. coli data into the WQP database for research, analysis and reporting purposes. Lake project staff will continue to lead the monitoring of E. coli at beaches and the WQT will provide technical assistance as needed.

Harmful Algal Bloom (HAB) Response

HAB response is a type of emergency response sampling that occurs when a HAB is suspected. All efforts are coordinated with Operations project staff and state agencies per the HAB Response Plan instructions for the specific state. These efforts occur only as needed.

Special Studies

Special studies are planned, non-routine efforts to answer questions about a reservoir and/or its watershed. These surveys are supported by ER 1110-2-8154. Types of special studies that have been conducted in the District include but are not limited to modeling, greenhouse gas, sediment, bathymetry, data collection efficacy analysis and complex HAB analyses. These studies are conducted on an as-needed basis.

Partnerships

Partnerships are critical to program success. The views of other federal, state and local agencies must be considered when developing or revising water control plans or designing new water quality studies. Because data collection can be costly and labor-intensive, efforts to share data collection will result in a more efficient and effective water quality program. Coupling water quality data with hydrologic, climatic and other environmental data is essential for a water management program.

The District's water quality partners include:

- United States Environmental Protection Agency
- United States Geological Service
- United State Fish and Wildlife Service
- Kentucky Division of Water
- Kentucky Department of Fish and Wildlife Resources
- Indiana Department of Environmental Management
- Indiana Department of Natural Resources
- Ohio Environmental Protection Agency
- Ohio Department of Natural Resources
- Ohio River Valley Water Sanitation Commission
- University of Cincinnati
- The Nature Conservancy
- Friends of Caesar Creek
- Friends of Lake Monroe
- Patoka Lake Watershed Committee
- East Fork Watershed Cooperative
- Salamonie Watershed Committee
- Several internal Corps entities

> "The Corps interests are strictly defined by statute, regulation, and policy to extend to specific areas that are influenced by and influencing the water the Corps manages. Because water resource management activities often interact with environments distant from the boundaries of Corps-managed property and are influenced by actions of others also distant from those properties, the Corps must actively pursue a water quality management philosophy committed to collaborating with a wide range of resource organizations, partners, and stakeholders."
>
> **ER 1110-2-8154**

The District's WQT prioritizes partnerships with other water resource agencies to leverage resources, obtain expertise and access services additional to what is available within the District. Every effort is taken to ensure that the District receives the best information and highest quality assessments that are available. Additionally, working collaboratively with partners not only leverages resources but also serves to further advance the field in general and improve water quality.

Technical Assistance

The District's WQP will provide technical support on water quality issues to all District activities as requested. The degree of support is dependent upon staff and resource availability. Currently, routine technical assistance is provided to the District Hydropower Coordinator, Water Management (WM), Planning and Operations.

Data Management and Analysis

Water quality monitoring and data collection are essential to understand and manage the environmental resources of Corps water projects. In order for the District's WQP to provide benefit to the District, the program must not only collect data, but organize, preserve the quality thereof and analyze data. Data maintenance and analysis are equally important to data collection.

When water quality data is received, it is formatted and imported into the District's live water quality database as soon as possible. All District water quality data is stored in one database located on a local server. This database is regularly backed up and secured in several locations for redundancy and protection. The District's water quality database is a Microsoft Access file. To interact with the database, the WQT uses a program called Data Analysis Software for Lakes, Estuaries and Rivers (DASLER). DASLER is used as an interface to work with the Access file.

DASLER is a software program that was developed by the Nashville Corps District for the management of Corps water quality data. The program is approved by ACE-IT and was created in 1996. Other components of DASLER include a GIS interface and numerous graphing and analysis utilities. Over the years, DASLER has been developed to better serve the Corps' water quality community and is still in development today. The District has used DASLER sporadically since 1998 and exclusively since 2012. The District has worked with the DASLER software developer to create our own utility in DASLER that assists us in more quickly and easily creating products needed to operate reservoirs.

Some data that are received (e.g. project profiles) are immediately imported, analyzed and used to make reservoir operations. Once these operations are made, the data are still used in other analyses. For more complex analyses, graphical and statistical methods are used. Data analysis currently conducted in the District include status analyses, determination of existing limnologic conditions, level of attainment of existing federal and state water quality standards and various biological assessments. Results of these assessments are shared in the District's WQP Annual Report. Future assessments include but are not limited to trend analyses, problem identification and quantification and the application of water quality models.

