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October 8, 2015

Ms. Tanya Lourigan, P.E.
Water Management Engineer
Wisconsin Department of Natural Resources
3911 Fish Hatchery Road
Fitchburg, WI 53711

Subject: Environmental Impact Statement for Estabrook Dam
Milwaukee County, Wisconsin

Dear Ms. Lourigan:

Enclosed is the Environmental Impact Statement for Estabrook Dam in Milwaukee County, Wisconsin. The owner and operator of the dam is Milwaukee County. The County Board went on record to implement Alternative 1 dam repair and no fish passage. If sufficient funding for fish passage becomes available in the future, the County would be interested in constructing fish passage at that time.

The distribution of the Environmental Impact Statement is attached. If you have any questions regarding the project, please contact me at your convenience.

Very truly yours,

AECOM Technical Services, Inc.

Donald F. Pirrung

Donald F. Pirrung, P.E.
Senior Engineer

Enclosure: Distribution List

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AECOM Environment

Prepared for:
Milwaukee County

Prepared by:
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Green Bay, WI
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September 2015

Environmental Impact Statement for Estabrook Dam

Milwaukee County, Wisconsin

Prepared by:

AECOM
1035 Kepler Drive
Green Bay, WI 54311

September 2015

Contents

LIST OF ATTACHMENTS

Executive Summary

Estabrook Dam is owned and operated by Milwaukee County, Wisconsin. The dam was built in the 1930s. The Wisconsin Department of Natural Resources (WDNR) issued an Administrative Order dated July 28, 2009, requiring the County to drawdown the impoundment until such time as the dam can be either repaired or abandoned.

The WDNR Administrative Order requires Milwaukee County to make structural repairs to the dam, to upgrade the gates and ice breakers, remove trees near the dam, remove debris immediately upstream of the dam, perform a structural analysis of the dam, and prepare an operation inspection and maintenance plan. These actions are necessary if the County intends to repair the dam.

The Environmental Impact Statement is being prepared pursuant to the National Environmental Policy Act (NEPA) and the Wisconsin Environmental Policy Act (WEPA) to disclose the environmental impacts of alternatives under consideration to address the 2009 Administrative Order.

NEPA requirements pertain to the need to obtain a wetlands related permit to perform construction related to the project. WEPA requirements are applicable to the project due to the WDNR Operational Order for Estabrook Dam.

In the 2009 Adopted Capital Improvements Budget, $1,904,400 in debt obligation was approved for dam rehabilitation. In 2014, the County retained AECOM to complete an environmental assessment compliant with State and Federal regulations as required by the Bureau of Land Management and the WDNR and evaluate and present alternatives for the dam. In September of that same year, the County submitted an action item in File No. 14-682 recommending removal of the dam as the preferred alternative of six proposed actions presented to the Milwaukee County Board. The Board approved the policy of dam removal from the County Executive’s recommended 2015 budget, however, reversed it back to repair in 2016. To date, the County Board has a budgeted amount of $1,600,000 in debt obligation for dam repair.

Four alternatives as described in the following Environmental Impact Statement for Estabrook Dam were reviewed based on economic, environmental, and social considerations:

- Alternative 1 –Rehabilitate the Dam Without Fish Passage
- Alternative 1A – Rehabilitate the Dam and Add Provisions for Fish Passage
- Alternative 2 – Abandon and Remove the Dam
- Alternative 4 – Gated Spillway Removed, Serpentine Overflow Spillway Lowered, and a 6.3-Foot High Rock Ramp

Milwaukee County has requested funding from the following multiple sources for the project:

a. WDNR Municipal Dam Grant: WDNR has set aside $400,000 for Estabrook Dam repair and fish passage or removal. This is the maximum grant amount and is based on a capital cost of $1,200,000. Higher cost projects are limited to this grant amount.

b. Wisconsin Stewardship Grant: WDNR has set aside $980,717 for Estabrook Dam repair, fish passage, or removal based on an estimated grant eligible project cost of $3,394,000

c. Sustain Our Great Lakes Grant: A grant application was submitted for $857,000 for the US Fish & Wildlife Foundation, but the grant was not awarded to the County for 2015. The County could apply in 2016 and would require matching funds.

d. National Oceanic and Atmospheric Administration (NOAA): A grant application for $897,000 was submitted for an Environmental Restoration grant in 2015 for fish passage (repair or removal) and environmental monitoring. This grant was not awarded to the County, but the County could reapply in 2016 and would require matching funds.

e. US Fish & Wildlife Service, Fish Passage Grant: This grant application is currently under review. The amount is $230,000 for fish passage, repair, or removal and a 1:1 match by the County is required. A decision on the grant is expected during fall 2015.

The WDNR Municipal Dam Grant and the WDNR Stewardship Grant do not require matching grants, but do require the County to fund the balance of the project costs plus long-term operation and maintenance costs.

Currently, the estimated capital cost for Alternative 1 is $2,287,000 for repair without fish passage. The WDNR allowed the County to include $1,087,000 associated with the Milwaukee River Sediment Cleanup project when determining the Stewardship Grant amount based on 25 percent of the eligible costs plus a 10 percent contingency fund. The Stewardship Grant based on dam repair only plus the sediment cleanup eligible cost is ($2,287,000 plus $1,087,000 equals $3,374,000) at 25 percent, the grant is $843,500 plus a 10 percent contingency of $84,350.

The funding information is summarized as follows:

Dam Repair Costs	$2,287,000
Fish Passage Costs	$1,107,000
County Allocated Funds	$1,600,000
WDNR Municipal Dam Grant	$400,000
WDNR Stewardship Fund	$927,850

Based on the cost projections, the County does not have sufficient funds for the original scope of dam repair. However, based on current bonding authority and awarded grants Alternative 1A, the preferred alternative, is underfunded.

Additionally, operation and maintenance costs for Alternative 1, dam repair, are estimated at $160,000 per year. The County receives $51,000 per year from tower rental that has been restricted for use for maintenance and operation of the dam. The remaining $109,000 per year required remains unfunded and will need to be requested annually through the budget process.

1.0 Introduction

Milwaukee County, a Wisconsin municipal body corporate, owns and operates Estabrook Dam in the Milwaukee River near Estabrook Drive and W. Hampton Avenue (Attachment 1). The WDNR has issued an Administrative Order dated July 28, 2009, requiring the County to drawdown the impoundment until such time as the dam can be either repaired or abandoned. WDNR issued a letter to the County dated September 26, 2008, requiring the drawdown until the dam was repaired. The dam gates have been open since 2008.

The dam was built in the late 1930's. The island was created by excavation of part of Estabrook Park. The island is Milwaukee County property. The construction also included excavation of a channel for the gated section of the dam. This EIS is being prepared pursuant to the NEPA and the WEPA to disclose the environmental impacts of alternatives under consideration to address the 2009 Administrative Order.

NEPA requirements pertain to the need to obtain a wetlands related permit to perform construction related to the project. WEPA requirements are applicable to the project due to the Operational Order for Estabrook Dam.

Milwaukee County has proposed repair of the dam, but has also solicited public input and regulatory input on a series of alternatives to repair, replace, or remove the dam. Upon receiving this input, Milwaukee County has finalized the EIS based on the selected project and is proceeding with implementation.

1.1 Project Background

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 gates that could be opened during times of flooding and closed during low water in order to maintain a pool of water above the dam for boating, bathing and fishing. The gated section of the dam extends from County owned parkland on the left (north) bank of the river to a central island under the jurisdiction of Milwaukee County. A fixed crest spillway then extends from the island to private lands on the right (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 (Attachment 2). Documentation describing when and the reasons for the County instituting a fall through spring pool 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 dam, the area near the dam had a rock ledge where the bedrock was higher in this section of the river. The rock ledge maintained a deep, narrow, and low-gradient meandering channel bounded by expansive wetlands. Based on 1937 aerial photographs and numerous other surveys and topographic maps, the river morphology never included a widening or lake-like natural feature. 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 for purposes of abating flooding. The channel modifications were considered 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. 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 is imbedded in the contaminated sediment behind the fixed crest spillway and must be removed and dealt with as contaminated material.
- Signing must meet specifications.
- A structural analysis including scour/undermining analysis of the dam must be completed.
- A written plan for operation, inspection, and maintenance must be developed as well as an Emergency Action Plan.

The WDNR Administrative Order dated July 28, 2009, requires the County to either repair or abandon the dam within established timelines and also requires the County to maintain the dam under a drawdown condition until the repairs are 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 loading conditions. In addition, debris which collects at the dam will be removed. Some tree removal near the dam structure is also required.

Milwaukee County retained AECOM 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 WDNR's Administrative Order.

The United States Environmental Protection Agency (USEPA), WDNR and Milwaukee County have investigated the sediments upstream of Estabrook Dam. Contaminated sediment containing organic and inorganic pollutants including carcinogenic polycyclic aromatic hydrocarbon (CPAH) and polychlorinated biphenyls (PCBs) was removed from the west oxbow of the Milwaukee River and Lincoln Creek about 1 mile upstream from the dam (2011). Additional sediment is scheduled to be removed during 2015, which will include the 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 and Section 16.

AECOM found sediment containing PCBs upstream from the dam. This information was shared with the USEPA, WDNR and Milwaukee County and these sediments will be part of the river sediment cleanup program for 2015.

As part of retaining AECOM in 2010, improvements to the Estabrook Dam were designed by AECOM and plans and specifications for these improvements are on file at Milwaukee County since 2011. Access easements are being acquired by the County to allow construction work at the dam regardless of the alternative. When the access easements are finalized, the County will submit the easements to WDNR so WDNR can then complete their review of the dam design improvements and provide comments/approval of the design documents.

The Bureau of Land Management (BLM) informed Milwaukee County that the island at the dam was under BLM jurisdiction and, therefore, a permit 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 alternatives to dam repair such as no action and dam removal.

In 2014, the Milwaukee River Preservation Association raised questions as to BLM's jurisdiction of the island. Aerial photographs from 1930's show the property is part of Milwaukee County's Estabrook Park and that the dam construction involved excavating a new river channel to construct the gated section of the dam and creation of an island. 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 therefore no longer a reviewing agency for this project. The NEPA requirements for this project are still appropriate due to wetland permitting requirements as further discussed in Section 1.2 of this EIS.

A series of Technical Advisory Team meetings have taken place with representatives from Milwaukee County, Southeastern Wisconsin Regional Planning Commission (SEWRPC), BLM, WDNR, US Fish and Wildlife Service, US Army Corps of Engineers, Himalayan Consultants, and AECOM from 2012 to the present. The representatives provided input on Estabrook Dam and alternatives to the dam. The alternatives included a no-action alternative; rehabilitate the dam; rehabilitate the dam and provide fish passage; removal of the dam, a new dam, and remove the dam while installing a "rock ramp" to develop a pool upstream similar to a dam but would also allow fish passage (Aadland,[1] 2010).

Milwaukee Riverkeeper has sued Milwaukee County and claims Estabrook Dam is a public nuisance. On May 24, 2012, the State of Wisconsin Circuit Court declared that Estabrook Dam is a public nuisance and ordered Milwaukee County to remedy the nuisance.

The public has been very vocal regarding the Estabrook Dam. One segment of the public supports rehabilitation of the dam. A group, the Milwaukee River Preservation Association, has strongly supported the dam project. About 350 private property owners live upstream from Estabrook Dam and along the impoundment. There are actually 163 residential properties with river frontage from the dam to West Bender Road. The advocates for the dam enjoy the aesthetics of the impoundment, and the canoeing, kayaking, motor boating, and other water-based recreational opportunities provided by the impoundment. They contend that the impoundment is important to maintaining their property value.

Another segment of the public supports removal of the dam to create a free-flowing river for purposes of enhancing environmental quality, recreation, reducing flood damages, and at a cost savings to taxpayers. They cite the environmental benefits and cost savings that followed the removal of the North Avenue Dam in 1997 and 13 other dams removed along the Milwaukee River or its principal tributaries since 1987. In these examples, aquatic habitat, water and sediment quality, fish passage and overall biological integrity, based on measured fish assemblages, have improved based on WDNR fish surveys. Recreational opportunities have also changed, some arguably for the better, in particular, those associated with fishing, kayaking, and canoeing. These positions are personal preferences. To date, there has been no evidence of negative impacts to riparian property values located along any of these former impoundments. In other instances requiring dam repairs, public and private dam owners have chosen to repair and maintain their dams in lieu of removal primarily over concerns over aesthetics, changes to property value and uses, and loss of preferred water-based recreational uses associated with deeper impoundments.

In addition to dam removals, investments have been made in order to facilitate fish passage and their access to spawning habitat including the removal or modification of culverts and bridges over 5 miles of concrete channel and drop structure removals, and construction of an engineered fishway around the Milwaukee River Thiensville Dam http://www.co.ozaukee.wi.us/619/Fish-Passage.

Milwaukee County has developed plans and specifications for dam repair in 2011. In 2012, Milwaukee County initiated the EIS preparation which has included public information meetings to solicit public input. Milwaukee County is proceeding with the EIS to address Estabrook Dam and alternatives with the objective to provide the public with detailed information about the array of alternatives to be considered in the decision-making process http://www.mkeriverkeeper.org/content/estabrook-dam-removal.

1.2 National Environmental Policy Act (NEPA) and Wisconsin Environmental Policy Act (WEPA)

Major actions that have the potential to affect the human environment and that involve federal funding, require a permit, or other authorization from a federal agency are subject to the requirements of the National Environmental Policy Act of 1969 (NEPA; 42 USC 4321 et. seq.). The proposed project is subject to the requirements of NEPA because approval from the US Army Corps of Engineers is required regarding potential wetland impacts as part of the dam repair project.

WDNR has offered the County a $400,000 grant from the Municipal Dam Program for dam repair (existing structure or rock ramps). The County would need to request a variance to use the money for dam removal, since the County originally indicated the money would be used for repairs. In addition, up to $2,000,000 from the Stewardship Program for dam repair (existing structure or rock ramp) or dam removal is potentially available, and funding levels depend on meeting the grant criteria which relates to the specific dam installation. Additional information on funding is provided in Section 2.7.

The WEPA program is similar to the NEPA program. The Operational Order for the dam requires the WEPA involvement.

The NEPA/WEPA programs require an EIS for these types of projects to determine the environmental impacts of the project. Initially, a draft Environmental Assessment (EA) was prepared in 2014 by AECOM. This EA was used to prepare an EIS. If the project's EIS results in a finding of no significant impact, the project can proceed with implementation.

1.3 Proposed Action

Milwaukee County has proposed repair of the dam but has also solicited public input and regulatory input on a series of alternatives to repair, replace, or remove the dam. Upon receiving this input, Milwaukee County has finalized the EIS based on the selected project and will proceed with implementation.

1.4 Purpose and Need for Proposed Action

An EIS is required to evaluate feasible alternatives to the dam and to meet state and federal regulatory requirements for a WEPA and NEPA project.

Repair of Estabrook Dam will address deteriorating structural components, provide public safety, comply with a WDNR Administrative Order requiring that Milwaukee County repair or abandon Estabrook Dam by December 31, 2016, maintain an impoundment, minimize adverse environmental impacts, solicit public and regulatory agency input, and address project costs.

The WDNR issued an Administrative Order for Dam Repair on September 26, 2008, after damage to a section of the fixed crest spillway (broken stoplogs) was observed. The Order required the impoundment to be drawn down by October 5, 2008. Milwaukee County completed the repairs by July 10, 2009.

The WDNR issued a second Administrative Order to address the outstanding deficiencies in 2009. The Order required the impoundment behind the dam to be drawn down in 2009 and not be refilled until all repairs have been completed. The impoundment has remained drawn down as the County has considered dam abandonment and repair options. The Milwaukee County Board has gone on record to repair the dam (Proposed Action). This EIS evaluates repair of the dam as well as alternatives. Alternatives are addressed in the EIS to provide technical documentation that the selected plan is environmentally sound. By evaluating alternatives, an overview of the options with associated costs and benefits are presented to allow regulatory agencies, Milwaukee County, and the public to provide input and to select the appropriate alternative to implement.

The term “Proposed Action” is used in the NEPA/WEPA process to designate the plan proposed by the property owner.

Milwaukee County is also required by the WDNR to prepare two separate dam “Operation” documents for the Estabrook Dam:

1. Inspection, Operation, and Maintenance Plan (IOM). A safety manual required for large dams under NR 333.07. Details would include when the dam is inspected, what components are inspected, what is the maintenance schedule for the dam, and it explains how the dam is operated (e.g., during floods, normal conditions, winter, etc.)

2. Operational Order. A decision document that establishes water levels for the dam under s.31.02, Wis. Stats. Depending on the dam/situation, the Order sets levels such as maximum, minimum, and/or normal water levels and flow release rates, seasonal drawdowns, etc. This EIS is needed to establish an Operational Order.

The requirements for these documents are presented in Wisconsin Administrative Code NR 333.07. The EIS includes a discussion of the Operation Plan and alternatives. There can be environmental impacts from the dam operation and that is the reason that the EIS addresses the Operation Plan and alternatives to the Operation Plan.

The County will have a safety manual on the dam operation and maintenance to protect dam workers and the public. Safety is a major concern with dams because dam operation during high flows can be dangerous to dam workers. Public safety is likewise important because the public uses the river for recreation, and the dams, in general, can adversely impact the public upstream, at the dam, and downstream especially during flood events.

1.5 Applicable Regulatory Requirements and Coordination

The following federal, state, and local permits or approvals are 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.

Tribal historic/cultural review includes input from Native American tribes on the project.

State of Wisconsin:

1. Wisconsin Chapter NR 30 permits for structures, shoreline stabilization, and dredging
2. Wisconsin Statutes Chapter 31 regulation of dams and bridges affecting navigable waters
3. Wisconsin Chapter NR 216 Wisconsin Pollutant Discharge Elimination System (WPDES) stormwater and wastewater permitting
4. Wisconsin Chapter NR 333 design standards for large dams
5. Wisconsin Chapter 116 floodplain approvals
6. Wisconsin Chapter 40 invasive species
7. Natural Heritage Inventory Compliance
8. State Archaeological site clearance required

The Natural Heritage Inventory compliance is performed based on a WDNR computer inventory on natural heritage sites and identifies plant and animal species that are threatened or endangered and could potentially be located in the project area. The State Archaeological site clearance involves contacting the State Historical Office about the potential for a historical or archaeological site being in the project area. In the case of Estabrook Dam, a site-specific archaeological survey was performed and is further discussed in Section 3 of the EIS.

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

Other:

1. Approval from the local special waste landfill of acceptance of the materials with PCB concentrations less than 50 ppm.
2. Approval from the out of state landfill for acceptance of materials with PCB concentrations greater than 50 ppm.

The sediment behind the dam will be removed during 2015 and, therefore, will not be an issue for the dam alternatives which will be implemented in 2016.

1.5.1 Technical Advisory Team

Milwaukee County solicited technical input from federal, state, and local agencies to evaluate repair of the dam as well as to identify and assess dam alternatives in accordance with NEPA/WEPA requirements. The team met multiple times from 2012 through 2014 to discuss the regulatory, environmental, and economic aspects of Estabrook Dam and alternatives. The team provided technical support to Milwaukee County staff and the County Board to allow the County Board to make long-term decisions based on sound technical documentation.

The Technical Advisory Team represented the following entities:

- Milwaukee County
- WDNR
- Bureau of Land Management (BLM)
- SEWRPC
- US Fish and Wildlife Service
- US Army Corps of Engineers
- AECOM
- Himalayan Consultants

The technical areas represented by the team include river flow modeling, flood and drainage considerations, fish passage, fish, other aquatic life and wildlife populations and their habitats, wetlands, river sediment and sedimentation, water quality, civil engineering, dam design, and other related environmental and engineering fields.

Milwaukee County issued a draft Environmental Assessment (EA) indicating the alternatives in July 2014 to regulatory agencies and the public. On June 5, 2014, a public scoping meeting was held. A public information meeting was held on September 3, 2014 to seek public input on the feasible alternatives. The public provided comments at this meeting and also provided written comments through the County website after the meeting. The Milwaukee County staff and the County Board reviewed the compiled technical information, Technical Advisory Team input, and public input to determine a preferred plan.

An EA was originally prepared for this project and distributed in draft form as discussed above. The Wisconsin Administrative Code NR150 has been revised in 2014 to require an EIS for this type of dam project addressing dam repair, dam removal, and operation plan. The WDNR indicated that this project will require an EIS. The EIS is required for projects that have potential environmental impacts or a project involving broad public controversy or other factors addressed in NR 150.20(4).

1.6 Contaminated Sediment Remediation and the Great Lakes Legacy Act Project

The sediment behind the fixed crest spillway of Estabrook Dam and other areas upstream from the dam are being addressed under a separate project under the Great Lakes Legacy Act. USEPA, Milwaukee County, and WDNR are working with contractors for designing and implementing the sediment project which includes access roads, staging and documentation areas, dewatering pads, and wastewater treatment facility. The sediment removal project is independent of the Estabrook Dam alternatives, but the project teams are working together to identify common elements that can be used by both projects, such as access roads and easements on the south side of the river to access the fixed crest spillway.

The Milwaukee River has established a channel through the impoundment area. Accumulated polychlorinated biphenyl (PCB) and CPAH contaminated sediment and debris are present upstream and adjacent to Estabrook Dam. As part of the Great Lakes Legacy project, the sediment and debris will be removed prior to dam rehabilitation during a separate sediment removal project that will mechanically remove approximately 9,500 cubic yards of accumulated sediments from above the dam during the Phase II sediment removal project. Phase II of the sediment remediation project follows the Phase I completed in 2012, whereby 120,000 cubic yards of contaminated sediment were removed from Lincoln Creek and the west oxbow of the Milwaukee River. The goal of the remediation is to eliminate contaminants that threaten human health and the environment. One measure of the project's success is to ultimately reduce concentrations of PCBs in fish contaminated with PCBs. Remediation of contaminated sediment is beneficial to human health regardless of the selected dam management alternative. Sediment accumulation patterns are dependent on the dam alternative, but the contamination will be gone.

The extent of the Phase II sediment remediation footprint is about 1.4 acres in area. Attachment 5 contains an aerial map showing the proposed areas for sediment removal as part of the Phase II program. The area immediately above the dam is referenced as Zone 5, based on the Lincoln Park/Milwaukee County River Channel Sediments Phase II Pre-Final Remedial Design Report dated January 2014, prepared by EA Engineering Science, and Technology, Inc. Conducting the Phase II sediment remediation during drawdown of the impoundment is more effective, less costly, and planned to be completed in 2015.

1.7 Fish Consumption Advisories

The WDNR provides fish consumption advisories for Wisconsin lakes and rivers including the Milwaukee River at Estabrook Dam. Carp is the only fish species with a Do Not Eat advisory in this reach. The fish consumption advisory is as follows from the WDNR website http://dnr.Wi.gov/topic/fishing/consumption/index.html.

County:	Milwaukee, Ozaukee
Advisory Area:	Milwaukee River from City of Grafton to Estabrook Falls including Lincoln Creek
Includes:	Lincoln Creek, Milwaukee River

Women up to age 50 (child bearing age) and children (under age 15) may safely eat:

1 Meal Per Week:	black crappie, bluegill, rainbow trout less than 22", rock bass

1 Meal Per Month:	brown trout less than 28”, bullheads, Chinook salmon, Coho salmon, largemouth bass, northern pike, rainbow trout larger than 22”, redhorses, smallmouth bass, walleye
6 Meals Per Year:	brown trout larger than 28”, channel catfish
Do Not Eat:	carp

All men (age 15 and older) and older women (50 and older) may safely eat:

1 Meal Per Week:	black crappie, bluegill, rainbow trout less than 22”, rock bass
1 Meal Per Month:	brown trout less than 28”, bullheads, Chinook salmon, Coho salmon, largemouth bass, northern pike, rainbow trout larger than 22”, redhorses, smallmouth bass, walleye
6 Meals Per Year:	brown trout larger than 28”, channel catfish
Do Not Eat:	carp

Women of child bearing age and children under age 15 have more restrictive fish consumption levels because they are more susceptible to health impacts due to fish consumption. The concern for child bearing women is to transfer the potential contaminants in the fish to the fetus. Young children can bioaccumulate the contaminants in fish over a lifetime of fish consumption and, therefore, more restrictive fish consumption is advised.

2.0 Identification of Alternatives and Physical Changes

This section provides an overview of the Proposed Action and alternatives considered regarding the Estabrook Dam. Physical changes with the alternatives are also presented in this section. This project has a long history of proponents in favor of maintaining or removing the dam. Important issues included the positive or negative effects of the dam, its impoundment and the existing and proposed dam and water level operational plan on fish, other aquatic life, wildlife habitat, water and sediment quality, sedimentation, flooding and drainage, water-based recreational uses and property values, water levels, institutional issues (e.g., access easements and permits, etc.), and costs. The Technical Advisory Team identified a number of issues that could potentially mitigate in whole or in part some of these negatively impacted issues. For example, the dam operation plan can negatively impact mussels if a seasonal drawdown results in exposed mussels in winter. A public scoping meeting was held to obtain input for consideration of additional alternatives and issues that could be addressed in the EIS. A preliminary screening of the alternatives was performed, and the most feasible alternatives were selected for a more in-depth evaluation of their benefits, impacts, and related costs. Public and agency review and comments from the draft EA and EIS will be solicited to provide Milwaukee County with the information needed to go forward with the Proposed Action or other dam or river management alternatives.

2.1 Identification of Alternatives

In addition to the Proposed Action – Rehabilitate the Dam, the Technical Advisory team and public identified the following alternatives for consideration for Estabrook Dam. These alternatives are as follows:

- Alternative 1 – Proposed Action – Rehabilitate the dam without fish passage.
- Alternative 1A – Rehabilitate the dam and add provisions for fish passage.
- Alternative 2 – Abandon and remove the dam.
- Alternative 3 – Abandon and remove the dam, providing a 5.5-foot high rock ramp to facilitate fish passage and establish an impoundment.
- Alternative 3A – Abandon and remove the dam, providing a 4-foot high rock ramp to facilitate fish passage and establish an impoundment.
- Alternative 4 – Gated spillway removed, serpentine overflow spillway lowered, and a 6.3-foot-high rock ramp constructed.
- Alternative 5 – No action.
- Alternative 6 – New dam.

2.2 Preliminary Screening of Alternatives

Milwaukee County decision makers and the public have decades of experience and technical tools available to weigh the socio-economic and environmental impacts, both positive and negative, associated with the Estabrook Dam. Social and environmental factors are known for the current dam operation. The Estabrook Dam was constructed in the Milwaukee River in the late 1930s. Over the last several decades, Milwaukee County has operated the dam gates to fill and drawdown the impoundment on a seasonal basis and in response to flood events. More recently, the dam gates have remained open since 2008, until such time that repairs and other issues are resolved. These changes enable the public to visualize, experience, and react to the array of associated dam management alternatives proposed for this EIS. For example, the open gates allow the public to see conditions as if the dam was removed. Contaminated sediment remediation projects have required the inventory of physical, chemical, and biological information not previously available. Water quality improvements and the removal of other dams along the lower Milwaukee River and other barriers to fish passage have created a heavily used destination recreational fishery. This is documented by WDNR creel surveys and observations. Dam removal has only recently evolved as a cost effective, technically and environmental sound river management practice. In instances whereby decisions are made to retain a dam, engineered fish passage facility designs have evolved to be effective at passing native fish around dams based on their unique migration behavior, swimming, and leaping abilities. State of the art hydrologic and hydraulic models have been developed and used to accurately predict flooding and drainage problems associated with dams and various flood and dam operating scenarios. Finally, structural engineering standards and practices allow for more accurate estimates of capital, operation, and maintenance cost for various dam management alternatives. These and other assessment tools will allow all parties to objectively evaluate the environmental and socio-economic benefits and impacts of the dam management alternatives presented in this EIS.

The following information is provided on each alternative and the preliminary screening of the alternatives.

2.2.1 Alternative 1 – Proposed Action – Rehabilitate the Dam and Alternative 1A – Rehabilitate the Dam and Add Fish Passage

Alternatives 1 and 1A are identical except Alternative 1A includes fish passage. The descriptions of these two alternatives are as follows:

Alternative 1 – Proposed Action – Rehabilitate the dam consists of making the structural improvements to the dam to extend its life and to meet the requirements stipulated in the July 28, 2009 WDNR Administrative Order. Other improvements include upgrading the gates and tree removal at the dam structure. This alternative would also require a dam gate and water level operation plan. Briefly, over the past several decades, the County has operated the dam gates and pool water level based on two annual periods: a summer (mid-May to mid-September) whereby the gates are 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. Ten gates are in place.

Milwaukee County Board has voted to implement the Alternative 1 – Proposed Action in 2010. At that time, the concept of addressing other alternatives to the dam had not been presented. The NEPA and WEPA requirements include addressing alternatives. At that time, the Milwaukee County Board voted to implement the Proposed Action, the option to remove the dam was dismissed in favor of rehabilitating the dam. In early 2015, the Milwaukee County Board voted to implement Alternative 1 – Proposed Action and allocated funds for dam repair.

Dams, as barrier to fish movement, fragment habitat needed for various life requisites (e.g., habitat types required for spawning, development, growth, etc.), reduce fish population resilience to environmental disturbances and elevated risks to local and watershed-scale extinctions, and diminished genetic diversity (NOAA, 2010)[2]. Freshwater mussels are the most threatened and rapidly declining group of aquatic organisms. Mussels are dependent on fish, often specific fish species, to serve as intermediate hosts for reproduction. Dams and other barriers to fish migration have been documented as an important factor responsible for reduced and extinct mussel populations (Aadland, 2010). The socio-economic benefits are diminished for the recreational fishery that have developed along the lower 32 miles of the Milwaukee River and its tributaries, including the Lake Michigan fall through spring runs of trout and salmon depends on the fish passage at the dams.

The Proposed Action would, therefore, have significant environmental and recreational fishing impacts. Though the County Board has not provided funding for fish passage at this time, the County has submitted grant applications for fish passage and would be amenable to fish passage if sufficient funding from other sources became available. Alternative 1 will be evaluated because it is the Proposed Action. The EIS process requires the Proposed Action to be evaluated in terms of positive and negative impacts.

2.2.2 Alternative 1A – Rehabilitate the Dam and Add Provisions for Fish Passage

Alternative 1A will require long-term annual operation and maintenance cost to operate the gates, to remove debris, and to maintain the dam. Alternative 1A is Alternative 1, the Proposed Action, with the addition of fish passage features. The provision for fish passage is a definite environmental benefit.

Alternative 1A is a refinement of the Proposed Action with added environmental benefits. The fish passage provision allows fish to pass through the dam area in a designated passage section of the dam.

Alternative 1 and 1A would require a water level Operation Plan. Briefly, two options for establishing a water level Operational Plan are considered:

1. A summer (mid-May to mid-September) whereby the gates are closed and impoundment maintains a full pool, and for the remainder of the year (mid-September to mid-May) the gates are normally closed and the stop logs are removed to lower the impoundment by 3 feet. The stop logs allow for lowering the water level up to 3 feet. Additional information on the Operation Plan is provided later in this section.

2. A year-round gates closed full pool condition.

Alternatives 1 and 1A include an option for a year-round gates closed full pool option as a means to avoid potential negative environmental impacts associated with opening the gates and draining the pool. Both options propose that the County have a gate operator on staff to monitor river levels, weather, debris, and river ice conditions in order to operate the closed dam gates and adjust the pool to prevent dam related flood and potential drainage damages to upstream properties, and to limit the County's liability exposure associated with these damages. A more detailed description of the operation plan for Alternatives 1 and 1A is contained in Attachment 10.

Alternatives 1 and 1A are classified by WDNR as large dams because the dam structural height is more than 6 feet and impounds more than 50 acre-feet of water. In addition to consistent inspection, maintenance, repair, and operation, the regulatory requirements for a large dam are as follows:

- Operation, inspection, and maintenance plan must be developed.
- Emergency action plan must be developed.

- An owner inspection would be required every 10 years.

The fish passage will consist of a series of pools and riffles of rocks and boulders (Aadland, 2010)[1]. The fish passage allows fish to migrate during spawning and other periods of the year, which promotes fish diversity, enhances fishing opportunities, and is intended to replicate conditions in a free-flowing river.

2.2.2.1 Physical Changes to Terrestrial Resources

The following repairs will be made to the Estabrook Dam according to the design construction documents and to comply with WDNR's dam repair orders of 2008 and 2009.

- Concrete will be repaired.
- Exposed reinforcing rod will be reconditioned.
- Supplemental reinforcing will be installed as necessary.
- Eleven grouted tie-down rock anchors and associated components on the upstream ends of the piers will be installed.
- Ten 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 dam repair order calls for the permanent removal of all trees and shrubs from the area within 15 feet around the left (north) and right (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 WDNR to determine the trees that must 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 WDNR. Temporary roads and staging areas will be constructed to access the dam for repairs. The sediments behind the fixed crest spillway will already be 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.

2.2.2.2 Physical Changes to Aquatic Resources

The Estabrook Dam impoundment has been drawn down since 2008. The Milwaukee River has established a channel through the impoundment area. PCB contaminated sediment and debris are present upstream and adjacent to Estabrook Dam. The sediment and debris will be removed during 2015 prior to dam rehabilitation or implementation of another alternative during a separate sediment removal project that will mechanically remove approximately 9,500 cy of accumulated sediments from above the dam during the Phase II sediment removal project which is jointly being conducted by USEPA, WDNR, and Milwaukee County. The extent of the sediment footprint is about 1.4 acres in area. Attachment 5 contains an aerial map showing the proposed areas for sediment removal as part of the Phase II program. The area immediately above the dam is referenced as Zone 5 based on the Lincoln Park/ Milwaukee County River Channel Sediments Phase II Pre-Final Remedial Design Report dated January 2014, prepared by EA Engineering, Science, and Technology, Inc.

The environmental impacts associated with Alternatives 1 and 1A are fairly well known based on the dam operation from the 1930s until the dam gates remained open in 2008. This period allows for environmental assessment of the actual conditions experienced for this alternative. The affected environment for Alternatives 1 and 1A is discussed in Section 3.

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.

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 have to come through negotiated access easements to private lands on the right (south) bank of the river.

The impoundment will be restored after completion of the dam rehabilitation project. At full pool elevation, the Estabrook impoundment is approximately 103 acres and extends beyond West Silver Spring Drive for an additional 0.9 miles upstream. Regarding the quantity and location of wetlands previously mapped as wetlands under Alternatives 1 or 1A, no perennial wetland vegetative cover types will develop from exposed floodplain sediment during the fall through winter drawdown of the impoundment. The rehabilitated Estabrook Dam will have no changes to previous dam dimensions and flow characteristics. At flood level, the Milwaukee River will continue to overtop the fixed crest and gated sections of dam structure. From the dam to the upstream end of the impoundment is about 2.5 miles.

SEWRPC completed a detailed analysis of Alternatives 1 and 1A on local hydraulic and the floodplain conditions. SEWRPC modeled the Estabrook Dam alternatives in 2014 (Attachment 3) 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 (Attachment 4). Under a 100-year frequency flood, and the 10 gates closed, the upstream river levels will exceed a 100-year flood elevation and will worsen the flood conditions. Under this scenario, the river levels will 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 can staff a dam operator to continually monitor river flows and weather conditions to control the gates, but the possibility remains if the 10 gates malfunction due to debris, ice, an electrical power outage or gate mechanical failure, the County can be liable for flood damage to upstream properties.

Under Alternatives 1 or 1A, the County proposes to have a dam operator to monitor river and weather conditions, and to regulate the gates accordingly.

Alternatives 1 and 1A will have the same river water surface elevations as the existing dam with the gates closed. Under normal (median) flow conditions, which assume that the Estabrook Dam gates are 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.

Alternative 1A will include a fish passage to allow fish to travel year-round upstream and downstream regardless of the dam gate operation. This environmental benefit is shared with all of the feasible alternatives except Alternative 1. Invasive species already are present on both sides of the dam and therefore, the dam does not appreciably change their presence. The dam is overtopped during major floods and therefore, was not a blockade against the movement of aquatic invasive species (AIS) along the Milwaukee River. The seasonal opening of the gates over the last several decades has created an avenue for the passage of beneficial fisheries and the fairly recent and unanticipated arrival of AIS.

Alternatives 1 and 1A will result in higher water temperatures due to the impoundment. Higher water temperatures result in lower dissolved oxygen in the water that can be detrimental to certain fish and aquatic life. Water quality data including river temperature is monitored by Milwaukee Riverkeeper and water quality information is provided in Attachment 11; (Milwaukee Riverkeeper[13, 14], 2014).

Sediment buildup over time will occur and can be detrimental to fish, mussels, and other aquatic life. When the gates are opened, the sudden flush of sediment can also be detrimental to fish, mussels, and other aquatic life.

2.2.2.3 Buildings, Treatment Units, Roads, and Other Structures

Alternatives 1 and 1A have a small existing building associated with the dam. The dam is a structure that will be rehabilitated. There is no treatment units associated with the dam. Access roads are required to make improvements to the dam. The access road in Estabrook Park is existing. The access road across the river is on private property and will serve as access for the sediment removal project and 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.

2.2.2.4 Dam Operation Plan for Alternative 1

The dam operation plan considers a summer plan and balance of the year plan for Alternative 1. For Alternative 1A, the impoundment would be year-round to allow the fish passage to function properly. The specifics of the plan for Alternative 1A are as follows:

1. Summer Operation Plan

The dam summer plan starts with refilling the pool no earlier than May 15 and has it drawn down completely by September 15. This schedule may vary depending upon weather and river flow conditions. For example, high river flows in May could cause a delay in filling the impoundment. The goal is to maintain a full pool during this period for aesthetics and recreational use. During this period, the 10 gates will be closed the majority of the time. The County will employ a dam gate operator to monitor river flows, river levels, debris, and weather conditions. The gates will be operated to limit the drawdown to 6 inches or less per day as per the WDNR requirements and minimum stage of the top of the fixed crest spillway. The fixed crest spillway is 6 inches lower than the gates. Estabrook Dam is required to pass at all times a minimum flow downstream at least 25 percent of the natural low flow which has been administratively set at Q7,10 S.Statutes 31.34, Wis. Stats.

The County proposes a normal water level in the pool based on the fixed crest spillway elevation. The gates will be operated as needed to establish the normal water level. If rising water levels occur above the normal, the County has the option to open gates to adjust pool levels accordingly.

2. Balance of the Year Operation Plan

The operation plan for the balance of the year consists of having the 10 gates closed and the stop logs removed to lower the impoundment by three feet. The lower impoundment will route the flow over the stop log area to minimize ice damage to the gates. The partial impoundment is more environmentally protective to aquatic life in the impoundment such as mussels. The drawdown will follow WDNR criteria of no more than 6 inches per day drawdown (Wisconsin Administrative Code Chapter NR 31). Additional information on the Operation Plan, pool levels, and river rating curve are contained in Attachment 10.

Refer to Attachment 10 regarding structural elevations for the dam and fish passage.

3. Year-Round Full Pool Operation Plan Feasibility

A year-round, full pool operational plan was considered. There are potential environmental benefits to aquatic life with this scenario. Aesthetics of the pool year round are also a positive. The mitigative measures to accomplish this full pool option are challenging and include additional risk to the dam for potential structural damage to the gates, and potential for the gates to malfunction if they have not been operated for extended periods.

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 10 gates to minimize ice buildup at the gates. 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. The gates could be temporarily opened to pass the ice flows, but WDNR regulations limit the drawdown to 6 inches per day, which could readily be exceeded under these conditions.

The full pool, year-round scenario has environmental and aesthetic benefits, but the operational plan to accomplish this approach would require substantial dam operator attention to meet WDNR criteria (Chapter NR 34) and to protect the dam gates from potential structural damage. This option had significant operational challenges which would be difficult to consistently overcome. Issues relate to the gates freezing in winter and become inoperable, or ice damage to gates. The potential exists for structural damage to the 10 gates. The design ice loading on these gates is 5,000 pounds per square foot, which reflects the power and force of these ice flows on the steel gates. Mitigation measures are being considered in design including antifreeze provisions for the gates, or aeration at the gates to reduce the potential for the gates to freeze during winter.

2.2.2.5 Fish Passage Layout for Alternative 1A

Alternative 1A would have a dam operation plan with a full pool year-round. This alternative includes the fish passage along the north shore (left bank when looking downstream). The fish passage would be constructed 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.

Fish passage will require hydraulic modeling evaluation of the river to verify the fish passage does not increase the 100-year flood elevation by 0.01 feet or more as stipulated in the Wisconsin Administrative Code NR 116.

Multiple fish passage layouts were evaluated on a preliminary basis including the following options:

Option 1: North Shore: The north shore option was presented above.

Option 2: Two fishways through the fixed crest spillway, one through the stoplog section, and one along the south shore. Both fishways start at the fixed crest spillway and continue downstream. The sill of the fixed crest spillway would move upstream.

Option 3: South Shore: The south shore option is through the fixed crest spillway. The fishway would operate under two conditions and have stoplogs similar to the current stoplogs. The stoplogs would be removed for spring fish passage, and installed during the summer. It would start at the fixed crest spillway and continue downstream. The sill for the fixed crest would move upstream.

The layout along the north shore (Option 1) was preferred because it provides improved accessibility for County staff to remove debris and perform general maintenance. This location also provides better design for fish passage as the flow through the fish passage can be adjacent to the main river flow, improving fish attraction flow to the fishway.

The south shore layouts (Options 2 and 3) are not as accessible as the north shore, does not allow the fishway flow to be adjacent to the main river flow, and the south shore involves private property. The fish passage layout at the stoplogs (Option 2) is not as accessible for County staff to remove debris as the north shore layout.

If the north shore fish passage layout adversely impacts the 100-year flood elevation, the mitigative measures include one or more of these options:

a. Lower the sidewall elevation of the fish passage.

b. Design the stoplogs to release prior to the 100-year flood occurring.

c. Locate the fish passage along the south shore and downstream of the dam instead of the north shore layout.

d. Lower the fixed crest spillway slightly, such as 0.1 to 0.5 feet.

2.2.2.6 Dam Operation Plan for Alternative 1A

A full impoundment year-round is proposed for Alternative 1A to allow the fish passage to properly function. An aeration system at the gates or a glycol antifreeze system to protect the gates is proposed. The County would provide staff to operate and maintain the dam similar to Alternative 1.

2.2.3 Alternative 2 – Abandon and Remove the Dam

Alternative 2 – Abandon and remove the dam would restore the river to a free flowing condition and provide fish passage. This alternative would eliminate the County's capital cost for dam repair and also eliminate the need for annual dam operation and maintenance costs. This alternative has merit and will be further addressed in the EIS.

2.2.3.1 Physical Changes to Terrestrial Resources

This alternative consists of physically removing the entire dam consisting of the gated section and fixed crest spillway. The gated section consists of 10 gates with electric/mechanical operators to raise or lower the gates. The gated section is about 182 feet long, constructed of reinforced concrete. The fixed crest spillway is a concrete and grouted stone structure approximately 450 feet long.

Alternative 2 would require a temporary access road to remove the dam. A perimeter fence will be constructed to restrict public access to the construction zone. After the dam is removed, the access road would be restored and the perimeter fence will be removed.

Concrete removed from the dam will be recycled and reused where possible. Potential uses of the concrete are as an aggregate for a road base or in concrete.

2.2.3.2 Physical Changes to Aquatic Resources

Alternative 2 restores the Milwaukee River to a free-flowing river. Compared to 103 surface acre impoundment under Alternatives 1 or 1A with gates closed and full pool conditions, the water surface area under Alternative 2 will decrease from 103 acres to 72 acres, assuming median river flow conditions. Emergent wetland vegetation will occur along the floodplain otherwise inundated by the impoundment under Alternatives1, 1A and 4. The impoundment under Alternative 4 at median flow is about 100 acres.

The river depth conditions (Table 2 of Attachment 3) for Alternative 2 will be lower than the existing river level conditions when the gates are open. Removal of the dam results in less restrictions in the river and an increase in flow capacity. These factors reduce the river level during a flood under Alternative 2 as compared to Alternatives 1 or 1A.

The SEWRPC modeling of the river (Attachment 3) showed Alternative 2 results in a decrease in water surface elevations for each analyzed flow condition relative to existing dam conditions including at each storm sewer outfall. Under a 100-year frequency flood, the water surface elevations in the area upstream of the removed dam would decrease between 0.7 and 1.5 feet as compared to existing conditions. For a 100-year flood, the water surface elevation in the upper reach would decrease by up to 0.5 feet. Under normal (median) flow conditions, the water surface elevation in the lower reach (upstream of the removed dam) would decrease between 3.7 and 7.5 feet with a maximum water depth ranging between 0.7 and 2.5 feet. The normal elevation in the upper reach would decrease between 0.5 and 4.6 feet with a maximum water depth ranging between 0.8 and 4.5 feet. From West Silver Spring Drive to West Bender Road, the maximum water depths with this alternative would be 1.5 to 2.1 feet, based on normal conditions.

The river distance from Estabrook Dam to West Bender Road is 3.2 miles. The stretch of river will have decreased water levels as compared to Alternatives 1 or 1A. Under median flow, the water level will be about 3.4 feet lower at West Silver Spring Drive as compared to Alternatives 1 or 1A. At West Bender Road, the water level under median flow conditions will be about 0.5 feet lower as compared to Alternatives 1 or 1A.

2.2.3.3 Buildings, Treatment Units, Roads, and Other Structures

As previously discussed, the small building and dam will be removed. Access road is needed to remove the dam. The access road on the south shore impacts wetlands and requires a Section 404 permit from the U.S. Army Corps of Engineers and WDNR permit. The access road on the south shore (right bank when looking downstream) will be removed and the area restored after construction.

2.2.4 Alternative 3 – Abandon and Remove Dam, Providing a 5.5-Foot High Rock Ramp to Facilitate Fish Passage and Establish an Impoundment

Alternative 3 provides the benefits of an impoundment beginning 1,600 feet upstream of the existing dam site. The 5.5-foot high ramp would create an impoundment similar to a dam, but without the large capital expense to repair the dam and eliminates the annual operating and maintenance costs associated with the dam gates. But some maintenance, including debris cleaning, is anticipated. The rock ramp allows fish passage. The passive nature of a rock ramp is similar to a natural river with riffles. Similarly, the rock ramp height will dictate the extent of a pool upstream and will be limited to a height that does not interfere with a 100-year frequency flood elevation.

SEWRPC evaluated Alternative 3 and determined the 5.5-foot high rock ramp will exceed the 100-year frequency flood elevations (Attachment 3). Therefore, this alternative is eliminated from further consideration because it would cause flooding at the 100-year frequency event.

2.2.5 Alternative 3A – Abandon and Remove Dam, Providing a 4-Foot High Rock Ramp to Facilitate Fish Passage and Establish an Impoundment

Alternative 3A is very similar to Alternative 3 and would be located in the same location as Alternative 3, which is 1,600 feet upstream of the dam. Multiple iterations of rock ramp heights were evaluated and a rock ramp not to exceed 4 feet high would not impact the 100-year frequency flood event based on this rock ramp location. The rock ramp height results in the structure being considered a “small dam,” which has fewer regulatory requirements compared to those of a “large dam.” If the structural height was more than 6 feet and impounds more than 50 acre-feet of water, the rock ramp would be considered a large dam under s.31, Wis. Stats.

SEWRPC modeled Alternative 3A and found this option can handle a 100-year frequency flood without increasing the 100-year flood elevations (Attachment 3).

The one physical drawback to Alternative 3A is the impoundment depth is limited as compared to Alternative 1A or Alternative 4. Alternative 3A has potential, but Alternative 4 has more benefits and similar costs and drawbacks. For these reasons, the EIS will address Alternative 4, and Alternative 3A will be dismissed.

2.2.6 Alternative 4 – Gated Spillway Removed, Serpentine Overflow Spillway Lowered, and a 6.3-Foot-High Rock Ramp Constructed

Alternative 4 presents a rock ramp option located at the gated section of the dam. This rock ramp is higher than the rock ramp option in Alternative 3A and therefore provides a deeper impoundment upstream. The rock ramp height results in the structure being considered as a large dam which has some regulatory requirements as discussed under Alternative 1A in Section 2.2.2.

Alternative 4 has merit as it provides for effective fish passage and will be further addressed in the EIS.

Alternative 4 is located at the dam where the river is wider as compared to Alternatives 3 and 3A, which would be 1,600 feet upstream from the dam. Though Alternative 4 has a 6.3-foot high rock ramp as compared to Alternative 3 (5.5-foot high), the river modeling by SEWRPC demonstrates Alternative 4 can handle a 100-year frequency flood without exceeding the 100-year flood elevation (Attachment 3). Therefore, Alternative 4 has merit and will be further evaluated.

The gated section of the dam would be removed in order to construct the rock ramp. Concrete rubble from the dam’s gated section will be used where possible to construct the lower portion of the rock ramp. The balance of the rock ramp will be constructed using stones and boulders (3 to 6 feet in size). Some smaller stones are also used to fill in the spaces between the larger stones to create a stone mass to avoid spaces between the stones. The rock ramp consists of constructing a section of rocks across the width of the former gated section. The rock ramp would slope up to a height above the river bed of 6.3 feet on average.

The rock ramp creates a relatively solid cross section. The rock ramp would have a 3 horizontal to 1 vertical slope on the upstream face and an arched weir shape on the downstream face that would direct flow generally to the center of the channel. The 3 to 5 percent longitudinal slope is similar to slopes of natural stream riffles and is gradual enough to enable fish passage and the downstream transport of ice and debris (Aadland,[1] 2010).

The objective of this alternative is to allow fish passage, maintain an impoundment upstream, provide a passive approach without the need to regulate the dam gates, and to create a natural environment similar to the bedrock ledge that existed at this location prior to the dam being constructed.

The impoundment would be year-round. The stoplogs would still exist with this alternative, but are expected to be normally in place. The stoplogs could be temporarily removed for maintenance of the rock ramp and allow for a lower pool elevation of 2.4 feet. The fixed crest spillway will be lowered from existing Elevation 616 to Elevation 615.4. The operation plan for Alternative 4 is contained in Attachment 10.

WDNR would consider Alternative 4 as a large dam based on WDNR dam regulations because the structural height is more than 6 feet and impounds more than 50 acre-feet of water. In Aadland's book[1] on rock ramps, there is discussion about not recommending a rock ramp for large dams. AECOM contacted Luther Aadland, who clarified this matter. Aadland is referring to a large dam, in this case, as being 30 to 40 feet high, which becomes impractical for a rock ramp being constructed. He said a rock ramp of 6.3 feet is very realistic to construct and maintain long-term. According to Aadland, a broad rock ramp when properly sloped is more effective at passing debris and ice than spillways. This is true because the rock ramp does not have structural members and gates that can cause ice and debris to collect on the dam as observed at Estabrook Dam.

2.2.6.1 Physical Changes to Terrestrial Resources

Alternative 4 requires the gated section of the dam to be removed in order to construct the fish passage. Alternative 4 will also include lowering the fixed crest spillway and structural improvements to the dam.

The terrestrial resources are expected to be about the same as Alternative 1A because the impoundment extent is similar but slightly shallower and extends not as far upstream as Alternative 1A as discussed below. Vegetation along the river bank will be about the same as Alternative 1A.

2.2.6.2 Physical Changes to Aquatic Resources

Alternative 4 uses a rock ramp similar to a condition of pools and riffles found in nature to provide fish passage and an impoundment upstream.

The SEWRPC modeling of the river (Table 5, Attachment 3) indicates this alternative under normal (median) flow conditions results in a water surface elevation near the dam of about 1.2 feet lower than if the dam was present. The maximum water depth ranged from 6.2 to 7.5 feet from the dam to West Hampton Avenue. The normal elevation in the upper reach would decrease between 0.4 and 1.2 feet with a maximum water depth ranging from 1.9 to 7.9 feet from Lincoln Park to West Bender Road. From West Silver Spring Drive to West Bender Road, the maximum water depths with this alternative would be 1.9 to 3.8 feet based on normal conditions.

The impoundment under Alternative 4 is year-round. Fish and other aquatic life will be able to move freely through the fish passage. Water levels will fluctuate on seasonal and daily variations in river flows.

The river length from the dam to West Silver Spring Drive is 1.9 miles and will be somewhat shallower than Alternatives 1 or 1A as discussed above. The impoundment would extend about 0.7 miles upstream of West Silver Spring Drive. This alternative provides a compromise between Alternatives 1, 1A and 2. An impoundment for recreation is provided without the expense of dam gates and associated operational costs. This option was optimized to provide the deepest impoundment that could also handle a 100-year frequency flood without increasing the flood elevation.

2.2.7 Alternative 5 – No Action

Alternative 5 – No action refers to Milwaukee County taking no action to repair the dam or to abandon the dam. The No Action alternative would violate WDNR's July 28, 2009 Administrative Order. Alternative 5 would mean the dam gates could not be operated. The dam is in need of structural repair which could lead to continued degradation of the dam. The potential for an impoundment upstream could not be realized under this alternative. Therefore, Alternative 5 – No Action, is eliminated from further consideration because it violates WDNR's Administrative Order and is not a sustainable solution.

The structural elements of the dam are in need of repair. The concrete has deteriorated in spots and repair is necessary to maintain structural integrity and to reduce the potential for accelerated deterioration. The extent of the necessary repairs is further discussed in Section 2.2.2.1.

2.2.8 Alternative 6 – New Dam

Alternative 6 – New Dam would replace the existing dam. The existing dam, built in the 1930s, is in need of repair, but the costs to construct a new dam would be substantially higher. The dam can be repaired at a much lower cost. For this reason, Alternative 6 is eliminated from further consideration.

2.3 Feasible Alternatives

Based on the preliminary screening of alternatives, the following alternatives are deemed feasible and will be further evaluated in this EIS.

- Alternative 1 – Proposed Action – Rehabilitate the dam and no fish passage.
- Alternative 1A – Rehabilitate the dam and add provisions for fish passage.
- Alternative 2 – Abandon and remove the dam.
- Alternative 4 – Gated spillway removed, serpentine overflow spillway lowered, and a 6.3-foot-high rock ramp constructed.
- Alternative 5 – No Action is eliminated from further consideration because it does not comply with the WDNR Administrative Order to repair the dam, does not allow for an impoundment as per the WDNR orders, and is not a sustainable solution over the long-term.

2.4 Actions Considered But Eliminated From Further Consideration

The following alternatives are eliminated from further consideration and are summarized below. Reasons for eliminating the alternative are discussed as follows:

Alternative 3 – Abandon and Remove Dam, Providing a 5.5-Foot High Rock Ramp to Facilitate Fish Passage and Establish an Impoundment

Section 2.2.4 describes Alternative 3 consisting of a 5.5-foot high rock ramp to be located about 1,600 feet upstream from Estabrook Dam. The rock ramp provides an impoundment for recreation and aesthetics, but exceeds the 100-year flood elevations during a 100-year flood event. Therefore, this alternative is eliminated from further consideration.

Alternative 3A – Abandon and Remove Dam, Providing a 4-Foot High Rock Ramp to Facilitate Fish Passage and Establish an Impoundment

This alternative is described in Section 2.2.5 and consists of a rock ramp similar to Alternative 3 and at the same proposed location, but would be 4 feet high instead of 5.5 feet high. The 4-foot high rock ramp could handle a 100-year frequency flood event without exceeding the 100-year flood elevations.

This alternative is feasible, but results in a shallower impoundment as compared to Alternative 4. The capital, operating, and maintenance costs for Alternative 3A would be similar to Alternative 4. The recreational benefits for motor boating regarding Alternative 3A are less than Alternative 4. For these reasons, Alternative 3A is eliminated from further consideration and Alternative 4 will be further evaluated.

Alternative 5 – No Action

The No Action alternative is eliminated from consideration because it does not address the WDNR Administrative Order, it would not allow an impoundment due to the WDNR restrictions, and is not a long-term sustainable solution. In the long-term, the dam would continue to deteriorate until it became a safety issue to County staff and the public. Section 2.2.7 contains additional information on this alternative.

Alternative 6 – New Dam

This alternative is described in Section 2.2.8 and consists of a new dam at the same general location as the existing dam. This alternative is cost prohibitive for the County, especially because the existing dam's life can be extended for an estimated 20 years through implementing some structural upgrades at a substantially lower cost. For these reasons, Alternative 6 is eliminated from further consideration.

2.5 Capital and Operating Costs for Feasible Alternatives

Milwaukee County is responsible for capital, operation, and maintenance costs for Estabrook Dam or the selected alternative. The following is an overview of the capital, operation, and maintenance costs for the dam and alternatives, plus a discussion on the potential funding sources.

The estimated capital and long-term annual operation and maintenance (O&M) costs of the four alternatives (Attachment 9) are as follows:

2.5.1 Alternative 1 – Proposed Action – Rehabilitate the Dam and No Fish Passage

This alternative is identical to Alternative 1A except without fish passage. Refer to Alternative 1A for additional information.

2.5.2 Alternative 1A – Rehabilitate the Dam and Add Provisions for Fish Passage

The operating costs include a dam gate operator who must be available to adjust the gates during high river flows and impending storm events. This is imperative to avoid flooding out upstream property owners during major storm events. Operating costs include routine dam gate maintenance and repair and debris removal, and these operating costs are long-term.

The capital costs include rehabilitation of the dam and adding fish passage. This capital cost is intended to extend the dam life for an additional 20 years. After 20 years, more rehabilitation to the dam can be expected because the dam at that point will be about 100 years old. The anticipated capital costs to rehabilitate the dam in 20 years is unknown, but could be assumed to be in the same range or more than the current proposed capital cost plus inflation. If a new dam is needed, the capital costs would be substantially more than the rehabilitation costs. These are important considerations when comparing the costs to the other two alternatives.

For Alternative 2, there are no future capital or operation and maintenance costs because the dam is removed. For Alternative 4, the rock ramp is not expected to need appreciable capital cost in the future, but some structural rehabilitation to the fixed crest spillway may be needed, but the associated cost would be relatively small. There are some operation and maintenance costs associated with Alternative 4, which are substantially less than Alternatives 1 and 1A.

2.5.3 Alternative 2 – Abandon and Remove the Dam

The capital costs include demolition of the dam and removal. There are no long-term operation and maintenance costs which result in substantial savings to the County. This is the most sustainable alternatives based on costs.

2.5.4 Alternative 4 – Gated Spillway Removed, Serpentine Overflow Spillway Lowered, and a 6.3-Foot High Rock Ramp Constructed

The capital costs include demolition of the dam's gated section and revisions to the rest of the dam. Fish passage is included using the rock ramp.

The operating costs include provisions for debris removal similar to a dam. Provisions to annually move around rocks which may have been altered by ice flows is included, which is conservative because most rock ramps require little such maintenance for moving rocks due to their large size (5 feet, 5 ton boulders are typical). There are smaller rocks involved with the ramp, but tend to be more protected from movement due to the surrounding larger stones.

