T R O U B L E D W A T E R S

A National Call for Renewal



Flood Protection / Water Management / Recreation THE MUSKINGUM RIVER BASIN THE MUSKINGUM WATERSHED, ALSO KNOWN AS THE MUSKINGUM RIVER BASIN, IS OHIO'S LARGEST DRAINAGE SYSTEM. SPANNING FIVE COUNTIES AND PORTIONS OF 22 OTHERS, THIS WATERSHED COVERS MORE THAN 8,000 SQUARE MILES AND INCLUDES THE AREA THAT DRAINS INTO THE MUSKINGUM RIVER AND ITS TRIBUTARIES. A SYSTEM OF 16 RESERVOIRS PROVIDES FLOOD PROTECTION FOR THE BASIN.

T R O U B L E D W A T E R S

A National Call for Renewal

Troubled Waters is the story of the Muskingum River Basin. This story tells how a region of people – driven to safeguard itself forever from the terrible devastation suffered during Ohio's 1913 flood – went on to build a national model for flood control.

It tells how this system of reservoirs has protected millions of people in the region – and in communities downstream – for nearly four generations.

And it tells how these lakes and reservoirs have evolved into lifelong sources of fun and recreation for families in the basin, who have enjoyed many long and relaxing days of boating and fishing, camping and hiking, picnicking and swimming.

But now, this important system is aging.

Changing times and unanticipated demands are endangering the flood protection, access to recreation, water quality, ecosystem, public safety and economic growth that this region has relied on since the 1930s.

It's unknown how the story of the Muskingum River Basin will unfold.

It all depends on the response to this national call for renewal.



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Our forefathers had the wisdom and vision to conceive this system. We must have the wisdom and vision to protect it. —Mark Kessinger, Project Manager, Corps of Engineers, Huntington District

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I remember when I was about 8 years old, sitting in a boat fishing with my grandfather on Clendening Lake, asking him questions, like "Where did the lakes come from?"

I thought they'd always been there. But my grandfather told me about the great storms of the 1900s that flooded all the little towns and roads. He talked about President Roosevelt and explained to me how the Corps of Engineers established a flood-control system here in the 1930s. He told me how it put people to work, how it made the community safer from floods and how the lakes became recreation areas.

It was so important to me to fish with Grandpa on those lakes: Clendening, Tappan, Leesville, Piedmont. Grandpa and I would go every other week or so – more if I could talk him into it.

The night before a fishing trip, we'd head to the cider press and dig for red worms in the leftover apples, because bluegills love red worms. We'd get up at daylight. Grandma would fry us some eggs and pack us a picnic lunch. Then we'd tie the aluminum boat on top of the old Plymouth, put the motor in the trunk and climb in. It was a whole routine.

Once we were out on the lake, Grandpa showed me different hooks, and how to catch bluegills. We'd sit in our boat in the shade. We'd eat. We'd talk. He was so patient, and he explained everything to me.

I have good memories, lasting memories, of fishing with Grandpa. Being out on those lakes with him was one of the greatest gifts I was ever given.

—Dick Roth Jr., age 61 of Strasburg, Ohio, still fishes at least once a week on the lakes of the Muskingum River Basin, where he first fished with his grandfather in 1951.







The valley sought a flood-control system after the 1913 flood.

1913 Flood Was Impetus for the Muskingum Watershed Conservancy District

The rain began falling in the Muskingum Valley around lunchtime on March 23, 1913. After enduring 8 inches of rain in just four days, the valley was in the throes of its worst flood ever recorded.

Families fled their homes. Cities in the valley were without light, power, water and fire protection.

In Coshocton, floodwaters spread across 30 city blocks – 8 feet deep in some areas.

At Zanesville, the Muskingum River crested at 51.8 feet, its highest stage ever recorded, which put 3,411 buildings under water.

In the end, eight people died, and property damage was estimated at nearly \$9 million in 1913 dollars, or \$219 million in today's dollars.

It didn't take long for people in the valley and across Ohio, who had endured similar flooding, destruction and loss of life from the same storm, to take action.

Browning Led the Bold, New Effort

The Ohio Conservancy Act, which became law in 1917, allowed the formation of conservancy districts – local agencies of the government – to plan, construct and administer flood-control and conservation projects. Ten years later, Bryce C. Browning, a vigorous, articulate leader in the flood-control initiative, presented a plan to establish a conservancy district in the Muskingum Valley.

