

DRAFT ENVIRONMENTAL IMPACT STATEMENT (dEIS) Department of Natural Resources (DNR)  
Southeast Region

NOTE TO REVIEWERS: This document is a DNR draft environmental impact statement (dEIS) that evaluates probable environmental effects. Your comments should address the completeness and accuracy of the dEIS. For your comments to be considered, they must be received by the contact person before 4:30 p.m., April 6<sup>th</sup>, 2016.

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Applicant: Milwaukee County Parks

Address: 9480 Watertown Plank Road, Wauwatosa, WI 53226

Title of Proposal: Estabrook Dam Rehabilitation and Operation

Location: Cities of Milwaukee and Glendale, Milwaukee County, Wisconsin

Township Range Section(s): Northeast Quarter of Section 5, Township 7 North, Range 22 East

## 1. Overview of the proposal

Milwaukee County, a Wisconsin municipal body corporate, owns and operates Estabrook Dam in the Milwaukee River near Estabrook Drive and West Hampton Avenue. The dam was built in the late 1930's. The construction also included excavation of a channel for the gated section of the dam. The Wisconsin Department of Natural Resources (the Department) issued an Administrative Order to Repair or Abandon Estabrook Dam dated July 28, 2009, requiring the County to drawdown the impoundment due to safety concerns until such time as the dam can be either repaired or removed. The Department had also previously issued an Administrative Order to Repair Estabrook Dam dated September 26, 2008 requiring the County to drawdown the impoundment until the dam was repaired, due to a damaged stoplog section of the fixed crest spillway. As a result, the dam gates have been open since 2008.

Repairing the dam is a Minor action and establishing an operating order is an Integrated Analysis action under NR 150.20, Wis. Adm. Code. While neither action requires an EIS, the Department has elected to use the EIS process to facilitate public review. There is no federal requirement to prepare an EIS.

Milwaukee County has solicited public and regulatory input on a series of alternatives to repair, replace or remove the dam. Upon receiving this input, Milwaukee County has selected to repair the dam with construction of a fish passage structure and is proceeding with plans for implementation. The Department will issue a Dam Operating Order to be implemented post-project completion. The County has proposed to operate the dam with a year-round, normal water level pool.

## 2. Purpose and Need

Estabrook Dam was constructed during the late 1930's by the Civilian Conservation Corps (CCC) and Civil Works Administration (CWA). The dam was constructed with 10 gates that could be opened during times of flooding and closed during low water in order to maintain a 103-acre pool of water above the dam for boating, bathing and fishing. The gated section of the dam extends from County owned parkland on the north bank of the river to a central island owned by Milwaukee County. A fixed crest spillway then extends from the island to private lands on the south bank of the river. On May 26, 1937, Milwaukee County received authorization from the Public Service Commission (PSC) of Wisconsin to construct, operate and maintain the dam with a run-of-the-river and normal water operating level equal to the elevation of the fixed crest portion of the spillway. Documentation of this authorization and historical information on the construction of the dam is on file with Milwaukee County Parks Department. Documentation describing when and the reasons for the County instituting a fall through spring drawdown are not known. The earliest correspondence describing manipulating

the dam gates for purposes of abating flooding and drainage problems was a letter from the City of Milwaukee to the County Parks Director in 1986.

Prior to the construction of the dam, the area located 0.5 miles upstream of the current dam was a rock ledge where the bedrock was higher in this section of the river. Based on measurements obtained from 1937 aerial photographs, the rock ledge maintained a low-gradient meandering channel dominated by runs and pools. The average width upstream of the rock outcrop crest to the 130-degree bend upstream of Silver Spring road was less than 180 feet bounded by expansive wetlands. Based on pre-dam 1937 aerial photographs and numerous other surveys and topographic maps, the river morphology never included a widening or "natural lake-like" feature. There are no historic documents that describe the depth of the river before modifications were made but the crest of the rock outcrop was lowered by six to seven feet suggesting the maximum depth would have been about the same and decreasing upstream.

Beginning in 1935, the rock ledge was excavated within the river channel, resulting in a deeper river channel that was widened and straightened for approximately 6,000 feet near the confluence of the east and west oxbows to abate flooding. The channel modifications were considered only partially effective for mitigating flooding and ice dams, in particular between West Silver Spring Drive and Bender Road (Wisconsin State Planning Board, 1940). The buildup of ice dams along the river upstream of Silver Spring Drive were reported as recently as the winter of 2014 despite the dam gates being fully opened and the pool drained since 2008. Historic planning documents inferred that the channel modifications would not be effective at reducing ice dams upstream of Silver Spring road due to the bend in the river and narrower channel widths. The public requested the local government construct a dam to create a pool for enhancing parkland aesthetics and recreational purposes. The dam was built with 10 gates to allow for adjusting the upstream pool elevation presumably for maintenance of the dam and to convey flood flows.

Estabrook Dam was inspected in 1995 and 2004. The following deficiencies were noted as work directives with timelines for completion:

- The gates of the dam require a variety of work and must be repaired and all returned to operating condition.
- The stoplogs and their supports on the fixed spillway need to be replaced.
- The left and right abutments of the dam need to be repaired and stabilized with firmly compacted soils and riprap.
- Concrete repairs need to be made to the piers of the dam.
- The icebreakers upstream of the gated section of the dam are deteriorated and must be removed or reconstructed.
- The concrete access stairs on both the left and right sides of the dam are unsafe and must be rebuilt.
- Trees and shrubs are growing in areas around the left and right abutments of both the gated sections of the dam and fixed crest spillway and must be removed and their holes filled with compacted tight soils and planted over with grass to stabilize the area.
- Extensive debris must be removed from both the fixed crest spillway and ice breakers upstream of the gated sections of the dam. Some of the debris may have come along with contaminated sediment and may need to be handled and disposed as contaminated material.
- Signing must meet specifications.
- A structural analysis including scour/undermining analysis of the dam must be completed. A structural analysis was submitted to the Department on September 28, 2010 which recommended structural reinforcing by adding tie down steel anchors to be grouted into bedrock on the upstream side of the gated spillway.
- An Inspection, Operation and Maintenance Plan must be developed as well as an Emergency Action Plan.

The Department's Administrative Order dated July 28, 2009, required the County to repair or abandon/remove the dam within established timelines and also required the County to maintain the dam under a drawdown condition until the repairs were completed. The repairs pertain to structural improvements and reconditioning of the gates to maintain proper operation. The structural improvements include installing rock anchors to stabilize the dam under all anticipated loading conditions. In addition, debris which has collected at the dam needed to be removed. Some tree removal near the dam structure was also required.

Milwaukee County retained a consultant to investigate the dam condition in 2010, to assess sediment quality and quantity upstream of the dam and to design improvements to the dam to meet the Department's Administrative Order.

The United States Environmental Protection Agency (USEPA), the Department and Milwaukee County have investigated the sediments upstream of Estabrook Dam. Contaminated sediments containing organic and inorganic pollutants including carcinogenic polycyclic aromatic hydrocarbons (CPAHs) and polychlorinated biphenyls (PCBs) were removed from the west oxbow of the Milwaukee River and Lincoln Creek about one mile upstream from the dam in 2011. Additional sediment was removed during 2015, including sediments directly behind the fixed crest spillway. Further information on the sediment removal project can be found at the WDNR project website: <http://dnr.wi.gov/topic/greatlakes/lincolnpark.html> . Sediments contaminated with PCBs and PAHs were found upstream from the dam and removed as part of the Lincoln Park Phase 2 project. Approximately 52,000 cubic yards of contaminated sediment were removed from the Milwaukee River, starting with the main channel between the oxbows and from directly behind and upstream from the fixed crest spillway.

Repairs to the Estabrook Dam were designed by an engineering firm and plans and specifications for these improvements have been on file at Milwaukee County since 2011. Access easements from adjacent property owners were acquired by the County to allow construction work at the dam.

On January 17, 2012, the Bureau of Land Management (BLM) informed Milwaukee County that the island at the dam was under BLM jurisdiction and an approval from BLM would be necessary to perform construction work on the dam. The proposed construction work would include structural repairs to the dam and removal of tress within 15 feet of the dam. The BLM said the National Environmental Policy Act (NEPA) must be followed and that an Environmental Assessment for the project must be prepared including evaluating practicable alternatives to dam repair.

In 2014, a Milwaukee-based citizen's alliance organization raised questions as to BLM's jurisdiction of the island. Aerial photographs from the 1930's have showed the property is part of Milwaukee County's Estabrook Park and that the island was created by the excavation of the new river channel to construct the gated section of the dam. BLM reviewed the documents on file and formally concurred that they do not have jurisdiction of the island in a letter to Milwaukee County dated June 24, 2015. BLM is no longer an agency having regulatory authority for the project.

Also in 2014, a Milwaukee-based non-profit organization filed a lawsuit against Milwaukee County claiming Estabrook Dam is a public nuisance. On May 24, 2014, the State of Wisconsin Circuit Court declared that Estabrook Dam is a public nuisance and ordered Milwaukee County to remedy the nuisance by repairing or removing the dam.

Because of the fiscal components of the project, Milwaukee County Board of Supervisors has decision making abilities as to whether the dam would be repaired or removed. The Board has considered options for the dam through an alternative analysis done by an independent consulting firm, which included capital and operational costs of the alternatives. The Board decided in 2015 that the dam would be repaired.

Milwaukee County re-submitted plans for repair to the Department on November 23, 2015. The repairs were re-submitted due to additional deterioration at the dam since the original plans were submitted in 2011. The updated repair plans also included a preliminary fish passage design. The final fish passage design will be submitted before the Department issues a plan approval.

Estabrook Dam currently does not have an operating order, but the County has operated the dam gates and pool water level based on two annual periods: a summer plan (mid-May to mid-September) whereby the gates are generally closed to maintain impoundment at a full pool, and for the remainder of the year (mid-September to mid-May) the gates are opened and the pool is drained. Additional provisions are in place to adjust the summer gates and pool water level in the event of flooding. These provisions entail opening the gates to accommodate the flood. Provisions are also in place to pass flow downstream during low flow conditions.

The Department has committed to issuing an operating order for the dam. An operating order is an official Department issued document that will establish water levels on the river at the dam and upstream of the dam, and specify standards of operation for the dam. Water levels upstream of man-made impoundments are regulated by the Department under s. 31.02, Wis. Stats. The goal is to develop an operating order that will improve the Milwaukee River ecosystem as well as balance the needs of those who own land on the river upstream of the dam, recreational users and Milwaukee County. The normal water level would be established at 616.6 feet National Geodetic Vertical Datum of 1929 (NGVD29). The normal water level would be maintained to the maximum extent practicable by the reasonable and proper operation of the gates. Although there would be no established maximum or minimum water level, operation of the dam would be consistent with keeping water levels within 0.5 feet above or below the normal water elevation. The normal water level elevation is currently proposed based upon the conceptual fish passage design and could change slightly, depending upon the final fish passage design.