The following summarizes the estimated capital costs and annual operation and maintenance costs for the alternatives:

Alternative	Estimated Capital Cost	Estimated Annual Operation and Maintenance Cost
1	$2,287,000	$160,000
1A	$3,394,000	$160,000
2	$1,674,000	$0
4	$2,419,000	$55,000

The estimated O&M costs are annual costs and can be expected to increase over time due to inflation. These annual costs are long-term. In addition, these costs will increase the most for Alternative 1A as the dam gets older.

Based on these cost estimates, Alternative 1A, rehabilitating the dam with fish passage, has the highest capital cost and highest annual O&M costs of the four alternatives. Alternative 2, which removes the dam and returns the Milwaukee River to a free-flowing condition, has the lowest capital cost and no annual O&M cost.

2.6 Present Worth Analysis

A present worth analysis considers the capital and O&M costs over a 20-year period to determine the overall project costs for the four alternatives. The annual O&M costs are converted to a present worth based on an inflation rate of 2 percent per year over the 20-year period. The resulting present worth is the theoretical amount of money needed at today's costs to pay for the annual O&M costs over the next 20 years. The total present worth cost is the capital cost plus the present worth of the annual O&M costs over 20 years. The following chart summarizes these present worth costs.

Present Worth Analysis

Alternative	Estimated Total Present Worth Costs
1	$4,903,000
1A	$6,010,000
2	$1,674,000
4	$3,318,000

Based on the present worth analysis, Alternative 1A has the highest total present worth cost. Alternative 2 has the lowest present worth cost and is about $4,336,000 lower in present worth than Alternative 1A. In terms of present worth, Alternative 1A is over three times as expensive as Alternative 2. Alternative 4 is about twice as expensive as Alternative 2, based on present worth. Alternative 1 is nearly three times as expensive as Alternative 2 based on present worth.

2.7 Funding

Milwaukee County has allocated $1,600,000 for dam repair. WDNR's Municipal Dam Grant Program contains funds for repair to the dam (existing structure or rock ramps). The County would need to request a variance to use the money for dam removal, since the County originally indicated the money would be used for repairs. The grant contains criteria for eligibility and has set aside $400,000 with a Milwaukee County cost-share. The Wisconsin Stewardship Fund has set aside $980,717 to the County for dam repair (existing structure and fish passage).

If the County proposes dam removal, the County would need to go back to the WDNR to change the grant applications for the Municipal Dam Grant and Stewardship Fund to reflect dam removal and associated lower costs.

The County has requested funding from three programs for fish passage as follows:

- US Fish & Wildlife Foundation, Sustain Our Great Lakes (SOGL) for $857,000. This grant is a 1:1 match by the County and the project was not awarded a SOGL grant in 2015.

- National Oceanic and Atmospheric Administration (NOAA), Environmental Restoration grant program for $897,000, which includes $40,000 for environmental monitoring after the fish passage installation is completed. This grant is a 1:1 match by the County. The project was not awarded a NOAA grant in 2015.

- US Fish & Wildlife Service, Fish Passage grant program, for $230,000. This grant is still pending as of July 2015, and is a 1:1 match by the County. The grant applies to all alternatives where fish passage is provided.

If a Court were to specifically order removal or repair as a remedy, some funding agencies will not fund the project. However, it appears that such funding would be available if the Court found the remedy to be appropriate, rather than ordering the remedy.

The funding (County allocated funds plus grants) for the capital cost for Alternative 1 is available and covers the cost estimate. The funding for Alternative 1A is available for dam repair only. The County Board has not dedicated funds for fish passage. If funding becomes available for fish passage, the County would be receptive to implementing fish passage.

The funding for Alternative 2 would require resubmitting and amending grant applications for the Municipal Dam Grant Program and Stewardship Fund. The County Board would need to revise their position on the project from dam repair to dam removal and also dedicate funding to dam removal instead of dam repair.

The rock ramp alternative would likewise require resubmitting for state grants. The pending fish passage grant applications would need to be amended. The County Board would need to change their position from dam repair to rock ramp and provide local funding.

The annual operation and maintenance costs for the dam or rock ramp will need to be funded by the County. The County has established a dam maintenance trust fund that receives about $51,000 per year in rental proceeds from television towers located in Lincoln Park. When dam operations would start in 2017, the trust fund will have over $250,000 that can be amortized toward O&M. Given the rental income vs. annual O&M costs, the County will need to budget about $110,000 (current dollars) annually for O&M for the life of the dam, minus whatever is amortized out of the trust fund capital.

The County's cost-share on these grants is summarized as follows:

1. WDNR Municipal Dam Grant – The County cost share is 50 percent of the first $400,000, then 25 percent of the next $800,000, with a maximum grant amount of $400,000 for a $1,200,000 project.

2. WDNR Stewardship Grant – The County cost-share is 25 percent of the eligible costs.

3. US Fish & Wildlife Service – The County's cost-share is projected at $355,000 and the US Fish & Wildlife grant amount is $230,000 for a total project of $585,000.

The annual operation and maintenance costs for the dam or rock ramp will need to be funded by the County. The County presently has a dedicated Estabrook Dam maintenance trust fund as noted above.

3.0 Affected Environment

This section identifies the affected environment of the four feasible Estabrook Dam alternatives in terms of physical environment, biological environment, cultural, socio/economic considerations, archaeological/ historical, and other special resources. Reference documents provided as attachments are identified.

3.1 Maps, Plans, and Other Descriptive Material

A listing of maps, plans, and other descriptive material provided in attachments are as follows.

Attachment 1:	Figure 1 Aerial Map
Attachment 2:	Estabrook Dam Historic Information
Attachment 3:	SEWRPC Technical Memo Dated April 25, 2014 Draft
Attachment 4:	SEWRPC email Dated April 29, 2014 Regarding Estabrook Dam Modeling With the Gates Closed and Stoplogs in Place
Attachment 5:	Excerpts from Lincoln Park/ Milwaukee County River Channel Sediments Phase II Pre-Final Remedial Design Report dated January 2014, prepared by EA Engineering, Science, and Technology, Inc.
Attachment 6:	County Parkways Map
Attachment 7:	Wetland Inventory Map
Attachment 8:	Wetland Related Correspondence
Attachment 9:	Cost Estimate for Alternatives
Attachment 10:	Operation Plan Information
Attachment 11:	Milwaukee River Water Quality Information
Attachment 12:	1937 Aerial Photo of the Dam
Attachment 13:	Historical Land Plat Survey
Attachment 14:	Birds of Estabrook Park
Attachment 15:	US Fish & Wildlife Trust Resources List
Attachment 16:	WDNR Time Extension Correspondence

Attachment 17:	Dam Photographs
Attachment 18:	State Historic Preservation Officer Correspondence
Attachment 19	Public Input
Attachment 20	Fish Passage Information

3.2 Physical Environment

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. 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 3.2 miles upstream at time of full pool and the riverbanks are only a few feet above normal water level.

Sediment Removal Project

Historic industrial activity in the watershed has contaminated sediment with PCB and other pollutants. USEPA, WDNR, and Milwaukee County are implementing Phase II of the sediment removal project to capture sediment from multiple locations from Lincoln Park and continuing downstream to Estabrook Dam. This Phase II began in 2014 and restoration will be completed in 2015. Additional information on this topic is found in Section 1.6.

Hazardous Materials

The sediment removal project involves removal of PCB and CPAH contaminated sediment which is separate from this EIS. No hazardous materials are involved with this project.

River Flows and Water Resources

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. There is development upstream of the dam and property owners within the floodplain who have mortgages are required to carry flood insurance.

SEWRPC's river modeling was performed (Attachment 3) 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.

River flows at Estabrook Dam are summarized as follows (Attachment 3):

- 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 and therefore, is not applicable.

Wetland and Riparian Zones

Wetlands are present within the floodplains of the Milwaukee River. Alternatives 1, 1A, and 4 create an impoundment that can affect the water levels in the wetlands. Alternative 2 will result in lower water depths within the wetlands within the river floodplain.

According to the US Fish & Wildlife Service resources list (Attachment 15), the project area includes the following wetland types:

Wetland	NWI Classification Code	Total Acres
Freshwater Forested/Shrub Wetland	PF01/EMBg	0.5422
Freshwater Forested/Shrub Wetland	PF01 Bg	4.4097
Riverine	R2UBH	662.8964

Regarding the riparian zone, if Alternative 1, 1A, or 4 is implemented, the riparian zones will remain unchanged. If Alternative 2 is implemented, the former impoundment will result in more exposed land. This exposed land is expected to remain in the public domain.

Air Resources

Air resources will remain unchanged under the four feasible alternatives long-term. In the short-term, all four feasible alternatives would have similar air impacts due to construction and/or demolition activities for the alternative. 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.

Global Climate Change

The project will not affect global climate change.

Livestock Grazing

The project will not affect livestock grazing. The land use is primarily urban and park land within the project area and no livestock grazing occurs in this area.

Noise and Odor

Noise will be a short-term issue during construction and/or demolition of the preferred alternative within the construction area and immediate vicinity. Noise will not be an issue long-term with any alternative.

Odor will not be an issue short-term or long-term with any alternative.

Soil Resources

Soil resources will not be appreciably affected by the alternatives. Alternative 1 or 1A will require concrete and stone riprap which means stone, gravel, and sand will be quarried at a commercial site for these materials.

Alternative 2 involves demolition of the dam, so construction materials will not be required. The demolished concrete will be recycled where feasible to be used as aggregate for road projects or other beneficial uses.

Alternative 4 will require stone, riprap, and some concrete work to rehabilitate parts of the dam and to construct the rock ramp. These materials will be obtained from commercial quarries.

3.3 Biological Environment

The biological environment is addressed in terms of aquatic and terrestrial for the alternatives.

3.3.1 Aquatic

The Estabrook Dam is located within the Milwaukee River South Watershed. The 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.[1]

Nearly 15 percent of all perennial stream miles in this watershed are 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. Establishing a natural channel with natural riparian buffer helps create more diverse habitat for biological activities. Where possible, the 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.[1]

Approximately $8 million has been invested to construct fish passages on the Milwaukee River in Ozaukee County to bypass dams. Fish passage is a very important element to the ecosystem because many species of life are dependent directly or indirectly on fish. Fish passage for Estabrook

Dam is important because it is downstream from these fish passages and fish migrating from Lake Michigan must pass through Estabrook Dam or its alternative to reach further upstream.

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.[1]

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.[1]

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 WDNR 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.

Fish Community

The fish found within the Milwaukee River and Estuary are typical of riverine systems in Wisconsin.[2] 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, 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, however, with the dam gates open, some migration is possible. Secondly, this dam is not a true barrier because the dam is submerged during a 100-year frequency flood. The Bridge Street Dam in Grafton was identified by WDNR and US Fish & Wildlife Service as the first complete barrier to aquatic invasive species.[2]

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 Kletsch Park Dam. Fish consumption advisories for the Milwaukee River watershed can be found on the website 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, horneyhead chub, white sucker, creek chub, central mud minnow, and redhorse. 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 not provide 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. The Milwaukee River is classified as a warm water sport fish community per NR 102 and NR 104. Fish passage is a component of all the alternatives, except Alternative 1, and will enhance the fish diversity and fish populations.

Invasive Species

Although Estabrook Dam, located 6.9 miles upstream of Lake Michigan, does obstruct fish movement when the gates are closed and river flow is below flood stage. The dam is not considered a complete barrier to aquatic invasive species (AIS) because the river overtops the dam during floods, as discussed above, and the leaping and swimming ability of Pacific salmon and rainbow trout. The WDNR and USFWS have identified the Milwaukee River, Village of Grafton's Bridge Street Dam, located 32 miles upstream of Lake Michigan, 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 2013, annual fishery surveys at multiple sites between the downstream of the Thiensville Dam and upstream of the Thiensville Dam did not include the capture of Round goby. These results suggest that the presence of Round goby upstream of the Thiensville Dam are the result of human introductions possibly by fisher bait releases.

Endangered, Threatened, and Special Concern Species

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 species legally designated as "Endangered" or "Threatened" as well as species in the advisory "Special Concern" category. There are no federally listed fish species in the Milwaukee River Basin.

Endangered

The striped shiner is the only state-listed endangered fish species that potentially exist or are known to exist in the Milwaukee River.[2]

Striped Shiner

The striped shiner is ranked with a global element of G5 and a state element rank of S1.[2] 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 expiration in Wisconsin. During the mid-1990's, WDNR crews sampled multiple reaches at various times along the Milwaukee River and identified a single specimen from the river in Ozaukee County.[2] 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 greater redhorse, redfin shiner, and longear sunfish.

Greater Redhorse

The greater redhorse is ranked globally as a G3 and has a state-wide ranking of S2S3.[2] These rankings reveal the greater redhorse is either very rare and local throughout its range, found locally abundant in a restricted range, or that other factors may make it vulnerable to extinction throughout its range. The Milwaukee River Basin is one of the most secure populations of greater redhorse in Wisconsin.[2] 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. There is no parental care; eggs are deposited on rock, rubble, or gravel where embryo and larvae develop without parental care. They are considered intolerant of degraded habitat.

Redfin Shiner

The redfin shiner is classified globally as G5 and has a state-wide ranking of S2.[2] These rankings reveal the redfin 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 (Becker, 1983, and Lyons, et al., 2000).[2] 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

The longear sunfish is ranked globally as a G5 and has a state-wide ranking of S2.[2] 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 (Lyons, et al., 2000).[2]

Special Concern

Three state-listed fish species of special concern that potentially exist or are known to exist include the banded killifish, least darter, and lake sturgeon.

Banded Killifish

The banded killifish is classified globally as G5 and state-wide as S3.[2] 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.[2]

Least Darter

The least darter is classified globally as G3 and state-wide as S3.[2] These rankings indicate the fish is either rare and local throughout its range, or found locally in a restricted range. They are rare or uncommon in Wisconsin.

Lake Sturgeon

Lake sturgeon is classified globally as G3/G4 (vulnerable) and state-wide as S3.[2] 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, WDNR observes a lake sturgeon in the Milwaukee River Estuary. Stocking of these fish has been underway near Newburg in Ozaukee County in the Milwaukee River.[2]

Mussels

A recent study was done of the Milwaukee River in the vicinity of the Estabrook Dam, the Milwaukee River Greenway. The study made a qualitative analysis of the 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. Of the 11 species identified, the Elktoe is classified as a species of Special Concern in the state of Wisconsin and the Ellipse is classified as a Wisconsin Threatened Species. The Elktoe is notable because of its status as a species of Special Concern in Wisconsin and it was identified, alive, in the Milwaukee River Greenway. Its' 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.[7]

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 mussel reproduction. This may be due to conditions related to contaminants, low oxygen, silt movement, drought, and temperature change.[7]

The most highly threatened and rapidly declining group of freshwater organisms is mussels (Vaughn and Taylor, 1999[9]). A major factor in the decline of freshwater mussels has been the large-scale impoundment of rivers over the past 75 years (Vaughn and Taylor, 1999[9]). 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 (Vaughn and Taylor, 1999[9]).

Various construction activities within the river can have an impact on the mussel population. Dredging, dam operations and associated fluctuations in water levels, dam removal, shoreline reconstruction, sediment removal, and other activities can negatively impact the existing mussel beds and the resulting population. Restoration of beds should be considered as part of a mitigation plan after such activities. Additionally, translocation and repatriation of mussel species also may be needed.[7]

Macroinvertebrates

No site-specific sampling of macroinvertebrates was performed for Estabrook Dam. SEWRPC[2] determined that riffle habitats contain the highest quality macroinvertebrate communities compared to pool, run, snag, or lake habitats in the Milwaukee River watershed. Habitat types such as lakes, pools, riffles, and runs generally contain very different compositions of substrates, water depths, and flows which affect the abundance and diversity of the macroinvertebrate community.

The Milwaukee River Watershed'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.[2] Eight, or 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.[2]

The five main groups of macroinvertebrates in the trophic structure include shredders, collectors, filterers, scrapers, and predators. The relative abundance of the groups is dependent upon the abundance of food and habitat. The types and diversity of these groups may be used as indicators of certain kinds of stream disturbance or pollution.[2]

The Lower Milwaukee River Watershed, referred to here as south of Ozaukee County, has been undergoing intensive development during the past 70 years, and open space has been declining. Increasing the population and also increasing the impervious surfaces usually results in degrading habitat.[2]

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.

3.3.2 Terrestrial

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 endangered or threatened plant species were found.

General, Federal, and State Sensitive and Threatened and Endangered Plant Species

No known general, federal, and state sensitive and threatened and endangered plant species will be affected by these alternatives.

Noxious and Invasive Weeds

The project involves construction activities within the river. The alternatives are not expected to affect noxious and invasive weeds.

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, beaver, muskrat, river otter, 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. Attachment 14 provides a list of birds observed at Estabrook Park compiled by Charles Hagner of the Friends of Estabrook Park and editor of Bird Watching Magazine.

General, Federal, and State Sensitive and Threatened and Endangered Species

The aquatic general, federal, and state sensitive and threatened and endangered species are presented earlier in this section. The state-threatened Butler's Gartersnake and habitat occur in Milwaukee County, but the dam and alternatives are not expected to affect the snake.

A discussion on the natural heritage inventory screen was performed for the USEPA sediment removal project which extends from Lincoln Park to Estabrook Dam. Refer to Section 4.2.1 for additional information. There were no federal listed threatened or endangered, proposed or candidate species located in the project area that would be affected by the proposed alternatives based on the Natural Heritage Inventory conducted on the USEPA sediment project.

Attachment 15 contains information from the US Fish & Wildlife Service regarding endangered species which could be in the project area. The northern long-eared bat is a proposed endangered species.

Migratory Birds

Migratory birds are found within the project area. Attachment 14 contains a listing of birds observed in Estabrook Park by Charles Hagner, editor of Bird Watching Magazine and a member of the Friends of Estabrook Park. 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 is short-term.

The US Fish & Wildlife Service's list of migratory birds in the project area is found in Attachment 15.

3.4 Cultural Environment

3.4.1 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 right (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 4-1/2 blocks to Lincoln

Park. The right (south) bank of the river at the dam is in private ownership and is currently owned by Wheaton Franciscan Services, Inc.

3.4.1.1 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. Among these activities, deeper drafting motorized boating would be the most impacted by the drawdown of the impoundment, especially during late summer and early fall base- and low-flow river conditions. Canoe and kayak may be limited in some access areas, most notably the upstream limits of the east oxbow with low water depth and the accumulation of debris. Accesses to lands formerly formed by the impoundment are generally accessible by walking, as these former sediments have become compacted, de-watered, and overgrown with vegetation. 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 have used the river for fishing, canoeing, kayaking, and motor boating. When the impoundment was present, these water sports were common. With the dam gates open, the water sports experiencing a decline in use is motor boating almost exclusively by riparians. There are no public launch facilities that also provide suitable parking for vehicle and trailers. Following drawdown of the impoundment, access for launching and landing small personal watercraft is available along accessible shorelines and road crossings.

3.4.2 Visual Resources

The visual resources of the alternatives vary by the alternative and involve personal preference to a degree. Some people prefer an impoundment, while others like a free flowing river.

Alternatives 1, 1A, and 4 create an impoundment that is viewed by some of the public very positively. Alternative 1 or 1A involves a seasonal impoundment from mid-May to mid-September and a partial drawdown for the balance of the year. During the partial drawdown, some mud flats may become exposed and are viewed as a detrimental impact from an aesthetic standpoint. The fill and draw nature of Alternatives 1 or 1A does not allow these shallow areas from developing aquatic vegetation, thereby resulting in mud flats. Secondly, the impoundment promotes sediment accumulation which becomes evident in the exposed mud flats.

Alternative 2 provides a different visual experience than Alternatives 1, 1A, and 4. A free-flowing river is returned with vegetated banks. The existing mud flats will become vegetated naturally.

Alternative 4 will create a year-round impoundment. Mud flats will primarily remain below water level year-round, which improves the aesthetics.

3.5 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 claim to have suffered the loss of recreational use, increased flooding, changed aesthetics, and disproportional loss of property values because the dam gates have been open since 2008.

Milwaukee County population in 2014 is about 953,000. The number of properties that directly benefit from the Estabrook Dam impoundment are about 350 properties. Based on an estimated population of 2.4 people per dwelling (US Census Bureau, Persons Per Household for Milwaukee County for 2008-2012), the 350 properties represent a population of about 840. In addition, the general public directly benefits from the aesthetics of the Milwaukee River and the nearby Estabrook Park and Lincoln Park. The Milwaukee River Parkway intersects the river at multiple locations and provides a scenic overlook of the river.

Downstream from Estabrook Dam is continuation of Estabrook Park, and 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 corridor and plans are underway to extend the hiking/bike trail in both directions from Estabrook Park. The Oak Leaf bike trail runs through Estabrook Park.

Upstream from Estabrook Park is Lincoln Park and primarily residential development in an urban setting. Lincoln Park and Estabrook Park provide an ideal recreation resource for the urban population and is a popular destination for biking, hiking, picnics, fishing, kayaking, canoeing, boating, bird watching, and enjoying nature in close proximity to populated cities and villages.

Section 2.5 contains a discussion of the estimated capital, operation, and maintenance for the feasible alternatives. Potential funding sources are also presented. The total present worth costs for the feasible alternatives is summarized below and further presented in Section 2.6 and Attachment 9.

Alternative	Estimated Total Present Worth Costs
1	$4,903,000
1A	$6,010,000
2	$1,674,000
4	$3,318,000

The results show Alternative 2 is the most cost effective based on a present worth analysis. Alternative 4 is about twice as expensive in total present worth as Alternative 2. Alternative 1 is nearly three times more expensive as Alternative 2 in terms of total present worth. Alternative 1A is over three times more expensive as Alternative 2 in terms of total present worth.

The potential for expanded redevelopment upstream and downstream from Estabrook Dam is possible in properly zoned areas. Upstream from Estabrook Dam, there are pockets of commercial development that could benefit from any of the four feasible alternatives. Most of the upstream property from Estabrook Dam is either park or residential development. The residential development dates back to the 1940s to 1960s in general.

Downstream from Estabrook Dam includes parkland, some commercial, industrial, and residential. The four alternatives present similar opportunities for development downstream. Since the North Avenue Dam was removed from the Milwaukee River formerly located downstream of Estabrook Dam, the surrounding area has seen a substantial redevelopment along the river, including condos, restaurants, and other businesses in the vicinity of the former North Avenue Dam.

3.6 Archaeological/Historical and Paleontological Resources

A report[3] entitled “Phase 1 Archaeological Survey for the Rehabilitation of Estabrook Dam on the Milwaukee River, Milwaukee County, Wisconsin” dated August 2012 and prepared by AVD Archaeological Services, Inc., 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.

AECOM has contacted the State of Wisconsin Historic Preservation Office 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. This statement is dated November 14, 2012, and is based on Alternative 1 Dam Repair (Attachment 18). If fish passage, a rock ramp, or dam removal is proposed for implementation, the State Historic Preservation Office will need to be contacted for additional input on the project. The State of Wisconsin Historic Preservation Officer (SHPO) contacted AECOM on February 13, 2015, to obtain an update on the project. Correspondence is provided in Attachment 18. Milwaukee County retained Mead & Hunt 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, the bridges, and Estabrook Dam were eligible as a historic place and are recorded in the National Register of Historic Places.

Milwaukee County will prepare a Historic American Engineering Record (HAER) study on Estabrook Dam if discussions with SHPO conclude that a HAER study is warranted. If Alternative 1A is selected, a HAER study may or may not be necessary depending on how SHPO views the fish passage as a change to the dam. If Alternative 2 or 4 is preferred, a HAER study will probably be required after discussions with SHPO.

Based on the results of the HAER study, additional steps may be necessary prior to dam modifications (Alternative 1A), or dam removal (Alternative 2) or significant alteration (Alternative 4). The additional steps taken on other dam projects where the dam was listed on the National Register of Historic Places include providing signage or a plaque recognizing the dam as a historically significant structure at the former dam site. The HAER study also includes past design documents for the dam to be a historic record for the structure.

3.7 Other Special Resources

There are no state natural areas or prime agricultural lands associated with this project.

3.8 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, as discussed in Section 1.6. This USEPA project involves WDNR and Milwaukee County and is separate from the Estabrook Dam EIS.

3.9 Environmental Justice

Environmental justice is the fair treatment and meaningful involvement of all people, regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies.

The feasible alternatives provide equal opportunity for the public to enjoy the Milwaukee River. The addition of a public boat launch in the impoundment area is recommended to provide better public access regarding Alternatives 1, 1A, and 4. If Alternative 2 is selected, canoe and kayak access is available in the County parks and at bridges.

3.10 Native American Religious Concerns

The project does not involve a Native American Religious site. Refer to Section 3.6 for additional information.

3.11 Wilderness

The project does not involve a wilderness.

3.12 Forests

The project does not involve forests.

3.13 Lands With Wilderness Characteristics

The project does not involve lands with wilderness characteristics.

3.14 Prime or Unique Farmland

The project does not involve prime or unique farmland.

3.15 Summary of Environmental Resources

The following is an overview of the primary environmental resources addressed for the project and feasible alternatives. Sections 3 and 4 provide specifics for the respective alternatives.

Resources Considered	Affected	Not Affected
Areas of Critical Environmental Concern		X
Environmental Justice		X
Fish Habitat	X	
Prime or Unique Farmlands		X
Fire and Fuels		X
Floodplains	X	
Forests		X
Native American Religious Concerns		X
Wilderness		X
Lands With Wilderness Characteristics		X
Wild and Scenic Rivers		X
Wetland and Riparian Zones	X	
Air Resources	X	
Archaeological / Historical Resources	X	
Paleontological Resources		X
Global Climate Change		X
Hazardous Materials		X
Livestock Grazing		X
Noise and Odor	X	
Recreation Resources	X	
Soil Resources	X	
General, Federal, and State Sensitive and T&E Plant Species		X
Noxious and Invasive Weeds		X
Visual Resources	X	
Water Resources	X	
General, Federal, and State Sensitive and T&E Wildlife Species		X
Migratory Birds	X	
Socioeconomics	X	

4.0 Environmental Consequences

Environmental consequences refer to the probable adverse and beneficial impacts including indirect and secondary impacts. This environmental assessment can draw upon the conditions when the dam was in operation as well as when the gates were open during the period of 2008 to the present to provide actual environmental benefits and negative impacts which could be expected for the four feasible Estabrook Dam alternatives.

4.1 Physical

4.1.1 Alternative 1 – Proposed Action – Rehabilitate the Dam and No Fish Passage

Alternative 1 is the same as Alternative 1A except Alternative 1 has no fish passage. These two alternatives have the same positive and negative impacts except regarding fish passage where Alternative 1 has a negative impact and Alternative 1A has a positive impact. Refer to Alternative 1A for additional discussion on the impacts to Alternative 1 and 1A below.

4.1.2 Alternative 1A – Rehabilitate the Dam and Add Provisions for 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. Refilling the impoundment will change the riverine setting that has been in place since drawdown in 2008. At full pool, the impoundment will extend approximately 3.2 miles upstream of Estabrook Dam. Visual changes will occur from a free flowing river to an impoundment, shallow lake setting. New slope protection both upstream and downstream of the gated dam structure will stabilize and protect the embankment. The sediment from behind the fixed crest spillway and further upstream will be removed as part of the Phase II USEPA Sediment Removal Project in 2015 (Attachment 5).

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 modelled the river based on the 100-year flood and the dam gates being closed to determine the effect on flood elevations. If the 10 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. This situation is a major concern to the County and additional precautions must be taken by the County to protect upstream property owners if Alternative 1 or 1A is implemented as follows:

1. Develop an Inspection, Operation, and Maintenance Plan for the dam to define the conditions and actions to be taken during significant storm events as well as seasonal operation of the dam. Further discussion on the Operation Plan is contained in Section 2.2.2.4 and Attachment 10.

2. Retain a dam gate operator to be available to regulate the dam gates to correspond to high river flows and impending storm events. Predicting significant storm events and high river flows can be a challenge and will require the County to have staff available to continually monitor river and weather conditions. A flood event somewhat greater than a 10-year frequency is large enough to cause upstream flooding equivalent to a 100-year flood if the 10 gates are closed at the time. This can be a huge liability issue to the County.

3. Provide a contingency plan to operate the dam gates in the event of gate malfunction due to a power outage or gate failure.

Long-term impacts include the positive aesthetics of the impoundment extending upstream from West Silver Spring Drive during normal (median) flow conditions.

A buildup of sediment in the impoundment can be expected over the long-term use of the dam. Sediment removal may be required in about 20 years. 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. The impoundment can result in elevated water temperature which can result in lower dissolved oxygen levels.

4.1.2.1 Wetland and Riparian Zone

Alternative 1 or 1A will result in wetlands within the floodplain having a deeper water depth due to the impoundment from mid-May to mid-September. For the balance of the year, the impoundment will be partially drawn down and the wetlands will experience reduced water levels.

Regarding the riparian zone, the impoundment will be in place mid-May to mid-September. The balance of the year the water level will be lower and will include more exposed land. Property owners with boat houses will be able to use these structures for their intended use.

4.1.2.2 Air Resources

Air resources long-term will not be affected under Alternative 1 or 1A. 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.

4.1.2.3 Noise and Odor

Short-term noise can be expected during construction activities. Long-term noise issues are not expected.

4.1.2.4 Soil Resources

Soil resources will not be appreciably affected by Alternative 1 or 1A, but materials such as gravel, sand, and stone will be needed for construction and will be obtained from a local quarry. Long-term soil resources do not apply to this alternative.

4.1.3 Alternative 2 – Abandon and Remove the Dam

The dam removal will return the river to a natural, free-flowing state. Dam demolition is a short-term condition which can result in dust, noise, and traffic congestion during the construction related activities. Best management practices for stormwater will be used during construction activities.

A buildup of sediment is not expected because the river is free-flowing. The aesthetics of the river will be similar to the existing conditions. Some woody vegetation and shrubs have developed along the river edge which can restrict debris. Where appropriate, this additional riverbed/bank vegetation has been accounted for in the floodplain modeling and, in the opinion of SEWRPC staff, would represent an insignificant barrier to floating ice and large debris.

The North Avenue Dam was removed and returned to a free-flowing river. This dam removal is viewed by environmentalists and the general public as a very positive action. River aesthetics are improved, development along the river including condominiums and retail establishments has greatly expanded, and fish diversity and populations have likewise been well documented. The vegetation also provides wildlife habitat along the Milwaukee River environmental corridor.

Alternative 2 is capable of handling the 100-year frequency flood. This alternative actually lowers the 100-year flood elevation as compared to Alternative 1 or 1A. No County staff is needed during a flood to operate dam gates or to remove debris as is the case with Alternative 1 or 1A. Alternative 2 provides a simpler, lowest cost, sustainable solution.

4.1.3.1 Wetland and Riparian Zone

Alternative 2 will result in wetlands within the floodplain to experience water levels similar as observed since 2008. As the river levels fluctuate, water levels within the wetlands will likewise see some fluctuation in water depth.

The riparian zone will experience more exposed land by removal of the dam. These exposed areas will continue to become vegetated with grasses, shrubs, and trees. Property owners with motor boats and boat houses will no longer be able to use their motor boats due to the shallower water, but use of canoes and kayaks will continue for the long-term.

4.1.3.2 Air Resources

Air resources long-term will not be affected by Alternative 2. In the short-term, air quality could be affected due to dust during demolition of the dam within the vicinity of the construction work.

4.1.3.3 Noise and Odor

In the short-term, noise can be expected during demolition of the dam if a person is in the vicinity of the construction zone. In the long-term, noise will not be an issue. Odor will not be an issue in either the short-term or long-term.

4.1.3.4 Soil Resources

Soil resources will not be an issue. Demolition of the dam will result in concrete that can be recycled for aggregate for road projects and thereby avoid the need to mine a comparable amount of aggregate.

4.1.4 Alternative 4 – Gated Spillway Removed, Serpentine Overflow Spillway Lowered, and a 6.3-Foot-High Rock Ramp Constructed

Alternative 4 requires the gated section of the dam to be removed, and a rock ramp built, and the fixed crest spillway lowered resulting in short-term impacts due to dust, noise, and traffic congestion during construction. Best management practices for stormwater will be used during the construction activities.

A buildup of sediment in the impoundment can be expected over the long-term use of the rock ramp. Sediment removal in the vicinity of the dam may be necessary long-term. Frequency of sediment removal is not known, but may be an event performed approximately every 20 years.

The rock ramp is intended to perform similar to the natural rock ledge which created an impoundment prior to the dam being constructed. The impoundment will extend to West Silver Spring Drive, but not quite as deep as Alternative 1 or 1A. Alternative 1 or 1A extends to 0.7 miles upstream from West Silver Spring Drive. The aesthetics of Alternative 4 will be similar to a shallow lake.

The rock ramp creates a flow condition similar to a natural pool and riffles which avoids the operation and maintenance associated with the dam. The rock ramp does not allow for lowering the water levels as in the case of a dam. The flashboards will remain in place under normal operating conditions. The County will have the option to remove the flashboards to lower the impoundment for maintenance purposes such as removal of debris or sediment removal. The flashboards could lower the impoundment by about 2.4 feet for this alternative.

Water levels for Alternative 4 are further discussed in Section 2.2.6. An operation, inspection, and maintenance plan and an emergency action plan must be developed, and an owner inspection would be required every 10 years.

Debris removal such as trees and brush will be required annually when it collects on the rock ramp or behind the fixed crest spillway. This debris removal is similar to the conditions with Alternative 1 or 1A.

O&M costs associated with Alternative 4 are primarily with debris removal. O&M costs are also included to annually reposition rocks and boulders for the rock ramp if the boulders and stones get moved by ice flows or floods. This matter was discussed with Luther Aadland of the Minnesota DNR who wrote the book "Reconnecting Rivers: Natural Channel Design in Dam Removals and Fish Passage."[1] Mr. Aadland provided the following comments on rock ramps:

1. Debris maintenance for rock ramps is similar or less than maintenance on a dam because the debris tends to flow over the rock ramp when higher flows occur.

2. Moving rocks or boulders annually to reposition after spring floods or ice flows have not been a problem because the boulder size is typically 5 feet weighing 5 tons and, therefore, not susceptible to movement during floods. Smaller rocks are also part of the ramp, but are more protected in the pools by the larger boulders during floods or ice flows.

3. Rock ramps are not intended for high head dams due to the massive amount of rock required to build the ramp. High head dams refer to dams being 30 to 40 feet high. Alternative 4 having a 6.3-foot high rock ramp can be readily accomplished.

4. Mr. Aadland has been personally involved in over 75 rock ramp projects throughout the United States and the ramps have been very successful in providing replacements to conventional dams, providing an impoundment, providing recreational opportunities, and fish passage with less cost than a conventional dam (less capital and O&M costs). In some cases, the ramps provide fish passage around existing dams.

5. The rock ramps tend to be a safer environment than a conventional dam which can create powerful currents immediately downstream from the dam, which has been the reason for drownings at some dams.

6. The rock ramps provide fish passage and thereby enhance the fish diversity and population. Mussels and other aquatic creatures likewise benefit.

7. Design features should take into account other species. For example, larger spaces in riprap can create potential traps for turtles. Therefore, these openings should be filled in with smaller stones to protect the turtles from getting stuck in the riprap.

The aesthetics of the river will be similar to when the dam gates were closed, but the impoundment will not be quite as deep as Alternative 1 or 1A.

The river will look more natural after the dam is partially removed. The rock ramp will typically be submerged and will resemble natural riffles.

Alternative 4 provides capacity to handle the 100-year frequency flood. No County labor is necessary to open gates during floods. This is a huge advantage for the County as compared to Alternative 1 or 1A which has potential liability to the County if the gates are not opened in time or if the gates malfunction during a major flood event (15-year flood or greater).

The rock ramp provides a year-round recreational impoundment with relatively stable river levels. The impoundment tends to increase water temperatures which can result in lower dissolved oxygen levels.

4.1.4.1 Wetland and Riparian Zones

Alternative 4 will cause the wetlands within the floodplain to have a deeper water depth due to the year-round impoundment.

Regarding the riparian zone, the impoundment will result in a shallow lake. The property owners with boat houses will be able to use these structures for their intended use.

4.1.4.2 Air Resources

Air resources long-term will not be affected under Alternative 4. During construction at the rock ramp, some dust will result, but will be short-term and primarily limited to the vicinity of the construction zone.

4.1.4.3 Noise and Odor

Short-term noise will result during construction activities in the vicinity of the construction zone. Long-term noise issues are not expected. Odor will not be an issue in either the short-term or long-term.

4.1.4.4 Soil Resources

Soil resources will not be appreciably affected by Alternative 4, but materials such as stone will be needed to build the rock ramp. The gated section of the dam will be demolished and the concrete will be reused as the base of the rock ramp and then stones placed over this reused broken concrete. Long-term soil resources do not apply to this alternative.

4.1.5 Physical Resources – Not Applicable

The following physical resources do not apply to these alternatives as discussed in Section 3.

- Hazardous Materials
- Wild and Scenic Rivers
- Livestock Grazing

4.2 Biological

Biological impacts refers to the wildlife, fisheries, water resources, water depth, plant community, and endangered resources. The impacts are presented as follows.

4.2.1 Wildlife

Wildlife will be displaced to other available habitat in the Milwaukee River environmental corridor when the impoundment is filled for Alternatives 1, 1A, and 4. Alternative 2 will not affect the wildlife because it is very similar to the conditions that existed since 2008. During construction/demolition work, wildlife will be temporarily disrupted until the work is completed for all alternatives.

Aquatic habitat will change under Alternatives 1, 1A, and 4 with a deeper pool. For Alternative 2, the aquatic habitat will be very similar to the conditions that existed since 2008.

No comprehensive surveys of turtles and herptiles have been completed for the Milwaukee River in the vicinity of Estabrook Dam. Snapping turtles, painted turtles, bullfrogs, and green frogs are expected to inhabit the area. Care will be provided during design of Alternatives 1, 1A, or 4 where riprap is proposed to minimize the spaces between the rocks that could potentially trap turtles. These spaces between the rocks will be filled in with smaller stone where possible.

A natural heritage inventory screen was performed for the USEPA sediment removal project which extends from Lincoln Park to Estabrook Dam. This project area includes two sites for Butler's gartersnake and incidental take authorization was provided by WDNR Bureau of Endangered Resources. The following is expected from the Sediment Removal project Environmental Assessment:

> "Based on the information submitted to our office, we have evaluated the proposed site according to the criteria of the Butler's Gartersnake Conservation Strategy (http://dnr.wi.gov/org/land/er/review/Butler). Due to the size and quality of suitable Butler's gartersnake habitat, the project was classified as containing a portion of two Tier 1 Sites (Site of Minimal Conservation Value). The sites were on the southern boundary where there appears to be wetland as well as along the eastern boundary in a small non-agricultural section. As a result, the site is covered under the broad Incidental Take Authorization for Tier 1 Butler's Gartersnake sites (http://dnr.wi.gov/org/land/er/take/TierOneButlers.htm). Per the authorization, no conservation measures are required for the state-listed snake and any take that results from the proposed project is covered. However, it is recommended that the voluntary measures described within the above Strategy be incorporated into the project design to benefit the snake at the site."

Based on the Natural Heritage Inventory (NHI), there are no federal listed threatened or endangered, proposed or candidate species located in the project area that would be affected by the proposed alternatives.

4.2.1.1 General, Federal, and State Sensitive and Threatened and Endangered Species

There are no known general, federal, and state sensitive threatened and endangered plant species that will be affected by these alternatives.

The northern long-eared bat is a proposed endangered species as reviewed by the US Fish & Wildlife Service and is further discussed in Attachment 15. Also, the state-threatened Butler's Gartersnake habitat occurs in Milwaukee County, but the dam and alternatives are not expected to affect the snake. Based on the Natural Heritage Inventory conducted on the USEPA sediment project, there were no federal listed threatened or endangered, proposed or candidate species located in the project area that would be affected by the proposed alternatives.

4.2.1.2 Migratory Birds

Migratory birds may experience some disruption during the construction period with any of the alternatives, but this impact is short-term during the construction. Long-term impacts to migratory birds are not expected with any of the alternatives.

4.2.2 Fisheries

The removal of contaminated sediment and debris will improve the health of the impoundment and fishery as part of the Sediment Removal Project, as discussed in Section 1.6. The drawdown of the impoundment should have positive impacts as the result of dredging of contaminated sediment, sediment compaction, and decreased plant density as a result of the drawdown. 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.

All feasible alternatives except Alternative 1 will allow fish passage which should increase the diversity and population of fish and will create a more natural environment. Recreational fishing opportunities will exist with alternatives and will be enhanced with alternatives providing fish passage.

The fish passage proposed under Alternatives 1A and 4, and the free-flowing river condition of Alternative 2, will increase the probability of developing sustainable populations of lake sturgeon and walleye within the waters. Recreational fishing opportunities would be greatly expanded along the river. Alternative 1 has no fish passage, which is a major negative impact to the aquatic life including fish and mussels.

The fishway provided with Alternatives 1A, 2, or 4 will contribute to creating self-sustaining populations of native Lake Michigan and Milwaukee estuary by enabling potamodromous lithophilic and phytophilic spawning fish to access historic spawning and nursery habitats including game fish (e.g., walleye, northern pike, smallmouth bass), and non-game fishes (e.g., white and longnose sucker, and shorthead, silver, golden, and greater redhorses). Barriers to fish movement, among other factors, are identified as limiting the distribution and long-term survivability of state listed species in the Milwaukee AOC including the endangered striped shiner, and threatened redfin shiner, greater redhorse, and longear sunfish. Lake sturgeon is listed as a state listed special concern species and is on the USFWS Region 3 Conservation Priority List (Rare/Declining species).

It is anticipated that the fish passage project will 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 very limited (about 1 acre), so the fish passage would substantially increase the spawning and nursery habitat. The fishway will expand and enhance water-based recreational activities including canoeing, kayaking, fishing, and wading as evidenced by ongoing user surveys.

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 Wisconsin Department of Natural Resources (WDNR) 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; Warzyn, 2014). Ecologically and recreationally important species possessing strong spawning migratory behavior that would benefit from removal of barriers include 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). Within the boundaries of the Milwaukee AOC state listed species of conservation need include the endangered striped shiner and threatened redfin shiner, greater redhorse, and longear sunfish.

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 (WDNR, http://dnr.wi.gov/topic/fishing/lakemichigan/lakesturgeon.html, USFWS, http://www.fws.gov/midwest/sturgeon/index.htm. The Milwaukee River is one of two Wisconsin rivers with ongoing lake sturgeon rearing facilities where Lake Michigan train lake sturgeon gamets from the Wolf River are developed, imprinted, and released to the Milwaukee Estuary and 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 fractured bedrock.

Juveniles must have unobstructed return access to the estuary and Lake Michigan for feeding and growth. Juvenile lake sturgeons from previous stockings have been captured from the Milwaukee River during false spawning runs and elsewhere in the estuary. WDNR anticipates previously stock 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 (Rare/ Declining species) (WDNR, 2005).

The impoundment created by Alternatives 1, 1A, and 4 will increase the water temperature. Higher water temperatures can adversely affect some fish species, especially cold water species such as trout. Alternative 2 provides better conditions for the fish by minimizing water temperature increases.

The impoundment created under Alternative 1, 1A, and 4 can increase the water temperature and thereby reduce the dissolved oxygen content which can affect fish species. Some fish species such as carp are more tolerant to higher water temperatures which can result in carp dominating the fish population. When this occurs, carp commonly uproot the vegetation and stir up the sediment resulting in muddy water within the impoundment which also reduces the aesthetics of the pool. These are all negative impacts which can be long-term.

The following is excerpted from the Sediment Removal project Environmental Assessment:[6]

> "The only other species (Butler's gartersnake) that came through in the NHI screen was the state-threatened greater redhorse. The WDNR Regional Ecologist suggested that we use methods to minimize disturbance to potential spawning areas and that we limit the use of rock in the waterway to the extent possible. The site areas are sediment deposition areas and not known to currently provide spawning habitat for the greater redhorse. Rock will be used for

> toe protection in high erosion areas along Lincoln Creek and some of the oxbow, and the rock spaces will be filled with granular material to avoid potential pitfall areas for other species."

The greater redhorse prefers clean water of medium to large rivers, over bottoms of sand, gravel, or boulders. Spawning occurs in May or June. The greater redhorse spawns over substrate consisting of gravel with mixtures of sand and small rubble in moderate to swift currents. It generally feeds on a diet of aquatic insects, mollusks, crustaceans, and plant material (Becker, 1983).[1]

Construction of Alternatives 1, 1A, and 4 could cause disruption to the greater redhorse spawning if this fish is present at Estabrook Dam and is spawning at the time of construction. If this occurs, it is probable that the fish will temporarily relocate to spawn in another nearby area of suitable habitat. The fish passage construction may enhance the river for this fish to spawn here in the future.

During demolition of the dam (Alternative 2), the greater redhorse would also be temporarily displaced if it is found near Estabrook Dam. The displacement of this fish would only occur during the demolition period.

WDNR proposes to require dam related construction activities to be done outside of the red horse spawning period in spring. This restriction would apply to all dam alternatives. Typically, the river flows are higher in spring and construction is delayed until the river flows return to normal. Normal river flow is preferred during construction to reduce the potential to overtop the coffer dam.

4.2.3 Mussels

The most highly threatened and rapidly declining group of freshwater organisms are mussels (Vaughn and Taylor, 1999[9]). A major factor in the decline of freshwater mussels has been the large-scale impoundment of rivers over the past 75 years (Vaughn and Taylor 1999[9]). 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 (Vaughn and Taylor, 1999[9]).

Dams can have negative impacts on the indigenous mussel population in a river environment. The Estabrook Dam can be expected to have similar negative impacts on the mussel population in the Milwaukee River. Dean[8], et. al. (2001), states that freshwater mussels have been devastated in North America due to dam impoundments on rivers. Dams change the physical, chemical, and biological aspects of rivers by restricting the movement of fish, altering flow regimes, increasing siltation upstream and from scouring downstream from the dam[8]. Periodic opening of gates can result in slugs of silt moving downstream from the dam and impacting mussels. The results are the mussel population gets fragmented by the dam, which can alter fish populations and restrict the migration of host fish for the mussels[8].

Dams affect the dispersion and life cycle of mussels by inhibiting the movement and migration of the host fish species, thereby restricting the dispersal and distribution of mussels.[8] An integral part of the mussel life cycle is the host fish. The glochidia (mussel larvae) attach themselves through various means to a host fish which will then carry the larvae until they form into juveniles and drop off. Dams may create a barrier for the host fish preventing longitudinal migration. The lack of migration, in turn, adversely affects the dispersion and distribution of mussel species throughout the river system.[8] Fish passages may allow the host fish to migrate more freely, alleviating these negative effects to the river system.

The impoundment created by a dam can have adverse effects as well. The river section below impoundments differs significantly from free flowing-rivers. These effects include altered seasonal timing of flow and temperature regimes, changes to patterns of scour and deposition of sediment, and altered transport of particulate organic matter, food base for mussels.[9] The altered seasonal timing of flow can result in abnormally high or low flows, sometimes on a daily basis. These flows can often occur at the “wrong” time of year.

Seasonal drawdown for Alternatives 1 or 1A could have a detrimental impact to aquatic life, especially mussels, unless the drawdown is reduced to a level that does not harm the aquatic life. Removing the stoplogs at the dam lowers the water level by 3 feet and still provides sufficient water for the mussels and other aquatic life to function. This water level is significantly higher than a complete drawdown with all 10 gates open. Dam operation with the stoplogs removed and 10 gates closed appears to be protective to the aquatic life.

A discharge that is either high during the wrong season or high too frequently can have devastating 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. The erosion and scour also results in an altered distribution of sediment. Increased sediment deposition can clog mussel siphons and gills which interferes with feeding and reproduction.[9] WDNR code limits lowering the impoundment levels to a maximum of 6 inches per day to be protective to the aquatic life.

A discharge 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 (mussels lack the ability to regulate their body temperature). 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;[15] both of which have a detrimental effect on the mussel population and reproductive potential as a whole. Mussels are limited to travel about 12 inches per day, so rapid changes to impoundment levels can be detrimental to mussels and should be avoided.

In summary, the seasonal drawdown associated with Alternative 1 or 1A levels must be managed to be protective of mussels and other aquatic life.

The impoundments created by Alternatives 1, 1A, and 4 can impact mussels through siltation and through the buildup of sediment within the impoundment. Alternative 1 or 1A can also affect mussels by the sudden release of sediment when the dam gates are opened which can affect mussels downstream from the dam. The fish passage features will allow fish to travel, which will allow mussels to find host fish. Alternative 2 is the most environmentally compatible solution for mussels.

4.2.4 Water Resources

4.2.4.1 Alternative 1 – Rehabilitate the Dam and No Fish Passage and Alternative 1A – Rehabilitate the Dam and Add Provisions for Fish Passage

Alternative 1 or 1A will include seasonal drawdowns. The operation plan for Alternative 1 or 1A is discussed in Section 2.2.2.4 and additional information is contained in Attachment 10.

A seasonal drawdown is proposed to start filling no earlier than May 15 and have the drawdown complete no later than September 15. The 10 gates are open to accomplish the partial drawdown, but will be closed after the desired impoundment level is reached. Refer to the Operation Plan for additional information.

The seasonal drawdown is initiated in mid-September to allow the ecosystem to adjust accordingly before winter arrives. This approach reduces the potential for certain species being caught off guard such as turtles, which could be affected if they began to hibernate, then the impoundment was lowered resulting in freezing out many species.

In mid-May, stoplogs will be installed to create a full impoundment.

The May 15 start to filling the impoundment could affect nesting waterfowl. If this is an issue, a later date to initiate filling the impoundment may be more appropriate.

The seasonal drawdown is proposed to reduce the potential of ice damage to the gates.

The seasonal drawdown can better accommodate ice flows in late winter/early spring. The seasonal drawdown also provides an opportunity for the County to remove debris, make repairs on the dam, for property owners to make repairs on their waterfront, and for communities to make improvements, if needed, to the storm sewer structures where they discharge at the river.

4.2.4.2 Alternative 2 – Abandon and Remove the Dam

This alternative restores the river to a natural free flowing condition with the fluctuations in water levels and river flows over time. No seasonal drawdowns are necessary. The river will self-regulate, thereby saving the County time and money because there is no maintenance. The fish and other aquatic species will benefit from genetic diversity and increased populations. Fish passages associated with Alternatives 1A and 4 are beneficial features, but can be species selective or species exclusionary. A free-flowing river is the most positive approach to guarantee fish travel.

4.2.4.3 Alternative 4 – Gated Spillway Removed, Serpentine Overflow Spillway Lowered, and a 6.3-Foot-High Rock Ramp Constructed

This alternative is similar to riffles which allows fish passage and provides a shallow impoundment in a natural setting. The alternative is a sustainable solution requiring no labor to operate gates as is the case with a dam (Alternative 1 or 1A). The disadvantages are that the impoundment is not as extensive as the dam in place and the gates closed provides swimming, canoeing, and boating opportunities extending up to West Bender Road. Another disadvantage is the impoundment cannot be drawn down as is the case with a dam, but is similar to a natural lake which likewise cannot be drawn down.

This alternative provides fish passage and has been implemented on over 75 projects throughout the United States. The fish passage promotes fish diversity and likewise enhances other species such as mussels, which use fish as hosts.

This alternative will increase water temperature as compared to Alternative 2. Increased water temperature in an impoundment can be detrimental to some fish species. During prolonged hot weather, fish die-offs could occur if water temperatures get too high, and dissolved oxygen is reduced due to the water temperature. This potential condition relates to Alternatives 1, 1A, and 4, but is less likely to occur with Alternative 2.

4.2.5 Water Depth

Water depths are discussed in Section 2 for the four feasible alternatives. The environmental impacts regarding water depths for the alternatives are summarized as follows:

Alternative 1 or 1A: An impoundment will allow for recreational opportunities including boating. The impoundment extends to 0.9 miles upstream of West Silver Spring Drive. Aesthetically, the impoundment will resemble a shallow lake that will extend about 2.8 miles.

Alternative 2: A free flowing natural river will be restored. Water depths will provide opportunities for canoeing, except during dry periods.

Alternative 4: The rock ramp will create a shallow impoundment which extends to 0.7 miles upstream of West Silver Spring Drive (2.6 miles from Estabrook Dam). Recreational opportunities include canoeing and boating. The impoundment depth will be about 1.2 feet shallower than the Alternative 1 or 1A impoundment. This alternative is an opportunity for recreation and aesthetics similar to Alternative 1 or 1A but without the expensive operation and maintenance costs associated with a dam. Some maintenance costs can be expected with Alternative 4 if logs get caught on the rock ramp, though the rock ramp can better accommodate logs than the dam. Some sediment removal can be expected over a couple decades with this alternative.

4.2.6 Plant Community

No Federal or State-designated Special Concern, Threatened, or Endangered plant species were found during observations of the site. Some shifts in plant community types and population can be expected for Alternatives 1, 1A, and 4 when the impoundment floods out current plant communities. The impoundment will create more aquatic plant communities to replace the terrestrial plant communities.

4.2.6.1 Noxious and Invasive Weeds

The project activities for all alternatives are primarily within the river. These alternatives are not expected to affect noxious and invasive weeds.

For Alternative 2, plant communities will be very similar to the existing communities that have been established since 2008.

4.2.7 Endangered Resources

A State-designated Endangered fish, the Striped Shiner, and two State-designated Threatened fish, Greater Redhorse and Longeared Sunfish, are known to occur in this reach of the Milwaukee River. In addition, suitable habitat may be present for the State-designated Threatened Butler's Gartersnake. This species was recently delisted as Threatened by the DNR. A State-designated Special concern mussel, the Elktoe, was found in the impoundment. All four alternatives are not expected to have a long-term effect on the Butler's Gartersnake. Alternative 1 and 1A are not expected to have an effect on the Elktoe mussel because the impoundment level even with a seasonal drawdown by removing the stoplogs is expected to be sufficient to maintain water levels for mussel habitat. If a lower seasonal impoundment was chosen, the mussels could be impacted, but that is not the plan. Alternative 4 is not expected to affect the mussels. Alternative 2 is not expected to affect this mussel because a free-flowing river will occur. Some disruption to this species may occur during construction work at the dam for all alternatives. WDNR will not allow construction to occur during the redhorse spawning period in spring. Refer to Section 3.3 for additional discussion on endangered resources.

4.3 Cultural

Cultural impacts refer to the land use, social and economic elements, and archaeological and historical aspects of the project and area.

4.3.1 Land Use

In general, the current land uses in the area are expected to continue with any of the four dam alternatives. The area is primarily developed. Some redevelopment may arise as a result of implementing any of these alternatives, and because the river sediment cleanup project will be completed in 2015. Redevelopment in the vicinity of the former North Avenue Dam has occurred and can be contributed to improved river conditions coupled with its proximity to the City of Milwaukee's downtown and popular east side neighborhoods.

4.3.1.1 Recreation

Specific impacts for the four alternatives are as follows.

Alternative 1 or 1A: The impoundment will provide more boating opportunities due to the deeper water depth than the other two alternatives. Some residents prefer the aesthetics of the impoundment as compared to a river. The alternative requires a canoe portage around the dam site, which is already established. The public is able to use the impoundment from mid-May to mid-September for boating, canoeing, and kayaking without the attention to low or high river flow affecting their recreational use. The public can travel upstream or downstream on the impoundment without the concerns of river current. The impoundment will continue to have a current, but the effect is less in an impoundment especially under normal river flow. These are advantages with the impoundment as compared to a free-flowing river.

Boat access to the impoundment is currently limited to a boat launch and if this alternative is selected, a public boat launch would be beneficial from a recreational standpoint. The existing boat launch is located at the end of a street with very limited parking. Canoe access is possible at the parks and near bridges.

Alternative 1 or 1A will contribute to the development of mud flats in the impoundment area which acts as a large settling basin where sediment will collect. Mud flats are common in rivers and can be created by the natural processes such as deposition in the river, but the impoundment promotes the settling of particles in the pool.

Alternative 2: Canoeing opportunities are available. The river is restored to its natural condition which has its own aesthetics which are enjoyed by many. Though canoeing and kayaking opportunities would exist with Alternative 2, the actual time when these recreational activities can occur are more limited than with Alternatives 1, 1A, and 4. When river flows are high, it can limit recreational activities to only those experienced canoe or kayak enthusiasts. During lower river flows, there may be limited opportunities because the crafts encounter protruding rocks. These natural restrictions on recreational use of the river are common and accepted by most people who enjoy the river experience.

Alternative 2 offers an abundance of positive environmental impacts beyond recreation. It is significantly better for the fish and mussels, provides aesthetics that differs from an impoundment but is very scenic in other ways. Other sections contain additional information on the positive attributes of Alternative 2.

Alternative 4: This rock ramp provides an impoundment that is shallower than Alternative 1 or 1A. Boating and canoeing opportunities will exist for three seasons and extend up to West Silver Spring Drive. In winter, the impoundment can provide hiking, cross country skiing, ice skating, and ice fishing opportunities. Aesthetics for an impoundment will be created as well as the aesthetics of riffles at the rock ramp in Estabrook Park. This alternative may require a canoe portage around the rock ramp site.

Alternative 4 will result in mud flats over time as the sediment settles out in the pool. The year round impoundment is anticipated to keep these mud flats submerged.

As noted under Alternative 1 or 1A, a public boat launch is recommended to increase public access for Alternative 4. Fishing opportunities will exist with all three alternatives which provide fish passage. Alternative 1 does not provide fish passage. Fishing is a popular activity on the Milwaukee River and the fish passage will enhance the fishing opportunities.

The recreational use of the impoundment can be year-round, when winter sports are considered, and is a major advantage of Alternatives 1, 1A, and 4. Alternative 2 provides recreational use of the river when the flows are sufficient.

4.3.1.2 Visual Resources

The visual resources differ among the four alternatives. Alternative 1 or 1A provides an impoundment which will resemble a small lake for the period of mid-May to mid-September. An impoundment about 3 feet lower will be present for the balance of the year.

Alternative 2 results in the aesthetics of a free-flowing river. The former impoundment became vegetated over time and creates a natural setting.

Alternative 4 creates a year-round impoundment. Vegetation around the impoundment will create a natural setting along most of the river. Mud flats will not be observed because they will be submerged.

Areas downstream from the dam are expected to remain unchanged regardless of the alternative unless some redevelopment would occur in the future.

4.3.2 Socio/Economic

The bulk of the work for the dam rehabilitation will occur in Estabrook Park, the central river island and property on the right (south) bank of the river owned by Wheaton Franciscan Services, Inc. Easements to access these non-County-owned properties will be obtained from those owners prior to the initiation of construction. No ethnic group or cultural group will be affected by any of the dam alternatives. Zoning will not be impacted by any of the alternatives.

The economics of the alternatives are presented in Section 3.5 and Attachment 9. Potential funding sources are available to address a portion of the capital costs. The actual funding will be determined at a later date based on the funding criteria and actual project specifics. Long-term O&M costs will be the responsibility of Milwaukee County taxpayers.

Alternative 1 has the second highest total present worth cost. Alternative 1 is about three times more in total present worth costs as Alternative 2.