It took several years to plan and design the right system for protecting the Muskingum River Basin. Engineers studying flood control in the early 1930s not only warned that the valley's problem was complex, but also that potential solutions were too costly for local communities with limited financial resources. Regional and federal cooperation was needed. I propose to create a civilian conservation corps... confining itself to forestry, the prevention of soil erosion, flood control and similar projects...this type of work is of definite, practical value, not only through the prevention of great present financial loss, but also as a means of creating future national wealth. This is brought home by the news we are receiving today of vast damage caused by floods on the Ohio and other rivers.

- President Franklin D. Roosevelt, in a message on March 21, 1933, entitled "Three Essentials for Unemployment Relief"

Building of Muskingum Dams, Reservoirs Was an Early Project in FDR's New Deal

Progress was made in 1933 after the creation of the Muskingum Watershed Conservancy District (MWCD), responsible for providing flood protection and water conservation, controlling soil erosion, and developing water uses.

The 1933 General Plan – prepared by renowned water-control engineer Arthur E. Morgan and his Dayton Morgan Engineering Company – said the Muskingum would benefit most from permanent lakes as well as flood-storage areas, and dams regulated by gate controls. Engineers said this solution would reduce flooding in the Muskingum River Basin and in communities downstream on the Ohio River.

For the first time ever, a system of reservoirs would be used to control flooding.

MWCD desperately wanted the flood-control and water-conservation project to become part of President Franklin D. Roosevelt's New Deal work-relief program, since it would employ 8,000 people and pay \$20 million in wages. At the same time, the Public Works Administration (PWA) was interested in funding large projects that would engage many unemployed workers still struggling during the Great Depression. Since MWCD had an engineering plan ready to go, the PWA in 1934 allocated more than \$22 million to the U.S. Army Corps of Engineers for the project. The Corps would engineer and build 14 reservoirs and move public utilities, roads and railways – even relocate villages – as required in the multi-county project area.

Bryce C. Browning, the original project champion, solicited grassroots support, lobbied Washington leaders and ultimately helped secure federal funds for land acquisition and reservoir construction.

On the Fast Track: 14 Flood-Control Projects Completed in 4 Years

Construction on the first dam, Tappan, began in 1935. Over the next four years, workers removed and replaced an amazing 12.7 million cubic yards of earth – enough to fill more than 1 million dump trucks.

The \$45 million system included 13 earthen dams and one concrete dam on the four main tributaries of the Muskingum River. The system featured gate-controlled outlets, which release impounded water through the dams, discharging floodwaters as required into downstream waters.

Four of the 14 reservoirs – Dover, Bolivar, Mohawk and Mohicanville – were built as "dry dams," which hold water only during flood events until these waters are safe for release. The other 10 reservoirs were permanent lakes that also provided flood storage.

In an 11th-hour decision during construction, water lines were installed at six reservoirs to provide a future source of drinking water.



The 14th and last dam – Dover, the only concrete dam – was completed in 1938. On July 17 that year, people across the country read their newspapers and listened to their radios for national coverage of the ceremony dedicating the Muskingum River Basin's model system – the nation's first to impound water for regional flood control.

The Flood Control Act of 1939 made the Corps of Engineers responsible for operating and maintaining the flood-control structures. MWCD is responsible for conservation and recreation on its lands and waters and assists the Corps with flood protection.



The Muskingum Watershed Conservancy District is the largest of Ohio's 21 active conservancy districts, encompassing more than 8,000 square miles, or one-fifth of the state. The headquarters is in New Philadelphia.



Muskingum System Is of National, Historic Importance

The Muskingum reservoir construction project is recognized as one of the most successful New Deal initiatives of the 1930s. The system has been called "a model of multipurpose water management."

Muskingum became the model for similar dam projects built nationwide.

The Corps of Engineers and MWCD were leading partners in the project, the nation's first cooperative effort of the federal government, a state and a public corporation.

The method the Corps used to construct the earthen dams proved to be innovative, safe and economical.

Arthur E. Morgan, the engineer who conceived the Muskingum reservoir system, earned the privilege of serving as President Roosevelt's first chairman of the Tennessee Valley Authority from 1933 to 1938.

Ongoing Protection, Improvements Have Enhanced System's Value to the Region and to the Nation

Since 1938, much progress has been made. Two more reservoirs were constructed: Dillon in 1959 and North Branch of Kokosing in 1972. All of these lakes have attracted waterfowl and upland game. Lands suitable for agriculture were leased to farmers. And forestry soon became a primary conservation activity. To date, MWCD has planted more than 13 million trees and improved other original stands through conservation.

More than 5.5 million people visit the basin's 12 lakes each year.