### 3. Authorities and Approvals

#### Local:

1. Right of Entry Permits from adjacent landowners
2. Construction Site Erosion Control Permit from City of Milwaukee/City of Glendale
3. City of Milwaukee/City of Glendale Floodplain Zoning Ordinances

#### State:

1. Wisconsin Statutes, Chapter 30 permits for structures, shoreline stabilization, and dredging
2. Wisconsin Statutes, Chapter 31 regulation of dams and bridges affecting navigable waters
3. Wisconsin Statutes, Chapter NR 281.36 permit for discharges into wetlands
4. Wisconsin Administrative Code, Chapter NR 216 Wisconsin Pollutant Discharge Elimination System (WPDES) stormwater and wastewater permitting
5. Wisconsin Administrative Code, Chapter NR 333 design standards for large dams
6. Wisconsin Administrative Code, Chapter NR 116 floodplain management program
7. Wisconsin Administrative Code, Chapter NR 40 invasive species
8. Wisconsin Statutes, Chapter 29.604 and Wisconsin Administrative Code, Chapter NR 27 Endangered Species - Natural Heritage Inventory
9. State Archaeological site clearance required

#### Federal:

1. Toxic Substances Control Act (TSCA) compliance
2. US Army Corps of Engineers Section 404
3. National Historic Preservation Act compliance
4. Tribal historic/cultural review
5. Federal Emergency Management Agency (FEMA) review of regional floodplain elevations
6. Federal Endangered Species Act

### 4. Alternatives

Milwaukee County submitted an Environmental Impact Report (EIR) to the Department on October 9, 2015, which included a proposed operating order for the dam, as well as alternatives to repair that were considered. These alternatives included a no-action alternative, rehabilitation of the dam, rehabilitation of the dam with provisions for fish passage, removal of the dam, construction of a new dam, and removal of the dam while installing a “rock ramp” to develop a pool upstream similar to a dam, that would also allow for fish passage. The Environmental Impact Report and details on these alternatives, including the capital and operational costs of the alternatives, can be found at <http://dnr.wi.gov/topic/EIA/documents/Estabrook/EstabrookEIR.pdf>.

Milwaukee County’s proposed action is to repair the dam with construction of a fish passage structure. The fish passage will allow fish to migrate during spawning and other periods of the year, which promotes fish and mussel diversity, enhances fish and mussel populations and fishing opportunities, and is intended to replicate conditions in a free-flowing river. The County has proposed to operate the dam and fish passage with a normal water level pool elevation, year-round. In addition, both full and partial winter drawdowns are being evaluated.

### Normal Water Level Operation

During this operation the six gates will be closed the majority of the time. The County would employ a dam gate operator to monitor river flows, river levels, debris, weather conditions and will open and close gates to maintain normal pool elevation as best as possible. A normal water level in the pool would be based on the fixed crest spillway elevation and the entrance weir to the fish passage. The gates would be operated as needed to maintain the normal water level. If rising water levels occur above the normal, the County would have the option to open gates to adjust pool levels accordingly.

### Alternative #1- Full Winter Drawdown Operation

From May 15<sup>th</sup> to September 15<sup>th</sup> of the calendar year, the gates would be closed and would operate to maintain normal water levels. The pool would be completely drawn down on September 15<sup>th</sup>. The gates would be operated to limit the drawdown to 6 inches or less per day as per the Department requirements. All stoplogs would also be removed. Following complete drawdown all gates would remain open until May 15<sup>th</sup>. The pool would be refilled no earlier than May 15. This schedule could vary depending upon weather and river flow conditions. During refilling, Estabrook Dam would be required to pass at all times a minimum flow downstream at least 25 percent of the natural low flow (s. 31.34, Wis. Stats).

### Alternative #2- Partial Winter Drawdown Operation

From May 15<sup>th</sup> to September 15<sup>th</sup> of the calendar year, the gates would be closed and would operate to maintain normal water levels. The pool would be lowered three feet starting on September 15<sup>th</sup>. Throughout the winter season, the six gates would be closed and the stop logs removed to lower the impoundment by three feet. The gates would first be opened to limit the drawdown to 6 inches or less per day as per the Department requirements. Once the pool had been lowered below the bottom of the stoplogs, the stoplogs would be removed. After stop logs were removed, the gates would be closed. The pool would be refilled no earlier than May 15. During refilling, Estabrook Dam would be required to pass at all times a minimum flow downstream at least 25 percent of the natural low flow (s. 31.34, Wis. Stats).

## **5. Manipulation of Terrestrial Resources**

### Manipulation of Terrestrial Resources needed for Repair with Fish Passage

The following repairs will be made to the Estabrook Dam according to the design construction documents and to comply with the Department's Administrative Order of 2009.

- Concrete will be repaired.
- Exposed reinforcing rod will be reconditioned.
- Supplemental reinforcing will be installed as necessary.
- Grouted tie-down rock anchors and associated components on the upstream ends of the piers will be installed.
- Steel slide gates and their components will be reconditioned.
- Concrete and stone rubble overflow spillway will be repaired.
- Steel framing and associated components of the stop logs at the north end of the fixed crest spillway will be reconditioned or replaced.
- Concrete icebreakers will be repaired or replaced.
- Slope protection (rock riprap over geotextile fabric) upstream and downstream of the gated dam structure will be installed.
- Dam safety signs on the island and gated structure and new portage signs will be installed.
- Vegetation will be cleared from the abutments, access roads and staging areas.

The construction of the fish passage structure along the north shore (left bank when looking downstream) will consist of a rock ramp including pools and riffles. A structural wall constructed parallel to the shore will separate the fish passage from the rest of the river. This wall will be connected to the compound weir, which runs perpendicular from the shore.

The two walls create a rectangular box along the north shore. The fish passage is located upstream from the dam in the area of the first four gates on the north end of the dam. These four gates will be removed because river flow through the fish passage is controlled by the fish passage structure. The compound weir allows control of the river flow during both high and low flows, while maintaining at least 10 percent of the flow through the fish passage during spring runoff conditions.

The dam repair order calls for the permanent removal of all trees and shrubs from the area within 15 feet around the north and south abutments for both the fixed crest spillway and gated sections of the dam. Removal is to include the complete removal of the stumps and roots, filling of the holes created with compacted tight soils and adding topsoil and grass seed to stabilize the area.

Milwaukee County Parks will work with the contractors and the Department to determine the trees that can be preserved. All areas that are disturbed from this project will be restored to the satisfaction of the Milwaukee County Parks Department, other affected landowners and the Department. Temporary roads and staging areas will be constructed to access the dam for repairs. The sediments behind the fixed crest spillway have already been removed as part of the sediment cleanup project. Access roads will allow for truck access to the dam for repairs. A perimeter fence will be constructed to restrict public access to the construction work zone.

During construction, access to the river from both the left and right banks will be required. Access to the northern portion of the dam will be through Estabrook Park. Access to the southern portion of the dam will come through negotiated access easements to private lands on the right (south) bank of the river.

#### Manipulation of Terrestrial Resources needed for Normal Water Level Operation

No manipulation of terrestrial resources would be needed.

#### Manipulation of Terrestrial Resources needed for Alternative #1- Full Winter Drawdown Operation

An operating deck for safe removal and installation of the stoplogs would be needed.

#### Manipulation of Terrestrial Resources needed for Alternative #2- Partial Winter Drawdown Operation

An operating deck for safe removal and installation of the stoplogs would be needed.

## **6. Manipulation of Aquatic Resources**

#### Manipulation of Aquatic Resources needed for Repair with Fish Passage

PCB and PAH contaminated sediment and debris were present upstream and adjacent to Estabrook Dam. The sediment and debris were removed during the 2015 Lincoln Park and Milwaukee River Channels Phase II sediment project. Approximately 10,000 cubic yards of contaminated sediment and debris were removed from behind the fixed crest spillway and upstream near the south bank to the Holiday Inn. In addition, trees and other vegetation were removed from the shoreline to facilitate sediment removal, and the shoreline was reshaped and planted per the project design. The project was completed as part of the US EPA Great Lakes Legacy Act, with Milwaukee County and the Department as the non-federal sponsors. The extent of the sediment footprint is about 1.4 acres.

Repair work on the dam spillway, embankments, and icebreakers will take place during drawdown conditions. Temporary diversion structures will be used during dam rehabilitation to direct flow through certain dam gates as other gates are being repaired. The diversion structures will be moved as needed until all gates have been repaired. Facilities and equipment will be located outside of the floodplain.

Southeastern Wisconsin Regional Planning Commission (SEWRPC) completed a detailed analysis of the proposed action on local hydraulic and the floodplain conditions. SEWRPC modeled the Estabrook Dam alternatives in 2014 under multiple flow conditions including mean flow, median flow, 10, 50, 100 and 500-year frequency flow events.

SEWRPC's river modeling takes into account the river cross sections and vegetative conditions of the river's floodplain. Vegetation has developed in some areas of the floodplain since the dam impoundment has been out of service. SEWRPC has adjusted some friction factors to account for this situation where warranted. These areas of recently developed vegetation represent a small fraction of the modeled river system as a whole. In addition, riverbed/bank vegetation would represent an insignificant barrier to floating ice.

SEWRPC also modeled Estabrook Dam with the gates closed to provide Milwaukee County with the technical understanding of the results of river levels under this scenario. Under a 100-year frequency flood with the 10 gates closed, the upstream river levels would exceed a 100-year flood elevation and would worsen the flood conditions. Under this scenario, the river levels would be as much as 1.5 feet greater than the 100-year flood elevation near the dam, and continue to exceed the 100-year flood elevation at West Bender Road. This situation provides potential liability issues for Milwaukee County. The County could staff a dam operator to continually monitor river flows and weather conditions to control the gates, but the possibility remains if the ten gates malfunction due to debris, ice, an electrical power outage or gate mechanical failure, the County could be liable for flood damage to upstream properties.

#### Manipulation of Aquatic Resources needed for Normal Pool Operation

At the normal water level, the impoundment would be approximately 103 acres and would extend beyond West Silver Spring Drive for an additional 0.9 miles upstream. At flood level, the Milwaukee River would continue to overtop the fixed crest and gated sections of dam structure. During larger floods, the dam would submerge even with all gates open. This means that there would be no discernable difference between water levels upstream and downstream of the dam. The distance from the dam to the upstream end of the impoundment would be about 2.5 miles.

Under normal flow conditions, which assume that the Estabrook Dam gates would be closed, the maximum water depth will be about 8.7 feet near the dam to about 2.4 to 9.1 feet in the upper reach defined as the river segment between the abandoned railroad bridge upstream of Lincoln Park and West Bender Road.

#### Manipulation of Aquatic Resources needed for Alternative #1 - Full Winter Drawdown Operation

The gates would be opened from September 15<sup>th</sup> to May 15<sup>th</sup> of the calendar year and the water levels would be slowly lowered until all gates are open and remain open until May 15<sup>th</sup>.

#### Manipulation of Aquatic Resources needed for Alternative #2 - Partial Winter Drawdown Operation

The stoplogs would be removed from September 15<sup>th</sup> to May 15<sup>th</sup> of the calendar year, causing the water levels to be lowered 3 feet.

## **7. Buildings, Treatment Units, Roads and Other Structures**

#### Structures needed for repair with fish passage

The proposed action has a small existing building associated with the dam. The dam is a structure that will be rehabilitated. There are no treatment units associated with the dam. Access roads are required to make improvements to the dam. There is an existing access road in Estabrook Park. The access road across the river is on private property and served as access for the sediment removal project and will provide access for the dam project.

The approximately 222-foot long concrete dam and abutments with 10 steel slide gates connects the left (north) bank of the Milwaukee River at Milwaukee County's Estabrook County Park to an island in the center of the river. The County has jurisdiction over the mid-river island. A 562-foot long fixed crest concrete and grouted limestone spillway is located immediately west of the island and connects the island with the right (south) bank of the Milwaukee River. The property on the right bank of the river is privately owned and under the control of Securant Bank & Trust and is listed for sale, and Wheaton Franciscan Services, Inc., where the dam touches the west bank. A series of 28 concrete and steel pylons referred to as "ice breakers" were added upstream of the dam and spillway around 1955 to help protect the structure from debris and ice. The County is in the process of modeling the fish passage design. The design will be modified until it meets all requirements of NR 116.

#### Structures needed for Normal Pool Operation

No other structures would be needed to operate the normal pool operation.

### Structures needed for Alternative #1- Full Winter Drawdown Operation

An operating deck for safe removal and installation of the stoplogs may be needed.

### Structures needed for Alternative #2- Partial Winter Drawdown Operation

An operating deck for safe removal and installation of the stoplogs may be needed.