Alternative 1A has the highest capital cost to rehabilitate the dam and to add fish passage. Alternatives 1 and 1A have the highest long-term annual O&M costs of the four alternatives.

There are about 350 property owners who directly benefit from the impoundment and these properties are located upstream from the dam. Additional people in the vicinity can enjoy the aesthetics of the impoundment. Lincoln Park and Estabrook Park users also benefit from the impoundment if the users view the impoundment as a benefit as compared to a free-flowing river, as provided under Alternative 2.

The total present worth of Alternative 1A is over three times higher than Alternative 2. These present worth costs reflect the long-term cost impacts associated with operation and maintenance of a dam.

Alternative 2 has the lowest estimated capital cost, no O&M cost, and lowest present worth of the four alternatives. From a Milwaukee County taxpayer standpoint, Alternative 2 is the most promising.

Alternative 4 has estimated capital costs slightly more than but similar to Alternative 1. The long-term annual O&M costs for Alternative 4 are significantly less than Alternative 1 or 1A because there are no dam O&M costs with Alternative 4. The total present worth of Alternative 4 is about $3,318,000 as compared to Alternative 1 at $4,903,000, Alternative 1A at $6,228,000, and Alternative 2 at $1,674,000.

Overall, Alternative 2 is the most cost-effective option of the four alternatives. Alternative 2 is about half the total present worth cost of Alternative 4 and is about one-third the total present worth cost of Alternative 1 or 1A. These cost savings over the 20-year period are substantial for Alternative 2 as compared to the other alternatives. In addition to the cost savings, Alternative 2 provides environmental benefits of a free-flowing river. As previously discussed, the North Avenue Dam removal has been a success story for Milwaukee and the area. Implementing Alternative 2 can have similar positive results.

A study of more than 30 removed dams of Wisconsin's 3,600 small dams provide the following findings (Born et al. 1998)[12]:

1. Dam removal has been complex and contentious with limited community-based support for removal and loss of the impoundment.

2. In the case study of 30 removed dams, the estimates costs of repairing the dam averaged more than three times the cost of removal.

3. Governmental funding and financing is a key factor in the dam removal determination.

4. Watershed ecological considerations are typically not a major factor for most local communities.

5. Watershed management and restoration increasingly incorporate dam removal options as part of an integrated approach.

Removal of the dam under Alternative 2 will impact property owners along the river in terms of the private boat houses, sea walls and related infrastructure. Boat houses will no longer be viable to store the boats to access the river because the river depth will be too low for boat operation for most of the year. The sea walls will no longer be needed due to the reduced water depth.

Municipalities may need to do some improvements to their storm sewer outlets at the river under Alternative 2. In most cases, the outlet will continue to function as is. In some cases, additional rip rap may be necessary to route the storm water discharge to the river. From a function standpoint, the storm sewer system may operate better due to lower flood levels and less concern with storm sewer backups on City streets.

Redevelopment along the Milwaukee River both upstream and downstream from Estabrook Park could occur through implementing any one of the four feasible alternatives and because of the USEPA's ongoing sediment cleanup project which will be completed in 2015. Redevelopment has occurred along the Milwaukee River in other areas.

4.3.2.1 Dam Removal Impacts on Property Values

Removal of the Estabrook Dam is expected to have little impact on property values in the area surrounding the existing waterway and current impoundment. Property values, real and assessed, are a significant concern for property owners and taxing authorities. Although little research has been focused on assessing the impacts of dam removal and loss of impoundment on property values, preliminary studies have indicated that riparian property values (after dam removal) have remained unchanged or decreased temporarily with a rebound within 2 years. After 10 years, property values showed no difference from the value prior to dam removal (Sarakinos[4], et. al., 2003). Based upon sales market data between 1993 and 2002, comparison of residential properties in south-central Wisconsin where a small dam remains intact, a small dam was removed, and the river or stream has been free-flowing for more than 20 years, indicate that there is no noticeable increase in property price between properties with shoreline frontage along a small impoundment and properties along a free-flowing river or stream. In fact, if the properties retain frontage on the stream, there is no significant change in property price, except for an increase related to the increase in lot size, after the stream has returned to a free-flowing riparian state (Provencher[5], et. al., 2006).

The rebound and potential for increased property values may be related to the desire of potential property buyers for homes with larger lot size, near free-flowing rivers as opposed to properties with less land area near impoundments. The potential for improved water quality and reduced flood risk may also create an increase in the intrinsic value of properties along free-flowing streams as opposed to man-made impoundments. Property adjacent to any water body (stream or impoundment) has a perceived, inherent value. It appears that over time the differences in value between riparian or lake frontage may not be significantly different. The proposed action may have short term impacts on property values in the area, but values can be expected to rebound to similar levels as expected prior to proposed activity at the dam.

The assessed property values for residential properties with river frontage from Estabrook Dam to West Bender Road is $36,331,900, based on 2014 Milwaukee County records. There are 163 residential properties with river frontage along the Estabrook Dam impoundment. The average residential assessed value for these properties is $222,900.

AECOM contacted the City of Milwaukee assessor's office to obtain input as to how an impoundment would be assessed compared to the dam removed and having river frontage. The City representative indicated the City's assessment guidelines include a discretionary increase by the assessor of 25 percent for property having water access. An impoundment or river frontage would be reviewed as water access and, therefore, there would not necessarily be a charge in the assessed property value.

AECOM contacted the appraisal firm retained by the City of Glendale, which is Accurate Appraisal, LLC in Menasha, Wisconsin, who indicated that property value along a free flowing river or an impoundment can be affected by the property owner's personal preference. For example, a boater may prefer an impoundment, but a fisherman may prefer a free flowing river. The appraiser recommended reviewing property sales in the area to determine if there is a trend in property values with waterfront access.

4.3.3 Archaeological/Historical and Paleontological Resources

From the Phase1 archaeological survey for rehabilitation of Estabrook Dam (AVD Archaeological Services, Inc.[3], 2012), no archaeological or paleontological resources will be affected by this project for any of the alternatives unless the dam is altered significantly. Refer to Section 3.8 for additional information. Estabrook Dam is listed on the National Register of Historic Places. Correspondence with SHPO is provided in Attachment 18.

Alternative 1 would not be expected to require a HAER study because the dam will be repaired only. Alternative 1A may require a HAER study, depending on the results from discussions with SHPO. The addition of the fish passage may or may not be considered by SHPO as a significant change.

Alternative 2 will require a HAER study because the dam would be removed. A plaque or signage would be located at the former dam site showing the historical aspects of the dam.

Alternative 4 will require a HAER study because the gated section of the dam would be replaced with the rock ramp. A plaque or signage would be located at the dam showing the historical aspects of the dam. In Section 3.7, information is provided on Estabrook Dam and filed with the National Register of Historic Places. In addition, Milwaukee County will prepare a Historic American Engineering Record (HAER) study on Estabrook Dam if discussions with SHPO conclude that a HAER study is warranted. If Alternative 1A is selected, a HAER study may or may not be necessary depending on how SHPO views the fish passage as a change to the dam. If Alternatives 2 or 4 are preferred, a HAER study will probably be required after discussions with SHPO.

Therefore, based on the results of the HAER study, additional steps may be necessary prior to dam removal (Alternative 2) or significant alteration (Alternative 4). The additional steps taken on other similar dam projects where the dam was listed on the National Register of Historic Places include providing signage or a plaque recognizing the dam as a historically significant structure at the former dam site. The plaque would provide a general overview of the dam history.

4.3.4 Other State Resources

There are no state natural areas or prime agricultural lands associated with this project.

4.3.5 Areas of Critical Environmental Concerns

The selected Estabrook Dam alternative to be implemented will be phased so construction does not interfere with the sediment removal project. The schedule completion for the sediment removal project is 2015, which will have ended before the dam alternative is implemented. The important aspect of the sediment removal project is to remove the sediment immediately upstream from the dam before the dam alternative is implemented.

4.3.6 Environmental Justice

If Alternative 1, 1A, or 4 is implemented, a public boat launch in the impoundment is recommended to expand the access of the public to the impoundments for recreation. The current access is very limited in terms of accessibility and parking in the impoundment.

4.4 Summary of Adverse Impacts That Cannot be Avoided

4.4.1 Alternative 1 – Rehabilitate the Dam and No Fish Passage and Alternative 1A – Rehabilitate the Dam and Add Provisions for Fish Passage

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

The impoundment will increase the water temperature which results in lower dissolved oxygen content which can affect some fish species . Carp can tolerate higher temperatures, can dominate the fish population, can uproot the aquatic vegetation, and stir up the sediment. These turbid conditions can adversely affect the pool aesthetics and directly affect the aquatic life.

Mud flats will continue to exist as sediment accumulates.

The seasonal drawdown is intended to protect the dam gates, and timing and water depth are important to protect the aquatic life from being impacted by freezing or desiccation. In spring, nesting ducks and other wildlife could be impacted if the filling of the impoundment happens too soon and floods out the nests. A delayed filling of the impoundment may be necessary some years to protect the wildlife.

Mussels may be impacted when the dam gates are intermittently opened and flush sediment downstream thereby affecting downstream mussels. Secondly, mussels can be impacted as sediment accumulates in the impoundment for Alternatives 1, 1A, and 4. Alternative 1 may possibly include a seasonal drawdown that limits the extent of drawdown such as 3 feet to the stoplogs so as to not impact mussels and other aquatic life. Alternative 1A proposes a full impoundment year round.

The aesthetics of a free flowing river will change to the aesthetics of a shallow lake impoundment. These aesthetics are not necessarily better or worse, but are different as long as the gates are closed.

Water levels will be deeper relative to the other alternatives considered due to the impoundment, which can be viewed as both a positive and negative impact, depending on a person's perspective. Some shifts in plant community types and population can be expected for Alternative 1 or 1A when the impoundment floods out current plant communities. The impoundment will create more aquatic plant communities to replace the terrestrial plant communities.

The alternative will require the County to invest in the dam repair as well as long-term operation and maintenance. On a total present worth basis, this alternative is three times more expensive than Alternative 2.

Alternative 1 does not include fish passage, which is a long-term negative impact to the fishery, to mussels that use the fish as a host, to biodiversity, and to recreation. Ozaukee County's multi-million dollar investment in fish passage upstream for Lake Sturgeon spawning will be severely, negatively impacted if fish passage is not implemented at Estabrook Dam. The lake sturgeon from Lake Michigan will not be able to spawn upstream. Spawning opportunities in the Milwaukee River from Lake Michigan to Estabrook Dam are very limited. Prime fish spawning habitat is further upstream and will not be made available to these lake sturgeon. This limited spawning opportunity affects all fish species and mussels. Nationwide, there is a substantial effort to create fish passage around dams to increase fish diversity and populations, which provides a more robust ecosystem and also expands recreational opportunities, especially in an urban setting where fishing is a popular recreation.

Wetlands along the south bank of river immediately upstream of Estabrook Dam will be impacted short-term during the construction of Alternatives 1, 1A, 2, and 4. These wetlands are also impacted by the 2015 sediment cleanup project. The wetlands are impacted by the construction of an access road to perform the construction work at the dam. This access road affecting the wetlands will be removed and area restored after construction is completed.

4.4.2 Alternative 2 – Abandon and Remove the Dam

Short-term impacts include dust, noise, and traffic congestion during demolition of the dam and during sediment removal. Aquatic wildlife will be temporarily displaced during demolition of the dam. Wetlands along the south bank (right bank when looking downstream) will be impacted short-term during construction and then restored after construction, as discussed above.

The aesthetics of a dam impoundment will be changed to the aesthetics of a free-flowing river as currently is the case while the dam gates have been open since 2008. The aesthetics are a personal preference and are not necessarily a negative. As a free-flowing river, fluctuations in water levels and river flows will occur, as is the case with the existing dam gates open. Recreational boating will be very limited to periods of high river flow, but other forms of recreation such as canoeing will be available where river flows are sufficient to allow canoeing.

The alternative will require the County to invest in the dam removal, which is a substantially lower cost than to repair the dam. Long-term dam operation and maintenance costs will be eliminated. The demolition of the dam may require additional procedural steps to allow implementation, depending on the results of the HAER study. Removal of the dam is a long-term impact based on its historical significance.

The buildup of sediment over time will not be an issue with Alternative 2 as compared to Alternatives 1, 1A, and 4. The presence of mud flats will be diminished or eliminated. Some existing mud flats will be removed under the sediment removal project in 2015. Other existing mud flats will become vegetated and aesthetically be improved.

Property owners along the river will no longer be able to use the boats and boat houses during most of the year.

Removal of dams has documented improved fish populations in terms of fish diversity and populations as seen since the North Avenue Dam was removed.

4.4.3 Alternative 4 – Gated Spillway Removed, Serpentine Overflow Spillway Lowered, and a 6.3-Foot-High Rock Ramp Constructed

Short-term impacts include dust, noise, and traffic congestion during demolition of the dam and during sediment removal. A buildup of sediment in the impoundment can be expected over the long-term use of the rock ramp. Best management practices for stormwater will be used during the construction activities. Wildlife will be displaced to other available habitat in the Milwaukee River environmental corridor when the impoundment is filled. Aquatic wildlife will be temporarily displaced during demolition of the dam gates and construction of the rock ramp. Aquatic habitat will change with a deeper pool. Wetlands along the south bank (right bank when looking downstream) will be impacted short-term during construction and then restored after construction, as discussed above.

Sediment accumulation in the impoundment can affect mussels as discussed under Alternatives 1 and 1A. Water temperature will increase in the impoundment which can affect some fish species and fish diversity.

Water levels will be deeper due to the impoundment, which can be viewed as both a positive and negative impact depending on a person's perspective. Some shifts in plant community types and population can be expected for Alternative 4 when the impoundment floods out current plant communities. The impoundment will create more aquatic plant communities to replace the terrestrial plant communities. Water levels stay relatively constant year round providing more stable conditions for aquatic life and wildlife as compared to Alternative 1 or 1A. Year round recreation is provided.

The alternative will require the County to invest in the dam gate section demolition, the rock ramp, and some long-term maintenance costs to remove sediment behind the rock ramp, possibly on a 20-year frequency.

The aesthetics of a free flowing river, as currently is the case since the gates were open since 2008, will change to a shallow lake impoundment. These aesthetics are not necessarily better or worse, but are different.

The demolition of the dam may require additional procedural steps to allow implementation depending on the results of the HAER study. Removal of the dam gate section is a long-term impact based on its historical significance.

4.5 Significance of Risk

The four feasible alternatives for Estabrook Dam have environmental benefits and negative impacts, as discussed in this EIS. The only significant risk is with Alternative 1 or 1A, due to the negative impact of increasing 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 experiences a 100-year flood discharge during summer, closed gates at Estabrook Dam will result in flood elevations upstream of the dam in excess of the 100-year flood elevations determined assuming the spillway gates are open. This situation provides significant liability and risk to Milwaukee County.

Milwaukee County will have a dam operator available to monitor weather, river flows, and gate position. The dam operator will maintain a pool level based on the fixed crest spillway elevation. When water levels increase appreciably, the operator will open gates to pass the increased flow. The pool level will be lowered by no more than 6 inches per day to comply with WDNR requirements. If the gates malfunction due to a power outage or gate mechanical issue and all 10 gates are closed during the flood event, Milwaukee County is 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 are provided, but operation of 10 gates manually can be a challenge during flood conditions.

4.6 Significance of Precedent

All four alternatives have been successfully implemented at other locations. One topic of significant precedence involves Alternative 1 or 1A which will require the County's dam gate operator to monitor river level, weather, and gate positions to take action before a flood event occurs to avoid the gates being closed during a significant flood.

4.7 Significance of Controversy Over Environmental Effects

The public and regulatory agencies have the benefit to observe environmental effects of Alternative 1 or 1A and Alternative 2. Alternative 1 or 1A is demonstrated by the decades of use of the dam and the resulting 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. Public support for the dam and against the dam are known facts on this project.

Alternative 1 or 1A with the proposed seasonal drawdown must be managed to limit the drawdown to about 3 feet to maintain adequate water depth to avoid a negative impact on mussels located in shallow areas of the impoundment. When the pool is drawn down, the mussels can be exposed, resulting in asphyxiation, desiccation, and predation. The mussels move very slowly and, therefore, have limited capabilities to adapt to such fluctuations in water levels. Mussels are among the most threatened aquatic species in North America and dams are a significant factor in the decline of the mussel populations. The 3 feet of seasonal drawdown reflects removing the stoplogs. This drawdown level is not anticipated to affect the mussels.

Alternative 2 will result in lower river levels as compared to the existing conditions experienced since 2008. This is the case because removing the dam increases the flow capacity in this reach, which results in lower water levels for a given flow. This can be a benefit when considering flood events, but can be a detriment under low river flows. Supporters of the dam prefer the impoundment for recreation, in particular, boating. This group also prefers the aesthetics of an impoundment resulting in a shallow lake setting. Their claim that the impoundment results in higher property values as compared to water frontage on the river is debatable based on available literature and on Milwaukee County's review of property values in the vicinity of the dam.

Supporters of dam removal prefer a free flowing natural river which saves tax payers money, has no annual operation and maintenance costs, and is sustainable. Alternative 1 or 1A's total present worth cost is about three times higher than Alternative 2. Alternative 4's total present worth cost is two times higher than Alternative 2. These cost savings over the 20-year period are substantial.

Alternative 4 provides a compromise to Alternatives 1, 1A, and 2 because it is sustainable, natural, resembles the natural conditions existing prior to the dam construction, and provides an impoundment extending upstream to West Silver Spring Drive and this impoundment is about 0.2 miles less than Alternative 1 or 1A. Alternative 4 results in a somewhat shallower impoundment than Alternative 1 or 1A, but still provides the recreational opportunities including boating plus the aesthetics of an impoundment similar to Alternative 1 or 1A, but without the substantial long-term operation and maintenance costs of a dam (Alternative 1 or 1A).

Milwaukee County Board has gone on record to support rehabilitating the dam (Alternative 1, Proposed Action). Alternative 1A is the same as the Proposed Action with the addition of fish passage which is a substantial environmental benefit and consistent with the multi-million dollar investment in fish passage upstream by Ozaukee County.

4.8 Cumulative Impacts

The following summarizes the primary cumulative impacts for the four feasible alternatives.

4.8.1 Alternative 1 – Rehabilitate the Dam, No Fish Passage

1. Second lowest capital cost and highest annual operation and maintenance cost.
2. Provides aesthetics of impoundment and recreation.
3. Long-term negative impact to fishery and mussels because of no fish passage.
4. Seasonal drawdown of impoundment required mid-September to mid-May.
5. Requires river flow, weather conditions, monitoring for gate operation.
6. All 10 gates must be open during major flood events.
7. Liability issues if gates malfunction during flood event.
8. Seasonal drawdown impacts can be mitigated:
    - Must maintain impoundment level at the stoplog elevation or higher to protect aquatic life.
9. Periodic opening of dam gates can suffocate mussels by flushing sediment downstream.
10. Dam creates mud flats, sediment buildup over years.

11. Reduces recreational fishing opportunities upstream due to fish passage.

12. Significantly limits the effectiveness of Ozaukee County's multi-million dollar investment in fish passages upstream and restoration of lake sturgeon.

4.8.2 Alternative 1A – Rehabilitate the Dam and Add Provisions for Fish Passage

1. Alternative 1A has the highest estimated capital cost at $3,612,000, highest annual estimated operation and maintenance cost at $160,000, and the highest total present worth cost of about $6,228,000 when compared to the other three feasible alternatives.

2. This alternative provides the aesthetics of an impoundment that can be enjoyed by the public for motor boating, canoeing, and other recreational activities.

3. The positive impact of fish passage allows for fish spawning, fish diversity, and expands sport fishing opportunities.

4. Seasonal drawdown of the impoundment is necessary to protect the dam gates from ice damage.

5. Seasonal drawdown from mid-September to mid-May can create environmental negative impact to mussels and to potentially other aquatic life such as invertebrates. Mussels located in shallow areas of the impoundment can be left exposed to the atmosphere during a drawdown. Mussels, traveling at 12 inches per day, cannot respond quickly enough to protect themselves from seasonal drawdown. The negative impacts to the mussels are potential freezing, asphyxiation, desiccation, or predation. Fresh water mussels are the most threatened species in North America. Dams have been a major reason that mussels are in a decline based on the technical literature. Mussels can live for decades. Negative impacts to mussels can be mitigated by maintaining a seasonal drawdown impoundment level at the stoplog elevation or higher to protect aquatic life.

6. Siltation within the impoundment can likewise negatively impact mussels. In addition, siltation can affect fish spawning areas. Over time, possibly 20 years, the silt buildup upstream of the dam will need to be removed.

7. Periodic, sudden opening of the dam gates can result in collected sediment behind the gates being flushed downstream, which can suffocate mussels when they get covered by sediments and are unable to migrate the matter.

4.8.3 Alternative 2 – Abandon and Remove the Dam

1. Alternative 2 has the lowest estimated capital cost at $1,674,000 and no operation and maintenance costs as compared to the other three feasible alternatives.

2. This alternative provides the aesthetics of a free-flowing river that can be enjoyed by the public for canoeing and kayaking, but motor boating would not be feasible during most of the year due to insufficient water depth.

3. This alternative results in a positive impact on the environment, especially for fishing and mussels.

4. A buildup of sediment is not an issue with this alternative as is the case with the other alternatives.

5. Alternative 2 will require a HAER study because demolition of the dam impacts a structure listed on the National Register of Historic Places.

4.8.4 Alternative 4 – Gated Spillway Removed, Serpentine Overflow Spillway Lowered, and a 6.3-Foot High Rock Ramp Constructed

1. Alternative 4 has costs that rank between Alternatives 1, 1A, and 2. The estimated capital cost is $2,419,000, and the estimated annual operation and maintenance costs are $55,000. The total present worth cost is about $3,318,000.

2. This alternative provides the aesthetics of an impoundment year-round that can be enjoyed by the public for motor boating, canoeing, and other recreational activities.

3. Fish passage is provided which is a positive impact.

4. Seasonal drawdown is not required, which is a positive impact on mussels and other aquatic life.

5. Siltation within the impoundment can impact mussels. In addition, siltation can affect fish spawning areas. Over time, possibly 20 years, the silt buildup upstream of the rock ramp will need to be removed.

6. The alternative will require a HAER study because demolition of a part of the dam is required. The dam is listed on the National Register of Historic Places.

5.0 Summary of Issue Identification Activities

5.1 Public Input

On June 5, 2014, Milwaukee County held a public scoping meeting on the Estabrook Dam Environmental Assessment. The document is now referred to as an EIS. Representatives from Milwaukee County, AECOM, and SEWRPC provided an overview of the project history, condition of the dam, identification of alternatives, and selection of feasible alternatives. The County website allowed the public to provide written comments on the public scoping meeting until June 14, 2014. There were 125 responses from the public on the website pertaining to the meeting itself, alternatives, their preference, and related topics. There were 73 comments supporting the dam (Alternative 1A), 31 comments supporting removing the dam (Alternative 2), and 5 comments proposing the rock ramp (Alternatives 3A or 4). The balance of the comments pertained to related topics or did not provide a preference to the alternative. Two letters were also received by the County supporting the dam repair (Alternative 1A). At the time, Alternative 1 had been eliminated from consideration because it did not include fish passage, which is an important environmental benefit.

Some of the comments raised in the public survey are as follows:

- Provide a public boat launch upstream of the dam to allow people other than the property owner’s access to the river/impoundment.
- The dam provides flood protection, and the other alternatives do not.
- The dam provides boating, canoeing, and kayaking opportunities with the impoundment.
- The current river levels allow for limited canoeing and kayaking because the river is either too high with fast current, or too low with rocks protruding.
- The impoundment directly benefits about 350 property owners and all Milwaukee County tax payers end up paying the long-term costs of the dam. Remove the dam.

The multiple comments about the dam providing flood protection were received. The technical basis needs to be clarified. The dam creates a substantial blockage in the river when the 10 gates are closed and the impoundment is in place. When the 10 gates are open, the dam can handle a 100-year frequency flood. The public views the gates open as flood relief, which is a true statement. If the 10 gates are closed, the dam will cause flood stages upstream similar to that of a 100-year flood event during an event only somewhat greater than a 10-year event. The County needs to be vigilant to monitor the weather and river flows to guard against this occurring if Alternative 1 or 1A is selected. If the gates malfunction due to a power outage or mechanical failure, the County is potentially liable for the upstream flooding caused by the dam.

Implementation of the other two Alternatives 2 and 4 would result in slightly lower flood stages during a 100-year event as compared to Alternative 1 or 1A (dam-in-place with gates open) (see Attachment 3, Table 7).

On September 3, 2014, a public information meeting was held at Nicolet High School to obtain public input on the project. The County also maintained a questionnaire on the County website to solicit public input. Attachment 19 summarizes the public’s responses to the written survey period at the meeting and the website survey. Representative letters on the alternatives are provided in

Attachment 19 and many more letters and emails were received with opinions on both the repair and removal of the dam.

Alternative 2 – Dam Removal was favored by the public by 53.9% in the written surveys and 68% of the website surveys. Alternative 1A – Dam Repair with Fish Passage was favored by 32.6% of the written surveys and 30% of the website surveys. Alternative 1 – Dam Repair was not specifically identified in the survey as an option.

5.2 Agency, Government, or Other Public Input

The following is a listing of agencies, citizen groups and individuals either contacted or who provided input into the EIS preparation.

Item	Date	Contact	Comment Summary
1	August 19, 2014	Charles Hagner, Friends of Estabrook Park	Bird Inventory for Estabrook Park
2	July 30, 2014	US Fish & Wildlife Service	Trust Resources List for Estabrook Dam
3	April 25, 2014	Mike Hahn, Chief Environmental Engineer, SEWRPC	Revised the April 8, 2014, Hydraulic Analysis Memo to include Alternative 4, rock ramp at dam.
4	April 16, 2014	Tanya Lourigan, WNDR	Provided an email requesting the Operational Plan be included in the EA.
5	April 16, 2014	Jim Keegan, Milwaukee County Parks	Provided an email requesting AECOM to include the Operational Plan in the EA.
6	April 16, 2014	Karl Stave, Milwaukee County	Provided an email summarizing the Operational Plan for Estabrook Dam.
7	April 15, 2014	David Dorner, Director, Milwaukee River Preservation Association	Provided email with comments on the SEWRPC Hydraulic Analysis for Estabrook Dam EA.
8	April 14, 2014	Sherman Banker, State Historic Preservation Officer (SHPO)	AECOM letter to SHPO requesting if the dam is classified as a historic structure.
9	April 14, 2014	Mike Hahn, Chief Environmental Engineer, SEWRPC	Email to Technical Advisory Team regarding the rock ramp alternative and DNR requirements if the rock ramp exceeds 6 feet and impounds more than 50 acre-feet of water is classified as a large dam.
10	April 11, 2014	Don Pirrung, AECOM	April 9, 2014 Meeting Minutes from Don Pirrung to Technical Advisory Team.
11	April 9, 2014	Estabrook Dam Technical Advisory Meeting	Technical Advisory meeting to discuss EA alternatives and river modeling.

Item	Date	Contact	Comment Summary
12	April 8, 2014	Mike Hahn and SEWRPC Staff Chief Environmental Engineers, SEWRPC	Hydraulic Analyses for Estabrook Dam Environmental Assessment, Preliminary Draft April 8, 2014.
13	March 11, 2014	Glen Goebel, President Milwaukee River Preservation Association	Background information of the Milwaukee River and Estabrook Dam.
14	March 4, 2014	Don Pirrung, AECOM	Draft letter from Milwaukee County to Dean Grettinger at Bureau of Land Management regarding Estabrook Dam responding to February 6, 2014 letter from BLM.
15	March 4, 2014	Don Pirrung, AECOM	Draft letter from Milwaukee County to Jesse Jensen, WDNR responding to WDNR's August 7, 2013 letter regarding Estabrook Dam.
16	March 3, 2014	Don Pirrung, AECOM	Email to Jesse Jensen WDNR regarding Estabrook Dam Critical Path schedule.
17	February 25, 2014	Glen Goebel, President Milwaukee River Preservation Association	Estabrook Dam Background Information.
18	February 22, 2014	Jesse Jensen, Water Management Specialist WDNR	Minutes from February 11, 2014 Estabrook Dam Technical Advisory Meeting.
19	February 12, 2014	Tanya Lourigan, Water Management Engineer, DNR	Template for an Inspection, Operation and Maintenance Plan (IOM) for a dam.
20	February 11, 2014	Estabrook Dam Technical Advisory Meeting	Discussion on Estabrook Dam Alternatives.
21	February 11, 2014	Marsha Burzinski, WDNR	EA Engineering, Science and Technology, Inc. Contaminated Zones and Deposits Figure for Phase II Milwaukee River and related text, dated January 2014.
22	February 6, 2014	Dean Grittinger, Field Manager Bureau of Land Management	February 6, 2014, letter to John Dargle, Milwaukee County Department of Parks, Recreation and Culture regarding Estabrook Dam Project.
23	February 2014	James Keegan, Milwaukee County Parks	Estabrook Dam EA Critical Path Schedule.
24	February 2014	Milwaukee River Preservation Association	Summary of Concerns to be included in Estabrook Dam EA Model.

Item	Date	Contact	Comment Summary
25	January 19, 2014	Karl Stave, Milwaukee County	Draft Estabrook Dam Stipulation and Proposed Order, State of Wisconsin Circuit Court, Milwaukee County, Milwaukee Riverkeeper, Plantiff vs Milwaukee County, Case No. 11 - CV - O0878784.
26	August 28, 2013	Mike Hahn, SEWRPC Chief Environmental Engineer	August 28, 2013 memo from Joshua Murray, SEWRPC to Milwaukee County regarding Estabrook Dam alternatives.
27	February 7, 2013	Anthony Jernigan, US Army Corps of Engineers	Fax stating Wisconsin State Historic Preservation Officer finds the proposed undertaking will have no adverse effect on one or more historic properties within project regarding archaeological survey, October 26, 2013 statement, for Estabrook Dam project.
28	December 20, 2012	Don Pirrung, AECOM	November 28, 2012 Estabrook Dam Technical Advisory Team Meeting Minutes
29	November 28, 2012	Estabrook Dam Technical Advisory Team	Team Meeting to discuss Estabrook Dam and potential environmental impacts and alternatives.
30	November 27, 2012	Marsha Burzynski, WDNR	Lincoln Park EA for Sediment Removal Phase I.
31	October 26, 2012	Tanya Lourigan, WDNR	October 26, 2012 letter from DNR to James Keegan, Milwaukee County Parks regarding Estabrook Dam time extension.
32	August 6, 2012	Don Pirrung, AECOM	Revised Meeting Minutes for July 12, 2012 Estabrook Dam Technical Advisory Team meeting.
33	August 2012	Allen P. Van Dyke AVD Archaeological Services, Inc.	Phase I Archaeological Survey for the Rehabilitation of Estabrook Dam on the Milwaukee River, Milwaukee County, WI.
34	July 27, 2012	Don Pirrung, AECOM	Email to Karl Stave, Milwaukee County regarding wetland acreage affected by Estabrook Dam.
35	July 24, 2012	Karl Stave, Milwaukee County	Milwaukee River Parkway District, review of historic features including dam as a contributing factor to the history features of the area.
36	July 3, 2012	Steve Elver, AECOM	Project overview Estabrook Dam, sent to Bureau of Land Management.

Item	Date	Contact	Comment Summary
37	February 27, 2012	Bernie Michaud, AECOM	Estabrook Park Dam Conceptual Fishway Design memo.
38	December 9, 2011	Tom Slawski, SEWRPC Principal Specialist - Biologist	SEWRPC No. CA-406-30 Wetland Inventory regarding Estabrook Dam project area.
39	June 30, 2011	Steve Elver, AECOM	Estabrook Dam - Removal of Dam Option Cost Estimate.
40	September 8, 2010	Steve Elver, AECOM	Estabrook Park Dam Structural Repair Option Cost Estimate.

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[2] "Environmental Assessment for Fish Passage in the Milwaukee River Watershed Project," prepared by National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Office of Habitat Conservation, January 2010.

[3] Phase 1 Archaeological Survey for the Rehabilitation of Estabrook Dam on the Milwaukee River, Milwaukee County, Wisconsin," prepared by AVD Archaeological Services, Inc.

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[5] Provencher, Bill, Helen Sarakinos, and Tanya Meyer, "Does Small Dam Removal Affect Local Property Values? An Empirical Analysis". University of Wisconsin-Madison, Department of Agricultural & Applied Economics, Staff Paper Series, July 2006.

[6] "Environmental Analysis and Discussion of the Need for an Environmental Impact Statement (EIS), for Lincoln Park and Milwaukee River Channels Sediment Remediation Project," Wisconsin Department of Natural Resources, June 28, 2010.

[7] Mussels of the Milwaukee River Greenway: A Preliminary Survey, Gary S. Casper, Great Lakes Ecological Services, LLC; and Jason M. Dare, Dare Ecosystem Management, LLC, March 6, 2013.

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[11] "Effects of Tributary Spatial Position, Urbanization, and Multiple Low-Head Dams on Warmwater Fish Community Structures in a Midwestern Stream," Thomas M. Slawski, Francis M. Veraldi, Stephen M. Pescitelli, and Michael J. Pauers, North American Journal of Fisheries Management 28:1020 – 1035, 2008.

[13] Milwaukee River at South of Estabrook Park Dam, Station 10012616, Reporting Period January 1, 2006 to January 1, 2013 Monitoring Data Report, Milwaukee River Keeper, Wisconsin Citizen–Based Stream Monitoring Report.

[14] Milwaukee River South of Estabrook Park Dam, 2013 Continuous Temperature Chart, Milwaukee River Keeper.

[15] Spooner, Daniel E., Caryn C. Vaughn, and Heather S. Galbraith. "Physiological Determination of Mussel Sensitivity to Water management Practices in the Kiamichi River and Review and Summarization of Literature Pertaining to Mussels of the Kiamichi and Little River Watersheds, Oklahoma." Oklahoma Department of Wildlife Conservation, Federal Aid Grant No. T-10-P-1, 2005.

ATTACHMENT 1:

FIGURE 1 AERIAL MAP

AECOM

LOCATION MAP

ESTABROOK DAM
MILWAUKEE COUNTY, WISCONSIN

DRN	PROJECT NO.	DATE	
CFF	60135722	4/15/2014	FIGURE 1

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ATTACHMENT 2:

ESTABROOK DAM HISTORIC INFORMATION

ESTABROOK PARK DAM

This dam is being constructed as part of a flood relief project, which has been under way since the fall of 1933, following an intense study of the flow from the area drained by the Milwaukee River, consisting of 640 square miles.

The Milwaukee River has its source about 60 miles northwest of the city of Milwaukee, and enters Lake Michigan at approximately the center of the City. Flood troubles started at the south end of Estabrook Park, and from that point to the Silver Spring Road, a distance of about 3½ miles, were a source of annoyance and damage to the built-up urban area, both within and without the City. From Silver Spring Road north for several miles damage by reason of flood occurred to the colonies of summer residences located along the river banks, and to truck gardens and green houses located on the river flats.

The cause of the trouble north of Capitol Drive was a limestone reef or outcrop about a mile long, over which the river flowed. This outcrop had an elevation of about 36 feet above lake level, and occurred approximately 7 miles upstream from the outlet, so that once the water passed beyond the obstruction there was sufficient fall for its rapid disposal. For a distance of 3 miles upstream from the outcrop there was no fall in the river bed; in fact, successive floods had gouged out the river bottom to such an extent that in this area most of the river bed was well below the top of the outcrop, thereby creating a body of still water as wide as the river and 3 miles long. In this area the river banks are only a few feet above normal water level and at flood stage the water soon rose above the banks. The area flooded was not large, but the damage was large in proportion to the area flooded, due to urban development.

As the result of successive floods, individuals, civic organizations, and delegations from the flooded district repeatedly invoked the aid of the various governmental bodies. Their petitions resulted in an exhaustive study of the condition.

In the fall of 1933 removal of the rock outcrop was inaugurated as a CWA project, Milwaukee County working on that portion lying east of Port Washington Road bridge and extending thru Estabrook Park. The City worked on the portion west of the bridge and extending through Lincoln Park. Consolidation of City and County parks, effective January 1, 1937, made Lincoln Park a part of the County system. About a year prior to this time, however, the County's portion of the work was taken up by the CCC, which carried it on to completion. The CCC is also carrying on construction of the dam.

Residents of the homes and cottages along the river bank located there with the idea of using the river for swimming, boating, canoeing, and the like, because the river was deep enough for such sports. In Lincoln Park a bathing pavilion and beach have been in use for many years. It was therefore necessary to maintain the normal river level during stages of ordinary flow. Removal of the rock outcrop caused the water to drop to such an extent that all recreational use was eliminated, and construction of a dam was necessary to maintain water at its previous level. The dam had to be designed to take care of flood waters, and to permit the flood relief work that had been done by removal of the rock to become effective.

The dam is located at the point farthest downstream at which it may be constructed without causing damage to adjacent property. This is also the location at which the structure best fits into the landscape. Observation of flood conditions resulted in the conclusion that it would be advisable to construct a dam with gates. It was felt that the gate section was necessary by reason of economy and operation. It was further determined, as a result of these studies, that a wier or crest section should be provided, over which ice could be permitted to pass. In order to present a completed structure of most pleasing appearance, and one that would blend with the landscape to best advantage, the landscape architects for the County suggested that the gate and crest sections of the dam be separated by a small island. The dam has been designed accordingly, with a gate section and a crest or spillway section.

The gate section of the dam is located in a channel 155 feet wide with a 3 to 1 slope on each side. This section is built of reinforced concrete with 10 vertical gates of the sliding type, each 11 feet 6 inches wide. At each end of the gate section there is a 10 foot 4 inch spillway and an abutment containing stairs leading to the operating bridge, which extends across the dam over the gates. In lowered position the gates form a spillway with top elevation of 36.30. It is desired to direct the water over the crest or curved spillway, except for a small amount, which will pass over the 10 foot 4 inch spillway at each end of the gate section.

At the entrance to the 155 foot channel containing the gates, there is to be placed a line of reinforced concrete ice guards 11 feet 6 inches on centers, in order to divert the larger blocks of floating ice away from the gates and direct this ice toward the curved spillway.

On the face of the stone spillway a fish ladder will be constructed, consisting of a series of small pools, each being a slight elevation above the other, so as to permit migratory fish to travel upstream.

9-1-39

Mr. M. W. Torkelson
Director
State Regional Planning Commission
Madison, Wisconsin.

Dear Mr. Torkelson,

This letter will acknowledge receipt of your letter of August 23, relative to work that has been done upon the Milwaukee River with respect to flood control. You asked me to review the statement submitted with your letter, and this I am gladly doing. I have looked back over our files and have reviewed especially the information submitted to the Government at the time the dam being built in Estabrook Park was designed. The following is a summary taken from this data, and covers, I believe, the points set forth in your summary:

The Milwaukee River, draining a watershed of approximately 840 square miles, has its source about 60 miles northwest of Milwaukee, in what is known as the Kettle Moraine District. The river empties into Lake Michigan at approximately the center of the City of Milwaukee.

Flood troubles experienced in Milwaukee County have taken place to the north of Lincoln Park, extending northerly to Kletzsch Park. To the north of Lincoln Park there have been two sources of trouble: That occurring in the lowlands along the river north of Silver Spring Road, where there are quite a large number of houses and cottages, some of which are used the year round - the other on Mud Creek, now known as Lincoln Creek, which empties into the Milwaukee River at Lincoln Park after flowing easterly through the northern portion of the City of Milwaukee.

The stormsewer for this portion of the City of Milwaukee empties into Lincoln Creek and, when the Milwaukee River reaches extreme flood stage, water backs up in Lincoln Creek into the stormsewer system, and has caused the City of Milwaukee considerable difficulty as a result. The difficulties north of Silver Spring Road, where a number of houses and cottages are located, comes about by reason of either floods caused by extremely heavy rainfall in the summertime, or by reason of a lesser amount of rainfall with the river congested by ice during the winter or spring.

Estabrook Park is located just to the east of Lincoln Park and both of these parks, as well as the river and the roads mentioned herein are shown upon the County map we are attaching.

Until 1933 a rock ledge about a mile long was located across the river channel at the southern end of Lincoln Park and the northern end of Estabrook Park. This ledge extended along the river about a half mile each way from Port Washington Road Bridge. The elevation of the ledge at its highest point, just to the west of the Port Washington Road Bridge, was approximately 36 feet above datum, which is the level of the river at the point where it empties into Lake Michigan. Lincoln Park is about 7 miles upstream. Therefore, with a fall of 36 feet in approximately 7 miles, flood conditions were not experienced downstream from Lincoln Park and the difficulty from floods occurred on the upstream side of Lincoln Park. Most of the complaints came from that area north of Silver Spring Road. The rock ledge or outcrop referred to acted as a dam. For a distance of 3 miles upstream from this ledge there was no fall in the river, but successive floods gouged out the river to such an extent that in this 3 mile area the river bed, for the most part, was ~~not~~ lower in elevation than the top of the rock ledge, thereby creating , in effect, a body of still water as wide as the river and about 3 miles long. It was in this area that the river banks were only a few feet above normal water level and in flood stage the water rose above tha banks. The area flooded was not large.

In the fall of 1933 removal of the rock ledge was inaugurated as a CWA project, Milwaukee County working on that portion lying east of Port Washington Road Bridge, and the City of Milwaukee operating the portion to the west of the bridge. Lincoln Park was then a City park, but has since been turned over to Milwaukee County. Removal of the ledge to a channel width of 200 feet and to a straight grade with a depth of 6 to 7 feet below the crest of the former ledge was completed a couple of years ago, and since that time the City of Milwaukee, and now Milwaukee County has continued with cutting through of the ox bow bends in Lincoln Park, which work will probably be completed next summer, thereby straightening the channel and increasing its capacity. Consideration is being given to continuing the channel deepening as far north as Kletzsch Park.

The level of the water in Estabrook and Lincoln Parks is to be regulated by a dam now being constructed in Estabrook Park. The crest of the dam will be at elevation 36, corresponding with the crest of the rock ledge removed, so as to maintain the same water level upstream as existed in the years past, in order that the water level at cottages and homes along the river north of Silver Spring Road will be maintained as previously, and also in order to increase water recreation facilities in Lincoln Park.

The dam now being built consists of a gate section that can be manually operated so as to lower the flood waters, and a rather long serpentine crest section, over which the water will flow at normal river stage. Elevation 36 was determined upon as the elevation of the crest of the dam in order to maintain the water level in the river at the same elevation that existed before removal of the rock ledge. Elevation 38, ~~was~~ a 2 foot rise, was decided upon as the maximum permissable increase in head for a 14,700 foot flow over the dam. This elevation was determined as the maximum permissable by the engineers of the City of Milwaukee, in order to avoid flooding of the streets of that portion of the City of Milwaukee draining into Lincoln Creek.

Our records indicate the maximum flood recorded in the

Milwaukee River was that of August, 1924, at which time a discharge of 14,700 c.f.s. took place. There had been any number of lesser floods, ranging from about 4,000 c.f.s. to 12,000 c.f.s. The City Engineer's office of the City of Milwaukee has made a rather extensive study of past floods and probable floods and their conclusion with respect to flood volume on the Milwaukee River is as follows:

1% chance flood (1 in 100 years (computed)	23,400	c.f.s.
4% " " (1 in 25 years) (maximum on record 1924)	14,700	"
30% " " (1 in 3 years)	6,400	"
Ordinary spring and fall flow	1,000	"
Minimum dry weather flow - August 18, 1934	9	"

We are enclosing print prepared in this office on river discharges for whatever value it may be to you.

The gate section of the dam consists of 10 gates set in a channel with 155 foot width and the crest section of the dam is 562 feet long at elevation 36. Our computations are that when the water reaches elevation 38 the gate section will be able to discharge 8,970 c.f.s., and that the discharge over the spillways will be 5,960, or a total of 14,930 c.f.s.

We believe that the work now being done will quite adequately take care of the situation with respect to Mud Creek, and will very considerably help the situation north of the Silver Spring Road. However, we make no predictions with respect to the actual effect north of Silver Spring Road, inasmuch as the channel has not been cleaned out, widened, or deepened north of Lincoln Park, and the other, and possibly more important factor of ice jams occurring during the winter months. During the winter of 1937-8 difficulty was experienced north of Silver Spring Road by reason of water and ice at a time when the river gauges showed a flow of ~~45,000~~ 4000 to 5000 c.f.s., which during time when there was no ice in the river would not be considered a severe flood.

Your statement is correct that the maximum floods have caused no substantial damage below the dam being built in Estabrook Park. As to the statement that the City of Milwaukee is no longer interested in any future measures for flood control above the City limits, and that the City Councilmen are against annexing areas to the north of Milwaukee, we have no information upon this, and therefore are unable to advise you with respect thereto.

What we have set forth above is rather long and pertains to the flood conditions in Milwaukee County only. We presume you will want to condense this information, but we are giving ~~you~~ to you somewhat in detail. If there is anything further we can furnish from our files, or from the plans and data we have on hand, do not hesitate to call upon us.

Yours very truly,
REGIONAL PLANNING DEPARTMENT

by ____________________
Supervising Engineer

EAH:B

UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE
WASHINGTON

ADDRESS ONLY
THE DIRECTOR, NATIONAL PARK SERVICE

December 17, 1940.

Mr. E. A. Howard, Supervising Engineer,
Regional Planning Department,
Milwaukee County,
Milwaukee, Wisconsin.

My dear Mr. Howard:

I have received the photograph of the Estabrook Park Dam, which you so kindly forwarded to me and I appreciate your thoughtfulness sincerely.

The dam is a very satisfactory appearing structure and I am sure that all of us who have had some association with it can be quite proud of the completed work. I hope that next summer, when the removable crest is in place and water is flowing over it, it will be possible to obtain another photograph from the opposite shore. With a flow of water over the masonry section I am sure that it will be an extremely attractive feature.

Sincerely yours,

E. F. Preece

E. F. Preece,
Senior Engineer.

ATTACHMENT 3:

SEWRPC TECHNICAL MEMO DATED APRIL 25, 2014 DRAFT

Kistner, Amy

From: Hahn, Michael G. [MHAHN@SEWRPC.org]
Sent: Friday, April 25, 2014 12:32 PM
To: Pirrung, Don
Cc: Murray, Joshua A.; Kevin Haley (kevin.haley@milwaukeecountywi.gov); 'james.keegan@milwaukeecountywi.gov'
Subject: FW: Estabrook Dam Memo
Attachments: ESTABROOK DAM EA HYDRAULIC ANALYSIS STAFF MEMO, Revised 04-25-14 PDF (00217870).PDF

Don,

Our revised Estabrook dam hydraulic analysis memo with Alternative 4 added is attached per distribution per your agreement with Milwaukee County.

Mike

Michael G. Hahn, P.E., P.H.
Chief Environmental Engineer
Southeastern Wisconsin Regional Planning Commission
P.O. Box 1607
W239 N1812 Rockwood Drive
Waukesha, WI 53187-1607
Phone: (262) 953-3243
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Web site: www.sewrpc.org

SOUTHEASTERN WISCONSIN REGIONAL PLANNING COMMISSION
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SEWRPC Staff Memorandum

HYDRAULIC ANALYSES FOR ESTABROOK DAM ENVIRONMENTAL ASSESSMENT

April 8, 2014
Revised April 25, 2014

INTRODUCTION AND BACKGROUND

An interagency technical advisory group meeting to discuss issues relative to the scope of a proposed Estabrook dam environmental assessment (EA) was convened by Milwaukee County, the owner of the dam, on November 28, 2012. During that meeting, there was considerable discussion of the need to develop and evaluate alternatives relative to the future status of the Estabrook dam, and Milwaukee County staff asked that the Southeastern Wisconsin Regional Planning Commission (SEWRPC) conduct hydraulic analyses of alternatives. A final decision on the specific features of each alternative was not made at that time, but it was decided that the SEWRPC hydraulic model of the Milwaukee River would incorporate bathymetric (riverbed elevation) survey data collected for the United States Environmental Protection Agency (USEPA) Lincoln Park/Milwaukee River Channel Phases 1 and 2 projects to remediate contaminated sediment within the Milwaukee River Area of Concern (AOC) and that the SEWRPC staff would coordinate with the Wisconsin Department of Natural Resources (WDNR) and County staffs to obtain those data.

On February 25, 2013, WDNR convened a meeting of a smaller interagency group to review specifics of the EA and coordinate the various components of the EA process. At that meeting, County staff agreed to coordinate with the Cities of Glendale and Milwaukee to provide SEWRPC with storm sewer outfall information for use in assessing relative changes in Milwaukee River stages at outfalls under the various alternatives to be evaluated hydraulically.

On August 27, 2013, Milwaukee County convened an Estabrook dam EA technical work group meeting at which one of the main topics of discussion was possible specific components of the alternatives relative to the dam.

A second full interagency technical advisory group meeting to discuss issues relative to the EA was organized by Milwaukee County on February 11, 2014. One of the main objectives of that meeting was obtaining agreement on 1) the alternatives to be addressed by the SEWRPC hydraulic analysis and 2) the specific components of each alternative. Based on that discussion, and on follow up discussions between the SEWRPC staff and the WDNR and County staffs for the purpose of clarifying details, the following alternative plans were selected for inclusion in the EA and for hydraulic analysis:

1) Rehabilitate the dam

1A) Rehabilitate the dam and add provisions for fish passage from downstream to upstream

2) Abandon and remove the dam

3) Abandon and remove the dam, providing a rock ramp to facilitate fish passage and establish an impoundment

The options of doing nothing or replacing the dam with a new structure were identified, but eliminated from further consideration. The do nothing alternative was eliminated because it would not address the existing deficiencies in the structure or public safety considerations, and therefore, would not be responsive to the WDNR Administrative Order requiring action relative to the dam. The option of constructing a new dam was eliminated because of the relatively high cost.

Another full interagency technical advisory group meeting was organized by Milwaukee County on April 9, 2014. One of the main objectives of that meeting was to discuss the April 8, 2014, preliminary draft SEWRPC hydraulic analysis. Based on that discussion, an additional alternative plan was identified and selected for inclusion in the EA and for hydraulic analysis. The additional alternative plan is:

4) Remove the gated spillway portion of the dam, lower the crest of, and rehabilitate, the serpentine overflow spillway, and provide a rock ramp at the location of the gated spillway to facilitate fish passage and establish an impoundment

SOURCES OF INFORMATION

The following sources of information were used in developing the hydraulic analysis:

1. Bathymetric data from the USEPA Lincoln Park/Milwaukee River Channel Phases 1 and 2 projects to remediate contaminated sediment within the Milwaukee River AOC

2. Storm sewer outfall information for the Cities of Glendale and Milwaukee as provided by the City of Milwaukee and the WDNR. Outfall pipe locations and sizes are available for both communities. Pipe invert elevations are only available for the City of Milwaukee.

3. The November 15, 2011, “owner’s review” version of the plans for the “Estabrook Dam Rehabilitation” prepared by AECOM Technical Services for the Milwaukee County Department of Parks, Recreation & Culture.

4. Information provided to SEWRPC by the Milwaukee River Preservation Association (MRPA), with their letter of March 11, 2014. The information provided by the MRPA that is directly applicable to the SEWRPC hydraulic analysis included a.) a map and accompanying table describing MRPA field observations of changes in vegetative growth in areas along the River that were once normally submerged, but have been continuously exposed since the current drawdown of the impoundment was ordered by WDNR for safety reasons, beginning in 2008 and b.) an undated report, apparently from the mid-1930s, by L. I. Johnstone entitled “Proposed Dam, Estabrook Park, Milwaukee County.” Additional information provided by MRPA was reviewed, but, while of interest relative to aspects of the status of the dam, were not directly applicable to the hydraulic analysis for the EA.

DESCRIPTION OF DAM FOR HYDRAULIC MODELING PURPOSES

Estabrook dam consists of two spillways separated by a natural island. From left to right, looking downstream, the dam and island components consist of:

- A concrete gated spillway with 10 steel vertical lift gates set in 11.5-foot-wide by 16-foot-high bays, with each gate, when closed, resting on a concrete sill at elevation 609.4 feet above National Geodetic Vertical Datum, 1929 adjustment (NGVD 29). Also, one 10-foot-wide bay with a concrete weir having a crest elevation of 616.5 feet above NGVD 29 is located on each end of the vertical lift gate section.

- The island,

- A serpentine concrete overflow spillway with 1) an 88-foot-long stop log section having a concrete crest elevation of 613.6 feet above NGVD 29 and a top-of-stop-log elevation of 616.4 feet above NGVD 29, and 2) a 450-foot-log concrete weir with a crest elevation ranging from 616.4 to 616.6 feet above NGVD 29.

SCOPE OF HYDRAULIC ANALYSIS

The hydraulic analysis of alternatives as performed by SEWRPC was for the purpose of determining the effect of the dam alternatives on water surface profiles of the Milwaukee River main stem under normal flow conditions (defined as the long-term median and mean flows based on 100 years of record at U.S. Geological Survey continuous streamflow gage No. 04087000) and flood flows with annual probabilities of occurrence of 10-, 2-, 1- and 0.2-percent (recurrence intervals of 10, 50, 100, and 500 years). The entire reach of the River in Milwaukee County was modeled, but the focus of the analysis was on the reach extending from just downstream of the dam upstream to W. Bender Road. In this reach the 10-percent-annual-probability flood flow is 8,790 cfs. The 2-percent-annual-probability flow ranges from 12,550 to 12,900 cfs. The 1-percent-annual-probability flow ranges from 14,340 to 14,800 cfs. The 0.2-percent-annual-probability flow ranges from 18,240 to 18,810 cfs. The median flow is 240 cfs, and the mean flow is 451 cfs, for the 100-year period of record.

In addition to estimating profiles under various flow conditions, the relative changes in River stage elevation at identified storm sewer outfalls were estimated.

The hydraulic analysis was not intended to address issues related to establishment of an operational order for the dam by the WDNR.

HYDRAULIC MODELING

The hydraulic analysis of the Milwaukee River main stem was performed using the U.S. Army Corps of Engineers HEC-RAS river analysis system computer program. The hydraulic model of the River was developed by the SEWRPC staff under an ongoing floodplain mapping study being conducted for the Milwaukee County Automated Mapping and Land Information System (MCAMLIS) Steering Committee and the Milwaukee Metropolitan Sewerage District. The hydraulic model which served as the starting point for the Estabrook dam EA analysis is the effective model for Federal flood insurance and local zoning purposes as described in the September 26, 2008, Federal Emergency Management Agency (FEMA) flood insurance study (FIS) for Milwaukee County.

Existing Condition
This condition was established to represent a comparative condition representative of a situation where the dam gates were allowed to be operated in response to changing flow conditions. Under flood flow conditions, the dam gates were assumed to be fully opened, similar to the current condition under the WDNR-ordered drawdown and to the condition attainable prior to the drawdown order. Under normal flow conditions, it was assumed that the gates could be closed so that those lower flows would be conveyed primarily over the overflow spillway and the two weir bays on either end of the gated spillway. That situation would be similar to the condition attainable prior to the drawdown order. In this case the "existing" designation refers to representation of existing Milwaukee River channel conditions and the ability to fully operate the dam consistent with the existing configuration. This is considered to be the appropriate condition to which the alternatives for the dam should be compared because it is consistent with maximization of the hydraulic capacity of the dam to pass floods and with the "normal" dam operating condition prior to the drawdown order when the impoundment was maintained outside of the winter months.

The first step in development of an existing condition HEC-RAS model for comparison with the models for the dam alternative conditions considered under the EA was refinement of the FEMA FIS model to reflect bathymetric data obtained under the USEPA Lincoln Park/Milwaukee River Channel Phases 1 and 2 projects for the Milwaukee River Area of Concern. For the Phase 1 sediment removal project, which has been implemented, as-built bathymetric information was available in the project area of the west Milwaukee River oxbow at the River's confluence with Lincoln Creek. For the Phase 2 project, which has been designed but has not yet been implemented, existing condition bathymetric survey information was available. The effective FEMA model was refined by modifying existing River channel cross sections to reflect as-built, post-project Phase 1 bathymetric conditions or existing, pre-project Phase 2 conditions and, where appropriate, adding channel and overbank cross sections to the model to represent those conditions.

In addition, the representation of Estabrook dam was refined to specifically reflect the elevation of the dam sill in the gated spillway section, to include the 10-foot-wide weir section on each end of the gated spillway, and to assume that the stop logs were in place under all flow conditions analyzed.

The model was also updated to reflect the two new Milwaukee River Parkway bridges over the west Milwaukee River oxbow, which were constructed after the date of the effective model.

Limited adjustments of Manning's roughness coefficients were made in the reach of the River generally between W. Hampton Avenue and the abandoned railroad bridge upstream of Lincoln Park to reflect vegetation which has become established since the drawdown of the impoundment was ordered by WDNR in 2008. The general locations of the areas were determined from the map and table provided by the MRPA, and were field checked by the SEWRPC staff on March 14, 2014.

1 and 1A) Rehabilitated Dam (With and Without Fish Passage)
The proposed dam repair and rehabilitation, as set forth on the 2011 plans prepared by AECOM Technical Services, would maintain the hydraulic characteristics of the existing dam. Also, as agreed during the February 11, 2014, interagency technical advisory group meeting, it is assumed that any fish passage facilities for the dam could be provided in such manner that the hydraulic characteristics of the dam would not be altered. Thus, the rehabilitated dam hydraulic model and the rehabilitated dam with fish passage hydraulic models are the same as the existing condition model.

2) Dam Abandoned and Removed
To represent this condition, the entire dam structure, including the gated and overflow spillway sections and the abutments, was assumed to be removed. The model for this condition was developed by modifying the existing condition model to reflect those removals.

3) Dam Abandoned and Removed with a 5.5-Foot-High Rock Ramp Constructed
This condition was represented by adding a 5.5-foot-high rock ramp across the full width of the Milwaukee River channel at a location approximately 1,600 feet upstream of the dam site. The rock ramp would have a crest elevation of 614.8 feet above NGVD 29, and an overflow length of 250 feet perpendicular to the direction of flow. The ramp would have a three horizontal on one vertical slope on its upstream face and a hemi-circular weir configuration on the downstream face with a slope ranging from 5 percent at the center of the weir to 3 percent at the banks to provide a slope gradual enough to enable fish passage.[1] That structure was added to the hydraulic model representing the condition with the dam abandoned and removed. This alternative was developed with the intent of maintaining an impoundment level similar to that with the dam in place, while facilitating fish passage.