Sometimes taken for granted, this comprehensive system has helped the valley avoid disastrous floods, which threatened the Muskingum River Basin about every other year before the 1930s. Since then, for nearly seven decades, these reservoirs have controlled Mother Nature's powerful floodwaters, saved lives and prevented an estimated \$6.4 billion in flood damage.

Muskingum's system of 16 reservoirs provides more than 521 billion gallons of floodwater storage capacity.

Flood Protection Is an Art and a Science

When it's storming, and flood-protection work begins in the Muskingum, there aren't enough hours in the day to manage it all, damtenders say.

"Someone has to understand the overall system to be able to say, 'Let Tappan run, but close down Clendening and Piedmont,'" said Nicholas Krupa, Muskingum Area Manager. "We decide whether to release flow at one dam, and hold water back at others, so certain areas don't get flooded."

Located throughout the valley are 55 gauges that measure stream elevations during storms. By phoning each gauge and listening to an electronic recording of stream elevation, engineers determine the gates that must be closed to manage floodwaters.

"Damtenders have only a little window of time to get in here and start closing gates so that homes and businesses don't get flooded," Krupa said. "Managing floodwaters is both an art and a science."



The Muskingum reservoir system was the nation's first to impound water for regional flood control.

Recreation Is Big Business in the Basin

Recreation was a natural outgrowth of the reservoirs. Hunting and fishing were two of the first recreational opportunities provided. Soon, numerous parks, marinas, campgrounds and youth camps were established.

The lakes now offer many affordable outdoor activities – such as boating, fishing, hiking, hunting, swimming, picnicking, camping, canoeing and wildlife observation – on 16,000 acres of water and 38,000 acres of land. Eight MWCD lakes provide 10 marinas and overnight accommodations ranging from primitive camping to cabins and lodges. MWCD also operates its own parks at five lakes.

The region enjoys remarkable economic benefits from travel and tourism in the Muskingum River Basin. More than 5.5 million people visit the basin's 12 lakes each year – producing an economic impact of more than \$273 million annually.



System of Dams Has Protected the Muskingum Region – and Regions Downstream

The Muskingum reservoir system is of national importance. Flood-protection benefits extend not only to the 2 million people in the Tuscarawas, Walhonding and Muskingum river valleys but also far down into the Ohio and Mississippi river valleys. Engineers estimate that this system has prevented \$6.4 billion in flood damage and saved countless lives.

Muskingum Lakes Helped Spur Region's Growth

In 1930, when plans for the flood-control system were under way, the valley's population was approximately 1 million. After 1938 – with the valley safer from floods – new businesses located in the basin, bringing more people, more jobs and more development. By 2000, the region's population had swelled to almost 2 million – a figure expected to increase 22 percent by 2050.

Because of population growth, higher personal income and more urbanization, planners expect even greater demands for recreational opportunities. Some evidence of this trend exists: Boating and fishing are on the rise; there are more boaters, and more types of boats, than ever.

MWCD's Lakes Provide Jobs, Improve Region's Economic Health

Jobs related to lake facilities: 7,500 Tax revenues generated by lake facilities: \$11.5 million Annual total payroll for lake-related jobs: \$68 million

Source: MWCD's 1998 economic impact study, Market Vision Research Inc.

The project has brought great and lasting benefits to the region – benefits that have multiplied over the years.



Decades of Change Now Threaten the Sustainability of the Muskingum River Basin

During the New Deal era, water-control engineer Arthur E. Morgan designed a flood-control system that would serve the Muskingum River Basin for 50 years.

But now almost seven decades have passed, and the system is aging. Since Morgan's time, numerous physical, economic and environmental changes have occurred. These changes and demands are jeopardizing the region's flood protection, access to recreation, water quality, ecosystem, public safety and economic growth. Concerns that must be addressed include:

Aging dams Sedimentation Acid mine drainage Hydrogen sulfide Stream contamination Impacts of growth

The effects of these concerns – all of which are interrelated – are both considerable and undesirable.

I've fished in the tailwaters of the Muskingum dams my whole life, ever since the dams were built. I remember catching a IO-pound, 4-ounce saugeye in Wills Creek in 1989 – a world's record for years. When I was 79, I asked my doctor for a knee replacement, because I couldn't get up and down the banks anymore to fish. I'm still fishing at Mohawk and Wills Creek at least three or four days a week, sometimes from morning till night. —Bill Seevers, 83, Millersburg, Ohio





Damtenders Monitor Structure, Function of Aging Dam Infrastructure

Since the 1930s, damtenders of the Muskingum have quietly maintained the dams during days of sun, and operated the gates to control floodwaters during days of torrential, unstoppable rain.