## **8. Emissions and Discharges**

### Emissions from repair with fish passage

Temporary air emissions due to construction vehicles may result from the proposed action. No long term emissions or discharges should result from the repair of the dam. Discharges of sediment from disturbing the bed and banks of the river could occur as a result of construction, but should be mitigated through erosion control best management practices.

### Emissions from Normal Pool Operation

Some discharge of sediment could occur when the gates are opened operated, which could be detrimental to fish, mussels, and other aquatic life.

### Emissions from Alternative #2 - Full Winter Drawdown Operation

When the gates would be opened from September 15<sup>th</sup> to May 15<sup>th</sup>, discharge of sediment could occur, which could be detrimental to fish, mussels, and other aquatic life.

### Emissions from Alternative #3 - Partial Winter Drawdown Operation

When stoplogs would be removed from September 15<sup>th</sup> to May 15<sup>th</sup>, discharge of sediment could occur, which could be detrimental to fish, mussels and other aquatic life.

## **9. Identify the maps, plans and other descriptive material attached**

Attachment 1: County map showing the general area of the project

Attachment 2: 2015 Aerial Photo

Attachment 3: Site development plan

Attachment 4: DNR county wetlands map

Attachment 5: Zoning map

## **10. Affected Physical Environment**

### Topography and Bathymetry

The Estabrook Dam is located in the Milwaukee River basin. A basin report is available at [http://dnr.wi.gov/water/basin/milw/milwaukee\\_801.pdf](http://dnr.wi.gov/water/basin/milw/milwaukee_801.pdf). The topography of the basin was formed by glacial deposits superimposed on underlying bedrock, and ranges from a high of 1,360 feet above sea level in the Northern Unit of the Kettle Moraine State Forest to 580 feet at the Milwaukee Harbor. The surface slopes downward from the north and west to the south and east. The physiography is typical of rolling ground moraine, although surface drainage networks are generally well connected, leaving relatively few areas of the watershed that are internally drained.

The dam and overflow spillway sit on a limestone ledge in the Milwaukee River. A mile long 200-foot wide, 6-foot deep channel was mined from the limestone ledge in the vicinity of the existing dam in the 1930s to help alleviate flooding in this area along the Milwaukee River. A dam was built on top of the limestone ledge at that time to maintain a pool of water above the dam, which was controlled by operating gates. This pool of water extends approximately 2.5 miles upstream at time of full pool.

### Hazardous Materials

The sediment removal project completed in 2015 involved removal of PCB and CPAH contaminated sediment. While hazardous materials are not anticipated with the dam repair, there is a possibility that they may be uncovered during construction. Coordination with the Department will be initiated if this occurs to ensure hazardous materials are handled in accordance with state law.

### River Flows and Water Resources

The Milwaukee River Basin consists of six watersheds, containing about 600 miles of perennial streams and 450 miles of intermittent streams draining nearly 900 square miles of land. Most of the stream miles in the basin are considered full fish and aquatic life streams, meaning they are capable of meeting water quality standards and have the ability to support a full range of fish and aquatic life as habitat and water quality allow.

The Estabrook Dam is located within the Milwaukee River South Watershed. This watershed covers about 168 square miles and is located in portions of Ozaukee and Milwaukee Counties. The Milwaukee River main stem enters the watershed west of the Village of Fredonia and flows for about 48 miles before entering the Milwaukee Harbor. Land cover in the watershed is a mix of rural and urban uses. Overall, the watershed is about 33 percent urban, with agriculture (25 percent), grasslands (21 percent), forests (12 percent) and wetlands (6 percent) making up the rest of the major land cover types. Fourteen cities and villages are found in this watershed. As with other watersheds in the basin, the streams in the Milwaukee River South Watershed exhibit a wide range of quality.

Within this urbanized watershed, approximately 15 percent of perennial stream miles have been significantly modified to the extent they have limited ability to sustain diverse biological communities. Many of these streams were straightened, enclosed, or lined with concrete to facilitate water movement downstream to alleviate flooding concerns. From a water quality and biological standpoint, this type of river modification causes wide fluctuations in water levels over short periods of time, increases channel scour, and provides little to no habitat for aquatic life. Milwaukee Metropolitan Sewerage District (MMSD) has implemented major flood water storage and river enhancement activities in Lincoln Creek, South Branch Creek and Indian Creek and other areas.

Approximately 61 miles of streams (10 percent of the total Milwaukee River basin stream miles) do not meet USEPA Clean Water Act water quality standards on a consistent basis and are listed as 303(d) impaired waters. With the exception of one stream in the North Branch Watershed, these lower quality stream miles are located in the most densely populated areas of the basin. Many of these streams were modified by straightening, enclosure, or concrete lining to move water off the land and more quickly downstream. Approximately 2.4 miles of the Milwaukee River near the Estabrook Dam are impaired due to contaminated sediment, point and non-point source pollutant impacts.

The Estabrook Dam is located within the Milwaukee River Estuary Area of Concern (AOC). The Milwaukee Estuary, part of the largest fresh surface water resource in the world (the Great Lakes Ecosystem), was designated an AOC in 1987 by the International Joint Commission because of historical modifications and pollutant loads that contributed toxic contaminants to the AOC and Lake Michigan. Sediments contaminated with PCBs, PAHs, and heavy metals were impairing public benefits such as fish consumption, healthy fisheries, boat access, and wildlife habitat. The Remedial Action Plan was updated in December 2014 by the Department Office of the Great Lakes and recommends fish passage at Estabrook Park. Eleven of a possible 14 beneficial uses identified by the International Joint Commission are impaired or suspected to be impaired for the Milwaukee Estuary AOC.

The floodplain of the Milwaukee River upstream from Estabrook Dam is defined on FEMA Flood Insurance Rate Maps. The 100-year frequency flood is based on Estabrook Dam having all 10 gates open and the stoplogs removed. There is development upstream of the dam and property owners within the floodplain who have mortgages that are required to carry flood insurance.

SEWRPC's river modeling was performed to evaluate the feasible alternatives and to address mean flow, median flow, 10-year, 50-year, 100-year and 500-year frequency events. Water depth under these flow scenarios was addressed to reflect recreational and environmental conditions. Modeling reports are on file with Milwaukee County Parks Department. River flows at Estabrook Dam are summarized as follows:

- Median Flow – 240 cfs
- Mean Flow – 451 cfs
- 10-Year Frequency Flood – 8,790 cfs

- 50-Year Frequency Flood – 12,900 cfs
- 100-Year Frequency Flood – 14,800 cfs
- 500-Year Frequency Flood – 18,810 cfs

#### Wild and Scenic Rivers

The Milwaukee River is not classified as a Wild and Scenic River.

#### Air Resources

Air resources will remain unchanged for the proposed action long-term. In the short-term, air impacts would be due to construction and/or demolition activities. Dust and construction equipment exhaust are the primary causes to affect localized air quality during the construction related activities for all feasible alternatives within the construction zone, immediate area, and access roads.

#### Noise and Odor

Noise will be a short-term issue during construction and/or demolition of the proposed action within the construction area and immediate vicinity. Noise will not be an issue long-term. Odor will not be an issue short-term or long-term.

#### Soil Resources

Soil resources will not be appreciably affected.

## **11. Affected Biological Environment**

#### Fish Community

The fish found within the Milwaukee River and Estuary are typical of riverine systems in Wisconsin. The fish survey report reviewed included the river system within Ozaukee and Milwaukee Counties. No specific survey was available for the Estabrook Impoundment. The connection to Lake Michigan has also allowed non-native species such as the Alewife, Sea Lamprey, Round Goby, Brown Trout, Rainbow Trout, Coho Salmon and Chinook Salmon to travel up river. Known or highly expected migrations occur from Lake Michigan and the Milwaukee Estuary up and down the river system. Barriers such as the Estabrook Dam can inhibit this migration. With the dam gates open during part of the year, however, some limited migration is possible. This dam is not a complete barrier because the dam is submerged during a 100-year frequency flood. However, during those high water events, fish migration over or under the gates would be very difficult. The Bridge Street Dam in Grafton was identified by The Department and US Fish & Wildlife Service as the first complete barrier to aquatic invasive species.

Some of the best smallmouth habitat on the Milwaukee River and southeast Wisconsin is located in between the Estabrook Dam and Milwaukee Estuary and upstream of the Kletzsch Park Dam. Fish consumption advisories for the Milwaukee River watershed can be found on the website: [www.dnr.wi.gov/FCSExternalAdvQry/FishAdvisorySrch.aspx](http://www.dnr.wi.gov/FCSExternalAdvQry/FishAdvisorySrch.aspx). The Milwaukee River contains a diverse cool and warm water fish community which includes sport and forage fish species. Gamefish and panfish known to be present or suspected upstream and/or downstream of the Estabrook Dam include lake sturgeon, smallmouth and largemouth bass, walleye, muskellunge, northern pike, bluegill, green sunfish, pumpkinseed, rock bass, bluegill, channel catfish, flathead catfish, yellow and black bullhead and yellow perch.

Common forage or non-game species in the Milwaukee River may include fathead minnow, golden shiner, common carp, stoneroller, common shiner, honeyhead chub, white sucker, creek chub, central mud minnow and redbreast. Fall migrations of Lake Michigan run Coho, Chinook salmon and brown trout and fall strains of rainbow trout and spring running strains of rainbow trout occur. The Milwaukee River does have limited suitable habitat for significant reproduction and recruitment of these trout and salmon species. However, rainbow trout are able to spawn and successfully reproduce in Pigeon Creek, which discharges to the Milwaukee River at Thiensville in southern Ozaukee County.

Opportunities to restore fish and aquatic life populations and their habitats in the Milwaukee Estuary will remain limited due to land use constraints. In recognition of these limitations, the Department Lake Michigan fish management plans recommend removing or modifying barriers to enable lake and estuary native potamodromous fish to access historic fluvial and wetland spawning and nursery habitats to increase their recruitment to the lake and estuary (WDNR, 2004,

2005a, and 2014; Wawrzyn, 2014). Ecologically and recreationally important species possessing strong spawning migratory behavior that would benefit from removal of barriers include lake sturgeon, northern pike, walleye, smallmouth bass, white and longnose sucker, and four species of Redhorse – the shorthead, golden, silver, and greater redhorse. Barriers to fish movement, among other factors, are identified as limiting the distribution and long-term survivability of state listed species (Lyons, et al., 2000; WDNR, 2005b).

### Invasive Species

Since the dam has historically been operated with a winter drawdown and because the river overtops the dam during floods, the dam is not considered a complete barrier to aquatic invasive species (AIS). Estabrook Dam is located 6.9 miles upstream of Lake Michigan, but the Department and US Fish and Wildlife Service (USFWS) have identified the Village of Grafton's Bridge Street Dam, located 32 miles upstream of Lake Michigan on the Milwaukee River, as the first complete barrier to fish and AIS. Round goby from Lake Michigan have migrated upstream to the Kletzsch Dam at river mile 10. Round goby have also been observed upstream and immediately downstream of the Thiensville Dam at river mile 20. As of 2015, annual fishery surveys at multiple sites downstream of the Thiensville Dam and upstream of the Thiensville Dam have detected these fish at multiple locations. These results suggest that the presence of Round goby upstream of the Thiensville Dam may be the result of human introductions, possibly by fishing bait releases.

The invasive aquatic and terrestrial plant species present within the project area should not be affected by the dam repair. All construction activities will follow the requirements of Wis. Admin. Code Chapter NR 40, to prevent the spread of invasive plants.