3A) Dam Abandoned and Removed with a Four-Foot-High Rock Ramp Constructed
This condition was represented by adding a four-foot-high rock ramp across the full width of the Milwaukee River channel at a location approximately 1,600 feet upstream of the dam site. The rock ramp would have a crest elevation of 613.3 feet above NGVD 29, and an overflow length of 230 feet perpendicular to the direction of flow. The rock ramp would have a four horizontal on one vertical slope on its upstream face and a hemi-circular weir configuration on the downstream face with a slope ranging from 3.6 percent at the center of the weir to 2.2 percent at the banks to provide a slope gradual enough to enable fish passage. That structure was added to the hydraulic model representing the condition with the dam abandoned and removed. This alternative was developed with the intent of maintaining an impoundment level, while facilitating fish passage, and would meet regulatory requirements set forth in local zoning ordinances and Chapter NR 116, "Wisconsin's Floodplain Management Program," of the *Wisconsin Administrative Code* that do not permit activities which would increase the 1-percent-annual-probability flood stage unless easements were obtained from all affected property owners and a Conditional Letter of Map Revision (CLOMR) were obtained from FEMA prior to any construction.[2]

4) Gated Spillway Portion of the Dam Abandoned and Removed, Lowered and Rehabilitated Serpentine Overflow Spillway, and a 6.3-Foot-High Rock Ramp Constructed
This condition was represented by adding a 6.3-foot-high rock ramp across the Milwaukee River channel at the location of the removed gated spillway portion of the dam and lowering and rehabilitating the serpentine overflow spillway. The rock ramp would have a crest elevation of 615.4 feet above NGVD 29, an overflow length of 200 feet perpendicular to the direction of flow, a three horizontal on one vertical slope on its upstream face, and a hemi-circular weir configuration on the downstream face with a slope ranging from 5.5 percent at the center of the weir to 3.3 percent at the banks to provide a slope gradual enough to enable fish passage. The crest elevation of the serpentine overflow spillway would be lowered to 615.4 feet above NGVD 29 to match the crest of the 6.3-foot-high rock ramp. With the exception of the lowered crest elevation, the serpentine spillway would be rehabilitated as set forth on the 2011 AECOM plans. This alternative was developed with the intent of facilitating fish passage, and maintaining an impoundment level as close as possible to that with the dam in place, while meeting regulatory requirements set forth in local zoning ordinances and Chapter NR 116, "Wisconsin's Floodplain Management Program," of the *Wisconsin Administrative Code* that do not permit activities which would increase the 1-percent-annual-probability flood stage unless easements were obtained from all affected property owners and a Conditional Letter of Map Revision (CLOMR) were obtained from FEMA prior to any construction.

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[1] *The rock ramp configurations under Alternatives 3, 3A, and 4 were established based on criteria set forth in Reconnecting Rivers: Natural Channel Design in Dam Removal and Fish Passage, 2010 by Luther P. Aadland.*

[2] *As part of a CLOMR application to FEMA it would be necessary to 1) prepare an analysis of alternatives to the proposed project, 2) obtain documentation that all affected municipalities concur with the proposed floodplain changes, 3) provide assurance that no insurable structures are affected by any changes in the 1-percent-probability flood profile, and 4) notify all property owners affected by the changes in the 1-percent-probability flood profile.*

COMPARISON OF RESULTS OF HYDRAULIC ANALYSES

Tables 1 through 5 set forth the results of the normal flow and flood flow profile computations for each of the five alternatives analyzed under normal flow conditions and the 10-, 2-, 1- and 0.2-percent-annual-probability floods. The changes in water surface elevations under the alternatives are compared to the corresponding elevations under the existing conditions model as described above. The estimated potential changes in water surface elevations in the River at storm sewer outfalls for each alternative relative to the existing condition elevation are shown in Tables 1 through 5. The storm sewer outfall locations are indicated in Exhibit 1. For the purposes of the comparisons described herein, except as noted below, the lower reach is defined as the reach between Estabrook dam and W. Hampton Avenue, the middle reach is defined as the reach between W. Hampton Avenue and the abandoned railroad bridge upstream of Lincoln Park, and the upper reach is defined as the reach between the abandoned railroad bridge upstream of Lincoln Park and W. Bender Road. The maximum water depth under normal flow conditions is defined as the difference between the median water surface elevation and the minimum channel elevation at a particular cross-section. Changes in maximum water depths are compared by River reach in Table 6. Changes in the 1-percent-annual-probability water surface elevations are compared by River reach in Table 7.

Comparison and Evaluation of River Water Surface Elevation Changes Under Alternative 1
Alternative 1 water surface elevations are shown in Table 1. As described above, the rehabilitated dam alternative is the same as the existing conditions model. Therefore there is no difference in water surface elevations as compared to existing conditions. Under normal (median) flow conditions, which assume that the Estabrook dam gates are closed, the maximum water depth of the lower reach ranges from 7.4 to 8.7 feet. The maximum depth of the middle reach ranges from 6.3 to 9.2 feet, and the maximum depth of the upper reach ranges from 2.4 to 9.1 feet.

Comparison and Evaluation of River Water Surface Elevation Changes Under Alternative 2
Alternative 2 water surface elevations are shown in Table 2. The dam removal alternative results in a decrease in water surface elevations for each analyzed flow condition relative to existing dam conditions, including at each storm sewer outfall. Under 1-percent-probability flood flow conditions, the water surface elevation in the lower reach would decrease between 0.7 and 1.5 feet as compared to existing conditions. The 1-percent-probability elevation in the middle reach would decrease between 0.5 and 0.7 foot, and the 1-percent-probability elevation in the upper reach would decrease by up to 0.5 foot. Under normal (median) flow conditions, the water surface elevation in the lower reach would decrease between 3.7 and 7.5 feet with a maximum water depth ranging between 0.7 and 2.5 feet. The normal elevation in the middle reach would decrease between 4.5 and 5.4 feet with a maximum water depth ranging between 1.6 and 4.5 feet. The normal elevation in the upper reach would decrease between 0.5 and 4.6 feet with a maximum water depth ranging between 0.8 and 4.5 feet.

Comparison and Evaluation of River Water Surface Elevation Changes Under Alternative 3
Alternative 3 water surface elevations are shown in Table 3. A 5.5-foot-high rock ramp was modeled in order to maximize the normal impoundment level upstream of the ramp while clearly meeting the definition of a dam that would not be regulated under Chapter NR 333, “Dam Design and Construction,” of the *Wisconsin Administrative Code.* Chapter NR 333 exempts dams with storage capacities of more than 50 acre-feet (as would be the case for an impoundment created upstream of a 5.5-foot-high rock ramp in the River), but a structural height of six feet or less, assuming the dam is not likely to endanger life, health or property.

While the 5.5-foot-high rock ramp alternative results in a decrease in water surface elevations for the normal (mean and median) flow conditions analyzed relative to existing conditions, including at each storm sewer outfall, it results in an increase in water surface elevations under each of the flood flow conditions analyzed, including the 1-percent-probability flood.

The increases in upstream flood stages under this alternative are caused because, at a given headwater elevation, the hydraulic capacity of the rock ramp would be less than that of Estabrook dam with the vertical lift gates open.

Under 1-percent-probability flood flow conditions, the water surface elevation in the lower reach, defined for this alternative as the reach between the rock ramp and W. Hampton Avenue, would increase between 0.7 and 1.2 feet as compared to existing conditions. The 1-percent-probability elevation in the middle reach would increase between 0.6 and 0.7 foot, and the 1-percent-probability elevation in the upper reach would increase by up to 0.6 foot. Thus, this alternative would not meet regulatory requirements set forth in local zoning ordinances and Chapter NR 116 of the *Wisconsin Administrative Code* that do not permit activities which would increase the 1-percent-annual-probability flood stage unless easements were obtained from all affected property owners and a Conditional Letter of Map Revision (CLOMR) were obtained from FEMA prior to any construction.

Under normal (median) flow conditions, the water surface elevation in the lower reach would decrease 1.6 feet with a maximum water depth ranging between 5.8 and 6.8 feet. The normal elevation in the middle reach would decrease 1.6 feet with a maximum water depth ranging between 4.7 and 7.6 feet. The normal elevation in the upper reach would decrease between 0.5 and 1.6 feet with a maximum water depth ranging between 1.7 and 7.5 feet.

Comparison and Evaluation of River Water Surface Elevation Changes Under Alternative 3A

Since Alternative 3 resulted in an increase in the 1-percent-annual-probability flood flow profile upstream of the rock ramp, an additional rock ramp alternative was analyzed. A four-foot-high rock ramp was modeled in order to maximize the impoundment level upstream of the ramp while not causing an increase in the 1-percent-probability flood profile. The rock ramp slopes of this alternative were reduced as compared with Alternative 3 due to the lower height of the crest and the desire to maintain the same design “foot print” and ramp cross-section locations in order to provide water surface elevation comparisons consistent with Alternatives 1, 2, and 3. The four-foot-high rock ramp would be expected to result in a decrease in water surface elevations for each analyzed flow condition relative to existing dam conditions, including at each storm sewer outfall. Alternative 3A water surface elevations are shown in Table 4.

Under 1-percent-probability flood flow conditions, the water surface elevation in the lower reach, also defined for this alternative as the reach between the rock ramp and W. Hampton Avenue, would decrease between 0.1 and 0.2 foot as compared to existing conditions. The 1-percent-probability elevation in the middle reach would decrease 0.1 foot, and the 1-percent-probability elevation in the upper reach would decrease by up to 0.1 foot. Thus, this alternative would meet regulatory requirements set forth in local zoning ordinances and Chapter NR 116 of the *Wisconsin Administrative Code* that do not permit activities which would increase the 1-percent-annual-probability flood stage unless easements were obtained from all affected property owners and a Conditional Letter of Map Revision (CLOMR) were obtained from FEMA prior to any construction.

Under normal (median) flow conditions, the water surface elevation in the lower reach would decrease 3.1 feet with a maximum water depth ranging between 4.3 and 5.3 feet. The normal elevation in the middle reach would decrease between 2.7 and 3.1 feet with a maximum water depth ranging between 3.6 and 6.5 feet. The normal elevation in the upper reach would decrease between 0.5 and 2.7 feet with a maximum water depth ranging between 1.5 and 6.4 feet.

Comparison and Evaluation of River Water Surface Elevation Changes Under Alternative 4

This alternative was developed to increase the elevation of the impoundment water surface as compared to Alternative 3A, while not causing an increase in the 1-percent-probability flood profile by moving the location of the rock ramp to the site of the removed gated spillway portion of the dam and maintaining the serpentine overflow spillway. Since the overall width of the Milwaukee River is greater at Estabrook Dam than at the location of the rock ramp included under Alternatives 3 and 3A, utilizing both a rock ramp at the gated spillway site and the overflow spillway with a lowered crest in tandem to establish the impoundment level allows for a greater conveyance capacity at a given headwater elevation to pass flood flows as compared to Alternatives 3 and 3A, while enabling establishment of a higher ramp crest to increase the elevation of the impoundment water surface under normal flow conditions. However, under this alternative, both the 6.3-foot-high rock ramp and the serpentine overflow spillway would meet the definition of a dam that would be regulated under Chapter NR 333.

The 6.3-foot- high rock ramp and lowered overflow spillway alternative would be expected to result in a decrease in water surface elevations upstream of the dam for the normal (mean and median) flow conditions and for the 2-, 1-, and 0.2-percent-probability flood flow conditions relative to existing dam conditions, including at each storm sewer outfall. Under the 10-percent-probability flood it would not be expected to result in hydraulically significant differences in water surface elevations. Alternative 4 water surface elevations are shown in Table 5.

Under 1-percent-probability flood flow conditions, the water surface elevation in the lower reach, would decrease between 0.2 and 0.4 foot as compared to existing conditions. The 1-percent-probability elevation in the middle reach would decrease 0.2 foot, and the 1-percent-probability elevation in the upper reach would decrease by up to 0.2 foot. Thus, this alternative would meet regulatory requirements set forth in local zoning ordinances and Chapter NR 116 of the *Wisconsin Administrative Code* that do not permit activities which would increase the 1-percent-annual-probability flood stage unless easements were be obtained from all affected property owners and a Conditional Letter of Map Revision (CLOMR) were obtained from FEMA prior to any construction.

Under normal (median) flow conditions, the water surface elevation in the lower reach would decrease 1.2 feet with a maximum water depth ranging between 6.2 and 7.5 feet. The normal elevation in the middle reach would decrease 1.2 feet with a maximum water depth ranging between 5.1 and 8.0 feet. The normal elevation in the upper reach would decrease between 0.4 and 1.2 feet with a maximum water depth ranging between 1.9 and 7.9 feet.

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ESTABROOK DAM EA HYDRAULIC ANALYSIS STAFF MEMO, REVISED 04/25/14 (00217296).DOC
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Table 1

WATER SURFACE PROFILE COMPARISON OF EXISTING DAM CONDITIONS TO ALTERNATIVE PLAN NO. 1: REHABILITATE THE DAM

				500-Yr Flow			100-Yr Flow			50-Yr Flow			10-Yr Flow			Median Flow			Mean Flow		
Model Reach	River Mile	Description[a]	Invert Elev NGVD29 (ft)	Dam Rehab W.S. Elev (NGVD29, ft)	Exist. Cond. W. S. Elev (NGVD29, ft)	Difference (ft)	Dam Rehab W.S. Elev (NGVD29, ft)	Exist. Cond. W. S. Elev (NGVD29, ft)	Difference (ft)	Dam Rehab W.S. Elev (NGVD29, ft)	Exist. Cond. W. S. Elev (NGVD29, ft)	Difference (ft)	Dam Rehab W.S. Elev (NGVD29, ft)	Exist. Cond. W. S. Elev (NGVD29, ft)	Difference (ft)	Dam Rehab W.S. Elev (NGVD29, ft)	Exist. Cond. W. S. Elev (NGVD29, ft)	Difference (ft)	Dam Rehab W.S. Elev (NGVD29, ft)	Exist. Cond. W. S. Elev (NGVD29, ft)	Difference (ft)
Milwaukee River - Lower Reach	**6.827**	**Cross-Section**		621.11	621.11	0.00	619.23	619.23	0.00	618.29	618.29	0.00	616.12	616.12	0.00	609.44	609.44	0.00	609.89	609.89	0.00
	6.8275	Estabrook Park Dam																			
	6.828	Outfall MkeR-7, left		621.65	621.65	0.00	619.96	619.96	0.00	619.17	619.17	0.00	617.50	617.50	0.00	613.17	613.17	0.00	613.51	613.51	0.00
	6.829	**Cross-Section**		622.18	622.18	0.00	620.68	620.68	0.00	620.05	620.05	0.00	618.88	618.88	0.00	616.89	616.89	0.00	617.12	617.12	0.00
	6.843	**Cross-Section**		622.18	622.18	0.00	620.67	620.67	0.00	620.04	620.04	0.00	618.87	618.87	0.00	616.89	616.89	0.00	617.12	617.12	0.00
	6.866	Outfall MkeR-8, right		622.16	622.16	0.00	620.66	620.66	0.00	620.03	620.03	0.00	618.87	618.87	0.00	616.89	616.89	0.00	617.12	617.12	0.00
	6.928	**Cross-Section**		622.10	622.10	0.00	620.63	620.63	0.00	620.01	620.01	0.00	618.87	618.87	0.00	616.89	616.89	0.00	617.12	617.12	0.00
	6.941	**Cross-Section**		622.14	622.14	0.00	620.66	620.66	0.00	620.05	620.05	0.00	618.89	618.89	0.00	616.89	616.89	0.00	617.12	617.12	0.00
	6.96	**Cross-Section**		622.16	622.16	0.00	620.69	620.69	0.00	620.07	620.07	0.00	618.90	618.90	0.00	616.89	616.89	0.00	617.12	617.12	0.00
	6.963	**Cross-Section**		622.17	622.17	0.00	620.70	620.70	0.00	620.08	620.08	0.00	618.91	618.91	0.00	616.89	616.89	0.00	617.12	617.12	0.00
	6.987	**Cross-Section**		622.32	622.32	0.00	620.82	620.82	0.00	620.18	620.18	0.00	618.97	618.97	0.00	616.89	616.89	0.00	617.12	617.12	0.00
	7.087	**Cross-Section**		622.68	622.68	0.00	621.15	621.15	0.00	620.48	620.48	0.00	619.18	619.18	0.00	616.89	616.89	0.00	617.12	617.12	0.00
	7.096	Outfall MkeR-9, left	610.8	622.66	622.66	0.00	621.14	621.14	0.00	620.47	620.47	0.00	619.17	619.17	0.00	616.89	616.89	0.00	617.12	617.12	0.00
	7.098	Outfall MkeR-10, left		622.66	622.66	0.00	621.14	621.14	0.00	620.47	620.47	0.00	619.17	619.17	0.00	616.89	616.89	0.00	617.12	617.12	0.00
	7.103	**Cross-Section**		622.65	622.65	0.00	621.13	621.13	0.00	620.47	620.47	0.00	619.17	619.17	0.00	616.89	616.89	0.00	617.12	617.12	0.00
	7.104	Outfall MkeR-11, right	615.6	622.66	622.66	0.00	621.13	621.13	0.00	620.47	620.47	0.00	619.17	619.17	0.00	616.89	616.89	0.00	617.12	617.12	0.00
	7.104	Outfall MkeR-12, right		622.66	622.66	0.00	621.13	621.13	0.00	620.47	620.47	0.00	619.17	619.17	0.00	616.89	616.89	0.00	617.12	617.12	0.00
	7.11	Port Washington Road																			
	7.117	**Cross-Section**		622.72	622.72	0.00	621.19	621.19	0.00	620.52	620.52	0.00	619.21	619.21	0.00	616.89	616.89	0.00	617.12	617.12	0.00
	7.16	**Cross-Section**		622.81	622.81	0.00	621.28	621.28	0.00	620.60	620.60	0.00	619.27	619.27	0.00	616.89	616.89	0.00	617.12	617.12	0.00
	7.17	IH 43																			
	7.183	**Cross-Section**		622.95	622.95	0.00	621.41	621.41	0.00	620.72	620.72	0.00	619.35	619.35	0.00	616.90	616.90	0.00	617.13	617.13	0.00
	7.189	**Cross-Section**		622.99	622.99	0.00	621.44	621.44	0.00	620.75	620.75	0.00	619.37	619.37	0.00	616.90	616.90	0.00	617.13	617.13	0.00
	7.19	Ramp to IH 43																			
	7.199	**Cross-Section**		623.11	623.11	0.00	621.54	621.54	0.00	620.84	620.84	0.00	619.44	619.44	0.00	616.92	616.92	0.00	617.16	617.16	0.00
	7.201	Outfall MkeR-13, right		623.11	623.11	0.00	621.54	621.54	0.00	620.84	620.84	0.00	619.44	619.44	0.00	616.92	616.92	0.00	617.16	617.16	0.00
	7.241	Outfall MkeR-14, right		623.20	623.20	0.00	621.63	621.63	0.00	620.92	620.92	0.00	619.51	619.51	0.00	616.92	616.92	0.00	617.16	617.16	0.00
	7.359	**Cross-Section**		623.44	623.44	0.00	621.87	621.87	0.00	621.15	621.15	0.00	619.69	619.69	0.00	616.92	616.92	0.00	617.16	617.16	0.00
	7.519	Outfall MkeR-15, right	629.46	623.91	623.91	0.00	622.31	622.31	0.00	621.57	621.57	0.00	620.01	620.01	0.00	616.92	616.92	0.00	617.16	617.16	0.00
	7.519	**Cross-Section**		623.91	623.91	0.00	622.31	622.31	0.00	621.57	621.57	0.00	620.01	620.01	0.00	616.92	616.92	0.00	617.16	617.16	0.00
	7.526	Outfall MkeR-16, right		623.92	623.92	0.00	622.32	622.32	0.00	621.58	621.58	0.00	620.02	620.02	0.00	616.92	616.92	0.00	617.16	617.16	0.00
	7.576	Outfall MkeR-17, right	618.1	623.99	623.99	0.00	622.40	622.40	0.00	621.66	621.66	0.00	620.08	620.08	0.00	616.92	616.92	0.00	617.16	617.16	0.00
	7.633	**Cross-Section**		624.07	624.07	0.00	622.48	622.48	0.00	621.74	621.74	0.00	620.15	620.15	0.00	616.92	616.92	0.00	617.16	617.16	0.00
	7.64	Outfall MkeR-18, right		624.08	624.08	0.00	622.49	622.49	0.00	621.75	621.75	0.00	620.16	620.16	0.00	616.92	616.92	0.00	617.16	617.16	0.00
	7.654	**Cross-Section**		624.09	624.09	0.00	622.50	622.50	0.00	621.76	621.76	0.00	620.17	620.17	0.00	616.92	616.92	0.00	617.16	617.16	0.00
	7.656	Outfall MkeR-19, right		624.11	624.11	0.00	622.52	622.52	0.00	621.78	621.78	0.00	620.18	620.18	0.00	616.92	616.92	0.00	617.16	617.16	0.00
	7.66	Hampton Avenue																			
	7.669	**Cross-Section**		624.26	624.26	0.00	622.65	622.65	0.00	621.89	621.89	0.00	620.26	620.26	0.00	616.92	616.92	0.00	617.16	617.16	0.00
	7.669	Outfall MkeR-20, right		624.26	624.26	0.00	622.65	622.65	0.00	621.89	621.89	0.00	620.26	620.26	0.00	616.92	616.92	0.00	617.16	617.16	0.00
	7.706	**Cross-Section**		624.50	624.50	0.00	622.81	622.81	0.00	622.02	622.02	0.00	620.34	620.34	0.00	616.92	616.92	0.00	617.16	617.16	0.00
	7.745	**Cross-Section**		624.66	624.66	0.00	622.95	622.95	0.00	622.14	622.14	0.00	620.42	620.42	0.00	616.92	616.92	0.00	617.16	617.16	0.00

Table 1 (continued)

Model Reach	River Mile	Description[a]	Invert Elev NGVD29 (ft)	500-Yr Flow			100-Yr Flow			50-Yr Flow			10-Yr Flow			Median Flow			Mean Flow		
				Dam Rehab W.S. Elev (NGVD29, ft)	Exist. Cond. W. S. Elev (NGVD29, ft)	Difference (ft)	Dam Rehab W.S. Elev (NGVD29, ft)	Exist. Cond. W. S. Elev (NGVD29, ft)	Difference (ft)	Dam Rehab W.S. Elev (NGVD29, ft)	Exist. Cond. W. S. Elev (NGVD29, ft)	Difference (ft)	Dam Rehab W.S. Elev (NGVD29, ft)	Exist. Cond. W. S. Elev (NGVD29, ft)	Difference (ft)	Dam Rehab W.S. Elev (NGVD29, ft)	Exist. Cond. W. S. Elev (NGVD29, ft)	Difference (ft)	Dam Rehab W.S. Elev (NGVD29, ft)	Exist. Cond. W. S. Elev (NGVD29, ft)	Difference (ft)
Milwaukee River - Middle Reach	**7.851**	**Cross-Section**		624.86	624.86	0.00	623.13	623.13	0.00	622.30	622.30	0.00	620.53	620.53	0.00	616.92	616.92	0.00	617.16	617.16	0.00
	7.876	**Cross-Section**		624.87	624.87	0.00	623.14	623.14	0.00	622.32	622.32	0.00	620.54	620.54	0.00	616.92	616.92	0.00	617.16	617.16	0.00
	7.934	**Cross-Section**		624.90	624.90	0.00	623.17	623.17	0.00	622.35	622.35	0.00	620.57	620.57	0.00	616.92	616.92	0.00	617.16	617.16	0.00
	7.945	Outfall MkeR-21, left		624.90	624.90	0.00	623.17	623.17	0.00	622.35	622.35	0.00	620.57	620.57	0.00	616.92	616.92	0.00	617.16	617.16	0.00
	8.003	**Cross-Section**		624.90	624.90	0.00	623.18	623.18	0.00	622.36	622.36	0.00	620.58	620.58	0.00	616.92	616.92	0.00	617.16	617.16	0.00
	8.098	Outfall MkeR-22, right	613.85	624.93	624.93	0.00	623.21	623.21	0.00	622.39	622.39	0.00	620.61	620.61	0.00	616.92	616.92	0.00	617.17	617.17	0.00
	8.132	**Cross-Section**		624.94	624.94	0.00	623.22	623.22	0.00	622.40	622.40	0.00	620.62	620.62	0.00	616.92	616.92	0.00	617.17	617.17	0.00
	8.141	**Cross-Section**		624.94	624.94	0.00	623.22	623.22	0.00	622.40	622.40	0.00	620.62	620.62	0.00	616.92	616.92	0.00	617.17	617.17	0.00
	8.145	**Cross-Section**		624.94	624.94	0.00	623.22	623.22	0.00	622.41	622.41	0.00	620.63	620.63	0.00	616.92	616.92	0.00	617.17	617.17	0.00
Milwaukee River - Right Split (west oxbow)	**7.8761**	**Cross-Section**		624.83	624.83	0.00	623.09	623.09	0.00	622.27	622.27	0.00	620.49	620.49	0.00	616.92	616.92	0.00	617.16	617.16	0.00
	7.9	Milwaukee River Parkway																			
	7.9341	**Cross-Section**		624.85	624.85	0.00	623.11	623.11	0.00	622.30	622.30	0.00	620.52	620.52	0.00	616.92	616.92	0.00	617.16	617.16	0.00
	8.0031	**Cross-Section**		624.92	624.92	0.00	623.20	623.20	0.00	622.38	622.38	0.00	620.59	620.59	0.00	616.92	616.92	0.00	617.16	617.16	0.00
	8.047	Lincoln Creek Confluence		624.92	624.92	0.00	623.20	623.20	0.00	622.38	622.38	0.00	620.59	620.59	0.00	616.92	616.92	0.00	617.16	617.16	0.00
	8.1321	**Cross-Section**		624.93	624.93	0.00	623.20	623.20	0.00	622.38	622.38	0.00	620.60	620.60	0.00	616.92	616.92	0.00	617.16	617.16	0.00
	8.1411	**Cross-Section**		624.90	624.90	0.00	623.18	623.18	0.00	622.36	622.36	0.00	620.58	620.58	0.00	616.92	616.92	0.00	617.16	617.16	0.00
	8.142	Milwaukee River Parkway																			
	8.1451	**Cross-Section**		624.91	624.91	0.00	623.19	623.19	0.00	622.37	622.37	0.00	620.59	620.59	0.00	616.92	616.92	0.00	617.17	617.17	0.00
Milwaukee River - Upper Reach	**8.229**	**Cross-Section**		624.68	624.68	0.00	623.02	623.02	0.00	622.24	622.24	0.00	620.54	620.54	0.00	616.92	616.92	0.00	617.17	617.17	0.00
	8.244	Outfall MkeR-23, right	615.04	624.71	624.71	0.00	623.05	623.05	0.00	622.27	622.27	0.00	620.57	620.57	0.00	616.92	616.92	0.00	617.17	617.17	0.00
	8.341	**Cross-Section**		624.90	624.90	0.00	623.26	623.26	0.00	622.48	622.48	0.00	620.76	620.76	0.00	616.92	616.92	0.00	617.17	617.17	0.00
	8.343	Outfall MkeR-24, right		624.89	624.89	0.00	623.26	623.26	0.00	622.48	622.48	0.00	620.76	620.76	0.00	616.92	616.92	0.00	617.17	617.17	0.00
	8.357	**Cross-Section**		624.84	624.84	0.00	623.23	623.23	0.00	622.45	622.45	0.00	620.75	620.75	0.00	616.92	616.92	0.00	617.17	617.17	0.00
	8.36	Railroad Bridge																			
	8.366	Outfall MkeR-25, right	613.02	625.02	625.02	0.00	623.37	623.37	0.00	622.58	622.58	0.00	620.85	620.85	0.00	616.95	616.95	0.00	617.19	617.19	0.00
	8.375	**Cross-Section**		625.20	625.20	0.00	623.51	623.51	0.00	622.71	622.71	0.00	620.94	620.94	0.00	616.97	616.97	0.00	617.21	617.21	0.00
	8.381	**Cross-Section**		625.21	625.21	0.00	623.53	623.53	0.00	622.73	622.73	0.00	620.96	620.96	0.00	616.97	616.97	0.00	617.21	617.21	0.00
	8.389	Outfall MkeR-27, left		625.33	625.33	0.00	623.61	623.61	0.00	622.79	622.79	0.00	620.98	620.98	0.00	616.97	616.97	0.00	617.21	617.21	0.00
	8.39	Outfall MkeR-26, right	611.95	625.34	625.34	0.00	623.62	623.62	0.00	622.79	622.79	0.00	620.99	620.99	0.00	616.97	616.97	0.00	617.21	617.21	0.00
	8.394	**Cross-Section**		625.40	625.40	0.00	623.66	623.66	0.00	622.82	622.82	0.00	621.00	621.00	0.00	616.97	616.97	0.00	617.21	617.21	0.00
	8.553	Outfall MkeR-28, left		626.15	626.15	0.00	624.36	624.36	0.00	623.49	623.49	0.00	621.58	621.58	0.00	616.97	616.97	0.00	617.22	617.22	0.00
	8.574	Outfall MkeR-29, right	616.26	626.25	626.25	0.00	624.45	624.45	0.00	623.58	623.58	0.00	621.65	621.65	0.00	616.97	616.97	0.00	617.22	617.22	0.00
	8.579	**Cross-Section**		626.27	626.27	0.00	624.47	624.47	0.00	623.60	623.60	0.00	621.67	621.67	0.00	616.97	616.97	0.00	617.22	617.22	0.00
	8.66	**Cross-Section**		626.73	626.73	0.00	624.88	624.88	0.00	623.99	623.99	0.00	621.98	621.98	0.00	616.98	616.98	0.00	617.23	617.23	0.00
	8.716	**Cross-Section**		626.90	626.90	0.00	625.06	625.06	0.00	624.16	624.16	0.00	622.16	622.16	0.00	616.98	616.98	0.00	617.23	617.23	0.00
	8.73	Outfall MkeR-30, left		626.88	626.88	0.00	625.05	625.05	0.00	624.16	624.16	0.00	622.15	622.15	0.00	616.98	616.98	0.00	617.23	617.23	0.00
	8.73	**Cross-Section**		626.88	626.88	0.00	625.05	625.05	0.00	624.16	624.16	0.00	622.15	622.15	0.00	616.98	616.98	0.00	617.23	617.23	0.00
	8.732	Outfall MkeR-31, right		626.89	626.89	0.00	625.06	625.06	0.00	624.17	624.17	0.00	622.16	622.16	0.00	616.98	616.98	0.00	617.23	617.23	0.00
	8.733	Outfall MkeR-33, left		626.90	626.90	0.00	625.07	625.07	0.00	624.18	624.18	0.00	622.17	622.17	0.00	616.98	616.98	0.00	617.23	617.23	0.00
	8.734	Outfall MkeR-32, right		626.91	626.91	0.00	625.07	625.07	0.00	624.18	624.18	0.00	622.17	622.17	0.00	616.98	616.98	0.00	617.23	617.23	0.00
	8.74	Silver Spring Road																			
	8.759	**Cross-Section**		627.07	627.07	0.00	625.22	625.22	0.00	624.33	624.33	0.00	622.32	622.32	0.00	616.98	616.98	0.00	617.24	617.24	0.00
	8.783	**Cross-Section**		627.14	627.14	0.00	625.29	625.29	0.00	624.39	624.39	0.00	622.39	622.39	0.00	616.98	616.98	0.00	617.25	617.25	0.00
	8.963	**Cross-Section**		627.70	627.70	0.00	625.87	625.87	0.00	624.97	624.97	0.00	622.93	622.93	0.00	616.99	616.99	0.00	617.26	617.26	0.00
	8.966	Outfall MkeR-34, right		627.71	627.71	0.00	625.88	625.88	0.00	624.98	624.98	0.00	622.94	622.94	0.00	616.99	616.99	0.00	617.26	617.26	0.00
	9.125	**Cross-Section**		628.28	628.28	0.00	626.45	626.45	0.00	625.55	625.55	0.00	623.49	623.49	0.00	617.00	617.00	0.00	617.29	617.29	0.00
	9.13	Outfall MkeR-35, left		628.31	628.31	0.00	626.47	626.47	0.00	625.57	625.57	0.00	623.51	623.51	0.00	617.00	617.00	0.00	617.29	617.29	0.00
	9.242	Outfall MkeR-36, left		628.87	628.87	0.00	627.02	627.02	0.00	626.11	626.11	0.00	624.02	624.02	0.00	617.01	617.01	0.00	617.33	617.33	0.00
	9.244	Outfall MkeR-37, right		628.88	628.88	0.00	627.03	627.03	0.00	626.12	626.12	0.00	624.03	624.03	0.00	617.01	617.01	0.00	617.33	617.33	0.00
	9.376	Outfall MkeR-38, left		629.54	629.54	0.00	627.67	627.67	0.00	626.76	626.76	0.00	624.63	624.63	0.00	617.02	617.02	0.00	617.37	617.37	0.00

Table 1 (continued)

Model Reach	River Mile	Description[a]	Invert Elev NGVD29 (ft)	500-Yr Flow Dam Rehab W.S. Elev (NGVD29, ft)	500-Yr Flow Exist. Cond. W. S. Elev (NGVD29, ft)	500-Yr Flow Difference (ft)	100-Yr Flow Dam Rehab W.S. Elev (NGVD29, ft)	100-Yr Flow Exist. Cond. W. S. Elev (NGVD29, ft)	100-Yr Flow Difference (ft)	50-Yr Flow Dam Rehab W.S. Elev (NGVD29, ft)	50-Yr Flow Exist. Cond. W. S. Elev (NGVD29, ft)	50-Yr Flow Difference (ft)	10-Yr Flow Dam Rehab W.S. Elev (NGVD29, ft)	10-Yr Flow Exist. Cond. W. S. Elev (NGVD29, ft)	10-Yr Flow Difference (ft)	Median Flow Dam Rehab W.S. Elev (NGVD29, ft)	Median Flow Exist. Cond. W. S. Elev (NGVD29, ft)	Median Flow Difference (ft)	Mean Flow Dam Rehab W.S. Elev (NGVD29, ft)	Mean Flow Exist. Cond. W. S. Elev (NGVD29, ft)	Mean Flow Difference (ft)
Milwaukee River - Upper Reach (continued)	**9.427**	**Cross-Section**		629.79	629.79	0.00	627.92	627.92	0.00	627.00	627.00	0.00	624.86	624.86	0.00	617.03	617.03	0.00	617.39	617.39	0.00
	9.471	Outfall MkeR-40, right		629.94	629.94	0.00	628.07	628.07	0.00	627.15	627.15	0.00	625.01	625.01	0.00	617.04	617.04	0.00	617.42	617.42	0.00
	9.476	Outfall MkeR-39, left		629.95	629.95	0.00	628.09	628.09	0.00	627.17	627.17	0.00	625.03	625.03	0.00	617.04	617.04	0.00	617.42	617.42	0.00
	9.601	Outfall MkeR-41, left		630.37	630.37	0.00	628.51	628.51	0.00	627.59	627.59	0.00	625.45	625.45	0.00	617.07	617.07	0.00	617.49	617.49	0.00
	9.632	Outfall MkeR-42, right		630.47	630.47	0.00	628.61	628.61	0.00	627.69	627.69	0.00	625.55	625.55	0.00	617.08	617.08	0.00	617.51	617.51	0.00
	9.669	**Cross-Section**		630.59	630.59	0.00	628.74	628.74	0.00	627.82	627.82	0.00	625.68	625.68	0.00	617.09	617.09	0.00	617.53	617.53	0.00
	9.834	Outfall MkeR-43, right		631.35	631.35	0.00	629.73	629.73	0.00	628.96	628.96	0.00	627.04	627.04	0.00	617.25	617.25	0.00	617.86	617.86	0.00
	9.846	**Cross-Section**		631.40	631.40	0.00	629.80	629.80	0.00	629.04	629.04	0.00	627.14	627.14	0.00	617.26	617.26	0.00	617.88	617.88	0.00
	9.854	Outfall MkeR-44, left		631.46	631.46	0.00	629.86	629.86	0.00	629.10	629.10	0.00	627.19	627.19	0.00	617.27	617.27	0.00	617.89	617.89	0.00
	9.973	Outfall MkeR-45, right		632.39	632.39	0.00	630.82	630.82	0.00	630.03	630.03	0.00	627.97	627.97	0.00	617.35	617.35	0.00	618.04	618.04	0.00
	10.009	**Cross-Section**		632.67	632.67	0.00	631.11	631.11	0.00	630.31	630.31	0.00	628.20	628.20	0.00	617.38	617.38	0.00	618.08	618.08	0.00
	10.015	Outfall MkeR-46, right		632.75	632.75	0.00	631.17	631.17	0.00	630.37	630.37	0.00	628.24	628.24	0.00	617.38	617.38	0.00	618.08	618.08	0.00
	10.023	**Cross-Section**		632.85	632.85	0.00	631.26	631.26	0.00	630.44	630.44	0.00	628.30	628.30	0.00	617.39	617.39	0.00	618.09	618.09	0.00
	10.025	Outfall MkeR-48, left		632.85	632.85	0.00	631.26	631.26	0.00	630.44	630.44	0.00	628.30	628.30	0.00	617.39	617.39	0.00	618.09	618.09	0.00
	10.038	Outfall MkeR-47, right		632.82	632.82	0.00	631.23	631.23	0.00	630.42	630.42	0.00	628.28	628.28	0.00	617.40	617.40	0.00	618.10	618.10	0.00
	10.04	Bender Road																			
	10.051	**Cross-Section**		632.80	632.80	0.00	631.21	631.21	0.00	630.40	630.40	0.00	628.26	628.26	0.00	617.40	617.40	0.00	618.11	618.11	0.00
Lincoln Creek - Lower Mainstream	**0**	**Cross-Section**		624.92[b]	624.92[b]	0.00	623.20[b]	623.20[b]	0.00	622.38[b]	622.38[b]	0.00	620.59[b]	620.59[b]	0.00						
	0.03	**Cross-Section**		624.92[b]	624.92[b]	0.00	623.20[b]	623.20[b]	0.00	622.38[b]	622.38[b]	0.00	620.59[b]	620.59[b]	0.00						
	0.0303	Outfall LC-1, right		624.92[b]	624.92[b]	0.00	623.20[b]	623.20[b]	0.00	622.38[b]	622.38[b]	0.00	620.59[b]	620.59[b]	0.00						
	0.14	**Cross-Section**		624.92[b]	624.92[b]	0.00	623.20[b]	623.20[b]	0.00	622.38[b]	622.38[b]	0.00	620.59[b]	620.59[b]	0.00						
	0.16	**Cross-Section**		624.92[b]	624.92[b]	0.00	623.20[b]	623.20[b]	0.00	622.38[b]	622.38[b]	0.00	620.59[b]	620.59[b]	0.00						
	0.18	**Cross-Section**		624.92[b]	624.92[b]	0.00	623.20[b]	623.20[b]	0.00	622.38[b]	622.38[b]	0.00	620.59[b]	620.59[b]	0.00						
	0.181	Outfall LC-2, right	612.1	624.92[b]	624.92[b]	0.00	623.20[b]	623.20[b]	0.00	622.38[b]	622.38[b]	0.00	620.59[b]	620.59[b]	0.00						
	0.21	**Cross-Section**		624.92[b]	624.92[b]	0.00	623.20[b]	623.20[b]	0.00	622.38[b]	622.38[b]	0.00	620.59[b]	620.59[b]	0.00						
	0.33	**Cross-Section**		624.92[b]	624.92[b]	0.00	623.20[b]	623.20[b]	0.00	622.38[b]	622.38[b]	0.00	621.04	621.04	0.00						
	0.333	Outfall LC-3, left	614.44	624.92[b]	624.92[b]	0.00	623.20[b]	623.20[b]	0.00	622.38[b]	622.38[b]	0.00	621.07	621.07	0.00						
	0.4	**Cross-Section**		624.92[b]	624.92[b]	0.00	623.50	623.50	0.00	623.00	623.00	0.00	621.71	621.71	0.00						
	0.41	**Cross-Section**		624.92[b]	624.92[b]	0.00	623.52	623.52	0.00	623.03	623.03	0.00	621.73	621.73	0.00						
	0.41	Outfall LC-4, left	614.23	624.92[b]	624.92[b]	0.00	623.52	623.52	0.00	623.03	623.03	0.00	621.73	621.73	0.00						
	0.419	Outfall LC-5, right	616.72	624.92[b]	624.92[b]	0.00	623.62	623.62	0.00	623.03	623.03	0.00	621.73	621.73	0.00						
	0.42	N. Green Bay Avenue																			
	0.43	**Cross-Section**		625.59	625.59	0.00	623.74	623.74	0.00	623.21	623.21	0.00	621.87	621.87	0.00						
	0.44	**Cross-Section**		625.58	625.58	0.00	623.72	623.72	0.00	623.20	623.20	0.00	621.85	621.85	0.00						
	0.47	**Cross-Section**		626.18	626.18	0.00	624.18	624.18	0.00	623.60	623.60	0.00	622.12	622.12	0.00						
	0.5	**Cross-Section**		626.26	626.26	0.00	624.25	624.25	0.00	623.66	623.66	0.00	622.19	622.19	0.00						
	0.54	**Cross-Section**		626.21	626.21	0.00	624.25	624.25	0.00	623.69	623.69	0.00	622.27	622.27	0.00						
	0.6	**Cross-Section**		626.00	626.00	0.00	624.18	624.18	0.00	623.65	623.65	0.00	622.30	622.30	0.00						
	0.61	**Cross-Section**		626.12	626.12	0.00	624.31	624.31	0.00	623.78	623.78	0.00	622.40	622.40	0.00						
	0.62	**Cross-Section**		626.44	626.44	0.00	624.72	624.72	0.00	624.16	624.16	0.00	622.67	622.67	0.00						
	0.631	Outfall LC-6, left	614.76	626.51	626.51	0.00	624.76	624.76	0.00	624.20	624.20	0.00	622.70	622.70	0.00						
	0.71	**Cross-Section**		627.05	627.05	0.00	625.05	625.05	0.00	624.45	624.45	0.00	622.95	622.95	0.00						
	0.75	**Cross-Section**		627.13	627.13	0.00	625.15	625.15	0.00	624.55	624.55	0.00	623.05	623.05	0.00						
	0.79	**Cross-Section**		627.23	627.23	0.00	625.25	625.25	0.00	624.65	624.65	0.00	623.12	623.12	0.00						
	0.794	**Cross-Section**		627.25	627.25	0.00	625.28	625.28	0.00	624.67	624.67	0.00	623.15	623.15	0.00						
	0.798	Outfall LC-7, right	615.47	627.39	627.39	0.00	625.32	625.32	0.00	624.70	624.70	0.00	623.18	623.18	0.00						
	0.799	Outfall LC-8, right	615.46	627.42	627.42	0.00	625.33	625.33	0.00	624.71	624.71	0.00	623.18	623.18	0.00						
	0.803	W. Villard Avenue																			
	0.81	**Cross-Section**		627.79	627.79	0.00	625.43	625.43	0.00	624.79	624.79	0.00	623.26	623.26	0.00						
	0.82	**Cross-Section**		628.12	628.12	0.00	625.57	625.57	0.00	624.91	624.91	0.00	623.33	623.33	0.00						

[b]*Water surface elevation determined using backwater from the confluence with the Right Split (west oxbow) of the Milwaukee River.*

Table 1 (continued)

Model Reach	River Mile	Description[a]	Invert Elev NGVD29 (ft)	500-Yr Flow			100-Yr Flow			50-Yr Flow			10-Yr Flow			Median Flow			Mean Flow		
				Dam Rehab W.S. Elev (NGVD29, ft)	Exist. Cond. W. S. Elev (NGVD29, ft)	Difference (ft)	Dam Rehab W.S. Elev (NGVD29, ft)	Exist. Cond. W. S. Elev (NGVD29, ft)	Difference (ft)	Dam Rehab W.S. Elev (NGVD29, ft)	Exist. Cond. W. S. Elev (NGVD29, ft)	Difference (ft)	Dam Rehab W.S. Elev (NGVD29, ft)	Exist. Cond. W. S. Elev (NGVD29, ft)	Difference (ft)	Dam Rehab W.S. Elev (NGVD29, ft)	Exist. Cond. W. S. Elev (NGVD29, ft)	Difference (ft)	Dam Rehab W.S. Elev (NGVD29, ft)	Exist. Cond. W. S. Elev (NGVD29, ft)	Difference (ft)
Lincoln Creek - Lower Mainstream (continued)	0.848	Outfall LC-10, left	619.6	628.11	628.11	0.00	625.58	625.58	0.00	624.93	624.93	0.00	623.35	623.35	0.00						
	0.877	Outfall LC-9, right	619.17	628.11	628.11	0.00	625.60	625.60	0.00	624.94	624.94	0.00	623.37	623.37	0.00						
	0.909	**Cross-Section**		628.10	628.10	0.00	625.61	625.61	0.00	624.96	624.96	0.00	623.40	623.40	0.00						
	0.912	N. 24th Place Footbridge																			
	0.915	**Cross-Section**		628.22	628.22	0.00	625.64	625.64	0.00	624.98	624.98	0.00	623.42	623.42	0.00						
	0.919	Outfall LC-11, right	619.35	628.25	628.25	0.00	625.65	625.65	0.00	624.99	624.99	0.00	623.44	623.44	0.00						
	0.93	**Cross-Section**		628.34	628.34	0.00	625.69	625.69	0.00	625.03	625.03	0.00	623.48	623.48	0.00						
	0.972	Outfall LC-12, left	617.81	628.44	628.44	0.00	625.82	625.82	0.00	625.15	625.15	0.00	623.61	623.61	0.00						
	0.974	Outfall LC-13, left	617.09	628.44	628.44	0.00	625.83	625.83	0.00	625.16	625.16	0.00	623.61	623.61	0.00						
	0.987	Outfall LC-14, right	619.4	628.47	628.47	0.00	625.87	625.87	0.00	625.19	625.19	0.00	623.65	623.65	0.00						
	1.07	**Cross-Section**		628.67	628.67	0.00	626.12	626.12	0.00	625.43	625.43	0.00	623.90	623.90	0.00						
	1.12	**Cross-Section**		628.92	628.92	0.00	626.45	626.45	0.00	625.77	625.77	0.00	624.19	624.19	0.00						
	1.138	Outfall LC-15, left	616.13	629.04	629.04	0.00	626.60	626.60	0.00	625.90	625.90	0.00	624.32	624.32	0.00						
	1.141	Outfall LC-16, right	621.01	629.06	629.06	0.00	626.63	626.63	0.00	625.93	625.93	0.00	624.34	624.34	0.00						
	1.17	**Cross-Section**		629.25	629.25	0.00	626.87	626.87	0.00	626.14	626.14	0.00	624.54	624.54	0.00						

[a] *References to "left" and "right" are based on looking in the downstream direction.*

[b] *Water surface elevation determined using backwater from the confluence with the Right Split (west oxbow) of the Milwaukee River.*

ESTABROOK DAM STORM SEWER INVENTORY TABLES (00217490).DOC
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Table 2

WATER SURFACE PROFILE COMPARISON OF EXISTING DAM CONDITIONS TO ALTERNATIVE PLAN NO. 2: ABANDON AND REMOVE THE DAM

				500-Yr Flow			100-Yr Flow			50-Yr Flow			10-Yr Flow			Median Flow			Mean Flow		
Model Reach	River Mile	Description[a]	Invert Elev NGVD29 (ft)	Dam Removal W.S. Elev (NGVD29, ft)	Exist. Cond. W. S. Elev (NGVD29, ft)	Difference (ft)	Dam Removal W.S. Elev (NGVD29, ft)	Exist. Cond. W. S. Elev (NGVD29, ft)	Difference (ft)	Dam Removal W.S. Elev (NGVD29, ft)	Exist. Cond. W. S. Elev (NGVD29, ft)	Difference |(ft)	Dam Removal W.S. Elev (NGVD29, ft)	Exist. Cond. W. S. Elev (NGVD29, ft)	Difference (ft)	Dam Removal W.S. Elev (NGVD29, ft)	Exist. Cond. W. S. Elev (NGVD29, ft)	Difference (ft)	Dam Removal W.S. Elev (NGVD29, ft)	Exist. Cond. W. S. Elev (NGVD29, ft)	Difference (ft)
Milwaukee River - Lower Reach	**6.827**	**Cross-Section**		621.11	621.11	0.00	619.23	619.23	0.00	618.29	618.29	0.00	616.12	616.12	0.00	609.44	609.44	0.00	609.89	609.89	0.00
	6.8275	Estabrook Park Dam																			
	6.828	Outfall MkeR-7, left		621.11	621.65	-0.54	619.23	619.96	-0.73	618.29	619.17	-0.88	616.12	617.50	-1.38	609.44	613.17	-3.73	609.89	613.51	-3.62
	6.829	**Cross-Section**		621.11	622.18	-1.07	619.23	620.68	-1.45	618.29	620.05	-1.76	616.12	618.88	-2.76	609.44	616.89	-7.45	609.89	617.12	-7.23
	6.843	**Cross-Section**		621.11	622.18	-1.07	619.22	620.67	-1.45	618.29	620.04	-1.75	616.12	618.87	-2.75	609.95	616.89	-6.94	610.13	617.12	-6.99
	6.866	Outfall MkeR-8, right		621.09	622.16	-1.07	619.21	620.66	-1.45	618.29	620.03	-1.74	616.14	618.87	-2.73	610.08	616.89	-6.81	610.31	617.12	-6.81
	6.928	**Cross-Section**		621.04	622.10	-1.06	619.19	620.63	-1.44	618.28	620.01	-1.73	616.20	618.87	-2.67	610.43	616.89	-6.46	610.79	617.12	-6.33
	6.941	**Cross-Section**		621.09	622.14	-1.05	619.25	620.66	-1.41	618.35	620.05	-1.70	616.27	618.89	-2.62	610.45	616.89	-6.44	610.81	617.12	-6.31
	6.96	**Cross-Section**		621.12	622.16	-1.04	619.30	620.69	-1.39	618.40	620.07	-1.67	616.34	618.90	-2.56	610.47	616.89	-6.42	610.85	617.12	-6.27
	6.963	**Cross-Section**		621.13	622.17	-1.04	619.31	620.70	-1.39	618.41	620.08	-1.67	616.36	618.91	-2.55	610.48	616.89	-6.41	610.86	617.12	-6.26
	6.987	**Cross-Section**		621.32	622.32	-1.00	619.48	620.82	-1.34	618.58	620.18	-1.60	616.50	618.97	-2.47	610.53	616.89	-6.36	610.93	617.12	-6.19
	7.087	**Cross-Section**		621.79	622.68	-0.89	619.98	621.15	-1.17	619.09	620.48	-1.39	617.07	619.18	-2.11	610.75	616.89	-6.14	611.18	617.12	-5.94
	7.096	Outfall MkeR-9, left	610.8	621.77	622.66	-0.89	619.97	621.14	-1.16	619.08	620.47	-1.39	617.08	619.17	-2.10	610.77	616.89	-6.12	611.20	617.12	-5.92
	7.098	Outfall MkeR-10, left		621.77	622.66	-0.89	619.97	621.14	-1.16	619.08	620.47	-1.39	617.08	619.17	-2.10	610.77	616.89	-6.12	611.20	617.12	-5.92
	7.103	**Cross-Section**		621.76	622.65	-0.89	619.97	621.13	-1.16	619.08	620.47	-1.39	617.08	619.17	-2.09	610.78	616.89	-6.11	611.21	617.12	-5.91
	7.104	Outfall MkeR-11, right	615.6	621.77	622.66	-0.89	619.98	621.13	-1.16	619.09	620.47	-1.39	617.09	619.17	-2.09	610.78	616.89	-6.11	611.21	617.12	-5.91
	7.104	Outfall MkeR-12, right		621.77	622.66	-0.89	619.98	621.13	-1.16	619.09	620.47	-1.39	617.09	619.17	-2.09	610.78	616.89	-6.11	611.21	617.12	-5.91
	7.11	Port Washington Road																			
	7.117	**Cross-Section**		621.85	622.72	-0.87	620.05	621.19	-1.14	619.16	620.52	-1.36	617.16	619.21	-2.05	610.81	616.89	-6.08	611.24	617.12	-5.88
	7.16	**Cross-Section**		621.96	622.81	-0.85	620.18	621.28	-1.10	619.30	620.60	-1.30	617.30	619.27	-1.97	610.87	616.89	-6.02	611.32	617.12	-5.80
	7.17	IH 43																			
	7.183	**Cross-Section**		622.15	622.95	-0.80	620.37	621.41	-1.04	619.48	620.72	-1.24	617.48	619.35	-1.87	610.91	616.90	-5.99	611.37	617.13	-5.76
	7.189	**Cross-Section**		622.19	622.99	-0.80	620.41	621.44	-1.03	619.53	620.75	-1.22	617.53	619.37	-1.84	610.92	616.90	-5.98	611.38	617.13	-5.75
	7.19	Ramp to IH 43																			
	7.199	**Cross-Section**		622.32	623.11	-0.79	620.53	621.54	-1.01	619.65	620.84	-1.19	617.62	619.44	-1.82	610.94	616.92	-5.98	611.41	617.16	-5.75
	7.201	Outfall MkeR-13, right		622.33	623.11	-0.79	620.54	621.54	-1.01	619.66	620.84	-1.19	617.63	619.44	-1.82	610.94	616.92	-5.98	611.41	617.16	-5.75
	7.241	Outfall MkeR-14, right		622.43	623.20	-0.77	620.65	621.63	-0.98	619.78	620.92	-1.15	617.76	619.51	-1.75	611.01	616.92	-5.91	611.49	617.16	-5.67
	7.359	**Cross-Section**		622.74	623.44	-0.70	620.99	621.87	-0.88	620.13	621.15	-1.02	618.14	619.69	-1.55	611.20	616.92	-5.72	611.71	617.16	-5.45
	7.519	Outfall MkeR-15, right	629.46	623.30	623.91	-0.61	621.57	622.31	-0.74	620.71	621.57	-0.86	618.73	620.01	-1.28	611.41	616.92	-5.51	611.97	617.16	-5.19
	7.519	**Cross-Section**		623.30	623.91	-0.61	621.57	622.31	-0.74	620.71	621.57	-0.86	618.73	620.01	-1.28	611.41	616.92	-5.51	611.97	617.16	-5.19
	7.526	Outfall MkeR-16, right		623.31	623.92	-0.61	621.58	622.32	-0.74	620.72	621.58	-0.86	618.74	620.02	-1.27	611.41	616.92	-5.51	611.98	617.16	-5.18
	7.576	Outfall MkeR-17, right	618.1	623.40	623.99	-0.59	621.68	622.40	-0.72	620.83	621.66	-0.83	618.85	620.08	-1.23	611.45	616.92	-5.47	612.03	617.16	-5.13
	7.633	**Cross-Section**		623.50	624.07	-0.57	621.79	622.48	-0.69	620.94	621.74	-0.80	618.97	620.15	-1.18	611.49	616.92	-5.43	612.08	617.16	-5.08
	7.64	Outfall MkeR-18, right		623.51	624.08	-0.57	621.80	622.49	-0.69	620.95	621.75	-0.80	618.98	620.16	-1.18	611.49	616.92	-5.43	612.08	617.16	-5.08
	7.654	**Cross-Section**		623.52	624.09	-0.57	621.82	622.50	-0.68	620.97	621.76	-0.79	619.00	620.17	-1.17	611.50	616.92	-5.42	612.09	617.16	-5.07
	7.656	Outfall MkeR-19, right		623.55	624.11	-0.57	621.84	622.52	-0.68	620.99	621.78	-0.78	619.02	620.18	-1.16	611.50	616.92	-5.42	612.09	617.16	-5.07
	7.66	Hampton Avenue																			
	7.669	**Cross-Section**		623.72	624.26	-0.54	622.00	622.65	-0.65	621.14	621.89	-0.75	619.13	620.26	-1.13	611.53	616.92	-5.39	612.12	617.16	-5.04
	7.669	Outfall MkeR-20, right		623.72	624.26	-0.54	622.00	622.65	-0.65	621.14	621.89	-0.75	619.13	620.26	-1.13	611.53	616.92	-5.39	612.12	617.16	-5.04
	7.706	**Cross-Section**		623.96	624.50	-0.54	622.17	622.81	-0.64	621.28	622.02	-0.74	619.24	620.34	-1.10	611.54	616.92	-5.38	612.14	617.16	-5.02
	7.745	**Cross-Section**		624.14	624.66	-0.52	622.32	622.95	-0.63	621.42	622.14	-0.72	619.35	620.42	-1.07	611.55	616.92	-5.37	612.16	617.16	-5.00

Decreases in water surface elevation relative to existing dam conditions.