By collecting data on weather, rainfall, runoff, river stages and water levels, they have determined the best ways to regulate floodwaters during local floods and at the start of major floods in 1945, 1952, 1959, 1969, 1980, 1998, 2004 and 2005.

The damtenders' function is much the same as it was nearly 70 years ago. But the system that they operate and maintain is not.

Like an outdated 19th century home needing major renovations, remodeling and contemporary additions, the Muskingum system of dams needs urgent repairs, restoration and modernization for the 21st century.

Dam Safety Is a Major Concern

All earthen dams leak to some extent. But the dams at Bolivar and Mohawk have a history of excessive downstream seepage. And because both were built on highly permeable foundations, these dams could become unstable if too much water seeps underneath the dams.

Damtenders continuously inspect and monitor both dams to ensure seepage is not progressing. If seepage progresses, soil particles could wash away, creating a rapidly eroding cavity that might cause a dam to collapse; this would produce a catastrophic rush of water downstream during a high-water event. If this disaster occurred, the potential loss of life and property would be significant: an estimated 800 people and \$826 million at Bolivar, and an estimated 307 people and \$449 million at Mohawk. Since the 1930s, very little has changed at Beach City dam.





Engineers now better understand how dam foundations behave and do not want to take unnecessary risks. Newly discovered dam safety issues must be addressed.

At Dover, the system's only concrete gravity dam, engineers worry about a geologic fault in the rock foundation, which potentially makes the dam unstable. If a significant flood overtopped the structure, the dam might fail, and concrete dam sections could begin sliding downstream. Such a failure would cause a rushing flood wave and considerable consequences: an estimated 733 deaths and \$670 million in property damage.



We are very concerned about dam safety in the Muskingum River Basin. In fact, the dams at Bolivar, Mohawk and Dover are priorities 1, 2 and 4 among all dam studies in our division. And these three dams are just the 'tip of the tip' of the iceberg.

– Eric Halpin, P.E., Chief, Geotechnical Engineering Branch, Corps of Engineers, Huntington District



Other Asset Management Needs Are Many, Varied

Operations and maintenance fixes are needed so dams comply with federal regulations, and function as an integrated system instead of as individual projects.

Modifications – such as raising dams and dikes and improving spillways, which stop water from overtopping and destroying dams – would protect people and property from less frequent, but more intense storms.

Outdated linen, paper and mylar maps must be replaced with electronic maps of the basin reflecting the current landscape so that decision making is based on accurate data.

Without modernization, areas currently protected from flooding will suffer increased damage because of operational restrictions and loss of floodwater storage. Localized flooding will occur, endangering life and property, and emergency-service costs will increase. Infrastructure improvements are needed to keep the Muskingum region – and regions downstream – safe from disasters.





Sediment is filling in the lake at Beach City – and other MWCD lakes.

Sedimentation Starts with Eroding Stream Banks

Changes are occurring on the banks of rivers and waterways upstream of the Muskingum reservoirs:

People and livestock have disturbed natural vegetation that once thrived near rivers and streams. These barren and eroding banks have upset the natural habitat for aquatic species and wildlife, producing unhealthy stream corridors and impairing water quality.

Farming up to a stream's edge and other agricultural practices have accelerated erosion and damaged the ecosystem.

Stream channels are unstable because of highly erosive soils and loose glacial till, a mixture of clay, sand, pebbles and other material.

Erosion is harming the environment and causing too much sediment to accumulate within stream channels and downstream – producing shallow water in the Muskingum reservoirs.

Sedimentation is excessive today because of upstream erosion and an aging reservoir system that has functioned 20 years beyond its original design life.

Some erosion is natural. But many lakes are filling in with sediment at higher rates than expected. Too much sedimentation hurts fishing and other recreational opportunities. For cleaner, healthier lakes and streams, we must address sediment erosion at its source. If we do nothing, people will keep losing an excessive amount of land to erosion, the lakes will continue filling in too fast, and our fisheries won't be as healthy or diverse.

– Randy Sanders, Environmental Administrator, Ohio Department of Natural Resources



Boating, Swimming, Fishing Curtailed in Several Areas

Sedimentation and the resulting degradation of the aquatic ecosystem have changed Dillon Lake, once a popular recreation destination in the basin.

Water depth has been lost; mud flats exist where a deep-water habitat once thrived. Flood storage is threatened since the reservoir is filling in fast with sediment. Boating areas are now closed, and swimming beaches are affected by sedimentation.

Visitors are staying away in ever greater numbers. In 1991, visits to Dillon Lake totaled 1,928,737. By 2003, total visits to Dillon Lake had plummeted to 908,698 – a decrease of more than 52 percent, according to the Ohio Department of Natural Resources.