### Endangered, Threatened and Special Concern Species

The Natural Heritage Inventory Review is performed based on a Department database inventory of natural heritage communities and plant and animal occurrences of threatened or endangered species that could potentially be located in the project area. The Wisconsin Natural Heritage Working List contains species known or suspected to be rare in the state and natural communities native to Wisconsin. It includes state and federal species legally designated as "Endangered" or "Threatened" as well as species in the state advisory "Special Concern" category. There are no federal listed threatened or endangered, proposed or candidate species located in the project area.

Each species is assigned a single global rank as well as a state rank for each state in which it occurs. Federal ranks are designated by the U.S. Fish and Wildlife Service under the provisions of the Endangered Species Act of 1973. State ranks are assigned by each state's Natural Heritage Program.

#### Global Element Ranks:

G1 = critically imperiled globally because of extreme rarity (5 or fewer occurrences or very few remaining individuals or acres) or because of some factor(s) making it especially vulnerable to extinction.

G2 = Imperiled globally because of rarity (6 to 20 occurrences or few remaining individuals or acres) or because of some factor(s) making it very vulnerable to extinction throughout its range.

G3 = either very rare and local throughout its range or found locally (even abundantly at some of its locations) in a restricted range (e.g., a single state or physiographic region) or because of other factors making it vulnerable to extinction throughout its range; in terms of occurrences, in the range of 21 to 100.

G4 = apparently globally secure, though it may be quite rare in parts of its range, especially at the periphery.

G5 = demonstrably secure globally, though it may be quite rare in parts of its range, especially at the periphery.

#### State Element Ranks:

S1 = critically imperiled in Wisconsin because of extreme rarity (5 or fewer occurrences or very few remaining individuals or acres) or because of some factor(s) making it especially vulnerable to extirpation from the state.

S2 = imperiled in Wisconsin because of rarity (6 to 20 occurrences or few remaining individuals or acres) or because of some factor(s) making it very vulnerable to extirpation from the state.

S3 = rare or uncommon in Wisconsin (21 to 100 occurrences).

S4 = apparently secure in Wisconsin, with many occurrences.

S5 = demonstrably secure in Wisconsin and essentially ineradicable under present conditions.

#### Endangered

The striped shiner is the only state-listed endangered fish species that potentially exists or is known to exist in the Milwaukee River. It is likely to avoid the dam project area once construction activities start.

##### Striped Shiner (*Luxilus chrysocephalus*)

The striped shiner is ranked with a global element of G5 and a state element rank of S1. These rankings reveal that this species is secure globally but is imperiled in Wisconsin. The S1 or critically imperiled ranking is due to extreme rarity defined as five or fewer occurrences per acre, very few remaining individuals, or some factors make it especially vulnerable to extirpation in Wisconsin. During the mid-1990's, Department crews sampled multiple reaches at various times along the Milwaukee River and identified a single specimen from the river in Ozaukee County. The striped shiner is a warm water species that spawns on clean coarse substrate, larger than coarse sand. The parents guard and ventilate their eggs keeping them clear of silt. They prefer flowing river habitats and their diet is predominantly macroinvertebrates. They are considered intolerant of degraded habitat.

#### Threatened

The state-listed threatened fish species that potentially exist or are known to exist in the Milwaukee River include the redbfin shiner and longear sunfish, both of which would benefit from removal of contaminated sediments and fish passage.

##### Redfin Shiner (*Lythrurus umbratilis*)

The redbfin shiner is classified globally as G5 and has a state-wide ranking of S2. These rankings reveal the redbfin shiner is secure globally and is rare in parts of its range. In Wisconsin it is very rare. It has been collected in the Milwaukee River in Milwaukee County very infrequently. This fish is a warm water species that can tolerate more turbid waters. They prefer pool cover in large, low-gradient rivers over boulders, cobble, sand, or stable silt. They spawn by scattering their eggs with adhesive membrane that sticks to coarse clean substrate, submerged alive or dead aquatic plants or recently flooded vegetation, or sometimes on logs or branches. The parents do not build a nest nor do they guard their eggs or ventilate the eggs to keep them clear of silt. They prefer macroinvertebrates for their diet.

##### Longear Sunfish (*Lepomis megalotis*)

The longear sunfish is ranked globally as a G5 and has a state-wide ranking of S2. These rankings consider the longear sunfish to be secure globally but may be rare in areas of its range. It is very rare in Wisconsin. Milwaukee River Basin populations have declined with few remnant populations in Washington and Fond du Lac Counties. This species prefers clear, shallow, moderately warm, still water of streams, rivers or lakes over rubble, gravel and sand with moderate aquatic vegetation. It spawns from June through early August in large colonies during peak water temperatures in the afternoon. Males build nests in sand or hard mud and defend the surrounding territory. Eggs hatch in three to five days and they become sexually mature in the second or third summer.

#### Special Concern

One reptile, the Butler's gartersnake, and four state-listed fish species of special concern that potentially exist or are known to exist include the greater redhorse, banded killifish, least darter and lake sturgeon.

##### Butler's gartersnake (*Thamnophis butleri*)

The Butler's gartersnake is ranked globally as a G4 and has a state-wide ranking of S3. It is limited geographically to the general Milwaukee area. It prefers almost any open-canopy wetland type, except open water, and adjacent open to semi-open canopy upland, including prairies, old fields and weedy vacant lots. They also prefer low-canopy vegetation, although they will occupy habitats with taller vegetation such as reed canary grass. Butler's gartersnake can be active from mid-March through early November, usually emerging shortly after frost-out and remaining active until daytime temperatures fall consistently below 50 degrees Fahrenheit. Breeding usually occurs in April and early May but can occur in fall and live young are born between mid-July and mid-August.

##### Greater Redhorse (*Moxostoma valenciennesi*)

The greater redhorse is ranked globally as a G4 and has a state-wide ranking of S3. These rankings reveal the greater redhorse is quite rare in parts of its range. The Milwaukee River Basin is one of the most secure populations of greater redhorse in Wisconsin. The greater redhorse is a warm water species. They spawn on clean coarse substrate, gravel-sized and larger. They inhabit large rivers and among the various Redhorse species, they have also adapted to lake environments. Their diet is predominantly macroinvertebrates. Eggs are deposited on rock, rubble or gravel where embryo and larvae develop without parental care. They are considered intolerant of degraded habitat and would benefit from contaminated sediment removal and fish passage.

#### Banded Killifish (*Fundulus diaphanus*)

The banded killifish is classified globally as G5 and state-wide as S3. The fish is considered to be secure globally but can be rare in areas of the range. In Wisconsin, this fish is considered rare or uncommon. The fish has been identified in the Milwaukee River upstream in Ozaukee County and would benefit from contaminated sediment removal and fish passage.

#### Least Darter (*Etheostoma microperca*)

The least darter is classified globally as G3 and state-wide as S3. These rankings indicate the fish is either rare or local throughout its range, or found locally in a restricted range. They are rare or uncommon in Wisconsin and would benefit from contaminated sediment removal and fish passage.

#### Lake Sturgeon (*Acipenser fulvescens*)

Lake sturgeon is classified globally as G3/G4 (vulnerable) and state-wide as S3. Globally, the fish is very rare and local throughout its range. It is rare or uncommon in Wisconsin, but there is a secure population in the Wolf/Fox River basins. Occasionally, a lake sturgeon is observed in the Milwaukee River Estuary. Historically, lake sturgeon were abundant in Lake Michigan, with spawning populations using many of the major tributaries and several shoal areas of the lake. Their rapid decline in Lake Michigan coincided with habitat destruction, degraded water quality and intensive commercial fishing associated with European settlement in the region. Lake sturgeon rehabilitation has become a focus of many Great Lakes restoration efforts. Strategies to increase their population have been identified because lake sturgeon populations are extremely small and believed to be a fraction of their historical abundance. The Department began a stocking program in 2006 using a streamside rearing facility (SRF) on the Milwaukee River. A non-profit organization has agreed to work with the Department on this project by providing a location for rearing and stocking fish. This has enabled the Department to produce ten year-classes of lake sturgeon using this facility. In these 10 years, the Department has stocked 10,735 Lake Sturgeon.

#### Mussels

A recent mussel study was done of the Milwaukee River in the vicinity of the Estabrook Dam, within the Milwaukee River Greenway. The study made a qualitative analysis of the native mussel populations in four areas of the river. The study identified 11 mussel species within the Milwaukee River Greenway (Elktoe, Spike, Wabash Pigtoe, Plain Pocketbook, Fat Mucket, White Heelsplitter, Fluted-shell, Giant Floater, Creeper, Lilliput and Ellipse). However, 3 of these species (Spike, Lilliput and Ellipse) were identified from shells and no live specimens were found. The Ellipse is classified as a Wisconsin Threatened Species. The Elktoe is classified as a species of Special Concern in the state of Wisconsin and was found alive, in the Milwaukee River Greenway. The species' typical habitat is flowing water with various substrates (silt, mud, sand, gravel, rock) that are stable. Natural or restored shorelines with vegetation, roots, logs and natural structures can create stable sediments and substrates to help the species.

It was noted that very few juveniles and sub-adult mussels were located during the study. This may indicate that the current condition of these areas of the river is not conducive to recent mussel reproduction. This may be due to conditions related to contaminants, low oxygen, silt movement, drought and temperature change.

Mussels are one of the most highly threatened and rapidly declining groups of freshwater organisms. A major factor in the decline of freshwater mussels has been the large-scale impoundment of rivers over the past 75 years. Mussels can live for decades and are vulnerable to habitat disturbance. Mussels are sedentary filter-feeders that may remain in approximately the same location for their entire long life span, so mussels are very limited when their habitat is altered. The effects from altered seasonality of flow and temperature regimes, changed patterns of sediment scour and deposition, changes in particulate organic matter (the food base for mussels) are all important factors that can occur with an impoundment.

### Macroinvertebrates

The Milwaukee River Basin's macroinvertebrate community quality has generally remained in the good-to-very good Hilsenhoff Biotic Index (HBI) rating from 1975 to the present, within most of the watersheds. Nearly 40 percent of the subwatersheds contained sites that ranked in the fair HBI classification which indicates some level of potential impairment to the macroinvertebrate abundance and diversity. Except for the Lincoln Creek subwatershed, most of the subwatersheds throughout the Milwaukee River watershed continue to sustain a fair to good-very good macroinvertebrate community.

No site-specific sampling of macroinvertebrates has been performed within the backwater pool of Estabrook Dam. Upstream sites at Green Tree Road and at Pioneer Road have historically scored, using the Hilsenhoff Biotic Index, as "good". Macroinvertebrate sampling has occurred downstream of the Dam. The closest collection site being approximately 170 meters downstream of the dam that was last sampled in 1999. Three samples scored Fair to Fairly Poor.

### Aquatic Plants

Aquatic plants surveys of the Estabrook impoundment are not included as part of the normal lake monitoring program and are not available. Submerged isolated patches of *Potamogeton natans* and *P.pectinatus* are present.

### Plant Communities

The plant community within and adjacent to the project site (Milwaukee River floodplain) is considered wetland complex and consists of wet meadow and second growth, southern wet to wet-mesic lowland hardwoods. No state or federally endangered or threatened plant species were found.

### Wetland and Riparian Zones

Wisconsin Wetland Inventory data indicates that the Milwaukee River South Watershed currently contains more than 6,000 acres of wetlands. Note that wetlands are the most abundant in the northern watersheds, and are least abundant in the urbanized areas.

Wetlands are present within the floodplains of the Milwaukee River. According to the Department mapping tool, the Surface Water Data Viewer (SWDV), the project area includes the following wetland types:

<b>Wetland</b>	<b>WWI Classification Code</b>
Forested wetland	T3K
Emergent wet meadow	E1H

The riparian zones will remain unchanged from previously impounded conditions prior to 2008.

