Water Quality

Actions

N9 Implement the City of Columbus Watershed Management Plan and work with regional partners to implement the Sustaining Scioto Adaptive Management Plan.

N10 Understand the types, likelihood, and severity of events that could adversely impact the quality of drinking water sources.

N11 Continue upgrades to sewer system and sewage treatment infrastructure to reduce sewage contamination of waterways.

N12 Design an educational campaign for individuals and businesses on proper use of tap water during an emergency.

A7 Improve data collection to anticipate and respond to harmful algal blooms.

A8 Continue upgrades to water and sewage treatment infrastructure to reduce harmful algal bloom toxins in drinking water.

Background

Increasing precipitation and rising temperatures heighten the risk of water supply contamination and the need for water treatment in Columbus.[1] Since the Hoover brothers pioneered new methods of water treatment in the early 1900's, Columbus has been a leader in providing its residents with high-quality drinking water. The Columbus water system has significant natural resilience because it gets its water from a variety of sources: the Scioto River, Big Walnut Creek, and groundwater that is pumped from the Scioto River Valley aquifer. In 2016, the Division of Water supplied over 49.5 billion gallons of drinking water to over 1.2 million residents throughout the Greater Columbus Area.[2]

However, all three of the water sources are susceptible to pollutants and need to be treated to meet water quality standards. Regional plans, such as ***Sustaining Scioto***, are in place to protect the quality of water in Columbus and should be implemented and continually evaluated to ensure they are adequate.[3] Some pollutants pose a risk to public health, such as nitrates and toxins from harmful algal blooms (HABs), while others affect the odor, taste, or clarity of our water. Pollutants enter the Scioto River and Big Walnut Creek in a variety of ways, from point source discharges (discharges from wastewater treatment plants and industry) that are regulated by the State and from non-point source discharges (runoff from farm fields, suburban lawns, and parks) that are largely unregulated. Due to a lack of overlying clay sediments, our groundwater is at a higher risk of contamination than many other groundwater sources.[4] As Columbus continues to grow and develop, the contamination pathways will likely increase, and water quality issues may become more frequent. More frequent and intense precipitation events will likely induce more runoff, while rising temperatures are expected to contribute to increasing pathogen concentrations in surface waters.[1] This chapter has four necessary (N) and two aspirational (A) actions to address water quality in Columbus.

N9 **Implement the City of Columbus Watershed Management Plan and work with regional partners to implement the Sustaining Scioto Adaptive Management Plan.**

The City of Columbus owns and operates three water treatment plants that serve the city and most of Central Ohio: The Dublin Road Water Plant, Hap Cremean Water Plant, and Parsons Avenue Water Plant. Each plant has a different water supply. The Dublin Road Water Plant utilizes water from the Griggs, O'Shaughnessy, and John R. Doutt Reservoirs and distributes it to northwestern and southwestern Franklin County and downtown Columbus. The Hap Cremean Water Plant treats water from the Hoover Reservoir and serves The Ohio State University (OSU) campus and northern Franklin County. The Parsons Avenue Water Plant withdraws groundwater and serves southeastern Franklin County. Several plans are already in place to protect these water sources. These plans should be implemented and continually evaluated to ensure that Columbus water customers continue to have access to safe drinking water.

The ***Watershed Management Section*** of the Columbus Department of Public Utilities (DPU) protects the city's surface-water supplies at its four reservoirs by jointly managing the reservoirs and adjacent land with the Columbus Recreation & Parks Department to protect drinking water quality.[5] In 2015, DPU began an analysis of its watershed to evaluate watershed characteristics, identify immediate and persistent risks to the watershed, identify strategies to address these risks, and develop a City Watershed Master Plan for implementation of these strategies.[5] The Watershed Management Section is currently implementing this plan with a focus on 1) reducing nutrients, sediments, and other agriculture-related contaminants of concern, 2) reducing the risk to source water associated with industrial, residential, and developed land uses, and 3) implementing best management of city-owned reservoir property to protect the integrity of shorelines and water quality. The City continues to implement this plan to reduce the risk of contaminated source water.

In 2015, a partnership led by the Mid-Ohio Regional Planning Commission (MORPC) released Sustaining Scioto, a document to guide actions among a number of agencies to ensure that there is sufficient, clean drinking water for residents and businesses of Central Ohio.[3] This document, which took four years to complete, is a comprehensive look at drinking water sourced by the Upper Scioto Basin. Sustaining Scioto provides near-, mid-, and long-term action items related to planning, collaboration, public education, emergency preparedness, operating procedures, and resource protection. Analyses included simulations by the U.S. Geological Survey (USGS) that take into account changes in climate, reservoir operations, land cover, and water use within the basin.[6] While the simulations include population growth for Central Ohio based on projections by MORPC, they did not factor in population relocation from elsewhere in the country due to climate impacts.