Beach City – once a favorite recreation spot – is offlimits for boating and swimming since sediment fills almost 100 percent of this 420-acre lake. Current average water depths have dropped to less than 3 feet. Fish species are fewer and less diverse because of poor water quality.

Boating also is very limited at Charles Mill Lake because of shallow water. Wills Creek, which used to be 17 miles long, is now just 7 miles long, since sedimentation has filled in more than 80 percent of the existing pool; less water surface is available for fishing and other recreational uses.

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Sediment is entering the region's waterways and reservoirs at ever-faster rates because of more urbanization and different land uses. As a result:

In shallow water, deep-water species cannot survive and lake-bottom organisms can suffocate. Sediment covers and smothers fish eggs, affecting the spawning and rearing habitat. Light cannot penetrate lake waters sufficiently, affecting the food chain.

Pollutants carried in sediment are endangering wildlife, fisheries and surface water ecosystems.

Boating and fishing areas are shrinking – some faster than others – eliminating recreational opportunities when water becomes too shallow to navigate. Sediment – the No. 1 pollutant of our nation's waterways – exists to some extent at all Muskingum River Basin lakes.

Forecast: Sedimentation Expected to Worsen Over the Next 50 Years

Mechanical dredging to deepen the lakes has been a short-term solution to address sedimentation. But dredging is expensive and intrusive, and can harm the environment. Long-term solutions are needed to control erosion, restore disturbed shorelines and banks, improve river and lake habitats and decrease sediments and chemicals being deposited in waterways.

Left unchecked, sedimentation will prevent the system from providing sufficient levels of flood protection throughout the basin. Continued sedimentation will further degrade the ecosystem and force the closure of additional recreation areas to the public.



Coal Mining: A Vital Industry to Much of the Muskingum River Basin

Coal mining in Ohio is a multibillion-dollar industry. Eight counties in the Muskingum River Basin are major producers of Ohio's coal. In fact, Belmont and Harrison counties are the top two coal-producing counties in the state.

About half the coal mined in Ohio is extracted through strip mining, which is more productive and less expensive than underground mining. Using giant power shovels and draglines, strip miners remove all soil and rock – called "mine spoil" – about 100 feet below the original surface. This exposes the coal for easy excavation.

Strip mining is heavily regulated, and requirements for surface reclamation are strict, thanks to the Surface Mining Control and Reclamation Act of 1977.

Some people think, 'The water is orange – it's always been orange – so what?' Our goal is to relate to the public why this orange water is a problem. It's why there are no fish species in these streams, why our water quality is so poor.

-Sandy Chenal, Coordinator, Crossroads Resource Conservation and Development Council Inc.

Mining Practices of the Past Producing Acid Mine Drainage

In the past, strip-mined land was not always restored properly. Mine spoil was not always returned and land re-graded; topsoil and vegetation sometimes were not replaced. As gently rolling landscapes were leveled, the flattened topography encouraged swift rainwater runoff, unhindered by grass or soil. Eroding piles of mine spoil increased sediment and sand downstream.

But it wasn't always this way.

Metal-laden acidic waters damage the aquatic ecosystem.





When coal and bedrock are exposed to oxygen and moisture, acid mine drainage – toxic, metal-laden, acidic water – is created. For years, this orange-colored discharge has been seeping from the hillsides and into the Muskingum River and its tributaries, the effect of less stringent reclamation laws through the mid-1970s and flooded underground mines upstream.

Eventually, acid mine drainage and other pollutants end up in the Muskingum reservoirs.

Ohio's coal mines became famous for using "Big Muskie" and other colossal earthmoving machines of the past, such as the "GEM of Egypt" and the "Silver Spade," for strip mining. No one in the 1930s could have imagined that such massive machines would have been developed for coal mining, or that certain mining practices ultimately would harm the water quality of the Muskingum River Basin.

Acid Mine Drainage from Exposed Coal Seams Threatens Water Quality

Acid mine drainage, sulfur and other pollutants from mined areas have entered the basin's rivers, streams and reservoirs, severely damaging the aquatic ecosystem and hurting recreational uses, such as fishing.

As many as 180 acid mine sites sit upstream of the Muskingum lakes. Sizeable resources are needed to remediate acid mine drainage, restore the ecosystem and improve water quality in the basin. Local fixes have tackled only a small percentage of the problem; without regional improvements, acid mine drainage and its effects will continue. Many upstream sites have been identified for immediate stream restoration.

Because the watersheds of Clendening, Tappan, Piedmont and Wills Creek are heavily mined, polluted water finds its way into these Muskingum lakes.