### Wildlife

The wildlife in the area of Estabrook Park is typical of southeastern Wisconsin. The grasses, bushes, trees and wetlands along the river combined with Estabrook Park and Lincoln Park provide an environmental corridor and habitat for a variety of wildlife including deer, raccoons, squirrels, mink, rabbits, chipmunks, skunks, foxes, beavers, muskrats, river otters and coyotes. Birds are likewise plentiful and include robins, cardinals, sparrows, crows and grackles. Ducks consist of both locals and migratory species such as mallards, teal and wood ducks. Herons are common along the river and marshes. As part of the Lake Michigan flyway, the corridor experiences diverse migrations of song birds and raptors. Osprey and Bald eagle are occasionally observed fishing the Milwaukee River corridor between upper Ozaukee County and as far downstream of the Estabrook Dam and Hubbard Park in the Village of Shorewood. Information on birds observed at Estabrook Park was compiled by Charles Hagner of the Friends of Estabrook Park and editor of Bird Watching Magazine and is on file with Milwaukee County Parks Department.

### Migratory Birds

Migratory birds are found within the project area. The proposed alternatives are not expected to have a significant impact on the migratory birds. The birds may experience some disruption during the construction period, but this impact would be short-term.

## 12. Affected Cultural Environment

### Land Use

The lands on the north bank of the Milwaukee River are located within the City of Milwaukee and are owned by Milwaukee County and are part of Estabrook and Lincoln Parks. The lands along the south bank are located within the City of Glendale and are in commercial ownership west to Port Washington Road and single family residential west of I-43 for approximately four and a half blocks to Lincoln Park. The south bank of the river at the dam is in private ownership and is currently owned by Wheaton Franciscan Services, Inc. No land use changes are anticipated with the dam repair or the operating order.

### Recreational Resources

The Milwaukee River is a public waterway. Much of the river corridor is characterized as primary environmental corridor. Recreational use of the river includes fishing, swimming, wading, motor boating, canoeing, kayaking, hiking, bird watching and other paddle sports. Canoe and kayak may be limited in some areas, most notably the upstream limits of the east oxbow with low water depth and the accumulation of debris. The sediment remediation project has significantly increased the effective water depth along Lincoln Creek and especially the west oxbow.

Estabrook Park is located on the north bank of the river near Estabrook Dam. The park provides activities including picnic areas, disc-golf, sand volleyball, skate park, soccer fields, softball diamond, tot lot, restrooms, paved multi-use trail, parking areas, dog exercise area and beer garden.

Residents upstream from Estabrook Dam use the river for fishing, canoeing, kayaking and motor boating. There is a City of Glendale public launch that is located at the end of North Apple Blossom Lane in Glendale. It is unimproved with little to no parking suitable for vehicles or trailers at the launch or on the street. There is a new Milwaukee County canoe launch in Estabrook Park.

### Archaeological/Historical

A report entitled "Phase 1 Archaeological Survey for the Rehabilitation of Estabrook Dam on the Milwaukee River, Milwaukee County, Wisconsin" dated August 2012 and prepared by an archaeological services company, presents the findings from the archaeological survey of the dam area, island and vicinity for access routes in Estabrook Park and along the south side of the river.

The findings from the report are that Estabrook Park contains an extensive distribution of artifacts in the ground. Various park related disturbances have destroyed the archaeological context in some parts of the site, but perhaps not in others. The proposed access road within the park has been regularly used in the past for similar purposes. If the present plan is not changed, there should be no damage to unaffected parts of the archaeological site.

The survey report was submitted to the State Historic Preservation Officer for review and the approval has been received. Eleven Tribal Historic Preservation Officers were contacted for comments concerning the project and only one response was received from the Stockbridge-Munsee Tribe, indicating the project was not within their area of interest. Milwaukee County contacted the State Historic Preservation Office (SHPO) in April 2014, to inquire about the historical significance of Estabrook Dam. The structure dates back to the 1930s. The State Historic Preservation Office indicated the proposed project will not have an adverse effect on the historic properties if the dam is repaired. Since fish passage is proposed for implementation, SHPO will need to be contacted for additional input on the project before the final plans for repair and fish passage are approved. The State Historic Preservation Officer contacted the County on February 13, 2015, to obtain an update on the project. Milwaukee County retained a private consulting firm to perform a study on the historical significance of Estabrook Park including the Estabrook Parkway, the bridges and Estabrook Dam. The study concluded that Estabrook Park, Estabrook Parkway and Estabrook Dam were eligible as a historic place and is recorded in the National Register of Historic Places. Correspondence with SHPO and historical study reports are on file with Milwaukee County Parks Department.

### Socio/Economic

Estabrook Dam is located in the Milwaukee River corridor within the highly urbanized City of Milwaukee. Urbanized development with more impervious areas contributes to flooding concerns in the area. Local residents who live adjacent

to the river and impoundment created above the dam have claimed the loss of recreational use, increased flooding, changed aesthetics and loss of property values since the dam gates were opened in 2008.

Milwaukee County population in 2015 was 947,735. There are about 350 properties that are directly adjacent to the Estabrook Dam impoundment. Based on an estimated population from the US Census Bureau of 2.4 people per dwelling, the 350 properties represent an estimated population of about 840 people, which is about 0.09% of the total population of the County.

The general public also benefits from the aesthetics of the Milwaukee River and the nearby Estabrook Park and Lincoln Park. Lincoln Park is upstream from Estabrook Park and primarily residential development in an urban setting surrounds the park. The residential development generally dates back to the 1940s to 1960s. Lincoln Park and Estabrook Park provide recreation resources for the urban population and are popular destinations for biking, hiking, picnics, fishing, kayaking, canoeing, boating, bird watching and enjoying nature in close proximity to populated cities and villages. The Milwaukee River Parkway intersects the river at multiple locations and provides a scenic overlook of the river.

Downstream from Estabrook Dam is a continuation of Estabrook Park, and adjacent urban development including residential, commercial and industrial development. The Village of Shorewood is to the east of Estabrook Park, the City of Milwaukee is to the south of Estabrook Park and the City of Glendale is to the north of Estabrook Park. The Milwaukee River includes a green space along the river corridor with a hiking/bike trail along parts of the river and plans are underway to extend the hiking/bike trail in both directions from Estabrook Park. The Oak Leaf Trail, owned and operated by Milwaukee County, runs through Estabrook Park.

There is potential for expanded redevelopment upstream and downstream from Estabrook Dam in properly zoned areas. Areas downstream from Estabrook Dam include parkland and some commercial, industrial and residential properties. Since the former North Avenue Dam was removed from the Milwaukee River downstream of Estabrook Dam, the surrounding area has seen substantial redevelopment along the river, including condos, restaurants and other businesses in the vicinity of the former North Avenue Dam.

### **13. Other Affected Special Resources**

#### Other Special Resources (State Natural Areas, prime agricultural lands)

There are no state natural areas, prime or unique agricultural lands, wilderness, forests or Native American Religious Concerns associated with this project.

#### Areas of Critical Environmental Concerns

The project area does include one area of environmental concern which is the sediment removal project from Lincoln Park to Estabrook Dam. This USEPA project involves the Department and Milwaukee County and is separate from the Estabrook Dam EIS.

### **14. Physical Effects**

#### Impacts of repair with fish passage

The dam repairs will provide dam structure stability and public safety and improve dam operations. The impoundment could be drawn down in the future for inspections, maintenance, repairs and invasive species management. New slope protection both upstream and downstream of the gated dam structure will stabilize and protect the embankment. Structural/mechanical improvements would be necessary such as addition of an aerator or a glycol antifreeze system to reduce freezing of the 6 gates to minimize ice buildup. The upstream ice breakers serve a function to minimize large ice flows from damaging the gates, but the potential exists for a buildup of ice against these gates which can result in structural damage during early spring ice out.

During the construction at the dam, some dust will result, but will be short-term and primarily limited to the vicinity of the construction zone. Short-term noise can be expected during construction activities, but long-term noise issues are not expected. Soil resources will not be appreciably affected with construction of the fish passage, but materials such as gravel, sand and stone will be needed for construction and will be obtained from a local quarry.

#### Impacts of Normal Pool Operation

With normal water levels, the impoundment will extend approximately 2.5 miles upstream of Estabrook Dam year-round.

There may be potential ice damage concerns by maintaining a normal water level through the winter. Issues relate to the gates freezing in winter and becoming inoperable, or to ice damage. The potential exists for structural damage to the 6 gates. The design ice loading on these steel gates is 5,000 pounds per square foot, which reflects the power and force of these ice flows. Structural/mechanical improvements would be necessary such as addition of an aerator or a glycol antifreeze system to reduce freezing of the gates at the six gates to minimize ice buildup.

SEWRPC modeled the river based on the 100-year flood and the dam gates open which resulted in determining the 100-year flood elevations from the dam and extending to approximately West Bender Road. SEWRPC has also modeled the river based on the 100-year flood and the dam gates being closed to determine the effect on flood elevations. If the 6 gates are closed during a 100-year frequency flood, the 100-year flood elevations will be exceeded and can contribute to upstream flooding. This situation has potential liability to the County due to flooding and associated property damage. If Milwaukee County maintains normal water levels by progressively opening the gates during flooding, there should be no additional contribution to upstream flooding. During larger flood events the dam will submerge and flooding could still occur upstream even with all the gates opened.

A buildup of sediment in the impoundment could be increased with the elimination of winter drawdowns as a long-term function of the dam. Some sediment will travel downstream during the periods that the gates are open.

#### Impacts of Alternative #1 - Full Winter Drawdown Operation

The gates would be fully opened during winter drawdown and sediment would travel downstream as a result. The potential for ice damage to the gates of the dam would be reduced with winter drawdown. Bank erosion within the impoundment would likely increase. The manipulated water levels would not allow for the establishment of bank stabilizing vegetation as drawdown would expose these slopes to erosion from water, wind and ice.

#### Impacts of Alternative #2 - Partial Winter Drawdown Operation

Stoplogs would be removed during partial winter drawdown. Some sediment would travel downstream when the stoplogs are removed. The potential for ice damage to the gates of the dam would be reduced with the drawdown. Bank erosion within the impoundment may increase, as manipulated water levels would not allow for the establishment of bank stabilizing vegetation.

## **15. Biological Effects**

#### Impacts of Repair with fish passage

The construction of a fish passage structure should increase the diversity and population of fish upstream of the dam and create a more natural riverine environment through the passage. The fish passage will increase the probability of developing sustainable populations of lake sturgeon and walleye within the watershed. Recreational fishing opportunities exist and would be enhanced with the implementation of the fish passage structure.

The fish passage structure will contribute to creating self-sustaining populations of native Lake Michigan and Milwaukee estuary species by enabling potamodromous lithophilic and phytophilic spawning fish to access historic spawning and nursery habitats including game fish (walleye, northern pike, smallmouth bass), and non-game fishes (lake sturgeon, white and longnose sucker, and shorthead, silver, golden and greater redhorses). Barriers to fish movement have been identified as a limiting factor to the distribution and long-term survivability of state listed species in the Milwaukee AOC including the endangered striped shiner, threatened redbfin shiner and longear sunfish, and special concern lake sturgeon (which is on the USFWS Region 3 Conservation Priority List as a Rare/Declining species).

It is estimated that the implementation of fish passage at the dam would make 25 river miles, 29 miles of tributary and 2,400 acres of wetland spawning and nursery habitat accessible to native Great Lakes fish. Spawning habitat in the Milwaukee River downstream of Estabrook Dam is limited to about 1 acre, so the fish passage would substantially increase access to the spawning and nursery habitat which would in turn benefit fish populations.