There is no need to develop an additional long-term management plan, but the City Watershed Master Plan and Sustaining Scioto should be updated periodically and the continued work of the partners to enact actions in these long-term documents should continue to be supported. The updates should include re-examinations of land use and development patterns, climate conditions, and population growth that includes climate-related migration. These updates will ensure that sufficient, high-quality drinking water will be provided for Columbus and Central Ohio residents, even as the community and the climate continue to change.

N10 **Understand the types, likelihood, and severity of events that could adversely impact the quality of drinking water sources.**

Understand and Plan for Adverse Impacts to Source Water Quality

The City Watershed Master Plan identifies and categorizes pollutants of consequence to the city's reservoirs and source water. It identifies future water-quality concerns using predictive modeling based on changes in the watershed such as conversion of agricultural land to impervious cover. The City Watershed Master Plan identifies immediate risks to the watershed, persistent risks, risks to continue to monitor/ inspect, and risks for periodic assessment. This assessment has informed the Watershed Management Section's work regarding traditional reservoir security and property management responsibilities. It has resulted in program updates including new agricultural and watershed conservation initiatives and a new focus on spill preparedness and intake protection. The Watershed Management Section should continue to implement these initiatives and periodically review its plans based on the most recent projections.

Sustaining Scioto also provides an improved understanding of the potential climate change-related risks including a greater frequency of extended dry periods interspersed with extreme rainfall events. The runoff that results from extreme precipitation events can lead to excess delivery of pollutants into waterways. As understanding of increased precipitation and extreme heat events improves, the City should continue to refine its near-, mid-, and long-term projections of the likelihood that these events will lead to nitrate or other water-quality limit exceedances that could affect the ability to provide safe drinking water. Excess nutrients, along with increasing temperatures, may result in HABs or greater concentrations of toxins in the water. As the nutrients and pollutants transported by runoff often originate from different non-point sources outside of the city, including agriculture, it is difficult to control how much is being delivered to our streams, rivers, and groundwater. In order to protect against this type of pollution, it is first necessary to improve our understanding of the types of events and conditions that can negatively affect our water quality. To better understand the likelihood of occurrence and ranges of severity of these events, additional data will need to be collected from watersheds and interpreted by the research community.

Understand and Plan for Adverse Impacts to the Treatment of Source Water

Critical infrastructure should be continually assessed to ensure that it is not susceptible to flooding and has a resilient electric supply. Many of these resilience requirements are already part of federal and state laws. For example, the Ohio Environmental Protection Agency (OEPA) requires treatment facilities to be located outside the floodplain and have two completely independent power supplies.[7] OEPA also requires all essential water-treatment chemicals to have at least a 30-day supply. To further improve its resilience, DPU is also in the process of adding standby power at both the Dublin Road and Hap Cremean water plants to provide backup power in the event of a regional power outage. The city's wastewater treatment plants are also built with 100% redundancy of designed treatment capacity. Both wastewater treatment plants have been recently upgraded, and utilizing all redundancy, can treat up to three times their design capacity for a sustained treatment capacity of 480 million gallons per day.

Franklin County Emergency Management and Homeland Security (FCEM & HS) can provide insight to continuing operations during regional flooding and electrical service disruptions. In the case of major water emergencies, the OEPA requires that each community water system maintain a written contingency plan for providing safe drinking water.[8] These plans should be continually updated as our knowledge improves.

N11 **Continue upgrades to sewer system and sewage treatment infrastructure to reduce sewage contamination of waterways.**

In 2005, the City of Columbus developed a Wet Weather Management Plan (WWMP) to satisfy two consent orders from the OEPA to reduce combined sewer overflows (CSO) and sanitary sewer overflows (SSO). Due to aging infrastructure, combined stormwater and sanitary sewer lines, and insufficient sewage treatment capacity, Columbus released millions of gallons of sewage each year during multiple rain events. In addition, some property owners experienced sewage backups in basements. The WWMP proposed mid- and long-term projects to be completed over a 40-year schedule; most of the improvements were set to take place before 2025, reducing pollution by 85% during the first 20 years.[9] Projects outlined in the WWMP included constructing new tunnels to direct flows to treatment plants, building storage tanks, and treatment plant improvements. Priority was given to CSO improvement, and by 2015, over one billion dollars had been spent to complete numerous WWMP projects and substantially reduce CSO volume.

Following the first ten years of implementation, the City revised the WWMP in 2015 and adopted ***Blueprint Columbus***, an integrated plan to capitalize on new technologies and flexibility provided by US EPA.[10] Blueprint Columbus addresses SSOs through three private-property improvement “pillars”: lateral lining, which addresses inflow and infiltration of rainwater into our sewer system by sealing sanitary laterals; roof water redirection; and sump pumps, which direct water away from the home’s foundation so that it cannot infiltrate through the lateral connection. The fourth pillar of Blueprint Columbus is green infrastructure (GI; e.g., rain gardens, pervious pavement), which is installed in residential areas to provide additional retention for the stormwater that was previously infiltrating pipes (Fig. 4). GI also has the added benefit of filtering stormwater runoff, which is said to be the source of 64% of pollution in our rivers and streams.