'We Have a Long Way to Go'

Acid mine drainage persists in the Muskingum's 14-mile-long Huff Run sub-watershed, which includes Tuscarawas and Carroll counties.

"Several fish species in the upper part of the watershed, where the water is high quality, cannot be found in the lower part of Huff Run," said Sandy Chenal, Coordinator, Crossroads RC&D, a regional improvement organization in eastern Ohio. "That tells you how fast a stream can lose its health."

Although a group of concerned citizens is working with government agencies to clean up Huff Run, less than 25 percent of the problem can be addressed with existing funding, Chenal said. Current project activities include public education, engineering, and design and construction of treatment systems.

"We are starting at the upper reaches of the watershed and working our way downstream," Chenal said. "But we have very limited financial resources to deal with such a widespread, technically complicated issue – much of which involves site-specific chemistry and physical site limitations. We have a long way to go."







High concentrations of hydrogen sulfide gas must be monitored carefully.

Acid Mine Drainage Ultimately Results in Hydrogen Sulfide Production

Water quality and public health concerns related to acid mine drainage continue as these waters run downstream and into the Muskingum's streams and reservoirs.

That's because runoff from the region's coal mines contains high concentrations of sulfate. During summer and fall, when high concentrations of sulfate from the streams mix with water from lake bottoms, hydrogen sulfide gas is produced.

Hydrogen sulfide, a hazardous substance to people and the environment, is a colorless, flammable gas that smells like sewer gas or rotten eggs. People exposed to even low levels of hydrogen sulfide gas can experience eye irritation, a sore throat and cough, shortness of breath and fluid in the lungs.

Hydrogen Sulfide Is Keeping People Away from Recreation Areas

During warm weather, hydrogen sulfide odors are being emitted from the Muskingum's tailwaters, where water is released downstream. Serious hydrogen sulfide problems exist at Tappan, Atwood, Leesville, Piedmont and Clendening reservoirs. Warning signs have been posted in several areas advising the public to stay away. In the past, these tailwaters were popular spots for fishing.



At Tappan Lake, hydrogen sulfide has eaten away as much as 1.25 inches of concrete at the outflow tunnel, exposing the metal reinforcing bar.

Hydrogen Sulfide Is Deteriorating Critical Infrastructure

Water is released routinely at the bottom of the dams through concrete outlet tunnels. However, release water with high concentrations of hydrogen sulfide is eating away portions of these outlet tunnels. Hydrogen sulfide damage also is apparent on the concrete and steel of highway bridges, presenting new concerns for their structural integrity and travelers' safety.



Releasing water from the bottom of a lake also releases dangerous hydrogen sulfide gas to surrounding areas. This not only degrades the ecosystem but also creates water quality problems downstream and a concern for public health and safety.



Damtenders Cannot Control the Quality of Water Released Downstream

The Muskingum dams were designed to allow water from lake bottoms to move through intake structures. Hydrogen sulfide was not a problem when the lakes were constructed in the 1930s; therefore, the dams were not designed to control the quality of water released through these intake structures – where hydrogen sulfide is now concentrated – and then into streams.

Modern engineering practices call for multilevel intake structures, which give damtenders more control over the quality of released water. Multilevel intakes are needed to replace the original intake structures at all Muskingum reservoirs.

In the meantime, concentrations of hydrogen sulfide gas are monitored continuously on the Muskingum lakes to ensure public health and safety. In recent analyses, hydrogen sulfide concentration exceeded 329 parts per million (ppm) at Clendening, and 65 ppm at Tappan; public and worker safety is a concern at levels exceeding 50 ppm. Thus, immediate solutions are needed to reduce – and ultimately eliminate – the hazards of hydrogen sulfide gas in the basin, meet environmental standards and improve water quality.

Reservoirs built before 1950 did not have multilevel intake structures for controlling water quality. Installing these modern structures at the Muskingum reservoirs would let damtenders greatly reduce the release of hydrogen sulfide waters downstream.



Water and Sewer Systems Don't Meet Today's Needs

The region's growing population is putting pressure on the water and sewer systems in the Muskingum River Basin.

Water systems are aging and need repairs.

Sewage collection and treatment systems serving many communities are inadequate. Treatment facilities, many substandard by today's measures, have not been maintained.

Approximately 100 communities within the basin require sewer system improvements. Needs include constructing new treatment plants, septic tanks and alternative collection systems; rehabilitating sewer systems; adding collectors and interceptors; and correcting problems with combined sewer overflows and infiltration/inflow.

Stream contamination from raw sewage now threatens water quality in the Muskingum. Untreated water breeds disease and bacteria, and fecal coliform can prevent people from enjoying water-based recreation.