Enabling fish passage and access to historic spawning and nursery habitats is a major focus of federal and state management agencies for restoration of Lake Michigan lake sturgeon populations (<http://dnr.wi.gov/topic/fishing/lakemichigan/lakesturgeon.html>, <http://www.fws.gov/midwest/sturgeon/index.html>). The

Milwaukee River is one of two Wisconsin rivers with ongoing lake sturgeon rearing facilities. At these facilities, fertilized eggs from Wolf River parents are developed, imprinted and released to the Milwaukee Estuary and to Lake Michigan to mature and ultimately return to their natal stream for spawning. These fish must pass the Estabrook Dam in order to reach segments of the river in Ozaukee County that contain optimal spawning habitat such as large cobble and boulder-sized bedrock.

Juveniles must have unobstructed return access from the estuary and Lake Michigan for feeding and growth. Juvenile lake sturgeons from previous stockings have been captured in the Milwaukee River during false spawning runs and elsewhere in the estuary. The Department anticipates previously stocked and imprinted fingerlings to mature and begin spawning runs around 2020. Lake sturgeon is a state listed special concern species and is on the USFWS Region 3 Conservation Priority List (WDNR, 2005).

Construction could cause disruption to the some native fish species spawning if these fish are present at Estabrook Dam and spawning during the time of construction. It is probable that fish will temporarily relocate to spawn in another nearby area of suitable habitat. Impacts to fish spawning due to construction activities can be minimized by limiting the time of the year that construction takes place.

The fish passage structure will allow for migration and movements of mussels' host fish. The glochidia (mussel larvae) attach themselves to a host fish, which will then carry the larvae until they form into juveniles and drop off. Since an integral part of the mussel life cycle is the host fish, allowing for fish migration will have a positive effect on mussels by expanding upstream diversity and populations.

Various construction activities within the river can have an impact on the mussel populations. Dredging, dam operations and associated fluctuations in water levels, dam removal, shoreline reconstruction, sediment removal and other activities can negatively impact existing mussel beds and populations. Restoration of mussel beds should be considered as part of a mitigation plan after such activities. Additionally, translocation and repatriation of mussel species also can be considered.

An integral part of the mussel life cycle is the host fish. Dams affect the dispersion and life cycle of mussels by inhibiting the movement and migration of the host fish species. Dams can create a barrier for the host fish preventing longitudinal migration which can adversely affect the dispersion and distribution of mussel species throughout the river system. The fish passage structure being added to the dam will help to alleviate the restrictions on the distribution of mussels in the Milwaukee River both upstream and downstream of the dam.

During construction/demolition work, wildlife, fish and other aquatic species and their habitat will be temporarily disrupted until the work is completed. Snapping turtles, painted turtles, bullfrogs and green frogs are expected to inhabit the area. The fish passage construction could also result in minor filling of wetlands along the bank associated with installation of riprap. This would be limited to less than 10,000 square feet of wetland. Care should be provided during design where riprap is proposed to minimize the spaces between the rocks that could potentially trap turtles, frogs and other species. The spaces between large rocks will be filled in with smaller stone where possible.

Migratory birds may experience some disruption during the construction period, but this impact will be short-term. Long-term impacts to migratory birds or other bird species are not expected.

#### Impacts of Normal Pool Operation

With normal water level operation, the fish passage would be functional year-round and would contribute to creating self-sustaining populations of native Lake Michigan and Milwaukee estuary species by enabling potamodromous lithophilic and phytophilic spawning fish to access historic spawning and nursery habitats including game fish (walleye, northern pike, smallmouth bass) and non-game fish (lake sturgeon, white and longnose sucker, and shorthead, silver, golden and greater redhorses).

Since the fish passage would allow for fish to travel year-round, it would also enhance the dispersal of mussel species and increasing mussel diversity and populations in areas of suitable habitat upstream from the dam. However, siltation and the buildup of sediment within the impoundment can also affect mussels by the release of sediment when the dam gates are opened, which could adversely affect mussels downstream from the dam.

Maintaining water levels year round may increase water temperatures. This may also result in lower dissolved oxygen content, affecting some fish species and possibly altering the fish community make-up of the impoundment. Carp populations may climb, as they can tolerate higher temperatures and low dissolved oxygen. Carp may degrade water

quality by uprooting aquatic vegetation and stirring up sediment. These turbid conditions may adversely affect pool aesthetics and aquatic life. Algae and blue-green algal communities within the impoundment may occasionally reach nuisance conditions.

Operating at normal pool would tend to create and maintain more aquatic plant communities. Wetlands within the floodplain would have a deeper water depth year round, due to the lack of a winter drawdown.

#### Impacts of Alternative #1 - Full Winter Drawdown Operation

The partial winter drawdown would make the installed fish passage unusable. Fish and other aquatic organisms could move freely downstream and upstream through the opened gates during the winter drawdown, however. Since the drawdown in 2008, the dam has functioned in this run off the river manner. In a manner similar to normal operation with fish passage, those fish that remain in the system should find improved conditions for spawning, feeding and growing conditions leading to an expected overall improvement in fish populations.

Erosion and scour can be caused by a release of water through the gates and can result in an altered distribution of sediment. Sudden releases of water by opening dam gates scours the river channel downstream and within the impoundment dislodging aquatic organisms. The exposed floor of the impoundment can undergo freeze and desiccation cycles which further impacts aquatic life and wildlife along the corridor. Closing the gates may also reduce downstream flows and desiccate the river channel and aquatic life.

A discharge that is either high during the wrong season or high too frequently can have distressing impacts on mussels. High water and high flows can displace juveniles before they can burrow or attach to substrate, resulting in a high mortality rate. The increased flow can produce a rise in erosion and subsequent deposition of material downstream both of which may result in loss of mussel habitat. Increased sediment deposition can clog mussel siphons and gills which interfere with feeding and reproduction.

Siltation and the buildup of sediment within the impoundment can result in a sudden release of sediment when the dam gates are periodically opened. This can adversely affect mussels downstream from the dam. Areas in the impoundment may also be dewatered as a result of the drawdown, leaving muddy flats and mussels stranded, leading to desiccation or predation. Mussels can move to deeper waters if the drawdown is slow enough. Seasonal drawdowns must be managed to be protective of mussels and other aquatic life both in the impoundment and downstream. The Department code limits lowering the impoundment levels to a maximum of 6 inches per day to be protective of aquatic life.

Wetlands within the floodplain would have a lower water depth during the draw down from mid-September to mid-May. This may change wetland hydrology and possibly wetland plant communities as plant species needing to be submerged in water year round may not be able to survive. Increased bank erosion due to lack of established bank-stabilizing vegetation may occur. Increased sediment from erosion may have an impact on aquatic life within the impoundment and downstream.

#### Impacts of Alternative #2 - Partial Winter Drawdown Operation

Since the gates would be closed during the partial winter drawdown, fish would be limited in their movement. The partial winter drawdown would make the installed fish passage unusable and fish could not to swim through the closed gated sections. This alternative would have negative impacts on fish and aquatic organisms as they would not be able move freely though the system from September 15<sup>th</sup> to May 15<sup>th</sup>. During this time there are substantial spawning runs from a variety of fish species including Chinook and Coho salmon, brown and rainbow trout, walleye, white sucker and Lake Sturgeon.

An integral part of the mussel life cycle is the host fish. If host fish movements were inhibited by the partial winter drawdown, dispersal and distribution of mussels would also be restricted throughout the river system.

A discharge from the dam that is too low during the wrong season or abnormally low for extended periods can also have adverse impacts on mussels. Significant periods of low flow below an impoundment can result in stranding mussels. Mortality in these situations is usually due to desiccation, asphyxiation, predation and thermal stress as mussels lack the ability to regulate their body temperature. Mussels can also be stranded by dewatering upstream from the dam during drawdowns. Mussels move very slowly and have limited capabilities to adapt to rapid changes in impoundment levels which can be detrimental to mussels and should be avoided. If stranding does not result in mortality, the associated physiological stress reduces mussel condition and ultimately reproductive potential. Mussels in shallow isolated pools are also exposed to hypoxia from algal production and ammonia pulses from decaying organics, both of which have a

detrimental effect on mussel populations and reproductive potential as a whole. Seasonal drawdowns must be managed to be protective of mussels and other aquatic life both downstream of the dam and in the impoundment.

The partial winter drawdown could have a detrimental impact to aquatic life unless the drawdown was reduced to a level that would not be harmful to aquatic life. The Department code limits lowering the impoundment levels to a maximum of six inches per day to be protective to the aquatic life. Removing the stoplogs at the dam would lower the water level by three feet and would still provide sufficient water for the mussels and other aquatic life to function. This water level would be significantly higher than a complete drawdown with all six gates open.

There may be an increase in bank erosion within the impoundment due to the inability of bank stabilizing vegetation to establish within the partial drawdown elevation. Wetlands within the floodplain would have a deeper water depth with the impoundment from mid-September to mid-May, but may experience stress similar to the full drawdown impacts, but on a reduced scale.

## **16. Cultural Effects**

### Impacts of Repair with fish passage

The bulk of the work for the dam rehabilitation will occur in Estabrook Park, the central river island and on the south bank of the river owned by Wheaton Franciscan Services, Inc. Easements to access property not owned by the County have been obtained from those owners, but may need to be updated prior to construction.

The addition of the fish passage may or may not be considered by SHPO as a significant change. Based on SHPO conclusions, the construction of fish passage may require a Historical American Engineering Record (HAER) study and additional steps may be necessary prior to construction. The additional steps taken on other dam projects in which the structure was listed on the National Register of Historic Places include providing signage or a plaque recognizing the dam as a historically significant structure. Past structure design documents may also need to be recorded to serve as a historic record for the structure.

Since the fish passage structure will allow for migration of fish throughout the river year-round, this will have a positive impact on fishing opportunities in the area.

### Impacts of Normal Pool Operation

With a normal water level operation, the public would be able to use the impoundment year-round without the attention to low or high river flow affecting their recreational use.

### Impacts of Alternative #1 - Full Winter Drawdown Operation

Deeper draft motorized boating would be the most impacted by the drawdown of the impoundment during early fall base- and low-flow river conditions.

Recreation may be impacted if mud flats develop in the impoundment area. These flats may act as a large settling basin where sediment would collect. Mud flats are common in rivers and can be created by the natural processes such as deposition in the river, but the impoundment may promote and accelerate the settling of sediment in the pool.

### Impacts of Alternative #2 - Partial Winter Drawdown Operation

Deeper draft motorized boating would be the most impacted by the drawdown of the impoundment, during early fall base- and low-flow river conditions.

## **17. Social/Economic Effects (including ethnic and cultural groups, and zoning if applicable)**

No ethnic group or cultural group will be significantly affected by the repair with fish passage operated at normal pool, full winter drawdown or partial winter drawdown. The Department does not anticipate economic impact to property values due to the repair of the dam with fish passage because the water level for the river will be established at levels near historic water levels, prior to the gates being opened in 2009. There is potential for increased economic impact from sport fishing due to the positive impact on fishing opportunities that the fish passage will provide.

## **18. Other Special Resources Effects**

No other Special Resources will be impacted by the repair with fish passage operated at normal pool, full winter drawdown or partial winter drawdown.

## **19. Summary of Adverse Impacts that Cannot be Avoided**

Short-term impacts include dust, noise and traffic congestion during repair of the dam. A buildup of sediment in the impoundment can be expected over the long-term function of the dam. Some sediment will travel downstream during the period when the gates are open. Best management practices for stormwater will be used during the construction activities.

Wildlife may be displaced to other available habitat in the Milwaukee River environmental corridor during construction and when the impoundment is filled. Aquatic life will be temporarily disrupted during construction at the dam. Aquatic habitat may change with a deeper pool and a variable sediment distribution.

Mussels downstream may be impacted if the dam gates are intermittently opened and sediment is flushed. Mussels upstream may be impacted as sediment accumulates in the impoundment.

Operating at normal pool year-round may create more aquatic plant communities to replace the terrestrial plant communities.

Wetlands along the south bank of river immediately upstream of Estabrook Dam will be impacted short-term during the construction of the proposed action.