Table 2 (continued)

				500-Yr Flow			100-Yr Flow			50-Yr Flow			10-Yr Flow			Median Flow			Mean Flow		
Model Reach	River Mile	Description[a]	Invert Elev NGVD29 (ft)	Dam Removal W.S. Elev (NGVD29, ft)	Exist. Cond. W. S. Elev (NGVD29, ft)	Difference (ft)	Dam Removal W.S. Elev (NGVD29, ft)	Exist. Cond. W. S. Elev (NGVD29, ft)	Difference (ft)	Dam Removal W.S. Elev (NGVD29, ft)	Exist. Cond. W. S. Elev (NGVD29, ft)	Difference |(ft)	Dam Removal W.S. Elev (NGVD29, ft)	Exist. Cond. W. S. Elev (NGVD29, ft)	Difference (ft)	Dam Removal W.S. Elev (NGVD29, ft)	Exist. Cond. W. S. Elev (NGVD29, ft)	Difference (ft)	Dam Removal W.S. Elev (NGVD29, ft)	Exist. Cond. W. S. Elev (NGVD29, ft)	Difference (ft)
Milwaukee River - Middle Reach	**7.851**	**Cross-Section**		624.37	624.86	-0.49	622.53	623.13	-0.60	621.61	622.30	-0.69	619.48	620.53	-1.05	612.19	616.92	-4.73	612.81	617.16	-4.35
	7.876	**Cross-Section**		624.38	624.87	-0.49	622.54	623.14	-0.60	621.63	622.32	-0.69	619.50	620.54	-1.04	612.20	616.92	-4.72	612.83	617.16	-4.33
	7.934	**Cross-Section**		624.41	624.90	-0.49	622.59	623.17	-0.58	621.67	622.35	-0.68	619.55	620.57	-1.02	612.23	616.92	-4.69	612.86	617.16	-4.30
	7.945	Outfall MkeR-21, left		624.41	624.90	-0.49	622.59	623.17	-0.58	621.67	622.35	-0.68	619.55	620.57	-1.02	612.23	616.92	-4.69	612.86	617.16	-4.30
	8.003	**Cross-Section**		624.42	624.90	-0.48	622.60	623.18	-0.58	621.68	622.36	-0.68	619.57	620.58	-1.01	612.26	616.92	-4.66	612.89	617.16	-4.27
	8.098	Outfall MkeR-22, right	613.85	624.45	624.93	-0.48	622.63	623.21	-0.58	621.72	622.39	-0.67	619.61	620.61	-1.00	612.28	616.92	-4.64	612.92	617.17	-4.25
	8.132	**Cross-Section**		624.46	624.94	-0.48	622.64	623.22	-0.58	621.73	622.40	-0.67	619.63	620.62	-0.99	612.29	616.92	-4.63	612.93	617.17	-4.24
	8.141	**Cross-Section**		624.46	624.94	-0.48	622.65	623.22	-0.57	621.74	622.40	-0.66	619.63	620.62	-0.99	612.29	616.92	-4.63	612.94	617.17	-4.23
	8.145	**Cross-Section**		624.47	624.94	-0.47	622.65	623.22	-0.57	621.74	622.41	-0.67	619.64	620.63	-0.99	612.30	616.92	-4.62	612.94	617.17	-4.23
Milwaukee River - Right Split (west oxbow)	**7.8761**	**Cross-Section**		624.33	624.83	-0.50	622.48	623.09	-0.61	621.56	622.27	-0.71	619.43	620.49	-1.06	612.19	616.92	-4.73	612.81	617.16	-4.35
	7.9	Milwaukee River Parkway																			
	7.9341	**Cross-Section**		624.35	624.85	-0.50	622.52	623.11	-0.59	621.60	622.30	-0.70	619.48	620.52	-1.04	612.23	616.92	-4.69	612.86	617.16	-4.30
	8.0031	**Cross-Section**		624.45	624.92	-0.47	622.62	623.20	-0.58	621.71	622.38	-0.67	619.58	620.59	-1.01	612.25	616.92	-4.67	612.89	617.16	-4.27
	8.047	Lincoln Creek Confluence		624.45	624.92	-0.47	622.62	623.20	-0.58	621.71	622.38	-0.67	619.58	620.59	-1.01	612.25	616.92	-4.67	612.89	617.16	-4.27
	8.1321	**Cross-Section**		624.45	624.93	-0.48	622.63	623.20	-0.57	621.71	622.38	-0.67	619.59	620.60	-1.01	612.25	616.92	-4.67	612.89	617.16	-4.27
	8.1411	**Cross-Section**		624.42	624.90	-0.48	622.60	623.18	-0.58	621.69	622.36	-0.67	619.57	620.58	-1.01	612.26	616.92	-4.66	612.90	617.16	-4.26
	8.142	Milwaukee River Parkway																			
	8.1451	**Cross-Section**		624.43	624.91	-0.48	622.61	623.19	-0.58	621.70	622.37	-0.67	619.59	620.59	-1.00	612.29	616.92	-4.63	612.93	617.17	-4.24
Milwaukee River - Upper Reach	**8.229**	**Cross-Section**		624.18	624.68	-0.50	622.43	623.02	-0.59	621.56	622.24	-0.68	619.54	620.54	-1.00	612.34	616.92	-4.58	613.01	617.17	-4.16
	8.244	Outfall MkeR-23, right	615.04	624.21	624.71	-0.49	622.47	623.05	-0.58	621.60	622.27	-0.67	619.59	620.57	-0.98	612.35	616.92	-4.57	613.02	617.17	-4.15
	8.341	**Cross-Section**		624.44	624.90	-0.46	622.73	623.26	-0.53	621.87	622.48	-0.61	619.89	620.76	-0.87	612.38	616.92	-4.54	613.07	617.17	-4.10
	8.343	Outfall MkeR-24, right		624.43	624.89	-0.46	622.73	623.26	-0.53	621.87	622.48	-0.61	619.89	620.76	-0.87	612.38	616.92	-4.54	613.07	617.17	-4.10
	8.357	**Cross-Section**		624.38	624.84	-0.46	622.69	623.23	-0.54	621.85	622.45	-0.60	619.88	620.75	-0.87	612.38	616.92	-4.54	613.08	617.17	-4.09
	8.36	Railroad Bridge																			
	8.366	Outfall MkeR-25, right	613.02	624.58	625.02	-0.44	622.86	623.37	-0.51	622.00	622.58	-0.59	620.00	620.85	-0.85	612.40	616.95	-4.54	613.11	617.19	-4.09
	8.375	**Cross-Section**		624.78	625.20	-0.42	623.02	623.51	-0.49	622.14	622.71	-0.57	620.12	620.94	-0.82	612.42	616.97	-4.55	613.13	617.21	-4.08
	8.381	**Cross-Section**		624.80	625.21	-0.41	623.04	623.53	-0.49	622.17	622.73	-0.56	620.14	620.96	-0.82	612.42	616.97	-4.55	613.13	617.21	-4.08
	8.389	Outfall MkeR-27, left		624.92	625.33	-0.41	623.12	623.61	-0.49	622.23	622.79	-0.56	620.17	620.98	-0.81	612.43	616.97	-4.54	613.13	617.21	-4.08
	8.39	Outfall MkeR-26, right	611.95	624.93	625.34	-0.41	623.13	623.62	-0.49	622.23	622.79	-0.56	620.17	620.99	-0.81	612.43	616.97	-4.54	613.13	617.21	-4.08
	8.394	**Cross-Section**		624.99	625.40	-0.41	623.17	623.66	-0.49	622.26	622.82	-0.56	620.19	621.00	-0.81	612.43	616.97	-4.54	613.13	617.21	-4.08
	8.553	Outfall MkeR-28, left		625.82	626.15	-0.33	623.97	624.36	-0.39	623.05	623.49	-0.44	620.93	621.58	-0.65	612.64	616.97	-4.33	613.36	617.22	-3.86
	8.574	Outfall MkeR-29, right	616.26	625.92	626.25	-0.32	624.07	624.45	-0.37	623.16	623.58	-0.42	621.03	621.65	-0.63	612.67	616.97	-4.30	613.39	617.22	-3.83
	8.579	**Cross-Section**		625.95	626.27	-0.32	624.10	624.47	-0.37	623.18	623.60	-0.42	621.05	621.67	-0.62	612.68	616.97	-4.29	613.40	617.22	-3.82
	8.66	**Cross-Section**		626.44	626.73	-0.29	624.55	624.88	-0.33	623.61	623.99	-0.38	621.44	621.98	-0.54	613.07	616.98	-3.91	613.65	617.23	-3.58
	8.716	**Cross-Section**		626.62	626.90	-0.28	624.74	625.06	-0.32	623.81	624.16	-0.35	621.65	622.16	-0.51	613.43	616.98	-3.55	613.91	617.23	-3.32
	8.73	Outfall MkeR-30, left		626.61	626.88	-0.27	624.73	625.05	-0.32	623.80	624.16	-0.36	621.65	622.15	-0.50	613.50	616.98	-3.48	613.95	617.23	-3.28
	8.73	**Cross-Section**		626.61	626.88	-0.27	624.73	625.05	-0.32	623.80	624.16	-0.36	621.65	622.15	-0.50	613.50	616.98	-3.48	613.95	617.23	-3.28
	8.732	Outfall MkeR-31, right		626.62	626.89	-0.27	624.74	625.06	-0.32	623.81	624.17	-0.36	621.66	622.16	-0.50	613.54	616.98	-3.44	614.00	617.23	-3.23
	8.733	Outfall MkeR-33, left		626.63	626.90	-0.27	624.75	625.07	-0.32	623.82	624.18	-0.36	621.67	622.17	-0.50	613.56	616.98	-3.42	614.02	617.23	-3.21
	8.734	Outfall MkeR-32, right		626.64	626.91	-0.27	624.76	625.07	-0.32	623.83	624.18	-0.36	621.68	622.17	-0.50	613.58	616.98	-3.40	614.04	617.23	-3.19
	8.74	Silver Spring Road																			
	8.759	**Cross-Section**		626.80	627.07	-0.27	624.92	625.22	-0.30	623.99	624.33	-0.34	621.85	622.32	-0.47	614.10	616.98	-2.88	614.62	617.24	-2.62
	8.783	**Cross-Section**		626.87	627.14	-0.27	624.99	625.29	-0.30	624.07	624.39	-0.32	621.94	622.39	-0.45	614.18	616.98	-2.80	614.73	617.25	-2.52
	8.963	**Cross-Section**		627.48	627.70	-0.22	625.62	625.87	-0.25	624.70	624.97	-0.27	622.57	622.93	-0.36	614.30	616.99	-2.69	614.91	617.26	-2.35
	8.966	Outfall MkeR-34, right		627.49	627.71	-0.22	625.63	625.88	-0.25	624.71	624.98	-0.27	622.58	622.94	-0.36	614.30	616.99	-2.69	614.92	617.26	-2.35
	9.125	**Cross-Section**		628.09	628.28	-0.19	626.25	626.45	-0.20	625.34	625.55	-0.21	623.21	623.49	-0.28	614.53	617.00	-2.47	615.19	617.29	-2.10
	9.13	Outfall MkeR-35, left		628.12	628.31	-0.19	626.28	626.47	-0.20	625.37	625.57	-0.21	623.23	623.51	-0.28	614.54	617.00	-2.46	615.20	617.29	-2.09

Decreases in water surface elevation relative to existing dam conditions.

Table 2 (continued)

Model Reach	River Mile	Description[a]	Invert Elev NGVD29 (ft)	500-Yr Flow Dam Removal W.S. Elev (NGVD29, ft)	500-Yr Flow Exist. Cond. W. S. Elev (NGVD29, ft)	500-Yr Flow Difference (ft)	100-Yr Flow Dam Removal W.S. Elev (NGVD29, ft)	100-Yr Flow Exist. Cond. W. S. Elev (NGVD29, ft)	100-Yr Flow Difference (ft)	50-Yr Flow Dam Removal W.S. Elev (NGVD29, ft)	50-Yr Flow Exist. Cond. W. S. Elev (NGVD29, ft)	50-Yr Flow Difference |(ft)	10-Yr Flow Dam Removal W.S. Elev (NGVD29, ft)	10-Yr Flow Exist. Cond. W. S. Elev (NGVD29, ft)	10-Yr Flow Difference (ft)	Median Flow Dam Removal W.S. Elev (NGVD29, ft)	Median Flow Exist. Cond. W. S. Elev (NGVD29, ft)	Median Flow Difference (ft)	Mean Flow Dam Removal W.S. Elev (NGVD29, ft)	Mean Flow Exist. Cond. W. S. Elev (NGVD29, ft)	Mean Flow Difference (ft)
Milwaukee River - Upper Reach (continued)	9.242	Outfall MkeR-36, left		628.70	628.87	-0.16	626.85	627.02	-0.17	625.93	626.11	-0.18	623.79	624.02	-0.23	614.77	617.01	-2.24	615.45	617.33	-1.88
	9.244	Outfall MkeR-37, right		628.71	628.88	-0.16	626.86	627.03	-0.17	625.94	626.12	-0.18	623.80	624.03	-0.23	614.77	617.01	-2.24	615.45	617.33	-1.88
	9.376	Outfall MkeR-38, left		629.40	629.54	-0.13	627.53	627.67	-0.14	626.61	626.76	-0.14	624.45	624.63	-0.18	615.05	617.02	-1.98	615.75	617.37	-1.63
	9.427	**Cross-Section**		629.67	629.79	-0.12	627.79	627.92	-0.13	626.87	627.00	-0.13	624.70	624.86	-0.16	615.15	617.03	-1.88	615.86	617.39	-1.53
	9.471	Outfall MkeR-40, right		629.82	629.94	-0.12	627.94	628.07	-0.12	627.02	627.15	-0.12	624.86	625.01	-0.15	615.28	617.04	-1.77	615.99	617.42	-1.43
	9.476	Outfall MkeR-39, left		629.84	629.95	-0.12	627.96	628.09	-0.12	627.04	627.17	-0.12	624.88	625.03	-0.15	615.29	617.04	-1.75	616.00	617.42	-1.42
	9.601	Outfall MkeR-41, left		630.26	630.37	-0.11	628.40	628.51	-0.11	627.48	627.59	-0.11	625.33	625.45	-0.12	615.65	617.07	-1.43	616.36	617.49	-1.13
	9.632	Outfall MkeR-42, right		630.36	630.47	-0.10	628.51	628.61	-0.10	627.59	627.69	-0.10	625.44	625.55	-0.12	615.73	617.08	-1.35	616.45	617.51	-1.06
	9.669	**Cross-Section**		630.49	630.59	-0.10	628.64	628.74	-0.10	627.72	627.82	-0.10	625.57	625.68	-0.11	615.84	617.09	-1.25	616.56	617.53	-0.97
	9.834	Outfall MkeR-43, right		631.26	631.35	-0.08	629.67	629.73	-0.05	628.91	628.96	-0.04	626.99	627.04	-0.05	616.52	617.25	-0.73	617.32	617.86	-0.53
	9.846	**Cross-Section**		631.32	631.40	-0.08	629.75	629.80	-0.05	629.00	629.04	-0.04	627.09	627.14	-0.05	616.57	617.26	-0.69	617.38	617.88	-0.50
	9.854	Outfall MkeR-44, left		631.38	631.46	-0.08	629.82	629.86	-0.05	629.06	629.10	-0.04	627.14	627.19	-0.05	616.58	617.27	-0.68	617.40	617.89	-0.49
	9.973	Outfall MkeR-45, right		632.35	632.39	-0.04	630.79	630.82	-0.03	630.00	630.03	-0.03	627.92	627.97	-0.04	616.79	617.35	-0.57	617.63	618.04	-0.41
	10.009	**Cross-Section**		632.64	632.67	-0.03	631.08	631.11	-0.03	630.28	630.31	-0.03	628.16	628.20	-0.04	616.85	617.38	-0.53	617.70	618.08	-0.38
	10.015	Outfall MkeR-46, right		632.72	632.75	-0.03	631.14	631.17	-0.03	630.34	630.37	-0.03	628.20	628.24	-0.04	616.85	617.38	-0.53	617.71	618.08	-0.38
	10.023	**Cross-Section**		632.82	632.85	-0.03	631.23	631.26	-0.03	630.42	630.44	-0.02	628.26	628.30	-0.04	616.86	617.39	-0.53	617.72	618.09	-0.37
	10.025	Outfall MkeR-48, left		632.82	632.85	-0.03	631.23	631.26	-0.03	630.42	630.44	-0.02	628.26	628.30	-0.04	616.86	617.39	-0.53	617.72	618.09	-0.37
	10.038	Outfall MkeR-47, right		632.79	632.82	-0.03	631.20	631.23	-0.03	630.39	630.42	-0.03	628.24	628.28	-0.04	616.88	617.40	-0.51	617.74	618.10	-0.36
	10.04	Bender Road																			
	10.051	**Cross-Section**		632.77	632.80	-0.03	631.18	631.21	-0.03	630.37	630.40	-0.03	628.22	628.26	-0.04	616.90	617.40	-0.50	617.75	618.11	-0.36
Lincoln Creek - Lower Mainstream	**0**	**Cross-Section**		624.45[b]	624.92[b]	-0.47	622.62[b]	623.20[b]	-0.58	621.71[b]	622.38[b]	-0.67	619.58[b]	620.59[b]	-1.01						
	0.03	**Cross-Section**		624.45[b]	624.92[b]	-0.47	622.62[b]	623.20[b]	-0.58	621.71[b]	622.38[b]	-0.67	619.58[b]	620.59[b]	-1.01						
	0.0303	Outfall LC-1, right		624.45[b]	624.92[b]	-0.47	622.62[b]	623.20[b]	-0.58	621.71[b]	622.38[b]	-0.67	619.58[b]	620.59[b]	-1.01						
	0.14	**Cross-Section**		624.45[b]	624.92[b]	-0.47	622.62[b]	623.20[b]	-0.58	621.71[b]	622.38[b]	-0.67	619.86	620.59[b]	-0.73						
	0.16	**Cross-Section**		624.45[b]	624.92[b]	-0.47	622.62[b]	623.20[b]	-0.58	621.71[b]	622.38[b]	-0.67	620.07	620.59[b]	-0.52						
	0.18	**Cross-Section**		624.45[b]	624.92[b]	-0.47	622.62[b]	623.20[b]	-0.58	621.71[b]	622.38[b]	-0.67	620.27	620.59[b]	-0.32						
	0.181	Outfall LC-2, right	612.1	624.45[b]	624.92[b]	-0.47	622.62[b]	623.20[b]	-0.58	621.71[b]	622.38[b]	-0.67	620.28	620.59[b]	-0.31						
	0.21	**Cross-Section**		624.45[b]	624.92[b]	-0.47	622.62[b]	623.20[b]	-0.58	621.71[b]	622.38[b]	-0.67	620.42	620.59[b]	-0.17						
	0.33	**Cross-Section**		624.45[b]	624.92[b]	-0.47	622.67	623.20[b]	-0.53	622.22	622.38[b]	-0.16	621.04	621.04	0.00						
	0.333	Outfall LC-3, left	614.44	624.45[b]	624.92[b]	-0.47	622.71	623.20[b]	-0.49	622.25	622.38[b]	-0.13	621.07	621.07	0.00						
	0.4	**Cross-Section**		624.87	624.92[b]	-0.05	623.50	623.50	0.00	623.00	623.00	0.00	621.71	621.71	0.00						
	0.41	**Cross-Section**		624.89	624.92[b]	-0.03	623.52	623.52	0.00	623.03	623.03	0.00	621.73	621.73	0.00						
	0.41	Outfall LC-4, left	614.23	624.89	624.92[b]	-0.03	623.52	623.52	0.00	623.03	623.03	0.00	621.73	621.73	0.00						
	0.419	Outfall LC-5, right	616.72	624.89	624.92[b]	-0.03	623.62	623.62	0.00	623.03	623.03	0.00	621.73	621.73	0.00						
	0.42	N. Green Bay Avenue																			
	0.43	**Cross-Section**		625.59	625.59	0.00	623.74	623.74	0.00	623.21	623.21	0.00	621.87	621.87	0.00						
	0.44	**Cross-Section**		625.58	625.58	0.00	623.72	623.72	0.00	623.20	623.20	0.00	621.85	621.85	0.00						
	0.47	**Cross-Section**		626.18	626.18	0.00	624.18	624.18	0.00	623.60	623.60	0.00	622.12	622.12	0.00						
	0.5	**Cross-Section**		626.26	626.26	0.00	624.25	624.25	0.00	623.66	623.66	0.00	622.19	622.19	0.00						
	0.54	**Cross-Section**		626.21	626.21	0.00	624.25	624.25	0.00	623.69	623.69	0.00	622.27	622.27	0.00						
	0.6	**Cross-Section**		626.00	626.00	0.00	624.18	624.18	0.00	623.65	623.65	0.00	622.30	622.30	0.00						
	0.61	**Cross-Section**		626.12	626.12	0.00	624.31	624.31	0.00	623.78	623.78	0.00	622.40	622.40	0.00						
	0.62	**Cross-Section**		626.44	626.44	0.00	624.72	624.72	0.00	624.16	624.16	0.00	622.67	622.67	0.00						
	0.631	Outfall LC-6, left	614.76	626.51	626.51	0.00	624.76	624.76	0.00	624.20	624.20	0.00	622.70	622.70	0.00						
	0.71	**Cross-Section**		627.05	627.05	0.00	625.05	625.05	0.00	624.45	624.45	0.00	622.95	622.95	0.00						
	0.75	**Cross-Section**		627.13	627.13	0.00	625.15	625.15	0.00	624.55	624.55	0.00	623.05	623.05	0.00						
	0.79	**Cross-Section**		627.23	627.23	0.00	625.25	625.25	0.00	624.65	624.65	0.00	623.12	623.12	0.00						
	0.794	**Cross-Section**		627.25	627.25	0.00	625.28	625.28	0.00	624.67	624.67	0.00	623.15	623.15	0.00						

Decreases in water surface elevation relative to existing dam conditions.

[b] *Water surface elevation determined using backwater from the confluence with the Right Split (west oxbow) of the Milwaukee River.*

Table 2 (continued)

Model Reach	River Mile	Description[a]	Invert Elev NGVD29 (ft)	500-Yr Flow			100-Yr Flow			50-Yr Flow			10-Yr Flow			Median Flow			Mean Flow		
				Dam Removal W.S. Elev (NGVD29, ft)	Exist. Cond. W. S. Elev (NGVD29, ft)	Difference (ft)	Dam Removal W.S. Elev (NGVD29, ft)	Exist. Cond. W. S. Elev (NGVD29, ft)	Difference (ft)	Dam Removal W.S. Elev (NGVD29, ft)	Exist. Cond. W. S. Elev (NGVD29, ft)	Difference (ft)	Dam Removal W.S. Elev (NGVD29, ft)	Exist. Cond. W. S. Elev (NGVD29, ft)	Difference (ft)	Dam Removal W.S. Elev (NGVD29, ft)	Exist. Cond. W. S. Elev (NGVD29, ft)	Difference (ft)	Dam Removal W.S. Elev (NGVD29, ft)	Exist. Cond. W. S. Elev (NGVD29, ft)	Difference (ft)
Lincoln Creek - Lower Mainstream (continued)	0.798	Outfall LC-7, right	615.47	627.39	627.39	0.00	625.32	625.32	0.00	624.70	624.70	0.00	623.18	623.18	0.00						
	0.799	Outfall LC-8, right	615.46	627.42	627.42	0.00	625.33	625.33	0.00	624.71	624.71	0.00	623.18	623.18	0.00						
	0.803	W. Villard Avenue																			
	0.81	**Cross-Section**		627.79	627.79	0.00	625.43	625.43	0.00	624.79	624.79	0.00	623.26	623.26	0.00						
	0.82	**Cross-Section**		628.12	628.12	0.00	625.57	625.57	0.00	624.91	624.91	0.00	623.33	623.33	0.00						
	0.848	Outfall LC-10, left	619.6	628.11	628.11	0.00	625.58	625.58	0.00	624.93	624.93	0.00	623.35	623.35	0.00						
	0.877	Outfall LC-9, right	619.17	628.11	628.11	0.00	625.60	625.60	0.00	624.94	624.94	0.00	623.37	623.37	0.00						
	0.909	**Cross-Section**		628.10	628.10	0.00	625.61	625.61	0.00	624.96	624.96	0.00	623.40	623.40	0.00						
	0.912	N. 24th Place Footbridge																			
	0.915	**Cross-Section**		628.22	628.22	0.00	625.64	625.64	0.00	624.98	624.98	0.00	623.42	623.42	0.00						
	0.919	Outfall LC-11, right	619.35	628.25	628.25	0.00	625.65	625.65	0.00	624.99	624.99	0.00	623.44	623.44	0.00						
	0.93	**Cross-Section**		628.34	628.34	0.00	625.69	625.69	0.00	625.03	625.03	0.00	623.48	623.48	0.00						
	0.972	Outfall LC-12, left	617.81	628.44	628.44	0.00	625.82	625.82	0.00	625.15	625.15	0.00	623.61	623.61	0.00						
	0.974	Outfall LC-13, left	617.09	628.44	628.44	0.00	625.83	625.83	0.00	625.16	625.16	0.00	623.61	623.61	0.00						
	0.987	Outfall LC-14, right	619.4	628.47	628.47	0.00	625.87	625.87	0.00	625.19	625.19	0.00	623.65	623.65	0.00						
	1.07	**Cross-Section**		628.67	628.67	0.00	626.12	626.12	0.00	625.43	625.43	0.00	623.90	623.90	0.00						
	1.12	**Cross-Section**		628.92	628.92	0.00	626.45	626.45	0.00	625.77	625.77	0.00	624.19	624.19	0.00						
	1.138	Outfall LC-15, left	616.13	629.04	629.04	0.00	626.60	626.60	0.00	625.90	625.90	0.00	624.32	624.32	0.00						
	1.141	Outfall LC-16, right	621.01	629.06	629.06	0.00	626.63	626.63	0.00	625.93	625.93	0.00	624.34	624.34	0.00						
	1.17	**Cross-Section**		629.25	629.25	0.00	626.87	626.87	0.00	626.14	626.14	0.00	624.54	624.54	0.00						

[a] *References to “left” and “right” are based on looking in the downstream direction.*

[b] *Water surface elevation determined using backwater from the confluence with the Right Split (west oxbow) of the Milwaukee River.*

ESTABROOK DAM STORM SEWER INVENTORY TABLES (00217490).DOC
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Table 3

WATER SURFACE PROFILE COMPARISON OF EXISTING DAM CONDITIONS TO ALTERNATIVE PLAN NO. 3: ABANDON AND REMOVE THE DAM AND PROVIDE A 5.5-FOOT-HIGH ROCK RAMP

Model Reach	River Mile	Description[a]	Invert Elev NGVD29 (ft)	500-Yr Flow			100-Yr Flow			50-Yr Flow			10-Yr Flow			Median Flow			Mean Flow		
				Dam Rem. w/Rock Ramp W.S. Elev (NGVD29, ft)	Exist. Cond. W. S. Elev (NGVD29, ft)	Difference (ft)	Dam Rem. w/Rock Ramp W.S. Elev (NGVD29, ft)	Exist. Cond. W. S. Elev (NGVD29, ft)	Difference (ft)	Dam Rem. w/Rock Ramp W.S. Elev (NGVD29, ft)	Exist. Cond. W. S. Elev (NGVD29, ft)	Difference (ft)	Dam Rem. w/Rock Ramp W.S. Elev (NGVD29, ft)	Exist. Cond. W. S. Elev (NGVD29, ft)	Difference (ft)	Dam Rem. w/Rock Ramp W.S. Elev (NGVD29, ft)	Exist. Cond. W. S. Elev (NGVD29, ft)	Difference (ft)	Dam Rem. w/Rock Ramp W.S. Elev (NGVD29, ft)	Exist. Cond. W. S. Elev (NGVD29, ft)	Difference (ft)
Milwaukee River - Lower Reach	**6.827**	**Cross-Section**		621.11	621.11	0.00	619.23	619.23	0.00	618.29	618.29	0.00	616.12	616.12	0.00	609.44	609.44	0.00	609.89	609.89	0.00
	6.8275	Estabrook Park Dam																			
	6.828	Outfall MkeR-7, left		621.11	621.65	-0.54	619.23	619.96	-0.73	618.29	619.17	-0.88	616.12	617.50	-1.38	609.44	613.17	-3.73	609.89	613.51	-3.62
	6.829	**Cross-Section**		621.11	622.18	-1.07	619.23	620.68	-1.45	618.29	620.05	-1.76	616.12	618.88	-2.76	609.44	616.89	-7.45	609.89	617.12	-7.23
	6.843	**Cross-Section**		621.11	622.18	-1.07	619.22	620.67	-1.45	618.29	620.04	-1.75	616.12	618.87	-2.75	609.95	616.89	-6.94	610.13	617.12	-6.99
	6.866	Outfall MkeR-8, right		621.09	622.16	-1.07	619.21	620.66	-1.45	618.29	620.03	-1.74	616.14	618.87	-2.73	610.08	616.89	-6.81	610.31	617.12	-6.81
	6.928	**Cross-Section**		621.04	622.10	-1.06	619.19	620.63	-1.44	618.28	620.01	-1.73	616.20	618.87	-2.67	610.43	616.89	-6.46	610.79	617.12	-6.33
	6.941	**Cross-Section - Rock Ramp**		621.08	622.14	-1.06	619.24	620.66	-1.42	618.33	620.05	-1.72	616.25	618.89	-2.64	610.45	616.89	-6.44	610.82	617.12	-6.30
	6.96	**Cross-Section - Rock Ramp**		620.70	622.16	-1.46	619.41	620.69	-1.28	619.00	620.07	-1.07	618.08	618.90	-0.82	615.10	616.89	-1.79	615.26	617.12	-1.86
	6.963	**Cross-Section**		622.91	622.17	0.74	621.85	620.70	1.15	621.28	620.08	1.20	619.93	618.91	1.02	615.30	616.89	-1.59	615.56	617.12	-1.56
	6.987	**Cross-Section**		623.03	622.32	0.71	621.95	620.82	1.13	621.35	620.18	1.17	619.97	618.97	1.00	615.30	616.89	-1.59	615.56	617.12	-1.56
	7.087	**Cross-Section**		623.34	622.68	0.66	622.19	621.15	1.04	621.57	620.48	1.09	620.12	619.18	0.94	615.30	616.89	-1.59	615.56	617.12	-1.56
	7.096	Outfall MkeR-9, left	610.8	623.32	622.66	0.66	622.18	621.14	1.04	621.56	620.47	1.08	620.12	619.17	0.95	615.30	616.89	-1.59	615.56	617.12	-1.56
	7.098	Outfall MkeR-10, left		623.32	622.66	0.66	622.18	621.14	1.04	621.56	620.47	1.08	620.12	619.17	0.95	615.30	616.89	-1.59	615.56	617.12	-1.56
	7.103	**Cross-Section**		623.31	622.65	0.66	622.17	621.13	1.04	621.55	620.47	1.08	620.12	619.17	0.95	615.30	616.89	-1.59	615.56	617.12	-1.56
	7.104	Outfall MkeR-11, right	615.6	623.31	622.66	0.66	622.17	621.13	1.04	621.55	620.47	1.08	620.12	619.17	0.95	615.30	616.89	-1.59	615.56	617.12	-1.56
	7.104	Outfall MkeR-12, right		623.31	622.66	0.66	622.17	621.13	1.04	621.55	620.47	1.08	620.12	619.17	0.95	615.30	616.89	-1.59	615.56	617.12	-1.56
	7.11	Port Washington Road																			
	7.117	**Cross-Section**		623.37	622.72	0.65	622.22	621.19	1.03	621.59	620.52	1.07	620.14	619.21	0.93	615.31	616.89	-1.58	615.57	617.12	-1.55
	7.16	**Cross-Section**		623.45	622.81	0.64	622.28	621.28	1.00	621.65	620.60	1.05	620.18	619.27	0.91	615.31	616.89	-1.58	615.57	617.12	-1.55
	7.17	IH 43																			
	7.183	**Cross-Section**		623.57	622.95	0.62	622.38	621.41	0.97	621.74	620.72	1.02	620.25	619.35	0.90	615.31	616.90	-1.59	615.57	617.13	-1.56
	7.189	**Cross-Section**		623.60	622.99	0.61	622.41	621.44	0.97	621.77	620.75	1.02	620.26	619.37	0.89	615.31	616.90	-1.59	615.57	617.13	-1.56
	7.19	Ramp to IH 43																			
	7.199	**Cross-Section**		623.71	623.11	0.60	622.50	621.54	0.96	621.85	620.84	1.01	620.33	619.44	0.89	615.32	616.92	-1.60	615.59	617.16	-1.57
	7.201	Outfall MkeR-13, right		623.71	623.11	0.60	622.50	621.54	0.96	621.85	620.84	1.01	620.33	619.44	0.89	615.32	616.92	-1.60	615.59	617.16	-1.57
	7.241	Outfall MkeR-14, right		623.78	623.20	0.59	622.57	621.63	0.94	621.91	620.92	0.99	620.38	619.51	0.87	615.32	616.92	-1.60	615.59	617.16	-1.57
	7.359	**Cross-Section**		623.99	623.44	0.55	622.75	621.87	0.88	622.08	621.15	0.93	620.51	619.69	0.82	615.32	616.92	-1.60	615.59	617.16	-1.57
	7.519	Outfall MkeR-15, right	629.46	624.40	623.91	0.49	623.09	622.31	0.78	622.39	621.57	0.82	620.74	620.01	0.73	615.33	616.92	-1.59	615.60	617.16	-1.56
	7.519	**Cross-Section**		624.40	623.91	0.49	623.09	622.31	0.78	622.39	621.57	0.82	620.74	620.01	0.73	615.33	616.92	-1.59	615.60	617.16	-1.56
	7.526	Outfall MkeR-16, right		624.41	623.92	0.49	623.10	622.32	0.78	622.40	621.58	0.82	620.75	620.02	0.73	615.33	616.92	-1.59	615.60	617.16	-1.56
	7.576	Outfall MkeR-17, right	618.1	624.47	623.99	0.47	623.16	622.40	0.76	622.45	621.66	0.79	620.80	620.08	0.72	615.33	616.92	-1.59	615.60	617.16	-1.56
	7.633	**Cross-Section**		624.53	624.07	0.46	623.22	622.48	0.74	622.51	621.74	0.77	620.85	620.15	0.70	615.33	616.92	-1.59	615.60	617.16	-1.56
	7.64	Outfall MkeR-18, right		624.54	624.08	0.46	623.23	622.49	0.74	622.52	621.75	0.77	620.85	620.16	0.70	615.33	616.92	-1.59	615.60	617.16	-1.56
	7.654	**Cross-Section**		624.55	624.09	0.46	623.24	622.50	0.74	622.53	621.76	0.77	620.86	620.17	0.69	615.33	616.92	-1.59	615.60	617.16	-1.56
	7.656	Outfall MkeR-19, right		624.57	624.11	0.46	623.26	622.52	0.74	622.54	621.78	0.77	620.87	620.18	0.69	615.33	616.92	-1.59	615.60	617.16	-1.56
	7.66	Hampton Avenue																			
	7.669	**Cross-Section**		624.70	624.26	0.44	623.36	622.65	0.71	622.64	621.89	0.75	620.94	620.26	0.68	615.33	616.92	-1.59	615.60	617.16	-1.56
	7.669	Outfall MkeR-20, right		624.70	624.26	0.44	623.36	622.65	0.71	622.64	621.89	0.75	620.94	620.26	0.68	615.33	616.92	-1.59	615.60	617.16	-1.56
	7.706	**Cross-Section**		624.94	624.50	0.44	623.51	622.81	0.70	622.76	622.02	0.74	621.01	620.34	0.67	615.33	616.92	-1.59	615.60	617.16	-1.56
	7.745	**Cross-Section**		625.08	624.66	0.42	623.63	622.95	0.68	622.86	622.14	0.72	621.08	620.42	0.66	615.33	616.92	-1.59	615.60	617.16	-1.56

Decreases in water surface elevation relative to existing dam conditions.

Increases in water surface elevation relative to existing dam conditions.

Table 3 (continued)

				500-Yr Flow			100-Yr Flow			50-Yr Flow			10-Yr Flow			Median Flow			Mean Flow		
Model Reach	River Mile	Description[a]	Invert Elev NGVD29 (ft)	Dam Rem. w/Rock Ramp W.S. Elev (NGVD29, ft)	Exist. Cond. W. S. Elev (NGVD29, ft)	Difference (ft)	Dam Rem. w/Rock Ramp W.S. Elev (NGVD29, ft)	Exist. Cond. W. S. Elev (NGVD29, ft)	Difference (ft)	Dam Rem. w/Rock Ramp W.S. Elev (NGVD29, ft)	Exist. Cond. W. S. Elev (NGVD29, ft)	Difference (ft)	Dam Rem. w/Rock Ramp W.S. Elev (NGVD29, ft)	Exist. Cond. W. S. Elev (NGVD29, ft)	Difference (ft)	Dam Rem. w/Rock Ramp W.S. Elev (NGVD29, ft)	Exist. Cond. W. S. Elev (NGVD29, ft)	Difference (ft)	Dam Rem. w/Rock Ramp W.S. Elev (NGVD29, ft)	Exist. Cond. W. S. Elev (NGVD29, ft)	Difference (ft)
Milwaukee River - Middle Reach	**7.851**	**Cross-Section**		625.26	624.86	0.40	623.79	623.13	0.66	623.00	622.30	0.70	621.17	620.53	0.64	615.33	616.92	-1.59	615.61	617.16	-1.55
	7.876	**Cross-Section**		625.27	624.87	0.40	623.79	623.14	0.65	623.01	622.32	0.69	621.18	620.54	0.64	615.33	616.92	-1.59	615.61	617.16	-1.55
	7.934	**Cross-Section**		625.30	624.90	0.40	623.82	623.17	0.65	623.04	622.35	0.69	621.20	620.57	0.63	615.33	616.92	-1.59	615.61	617.16	-1.55
	7.945	Outfall MkeR-21, left		625.30	624.90	0.40	623.82	623.17	0.65	623.04	622.35	0.69	621.20	620.57	0.63	615.33	616.92	-1.59	615.61	617.16	-1.55
	8.003	**Cross-Section**		625.30	624.90	0.40	623.83	623.18	0.65	623.04	622.36	0.68	621.21	620.58	0.63	615.33	616.92	-1.59	615.61	617.16	-1.55
	8.098	Outfall MkeR-22, right	613.85	625.32	624.93	0.39	623.85	623.21	0.64	623.06	622.39	0.67	621.23	620.61	0.62	615.33	616.92	-1.59	615.61	617.17	-1.56
	8.132	**Cross-Section**		625.33	624.94	0.39	623.86	623.22	0.64	623.07	622.40	0.67	621.24	620.62	0.62	615.33	616.92	-1.59	615.61	617.17	-1.56
	8.141	**Cross-Section**		625.34	624.94	0.40	623.86	623.22	0.64	623.07	622.40	0.67	621.24	620.62	0.62	615.33	616.92	-1.59	615.61	617.17	-1.56
	8.145	**Cross-Section**		625.34	624.94	0.40	623.86	623.22	0.64	623.08	622.41	0.67	621.24	620.63	0.61	615.33	616.92	-1.59	615.61	617.17	-1.56
Milwaukee River - Right Split (west oxbow)	**7.8761**	**Cross-Section**		625.24	624.83	0.41	623.75	623.09	0.66	622.96	622.27	0.69	621.14	620.49	0.65	615.33	616.92	-1.59	615.60	617.16	-1.56
	7.9	Milwaukee River Parkway																			
	7.9341	**Cross-Section**		625.26	624.85	0.41	623.78	623.11	0.67	622.99	622.30	0.69	621.16	620.52	0.64	615.33	616.92	-1.59	615.61	617.16	-1.55
	8.0031	**Cross-Section**		625.32	624.92	0.40	623.84	623.20	0.64	623.06	622.38	0.68	621.23	620.59	0.64	615.33	616.92	-1.59	615.61	617.16	-1.55
	8.047	Lincoln Creek Confluence		625.32	624.92	0.40	623.84	623.20	0.64	623.06	622.38	0.68	621.23	620.59	0.64	615.33	616.92	-1.59	615.61	617.16	-1.55
	8.1321	**Cross-Section**		625.33	624.93	0.40	623.85	623.20	0.65	623.07	622.38	0.69	621.23	620.60	0.63	615.33	616.92	-1.59	615.61	617.16	-1.55
	8.1411	**Cross-Section**		625.30	624.90	0.40	623.83	623.18	0.65	623.05	622.36	0.69	621.22	620.58	0.64	615.33	616.92	-1.59	615.61	617.16	-1.55
	8.142	Milwaukee River Parkway																			
	8.1451	**Cross-Section**		625.31	624.91	0.40	623.83	623.19	0.64	623.05	622.37	0.68	621.22	620.59	0.63	615.33	616.92	-1.59	615.61	617.17	-1.56
Milwaukee River - Upper Reach	**8.229**	**Cross-Section**		625.08	624.68	0.40	623.68	623.02	0.66	622.92	622.24	0.68	621.15	620.54	0.61	615.33	616.92	-1.59	615.61	617.17	-1.56
	8.244	Outfall MkeR-23, right	615.04	625.11	624.71	0.40	623.71	623.05	0.65	622.95	622.27	0.67	621.17	620.57	0.60	615.33	616.92	-1.59	615.61	617.17	-1.56
	8.341	**Cross-Section**		625.28	624.90	0.38	623.87	623.26	0.61	623.11	622.48	0.63	621.33	620.76	0.57	615.33	616.92	-1.59	615.62	617.17	-1.55
	8.343	Outfall MkeR-24, right		625.27	624.89	0.38	623.87	623.26	0.61	623.11	622.48	0.63	621.33	620.76	0.57	615.33	616.92	-1.59	615.62	617.17	-1.55
	8.357	**Cross-Section**		625.22	624.84	0.38	623.83	623.23	0.60	623.08	622.45	0.63	621.32	620.75	0.57	615.33	616.92	-1.59	615.62	617.17	-1.55
	8.36	Railroad Bridge																			
	8.366	Outfall MkeR-25, right	613.02	625.39	625.02	0.37	623.96	623.37	0.59	623.20	622.58	0.61	621.41	620.85	0.56	615.36	616.95	-1.59	615.65	617.19	-1.55
	8.375	**Cross-Section**		625.55	625.20	0.35	624.08	623.51	0.57	623.31	622.71	0.60	621.49	620.94	0.55	615.38	616.97	-1.59	615.67	617.21	-1.54
	8.381	**Cross-Section**		625.57	625.21	0.36	624.10	623.53	0.57	623.32	622.73	0.59	621.50	620.96	0.54	615.38	616.97	-1.59	615.67	617.21	-1.54
	8.389	Outfall MkeR-27, left		625.67	625.33	0.35	624.17	623.61	0.56	623.38	622.79	0.59	621.53	620.98	0.55	615.38	616.97	-1.59	615.67	617.21	-1.54
	8.39	Outfall MkeR-26, right	611.95	625.69	625.34	0.35	624.18	623.62	0.56	623.38	622.79	0.59	621.53	620.99	0.55	615.38	616.97	-1.59	615.67	617.21	-1.54
	8.394	**Cross-Section**		625.74	625.40	0.34	624.21	623.66	0.55	623.41	622.82	0.59	621.55	621.00	0.55	615.38	616.97	-1.59	615.67	617.21	-1.54
	8.553	Outfall MkeR-28, left		626.44	626.15	0.29	624.82	624.36	0.46	623.99	623.49	0.50	622.03	621.58	0.46	615.39	616.97	-1.58	615.69	617.22	-1.53
	8.574	Outfall MkeR-29, right	616.26	626.53	626.25	0.28	624.90	624.45	0.45	624.06	623.58	0.48	622.09	621.65	0.44	615.39	616.97	-1.58	615.69	617.22	-1.53
	8.579	**Cross-Section**		626.55	626.27	0.28	624.92	624.47	0.45	624.08	623.60	0.48	622.11	621.67	0.44	615.39	616.97	-1.58	615.69	617.22	-1.53
	8.66	**Cross-Section**		626.98	626.73	0.25	625.29	624.88	0.41	624.42	623.99	0.43	622.38	621.98	0.40	615.39	616.98	-1.59	615.71	617.23	-1.52
	8.716	**Cross-Section**		627.14	626.90	0.24	625.45	625.06	0.39	624.57	624.16	0.41	622.53	622.16	0.37	615.40	616.98	-1.58	615.72	617.23	-1.51
	8.73	Outfall MkeR-30, left		627.12	626.88	0.24	625.44	625.05	0.39	624.56	624.16	0.40	622.53	622.15	0.38	615.40	616.98	-1.58	615.72	617.23	-1.51
	8.73	**Cross-Section**		627.12	626.88	0.24	625.44	625.05	0.39	624.56	624.16	0.40	622.53	622.15	0.38	615.40	616.98	-1.58	615.72	617.23	-1.51
	8.732	Outfall MkeR-31, right		627.13	626.89	0.24	625.45	625.06	0.39	624.57	624.17	0.40	622.54	622.16	0.38	615.40	616.98	-1.58	615.72	617.23	-1.51
	8.733	Outfall MkeR-33, left		627.14	626.90	0.24	625.46	625.07	0.39	624.58	624.18	0.40	622.54	622.17	0.38	615.40	616.98	-1.58	615.72	617.23	-1.51
	8.734	Outfall MkeR-32, right		627.15	626.91	0.24	625.46	625.07	0.39	624.58	624.18	0.40	622.55	622.17	0.38	615.40	616.98	-1.58	615.73	617.23	-1.51
	8.74	Silver Spring Road																			
	8.759	**Cross-Section**		627.31	627.07	0.24	625.60	625.22	0.38	624.72	624.33	0.39	622.67	622.32	0.35	615.42	616.98	-1.56	615.76	617.24	-1.48
	8.783	**Cross-Section**		627.37	627.14	0.23	625.65	625.29	0.36	624.77	624.39	0.38	622.73	622.39	0.34	615.43	616.98	-1.55	615.78	617.25	-1.47
	8.963	**Cross-Section**		627.91	627.70	0.21	626.18	625.87	0.31	625.29	624.97	0.32	623.22	622.93	0.29	615.45	616.99	-1.54	615.84	617.26	-1.42
	8.966	Outfall MkeR-34, right		627.92	627.71	0.21	626.19	625.88	0.31	625.30	624.98	0.32	623.23	622.94	0.29	615.45	616.99	-1.54	615.84	617.26	-1.42

Decreases in water surface elevation relative to existing dam conditions.

Increases in water surface elevation relative to existing dam conditions.

Table 3 (continued)

Model Reach	River Mile	Description[a]	Invert Elev NGVD29 (ft)	500-Yr Flow: Dam Rem. w/Rock Ramp W.S. Elev (NGVD29, ft)	500-Yr Flow: Exist. Cond. W. S. Elev (NGVD29, ft)	500-Yr Flow: Difference (ft)	100-Yr Flow: Dam Rem. w/Rock Ramp W.S. Elev (NGVD29, ft)	100-Yr Flow: Exist. Cond. W. S. Elev (NGVD29, ft)	100-Yr Flow: Difference (ft)	50-Yr Flow: Dam Rem. w/Rock Ramp W.S. Elev (NGVD29, ft)	50-Yr Flow: Exist. Cond. W. S. Elev (NGVD29, ft)	50-Yr Flow: Difference (ft)	10-Yr Flow: Dam Rem. w/Rock Ramp W.S. Elev (NGVD29, ft)	10-Yr Flow: Exist. Cond. W. S. Elev (NGVD29, ft)	10-Yr Flow: Difference (ft)	Median Flow: Dam Rem. w/Rock Ramp W.S. Elev (NGVD29, ft)	Median Flow: Exist. Cond. W. S. Elev (NGVD29, ft)	Median Flow: Difference (ft)	Mean Flow: Dam Rem. w/Rock Ramp W.S. Elev (NGVD29, ft)	Mean Flow: Exist. Cond. W. S. Elev (NGVD29, ft)	Mean Flow: Difference (ft)
Milwaukee River - Upper Reach (continued)	**9.125**	**Cross-Section**		628.45	628.28	0.17	626.71	626.45	0.26	625.82	625.55	0.27	623.72	623.49	0.23	615.49	617.00	-1.51	615.94	617.29	-1.35
	9.13	Outfall MkeR-35, left		628.47	628.31	0.17	626.73	626.47	0.26	625.84	625.57	0.27	623.74	623.51	0.23	615.49	617.00	-1.51	615.95	617.29	-1.35
	9.242	Outfall MkeR-36, left		629.02	628.87	0.15	627.24	627.02	0.23	626.34	626.11	0.23	624.22	624.02	0.20	615.56	617.01	-1.45	616.06	617.33	-1.26
	9.244	Outfall MkeR-37, right		629.03	628.88	0.15	627.25	627.03	0.22	626.35	626.12	0.23	624.22	624.03	0.19	615.56	617.01	-1.45	616.07	617.33	-1.26
	9.376	Outfall MkeR-38, left		629.66	629.54	0.13	627.86	627.67	0.19	626.94	626.76	0.19	624.78	624.63	0.16	615.64	617.02	-1.39	616.21	617.37	-1.17
	9.427	**Cross-Section**		629.91	629.79	0.12	628.09	627.92	0.17	627.17	627.00	0.17	625.00	624.86	0.14	615.67	617.03	-1.36	616.26	617.39	-1.13
	9.471	Outfall MkeR-40, right		630.05	629.94	0.11	628.23	628.07	0.16	627.31	627.15	0.16	625.14	625.01	0.13	615.73	617.04	-1.31	616.34	617.42	-1.07
	9.476	Outfall MkeR-39, left		630.07	629.95	0.11	628.25	628.09	0.16	627.33	627.17	0.16	625.16	625.03	0.13	615.73	617.04	-1.31	616.35	617.42	-1.07
	9.601	Outfall MkeR-41, left		630.46	630.37	0.10	628.65	628.51	0.14	627.73	627.59	0.14	625.56	625.45	0.11	615.90	617.07	-1.17	616.58	617.49	-0.91
	9.632	Outfall MkeR-42, right		630.56	630.47	0.09	628.75	628.61	0.14	627.83	627.69	0.14	625.66	625.55	0.11	615.94	617.08	-1.14	616.64	617.51	-0.87
	9.669	**Cross-Section**		630.68	630.59	0.09	628.87	628.74	0.13	627.95	627.82	0.13	625.78	625.68	0.10	615.99	617.09	-1.10	616.71	617.53	-0.82
	9.834	Outfall MkeR-43, right		631.41	631.35	0.06	629.80	629.73	0.07	629.02	628.96	0.06	627.09	627.04	0.05	616.56	617.25	-0.69	617.38	617.86	-0.48
	9.846	**Cross-Section**		631.46	631.40	0.06	629.87	629.80	0.07	629.10	629.04	0.06	627.19	627.14	0.05	616.60	617.26	-0.66	617.43	617.88	-0.45
	9.854	Outfall MkeR-44, left		631.52	631.46	0.06	629.93	629.86	0.07	629.16	629.10	0.06	627.24	627.19	0.05	616.61	617.27	-0.65	617.44	617.89	-0.45
	9.973	Outfall MkeR-45, right		632.43	632.39	0.04	630.87	630.82	0.05	630.07	630.03	0.04	628.00	627.97	0.03	616.81	617.35	-0.54	617.66	618.04	-0.37
	10.009	**Cross-Section**		632.71	632.67	0.04	631.15	631.11	0.04	630.35	630.31	0.04	628.23	628.20	0.03	616.87	617.38	-0.51	617.73	618.08	-0.35
	10.015	Outfall MkeR-46, right		632.79	632.75	0.04	631.21	631.17	0.04	630.41	630.37	0.04	628.28	628.24	0.03	616.88	617.38	-0.51	617.74	618.08	-0.35
	10.023	**Cross-Section**		632.89	632.85	0.04	631.30	631.26	0.04	630.48	630.44	0.04	628.34	628.30	0.04	616.89	617.39	-0.50	617.75	618.09	-0.34
	10.025	Outfall MkeR-48, left		632.89	632.85	0.04	631.30	631.26	0.04	630.48	630.44	0.04	628.34	628.30	0.04	616.89	617.39	-0.50	617.75	618.09	-0.34
	10.038	Outfall MkeR-47, right		632.86	632.82	0.03	631.27	631.23	0.04	630.45	630.42	0.03	628.31	628.28	0.03	616.91	617.40	-0.49	617.77	618.10	-0.33
	10.04	Bender Road																			
	10.051	**Cross-Section**		632.83	632.80	0.03	631.25	631.21	0.04	630.43	630.40	0.03	628.29	628.26	0.03	616.92	617.40	-0.48	617.78	618.11	-0.33
Lincoln Creek - Lower Mainstream	**0**	**Cross-Section**		625.32[b]	624.92[b]	0.40	623.84[b]	623.20[b]	0.64	623.06[b]	622.38[b]	0.68	621.23[b]	620.59[b]	0.64						
	0.03	**Cross-Section**		625.32[b]	624.92[b]	0.40	623.84[b]	623.20[b]	0.64	623.06[b]	622.38[b]	0.68	621.23[b]	620.59[b]	0.64						
	0.0303	Outfall LC-1, right		625.32[b]	624.92[b]	0.40	623.84[b]	623.20[b]	0.64	623.06[b]	622.38[b]	0.68	621.23[b]	620.59[b]	0.64						
	0.14	**Cross-Section**		625.32[b]	624.92[b]	0.40	623.84[b]	623.20[b]	0.64	623.06[b]	622.38[b]	0.68	621.23[b]	620.59[b]	0.64						
	0.16	**Cross-Section**		625.32[b]	624.92[b]	0.40	623.84[b]	623.20[b]	0.64	623.06[b]	622.38[b]	0.68	621.23[b]	620.59[b]	0.64						
	0.18	**Cross-Section**		625.32[b]	624.92[b]	0.40	623.84[b]	623.20[b]	0.64	623.06[b]	622.38[b]	0.68	621.23[b]	620.59[b]	0.64						
	0.181	Outfall LC-2, right	612.1	625.32[b]	624.92[b]	0.40	623.84[b]	623.20[b]	0.64	623.06[b]	622.38[b]	0.68	621.23[b]	620.59[b]	0.64						
	0.21	**Cross-Section**		625.32[b]	624.92[b]	0.40	623.84[b]	623.20[b]	0.64	623.06[b]	622.38[b]	0.68	621.23[b]	620.59[b]	0.64						
	0.33	**Cross-Section**		625.32[b]	624.92[b]	0.40	623.84[b]	623.20[b]	0.64	623.06[b]	622.38[b]	0.68	621.23[b]	621.04	0.19						
	0.333	Outfall LC-3, left	614.44	625.32[b]	624.92[b]	0.40	623.84[b]	623.20[b]	0.64	623.06[b]	622.38[b]	0.68	621.23[b]	621.07	0.16						
	0.4	**Cross-Section**		625.32[b]	624.92[b]	0.40	623.84[b]	623.50	0.34	623.06[b]	623.00	0.06	621.71	621.71	0.00						
	0.41	**Cross-Section**		625.32[b]	624.92[b]	0.40	623.84[b]	623.52	0.32	623.06[b]	623.03	0.03	621.73	621.73	0.00						
	0.41	Outfall LC-4, left	614.23	625.32[b]	624.92[b]	0.40	623.84[b]	623.52	0.32	623.06[b]	623.03	0.03	621.73	621.73	0.00						
	0.419	Outfall LC-5, right	616.72	625.32[b]	624.92[b]	0.40	623.84[b]	623.62	0.32	623.06[b]	623.03	0.03	621.73	621.73	0.00						
	0.42	N. Green Bay Avenue																			
	0.43	**Cross-Section**		625.59	625.59	0.00	623.84[b]	623.74	0.10	623.21	623.21	0.00	621.87	621.87	0.00						
	0.44	**Cross-Section**		625.58	625.58	0.00	623.84[b]	623.72	0.12	623.20	623.20	0.00	621.85	621.85	0.00						
	0.47	**Cross-Section**		626.18	626.18	0.00	624.18	624.18	0.00	623.60	623.60	0.00	622.12	622.12	0.00						
	0.5	**Cross-Section**		626.26	626.26	0.00	624.25	624.25	0.00	623.66	623.66	0.00	622.19	622.19	0.00						
	0.54	**Cross-Section**		626.21	626.21	0.00	624.25	624.25	0.00	623.69	623.69	0.00	622.27	622.27	0.00						
	0.6	**Cross-Section**		626.00	626.00	0.00	624.18	624.18	0.00	623.65	623.65	0.00	622.30	622.30	0.00						
	0.61	**Cross-Section**		626.12	626.12	0.00	624.31	624.31	0.00	623.78	623.78	0.00	622.40	622.40	0.00						
	0.62	**Cross-Section**		626.44	626.44	0.00	624.72	624.72	0.00	624.16	624.16	0.00	622.67	622.67	0.00						
	0.631	Outfall LC-6, left	614.76	626.51	626.51	0.00	624.76	624.76	0.00	624.20	624.20	0.00	622.70	622.70	0.00						

(blue) Decreases in water surface elevation relative to existing dam conditions.

(orange) Increases in water surface elevation relative to existing dam conditions.