Public utilities must be modernized to serve residents and visitors in the Muskingum River Basin. Problems with raw or inadequately treated sewage running into streams must be addressed.

Overloading the water and wastewater systems produces unsafe discharges into streams and lakes – and water quality problems.



Safe Drinking Water: A Growing Need for the Region

Even though only a few communities presently plan to use the Muskingum reservoirs as raw water sources, the need to use the lakes for drinking water will become more important in the future.

With population expanding in the northern counties, and demands for development increasing, the basin must investigate opportunities for restoring reservoir capacities so that drinking water can be supplied to even more communities. The reservoirs today are capable of providing drinking water, when needed.



Water and sewer system deficiencies exist in numerous communities throughout the Muskingum River Basin.

Changes in Land Use Over Time Affect Flood-Protection Strategies and the Quality of the Environment, Ecosystem

Since the days of Bryce C. Browning and Arthur E. Morgan, land use within the Muskingum River Basin has changed dramatically.

Residential, commercial and industrial development – especially in the basin's northern counties – has brought economic prosperity, altered the landscape and presented new challenges for people managing, operating and maintaining the reservoir system:

Land use changes have damaged the sensitive ecosystem near shorelines and banks, reducing its function and value.

Paved surfaces, which have replaced soil and green space, allow more runoff and more potential for flooding during storms. Increased runoff destabilizes channels, spoils stream equilibrium and transports more sediment downstream.

Unwise development has resulted in facilities without storm water detention or retention structures.

Ecosystem restoration is needed in the Muskingum River Basin.





The dams and reservoirs were built primarily on undeveloped lands in the 1930s. As the region's population has grown, many areas surrounding the lakes have been developed – putting new pressures on our water resources.

Sound Floodplain Management Can Deliver Greater Levels of Flood Protection

While the reservoirs help protect life and property throughout the basin, the system cannot provide the same level of protection to every area within the region.

Development has occurred in sensitive floodplains, putting people and property at risk during high-water events. Protecting people and property requires better floodplain management and land use controls, and enforcement of ordinances and regulations. Organizations in the region must work together to identify ways to manage development in the basin and educate the public about the consequences of developing in floodplains.

The Muskingum's floodplain contains approximately 17,000 structures valued at \$1.7 billion.





Ecosystem restoration will curb erosion and sedimentation and improve the environment.

Flood Protection, Recreation Won't Exist Without Renewal

The Muskingum River Basin system, built to last 50 years, is now almost 70 years old.

Despite its age, this system has protected the region from flooding and provided opportunities for recreation over thousands of acres of land and water.

Nevertheless, the reservoirs have remained much the same since their construction in the 1930s. Short-term fixes, supported by limited revenue sources, have maintained the system. But now modernization – not simply maintenance – is required.

The entire system must be renewed. The harmful and negative consequences of aging dams, sedimentation, acid mine drainage, hydrogen sulfide, stream contamination and the impacts of growth must be addressed. If these issues are not addressed, flood protection, access to recreation, water quality, the ecosystem, public safety and economic growth will remain at risk – threatening the future of the basin. The time has come for systematic approaches to solve these urgent problems.

No longer can we pick and choose projects here and there. We'll never catch up if we don't have a major effort that looks globally at the Muskingum Watershed.

-John Hoopingarner, Executive Director, MWCD

Tackling water resources challenges in partnership with stakeholders is known as the watershed approach. Such collaborations bring a variety of resources, organizations and perspectives to the table. Stakeholder partners solve problems by analyzing the system and its needs as a whole, in a larger geographic context and in a balanced, sustainable manner.

No Single Entity Has All the Technical, Financial Resources for Comprehensive Renewal

The Corps of Engineers – which has a proud, 200-year history of building and maintaining flood-protection and other multipurpose engineering and environmental projects – is working with a multi-agency Oversight Committee to plan a long-term strategy for renewal. This strategy is known as the Muskingum River Basin Initiative. This initiative will:

Repair and modernize the aging reservoir system through *infrastructure renewal*, and

Improve water quality and the environment through comprehensive ecosystem restoration.

Members of the Oversight Committee, led by the Corps of Engineers and MWCD, are collaborating on this initiative to ensure a delicate balance between flood protection, recreation and land use – and the best possible plan for the region. Current members of this partnership, which is anticipated to grow, include **federal**, **state and local stakeholders**:

Buckeye Hills Resource Conservation and Development Council

Crossroads Resource Conservation and Development Council Inc.