## **20. Short and Long-Term Environmental Effects**

### Effects of Repair with Fish Passage

Short-term impacts include dust, noise and traffic congestion during repair to the dam and construction of the fish passage. Best management practices for stormwater will be used during the construction activities. Long-term effects of repairing the dam with fish passage include dam stability, fish movement allowed both upstream and downstream of the dam, and maintenance of an upstream pool for recreation.

### Effects of Normal Pool Operation

A buildup of sediment in the impoundment could be expected over the long-term function of the dam when operated at normal pool year-round. Some sediment would travel downstream during the period when the gates are periodically opened. There is risk of ice damage to the dam and shoreline during the winter with this alternative. Optimal fish movement would be facilitated with this alternative because there would be water flowing over the fish passage structure at all times of the year.

### Effects of Alternative #1 - Full Winter Drawdown Operation

Short-term effects of this alternative include annual releases of sediment to the downstream portion of the river, which could have effects of fish, mussels and other aquatic species. The lowered pool would cause areas upstream from the dam to be dewatered also affecting aquatic species. Potential long-term effects include less sediment buildup behind the dam, and although the fish passage design will not function with the lowered water elevation, fish would be able to migrate through the open gates during these times of the year.

### Effects of Alternative #2 - Partial Winter Drawdown Operation

Some sediment would travel downstream when the gates are opened. Potential long-term effects include less sediment buildup behind the dam, but the fish passage structure would not function as well with the lower water elevation and fish would not be able to move unless the fish passage was kept submerged by means of pumping water over it.

## **21. Cumulative Impacts**

### Impacts of Repair with Fish Passage

Cumulative impacts of this alternative include a greatly increased area of aquatic habitat available to fish and other aquatic life.

#### Impacts of Normal Pool Operation

There are no cumulative impacts of this alternative.

#### Impacts of Alternative #1 - Full Winter Drawdown Operation

There are no cumulative impacts of this alternative.

#### Impacts of Alternative #2 - Partial Winter Drawdown Operation

The movement of fish and other aquatic species may be more restricted with this alternative.

## **22. Risk**

#### Risk of Repair with Fish Passage

The risk with the repair to fish passage is that additional aquatic invasive species might pass through the structure that might not otherwise have been able to pass through the open gates or under flood conditions. Construction-related risks include safety concerns and hazardous material spills during construction.

#### Risk of Normal Pool Operation

The risk associated with normal pool operation would be increased flood elevations exceeding the current 100-year flood levels when the dam gates are closed. The Operation Plan calls for the gates to be closed during summer but still passing at least minimum flow downstream at all times. If the Milwaukee River experienced a 100-year flood discharge during summer, closed gates at Estabrook Dam would result in flood elevations upstream of the dam in excess of the 100-year flood elevations determined with the assumption that the spillway gates are open. This situation provides a liability risk to Milwaukee County.

Milwaukee County will have a dam operator available to monitor weather, river flows and gate position. The dam operator would maintain a pool level based on the fixed crest spillway elevation. When water levels increase appreciably, the operator would open gates to pass the increased flow. If the gates malfunctioned due to a power outage or gate mechanical issue and all 6 gates were closed during the flood event, Milwaukee County would be at risk of causing 100-year flood elevations upstream from the dam during a flood flow event only somewhat greater than a 10-year event. Manual overrides on the gates will be provided, but operation of the gates manually could be a challenge during flood conditions. There is also a risk of ice damaging the gates of the dam in the winter.

#### Risk of Alternative #1 - Full Winter Drawdown Operation

There is a safety risk concerned with removing the stoplogs without an operating deck.

#### Risk of Alternative #2 - Partial Winter Drawdown Operation

There is a safety risk concerned with removing the stoplogs without an operating deck.

## **23. Precedent**

The proposed action to repair the dam with a fish passage structure has been successfully implemented at other locations, the nearest being the Milwaukee River in Thiensville. One change for Milwaukee County would be the requirement that the County's dam gate operator monitor river levels, weather and gate positions to take action before a flood event occurs to avoid the gates being closed during a significant flood.

## **24. Controversy over Environmental Effects**

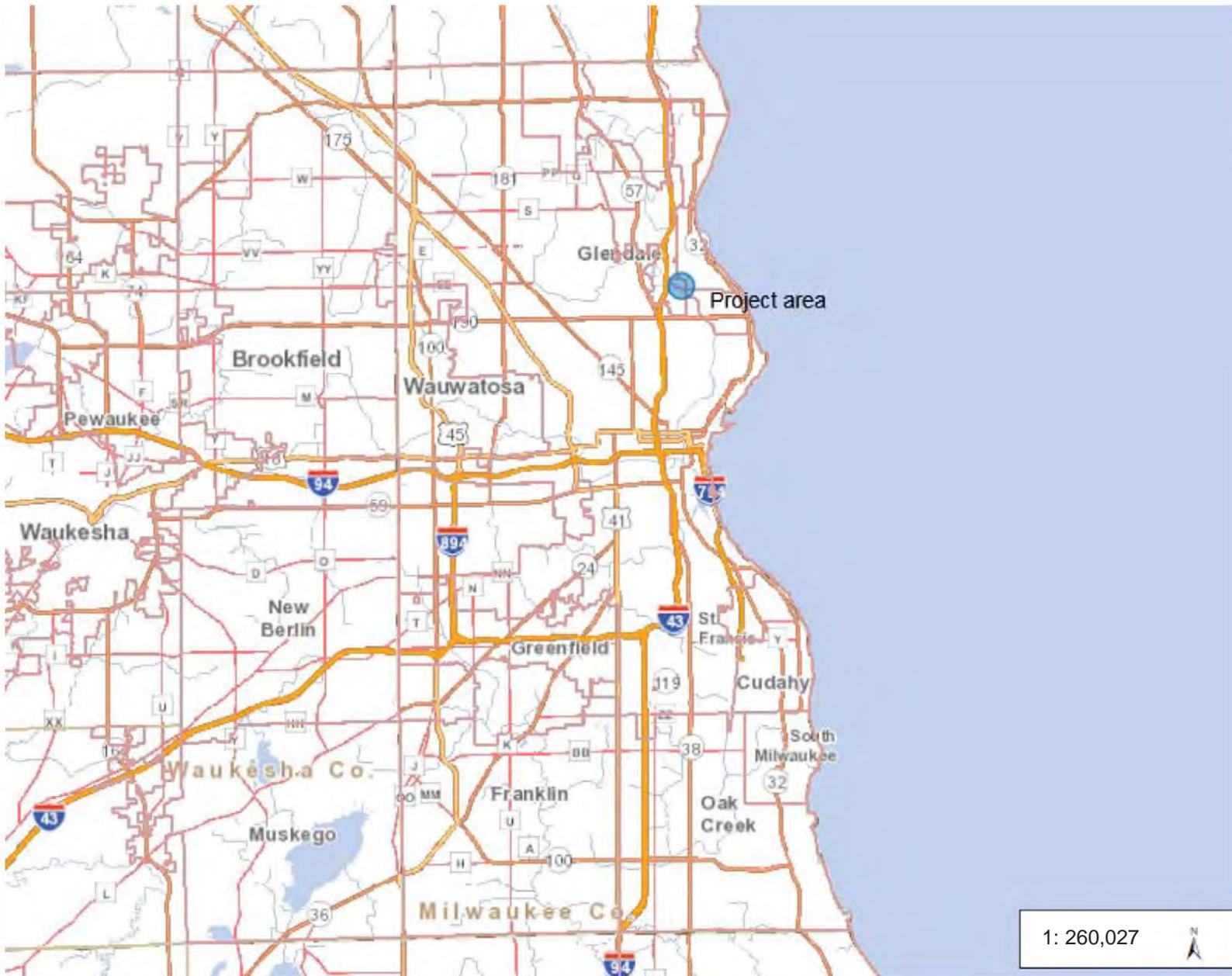
The public and regulatory agencies have the benefit of observing the potential environmental effects of the proposed action because the gates have been open since 2009, following decades of use of the dam and the impoundment. The

public is aware of the recreational opportunities and aesthetics of the impoundment. The sediment buildup upstream of the dam is likewise well documented.

Supporters of removal and supporters of repair have been very vocal. Supporters of the dam prefer the impoundment for recreation, especially boating. This group also prefers the aesthetics of an impoundment resulting in a shallow lake setting. Supporters of dam removal prefer a free flowing natural river.



# County Map Showing Location of Project



### Legend

Cities, Towns & Villages

City

Village

Civil Town

Rivers and Streams

Open Water

1: 260,027



8.2 0 4.10 8.2 Miles

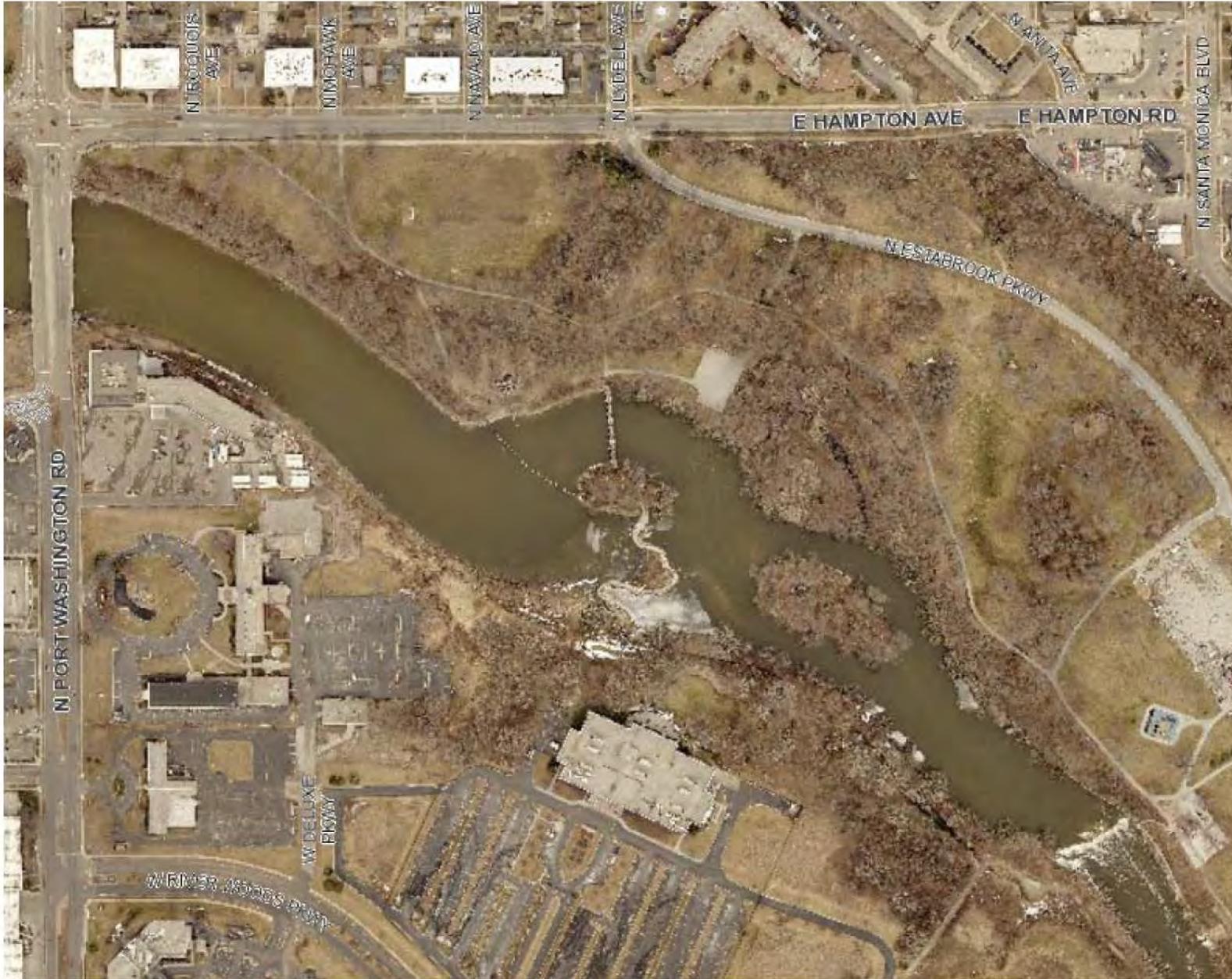
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### Notes