[b]*Water surface elevation determined using backwater from the confluence with the Right Split (west oxbow) of the Milwaukee River.*

Table 3 (continued)

Model Reach	River Mile	Description[a]	Invert Elev NGVD29 (ft)	500-Yr Flow			100-Yr Flow			50-Yr Flow			10-Yr Flow			Median Flow			Mean Flow		
				Dam Rem. w/Rock Ramp W.S. Elev (NGVD29, ft)	Exist. Cond. W. S. Elev (NGVD29, ft)	Difference (ft)	Dam Rem. w/Rock Ramp W.S. Elev (NGVD29, ft)	Exist. Cond. W. S. Elev (NGVD29, ft)	Difference (ft)	Dam Rem. w/Rock Ramp W.S. Elev (NGVD29, ft)	Exist. Cond. W. S. Elev (NGVD29, ft)	Difference (ft)	Dam Rem. w/Rock Ramp W.S. Elev (NGVD29, ft)	Exist. Cond. W. S. Elev (NGVD29, ft)	Difference (ft)	Dam Rem. w/Rock Ramp W.S. Elev (NGVD29, ft)	Exist. Cond. W. S. Elev (NGVD29, ft)	Difference (ft)	Dam Rem. w/Rock Ramp W.S. Elev (NGVD29, ft)	Exist. Cond. W. S. Elev (NGVD29, ft)	Difference (ft)
Lincoln Creek - Lower Mainstream (continued)	**0.71**	**Cross-Section**		627.05	627.05	0.00	625.05	625.05	0.00	624.45	624.45	0.00	622.95	622.95	0.00						
	0.75	**Cross-Section**		627.13	627.13	0.00	625.15	625.15	0.00	624.55	624.55	0.00	623.05	623.05	0.00						
	0.79	**Cross-Section**		627.23	627.23	0.00	625.25	625.25	0.00	624.65	624.65	0.00	623.12	623.12	0.00						
	0.794	**Cross-Section**		627.25	627.25	0.00	625.28	625.28	0.00	624.67	624.67	0.00	623.15	623.15	0.00						
	0.798	Outfall LC-7, right	615.47	627.39	627.39	0.00	625.32	625.32	0.00	624.70	624.70	0.00	623.18	623.18	0.00						
	0.799	Outfall LC-8, right	615.46	627.42	627.42	0.00	625.33	625.33	0.00	624.71	624.71	0.00	623.18	623.18	0.00						
	0.803	W. Villard Avenue																			
	0.81	**Cross-Section**		627.79	627.79	0.00	625.43	625.43	0.00	624.79	624.79	0.00	623.26	623.26	0.00						
	0.82	**Cross-Section**		628.12	628.12	0.00	625.57	625.57	0.00	624.91	624.91	0.00	623.33	623.33	0.00						
	0.848	Outfall LC-10, left	619.6	628.11	628.11	0.00	625.58	625.58	0.00	624.93	624.93	0.00	623.35	623.35	0.00						
	0.877	Outfall LC-9, right	619.17	628.11	628.11	0.00	625.60	625.60	0.00	624.94	624.94	0.00	623.37	623.37	0.00						
	0.909	**Cross-Section**		628.10	628.10	0.00	625.61	625.61	0.00	624.96	624.96	0.00	623.40	623.40	0.00						
	0.912	N. 24th Place Footbridge																			
	0.915	**Cross-Section**		628.22	628.22	0.00	625.64	625.64	0.00	624.98	624.98	0.00	623.42	623.42	0.00						
	0.919	Outfall LC-11, right	619.35	628.25	628.25	0.00	625.65	625.65	0.00	624.99	624.99	0.00	623.44	623.44	0.00						
	0.93	**Cross-Section**		628.34	628.34	0.00	625.69	625.69	0.00	625.03	625.03	0.00	623.48	623.48	0.00						
	0.972	Outfall LC-12, left	617.81	628.44	628.44	0.00	625.82	625.82	0.00	625.15	625.15	0.00	623.61	623.61	0.00						
	0.974	Outfall LC-13, left	617.09	628.44	628.44	0.00	625.83	625.83	0.00	625.16	625.16	0.00	623.61	623.61	0.00						
	0.987	Outfall LC-14, right	619.4	628.47	628.47	0.00	625.87	625.87	0.00	625.19	625.19	0.00	623.65	623.65	0.00						
	1.07	**Cross-Section**		628.67	628.67	0.00	626.12	626.12	0.00	625.43	625.43	0.00	623.90	623.90	0.00						
	1.12	**Cross-Section**		628.92	628.92	0.00	626.45	626.45	0.00	625.77	625.77	0.00	624.19	624.19	0.00						
	1.138	Outfall LC-15, left	616.13	629.04	629.04	0.00	626.60	626.60	0.00	625.90	625.90	0.00	624.32	624.32	0.00						
	1.141	Outfall LC-16, right	621.01	629.06	629.06	0.00	626.63	626.63	0.00	625.93	625.93	0.00	624.34	624.34	0.00						
	1.17	**Cross-Section**		629.25	629.25	0.00	626.87	626.87	0.00	626.14	626.14	0.00	624.54	624.54	0.00						

[a]*References to "left" and "right" are based on looking in the downstream direction.*

[b]*Water surface elevation determined using backwater from the confluence with the Right Split (west oxbow) of the Milwaukee River.*

Table 4

WATER SURFACE PROFILE COMPARISON OF EXISTING DAM CONDITIONS TO ALTERNATIVE PLAN NO. 3A: ABANDON AND REMOVE THE DAM AND PROVIDE A 4-FOOT-HIGH ROCK RAMP

				500-Yr Flow			100-Yr Flow			50-Yr Flow			10-Yr Flow			Median Flow			Mean Flow		
Model Reach	River Mile	Description[a]	Invert Elev NGVD29 (ft)	Rock Ramp Mod. W.S. Elev (NGVD29, ft)	Exist. Cond. W. S. Elev (NGVD29, ft)	Difference (ft)	Rock Ramp Mod. W.S. Elev (NGVD29, ft)	Exist. Cond. W. S. Elev (NGVD29, ft)	Difference (ft)	Rock Ramp Mod. W.S. Elev (NGVD29, ft)	Exist. Cond. W. S. Elev (NGVD29, ft)	Difference (ft)	Rock Ramp Mod. W.S. Elev (NGVD29, ft)	Exist. Cond. W. S. Elev (NGVD29, ft)	Difference (ft)	Rock Ramp Mod. W.S. Elev (NGVD29, ft)	Exist. Cond. W. S. Elev (NGVD29, ft)	Difference (ft)	Rock Ramp Mod. W.S. Elev (NGVD29, ft)	Exist. Cond. W. S. Elev (NGVD29, ft)	Difference (ft)
Milwaukee River - Lower Reach	**6.827**	**Cross-Section**		621.11	621.11	0.00	619.23	619.23	0.00	618.29	618.29	0.00	616.12	616.12	0.00	609.44	609.44	0.00	609.89	609.89	0.00
	6.8275	Estabrook Park Dam																			
	6.828	Outfall MkeR-7, left		621.11	621.65	-0.54	619.23	619.96	-0.73	618.29	619.17	-0.88	616.12	617.50	-1.38	609.44	613.17	-3.73	609.89	613.51	-3.62
	6.829	**Cross-Section**		621.11	622.18	-1.07	619.23	620.68	-1.45	618.29	620.05	-1.76	616.12	618.88	-2.76	609.44	616.89	-7.45	609.89	617.12	-7.23
	6.843	**Cross-Section**		621.11	622.18	-1.07	619.22	620.67	-1.45	618.29	620.04	-1.75	616.12	618.87	-2.75	609.95	616.89	-6.94	610.13	617.12	-6.99
	6.866	Outfall MkeR-8, right		621.09	622.16	-1.07	619.21	620.66	-1.45	618.29	620.03	-1.74	616.14	618.87	-2.73	610.08	616.89	-6.81	610.31	617.12	-6.81
	6.928	**Cross-Section**		621.04	622.10	-1.06	619.19	620.63	-1.44	618.28	620.01	-1.73	616.20	618.87	-2.67	610.43	616.89	-6.46	610.79	617.12	-6.33
	6.941	**Cross-Section - Rock Ramp**		621.09	622.14	-1.05	619.25	620.66	-1.41	618.34	620.05	-1.71	616.27	618.89	-2.62	610.46	616.89	-6.43	610.83	617.12	-6.29
	6.96	**Cross-Section - Rock Ramp**		621.02	622.16	-1.14	619.17	620.69	-1.52	618.25	620.07	-1.82	616.68	618.90	-2.22	613.62	616.89	-3.27	613.79	617.12	-3.33
	6.963	**Cross-Section**		622.03	622.17	-0.14	620.48	620.70	-0.22	619.79	620.08	-0.29	618.50	618.91	-0.41	613.83	616.89	-3.06	614.09	617.12	-3.03
	6.987	**Cross-Section**		622.18	622.32	-0.14	620.61	620.82	-0.21	619.90	620.18	-0.28	618.57	618.97	-0.40	613.83	616.89	-3.06	614.10	617.12	-3.02
	7.087	**Cross-Section**		622.56	622.68	-0.12	620.96	621.15	-0.19	620.23	620.48	-0.25	618.80	619.18	-0.38	613.83	616.89	-3.06	614.10	617.12	-3.02
	7.096	Outfall MkeR-9, left	610.8	622.54	622.66	-0.12	620.95	621.14	-0.19	620.22	620.47	-0.25	618.80	619.17	-0.37	613.83	616.89	-3.06	614.10	617.12	-3.02
	7.098	Outfall MkeR-10, left		622.54	622.66	-0.12	620.95	621.14	-0.19	620.22	620.47	-0.25	618.80	619.17	-0.37	613.83	616.89	-3.06	614.10	617.12	-3.02
	7.103	**Cross-Section**		622.53	622.65	-0.12	620.94	621.13	-0.19	620.22	620.47	-0.25	618.80	619.17	-0.37	613.83	616.89	-3.06	614.10	617.12	-3.02
	7.104	Outfall MkeR-11, right	615.6	622.54	622.66	-0.12	620.94	621.13	-0.19	620.22	620.47	-0.25	618.80	619.17	-0.37	613.83	616.89	-3.06	614.10	617.12	-3.02
	7.104	Outfall MkeR-12, right		622.54	622.66	-0.12	620.94	621.13	-0.19	620.22	620.47	-0.25	618.80	619.17	-0.37	613.83	616.89	-3.06	614.10	617.12	-3.02
	7.11	Port Washington Road																			
	7.117	**Cross-Section**		622.60	622.72	-0.12	621.00	621.19	-0.19	620.27	620.52	-0.25	618.84	619.21	-0.37	613.83	616.89	-3.06	614.10	617.12	-3.02
	7.16	**Cross-Section**		622.69	622.81	-0.12	621.09	621.28	-0.19	620.36	620.60	-0.24	618.91	619.27	-0.36	613.83	616.89	-3.06	614.11	617.12	-3.01
	7.17	IH 43																			
	7.183	**Cross-Section**		622.84	622.95	-0.11	621.23	621.41	-0.18	620.49	620.72	-0.23	619.00	619.35	-0.35	613.83	616.90	-3.07	614.11	617.13	-3.02
	7.189	**Cross-Section**		622.88	622.99	-0.11	621.27	621.44	-0.17	620.52	620.75	-0.23	619.03	619.37	-0.34	613.83	616.90	-3.07	614.11	617.13	-3.02
	7.19	Ramp to IH 43																			
	7.199	**Cross-Section**		623.00	623.11	-0.11	621.37	621.54	-0.17	620.61	620.84	-0.23	619.10	619.44	-0.34	613.84	616.92	-3.08	614.11	617.16	-3.05
	7.201	Outfall MkeR-13, right		623.00	623.11	-0.11	621.37	621.54	-0.17	620.61	620.84	-0.23	619.10	619.44	-0.34	613.84	616.92	-3.08	614.11	617.16	-3.05
	7.241	Outfall MkeR-14, right		623.09	623.20	-0.11	621.46	621.63	-0.16	620.70	620.92	-0.22	619.17	619.51	-0.33	613.84	616.92	-3.08	614.12	617.16	-3.04
	7.359	**Cross-Section**		623.34	623.44	-0.10	621.72	621.87	-0.15	620.96	621.15	-0.19	619.38	619.69	-0.31	613.84	616.92	-3.08	614.13	617.16	-3.03
	7.519	Outfall MkeR-15, right	629.46	623.82	623.91	-0.09	622.18	622.31	-0.13	621.40	621.57	-0.17	619.74	620.01	-0.27	613.85	616.92	-3.07	614.14	617.16	-3.02
	7.519	**Cross-Section**		623.82	623.91	-0.09	622.18	622.31	-0.13	621.40	621.57	-0.17	619.74	620.01	-0.27	613.85	616.92	-3.07	614.14	617.16	-3.02
	7.526	Outfall MkeR-16, right		623.83	623.92	-0.09	622.19	622.32	-0.13	621.41	621.58	-0.17	619.75	620.02	-0.27	613.85	616.92	-3.07	614.14	617.16	-3.02
	7.576	Outfall MkeR-17, right	618.1	623.91	623.99	-0.09	622.27	622.40	-0.13	621.49	621.66	-0.16	619.82	620.08	-0.26	613.85	616.92	-3.07	614.15	617.16	-3.01
	7.633	**Cross-Section**		623.99	624.07	-0.08	622.36	622.48	-0.12	621.58	621.74	-0.16	619.90	620.15	-0.25	613.85	616.92	-3.07	614.15	617.16	-3.01
	7.64	Outfall MkeR-18, right		624.00	624.08	-0.08	622.37	622.49	-0.12	621.59	621.75	-0.16	619.91	620.16	-0.25	613.85	616.92	-3.07	614.15	617.16	-3.01
	7.654	**Cross-Section**		624.01	624.09	-0.08	622.38	622.50	-0.12	621.60	621.76	-0.16	619.92	620.17	-0.25	613.86	616.92	-3.06	614.16	617.16	-3.00
	7.656	Outfall MkeR-19, right		624.03	624.11	-0.08	622.40	622.52	-0.12	621.62	621.78	-0.16	619.93	620.18	-0.25	613.86	616.92	-3.06	614.16	617.16	-3.00
	7.66	Hampton Avenue																			
	7.669	**Cross-Section**		624.18	624.26	-0.08	622.53	622.65	-0.12	621.74	621.89	-0.15	620.02	620.26	-0.24	613.86	616.92	-3.06	614.16	617.16	-3.00
	7.669	Outfall MkeR-20, right		624.18	624.26	-0.08	622.53	622.65	-0.12	621.74	621.89	-0.15	620.02	620.26	-0.24	613.86	616.92	-3.06	614.16	617.16	-3.00
	7.706	**Cross-Section**		624.42	624.50	-0.08	622.69	622.81	-0.12	621.87	622.02	-0.15	620.10	620.34	-0.24	613.86	616.92	-3.06	614.16	617.16	-3.00
	7.745	**Cross-Section**		624.59	624.66	-0.07	622.83	622.95	-0.12	621.99	622.14	-0.15	620.19	620.42	-0.23	613.86	616.92	-3.06	614.16	617.16	-3.00

Decreases in water surface elevation relative to existing dam conditions.

Table 4 (continued)

Model Reach	River Mile	Description[a]	Invert Elev NGVD29 (ft)	500-Yr Flow			100-Yr Flow			50-Yr Flow			10-Yr Flow			Median Flow			Mean Flow		
				Rock Ramp Mod. W.S. Elev (NGVD29, ft)	Exist. Cond. W. S. Elev (NGVD29, ft)	Difference (ft)	Rock Ramp Mod. W.S. Elev (NGVD29, ft)	Exist. Cond. W. S. Elev (NGVD29, ft)	Difference (ft)	Rock Ramp Mod. W.S. Elev (NGVD29, ft)	Exist. Cond. W. S. Elev (NGVD29, ft)	Difference (ft)	Rock Ramp Mod. W.S. Elev (NGVD29, ft)	Exist. Cond. W. S. Elev (NGVD29, ft)	Difference (ft)	Rock Ramp Mod. W.S. Elev (NGVD29, ft)	Exist. Cond. W. S. Elev (NGVD29, ft)	Difference (ft)	Rock Ramp Mod. W.S. Elev (NGVD29, ft)	Exist. Cond. W. S. Elev (NGVD29, ft)	Difference (ft)
Milwaukee River - Middle Reach	**7.851**	**Cross-Section**		624.79	624.86	-0.07	623.02	623.13	-0.11	622.16	622.30	-0.14	620.30	620.53	-0.23	614.23	616.92	-2.69	614.47	617.16	-2.69
	7.876	**Cross-Section**		624.80	624.87	-0.07	623.03	623.14	-0.11	622.17	622.32	-0.15	620.31	620.54	-0.23	614.23	616.92	-2.69	614.47	617.16	-2.69
	7.934	**Cross-Section**		624.83	624.90	-0.07	623.07	623.17	-0.10	622.21	622.35	-0.14	620.35	620.57	-0.22	614.23	616.92	-2.69	614.47	617.16	-2.69
	7.945	Outfall MkeR-21, left		624.83	624.90	-0.07	623.07	623.17	-0.10	622.21	622.35	-0.14	620.35	620.57	-0.22	614.23	616.92	-2.69	614.47	617.16	-2.69
	8.003	**Cross-Section**		624.83	624.90	-0.07	623.07	623.18	-0.11	622.22	622.36	-0.14	620.36	620.58	-0.22	614.23	616.92	-2.69	614.48	617.16	-2.68
	8.098	Outfall MkeR-22, right	613.85	624.86	624.93	-0.07	623.10	623.21	-0.11	622.25	622.39	-0.14	620.39	620.61	-0.22	614.24	616.92	-2.68	614.49	617.17	-2.68
	8.132	**Cross-Section**		624.87	624.94	-0.07	623.11	623.22	-0.11	622.26	622.40	-0.14	620.40	620.62	-0.22	614.24	616.92	-2.68	614.49	617.17	-2.68
	8.141	**Cross-Section**		624.87	624.94	-0.07	623.11	623.22	-0.11	622.27	622.40	-0.13	620.40	620.62	-0.22	614.24	616.92	-2.68	614.49	617.17	-2.68
	8.145	**Cross-Section**		624.87	624.94	-0.07	623.12	623.22	-0.10	622.27	622.41	-0.14	620.41	620.63	-0.22	614.24	616.92	-2.68	614.49	617.17	-2.68
Milwaukee River - Right Split (west oxbow)	**7.8761**	**Cross-Section**		624.76	624.83	-0.07	622.98	623.09	-0.11	622.12	622.27	-0.15	620.26	620.49	-0.23	614.23	616.92	-2.69	614.47	617.16	-2.69
	7.9	Milwaukee River Parkway																			
	7.9341	**Cross-Section**		624.78	624.85	-0.07	623.01	623.11	-0.10	622.15	622.30	-0.15	620.29	620.52	-0.23	614.23	616.92	-2.69	614.47	617.16	-2.69
	8.0031	**Cross-Section**		624.85	624.92	-0.07	623.10	623.20	-0.10	622.24	622.38	-0.14	620.37	620.59	-0.22	614.23	616.92	-2.69	614.47	617.16	-2.69
	8.047	Lincoln Creek Confluence		624.85	624.92	-0.07	623.10	623.20	-0.10	622.24	622.38	-0.14	620.37	620.59	-0.22	614.23	616.92	-2.69	614.47	617.16	-2.69
	8.1321	**Cross-Section**		624.86	624.93	-0.07	623.10	623.20	-0.10	622.24	622.38	-0.14	620.38	620.60	-0.22	614.23	616.92	-2.69	614.47	617.16	-2.69
	8.1411	**Cross-Section**		624.83	624.90	-0.07	623.07	623.18	-0.11	622.22	622.36	-0.14	620.36	620.58	-0.22	614.23	616.92	-2.69	614.47	617.16	-2.69
	8.142	Milwaukee River Parkway																			
	8.1451	**Cross-Section**		624.84	624.91	-0.07	623.08	623.19	-0.11	622.23	622.37	-0.14	620.37	620.59	-0.22	614.23	616.92	-2.69	614.48	617.17	-2.69
Milwaukee River - Upper Reach	**8.229**	**Cross-Section**		624.61	624.68	-0.07	622.92	623.02	-0.10	622.10	622.24	-0.14	620.32	620.54	-0.22	614.24	616.92	-2.68	614.50	617.17	-2.67
	8.244	Outfall MkeR-23, right	615.04	624.64	624.71	-0.07	622.95	623.05	-0.10	622.13	622.27	-0.14	620.35	620.57	-0.22	614.24	616.92	-2.68	614.50	617.17	-2.67
	8.341	**Cross-Section**		624.83	624.90	-0.07	623.16	623.26	-0.10	622.36	622.48	-0.12	620.56	620.76	-0.20	614.25	616.92	-2.67	614.51	617.17	-2.66
	8.343	Outfall MkeR-24, right		624.82	624.89	-0.07	623.16	623.26	-0.10	622.36	622.48	-0.12	620.56	620.76	-0.20	614.25	616.92	-2.67	614.51	617.17	-2.66
	8.357	**Cross-Section**		624.77	624.84	-0.07	623.13	623.23	-0.10	622.33	622.45	-0.12	620.55	620.75	-0.20	614.25	616.92	-2.67	614.51	617.17	-2.66
	8.36	Railroad Bridge																			
	8.366	Outfall MkeR-25, right	613.02	624.96	625.02	-0.07	623.28	623.37	-0.10	622.46	622.58	-0.12	620.65	620.85	-0.20	614.27	616.95	-2.67	614.54	617.19	-2.66
	8.375	**Cross-Section**		625.14	625.20	-0.06	623.42	623.51	-0.09	622.59	622.71	-0.12	620.75	620.94	-0.19	614.29	616.97	-2.68	614.56	617.21	-2.65
	8.381	**Cross-Section**		625.15	625.21	-0.06	623.44	623.53	-0.09	622.61	622.73	-0.12	620.77	620.96	-0.19	614.29	616.97	-2.68	614.56	617.21	-2.65
	8.389	Outfall MkeR-27, left		625.27	625.33	-0.06	623.52	623.61	-0.09	622.67	622.79	-0.12	620.80	620.98	-0.18	614.29	616.97	-2.68	614.56	617.21	-2.65
	8.39	Outfall MkeR-26, right	611.95	625.28	625.34	-0.06	623.53	623.62	-0.09	622.67	622.79	-0.12	620.80	620.99	-0.18	614.29	616.97	-2.68	614.56	617.21	-2.65
	8.394	**Cross-Section**		625.34	625.40	-0.06	623.57	623.66	-0.09	622.70	622.82	-0.12	620.82	621.00	-0.18	614.29	616.97	-2.68	614.56	617.21	-2.65
	8.553	Outfall MkeR-28, left		626.10	626.15	-0.05	624.28	624.36	-0.07	623.40	623.49	-0.09	621.42	621.58	-0.15	614.31	616.97	-2.66	614.61	617.22	-2.61
	8.574	Outfall MkeR-29, right	616.26	626.20	626.25	-0.05	624.38	624.45	-0.07	623.49	623.58	-0.09	621.50	621.65	-0.15	614.31	616.97	-2.66	614.62	617.22	-2.60
	8.579	**Cross-Section**		626.22	626.27	-0.05	624.40	624.47	-0.07	623.51	623.60	-0.09	621.52	621.67	-0.15	614.31	616.97	-2.66	614.62	617.22	-2.60
	8.66	**Cross-Section**		626.68	626.73	-0.05	624.82	624.88	-0.06	623.91	623.99	-0.08	621.85	621.98	-0.13	614.33	616.98	-2.65	614.66	617.23	-2.57
	8.716	**Cross-Section**		626.86	626.90	-0.04	625.00	625.06	-0.06	624.09	624.16	-0.07	622.04	622.16	-0.12	614.36	616.98	-2.62	614.71	617.23	-2.52
	8.73	Outfall MkeR-30, left		626.84	626.88	-0.04	624.99	625.05	-0.06	624.08	624.16	-0.08	622.03	622.15	-0.12	614.36	616.98	-2.62	614.72	617.23	-2.51
	8.73	**Cross-Section**		626.84	626.88	-0.04	624.99	625.05	-0.06	624.08	624.16	-0.08	622.03	622.15	-0.12	614.36	616.98	-2.62	614.72	617.23	-2.51
	8.732	Outfall MkeR-31, right		626.85	626.89	-0.04	625.00	625.06	-0.06	624.09	624.17	-0.08	622.04	622.16	-0.12	614.37	616.98	-2.61	614.73	617.23	-2.50
	8.733	Outfall MkeR-33, left		626.86	626.90	-0.04	625.01	625.07	-0.06	624.10	624.18	-0.08	622.05	622.17	-0.12	614.37	616.98	-2.61	614.74	617.23	-2.49
	8.734	Outfall MkeR-32, right		626.87	626.91	-0.04	625.01	625.07	-0.06	624.10	624.18	-0.08	622.05	622.17	-0.12	614.38	616.98	-2.60	614.75	617.23	-2.48
	8.74	Silver Spring Road																			
	8.759	**Cross-Section**		627.03	627.07	-0.04	625.16	625.22	-0.06	624.26	624.33	-0.07	622.21	622.32	-0.11	614.48	616.98	-2.50	614.92	617.24	-2.32
	8.783	**Cross-Section**		627.10	627.14	-0.04	625.23	625.29	-0.06	624.32	624.39	-0.07	622.28	622.39	-0.11	614.52	616.98	-2.46	614.98	617.25	-2.27
	8.963	**Cross-Section**		627.67	627.70	-0.03	625.82	625.87	-0.05	624.91	624.97	-0.06	622.84	622.93	-0.09	614.59	616.99	-2.40	615.12	617.26	-2.14
	8.966	Outfall MkeR-34, right		627.68	627.71	-0.03	625.83	625.88	-0.05	624.92	624.98	-0.06	622.85	622.94	-0.09	614.59	616.99	-2.40	615.12	617.26	-2.14
	9.125	**Cross-Section**		628.25	628.28	-0.03	626.41	626.45	-0.04	625.51	625.55	-0.04	623.42	623.49	-0.07	614.73	617.00	-2.27	615.33	617.29	-1.96
	9.13	Outfall MkeR-35, left		628.28	628.31	-0.03	626.43	626.47	-0.04	625.53	625.57	-0.04	623.44	623.51	-0.07	614.74	617.00	-2.26	615.34	617.29	-1.95
	9.242	Outfall MkeR-36, left		628.84	628.87	-0.03	626.98	627.02	-0.04	626.08	626.11	-0.04	623.96	624.02	-0.06	614.92	617.01	-2.10	615.56	617.33	-1.77
	9.244	Outfall MkeR-37, right		628.85	628.88	-0.03	626.99	627.03	-0.04	626.09	626.12	-0.04	623.97	624.03	-0.06	614.92	617.01	-2.09	615.56	617.33	-1.77

Decreases in water surface elevation relative to existing dam conditions.

Table 4 (continued)

Model Reach	River Mile	Description[a]	Invert Elev NGVD29 (ft)	500-Yr Flow Rock Ramp Mod. W.S. Elev (NGVD29, ft)	500-Yr Flow Exist. Cond. W. S. Elev (NGVD29, ft)	500-Yr Flow Difference (ft)	100-Yr Flow Rock Ramp Mod. W.S. Elev (NGVD29, ft)	100-Yr Flow Exist. Cond. W. S. Elev (NGVD29, ft)	100-Yr Flow Difference (ft)	50-Yr Flow Rock Ramp Mod. W.S. Elev (NGVD29, ft)	50-Yr Flow Exist. Cond. W. S. Elev (NGVD29, ft)	50-Yr Flow Difference (ft)	10-Yr Flow Rock Ramp Mod. W.S. Elev (NGVD29, ft)	10-Yr Flow Exist. Cond. W. S. Elev (NGVD29, ft)	10-Yr Flow Difference (ft)	Median Flow Rock Ramp Mod. W.S. Elev (NGVD29, ft)	Median Flow Exist. Cond. W. S. Elev (NGVD29, ft)	Median Flow Difference (ft)	Mean Flow Rock Ramp Mod. W.S. Elev (NGVD29, ft)	Mean Flow Exist. Cond. W. S. Elev (NGVD29, ft)	Mean Flow Difference (ft)
Milwaukee River - Upper Reach (continued)	9.376	Outfall MkeR-38, left		629.51	629.54	-0.02	627.64	627.67	-0.03	626.72	626.76	-0.03	624.58	624.63	-0.05	615.13	617.02	-1.90	615.82	617.37	-1.55
	9.427	**Cross-Section**		629.77	629.79	-0.02	627.89	627.92	-0.03	626.97	627.00	-0.03	624.82	624.86	-0.04	615.21	617.03	-1.82	615.92	617.39	-1.47
	9.471	Outfall MkeR-40, right		629.92	629.94	-0.02	628.04	628.07	-0.03	627.12	627.15	-0.03	624.97	625.01	-0.04	615.32	617.04	-1.72	616.04	617.42	-1.38
	9.476	Outfall MkeR-39, left		629.93	629.95	-0.02	628.06	628.09	-0.03	627.14	627.17	-0.03	624.99	625.03	-0.04	615.34	617.04	-1.70	616.05	617.42	-1.36
	9.601	Outfall MkeR-41, left		630.35	630.37	-0.02	628.49	628.51	-0.02	627.57	627.59	-0.02	625.42	625.45	-0.03	615.66	617.07	-1.41	616.39	617.49	-1.10
	9.632	Outfall MkeR-42, right		630.45	630.47	-0.02	628.59	628.61	-0.02	627.67	627.69	-0.02	625.53	625.55	-0.02	615.74	617.08	-1.34	616.48	617.51	-1.03
	9.669	**Cross-Section**		630.57	630.59	-0.02	628.72	628.74	-0.02	627.80	627.82	-0.02	625.66	625.68	-0.02	615.84	617.09	-1.25	616.58	617.53	-0.95
	9.834	Outfall MkeR-43, right		631.33	631.35	-0.02	629.72	629.73	-0.01	628.95	628.96	-0.01	627.03	627.04	-0.01	616.52	617.25	-0.73	617.33	617.86	-0.53
	9.846	**Cross-Section**		631.38	631.40	-0.02	629.79	629.80	-0.01	629.03	629.04	-0.01	627.13	627.14	-0.01	616.57	617.26	-0.69	617.38	617.88	-0.50
	9.854	Outfall MkeR-44, left		631.44	631.46	-0.02	629.85	629.86	-0.01	629.09	629.10	-0.01	627.18	627.19	-0.01	616.58	617.27	-0.68	617.40	617.89	-0.49
	9.973	Outfall MkeR-45, right		632.39	632.39	0.00	630.81	630.82	-0.01	630.02	630.03	-0.01	627.96	627.97	-0.01	616.79	617.35	-0.57	617.63	618.04	-0.41
	10.009	**Cross-Section**		632.67	632.67	0.00	631.10	631.11	-0.01	630.30	630.31	-0.01	628.19	628.20	-0.01	616.85	617.38	-0.53	617.70	618.08	-0.38
	10.015	Outfall MkeR-46, right		632.75	632.75	0.00	631.16	631.17	-0.01	630.36	630.37	-0.01	628.23	628.24	-0.01	616.85	617.38	-0.53	617.71	618.08	-0.38
	10.023	**Cross-Section**		632.85	632.85	0.00	631.25	631.26	-0.01	630.44	630.44	0.00	628.29	628.30	-0.01	616.86	617.39	-0.53	617.72	618.09	-0.37
	10.025	Outfall MkeR-48, left		632.85	632.85	0.00	631.25	631.26	-0.01	630.44	630.44	0.00	628.29	628.30	-0.01	616.86	617.39	-0.53	617.72	618.09	-0.37
	10.038	Outfall MkeR-47, right		632.82	632.82	-0.01	631.22	631.23	-0.01	630.41	630.42	-0.01	628.27	628.28	-0.01	616.88	617.40	-0.51	617.74	618.10	-0.36
	10.04	Bender Road																			
	10.051	**Cross-Section**		632.79	632.80	-0.01	631.20	631.21	-0.01	630.39	630.40	-0.01	628.25	628.26	-0.01	616.90	617.40	-0.50	617.75	618.11	-0.36
Lincoln Creek - Lower Mainstream	**0**	**Cross-Section**		624.85[b]	624.92[b]	-0.07	623.10[b]	623.20[b]	-0.10	622.24[b]	622.38[b]	-0.14	620.37[b]	620.59[b]	-0.22						
	0.03	**Cross-Section**		624.85[b]	624.92[b]	-0.07	623.10[b]	623.20[b]	-0.10	622.24[b]	622.38[b]	-0.14	620.37[b]	620.59[b]	-0.22						
	0.0303	Outfall LC-1, right		624.85[b]	624.92[b]	-0.07	623.10[b]	623.20[b]	-0.10	622.24[b]	622.38[b]	-0.14	620.37[b]	620.59[b]	-0.22						
	0.14	**Cross-Section**		624.85[b]	624.92[b]	-0.07	623.10[b]	623.20[b]	-0.10	622.24[b]	622.38[b]	-0.14	620.37[b]	620.59[b]	-0.22						
	0.16	**Cross-Section**		624.85[b]	624.92[b]	-0.07	623.10[b]	623.20[b]	-0.10	622.24[b]	622.38[b]	-0.14	620.37[b]	620.59[b]	-0.22						
	0.18	**Cross-Section**		624.85[b]	624.92[b]	-0.07	623.10[b]	623.20[b]	-0.10	622.24[b]	622.38[b]	-0.14	620.37[b]	620.59[b]	-0.22						
	0.181	Outfall LC-2, right	612.1	624.85[b]	624.92[b]	-0.07	623.10[b]	623.20[b]	-0.10	622.24[b]	622.38[b]	-0.14	620.37[b]	620.59[b]	-0.22						
	0.21	**Cross-Section**		624.85[b]	624.92[b]	-0.07	623.10[b]	623.20[b]	-0.10	622.24[b]	622.38[b]	-0.14	620.42	620.59[b]	-0.17						
	0.33	**Cross-Section**		624.85[b]	624.92[b]	-0.07	623.10[b]	623.20[b]	-0.10	622.24[b]	622.38[b]	-0.14	621.04	621.04	0.00						
	0.333	Outfall LC-3, left	614.44	624.85[b]	624.92[b]	-0.07	623.10[b]	623.20[b]	-0.10	622.24[b]	622.38[b]	-0.14	621.07	621.07	0.00						
	0.4	**Cross-Section**		624.87	624.92[b]	-0.05	623.50	623.50	0.00	623.00	623.00	0.00	621.71	621.71	0.00						
	0.41	**Cross-Section**		624.89	624.92[b]	-0.03	623.52	623.52	0.00	623.03	623.03	0.00	621.73	621.73	0.00						
	0.41	Outfall LC-4, left	614.23	624.89	624.92[b]	-0.03	623.52	623.52	0.00	623.03	623.03	0.00	621.73	621.73	0.00						
	0.419	Outfall LC-5, right	616.72	624.89	624.92[b]	-0.03	623.52	623.62	0.00	623.03	623.03	0.00	621.73	621.73	0.00						
	0.42	N. Green Bay Avenue																			
	0.43	**Cross-Section**		625.59	625.59	0.00	623.74	623.74	0.00	623.21	623.21	0.00	621.87	621.87	0.00						
	0.44	**Cross-Section**		625.58	625.58	0.00	623.72	623.72	0.00	623.20	623.20	0.00	621.85	621.85	0.00						
	0.47	**Cross-Section**		626.18	626.18	0.00	624.18	624.18	0.00	623.60	623.60	0.00	622.12	622.12	0.00						
	0.5	**Cross-Section**		626.26	626.26	0.00	624.25	624.25	0.00	623.66	623.66	0.00	622.19	622.19	0.00						
	0.54	**Cross-Section**		626.21	626.21	0.00	624.25	624.25	0.00	623.69	623.69	0.00	622.27	622.27	0.00						
	0.6	**Cross-Section**		626.00	626.00	0.00	624.18	624.18	0.00	623.65	623.65	0.00	622.30	622.30	0.00						
	0.61	**Cross-Section**		626.12	626.12	0.00	624.31	624.31	0.00	623.78	623.78	0.00	622.40	622.40	0.00						
	0.62	**Cross-Section**		626.44	626.44	0.00	624.72	624.72	0.00	624.16	624.16	0.00	622.67	622.67	0.00						
	0.631	Outfall LC-6, left	614.76	626.51	626.51	0.00	624.76	624.76	0.00	624.20	624.20	0.00	622.70	622.70	0.00						
	0.71	**Cross-Section**		627.05	627.05	0.00	625.05	625.05	0.00	624.45	624.45	0.00	622.95	622.95	0.00						
	0.75	**Cross-Section**		627.13	627.13	0.00	625.15	625.15	0.00	624.55	624.55	0.00	623.05	623.05	0.00						
	0.79	**Cross-Section**		627.23	627.23	0.00	625.25	625.25	0.00	624.65	624.65	0.00	623.12	623.12	0.00						
	0.794	**Cross-Section**		627.25	627.25	0.00	625.28	625.28	0.00	624.67	624.67	0.00	623.15	623.15	0.00						
	0.798	Outfall LC-7, right	615.47	627.39	627.39	0.00	625.32	625.32	0.00	624.70	624.70	0.00	623.18	623.18	0.00						

Decreases in water surface elevation relative to existing dam conditions.

[b]*Water surface elevation determined using backwater from the confluence with the Right Split (west oxbow) of the Milwaukee River.*

Table 4 (continued)

Model Reach	River Mile	Description[a]	Invert Elev NGVD29 (ft)	500-Yr Flow			100-Yr Flow			50-Yr Flow			10-Yr Flow			Median Flow			Mean Flow		
				Rock Ramp Mod. W.S. Elev (NGVD29, ft)	Exist. Cond. W. S. Elev (NGVD29, ft)	Difference (ft)	Rock Ramp Mod. W.S. Elev (NGVD29, ft)	Exist. Cond. W. S. Elev (NGVD29, ft)	Difference (ft)	Rock Ramp Mod. W.S. Elev (NGVD29, ft)	Exist. Cond. W. S. Elev (NGVD29, ft)	Difference (ft)	Rock Ramp Mod. W.S. Elev (NGVD29, ft)	Exist. Cond. W. S. Elev (NGVD29, ft)	Difference (ft)	Rock Ramp Mod. W.S. Elev (NGVD29, ft)	Exist. Cond. W. S. Elev (NGVD29, ft)	Difference (ft)	Rock Ramp Mod. W.S. Elev (NGVD29, ft)	Exist. Cond. W. S. Elev (NGVD29, ft)	Difference (ft)
Lincoln Creek - Lower Mainstream (continued)	0.799	Outfall LC-8, right	615.46	627.42	627.42	0.00	625.33	625.33	0.00	624.71	624.71	0.00	623.18	623.18	0.00						
	0.803	W. Villard Avenue																			
	0.81	**Cross-Section**		627.79	627.79	0.00	625.43	625.43	0.00	624.79	624.79	0.00	623.26	623.26	0.00						
	0.82	**Cross-Section**		628.12	628.12	0.00	625.57	625.57	0.00	624.91	624.91	0.00	623.33	623.33	0.00						
	0.848	Outfall LC-10, left	619.6	628.11	628.11	0.00	625.58	625.58	0.00	624.93	624.93	0.00	623.35	623.35	0.00						
	0.877	Outfall LC-9, right	619.17	628.11	628.11	0.00	625.60	625.60	0.00	624.94	624.94	0.00	623.37	623.37	0.00						
	0.909	**Cross-Section**		628.10	628.10	0.00	625.61	625.61	0.00	624.96	624.96	0.00	623.40	623.40	0.00						
	0.912	N. 24th Place Footbridge																			
	0.915	**Cross-Section**		628.22	628.22	0.00	625.64	625.64	0.00	624.98	624.98	0.00	623.42	623.42	0.00						
	0.919	Outfall LC-11, right	619.35	628.25	628.25	0.00	625.65	625.65	0.00	624.99	624.99	0.00	623.44	623.44	0.00						
	0.93	**Cross-Section**		628.34	628.34	0.00	625.69	625.69	0.00	625.03	625.03	0.00	623.48	623.48	0.00						
	0.972	Outfall LC-12, left	617.81	628.44	628.44	0.00	625.82	625.82	0.00	625.15	625.15	0.00	623.61	623.61	0.00						
	0.974	Outfall LC-13, left	617.09	628.44	628.44	0.00	625.83	625.83	0.00	625.16	625.16	0.00	623.61	623.61	0.00						
	0.987	Outfall LC-14, right	619.4	628.47	628.47	0.00	625.87	625.87	0.00	625.19	625.19	0.00	623.65	623.65	0.00						
	1.07	**Cross-Section**		628.67	628.67	0.00	626.12	626.12	0.00	625.43	625.43	0.00	623.90	623.90	0.00						
	1.12	**Cross-Section**		628.92	628.92	0.00	626.45	626.45	0.00	625.77	625.77	0.00	624.19	624.19	0.00						
	1.138	Outfall LC-15, left	616.13	629.04	629.04	0.00	626.60	626.60	0.00	625.90	625.90	0.00	624.32	624.32	0.00						
	1.141	Outfall LC-16, right	621.01	629.06	629.06	0.00	626.63	626.63	0.00	625.93	625.93	0.00	624.34	624.34	0.00						
	1.17	**Cross-Section**		629.25	629.25	0.00	626.87	626.87	0.00	626.14	626.14	0.00	624.54	624.54	0.00						

[a] *References to “left” and “right” are based on looking in the downstream direction.*

[b] *Water surface elevation determined using backwater from the confluence with the Right Split (west oxbow) of the Milwaukee River.*

ESTABROOK DAM STORM SEWER INVENTORY TABLES (00217490).DOC
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Table 5

WATER SURFACE PROFILE COMPARISON OF EXISTING DAM CONDITIONS TO ALTERNATIVE PLAN NO. 4
ABANDON AND REMOVE GATED PORTION OF DAM, LOWER AND REHABILITATE SERPENTINE OVERFLOW SPILLWAY, AND PROVIDE A 6.3-FOOT-HIGH ROCK RAMP

				500-Yr Flow			100-Yr Flow			50-Yr Flow			10-Yr Flow			Median Flow			Mean Flow		
Model Reach	River Mile	Description[a]	Invert Elev NGVD29 (ft)	Rock Ramp w/Fixed Crest at 615.4 ft NGVD29	Exist. Cond. W. S. Elev (NGVD29, ft)	Difference (ft)	Rock Ramp w/Fixed Crest at 615.4 ft NGVD29	Exist. Cond. W. S. Elev (NGVD29, ft)	Difference (ft)	Rock Ramp w/Fixed Crest at 615.4 ft NGVD29	Exist. Cond. W. S. Elev (NGVD29, ft)	Difference (ft)	Rock Ramp w/Fixed Crest at 615.4 ft NGVD29	Exist. Cond. W. S. Elev (NGVD29, ft)	Difference (ft)	Rock Ramp w/Fixed Crest at 615.4 ft NGVD29	Exist. Cond. W. S. Elev (NGVD29, ft)	Difference (ft)	Rock Ramp w/Fixed Crest at 615.4 ft NGVD29	Exist. Cond. W. S. Elev (NGVD29, ft)	Difference (ft)
Milwaukee River - Lower Reach	**6.827**	**Cross-Section - Rock Ramp**		621.06	621.11	-0.05	619.17	619.23	-0.06	618.23	618.29	-0.06	616.06	616.12	-0.06	609.47	609.44	0.03	609.94	609.89	0.05
	6.8275	Estabrook Park Dam																			
	6.828	Outfall MkeR-7, left		621.34	621.65	-0.31	619.72	619.96	-0.24	619.04	619.17	-0.13	617.47	617.50	-0.03	612.60	613.17	-0.57	612.92	613.51	-0.59
	6.829	**Cross-Section**		621.62	622.18	-0.56	620.27	620.68	-0.41	619.85	620.05	-0.20	618.88	618.88	0.00	615.72	616.89	-1.17	615.89	617.12	-1.23
	6.843	**Cross-Section**		621.61	622.18	-0.57	620.27	620.67	-0.40	619.85	620.04	-0.19	618.88	618.87	0.01	615.72	616.89	-1.17	615.89	617.12	-1.23
	6.866	Outfall MkeR-8, right		621.59	622.16	-0.57	620.26	620.66	-0.40	619.84	620.03	-0.19	618.88	618.87	0.01	615.72	616.89	-1.17	615.89	617.12	-1.23
	6.928	**Cross-Section**		621.54	622.10	-0.56	620.22	620.63	-0.41	619.82	620.01	-0.19	618.87	618.87	0.00	615.72	616.89	-1.17	615.89	617.12	-1.23
	6.941	**Cross-Section**		621.58	622.14	-0.56	620.26	620.66	-0.40	619.86	620.05	-0.19	618.89	618.89	0.00	615.72	616.89	-1.17	615.89	617.12	-1.23
	6.96	**Cross-Section**		621.61	622.16	-0.55	620.29	620.69	-0.40	619.88	620.07	-0.19	618.91	618.90	0.01	615.72	616.89	-1.17	615.89	617.12	-1.23
	6.963	**Cross-Section**		621.62	622.17	-0.55	620.30	620.70	-0.40	619.89	620.08	-0.19	618.91	618.91	0.00	615.72	616.89	-1.17	615.89	617.12	-1.23
	6.987	**Cross-Section**		621.79	622.32	-0.53	620.43	620.82	-0.39	620.00	620.18	-0.18	618.98	618.97	0.01	615.72	616.89	-1.17	615.89	617.12	-1.23
	7.087	**Cross-Section**		622.21	622.68	-0.47	620.81	621.15	-0.34	620.32	620.48	-0.16	619.18	619.18	0.00	615.72	616.89	-1.17	615.89	617.12	-1.23
	7.096	Outfall MkeR-9, left	610.8	622.19	622.66	-0.48	620.80	621.14	-0.34	620.31	620.47	-0.17	619.18	619.17	0.01	615.72	616.89	-1.17	615.89	617.12	-1.23
	7.098	Outfall MkeR-10, left		622.18	622.66	-0.48	620.80	621.14	-0.34	620.31	620.47	-0.17	619.18	619.17	0.01	615.72	616.89	-1.17	615.89	617.12	-1.23
	7.103	**Cross-Section**		622.17	622.65	-0.48	620.79	621.13	-0.34	620.30	620.47	-0.17	619.18	619.17	0.01	615.72	616.89	-1.17	615.89	617.12	-1.23
	7.104	Outfall MkeR-11, right	615.6	622.18	622.66	-0.48	620.79	621.13	-0.34	620.30	620.47	-0.17	619.18	619.17	0.01	615.72	616.89	-1.17	615.89	617.12	-1.23
	7.104	Outfall MkeR-12, right		622.18	622.66	-0.48	620.79	621.13	-0.34	620.30	620.47	-0.17	619.18	619.17	0.01	615.72	616.89	-1.17	615.89	617.12	-1.23
	7.11	Port Washington Road																			
	7.117	**Cross-Section**		622.25	622.72	-0.47	620.85	621.19	-0.34	620.36	620.52	-0.16	619.21	619.21	0.00	615.73	616.89	-1.16	615.89	617.12	-1.23
	7.16	**Cross-Section**		622.35	622.81	-0.46	620.95	621.28	-0.33	620.44	620.60	-0.16	619.27	619.27	0.00	615.73	616.89	-1.16	615.90	617.12	-1.22
	7.17	IH 43																			
	7.183	**Cross-Section**		622.52	622.95	-0.43	621.09	621.41	-0.32	620.57	620.72	-0.15	619.35	619.35	0.00	615.73	616.90	-1.17	615.90	617.13	-1.23
	7.189	**Cross-Section**		622.56	622.99	-0.43	621.13	621.44	-0.31	620.60	620.75	-0.15	619.38	619.37	0.01	615.73	616.90	-1.17	615.90	617.13	-1.23
	7.19	Ramp to IH 43																			
	7.199	**Cross-Section**		622.68	623.11	-0.43	621.23	621.54	-0.31	620.69	620.84	-0.15	619.45	619.44	0.01	615.75	616.92	-1.17	615.92	617.16	-1.24
	7.201	Outfall MkeR-13, right		622.68	623.11	-0.43	621.23	621.54	-0.31	620.69	620.84	-0.15	619.45	619.44	0.01	615.75	616.92	-1.17	615.92	617.16	-1.24
	7.241	Outfall MkeR-14, right		622.78	623.20	-0.42	621.33	621.63	-0.30	620.78	620.92	-0.14	619.52	619.51	0.01	615.75	616.92	-1.17	615.92	617.16	-1.24
	7.359	**Cross-Section**		623.06	623.44	-0.38	621.60	621.87	-0.27	621.02	621.15	-0.13	619.70	619.69	0.01	615.75	616.92	-1.17	615.92	617.16	-1.24
	7.519	Outfall MkeR-15, right	629.46	623.57	623.91	-0.34	622.08	622.31	-0.23	621.46	621.57	-0.11	620.01	620.01	0.00	615.75	616.92	-1.17	615.92	617.16	-1.24
	7.519	**Cross-Section**		623.57	623.91	-0.34	622.08	622.31	-0.23	621.46	621.57	-0.11	620.01	620.01	0.00	615.75	616.92	-1.17	615.92	617.16	-1.24
	7.526	Outfall MkeR-16, right		623.58	623.92	-0.34	622.09	622.32	-0.23	621.47	621.58	-0.11	620.02	620.02	0.00	615.75	616.92	-1.17	615.92	617.16	-1.24
	7.576	Outfall MkeR-17, right	618.1	623.66	623.99	-0.33	622.17	622.40	-0.23	621.55	621.66	-0.11	620.09	620.08	0.01	615.75	616.92	-1.17	615.93	617.16	-1.24
	7.633	**Cross-Section**		623.75	624.07	-0.32	622.26	622.48	-0.22	621.63	621.74	-0.11	620.16	620.15	0.01	615.75	616.92	-1.17	615.93	617.16	-1.23
	7.64	Outfall MkeR-18, right		623.76	624.08	-0.32	622.27	622.49	-0.22	621.64	621.75	-0.11	620.16	620.16	0.00	615.75	616.92	-1.17	615.93	617.16	-1.23
	7.654	**Cross-Section**		623.77	624.09	-0.32	622.28	622.50	-0.22	621.65	621.76	-0.11	620.17	620.17	0.00	615.75	616.92	-1.17	615.93	617.16	-1.23
	7.656	Outfall MkeR-19, right		623.80	624.11	-0.32	622.30	622.52	-0.22	621.67	621.78	-0.11	620.18	620.18	0.00	615.75	616.92	-1.17	615.93	617.16	-1.23
	7.66	Hampton Avenue																			
	7.669	**Cross-Section**		623.96	624.26	-0.30	622.44	622.65	-0.21	621.79	621.89	-0.10	620.26	620.26	0.00	615.75	616.92	-1.17	615.93	617.16	-1.23
	7.669	Outfall MkeR-20, right		623.96	624.26	-0.30	622.44	622.65	-0.21	621.79	621.89	-0.10	620.26	620.26	0.00	615.75	616.92	-1.17	615.93	617.16	-1.23
	7.706	**Cross-Section**		624.20	624.50	-0.30	622.60	622.81	-0.21	621.92	622.02	-0.10	620.34	620.34	0.00	615.75	616.92	-1.17	615.93	617.16	-1.23
	7.745	**Cross-Section**		624.37	624.66	-0.29	622.74	622.95	-0.21	622.04	622.14	-0.10	620.42	620.42	0.00	615.75	616.92	-1.17	615.93	617.16	-1.23

Decreases in water surface elevation relative to existing dam conditions.

Increases in water surface elevation relative to existing dam conditions.

Table 5 (continued)

Model Reach	River Mile	Description[a]	Invert Elev NGVD29 (ft)	500-Yr Flow			100-Yr Flow			50-Yr Flow			10-Yr Flow			Median Flow			Mean Flow		
				Rock Ramp w/Fixed Crest at 615.4 ft NGVD29	Exist. Cond. W. S. Elev (NGVD29, ft)	Difference (ft)	Rock Ramp w/Fixed Crest at 615.4 ft NGVD29	Exist. Cond. W. S. Elev (NGVD29, ft)	Difference (ft)	Rock Ramp w/Fixed Crest at 615.4 ft NGVD29	Exist. Cond. W. S. Elev (NGVD29, ft)	Difference (ft)	Rock Ramp w/Fixed Crest at 615.4 ft NGVD29	Exist. Cond. W. S. Elev (NGVD29, ft)	Difference (ft)	Rock Ramp w/Fixed Crest at 615.4 ft NGVD29	Exist. Cond. W. S. Elev (NGVD29, ft)	Difference (ft)	Rock Ramp w/Fixed Crest at 615.4 ft NGVD29	Exist. Cond. W. S. Elev (NGVD29, ft)	Difference (ft)
Milwaukee River - Middle Reach	**7.851**	**Cross-Section**		624.58	624.86	-0.28	622.93	623.13	-0.20	622.21	622.30	-0.09	620.53	620.53	0.00	615.75	616.92	-1.17	615.93	617.16	-1.23
	7.876	**Cross-Section**		624.59	624.87	-0.28	622.95	623.14	-0.19	622.22	622.32	-0.10	620.54	620.54	0.00	615.75	616.92	-1.17	615.93	617.16	-1.23
	7.934	**Cross-Section**		624.63	624.90	-0.27	622.98	623.17	-0.19	622.26	622.35	-0.09	620.57	620.57	0.00	615.75	616.92	-1.17	615.93	617.16	-1.23
	7.945	Outfall MkeR-21, left		624.63	624.90	-0.27	622.98	623.17	-0.19	622.26	622.35	-0.09	620.57	620.57	0.00	615.75	616.92	-1.17	615.93	617.16	-1.23
	8.003	**Cross-Section**		624.63	624.90	-0.27	622.99	623.18	-0.19	622.27	622.36	-0.09	620.59	620.58	0.01	615.75	616.92	-1.17	615.93	617.16	-1.23
	8.098	Outfall MkeR-22, right	613.85	624.66	624.93	-0.27	623.02	623.21	-0.19	622.30	622.39	-0.09	620.61	620.61	0.00	615.75	616.92	-1.17	615.93	617.17	-1.24
	8.132	**Cross-Section**		624.67	624.94	-0.27	623.03	623.22	-0.19	622.31	622.40	-0.09	620.62	620.62	0.00	615.75	616.92	-1.17	615.93	617.17	-1.24
	8.141	**Cross-Section**		624.67	624.94	-0.27	623.03	623.22	-0.19	622.31	622.40	-0.09	620.63	620.62	0.01	615.75	616.92	-1.17	615.93	617.17	-1.24
	8.145	**Cross-Section**		624.68	624.94	-0.26	623.04	623.22	-0.18	622.31	622.41	-0.10	620.63	620.63	0.00	615.75	616.92	-1.17	615.94	617.17	-1.23
Milwaukee River - Right Split (west oxbow)	**7.8761**	**Cross-Section**		624.55	624.83	-0.28	622.89	623.09	-0.20	622.17	622.27	-0.10	620.50	620.49	0.01	615.75	616.92	-1.17	615.93	617.16	-1.23
	7.9	Milwaukee River Parkway																			
	7.9341	**Cross-Section**		624.58	624.85	-0.27	622.92	623.11	-0.19	622.20	622.30	-0.10	620.53	620.52	0.01	615.75	616.92	-1.17	615.93	617.16	-1.23
	8.0031	**Cross-Section**		624.65	624.92	-0.27	623.01	623.20	-0.19	622.29	622.38	-0.09	620.60	620.59	0.01	615.75	616.92	-1.17	615.93	617.16	-1.23
	8.047	Lincoln Creek Confluence		624.65	624.92	-0.27	623.01	623.20	-0.19	622.29	622.38	-0.09	620.60	620.59	0.01	615.75	616.92	-1.17	615.93	617.16	-1.23
	8.1321	**Cross-Section**		624.66	624.93	-0.27	623.02	623.20	-0.18	622.29	622.38	-0.09	620.60	620.60	0.00	615.75	616.92	-1.17	615.93	617.16	-1.23
	8.1411	**Cross-Section**		624.63	624.90	-0.27	622.99	623.18	-0.19	622.27	622.36	-0.09	620.59	620.58	0.01	615.75	616.92	-1.17	615.93	617.16	-1.23
	8.142	Milwaukee River Parkway																			
	8.1451	**Cross-Section**		624.64	624.91	-0.27	623.00	623.19	-0.19	622.28	622.37	-0.09	620.60	620.59	0.01	615.75	616.92	-1.17	615.93	617.17	-1.24
Milwaukee River - Upper Reach	**8.229**	**Cross-Section**		624.40	624.68	-0.28	622.83	623.02	-0.19	622.15	622.24	-0.09	620.54	620.54	0.00	615.75	616.92	-1.17	615.94	617.17	-1.23
	8.244	Outfall MkeR-23, right	615.04	624.43	624.71	-0.28	622.86	623.05	-0.19	622.18	622.27	-0.09	620.57	620.57	0.00	615.75	616.92	-1.17	615.94	617.17	-1.23
	8.341	**Cross-Section**		624.64	624.90	-0.26	623.09	623.26	-0.17	622.40	622.48	-0.08	620.77	620.76	0.01	615.75	616.92	-1.17	615.94	617.17	-1.23
	8.343	Outfall MkeR-24, right		624.63	624.89	-0.26	623.09	623.26	-0.17	622.40	622.48	-0.08	620.77	620.76	0.01	615.75	616.92	-1.17	615.94	617.17	-1.23
	8.357	**Cross-Section**		624.59	624.84	-0.25	623.05	623.23	-0.18	622.37	622.45	-0.08	620.75	620.75	0.00	615.75	616.92	-1.17	615.94	617.17	-1.23
	8.36	Railroad Bridge																			
	8.366	Outfall MkeR-25, right	613.02	624.78	625.02	-0.24	623.20	623.37	-0.17	622.50	622.59	-0.09	620.85	620.85	0.00	615.78	616.95	-1.17	615.96	617.19	-1.23
	8.375	**Cross-Section**		624.97	625.20	-0.23	623.35	623.51	-0.16	622.63	622.71	-0.08	620.94	620.94	0.00	615.80	616.97	-1.17	615.98	617.21	-1.23
	8.381	**Cross-Section**		624.99	625.21	-0.22	623.37	623.53	-0.16	622.65	622.73	-0.08	620.96	620.96	0.00	615.80	616.97	-1.17	615.98	617.21	-1.23
	8.389	Outfall MkeR-27, left		625.10	625.33	-0.23	623.45	623.61	-0.16	622.71	622.79	-0.08	620.99	620.98	0.01	615.80	616.97	-1.17	615.99	617.21	-1.22
	8.39	Outfall MkeR-26, right	611.95	625.11	625.34	-0.23	623.46	623.62	-0.16	622.71	622.79	-0.08	620.99	620.99	0.00	615.80	616.97	-1.17	615.99	617.21	-1.22
	8.394	**Cross-Section**		625.17	625.40	-0.23	623.50	623.66	-0.16	622.74	622.82	-0.08	621.01	621.00	0.01	615.80	616.97	-1.17	615.99	617.21	-1.22
	8.553	Outfall MkeR-28, left		625.96	626.15	-0.19	624.23	624.36	-0.13	623.43	623.49	-0.06	621.58	621.58	0.00	615.80	616.97	-1.17	616.00	617.22	-1.22
	8.574	Outfall MkeR-29, right	616.26	626.07	626.25	-0.18	624.33	624.45	-0.12	623.52	623.58	-0.06	621.65	621.65	0.00	615.80	616.97	-1.17	616.00	617.22	-1.22
	8.579	**Cross-Section**		626.09	626.27	-0.18	624.35	624.47	-0.12	623.54	623.60	-0.06	621.67	621.67	0.00	615.80	616.97	-1.17	616.00	617.22	-1.22
	8.66	**Cross-Section**		626.56	626.73	-0.17	624.77	624.88	-0.11	623.93	623.99	-0.06	621.99	621.98	0.01	615.81	616.98	-1.17	616.02	617.23	-1.21
	8.716	**Cross-Section**		626.74	626.90	-0.16	624.95	625.06	-0.11	624.11	624.16	-0.05	622.16	622.16	0.00	615.81	616.98	-1.17	616.03	617.23	-1.20
	8.73	Outfall MkeR-30, left		626.73	626.88	-0.15	624.94	625.05	-0.11	624.10	624.16	-0.06	622.15	622.15	0.00	615.81	616.98	-1.17	616.03	617.23	-1.20
	8.73	**Cross-Section**		626.73	626.88	-0.15	624.94	625.05	-0.11	624.10	624.16	-0.06	622.15	622.15	0.00	615.81	616.98	-1.17	616.03	617.23	-1.20
	8.732	Outfall MkeR-31, right		626.74	626.89	-0.15	624.95	625.06	-0.11	624.11	624.17	-0.06	622.16	622.16	0.00	615.81	616.98	-1.17	616.03	617.23	-1.20
	8.733	Outfall MkeR-33, left		626.75	626.90	-0.15	624.96	625.07	-0.11	624.12	624.18	-0.06	622.17	622.17	0.00	615.81	616.98	-1.17	616.03	617.23	-1.20
	8.734	Outfall MkeR-32, right		626.76	626.91	-0.15	624.96	625.07	-0.11	624.12	624.18	-0.06	622.17	622.17	0.00	615.81	616.98	-1.17	616.03	617.23	-1.20
	8.74	Silver Spring Road																			
	8.759	**Cross-Section**		626.92	627.07	-0.15	625.12	625.22	-0.10	624.28	624.33	-0.05	622.32	622.32	0.00	615.82	616.98	-1.16	616.05	617.24	-1.19
	8.783	**Cross-Section**		626.99	627.14	-0.15	625.19	625.29	-0.10	624.35	624.39	-0.04	622.39	622.39	0.00	615.83	616.98	-1.15	616.07	617.25	-1.18
	8.963	**Cross-Section**		627.58	627.70	-0.12	625.78	625.87	-0.09	624.93	624.97	-0.04	622.93	622.93	0.00	615.84	616.99	-1.15	616.11	617.26	-1.15
	8.966	Outfall MkeR-34, right		627.59	627.71	-0.12	625.79	625.88	-0.09	624.94	624.98	-0.04	622.94	622.94	0.00	615.84	616.99	-1.15	616.11	617.26	-1.15

Decreases in water surface elevation relative to existing dam conditions. (blue)

Increases in water surface elevation relative to existing dam conditions. (orange)

Table 5 (continued)