The Blueprint Columbus solutions are deemed less expensive, more rapidly deployable, and of greater benefit to the local economy while providing co-benefits to ecosystems and

Figure 4. *Four pillars utilized by the City to address sanitary sewer overflows within Blueprint Columbus.*[10]

Replacing Impermeable Surfaces

One potential target to reduce impermeable surfaces is Columbus City Schools. ***Blueprint Columbus*** has already started working with some schools in neighborhoods such as Clintonville and Linden and is developing a Blueprint schools curriculum. Paved lots could be converted to playgrounds with permeable surfaces, and rain gardens and natural landscapes should be planted. Co-benefits of these actions include a reduction in heat absorbed by blacktopped surfaces. ***Chicago*** has already seen success with this type of action.[11]

neighborhoods. Blueprint Columbus is currently in the second year of implementation, with data being collected as portions of the project are completed. Based on the results of these projects, plans may need to be adapted. Currently, Blueprint Columbus provides the best plan to reduce sewage contamination of waterways with accountability provided by OEPA. Deploying GI through Blueprint Columbus is an innovative way to detain additional stormwater and reduce the amount of total suspended solids (phosphorus, nitrogen, metals, etc.) entering the city's streams, further improving the city's water quality.

N12 Design an educational campaign for individuals and businesses on proper use of tap water during an emergency.

One of the challenges during a drinking-water emergency is ensuring individuals and businesses are aware of the emergency and know how to respond. How to handle the water during an emergency often depends on the pollutant that is present. Most water outages are due to a water main break, and individuals are accustomed to advisories to boil their water. Not all pollutants can be addressed through boiling, such as toxins produced by HABs. A second challenge is ensuring that people know the ways in which the water may safely be used (e.g., use in bathing and flushing toilets only), even if it cannot be consumed. Recent drinking-water crises in the cities of Toledo, Ohio and Flint, Michigan provide contrasting case studies in public health response and messaging.

Since most individuals do not have access to detailed knowledge on water pollutants, accurate information needs to be clearly communicated in a timely fashion. A team of experts within Columbus Public Health and DPU, with backgrounds in science, communication, and the local community, needs to vet information before it is broadcast. To the extent possible, this messaging should be developed in advance of emergencies to facilitate rapid dissemination when needed.

A7 Improve data collection to anticipate and respond to harmful algal blooms.

The Division of Water has a ***Water Quality Assurance Lab (WQAL)*** that provides independent monitoring and analyses of watersheds and researches new treatment methods.[12] The division's extensive source-water-quality monitoring network provides an early warning to the water treatment plants for different types of water-quality events (e.g., high nitrate levels, algal blooms including HABs, spills) and other water-quality changes that may impact water treatment. The network consists of multiple real-time online monitors used in conjunction with routine grab sample analysis. Columbus started its algae monitoring program in the late 1930s and has continued routine monitoring since that time. The real-time, water-quality sensor program began in the early 1990s and has been expanded multiple times to nearly a dozen locations throughout the watershed. The grab sample program is conducted at least bi-weekly throughout the 13-county watershed for Columbus and is modified as the source-water-quality characteristics change. The sample locations include wells, creeks, rivers, reservoirs, and quarries. Columbus collaborates with OSU for water-quality testing and the United States Geological Survey for some water-quality monitors and stream gauges.

Extensive research is being conducted in the Maumee River Drainage and Western Basin of Lake Erie to ***forecast algal blooms*** that impact the water supplies of communities along the lake.[13] This research is expensive, involves extensive technical expertise, and draws from remote sensing and water sampling data. As this research continues, findings may be used to inform advances in monitoring systems in Central Ohio.

A8 Continue upgrades to water and sewage treatment infrastructure to reduce harmful algal bloom toxins in drinking water.

The City has constructed an ozone/biologically-active filter treatment system at both the Hap Cremean and Dublin Road water treatment plants to treat source water containing microbial pathogens, HABs, and emerging contaminants. Other cities are now emulating Columbus and designing similar systems due to the negative consequences HABs have had on their source water supplies. Within Ohio, these communities include Toledo, Oregon, and Celina.

Based on emerging research on algal-bloom occurrences and toxicity, knowledge gathered through monitoring systems, and impacts of blooms on drinking-water supplies when they occur, the City can determine how best to allocate resources for additional treatment infrastructure. Due to its high cost, investment in infrastructure should be carefully considered well in advance of its need, and options involving conservation practices that limit nutrient loading within the watershed should be considered. Such conservation practices would necessarily extend into the upper watershed outside of city boundaries. ***New York City's*** water treatment system serves as an example of a system that includes water preserves upstream in the watershed to protect water resources for the city's needs. These measures provide sufficient, clean drinking water and are less expensive than other water treatment infrastructure[14, 15, 16]

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