Northeast Ohio Four County Regional Planning and Development Organization

Ohio Agricultural Research & Development Center

Ohio Department of Natural Resources

Ohio EPA

USDA Forest Service

USDA Natural Resources Conservation Service

- U.S. Fish & Wildlife Service
- U.S. Geological Survey



Stakeholders serving on the Oversight Committee – who well understand the needs of the Muskingum River Basin – are natural partners to help plan and implement this critical initiative.

> The multiyear, multibillion-dollar effort needed to renew the Muskingum River Basin has been compared to other important water resources renewal projects under way in the Everglades, Chesapeake Bay and coastal Louisiana.

Given all the potential benefits – to human safety, water quality, environmental restoration, recreation and the economy – it's impossible to overstate the importance of this watershed initiative. This is a farsighted strategy for renewal.

-Sam Speck, Director, ODNR



The best plan for renewing the valley will balance flood protection, recreation and land use.



We are encouraged to believe that a wise and sensible beginning has been made. In the present spirit of mutual confidence and mutual encouragement, we go forward. —President Tranklin D. Roosevelt Renewing the basin again will require a significant public investment.





Some Improvements Are Under Way – But Many More Are Needed

Hundreds of critical projects, large and small, have been identified, and some initial work has begun:

The Corps of Engineers is beginning to convert some of the original intake structures to multilevel intakes; repairing dams, bridges and tunnels; and installing an automated flood-warning system, which will notify populations threatened by imminent flooding.

A comprehensive ecosystem restoration program, which encompasses the upstream watershed feeding the lakes, is being studied.

But these preliminary steps for renewal pale in comparison to the magnitude of structural and environmental improvements needed – an effort estimated to cost more than \$2 billion and require several decades to complete. Existing funding programs, designed for smaller-scale projects, are clearly insufficient for addressing the enormity of the problems, and the breadth and depth of required solutions.



The multiyear renewal program will create highpaying construction jobs in the region – just as the original dam construction project did in the 1930s. We have a window of opportunity now to renew the system economically. If renewal is deferred, replacement will be necessary – at a much higher cost than renewal. The total estimated cost to rebuild all 16 reservoirs, which cost \$60 million originally, is more than 26 times that today.

Precedents exist for the federal government to address regional problems of national significance. The Energy and Water Development Appropriations Act of 1981 authorized flood-protection measures for portions of Virginia, West Virginia and Kentucky affected by a record flood in 1977. Section 202 of the legislation directed the Corps of Engineers to design and construct flood-damage reduction measures in these areas. Ultimately, the Corps provided flood protection for thousands of homes.

The Funding Challenges Are Real

It was in the national interest – and in the interest of the state, the region and local communities – to support construction of the Muskingum River Basin system in the 1930s.

Clearly, these same entities now must step forward to contribute resources in the interest of preserving, protecting and enhancing this nationally significant, economically important system. What is needed is a long-term commitment to renewal from citizens, landowners, industries and businesses, and from government officials at all levels.

The Muskingum River Basin has a history of reaching out to secure local, regional, state and federal cooperation and resources – a history begun by citizens and leaders in the aftermath of the 1913 flood. This level of cooperation, and even more resources, again must emerge to address today's needs in the basin.

Now is the time to repeat our proud history.

Now is the time to respond to this national call for renewal.



For More Information, Contact:

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Muskingum Watershed Conservancy District (MWCD) P.O. Box 349 1319 Third Street N.W. New Philadelphia, OH 44663

877.363.8500 (toll-free) 330.343.6647 www.mwcdlakes.com

Citizens: What You Can Do

Visit www.muskingumbasin.org to remain current on program developments and learn about public involvement opportunities related to the Muskingum River Basin Initiative.

Email us at: info@muskingumbasin.org



Citizens and leaders of the past took bold steps when they invested in a watershed approach to flood protection for this region. We should take the same bold steps and be willing to reinvest in a system that has proven itself, and paid for itself, over and over again. Now is the time for stakeholders at all levels to respond in concert to this national call for renewal.

-William E. Bulen Jr., Colonel Corps of Engineers, Huntington District









UAS



BUCKEYE HALS ROAD











STRONG PARTNERSHIPS HAVE BEEN ESTABLISHED IN THE MUSKINGUM SO STAKEHOLDERS CAN PLAN INTELLIGENTLY, PRIORITIZE PROBLEMS AND EXPEND FUNDS WISELY TO ADDRESS WATERSHED MANAGEMENT ISSUES THAT MOST AFFECT THE PUBLIC. STRONG AND DURABLE PARTNERSHIPS ARE NECESSARY FOR AN INITIATIVE OF THIS MAGNITUDE TO SUCCEED.