# 2015 Aerial Photo Map



## Legend

- Plat of Survey
- FORECLOSURE
- Subdivision Docs
- Condo Docs
- CSM Docs
- 2015 COLOR
  - Red: Band\_1
  - Green: Band\_2
  - Blue: Band\_3
- County Boundary
- City Limits Outline
- Streets
  - Primary
  - Secondary
  - Freeway
  - Primary Ramp
  - Freeway Ramp
  - A71
- Railroad 8k
- Transportation Poly
- Bridge Structure
- Structure
- Structure Large Shadow
- Transportation Poly
  - <all other values>
  - Paved Road
  - Paved Airport Runway
  - Paved Driveway
  - Paved Parking
  - Paved Shoulder
  - Sidewalk
  - Unpaved Driveway
  - Unpaved Parking
  - Unpaved Shoulder
- Open Water Gradient
- Open Water
- Stream
- Hillshade
  - High : 180
  - Low : 0

1: 4,059



677 0 338 677 Feet

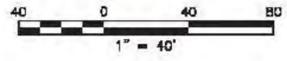
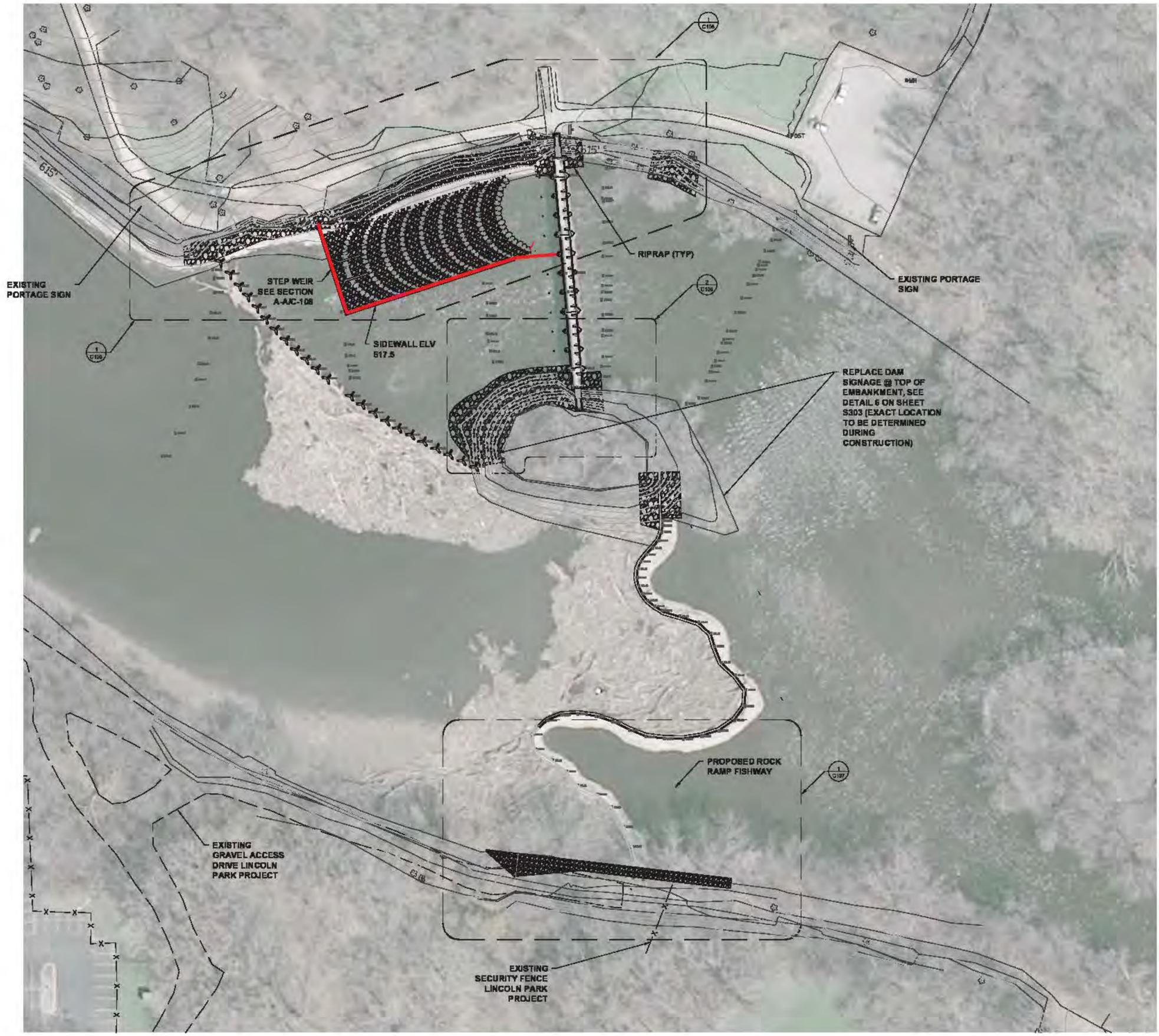
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## Notes



NOT FOR CONSTRUCTION

AECOM WWW.AECOM.COM AECOM TECHNICAL SERVICES, Inc. 847-279-2500		<b>AECOM</b>	
PROJECT NUMBER: 60181483			
SCALE:	DATE:	DRN:	DATE:
AS SHOWN	06/05/2015	GRN/APP/01	06/05/2015



MILWAUKEE COUNTY DEPT. OF ADMIN  
SERVICES - AE & ES SECTION  
CITY CAMPUS - 2711 W. WELLS ST. - 2ND FLOOR - MILWAUKEE, WI 53208

REVISIONS:  
60% DESIGN  
SUBMITTAL  
06/05/2015

DATE: 06/05/2015  
PROJECT: P06210616  
SHEET: 687  
BUILDING NO: N/A

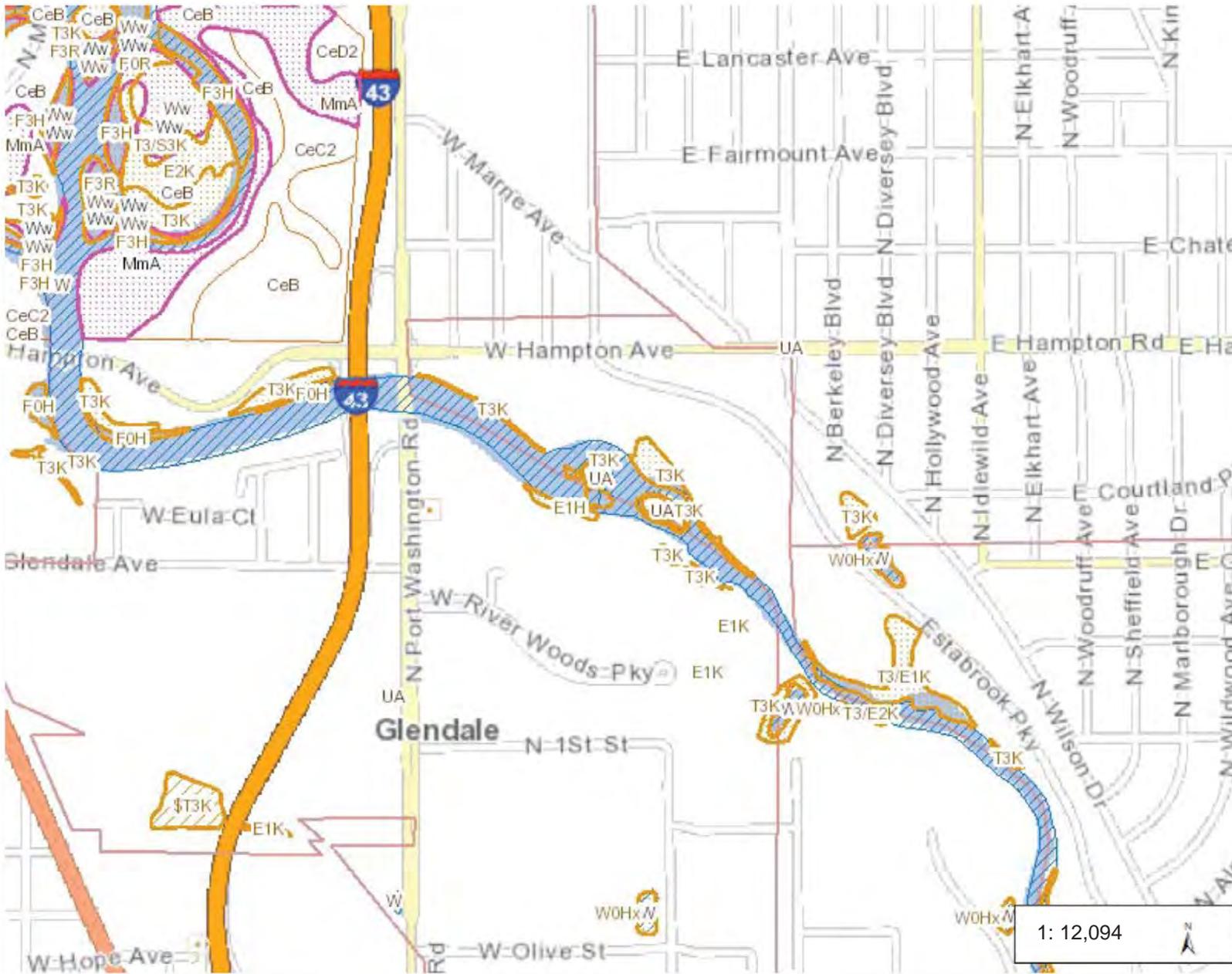
# ESTABROOK DAM REHABILITATION

**WORKING DRAFT**

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# Wisconsin Wetland Map



**Legend**

- Wetland Class Points**
  - Dammed pond
  - Excavated pond
  - Filled excavated pond
  - Filled/draind wetland
  - Wetland too small to delineate
- Filled Points**
- Wetland Class Areas**
  - Wetland
  - Upland
- Filled Areas**
- NRCS Wetspots**
- Wetland Indicators**
- NRCS Wisconsin Soils**
  - Soil Mapping Unit
  - Water
- Critical Habitat Areas**
  - Other Public Rights Feature
  - Sensitive Area Designation
- Cities, Towns & Villages**
  - City
  - Village
  - Civil Town
- Rivers and Streams**
- Open Water**

**Notes**

0.4 0 0.19 0.4 Miles

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# Zoning Map



## Legend

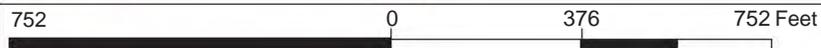
- County Parks
- Municipal and State Parks

### Glendale Zoning

- B1
- B1A1
- B1A2
- B1B
- B1C1
- B1D1
- B1D2
- B1F1
- B1F2
- B1G1
- B1G2
- B1H1
- B1H2
- B1I1
- B1I2
- B1J
- B1K
- B1L
- B1M
- B1N
- B1O
- B1P
- B2
- B3
- B4
- B5
- C1
- M1
- P1
- PUD
- R2
- R3
- R7
- R7A
- R8
- S1

- Plat of Survey
- FORECLOSURE
- Subdivision Docs
- Condo Docs
- CSM Docs
- 2015 COLOR
- Red, Road 1

1:4,512



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## Notes