The Water Resources Development Act (WRDA) of 2007 directed the Corps to make all water data accessible to the public via the internet. In 2009, the Committee on Water Quality submitted a Water Quality Data Implementation Plan to meet the requirements of WRDA 2007.

The Corps is in the beginning stages of satisfying the WRDA requirement by making water quality data publically available via Access 2 Water (A2W). Once the A2W program and process is complete, the District WQP will migrate all program data to the A2W website for public use. Currently, the public can access any data by contacting the District WQT; this information and the WQT's contact information is found on the WQT's webpage.

Planning and Reporting

The District WQP produces several plans and reports that aid in managing the program (Table 7). Some plans and/or reports are updated annually. However, some are updated only as needed. It should be noted that keeping these documents up to date requires adequate staff. Some of these documents do not yet exist but the creation and implementation of them is a goal, so they are still listed in the table below.

Table 7: Description and status of Water Quality Program plan and report documents.

Document	Update Frequency	Description	Existence
Water Quality Program Management Plan	Annually	Aids in establishing program goals, objectives and priorities for surface water quality issues within the District.	YES
Annual Operating Plan	Annually	Lists program priorities and needs for the WQP within a specific fiscal year. A fiscal year budget summary is included.	YES (abbreviated)
Annual WQ Report	Annually	Detailed review and assessment of water quality activities over the previous calendar year. Findings and recommendations from this report are used to prioritize future budget requests and monitoring needs.	YES
HAB Response Plans	As needed	Assists in protecting the public from the potential threats posed by HABs. They are coordinated with state agencies and Operations.	YES
E. coli SOP	As needed	Serves as reference information on E. coli collection, monitoring and response at LRL lake projects that operate public beaches.	YES
Database Management SOP	As needed	Serves as reference information regarding data management practices for the Water Quality Program in the District.	NO
Exceedance Assessments	Annually	Assesses impacts of reservoir operations and policy requirement attainments. Exceedances are included in the Water Quality Program Annual Report.	YES

Document	Update Frequency	Description	Existence
State Sampling Plans	As needed	Often required by state agencies for accepting data external to their agency.	YES
Strategic Plan Implementation Record	As needed	Describes and records the implementation of the LRD WQP Strategic Plan in the District's WQP.	YES
Water Management Annual Report (contribution)	As requested	Reviews and assesses the management of the District's multi-purpose reservoirs and technical support of the Ohio River locks and dams.	YES
Water Management Program Management Plan (contribution)	As requested	Establishes the basis for managing the Water Management products and services conducted by the District, Water Management Team.	YES
Quality Assurance / Quality Control	As needed	A quality assurance/quality control program covering all aspects of data collection and analysis is required to ensure that data is valid and reproducible.	NO
Reservoir Water Control Manuals (contribution)	As requested	For day-to-day use in water control for essentially all foreseeable conditions affecting a project or a system. Water control plans should be updated not less than once every 10 years.	YES

Programmatic planning promotes the success of programs in many ways. Planning establishes priorities and guides the alignment of programmatic elements to meet district, regional and national objectives. Programmatic planning ensures that programs stay on track long-term when impairments such as inadequate manpower or funding occur. Additionally, prioritization through adequate planning increases the likelihood that the best decision will be made in any given situation.

ER 1110-2-8154 recognizes that various types of reports are required to ensure that adequate information is available to HQUSACE, divisions, districts, other agencies and the public. The ER lists several types of reports including project-specific reports, needs assessment reports, special situation reports, special study reports and annual water quality summary reports. Reports are important as they interpret and share water quality data and analyses.

Risks, Challenges and Prioritization

With so many working parts, integration between offices and a field that involves the environment, it's no surprise that implementing a WQP carries a substantial amount of risk. Risks to the WQP can be separated into three categories – internal, external and natural. Specific risks and impacts of each type are described below.

Internal risks include funding constraints, contracting issues and staffing limitations. A loss of funding, staff or contracting authority will ultimately result in a decreased ability to meet WQP objectives and maintain compliance with laws and regulations. The program serves as the only long-term, continuous water quality monitoring effort within the District. Data collection is vital for determining long-term trends relative to state water quality standards, watershed conditions, recreational conditions and drinking water quality. Additionally, the states use data to determine compliance with state water quality standards, determine if waters require listing on impaired waters lists and determine if TMDL requirements are achieved.