Model Reach	River Mile	Description[a]	Invert Elev NGVD29 (ft)	500-Yr Flow			100-Yr Flow			50-Yr Flow			10-Yr Flow			Median Flow			Mean Flow		
				Rock Ramp w/Fixed Crest at 615.4 ft NGVD29	Exist. Cond. W. S. Elev (NGVD29, ft)	Difference (ft)	Rock Ramp w/Fixed Crest at 615.4 ft NGVD29	Exist. Cond. W. S. Elev (NGVD29, ft)	Difference (ft)	Rock Ramp w/Fixed Crest at 615.4 ft NGVD29	Exist. Cond. W. S. Elev (NGVD29, ft)	Difference (ft)	Rock Ramp w/Fixed Crest at 615.4 ft NGVD29	Exist. Cond. W. S. Elev (NGVD29, ft)	Difference (ft)	Rock Ramp w/Fixed Crest at 615.4 ft NGVD29	Exist. Cond. W. S. Elev (NGVD29, ft)	Difference (ft)	Rock Ramp w/Fixed Crest at 615.4 ft NGVD29	Exist. Cond. W. S. Elev (NGVD29, ft)	Difference (ft)
Milwaukee River - Upper Reach (continued)	**9.125**	**Cross-Section**		628.17	628.28	-0.11	626.38	626.45	-0.07	625.52	625.55	-0.03	623.49	623.49	0.00	615.87	617.00	-1.13	616.19	617.29	-1.10
	9.13	Outfall MkeR-35, left		628.20	628.31	-0.11	626.40	626.47	-0.07	625.54	625.57	-0.03	623.51	623.51	0.00	615.87	617.00	-1.13	616.19	617.29	-1.10
	9.242	Outfall MkeR-36, left		628.77	628.87	-0.09	626.96	627.02	-0.06	626.09	626.11	-0.02	624.02	624.02	0.00	615.91	617.01	-1.10	616.29	617.33	-1.04
	9.244	Outfall MkeR-37, right		628.78	628.88	-0.09	626.97	627.03	-0.06	626.10	626.12	-0.02	624.03	624.03	0.00	615.91	617.01	-1.10	616.29	617.33	-1.04
	9.376	Outfall MkeR-38, left		629.46	629.54	-0.08	627.63	627.67	-0.04	626.73	626.76	-0.03	624.63	624.63	0.00	615.96	617.02	-1.06	616.40	617.37	-0.98
	9.427	**Cross-Section**		629.72	629.79	-0.07	627.88	627.92	-0.04	626.98	627.00	-0.02	624.86	624.86	0.00	615.98	617.03	-1.05	616.44	617.39	-0.95
	9.471	Outfall MkeR-40, right		629.87	629.94	-0.07	628.03	628.07	-0.04	627.13	627.15	-0.02	625.01	625.01	0.00	616.02	617.04	-1.02	616.51	617.42	-0.91
	9.476	Outfall MkeR-39, left		629.88	629.95	-0.07	628.05	628.09	-0.04	627.15	627.17	-0.02	625.03	625.03	0.00	616.02	617.04	-1.02	616.51	617.42	-0.90
	9.601	Outfall MkeR-41, left		630.30	630.37	-0.06	628.47	628.51	-0.04	627.57	627.59	-0.02	625.46	625.45	0.01	616.13	617.07	-0.94	616.71	617.49	-0.78
	9.632	Outfall MkeR-42, right		630.41	630.47	-0.06	628.57	628.61	-0.04	627.67	627.69	-0.02	625.56	625.55	0.01	616.16	617.08	-0.92	616.75	617.51	-0.76
	9.669	**Cross-Section**		630.53	630.59	-0.06	628.70	628.74	-0.04	627.80	627.82	-0.02	625.69	625.68	0.01	616.19	617.09	-0.90	616.81	617.53	-0.72
	9.834	Outfall MkeR-43, right		631.30	631.35	-0.04	629.71	629.73	-0.02	628.95	628.96	-0.01	627.04	627.04	0.00	616.65	617.25	-0.60	617.43	617.86	-0.43
	9.846	**Cross-Section**		631.36	631.40	-0.04	629.78	629.80	-0.02	629.03	629.04	-0.01	627.14	627.14	0.00	616.68	617.26	-0.58	617.47	617.88	-0.41
	9.854	Outfall MkeR-44, left		631.42	631.46	-0.04	629.84	629.86	-0.02	629.09	629.10	-0.01	627.19	627.19	0.00	616.69	617.27	-0.57	617.48	617.89	-0.41
	9.973	Outfall MkeR-45, right		632.37	632.39	-0.02	630.81	630.82	-0.01	630.03	630.03	0.00	627.97	627.97	0.00	616.87	617.35	-0.49	617.70	618.04	-0.33
	10.009	**Cross-Section**		632.65	632.67	-0.02	631.10	631.11	-0.01	630.31	630.31	0.00	628.20	628.20	0.00	616.92	617.38	-0.46	617.77	618.08	-0.31
	10.015	Outfall MkeR-46, right		632.73	632.75	-0.02	631.16	631.17	-0.01	630.37	630.37	0.00	628.24	628.24	0.00	616.93	617.38	-0.46	617.77	618.08	-0.31
	10.023	**Cross-Section**		632.84	632.85	-0.01	631.25	631.26	-0.01	630.44	630.44	0.00	628.30	628.30	0.00	616.94	617.39	-0.45	617.78	618.09	-0.31
	10.025	Outfall MkeR-48, left		632.84	632.85	-0.01	631.25	631.26	-0.01	630.44	630.44	0.00	628.30	628.30	0.00	616.94	617.39	-0.45	617.78	618.09	-0.31
	10.038	Outfall MkeR-47, right		632.81	632.82	-0.01	631.22	631.23	-0.01	630.41	630.42	-0.01	628.28	628.28	0.00	616.96	617.40	-0.44	617.80	618.10	-0.30
	10.04	Bender Road																			
	10.051	**Cross-Section**		632.78	632.80	-0.02	631.20	631.21	-0.01	630.39	630.40	-0.01	628.26	628.26	0.00	616.97	617.40	-0.43	617.81	618.11	-0.30
Lincoln Creek - Lower Mainstream	**0**	**Cross-Section**		624.65[b]	624.92[b]	-0.27	623.10[b]	623.20[b]	-0.10	622.29[b]	622.38[b]	-0.09	620.60[b]	620.59[b]	0.01						
	0.03	**Cross-Section**		624.65[b]	624.92[b]	-0.27	623.10[b]	623.20[b]	-0.10	622.29[b]	622.38[b]	-0.09	620.60[b]	620.59[b]	0.01						
	0.0303	Outfall LC-1, right		624.65[b]	624.92[b]	-0.27	623.10[b]	623.20[b]	-0.10	622.29[b]	622.38[b]	-0.09	620.60[b]	620.59[b]	0.01						
	0.14	**Cross-Section**		624.65[b]	624.92[b]	-0.27	623.10[b]	623.20[b]	-0.10	622.29[b]	622.38[b]	-0.09	620.60[b]	620.59[b]	0.01						
	0.16	**Cross-Section**		624.65[b]	624.92[b]	-0.27	623.10[b]	623.20[b]	-0.10	622.29[b]	622.38[b]	-0.09	620.60[b]	620.59[b]	0.01						
	0.18	**Cross-Section**		624.65[b]	624.92[b]	-0.27	623.10[b]	623.20[b]	-0.10	622.29[b]	622.38[b]	-0.09	620.60[b]	620.59[b]	0.01						
	0.181	Outfall LC-2, right	612.1	624.65[b]	624.92[b]	-0.27	623.10[b]	623.20[b]	-0.10	622.29[b]	622.38[b]	-0.09	620.60[b]	620.59[b]	0.01						
	0.21	**Cross-Section**		624.65[b]	624.92[b]	-0.27	623.10[b]	623.20[b]	-0.10	622.29[b]	622.38[b]	-0.09	620.60[b]	620.59[b]	0.01						
	0.33	**Cross-Section**		624.65[b]	624.92[b]	-0.27	623.10[b]	623.20[b]	-0.10	622.29[b]	622.38[b]	-0.09	621.04	621.04	0.00						
	0.333	Outfall LC-3, left	614.44	624.65[b]	624.92[b]	-0.27	623.10[b]	623.20[b]	-0.10	622.29[b]	622.38[b]	-0.09	621.07	621.07	0.00						
	0.4	**Cross-Section**		624.87	624.92[b]	-0.05	623.50	623.50	0.00	623.00	623.00	0.00	621.71	621.71	0.00						
	0.41	**Cross-Section**		624.89	624.92[b]	-0.03	623.52	623.52	0.00	623.03	623.03	0.00	621.73	621.73	0.00						
	0.41	Outfall LC-4, left	614.23	624.89	624.92[b]	-0.03	623.52	623.52	0.00	623.03	623.03	0.00	621.73	621.73	0.00						
	0.419	Outfall LC-5, right	616.72	624.89	624.92[b]	-0.03	623.52	623.62	0.00	623.03	623.03	0.00	621.73	621.73	0.00						
	0.42	N. Green Bay Avenue																			
	0.43	**Cross-Section**		625.59	625.59	0.00	623.74	623.74	0.00	623.21	623.21	0.00	621.87	621.87	0.00						
	0.44	**Cross-Section**		625.58	625.58	0.00	623.72	623.72	0.00	623.20	623.20	0.00	621.85	621.85	0.00						
	0.47	**Cross-Section**		626.18	626.18	0.00	624.18	624.18	0.00	623.60	623.60	0.00	622.12	622.12	0.00						
	0.5	**Cross-Section**		626.26	626.26	0.00	624.25	624.25	0.00	623.66	623.66	0.00	622.19	622.19	0.00						
	0.54	**Cross-Section**		626.21	626.21	0.00	624.25	624.25	0.00	623.69	623.69	0.00	622.27	622.27	0.00						
	0.6	**Cross-Section**		626.00	626.00	0.00	624.18	624.18	0.00	623.65	623.65	0.00	622.30	622.30	0.00						
	0.61	**Cross-Section**		626.12	626.12	0.00	624.31	624.31	0.00	623.78	623.78	0.00	622.40	622.40	0.00						
	0.62	**Cross-Section**		626.44	626.44	0.00	624.72	624.72	0.00	624.16	624.16	0.00	622.67	622.67	0.00						
	0.631	Outfall LC-6, left	614.76	626.51	626.51	0.00	624.76	624.76	0.00	624.20	624.20	0.00	622.70	622.70	0.00						

Decreases in water surface elevation relative to existing dam conditions.

Increases in water surface elevation relative to existing dam conditions.

[b]*Water surface elevation determined using backwater from the confluence with the Right Split (west oxbow) of the Milwaukee River.*

Table 5 (continued)

Model Reach	River Mile	Description[a]	Invert Elev NGVD29 (ft)	500-Yr Flow			100-Yr Flow			50-Yr Flow			10-Yr Flow			Median Flow			Mean Flow		
				Rock Ramp w/Fixed Crest at 615.4 ft NGVD29	Exist. Cond. W. S. Elev (NGVD29, ft)	Difference (ft)	Rock Ramp w/Fixed Crest at 615.4 ft NGVD29	Exist. Cond. W. S. Elev (NGVD29, ft)	Difference (ft)	Rock Ramp w/Fixed Crest at 615.4 ft NGVD29	Exist. Cond. W. S. Elev (NGVD29, ft)	Difference (ft)	Rock Ramp w/Fixed Crest at 615.4 ft NGVD29	Exist. Cond. W. S. Elev (NGVD29, ft)	Difference (ft)	Rock Ramp w/Fixed Crest at 615.4 ft NGVD29	Exist. Cond. W. S. Elev (NGVD29, ft)	Difference (ft)	Rock Ramp w/Fixed Crest at 615.4 ft NGVD29	Exist. Cond. W. S. Elev (NGVD29, ft)	Difference (ft)
Lincoln Creek - Lower Mainstream (continued)	**0.71**	**Cross-Section**		627.05	627.05	0.00	625.05	625.05	0.00	624.45	624.45	0.00	622.95	622.95	0.00						
	0.75	**Cross-Section**		627.13	627.13	0.00	625.15	625.15	0.00	624.55	624.55	0.00	623.05	623.05	0.00						
	0.79	**Cross-Section**		627.23	627.23	0.00	625.25	625.25	0.00	624.65	624.65	0.00	623.12	623.12	0.00						
	0.794	**Cross-Section**		627.25	627.25	0.00	625.28	625.28	0.00	624.67	624.67	0.00	623.15	623.15	0.00						
	0.798	Outfall LC-7, right	615.47	627.39	627.39	0.00	625.32	625.32	0.00	624.70	624.70	0.00	623.18	623.18	0.00						
	0.799	Outfall LC-8, right	615.46	627.42	627.42	0.00	625.33	625.33	0.00	624.71	624.71	0.00	623.18	623.18	0.00						
	0.803	W. Villard Avenue																			
	0.81	**Cross-Section**		627.79	627.79	0.00	625.43	625.43	0.00	624.79	624.79	0.00	623.26	623.26	0.00						
	0.82	**Cross-Section**		628.12	628.12	0.00	625.57	625.57	0.00	624.91	624.91	0.00	623.33	623.33	0.00						
	0.848	Outfall LC-10, left	619.6	628.11	628.11	0.00	625.58	625.58	0.00	624.93	624.93	0.00	623.35	623.35	0.00						
	0.877	Outfall LC-9, right	619.17	628.11	628.11	0.00	625.60	625.60	0.00	624.94	624.94	0.00	623.37	623.37	0.00						
	0.909	**Cross-Section**		628.10	628.10	0.00	625.61	625.61	0.00	624.96	624.96	0.00	623.40	623.40	0.00						
	0.912	N. 24th Place Footbridge																			
	0.915	**Cross-Section**		628.22	628.22	0.00	625.64	625.64	0.00	624.98	624.98	0.00	623.42	623.42	0.00						
	0.919	Outfall LC-11, right	619.35	628.25	628.25	0.00	625.65	625.65	0.00	624.99	624.99	0.00	623.44	623.44	0.00						
	0.93	**Cross-Section**		628.34	628.34	0.00	625.69	625.69	0.00	625.03	625.03	0.00	623.48	623.48	0.00						
	0.972	Outfall LC-12, left	617.81	628.44	628.44	0.00	625.82	625.82	0.00	625.15	625.15	0.00	623.61	623.61	0.00						
	0.974	Outfall LC-13, left	617.09	628.44	628.44	0.00	625.83	625.83	0.00	625.16	625.16	0.00	623.61	623.61	0.00						
	0.987	Outfall LC-14, right	619.4	628.47	628.47	0.00	625.87	625.87	0.00	625.19	625.19	0.00	623.65	623.65	0.00						
	1.07	**Cross-Section**		628.67	628.67	0.00	626.12	626.12	0.00	625.43	625.43	0.00	623.90	623.90	0.00						
	1.12	**Cross-Section**		628.92	628.92	0.00	626.45	626.45	0.00	625.77	625.77	0.00	624.19	624.19	0.00						
	1.138	Outfall LC-15, left	616.13	629.04	629.04	0.00	626.60	626.60	0.00	625.90	625.90	0.00	624.32	624.32	0.00						
	1.141	Outfall LC-16, right	621.01	629.06	629.06	0.00	626.63	626.63	0.00	625.93	625.93	0.00	624.34	624.34	0.00						
	1.17	**Cross-Section**		629.25	629.25	0.00	626.87	626.87	0.00	626.14	626.14	0.00	624.54	624.54	0.00						

[a]*References to "left" and "right" are based on looking in the downstream direction.*

[b]*Water surface elevation determined using backwater from the confluence with the Right Split (west oxbow) of the Milwaukee River.*

Table 6

MAXIMUM WATER DEPTH UNDER MEDIAN FLOW CONDITIONS

Condition Alternative	Lower Reach (Estabrook dam or Rock Ramp to W. Hampton Avenue) (feet)	Middle Reach (W. Hampton Avenue to abandoned railroad bridge upstream of Lincoln Park) (feet)	Upper Reach (Abandoned Railroad Bridge Upstream of Lincoln Park to W. Bender Road) (feet)	W. Silver Spring Drive to W. Bender Road (subreach of Upper Reach) (feet)
Existing Condition	7.4 to 8.7	6.3 to 9.2	2.4 to 9.1	2.4 to 5.0
Alternatives 1 and 1A Rehabilitated Dam (with and without fish passage)	7.4 to 8.7	6.3 to 9.2	2.4 to 9.1	2.4 to 5.0
Alternative 2 Dam Abandoned and Removed	0.7 to 2.5	1.6 to 4.5	0.8 to 4.5	1.5 to 2.1
Alternative 3 Dam Abandoned and Removed with a 5.5-Foot-High Rock Ramp Constructed	5.8 to 6.8	4.7 to 7.6	1.7 to 7.5	1.7 to 3.4
Alternative 3A Dam Abandoned and Removed with a Four-Foot-High Rock Ramp Constructed	4.3 to 5.3	3.6 to 6.5	1.5 to 6.4	1.5 to 2.5
Alternative 4 Gated Portion of Dam Abandoned and Removed with a 6.3-Foot-High Rock Ramp Constructed and Lowered and Rehabilitated Overflow Spillway	6.2 to 7.5	5.1 to 8.0	1.9 to 7.9	1.9 to 3.8

Source: SEWRPC.

Table 7

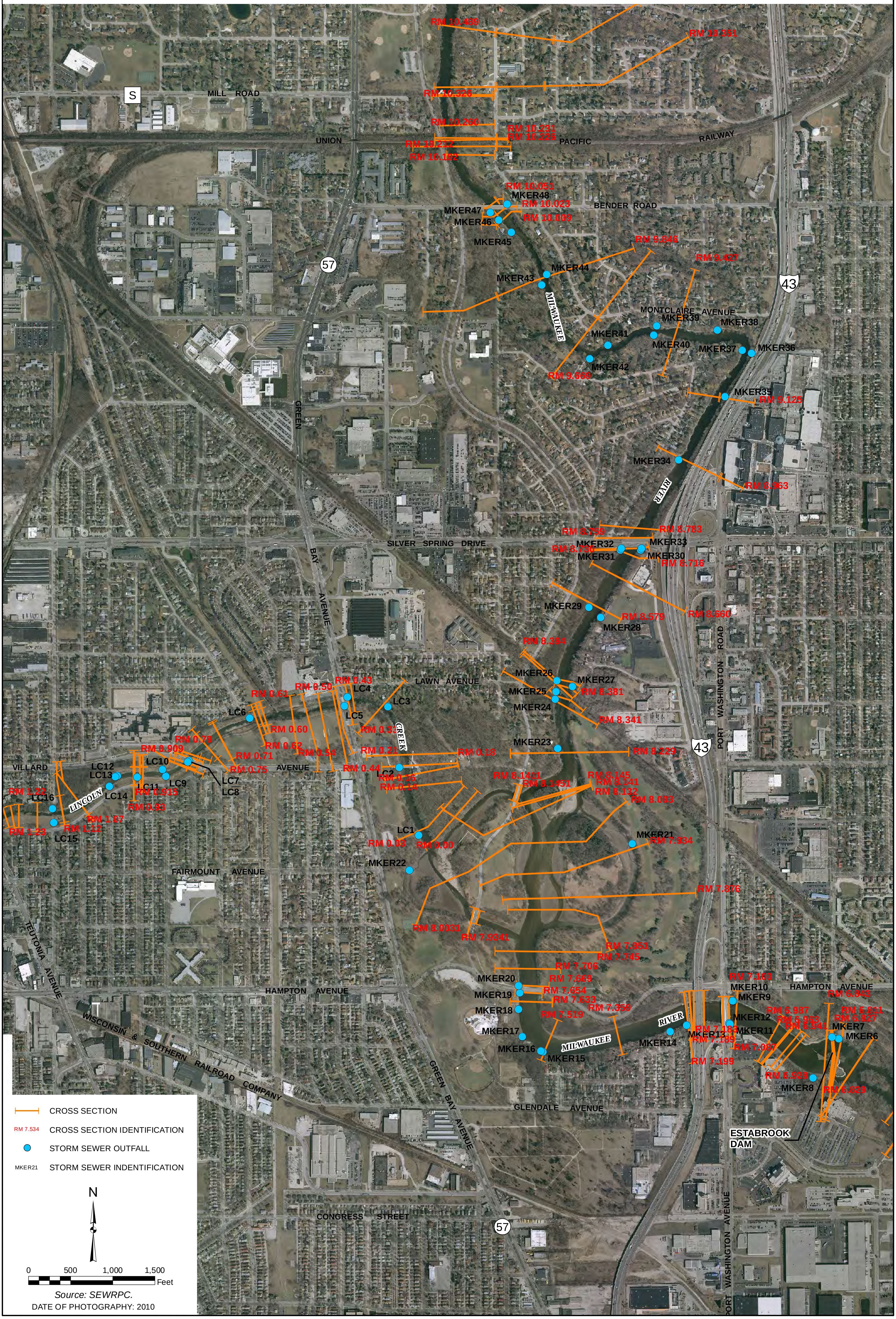
CHANGES IN ONE-PERCENT-ANNUAL-PROBABILITY WATER SURFACE ELEVATIONS AS COMPARED TO EXISTING CONDITIONS

Condition Alternative	Lower Reach (Estabrook dam or Rock Ramp to W. Hampton Avenue) (feet)	Middle Reach (W. Hampton Avenue to abandoned railroad bridge upstream of Lincoln Park) (feet)	Upper Reach (Abandoned Railroad Bridge Upstream of Lincoln Park to W. Bender Road) (feet)	W. Silver Spring Drive to W. Bender Road (subreach of Upper Reach) (feet)
Alternatives 1 and 1A Rehabilitated Dam (with and without fish passage)	0	0	0	0
Alternative 2 Dam Abandoned and Removed	-0.7 to -1.5	-0.5 to -0.7	0 to -0.5	0 to -0.3
Alternative 3 Dam Abandoned and Removed with a 5.5-Foot-High Rock Ramp Constructed	0.7 to 1.2	0.6 to 0.7	0 to 0.6	0 to 0.4
Alternative 3A Dam Abandoned and Removed with a Four-Foot-High Rock Ramp Constructed	-0.1 to -0.2	-0.1	0 to -0.1	0 to -0.1
Alternative 4 Gated Portion of Dam Abandoned and Removed with a 6.3-Foot-High Rock Ramp Constructed and Lowered and Rehabilitated Overflow Spillway	-0.2 to -0.4	-0.2	0 to -0.2	0 to -0.1

Source: SEWRPC.

Exhibit 1

MILWAUKEE RIVER FROM ESTABROOK DAM THROUGH W. BENDER ROAD



ATTACHMENT 4:

SEWRPC EMAIL DATED APRIL 29, 2014 REGARDING ESTABROOK DAM MODELING WITH THE GATES CLOSED AND STOP LOGS IN PLACE

Kistner, Amy

From: Hahn, Michael G. [MHAHN@SEWRPC.org]
Sent: Tuesday, April 29, 2014 9:50 AM
To: Pirrung, Don
Cc: Kevin Haley (kevin.haley@milwaukeecountywi.gov); Murray, Joshua A.
Subject: Estabrook dam hydraulic analysis
Attachments: Estabrook Dam Existing Condition Comparison (00217908).XLS

Don,

We have completed the hydraulic analysis of the Estabrook dam under flood conditions with all slide gates closed and the stop logs in place as requested by you and the County staff. The results of that analysis are attached.

Please let me know if you have any questions.

Mike

Michael G. Hahn, P.E., P.H.
Chief Environmental Engineer
Southeastern Wisconsin Regional Planning Commission
P.O. Box 1607
W239 N1812 Rockwood Drive
Waukesha, WI 53187-1607
Phone: (262) 953-3243
Fax: (262) 547-1103
E-mail: mhahn@sewrpc.org
Web site: www.sewrpc.org

Estabrook Dam Existing Condition Comparison (00217908).xls

Water Surface Profile Comparison of Existing Dam Conditions to Condition Assuming Gates are Closed During Flood Flow Events

Model Reach	River Mile	Description[a]	Invert Elev NGVD29 (ft)	500-Yr Flow Gates Closed W.S. Elev (NGVD29, ft)	500-Yr Flow Exist. Cond. W. S. Elev (NGVD29, ft)	500-Yr Flow Difference (ft)	100-Yr Flow Gates Closed W.S. Elev (NGVD29, ft)	100-Yr Flow Exist. Cond. W. S. Elev (NGVD29, ft)	100-Yr Flow Difference (ft)	50-Yr Flow Gates Closed W.S. Elev (NGVD29, ft)	50-Yr Flow Exist. Cond. W. S. Elev (NGVD29, ft)	50-Yr Flow Difference (ft)	10-Yr Flow Gates Closed W.S. Elev (NGVD29, ft)	10-Yr Flow Exist. Cond. W. S. Elev (NGVD29, ft)	10-Yr Flow Difference (ft)
Milwaukee River - Lower Reach	**6.827**	**Cross-Section**		621.11	621.11	0.00	619.23	619.23	0.00	618.29	618.29	0.00	616.12	616.12	0.00
	6.8275	Estabrook Park Dam													
	6.828	Outfall MkeR-7, left		622.08	621.65	0.44	620.72	619.96	0.77	620.01	619.17	0.84	618.35	617.50	0.85
	6.829	**Cross-Section**		623.05	622.18	0.87	622.21	620.68	1.53	621.72	620.05	1.67	620.57	618.88	1.69
	6.843	**Cross-Section**		623.04	622.18	0.86	622.21	620.67	1.54	621.72	620.04	1.68	620.56	618.87	1.69
	6.866	Outfall MkeR-8, right		623.02	622.16	0.86	622.20	620.66	1.54	621.71	620.03	1.68	620.56	618.87	1.69
	6.928	**Cross-Section**		622.97	622.10	0.87	622.16	620.63	1.53	621.68	620.01	1.67	620.55	618.87	1.68
	6.941	**Cross-Section**		623.00	622.14	0.86	622.18	620.66	1.52	621.70	620.05	1.65	620.56	618.89	1.67
	6.96	**Cross-Section**		623.02	622.16	0.86	622.20	620.69	1.51	621.71	620.07	1.64	620.57	618.90	1.67
	6.963	**Cross-Section**		623.02	622.17	0.85	622.20	620.70	1.50	621.72	620.08	1.64	620.57	618.91	1.66
	6.987	**Cross-Section**		623.14	622.32	0.82	622.29	620.82	1.47	621.79	620.18	1.61	620.61	618.97	1.64
	7.087	**Cross-Section**		623.44	622.68	0.76	622.51	621.15	1.36	621.98	620.48	1.50	620.74	619.18	1.56
	7.096	Outfall MkeR-9, left	610.8	623.42	622.66	0.76	622.50	621.14	1.36	621.97	620.47	1.50	620.73	619.17	1.56
	7.098	Outfall MkeR-10, left		623.42	622.66	0.76	622.50	621.14	1.36	621.97	620.47	1.50	620.73	619.17	1.56
	7.103	**Cross-Section**		623.41	622.65	0.76	622.49	621.13	1.36	621.97	620.47	1.50	620.73	619.17	1.56
	7.104	Outfall MkeR-11, right	615.6	623.41	622.66	0.76	622.49	621.13	1.36	621.97	620.47	1.50	620.73	619.17	1.56
	7.104	Outfall MkeR-12, right		623.41	622.66	0.76	622.49	621.13	1.36	621.97	620.47	1.50	620.73	619.17	1.56
	7.11	Port Washington Road													
	7.117	**Cross-Section**		623.47	622.72	0.75	622.53	621.19	1.34	622.00	620.52	1.48	620.75	619.21	1.54
	7.16	**Cross-Section**		623.54	622.81	0.73	622.59	621.28	1.31	622.05	620.60	1.45	620.79	619.27	1.52
	7.17	IH 43													
	7.183	**Cross-Section**		623.66	622.95	0.71	622.69	621.41	1.28	622.14	620.72	1.42	620.84	619.35	1.49
	7.189	**Cross-Section**		623.69	622.99	0.70	622.71	621.44	1.27	622.16	620.75	1.41	620.85	619.37	1.48
	7.19	Ramp to IH 43													
	7.199	**Cross-Section**		623.80	623.11	0.69	622.81	621.54	1.27	622.25	620.84	1.41	620.92	619.44	1.48
	7.201	Outfall MkeR-13, right		623.80	623.11	0.69	622.81	621.54	1.27	622.25	620.84	1.41	620.92	619.44	1.48
	7.241	Outfall MkeR-14, right		623.87	623.20	0.68	622.87	621.63	1.24	622.30	620.92	1.38	620.96	619.51	1.45
	7.359	**Cross-Section**		624.08	623.44	0.64	623.03	621.87	1.16	622.45	621.15	1.30	621.06	619.69	1.37
	7.519	Outfall MkeR-15, right	629.46	624.48	623.91	0.57	623.35	622.31	1.04	622.73	621.57	1.16	621.26	620.01	1.25
	7.519	**Cross-Section**		624.48	623.91	0.57	623.35	622.31	1.04	622.73	621.57	1.16	621.26	620.01	1.25
	7.526	Outfall MkeR-16, right		624.49	623.92	0.57	623.36	622.32	1.04	622.74	621.58	1.16	621.27	620.02	1.25
	7.576	Outfall MkeR-17, right	618.1	624.54	623.99	0.55	623.41	622.40	1.01	622.79	621.66	1.13	621.31	620.08	1.23
	7.633	**Cross-Section**		624.60	624.07	0.53	623.47	622.48	0.99	622.84	621.74	1.10	621.35	620.15	1.20
	7.64	Outfall MkeR-18, right		624.61	624.08	0.53	623.47	622.49	0.99	622.84	621.75	1.10	621.35	620.16	1.20
	7.654	**Cross-Section**		624.62	624.09	0.53	623.48	622.50	0.98	622.85	621.76	1.09	621.36	620.17	1.19
	7.656	Outfall MkeR-19, right		624.64	624.11	0.53	623.50	622.52	0.98	622.86	621.78	1.09	621.37	620.18	1.19
	7.66	Hampton Avenue													
	7.669	**Cross-Section**		624.77	624.26	0.51	623.60	622.65	0.95	622.95	621.89	1.06	621.42	620.26	1.16
	7.669	Outfall MkeR-20, right		624.77	624.26	0.51	623.60	622.65	0.95	622.95	621.89	1.06	621.42	620.26	1.16
	7.706	**Cross-Section**		625.01	624.50	0.51	623.75	622.81	0.94	623.07	622.02	1.05	621.49	620.34	1.15
	7.745	**Cross-Section**		625.15	624.66	0.49	623.86	622.95	0.91	623.17	622.14	1.03	621.55	620.42	1.13
Milwaukee River - Middle Reach	**7.851**	**Cross-Section**		625.33	624.86	0.47	624.01	623.13	0.88	623.30	622.30	1.00	621.63	620.53	1.10
	7.876	**Cross-Section**		625.34	624.87	0.47	624.02	623.14	0.88	623.31	622.32	0.99	621.64	620.54	1.10
	7.934	**Cross-Section**		625.36	624.90	0.46	624.04	623.17	0.87	623.33	622.35	0.98	621.66	620.57	1.09
	7.945	Outfall MkeR-21, left		625.36	624.90	0.46	624.04	623.17	0.87	623.33	622.35	0.98	621.66	620.57	1.09
	8.003	**Cross-Section**		625.37	624.90	0.47	624.05	623.18	0.87	623.33	622.36	0.97	621.67	620.58	1.09
	8.098	Outfall MkeR-22, right	613.85	625.39	624.93	0.46	624.06	623.21	0.86	623.35	622.39	0.96	621.68	620.61	1.08
	8.132	**Cross-Section**		625.40	624.94	0.46	624.07	623.22	0.85	623.36	622.40	0.96	621.69	620.62	1.07
	8.141	**Cross-Section**		625.40	624.94	0.46	624.08	623.22	0.86	623.36	622.40	0.96	621.69	620.62	1.07
	8.145	**Cross-Section**		625.40	624.94	0.46	624.08	623.22	0.86	623.37	622.41	0.96	621.69	620.63	1.06
Milwaukee River - Right Split (west oxbow)	**7.8761**	**Cross-Section**		625.31	624.83	0.48	623.98	623.09	0.89	623.26	622.27	0.99	621.60	620.49	1.11
	7.9	Milwaukee River Parkway													
	7.9341	**Cross-Section**		625.32	624.85	0.47	624.00	623.11	0.89	623.28	622.30	0.98	621.62	620.52	1.10
	8.0031	**Cross-Section**		625.39	624.92	0.47	624.06	623.20	0.86	623.36	622.38	0.98	621.68	620.59	1.09
	8.047	Lincoln Creek Confluence		625.39	624.92	0.47	624.06	623.20	0.86	623.36	622.38	0.98	621.68	620.59	1.09
	8.1321	**Cross-Section**		625.39	624.93	0.46	624.07	623.20	0.87	623.36	622.38	0.98	621.69	620.60	1.09
	8.1411	**Cross-Section**		625.37	624.90	0.47	624.05	623.18	0.87	623.34	622.36	0.98	621.67	620.58	1.09
	8.142	Milwaukee River Parkway													
	8.1451	**Cross-Section**		625.37	624.91	0.46	624.05	623.19	0.86	623.35	622.37	0.98	621.68	620.59	1.09
Milwaukee River - Upper Reach	**8.229**	**Cross-Section**		625.15	624.68	0.47	623.90	623.02	0.88	623.21	622.24	0.97	621.61	620.54	1.07
	8.244	Outfall MkeR-23, right	615.04	625.18	624.71	0.47	623.92	623.05	0.87	623.23	622.27	0.96	621.63	620.57	1.06
	8.341	**Cross-Section**		625.34	624.90	0.44	624.08	623.26	0.82	623.38	622.48	0.90	621.76	620.76	1.00
	8.343	Outfall MkeR-24, right		625.33	624.89	0.44	624.08	623.26	0.82	623.38	622.48	0.90	621.76	620.76	1.00
	8.357	**Cross-Section**		625.28	624.84	0.44	624.04	623.23	0.81	623.36	622.45	0.91	621.74	620.75	0.99
	8.36	Railroad Bridge													
	8.366	Outfall MkeR-25, right	613.02	625.45	625.02	0.42	624.16	623.37	0.79	623.47	622.58	0.88	621.82	620.85	0.97
	8.375	**Cross-Section**		625.61	625.20	0.41	624.28	623.51	0.77	623.57	622.71	0.86	621.90	620.94	0.96
	8.381	**Cross-Section**		625.62	625.21	0.41	624.30	623.53	0.77	623.58	622.73	0.85	621.91	620.96	0.95
	8.389	Outfall MkeR-27, left		625.73	625.33	0.40	624.37	623.61	0.76	623.64	622.79	0.85	621.94	620.98	0.96
	8.39	Outfall MkeR-26, right	611.95	625.74	625.34	0.40	624.38	623.62	0.76	623.64	622.79	0.85	621.94	620.99	0.96
	8.394	**Cross-Section**		625.80	625.40	0.40	624.41	623.66	0.75	623.67	622.82	0.85	621.96	621.00	0.96
	8.553	Outfall MkeR-28, left		626.49	626.15	0.34	624.99	624.36	0.64	624.20	623.49	0.71	622.38	621.58	0.81
	8.574	Outfall MkeR-29, right	616.26	626.58	626.25	0.33	625.07	624.45	0.62	624.27	623.58	0.69	622.44	621.65	0.78
	8.579	**Cross-Section**		626.60	626.27	0.33	625.09	624.47	0.62	624.29	623.60	0.69	622.45	621.67	0.78
	8.66	**Cross-Section**		627.02	626.73	0.29	625.44	624.88	0.56	624.62	623.99	0.63	622.70	621.98	0.72
	8.716	**Cross-Section**		627.18	626.90	0.28	625.59	625.06	0.53	624.76	624.16	0.60	622.83	622.16	0.67
	8.73	Outfall MkeR-30, left		627.16	626.88	0.28	625.58	625.05	0.53	624.75	624.16	0.59	622.83	622.15	0.68
	8.73	**Cross-Section**		627.16	626.88	0.28	625.58	625.05	0.53	624.75	624.16	0.59	622.83	622.15	0.68
	8.732	Outfall MkeR-31, right		627.17	626.89	0.28	625.59	625.06	0.53	624.76	624.17	0.59	622.84	622.16	0.68
	8.733	Outfall MkeR-33, left		627.18	626.90	0.28	625.60	625.07	0.53	624.77	624.18	0.59	622.84	622.17	0.68
	8.734	Outfall MkeR-32, right		627.19	626.91	0.28	625.60	625.07	0.53	624.77	624.18	0.59	622.85	622.17	0.67
	8.74	Silver Spring Road													
	8.759	**Cross-Section**		627.35	627.07	0.28	625.73	625.22	0.51	624.90	624.33	0.57	622.96	622.32	0.64
	8.783	**Cross-Section**		627.41	627.14	0.27	625.79	625.29	0.50	624.95	624.39	0.56	623.01	622.39	0.62
	8.963	**Cross-Section**		627.94	627.70	0.24	626.29	625.87	0.42	625.44	624.97	0.47	623.45	622.93	0.52
	8.966	Outfall MkeR-34, right		627.95	627.71	0.24	626.30	625.88	0.42	625.45	624.98	0.47	623.46	622.94	0.52
	9.125	**Cross-Section**		628.48	628.28	0.20	626.81	626.45	0.36	625.95	625.55	0.40	623.92	623.49	0.43
	9.13	Outfall MkeR-35, left		628.50	628.31	0.20	626.83	626.47	0.36	625.97	625.57	0.40	623.94	623.51	0.43
	9.242	Outfall MkeR-36, left		629.04	628.87	0.18	627.33	627.02	0.31	626.45	626.11	0.34	624.38	624.02	0.36
	9.244	Outfall MkeR-37, right		629.05	628.88	0.18	627.34	627.03	0.31	626.46	626.12	0.34	624.39	624.03	0.36
	9.376	Outfall MkeR-38, left		629.69	629.54	0.15	627.93	627.67	0.26	627.03	626.76	0.28	624.92	624.63	0.29
	9.427	**Cross-Section**		629.93	629.79	0.14	628.16	627.92	0.24	627.25	627.00	0.25	625.12	624.86	0.26
	9.471	Outfall MkeR-40, right		630.07	629.94	0.13	628.30	628.07	0.23	627.39	627.15	0.24	625.26	625.01	0.25
	9.476	Outfall MkeR-39, left		630.09	629.95	0.13	628.31	628.09	0.23	627.40	627.17	0.24	625.27	625.03	0.25
	9.601	Outfall MkeR-41, left		630.48	630.37	0.12	628.71	628.51	0.20	627.80	627.59	0.21	625.66	625.45	0.21
	9.632	Outfall MkeR-42, right		630.58	630.47	0.11	628.80	628.61	0.19	627.89	627.69	0.20	625.76	625.55	0.20
	9.669	**Cross-Section**		630.70	630.59	0.11	628.92	628.74	0.18	628.01	627.82	0.19	625.87	625.68	0.19
	9.834	Outfall MkeR-43, right		631.42	631.35	0.07	629.83	629.73	0.11	629.05	628.96	0.10	627.14	627.04	0.10
	9.846	**Cross-Section**		631.47	631.40	0.07	629.90	629.80	0.10	629.13	629.04	0.09	627.23	627.14	0.09
	9.854	Outfall MkeR-44, left		631.53	631.46	0.07	629.96	629.86	0.10	629.19	629.10	0.09	627.28	627.19	0.09
	9.973	Outfall MkeR-45, right		632.44	632.39	0.05	630.89	630.82	0.07	630.10	630.03	0.07	628.03	627.97	0.07
	10.009	**Cross-Section**		632.71	632.67	0.04	631.17	631.11	0.06	630.37	630.31	0.06	628.26	628.20	0.06
	10.015	Outfall MkeR-46, right		632.79	632.75	0.04	631.23	631.17	0.06	630.43	630.37	0.06	628.31	628.24	0.06
	10.023	**Cross-Section**		632.89	632.85	0.04	631.32	631.26	0.06	630.50	630.44	0.06	628.37	628.30	0.07
	10.025	Outfall MkeR-48, left		632.89	632.85	0.04	631.32	631.26	0.06	630.50	630.44	0.06	628.37	628.30	0.07
	10.038	Outfall MkeR-47, right		632.86	632.82	0.04	631.29	631.23	0.05	630.47	630.42	0.05	628.34	628.28	0.06
	10.04	Bender Road													
	10.051	**Cross-Section**		632.84	632.80	0.04	631.26	631.21	0.05	630.45	630.40	0.05	628.32	628.26	0.06
Lincoln Creek - Lower Mainstream	**0**	**Cross-Section**		625.39[b]	624.92[b]	0.47	624.06[b]	623.20[b]	0.86	623.36[b]	622.38[b]	0.98	621.68[b]	620.59[b]	1.09
	0.03	**Cross-Section**		625.39[b]	624.92[b]	0.47	624.06[b]	623.20[b]	0.86	623.36[b]	622.38[b]	0.98	621.68[b]	620.59[b]	1.09
	0.0303	Outfall LC-1, right		625.39[b]	624.92[b]	0.47	624.06[b]	623.20[b]	0.86	623.36[b]	622.38[b]	0.98	621.68[b]	620.59[b]	1.09
	0.14	**Cross-Section**		625.39[b]	624.92[b]	0.47	624.06[b]	623.20[b]	0.86	623.36[b]	622.38[b]	0.98	621.68[b]	620.59[b]	1.09
	0.16	**Cross-Section**		625.39[b]	624.92[b]	0.47	624.06[b]	623.20[b]	0.86	623.36[b]	622.38[b]	0.98	621.68[b]	620.59[b]	1.09
	0.18	**Cross-Section**		625.39[b]	624.92[b]	0.47	624.06[b]	623.20[b]	0.86	623.36[b]	622.38[b]	0.98	621.68[b]	620.59[b]	1.09
	0.181	Outfall LC-2, right	612.1	625.39[b]	624.92[b]	0.47	624.06[b]	623.20[b]	0.86	623.36[b]	622.38[b]	0.98	621.68[b]	620.59[b]	1.09
	0.21	**Cross-Section**		625.39[b]	624.92[b]	0.47	624.06[b]	623.20[b]	0.86	623.36[b]	622.38[b]	0.98	621.68[b]	620.59[b]	1.09

Estabrook Dam Existing Condition Comparison (00217908).xls

Water Surface Profile Comparison of Existing Dam Conditions to Condition Assuming Gates are Closed During Flood Flow Events

				500-Yr Flow			100-Yr Flow			50-Yr Flow			10-Yr Flow		
Model Reach	River Mile	Description[a]	Invert Elev NGVD29 (ft)	Gates Closed W.S. Elev (NGVD29, ft)	Exist. Cond. W. S. Elev (NGVD29, ft)	Difference (ft)	Gates Closed W.S. Elev (NGVD29, ft)	Exist. Cond. W. S. Elev (NGVD29, ft)	Difference (ft)	Gates Closed W.S. Elev (NGVD29, ft)	Exist. Cond. W. S. Elev (NGVD29, ft)	Difference (ft)	Gates Closed W.S. Elev (NGVD29, ft)	Exist. Cond. W. S. Elev (NGVD29, ft)	Difference (ft)
	0.33	**Cross-Section**		625.39[b]	624.92[b]	0.47	624.06[b]	623.20[b]	0.86	623.36[b]	622.38[b]	0.98	621.68[b]	621.04	0.64
	0.333	Outfall LC-3, left	614.44	625.39[b]	624.92[b]	0.47	624.06[b]	623.20[b]	0.86	623.36[b]	622.38[b]	0.98	621.68[b]	621.07	0.61
	0.4	**Cross-Section**		625.39[b]	624.92[b]	0.47	624.06[b]	623.50	0.56	623.36[b]	623.00	0.36	621.71	621.71	0.00
	0.41	**Cross-Section**		625.39[b]	624.92[b]	0.47	624.06[b]	623.52	0.54	623.36[b]	623.03	0.33	621.73	621.73	0.00
	0.41	Outfall LC-4, left	614.23	625.39[b]	624.92[b]	0.47	624.06[b]	623.52	0.54	623.36[b]	623.03	0.33	621.73	621.73	0.00
	0.419	Outfall LC-5, right	616.72	625.39[b]	624.92[b]	0.47	624.06[b]	623.62	0.44	623.36[b]	623.03	0.33	621.73	621.73	0.00
	0.42	N. Green Bay Avenue													
	0.43	**Cross-Section**		625.59	625.59	0.00	624.06[b]	623.74	0.32	623.36[b]	623.21	0.15	621.87	621.87	0.00
	0.44	**Cross-Section**		625.58	625.58	0.00	624.06[b]	623.72	0.34	623.36[b]	623.20	0.16	621.85	621.85	0.00
	0.47	**Cross-Section**		626.18	626.18	0.00	624.18	624.18	0.00	623.60	623.60	0.00	622.12	622.12	0.00
	0.5	**Cross-Section**		626.26	626.26	0.00	624.25	624.25	0.00	623.66	623.66	0.00	622.19	622.19	0.00
	0.54	**Cross-Section**		626.21	626.21	0.00	624.25	624.25	0.00	623.69	623.69	0.00	622.27	622.27	0.00
	0.6	**Cross-Section**		626.00	626.00	0.00	624.18	624.18	0.00	623.65	623.65	0.00	622.30	622.30	0.00
	0.61	**Cross-Section**		626.12	626.12	0.00	624.31	624.31	0.00	623.78	623.78	0.00	622.40	622.40	0.00
	0.62	**Cross-Section**		626.44	626.44	0.00	624.72	624.72	0.00	624.16	624.16	0.00	622.67	622.67	0.00
	0.631	Outfall LC-6, left	614.76	626.51	626.51	0.00	624.76	624.76	0.00	624.20	624.20	0.00	622.70	622.70	0.00
	0.71	**Cross-Section**		627.05	627.05	0.00	625.05	625.05	0.00	624.45	624.45	0.00	622.95	622.95	0.00
	0.75	**Cross-Section**		627.13	627.13	0.00	625.15	625.15	0.00	624.55	624.55	0.00	623.05	623.05	0.00
	0.79	**Cross-Section**		627.23	627.23	0.00	625.25	625.25	0.00	624.65	624.65	0.00	623.12	623.12	0.00
	0.794	**Cross-Section**		627.25	627.25	0.00	625.28	625.28	0.00	624.67	624.67	0.00	623.15	623.15	0.00
	0.798	Outfall LC-7, right	615.47	627.39	627.39	0.00	625.32	625.32	0.00	624.70	624.70	0.00	623.18	623.18	0.00
	0.799	Outfall LC-8, right	615.46	627.42	627.42	0.00	625.33	625.33	0.00	624.71	624.71	0.00	623.18	623.18	0.00
	0.803	W. Villard Avenue													
	0.81	**Cross-Section**		627.79	627.79	0.00	625.43	625.43	0.00	624.79	624.79	0.00	623.26	623.26	0.00
	0.82	**Cross-Section**		628.12	628.12	0.00	625.57	625.57	0.00	624.91	624.91	0.00	623.33	623.33	0.00
	0.848	Outfall LC-10, left	619.6	628.11	628.11	0.00	625.58	625.58	0.00	624.93	624.93	0.00	623.35	623.35	0.00
	0.877	Outfall LC-9, right	619.17	628.11	628.11	0.00	625.60	625.60	0.00	624.94	624.94	0.00	623.37	623.37	0.00
	0.909	**Cross-Section**		628.10	628.10	0.00	625.61	625.61	0.00	624.96	624.96	0.00	623.40	623.40	0.00
	0.912	N. 24th Place Footbridge													
	0.915	**Cross-Section**		628.22	628.22	0.00	625.64	625.64	0.00	624.98	624.98	0.00	623.42	623.42	0.00
	0.919	Outfall LC-11, right	619.35	628.25	628.25	0.00	625.65	625.65	0.00	624.99	624.99	0.00	623.44	623.44	0.00
	0.93	**Cross-Section**		628.34	628.34	0.00	625.69	625.69	0.00	625.03	625.03	0.00	623.48	623.48	0.00
	0.972	Outfall LC-12, left	617.81	628.44	628.44	0.00	625.82	625.82	0.00	625.15	625.15	0.00	623.61	623.61	0.00
	0.974	Outfall LC-13, left	617.09	628.44	628.44	0.00	625.83	625.83	0.00	625.16	625.16	0.00	623.61	623.61	0.00
	0.987	Outfall LC-14, right	619.4	628.47	628.47	0.00	625.87	625.87	0.00	625.19	625.19	0.00	623.65	623.65	0.00
	1.07	**Cross-Section**		628.67	628.67	0.00	626.12	626.12	0.00	625.43	625.43	0.00	623.90	623.90	0.00
	1.12	**Cross-Section**		628.92	628.92	0.00	626.45	626.45	0.00	625.77	625.77	0.00	624.19	624.19	0.00
	1.138	Outfall LC-15, left	616.13	629.04	629.04	0.00	626.60	626.60	0.00	625.90	625.90	0.00	624.32	624.32	0.00
	1.141	Outfall LC-16, right	621.01	629.06	629.06	0.00	626.63	626.63	0.00	625.93	625.93	0.00	624.34	624.34	0.00
	1.17	**Cross-Section**		629.25	629.25	0.00	626.87	626.87	0.00	626.14	626.14	0.00	624.54	624.54	0.00

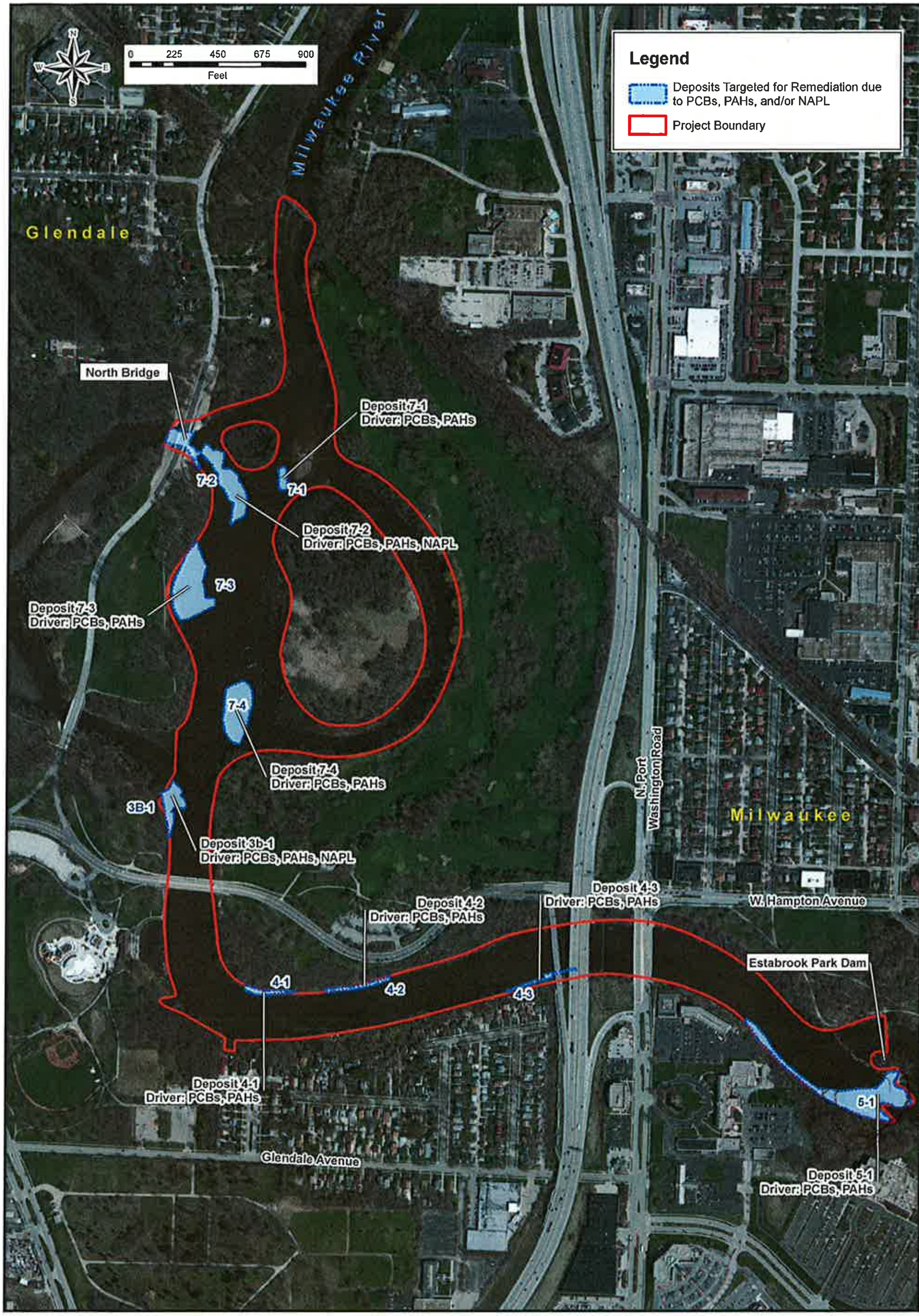
[a] *References to "left" and "right" are based on looking in the downstream direction.*

[b] *Water surface elevation determined using backwater from the confluence with the Right Split (west oxbow) of the Milwaukee River*

Increases in water surface elevation relative to existing dam conditions.

ATTACHMENT 5:

EXCERPTS FROM LINCOLN PARK/MILWAUKEE COUNTY RIVER CHANNEL SEDIMENTS PHASE II PRE-FINAL REMEDIAL DESIGN REPORT DATED JANUARY 2014, PREPARED BY EA ENGINEERING, SCIENCE, AND TECHNOLOGY, INC.



Source: ArcGIS Online Map Service 2012.

Total PCB data from CH2M Hill 2011, Phase II Remedial Investigation.

EA Engineering, Science, and Technology, Inc.				LINCOLN PARK / MILWAUKEE RIVER CHANNEL SEDIMENTS SITE PHASE II FS / RD GLENDALE, MILWAUKEE COUNTY, WISCONSIN			CONTAMINATED ZONES AND DEPOSITS		
PROJECT MGR.	DESIGNED BY	DRAWN BY	CHECKED BY	DATE	SCALE	PROJECT NO.	FILE NAME	DRAWING NO.	FIGURE
MC	RF	RF	JB	JAN 2014	AS SHOWN	6256105	–	–	2

2.3.1.2 Zone 3

Deposit 3b-1: The maximum reported total PCB concentration in this deposit is 1.6 mg/kg and the maximum reported total PAH concentration is 37 mg/kg. LNAPL was detected in this deposit. The estimated *in-situ* volume of sediments for disposal in this deposit is 1,108 cy of Non-TSCA regulated materials, over an area of approximately 0.4 acre. Contamination extends to an average depth of 1.0 ft bss.

2.3.1.3 Zone 4

Deposit 4-1: The maximum reported total PCB concentration in this deposit is 1.5 mg/kg and the maximum reported total PAH concentration is 117 mg/kg. The estimated *in-situ* volume of sediments for disposal in this deposit is 449 cy of Non-TSCA regulated materials, over an area of approximately 0.1 acre with an average depth of 0.86 ft bss.

Deposit 4-2: The maximum reported total PCB concentration in this deposit is 1.9 mg/kg and the maximum reported total PAH concentration is 33 mg/kg. The estimated *in-situ* volume of sediments for disposal in this deposit is 694 cy of Non-TSCA regulated materials, over an area of approximately 0.2 acre with an average depth of 1.1 ft bss.

Deposit 4-3: The maximum reported total PCB concentration in this deposit is 3.7 mg/kg and the maximum reported total PAH concentration is 115 mg/kg. The estimated *in-situ* volume of sediments for disposal in this deposit is 309 cy of Non-TSCA regulated materials, over an area of approximately 0.1 acre with an average depth of 0.46 ft bss.

2.3.1.4 Zone 5

Deposit 5-1 – The maximum reported total PCB concentration in this deposit is 230 mg/kg and the maximum reported total PAH concentration is 469 mg/kg. The estimated in-situ volume of sediments for disposal 9,488 cy, and 242 cy of Non-TSCA and TSCA regulated materials, respectively. The deposit covers an area of approximately 1.4 acres and with an average bottom depth of the deposit of 2.2 ft bss.

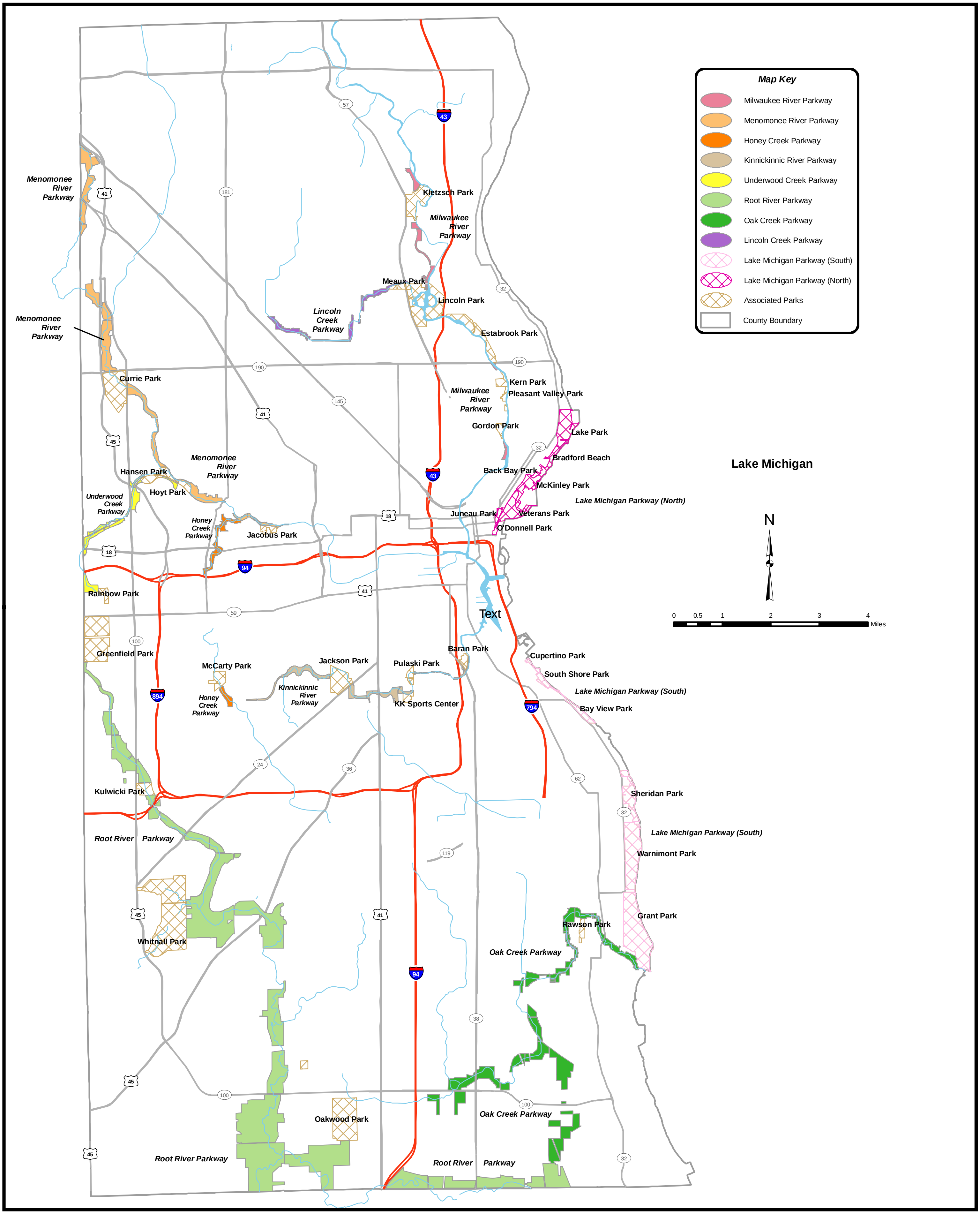
2.3.2 Water

Water requiring treatment will be generated from the following sources:

- Cofferdams: initial surface water, precipitation, in-situ sediment dewatering, storm sewers outfalls
- Hydraulic dredging: slurry water
- Dewatering pad: sediment dewatering, precipitation
- Decontamination pad: decontamination water, precipitation
- Water Treatment pad: precipitation, leaks, and spills.