External risks include laboratory quality assurance/quality control (QA/QC) issues, laboratory closure and sample equipment malfunctions and repair delays. The WQT Leader is responsible for deciding how to address such issues and determining both short and long-term program impacts.

Natural risks include weather (short-term) and climate (long-term) impacts. Weather can influence scheduled sampling events, and poses the most risk to events that are coordinated between multiple agencies. Climatic conditions can also impose risks to scheduled monitoring efforts. Prolonged drought conditions have the potential to reduce inflow and in-lake sample locations. Expansive floods can alter inflow sample locations and sample schedules. The WQT Leader will be responsible for determining alterations or modifications to annual sampling schedules related to such natural risks.

> ER 1110-2-8154 states that Corps Districts will adopt the following as a general objective: "Integrate water quality considerations into all water control management decisions."

The WQT Leader, in consultation with the rest of the WQT and the Environmental Engineering Section Chief, will determine the most effective plan to address any of the aforementioned risks. When funding and staffing limitations exist, prioritizing activities can be difficult. However, this is when adequate planning is most critical. Although priorities may change year to year, below is a general description of WQP priorities (Table 8). It should be noted that all items included in Table 8 are supported by Corps policy and are important. However, Table 8 can be used to promote a general understanding of how decisions are made in the WQP.

Table 8: Prioritized Water Quality Program Activities. Activities are listed from highest to lowest priority.

Activity	Description	Impacts
Emergency Response	Response to unusual or hazardous conditions such as HABs or E. coli.	• Project purposes
Project Profiles	Used to manage the quality of releases from the reservoir.	• Daily operation • Compliance assessment • Trend analysis • Technical support
Data Management (Current Year)	Ensures that data integrity is preserved for current and future needs.	• Current analysis • Future analysis • Data integrity
Plans and Reports	Promotes the most efficient use of resources, analysis and communication.	• Efficiency • Analysis • Communication
Tailwater Assessments	Used to manage the quality of releases of a large number of water quality parameters from the reservoir.	• Compliance • Trends • Technical support
Ambient Surveys (Reduced)	Monitors water quality within reservoir and primary tributaries on a basic scale.	• Technical support • Modeling • Trend analysis
Intensive Surveys	Captures seasonal water quality conditions within the reservoir and primary tributaries.	• Daily operation • Seasonal impacts • Trend analysis • Technical support
Biological Surveys	Monitors long-term water quality conditions.	• Long-term impacts
Ambient Surveys (Full)	Monitors water quality within the reservoir and primary tributaries on a thorough scale.	• Modeling capabilities
Data Management (Previous Years)	Ensures historical data is preserved and curated for reliable use in the current and future.	• Trend analysis • Modeling • Complex analyses • Partnerships
Partnerships	Relationships with others that are beneficial to District water quality objectives.	• Improved technical support • Resource leveraging • Advancement of field • Water quality improvements
Special Studies	Improve and deepen understanding of specific questions or issues.	• Complex analyses • Technical support

Future Outlook

The future looks fair for the District's WQP. The WQT is a small but capable team experienced at finding and implementing efficient solutions to challenges that arise. However, funding for the WQP has been sporadic in the past few years. Additionally, the WQT has been decreased to only two full time permanent members. These events make carrying out WQP objectives difficult, and in some cases, impossible. Even though the future is uncertain, the WQT always plans for success. The WQT has identified several overarching goals that are critical for program success and development. The goals are listed below in no particular order.

- Development and use of DASLER
- Protection of a diverse knowledge base through staff training and partnerships
- Coordination with other agencies and Corps teams
- Pursuit of adequate funding by communicating needs and preparing for execution
- Implementation of more complex data analyses
- Improvement and streamlining of processes
- Creation and refinement of reservoir specific sampling plans
- Increased coordination and partnership with the District's Water Management Team

One of the listed goals is increased coordination and partnership with the District's Water Management Team (WMT). It is Corps policy that a district's WQT and WMT work closely together. Incredible strides have been made in increasing the coordination between both teams within the past year. Activities to this end include water quality directives, regular meetings between respective Team leaders, increased communication, partnerships on projects and input on plans and reports.