ATTACHMENT 6:

COUNTY PARKWAYS MAP



Milwaukee County Parkway System

ATTACHMENT 7:

WETLAND INVENTORY MAP


Estabrook Dam Rehabilitation
NE Quarter, Section 5, T07N-R22E
Cities of Milwaukee and Glendale, Milwaukee County
West Hampton Avenue
West River Woods Parkway
North 1st Street
1
2
3
4
5
6
7
8
Legend
Project Area
Primary Environmental Corridor
Wetland
Plant Community Number
Preliminary Wetland Delineation
by SEWRPC on 11/17/11
N
0
100
200
Feet
Source: SEWRPC
Date of Photography: 2010
CA#406-30

ATTACHMENT 8:

WETLAND RELATED CORRESPONDENCE

December 9, 2011

Mr. Karl D. Stave, P.E.
Milwaukee County Department of Public Works
2711 W. Wells Street
Milwaukee, WI 53208

Re: SEWRPC No. CA-406-30

Dear Mr. Stave:

This will respond to your electronic mail message of October 25, 2011, requesting the Commission staff to conduct a field inspection of the Estabrook Dam rehabilitation site, including lands adjacent to the dam where access roads and stockpile areas are proposed, for the purpose of identifying in the field the boundary of any wetlands within the project area. The project area is located in parts of the Northeast one-quarter of U.S. Public Land Survey Section 5, Township 7 North, Range 22 East, Cities of Glendale and Milwaukee, Milwaukee County, Wisconsin.

Following the receipt of your electronic mail message, the Commission staff contacted you to discuss our field schedule constraints given that the end of the wetland delineation season was fast approaching. The regulatory agencies, namely the U.S. Army Corps of Engineers and the Wisconsin Department of Natural Resources, have set guidelines restricting final wetland determinations to the growing season. The growing season in this region typically extends between early April and early November. Due to the backlog of wetland delineation projects, the Commission staff indicated to you that a wetland delineation on the Estabrook Dam site would not be possible during the 2011 growing season. Instead, it was agreed that a preliminary wetland delineation would be scheduled in mid November after the growing season had ended, and then verified when the growing season begins in the spring of 2012.

Accordingly, Dr. Donald M. Reed, Commission Chief Biologist, conducted a field inspection of the Estabrook Dam rehabilitation site on November 17, 2011. A preliminary identification and staking of the wetland boundaries was completed. It is the Commission staff's expectation that the wetland boundaries will be surveyed and identified on forthcoming design plans attendant to the dam rehabilitation. A list of plant species identified within the subject wetlands is attached hereto as Exhibit A. Please note that the Commission staff will schedule a field inspection in the spring of 2012 after the growing season begins for the purpose of verifying our preliminary wetland delineation.

In addition, please be advised that the wetlands located within the designated Primary Environmental Corridor as shown on the attached map, have been designated as ADID wetlands under the Section 404(b)(1) Guidelines of the Clean Water Act.

Should you have any questions regarding this information, please do not hesitate to call.

Sincerely,

Kenneth R. Yunker, P.E.
Executive Director

KRY/DMR/CJJ/dad
#160145 v1 - ca406-30 2011 visit

Enclosures

cc: Mr. Don Pirrung
Mr. Richard E. Maslowski
Ms. Sharon Robinson
Ms. Jamie Lambert
Mr. Anthony Jernigan

SVY3865
CA406-30

EXHIBIT A

PRELIMINARY VEGETATION SURVEY
ESTABROOK DAM REHABILITATION

Date: November 17, 2011

Observers: Donald M. Reed, Ph.D., Chief Biologist
Christopher J. Jors, Biologist
Kristi Sherfinski, Biologist
Southeastern Wisconsin Regional Planning Commission

Location: Cities of Glendale and Milwaukee in parts of the Northeast one-quarter of U.S. Public Land Survey Section 5, Township 7 North, Range 22 East, Milwaukee County, Wisconsin.

Species List: Plant Community Area No. 1

GRAMINEAE
- Poa pratensis[1]--Kentucky bluegrass
- Eragrostis poaeoides[1]--Low love grass
- Elymus virginicus--Virginia wild rye
- Phalaris arundinacea[1]--Reed canary grass
- Panicum dichotomiflorum--Knee grass

CYPERACEAE
- Carex sp.--Sedge

JUNCACEAE
- Juncus dudleyi--Dudley's rush

IRIDACEAE
- Iris virginica--Virginia blueflag

SALICACEAE
- Populus deltoides--Cottonwood
- Salix (alba?[1])--White willow
- Salix nigra[2]--Black willow
- Salix interior--Sandbar willow

ULMACEAE
- Ulmus americana--American elm

URTICACEAE
- Urtica dioica--Stinging nettle

POLYGONACEAE
- Polygonum pensylvanicum--Pinkweed
- Polygonum punctatum--Smartweed

AMARANTHACEAE
- Amaranthus retroflexus[1]--Redroot pigweed

CRUCIFERAE
- Barbarea vulgaris[1]--Yellow rocket
- Alliaria officinalis[1,2]--Garlic-mustard

SAXIFRAGACEAE
- Ribes americanum--Wild black currant

ROSACEAE

Geum canadense--White avens
Rubus occidentalis--Black raspberry
Rosa multiflora[1]--Multiflora rose
Crataegus sp.--Hawthorn

CELASTRACEAE

Euonymus atropurpureus--Burning bush

ACERACEAE

Acer saccharinum[2]--Silver maple
Acer negundo[2]--Boxelder

RHAMNACEAE

Rhamnus cathartica[1,2]--Common buckthorn
Rhamnus frangula[1]--Glossy buckthorn

VITACEAE

Vitis riparia--Riverbank grape

LYTHRACEAE

Lythrum salicaria[1]--Purple loosestrife

UMBELLIFERAE

Cryptotaenia canadensis--Honewort
Daucus carota[1]--Queen Anne's lace

CORNACEAE

Cornus stolonifera--Red-osier dogwood

OLEACEAE

Fraxinus pennsylvanica--Green ash

CONVOLVULACEAE

Cuscuta sp.--Dodder

HYDROPHYLLACEAE

Hydrophyllum virginianum--Virginia waterleaf

LABIATAE

Glechoma hederacea[1]--Creeping Charlie

SOLANACEAE

Solanum dulcamara[1]--Deadly nightshade

PLANTAGINACEAE

Plantago major[1]--Common plantain

CAPRIFOLIACEAE

Viburnum opulus[1]--European highbush-cranberry
Lonicera X *bella*[1]--Hybrid honeysuckle

DIPSACACEAE

Dipsacus sylvestris[1]--Common teasel

COMPOSITAE

Rudbeckia laciniata--Green-headed coneflower
Ambrosia artemisiifolia--Common ragweed
Xanthium strumarium--Cocklebur
Artemisia vulgaris[1]--Mugwort
Artemisia sp.[1]--Wormwood
Solidago gigantea--Giant goldenrod
Solidago altissima--Tall goldenrod

COMPOSITAE cont'

Aster lateriflorus--Calico aster
Erigeron strigosus--Daisy fleabane
Conyza canadensis--Horseweed
Eupatorium serotinum[1]--Late boneset
Arctium minus[1]--Common burdock
Cirsium arvense[1]--Canada thistle
Taraxacum officinale[1]--Common dandelion
Lactuca serriola[1]--Prickly wild lettuce

Total number of plant species: 58
Number of alien, or non-native, plant species: 25 (43 percent)

This approximately 0.1-acre plant community area is part of the Milwaukee River floodplain-wetland complex and consists of fresh (wet) meadow and second growth, Southern wet to wet-mesic lowland hardwoods. Disturbances to the plant community area include clearing of vegetation, dumping, the ad hoc establishment of footpaths, past filling, siltation and sedimentation due to stormwater runoff from adjacent lands, and water level changes due to impoundment. While no Federal- or State-designated Special Concern, Threatened, or Endangered species were observed during the field inspection, Striped shiner (Luxilus chrysocephalus), a State-designated Endangered fish species; and Greater redhorse (Moxostoma valenciennesi), a State-designated Threatened fish species, are known to occur in this reach of the Milwaukee River.

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[1] Alien or non-native plant species
[2] Co-dominant plant species

Plant Community Area No. 2

GRAMINEAE
- *Phalaris arundinacea*[1]--Reed canary grass

ARACEAE
- *Acorus calamus*--Sweet flag

LEMNACEAE
- *Lemna minor*--Lesser duckweed

IRIDACEAE
- *Iris virginica*--Virginia blueflag

SALICACEAE
- *Salix nigra*[2]--Black willow

ULMACEAE
- *Ulmus americana*--American elm

URTICACEAE
- *Urtica dioica*--Stinging nettle

POLYGONACEAE
- *Rumex crispus*[1]--Curly dock
- *Polygonum lapathifolium*--Smartweed
- *Polygonum pensylvanicum*--Pinkweed
- *Polygonum punctatum*--Smartweed
- *Polygonum persicaria*[1]--Lady's thumb

AMARANTHACEAE
- *Amaranthus retroflexus*[1]--Redroot pigweed

RANUNCULACEAE
- *Ranunculus acris*[1]--Tall buttercup

CRUCIFERAE
- *Brassica* sp.[1]--Mustard
- *Lepidium campestre*[1]--Field-cress
- *Alliaria officinalis*[1]--Garlic-mustard

ROSACEAE
- *Potentilla recta*[1]--Sulfur cinquefoil

FABACEAE
- *Trifolium repens*[1]--White clover

CELASTRACEAE
- *Celastrus scandens*--Bittersweet

ACERACEAE
- *Acer saccharinum*[2]--Silver maple
- *Acer negundo*--Boxelder

RHAMNACEAE
- *Rhamnus cathartica*[1,2]--Common buckthorn
- *Rhamnus frangula*[1]--Glossy buckthorn

VITACEAE
- *Vitis riparia*--Riverbank grape

LYTHRACEAE
- *Lythrum salicaria*[1]--Purple loosestrife

ONAGRACEAE

<u>Epilobium</u> <u>coloratum</u>--Willow-herb
<u>Oenothera</u> <u>biennis</u>--Evening-primrose

CORNACEAE

<u>Cornus</u> <u>stolonifera</u>--Red-osier dogwood

OLEACEAE

<u>Fraxinus</u> <u>pennsylvanica</u>--Green ash

ASCLEPIADACEAE

<u>Asclepias</u> <u>incarnata</u>--Marsh milkweed

CONVOLVULACEAE

<u>Cuscuta</u> sp.--Dodder

VERBENACEAE

<u>Verbena</u> <u>urticifolia</u>--White vervain
<u>Verbena</u> <u>hastata</u>--Blue vervain

LABIATAE

<u>Mentha</u> <u>arvensis</u>--Wild mint

SOLANACEAE

<u>Solanum</u> <u>dulcamara</u>[1]--Deadly nightshade

CAPRIFOLIACEAE

<u>Viburnum</u> <u>opulus</u>[1]--European highbush-cranberry
<u>Lonicera</u> X <u>bella</u>[1]--Hybrid honeysuckle

DIPSACACEAE

<u>Dipsacus</u> <u>sylvestris</u>[1]--Common teasel

COMPOSITAE

<u>Bidens</u> sp.--Beggars-ticks
<u>Ambrosia</u> <u>trifida</u>--Giant ragweed
<u>Ambrosia</u> <u>artemisiifolia</u>--Common ragweed
<u>Xanthium</u> <u>strumarium</u>--Cocklebur
<u>Artemisia</u> <u>vulgaris</u>[1]--Mugwort
<u>Erechtites</u> <u>hieracifolia</u>--Pilewort
<u>Solidago</u> <u>altissima</u>--Tall goldenrod
<u>Aster</u> <u>lateriflorus</u>--Calico aster
<u>Aster</u> <u>simplex</u>--Marsh aster
<u>Conyza</u> <u>canadensis</u>--Horseweed
<u>Vernonia</u> <u>fasciculata</u>--Common ironweed
<u>Arctium</u> <u>minus</u>[1]--Common burdock
<u>Cirsium</u> <u>arvense</u>[1]--Canada thistle
<u>Sonchus</u> <u>arvensis</u>[1]--Sow thistle

Total number of plant species: 53
Number of alien, or non-native, plant species: 21 (40 percent)

This approximately 0.2-acre plant community area is part of the Milwaukee River floodplain-wetland complex and consists of fresh (wet) meadow and second growth, Southern wet to wet-mesic lowland hardwoods. Disturbances to the plant community area include dumping, past filling, siltation and sedimentation due to stormwater runoff from adjacent lands, and water level changes due to impoundment. While no Federal- or State-designated Special Concern, Threatened, or Endangered species were observed during the field inspection, Striped shiner (Luxilus chrysocephalus), a State-designated Endangered fish species; and Greater redhorse (Moxostoma valenciennesi), a State-designated Threatened fish species, are known to occur in this reach of the Milwaukee River.

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[1] Alien or non-native plant species
[2] Co-dominant plant species

Plant Community Area No. 3

GRAMINEAE

Poa compressa[1]--Canada bluegrass
Poa pratensis[1]--Kentucky bluegrass
Elymus virginicus--Virginia wild rye
Panicum dichotomiflorum--Knee grass
Echinochloa crusgalli[1]--Barnyard grass

CYPERACEAE

Carex sp.--Sedge

LEMNACEAE

Lemna minor--Lesser duckweed

LILIACEAE

Hemerocallis fulva[1]--Day-lily

IRIDACEAE

Iris virginica--Virginia blueflag

SALICACEAE

Populus deltoides--Cottonwood
Salix nigra[2]--Black willow
Salix interior--Sandbar willow

URTICACEAE

Urtica dioica--Stinging nettle
Boehmeria cylindrica--False nettle

POLYGONACEAE

Rumex crispus[1]--Curly dock
Polygonum pensylvanicum--Pinkweed
Polygonum punctatum--Smartweed

AMARANTHACEAE

Amaranthus retroflexus[1]--Redroot pigweed

RANUNCULACEAE

Ranunculus sceleratus--Cursed crowfoot

CRUCIFERAE

Alliaria officinalis[1]--Garlic-mustard

CRASSULACEAE

Penthorum sedoides--Ditch stonecrop

ROSACEAE

Geum canadense--White avens

ACERACEAE

Acer saccharinum[2]--Silver maple
Acer negundo--Boxelder

BALSAMINACEAE

Impatiens capensis--Jewelweed

RHAMNACEAE

Rhamnus cathartica[1,2]--Common buckthorn
Rhamnus frangula[1]--Glossy buckthorn

VITACEAE

Vitis riparia--Riverbank grape

LYTHRACEAE

Lythrum salicaria[1]--Purple loosestrife

ONAGRACEAE

Epilobium coloratum--Willow-herb

CORNACEAE

Cornus amomum--Silky dogwood
Cornus stolonifera--Red-osier dogwood
Cornus racemosa--Grey dogwood

PRIMULACEAE

Lysimachia nummularia[1]--Moneywort

OLEACEAE

Fraxinus pennsylvanica--Green ash

ASCLEPIADACEAE

Asclepias incarnata--Marsh milkweed

SOLANACEAE

Solanum dulcamara[1]--Deadly nightshade

CAPRIFOLIACEAE

Viburnum opulus[1]--European highbush-cranberry
Lonicera X bella[1]--Hybrid honeysuckle

COMPOSITAE

Bidens sp.--Beggars-ticks
Ambrosia artemisiifolia--Common ragweed
Xanthium strumarium--Cocklebur
Artemisia vulgaris[1]--Mugwort
Solidago gigantea--Giant goldenrod
Aster pilosus--Frost aster
Aster lateriflorus--Calico aster
Conyza canadensis--Horseweed
Vernonia fasciculata--Common ironweed

Total number of plant species: 48
Number of alien, or non-native, plant species: 15 (31 percent)

This approximately 0.4-acre plant community area is part of the Milwaukee River floodplain-wetland complex and consists of second growth, Southern wet to wet-mesic lowland hardwoods. Disturbances to the plant community area include clearing of vegetation, dumping, the ad hoc establishment of footpaths, past filling, siltation and sedimentation due to stormwater runoff from adjacent lands, and water level changes due to impoundment. While no Federal- or State-designated Special Concern, Threatened, or Endangered species were observed during the field inspection, Striped shiner (Luxilus chrysocephalus), a State-designated Endangered fish species; and Greater redhorse (Moxostoma valenciennesi), a State-designated Threatened fish species, are known to occur in this reach of the Milwaukee River.

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[1] Alien or non-native plant species
[2] Co-dominant plant species

Plant Community Area No. 4

GRAMINEAE
Elymus virginicus--Virginia wild rye

CYPERACEAE
Carex sp.--Sedge

SALICACEAE
Populus deltoides[1]--Cottonwood

POLYGONACEAE
Polygonum persicaria[2]--Lady's thumb

CRUCIFERAE
Alliaria officinalis[2]--Garlic-mustard

SAXIFRAGACEAE
Ribes americanum--Wild black currant

ACERACEAE
Acer negundo--Boxelder

RHAMNACEAE
Rhamnus cathartica[1,2]--Common buckthorn

VITACEAE
Vitis riparia--Riverbank grape

CORNACEAE
Cornus racemosa--Grey dogwood

OLEACEAE
Fraxinus pennsylvanica--Green ash

CAPRIFOLIACEAE
Viburnum opulus[2]--European highbush-cranberry

COMPOSITAE
Aster lateriflorus--Calico aster

Total number of plant species: 13
Number of alien, or non-native, plant species: 4 (31 percent)

This approximately 0.3-acre wetland plant community area consists of an ephemeral pond with second growth, Southern wet to wet-mesic lowland hardwoods. Disturbances to the plant community area include dumping, the ad hoc establishment of footpaths, past filling, and siltation and sedimentation due to stormwater runoff from adjacent lands. No Federal- or State-designated Special Concern, Threatened, or Endangered species were observed during the field inspection.

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[1] Co-dominant plant species
[2] Alien or non-native plant species

Plant Community Area No. 5

GRAMINEAE

- *Poa pratensis*[1]--Kentucky bluegrass
- *Elymus virginicus*--Virginia wild rye
- *Phalaris arundinacea*[1,2]--Reed canary grass

CYPERACEAE

- *Scirpus atrovirens*--Green bulrush
- *Carex* sp.--Sedge

JUNCACEAE

- *Juncus tenuis*--Path rush

URTICACEAE

- *Urtica dioica*--Stinging nettle

CRUCIFERAE

- *Alliaria officinalis*[1]--Garlic-mustard

ROSACEAE

- *Geum canadense*--White avens

ACERACEAE

- *Acer negundo*--Boxelder

BALSAMINACEAE

- *Impatiens capensis*--Jewelweed

RHAMNACEAE

- *Rhamnus cathartica*[1]--Common buckthorn

ONAGRACEAE

- *Epilobium coloratum*--Willow-herb

CORNACEAE

- *Cornus stolonifera*--Red-osier dogwood

OLEACEAE

- *Fraxinus pennsylvanica*--Green ash

VERBENACEAE

- *Verbena urticifolia*--White vervain

LABIATAE

- *Glechoma hederacea*[1]--Creeping Charlie

SOLANACEAE

- *Solanum dulcamara*[1]--Deadly nightshade

CAPRIFOLIACEAE

- *Lonicera* X *bella*[1]--Hybrid honeysuckle

COMPOSITAE

- *Solidago gigantea*--Giant goldenrod
- *Solidago graminifolia*--Grassleaf goldenrod
- *Aster pilosus*--Frost aster
- *Aster lateriflorus*--Calico aster
- *Cirsium arvense*[1]--Canada thistle

Total number of plant species: 24
Number of alien, or non-native, plant species: 8 (33 percent)

This approximately 0.1-acre wetland plant community area consists of an ephemeral pond with fresh (wet) meadow. Disturbances to the plant community area include the ad hoc establishment of foot paths and tire ruts, past filling, siltation and sedimentation due to stormwater runoff from adjacent lands, and water level changes due to impoundment. No Federal- or State-designated Special Concern, Threatened, or Endangered species were observed during the field inspection.

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[1] Alien or non-native plant species
[2] Dominant plant species

Plant Community Area No. 6

TYPHACEAE

- Typha latifolia--Broad-leaved cat-tail
- Typha angustifolia[1]--Narrow-leaved cat-tail

GRAMINEAE

- Poa pratensis[2]--Kentucky bluegrass
- Phragmites australis--Tall reed grass
- Agrostis stolonifera[1,2]--Redtop grass
- Phalaris arundinacea[1,2]--Reed canary grass

JUNCACEAE

- Juncus dudleyi--Dudley's rush

SALICACEAE

- Salix nigra--Black willow
- Salix interior--Sandbar willow

POLYGONACEAE

- Rumex crispus[2]--Curly dock

CRUCIFERAE

- Barbarea vulgaris[2]--Yellow rocket
- Alliaria officinalis[2]--Garlic-mustard

ROSACEAE

- Potentilla recta[2]--Sulfur cinquefoil

ACERACEAE

- Acer negundo--Boxelder

RHAMNACEAE

- Rhamnus cathartica[2]--Common buckthorn

ONAGRACEAE

- Epilobium coloratum--Willow-herb

UMBELLIFERAE

- Daucus carota[2]--Queen Anne's lace

OLEACEAE

- Fraxinus pennsylvanica--Green ash

PLANTAGINACEAE

- Plantago major[2]--Common plantain

CAPRIFOLIACEAE

- Lonicera X bella[2]--Hybrid honeysuckle

COMPOSITAE

- Bidens sp.--Beggars-ticks
- Solidago gigantea--Giant goldenrod
- Solidago altissima--Tall goldenrod
- Solidago graminifolia--Grassleaf goldenrod
- Aster pilosus--Frost aster
- Aster lateriflorus--Calico aster
- Cirsium arvense[2]--Canada thistle
- Taraxacum officinale[2]--Common dandelion

Total number of plant species: 28
Number of alien, or non-native, plant species: 13 (46 percent)

This approximately 0.1-acre wetland plant community area consists of shallow marsh and fresh (wet) meadow. Disturbances to the plant community area include dumping, filling, grading, and siltation and sedimentation due to stormwater runoff from adjacent lands. No Federal- or State-designated Special Concern, Threatened, or Endangered species were observed during the field inspection.

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[1] Co-dominant plant species
[2] Alien or non-native plant species

Plant Community Area No. 7

TYPHACEAE
Typha angustifolia[1]--Narrow-leaved cat-tail

GRAMINEAE
Poa pratensis[2]--Kentucky bluegrass
Phragmites australis[1]--Tall reed grass
Agrostis stolonifera[2]--Redtop grass
Phalaris arundinacea[1,2]--Reed canary grass
Echinochloa crusgalli[2]--Barnyard grass

CYPERACEAE
Eleocharis erythropoda--Red-root spike-rush
Scirpus validus--Soft-stemmed bulrush

POLYGONACEAE
Rumex crispus[2]--Curly dock

COMPOSITAE
Solidago gigantea--Giant goldenrod
Solidago graminifolia--Grassleaf goldenrod
Aster pilosus--Frost aster
Aster lateriflorus--Calico aster

Total number of plant species: 13
Number of alien, or non-native, plant species: 5 (38 percent)

This approximately 0.1-acre wetland plant community area consists of shallow marsh and fresh (wet) meadow. Disturbances to the plant community area include dumping, filling, grading, side casting of dredge spoil material, and siltation and sedimentation due to stormwater runoff from adjacent lands. No Federal- or State-designated Special Concern, Threatened, or Endangered species were observed during the field inspection.

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[1] Co-dominant plant species
[2] Alien or non-native plant species

Plant Community Area No. 8

GRAMINEAE

Poa compressa[1,2]--Canada bluegrass
Poa pratensis[1]--Kentucky bluegrass
Phragmites australis--Tall reed grass
Agropyron repens[1]--Quack grass
Agrostis stolonifera[1]--Redtop grass
Phalaris arundinacea[1]--Reed canary grass
Panicum capillare--Witch grass

JUNCACEAE

Juncus dudleyi[2]--Dudley's rush
Juncus torreyi--Torrey's rush

ONAGRACEAE

Epilobium coloratum--Willow-herb

COMPOSITAE

Solidago graminifolia--Grassleaf goldenrod
Aster pilosus--Frost aster
Aster lateriflorus--Calico aster

Total number of plant species: 13
Number of alien, or non-native, plant species: 5 (38 percent)

This approximately 0.1-acre wetland plant community area consists of fresh (wet) meadow. Disturbances to the plant community area include dumping, filling, grading, side casting of dredge spoil material, and siltation and sedimentation due to stormwater runoff from adjacent lands. No Federal- or State-designated Special Concern, Threatened, or Endangered species were observed during the field inspection.

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[1] Alien or non-native plant species
[2] Co-dominant plant species

ATTACHMENT 9:

COST ESTIMATE FOR ALTERNATIVES

ATTACHMENT 9

COST ESTIMATES FOR ALTERNATIVES

A. Estimated Annual Operation and Maintenance Costs:

1. Alternative 1 or Alternative 1A:

	Annual O&M Cost
Labor and Fringe Benefits	$67,500
Debris Removed	50,000
River Flow Monitoring and Computer Costs	12,500
Annual O&M Cost	$160,000

2. Alternative 2:

Annual O&M Cost is zero.

3. Alternative 4:

	Annual O&M Cost
Debris Maintenance	$40,000
Rock Ramp Alternatives	15,000
Annual O&M Cost	$55,000

CAPITAL COST SUMMARY

Alternative 1

Structural Repair Dam	$2,287,000

Alternative 1A

Structural Repair Dam	$2,287,000
Fish Passage Addition	$1,107,000
	$3,394,000

Alternative 2

Capital Cost Estimate	$1,673,690

Use $1,674,000

Alternative 4

Capital Cost Estimate	$2,419,045

Use $2,419,000

ATTACHMENT 9
COST ESTIMATES FOR ALTERNATIVES

Present Worth Analysis

Prepared by Don Pirrung, AECOM

A. Estimated Capital Cost:

Alternative 1:	$2,287,000
Alternative 1A:	$3,612,000
Alternative 2:	$1,674,000
Alternative 4:	$2,419,000

B. Estimated Annual O&M Cost:

Alternative 1A:	$160,000
Alternative 2:	$0
Alternative 4:	$55,000

C. Present Worth of O&M Costs:

Interest Rate:	2%
Time Period:	20 Years
Present Worth Factor:	16.351
Present Worth:	Factor x Annual O&M Cost

Alternative 1: 16.351 x $160,000	Present Worth = $2,616,000
Alternative 1A: 16.351 x $160,000	Present Worth = $2,616,000
Alternative 2:	Present Worth = 0
Alternative 4: 16.351 x $55,000	Present Worth = $899,000

D. Total Present Worth:

Total Present Worth = Capital Cost + Present Worth O&M Costs

1. Alternative 1: $2,287,000 + $2,616,000	Total Present Worth = $4,903,000
2. Alternative 1A: $3,612,000 + $2,616,000	Total Present Worth = $6,228,000
3. Alternative 2: $1,674,000 + 0	Total Present Worth = $1,674,000
4. Alternative 4: $2,419,000 + $899,000	Total Present Worth = $3,318,000

AECOM Cost Estimate - Estabrook Park Dam

Structural Repair Option - $2,287,000 Budget

06/05/2015 Note: This estimate does not include sediment removal, which is covered in a separate, environmental cost estimate.

Opinion of Probable Structural Project Costs

Client: Milwaukee County DPW
Address: 2711 West Wells St, Milwaukee, WI

	Description	Units	Unit Cost	Quantity	Total Cost	Comments
1.00	General					
1.1	Mobilization / Demobilization	ls	$37,000.00	1	$37,000	segmental barge, small crane, incidental equipment
1.2	Erosion Control	ls	$100.00	1	$100	silt fence and turbidity barriers
1.3	Site Restoration	ls	$16,000.00	1	$16,000	repair pavements, grading, seeding and mulching
1.4	Diversion of water	ls	$90,000.00	1	$90,000	Porta-dam installation during pier repairs, with stoplogs removed on overflow spillway
2.00	Gated Spillway - Concrete Repairs					
2.01	Concrete surface repairs - abutments and stairs	sf	$95.00	770	$73,150	reconstruct stairs, complete abutment surface reconstruction
2.02	Concrete surface repairs - bridge deck and walls	sf	$85.00	600	$51,000	partial depth repair of deck, partial to full depth repair of walls, sawcut closed expansion joints and replace joint material
2.03	Pier reconstruction - below Elv. 618.35'	sf	$120.00	3400	$408,000	complete surface reconstruction below Elv. 618.35', all 11 piers
2.04	Concrete surface repairs - pier above Elv. 618.35'	sf	$85.00	960	$81,600	partial depth repair above Elv. 618.35 as needed, all 11 piers
2.05	Install grouted tie down anchors in upstream piers, for stability with ice loading at full pool	ls	$315,000.00	1	$315,000	Includes 11 tie down anchors into bedrock, with mobilization
3.00	Gated Spillway - Gate Repairs					
3.01	Prepare and paint slide gates	ea	$3,700.00	10	$37,000	sandblast, prime and paint all 10 slide gates in place
3.02	Misc. repairs to gates, guides and seals	ls	$12,000.00	1	$12,000	as needed based upon inspection after cleaning
3.03	Replacement of Motorized Equipment for Gates 6, 7, 8 and 9	ls	$60,000.00	1	$60,000	Replacement of motorized equipment to be equivalent to existing motorized equipment for Gates 1 to 5 and 10, except automated assemblies.
4.00	Ice Breakers - Concrete Repairs					
4.01	Replace Ice Breakers	ea	$6,000.00	24	$144,000	Replace existing Ice breakers to match existing.
5.00	Overflow Spillway					
5.01	New flashboards	ls	$1,200.00	1	$1,200	4"x8"x7'4" timber, recently replaced with new ones - budget for stockpile of new ones
5.02	Repair / replace bent supports	ls	$2,500.00	4	$10,000	assume 4 to be repaired
5.03	Concrete surface repairs	sf	$80.00	1,500	$120,000	chipping, anchors, and polymer modified concrete repair of crest
6.00	Slope Protection					
6.01	Riprap	cy	$90.00	700	$63,000	24" layer of riprap, left and right banks u/s and d/s of gated spillway & Fixed Crest Spillway
6.02	Geotextile	sy	$4.00	1,800	$7,200	
7.00	Debris Removal	ls	$40,000.00	1	$40,000	upstream of gated spillway and ice breakers, not incl. environmental cleanup area
8.00	Miscellaneous					
8.01	Repair / replace handrails, fences, gates, etc.	ls	$6,000.00	1	$6,000	
8.02	Misc. Site Electrical Work	ls	$16,000.00	1	$16,000	Per Milwaukee County recommendation
8.03	Aeration System by Gated Structure	ls	$20,000	1	$20,000	Estimated 5 aeration units included electrical

	Construction Sub-Total:		$1,608,250
	Construction Contingency:	20%	$322,000
	Construction Estimate:		$1,931,000
9.00	Engineering		
9.01	Engineering design		$194,000
9.02	Resident engineering and contract administration		$100,000
9.03	Prepare EAP and IOM plans		$15,000
	Engineering Subtotal:		$309,000
	Engineering Contingency:	15%	$47,000
	Engineering Estimate:		$356,000
	Total Project Cost Estimate:		**$2,287,000**

Information presented on this sheet represents our opinion of probable costs in 2015 dollars, based upon previous unit rates and quantities updated from the AECOM's 2012 Cost Estimate. Unit and lump-sum prices are based on costs for similar projects, our engineering judgment, and/or published cost data. Actual bids and total project costs may vary based on contractor's perceived risk, site access, season, market conditions, etc. No warranties concerning the accuracy of costs presented herein are expressed or implied.

Note: This rehabilitation estimate is to extend the life of the dam structures for 20 years, with some regular maintenance. This estimate is for repairs of existing structural components only, not including the nearby transformer building. Costs for replacement or remodeling of structures is not included.

Planning Level Opinion of Probable Cost				Date:	8/12/2015
Option No. 4 - Fish Passage Adjacent to North Bank					
Project:	Estabrook Park Dam Rehabilitation			AECOM Project No.:	60181463
Client:	Milwaukee County				
Location:	Milwaukee, Wisconsin			Estimator:	J. Hiller/D. Pirrung
Prepared by:	AECOM			Checked by:	
Option 4 - Construct One Fish Passageway at Gated Section - One passageway adjacent to the north shoreline. No stoplogs required.					
Item	Description	Quantity	Units	Unit Cost	Total
1.0	**Site Preparation / Erosion Control**				
1.1	Silt Screen	200	lf	$25.00	$5,000
1.2	Coffer Dam	1	ls	$40,000.00	$40,000
1.3	Removing Spillway	200	cy	$200.00	$40,000
1.4	Traffic Control	1	ls	$2,000.00	$2,000
1.5	Localized Dewatering	90	days	$300.00	$27,000
				Subtotal	**$114,000**
2.0	**Proposed New Rock Arch Rapids Fishway**				
2.1	Concrete Wall	355	cy	$800.00	$284,000
2.2	Rock Ramp Field Stone	910	cy	$200.00	$182,000
2.3	Rock Ramp Sub-base Stone	400	cy	$100.00	$40,000
2.4	Boulder Weirs	260	cy	$250.00	$65,000
2.5	Footing Rock Anchors	309	ea	$100.00	$30,900
2.6	Stop Log and stanchions	1	ls	$20,000.00	$20,000
2.7	Grating and Railings		ls	$15,000.00	$0
				Subtotal	**$621,900**
3.0	**Earthwork**				
3.1	Salvaged Rubble Stone Masonry and Stone Fill	200	cy	$35.00	$7,000
3.2	Geotextile Fabric	250	sy	$4.00	$1,000
3.3	Rip Rap	300	cy	$90.00	$27,000
				Subtotal	**$35,000**
4.0	**Site Restoration / Landscaping**				
4.1	Site Restoration / Landscaping	1	ls	$5,000.00	$5,000
				Subtotal	**$5,000**
				Subtotals:	$775,900
				Mobilization (10%)	$77,590
				Construction Contingency (20%):	$170,698
				Construction Resident Engineering:	$81,935
				Total Estimated Cost:	**$1,107,000**

Information presented on this sheet represent our opinion of probable costs in 2014 dollars. Unit and lump-sum prices are based on costs for similar projects, engineering judgment, and/or published cost data. Actual bids and total project costs may vary based on contractor's perceived risk, site access, season, market conditions, etc. No warranties concerning the accuracy of costs presented herein are expressed or implied.

Planning Level Opinion of Probable Cost
Alternative 2 - Dam Abandoned and Removed

Date: 5/9/2014

Project: Estabrook Park Dam Rehabilitation

AECOM Project No.: 60181463

Client: Milwaukee County

Location: Milwaukee, Wisconsin

Estimator: C. Dean

Prepared b AECOM

Checked by: J. Hiller

Engineers Preliminary Estimate of Probable Costs (not including environmental sediment cleanup costs)

Number	Description	Quantity	Rate	Units	Budget	Description
1	Mobilization/ Demob.	1		Estimate	$37,000	
2	Silt Fence	1		Estimate	$4,200	
3	Site Restoration	1		Estimate	$15,750	
4	Diversion of water, two sides	1		Estimate	$31,500	
5	Ice Breaker Removal/Disposal	24	1575	Ea	$37,800	Dispose at gated dam area
6	Concrete Removal, gated side	1		Estimate	$26,000	Cut down to El. 38' and drop in place
7	Gate and equipment removal	1		Estimate	$10,500	Cost less salvage value
8	Concrete Removal, fixed side	1190	185	Cubic Yard	$220,150	Dispose at gated dam area
9	Masonry Removal, fixed side	1		Estimate	$42,000	Use as riprap and fill
10	Additional Fill at gated side	20,000	32	Cubic Yard	$640,000	Use clean dredged sediment?
11	Soil, seed, grade at gated side	2800	63	Cubic Yard	$176,400	Design as additional overflow spillway
			Subtotal			1,241,300
12	Engineering fees, 10% estimate				$124,130	
13	20% Contigency (Design and Construciton)				$248,260	
14	Restoration part-time oversight	1		Estimate	$60,000	
			TOTAL		**$1,673,690**	**plus environmental costs with dredging**

Notes

This preliminary estimate needs to be refined before financial commitments are made.

The exact amount of fill on the north side of the island will depend on requirements of WDNR.

We assume we can fill north of the island more like an earthen overflow spillway section than trying to fill completely to original finish grades before the gated section was excavated. - Verify

Our estimate of engineering fees covers tasks for development of plan and specifications. Fees for hydraulic modeling or other studies, if required for restoration permitting, may increase this estimate.

Planning Level Opinion of Probable Cost Date: 5/9/2014

Alternative 4 - Removal of Gated Structure, Fixed Crest Spillway Modification & Rock Ramp at Gated Structure

Project: Estabrook Park Dam Rehabilitation AECOM Project No.: 60181463

Client: Milwaukee County

Location: Milwaukee, Wisconsin Estimator: C. Dean

Prepared by: AECOM Checked by: J. Hiller

Engineers Preliminary Estimate of Probable Costs (not including environmental sediment cleanup costs)

Item	Description	Quantity	Rate	Units	Budget	Description
1.0	Mobilization/ Demob.	1		Estimate	$37,000	
2.0	Silt Fence	1		Estimate	$4,200	
3.0	Site Restoration	1		Estimate	$15,750	
4.0	Diversion of water, two sides	1		Estimate	$31,500	
5.0	Ice Breaker Removal/Disposal	24	$ 1,575	Ea	$37,800	Dispose at gated dam area
6.0	Concrete Removal, gated side	1		Estimate	$26,000	Cut down to El. 38' and re-use concrete for Rapids
7.0	Gate and equipment removal	1		Estimate	$10,500	Cost less salvage value
8.0	Fixed Crest Spillway - Raise 88 ft. section up 2 ft.	30	$ 150	Cubic Yard	$4,500	Stop Log Location Raise 2 ft. to Elv. 615.4 for 88 ft. long section
9.0	Fixed Crest Spillway - Lower 450 ft. section down 2 ft.	120	$ 200	Cubic Yard	$24,000	Lower 450 ft. section down 2 ft. to Elev. 615.4, Install new 12-inch high concrete cap section
10.0	Proposed New Rock Arch Rapids Fishway					
	10.1 Rock Ramp Field Stone	3700	$ 125	Cubic Yard	$462,500	
	10.2 Rock Ramp Sub-base Stone	2300	$ 90	Cubic Yard	$207,000	
	10.3 Boulder Weirs	1100	$ 125	Cubic Yard	$137,500	
				Item 10: Subtotal		$807,000
11.0	Additional Fill at gated side	20,000	$ 32	Cubic Yard	$640,000	Use clean dredged sediment?
12.0	Soil, seed, grade at gated side	2800	$ 63	Cubic Yard	$176,400	Land side and Island sides of gated structure
				Subtotal		1,814,650
13.0	Engineering fees, 10% estimate				$181,465	
14.0	20% Contingency (Design & Construction Phase)				$362,930	
15.0	Restoration part-time oversight	1		Estimate	$60,000	
				TOTAL	**$2,419,045**	**plus environmental costs with dredging**

Notes

1. This preliminary estimate needs to be refined before financial commitments are made.
2. The exact amount of fill on the north side of the island will depend on requirements of WDNR.
3. Rock Arch Rapids Fishway will be constructed on the north side of the island.
4. Our estimate of engineering fees covers tasks for development of plan and specifications. Fees for hydraulic modeling or other studies, if required for restoration permitting, may increase this estimate.
5. Information presented on this sheet represent our opinion of probable costs in 2014 dollars. Unit and lump-sum prices are based on costs for similar projects, engineering judgment, and/or published cost data. Actual bids and total project costs may vary based on contractor's perceived risk, site access, season, market conditions, etc. No warranties concerning the accuracy of

ATTACHMENT 10:

OPERATION PLAN INFORMATION

ATTACHMENT 10
OPERATION PLAN

Prepared by Don Pirrung, AECOM

I. Alternative 1 – Rehabilitate the Dam (No Fish Passage)

A. Operation Plan

The County may decide to keep the impoundment year round though this condition has not been tried. The County desires to have the flexibility to lower the impoundment during winter to reduce the potential for ice damage to the gates. Two operation plan options are presented as follows:

1. Option 1: Year Round Impoundment

This option maintains a year round impoundment with river levels based on flow over the fixed crest spillway and the gates normally closed. This approach basically eliminates fish passage, which is a negative impact to the fish and other aquatic life such as mussels. River elevations are presented under the summer conditions as indicated in the next option. The stoplogs remain in place year round.

2. Option 2: Seasonal Impoundment

This dam operation option considers two periods with a full impoundment during summer, and a lower impoundment during the balance of the year.

a. Summer Period From May 15 to September 15: Full Impoundment

Dates: Start refilling pool no earlier than May 15 and have drawdown completed by September 15.

Actions: The following actions would occur:

(1) Temporarily open the gates to lower the river level below the bottom of the stoplogs. This will allow the County staff to install the stoplogs. The temporary opening of the gates is needed to safely install the stoplogs by diverting the river through the gates. This action may take 1 to 2 days to complete.
(2) Close the gates after the stoplogs are installed to allow the impoundment to fill.

The County will have a gate operator on staff to monitor river levels, weather conditions, and gate positions. If a storm or high river levels are observed, the dam operator will open the gates as appropriate to pass the river flow to maintain a normal pool level. WDNR criteria limits drawdown to 6 inches per day or less.

Estabrook Dam is required to pass at all times a minimum flow downstream at least 25 percent of the natural low flow, which has been administratively set at Q710, S.Statutes 31.34, Wis. Stats.

The County proposes a normal water level in the pool based on the fixed crest spillway elevation. The gates will be operated as needed to establish the normal water level. If rising water levels occur above the normal, the County has the option to open gates to adjust pool levels accordingly.

Refer to SEWRPC's Technical Memo dated April 25, 2014, for additional information on river flows, flood frequency, and impoundment levels (Attachment 3). A rating curve is provided for the dam and is based on the 10 gates open. After the high flows have passed, the dam operator will gradually close the 10 gates to maintain the impoundment.

When the gates are closed, the river will flow over the fixed crest spillway. The key dam elevations are as follows:

Fixed Crest Spillway	Elevation 616
Bottom of Stoplogs	Elevation 613
Bottom of Slab Gated Section	Elevation 609
Top of Gate Piers	Elevation 618
Top of Stoplogs	Elevation 616

b. Balance of the Year Period From September 15 to May 15: Partial Impoundment

Actions: Gates are normally closed. The drawdown will follow WDNR criteria of no more than 6 inches per day drawdown.

The gates will be opened temporarily to allow the stoplogs to be removed. This temporary opening of the gates is expected to occur until the full impoundment is lowered below the bottom of the stoplogs. The 6-inch maximum per day lowering of the river level will be maintained. The removal of the stoplogs lowers the river level by 3 feet. The partial drawdown allows a sufficient water depth in the impoundment for aquatic life such as mussels.

The seasonal impoundment will result in the river flow passing through the stoplog section primarily.

B. River Levels

Refer to the SEWRPC Technical Memo dated April 25, 2014, for river levels for this alternative (Attachment 3). During flood events, the 10 gates are assumed to be open.

II. Alternative 1A – Rehabilitate the Dam and Add Fish Passage

Operation Plan: Full Impoundment Year Round

A year round full impoundment is proposed in conjunction with the fish passage. The fish passage will include a compound weir to route about 10 percent or slightly more of the river flow through the fish passage. The stoplogs will not be adjusted with this operation.

The County will have a gate operator on staff to monitor river levels, weather conditions, and gate positions. If a storm or high river levels are observed, the dam operator will open the gates as appropriate to pass the river flow to maintain a normal pool level. WDNR criteria limits drawdown to 6 inches per day or less.

Estabrook Dam is required to pass at all times a minimum flow downstream at least 25 percent of the natural low flow, which has been administratively set at Q710, S.Statutes 31.34, Wis. Stats.

The County proposes a normal water level in the pool based on the fixed crest spillway elevation. The gates will be operated as needed to establish the normal water level. If rising water levels occur above the normal, the County has the option to open gates to adjust pool levels accordingly.

Refer to SEWRPC's Technical Memo dated April 25, 2014, for additional information on river flows, flood frequency, and impoundment levels (Attachment 3). After the high flows have passed, the dam operator will gradually close the gates to maintain the impoundment.

When the gates are closed, the river will flow over the fixed crest spillway. The key dam elevations are as follows:

Fixed Crest Spillway	Elevation 616
Bottom of Stoplogs	Elevation 613
Bottom of Slab Gated Section	Elevation 609
Top of Gate Piers	Elevation 618
Top of Stoplogs	Elevation 616

The fish passage layout is underway. The proposed layout removes four gates and replaces with the fish passage. River flow through the fish passage is controlled by a compound weir. A rating curve will be prepared for the dam and submitted to WDNR after the design is completed.

III. Alternative 2 – Abandon and Remove the Dam

No operation plan is necessary because the dam is removed.

IV. Alternative 4 – Gated Spillway Removed, Serpentine Overflow Spillway Lowered, and a 6.3-Foot High Rock Ramp Constructed

The rock ramp will replace the gated section of the dam. The rock ramp will have a crest elevation of 615.4 and an overflow length of 200 feet perpendicular to the flow, a three horizontal to one vertical slope on its upstream face, and a hemi-circular weir configuration on the downstream face with a slope ranging from 5.5 percent at the center of the weir to 3.3 percent at the banks to provide a slope gradual enough to enable fish passage (April 25, 2014 SEWRPC Technical Memo).

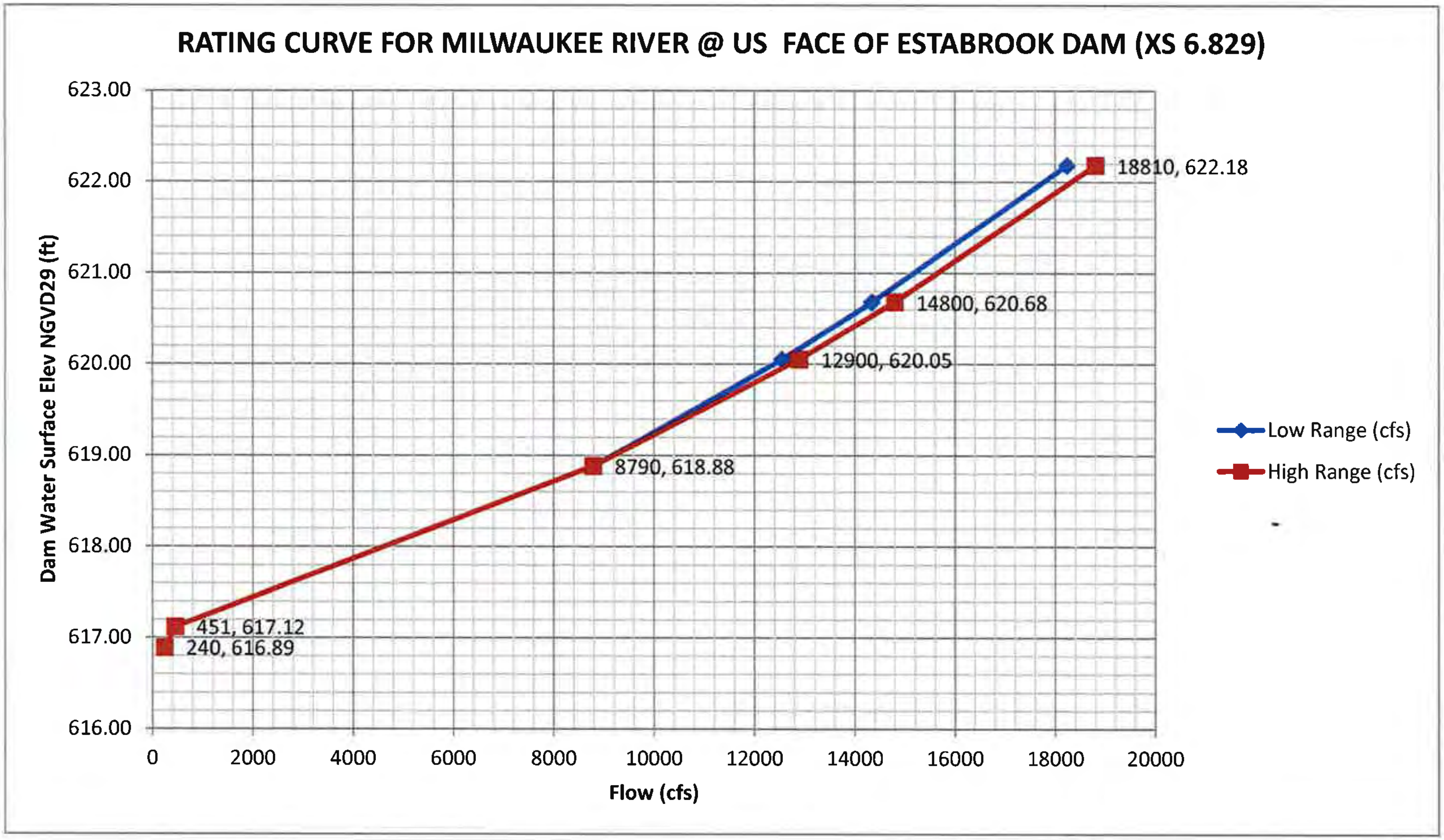
The existing stoplogs may or may not be left in place. The bottom of the stoplogs is Elevation 613 and the top of the stoplogs would be revised from Elevation 616 to Elevation 615.4. The stoplogs would allow the County the option to lower the pool an additional 2.4 feet for maintenance, for example.

A. Operation Plan

The operation plan is to maintain a pool year-round. The stoplogs allow the county to lower the pool by 2.4 feet to perform maintenance on a short-term basis. Water levels would be adjusted to comply with WDNR's criteria to limit drawdown to no more than 6 inches per day.

B. River Levels

Refer to the SEWRPC Technical Memo dated April 25, 2014, for river levels for this alternative (Attachment 3).

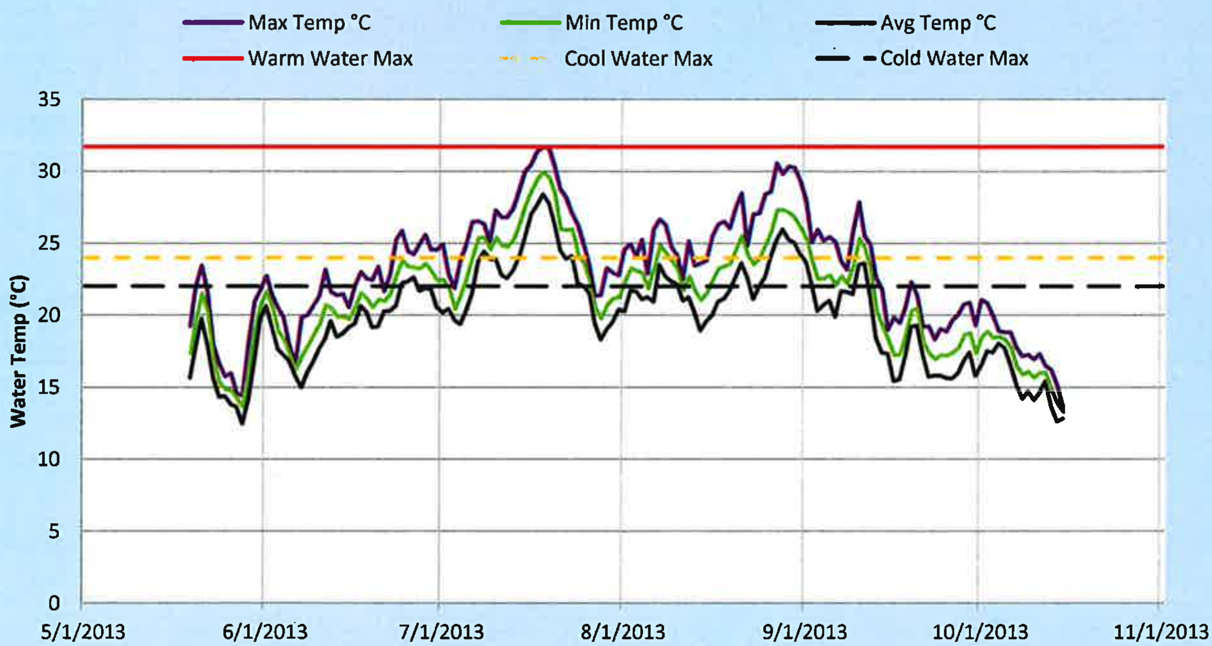


Annual Probability of Occurrence	Dam Rehab W.S. Elev NGVD29 (ft)	Low Range (cfs)	High Range (cfs)
Median Flow	616.89	240	240
Mean Flow	617.12	451	451
10-percent-annual-probability	618.88	8790	8790
2-percent-annual-probability	620.05	12550	12900
1-percent-annual-probability	620.68	14340	14800
0.2-percent-annual-probability	622.18	18240	18810

ATTACHMENT 11:

MILWAUKEE RIVER WATER QUALITY INFORMATION

Milwaukee River S of Estabrook Park Dam
2013 Continous Temperature Chart



Warm Water Max: Maximum instantaneous temperature shall not exceed 31.7°C per DNR NR 102.04 for warm water fish.
Cool Water Max: Maximum **daily mean temp** DNR standard for cool water streams (24°C)
Cold Water Max: Maximum **daily mean temp** DNR standard for cold water streams (22°C)

milwaukee RIVERKEEPER®

Milwaukee River at South of Estabrook Park Dam, 10012616
Milwaukee River
Latitude: 43.10139, Longitude: -87.91028

Cheryl Nenn, Milwaukee Riverkeeper
William Kalmer, Milwaukee Riverkeeper
Janet Amundson, Milwaukee Riverkeeper
Jason Schroeder, Milwaukee Riverkeeper
Joe Rath, Milwaukee Riverkeeper
John Schafer, Milwaukee Riverkeeper

Reporting Period: 01/01/2006 to 01/01/2013

Understanding the Level 2 Stream Monitoring Data Report

This report provides summary information for data gathered by volunteers participating in Level 2 monitoring of the Citizen Based Stream Monitoring Program. The report includes data for Milwaukee River - South Of Estabrook Park Dam which is referred to as Station ID 10012616, and includes all data entered into the WDNR database (SWIMS) under the CBSM program. This report includes any data collected between the dates of 01/01/2006 and 01/01/2013.

This report highlights monthly recorded values for dissolved oxygen (DO), pH, transparency, and temperature. Data are summarized to report minimum, maximum, mean, and median values for the period the site has been monitored. We also report minimum, maximum, and mean daily temperatures calculated from temperature data originally recorded hourly by continuous data loggers.

Helpful Terms

In this report, for each parameter monitored, some statistical information is provided to help explain what has been found. You may want to refer back to this section as you read through the report to help you understand what is being presented.

Mean: This is the average score in a dataset, or a typical expected value.

Median: This is the middle value in a data set of ranked values. When few data points have been collected, the median is considered a better estimate than the mean for a typical expected value.

For instance, assume the following readings (in mg/L) were found for five D.O. assessments: 10.5, 10.0, 12.5, 14.5, and 8.0. Ranking them in order from lowest to highest, we get: 8.0, 10.0, 10.5, 12.5, and 14.5. The value in the middle of that ranked data set is 10.5.

Thus, 10.5 mg/L is the median. (If you have an even number of data points in the data set, the median is the mean of the middle two numbers in the ranked list.)

If we determined the mean for the same data set, very high and/or low values might affect it. For this example the mean is determined in the following way:
8.0 + 10.0 + 10.5 + 12.5 + 14.5 = 55.5

55.5/ 5 = 11.1 mg/L Thus, 11.1 mg/L is the mean.

Although there isn't a large difference in the median (10.5 mg/L) and the mean (11.1 mg/L) in this example, in a small data set where one or two values are very different than most of the other values, using the median instead of the mean should provide a better estimate of the expected value. In a large data set, the mean and median are expected to be the same or nearly the same.

Dissolved Oxygen

Dissolved oxygen (DO) is a gas found in water that is critical for sustaining aquatic life (just as oxygen is required for us to survive). Dissolved oxygen enters water through mixing with air in turbulent waters or through photosynthetic processes by aquatic plants and algae. Dissolved oxygen leaves water through decomposition of organic materials that have entered the system from point or non-point source inputs (such as runoff from a yard or field), plant respiration and oxygen demand by organisms such as macroinvertebrates and fish. DO varies over a 24-hour period, with lowest levels expected just before sunrise, when plants and animals have been respiring, but photosynthesis has not been occurring. This flux over a 24-hour period is called diurnal variation. Large fluctuations in diurnal DO levels (e.g., 8-10 mg/L and supersaturated conditions at times) generally indicate increased photosynthesis and respiration due to elevated levels of plant and/or algal growth. Streams having levels of dissolved oxygen at greater than 100% saturation (i.e. supersaturation) do so during the day when the rate of oxygen production via photosynthesis exceeds the rate of diffusion of dissolved oxygen from water to air. Levels of DO saturation typically range from 80-120%, although highly productive streams can experience levels upwards of 140-150% during the middle of the day.

Dissolved oxygen levels are important in determining various communities of aquatic life. DO levels below 2 mg/L generally do not support aquatic life, and most fish and many insects cannot tolerate levels below 4-5 mg/L for a sustained period of time. DO levels above 7 mg/L are amenable to coldwater species such as trout. Different species of fish will migrate within a stream to seek suitable dissolved oxygen conditions.

There are several categories by which waters of Wisconsin are classified by state law. These include (but aren't limited to) trout waters, other fish or aquatic life-designated waters, limited forage fish communities, and limited aquatic life communities. There are defined DO minimums set for each type of classification. The minimums are designed to allow the aquatic organisms defined in the classification to survive in those waters. Since different organisms have different DO requirements, the DO minimums vary based on stream classification. The table below shows the minimum DO allowed in waters classified in certain ways by Wisconsin state law.

Stream classification	**Minimum dissolved oxygen allowed**
Trout waters	6 mg/l (out of spawning season) and 7 mg/L (during spring/fall spawning season)
Fish or aquatic life-designated waters	5 mg/L
Limited forage fish waters	3 mg/L
Limited aquatic life waters	1 mg/L

Is My Site on a Warm Water or Cold Water Stream?

You can identify if your stream is designated as a trout stream by opening this file from the Wisconsin Department of Natural Resources (WDNR) website (available at: http://dnr.wi.gov/fish/species/trout/wisconsintroutstreams.pdf).

Lists of waters that are designated as limited forage fish or limited aquatic life communities are included in Chapter NR 104 Uses and Designated Standards (available at: http://dnr.wi.gov/org/water/wm/wqs/codes/nr104.pdf) and in Chapter NR 102 Water Quality

Standards for Wisconsin Surface Waters (available at: http://www.legis.state.wi.us/rsb/code/nr/nr102.pdf).

You can also create your own maps of your monitoring station and river using the ***Surface Water Data Viewer***. More information is located at: http://dnr.wi.gov/org/water/data_viewer.htm

Dissolved Oxygen and Temperature -- a Special Link

Since DO and temperature are intimately related (e.g., water with a higher temperature can hold less oxygen than water with a lower temperature, so the general concentration of the two parameters in water generally mimic one another), it's important to consider the two together.

Dissolved oxygen content in streams is linked with temperature requirements of aquatic life. Colder water generally holds more oxygen and warmer water holds less oxygen.

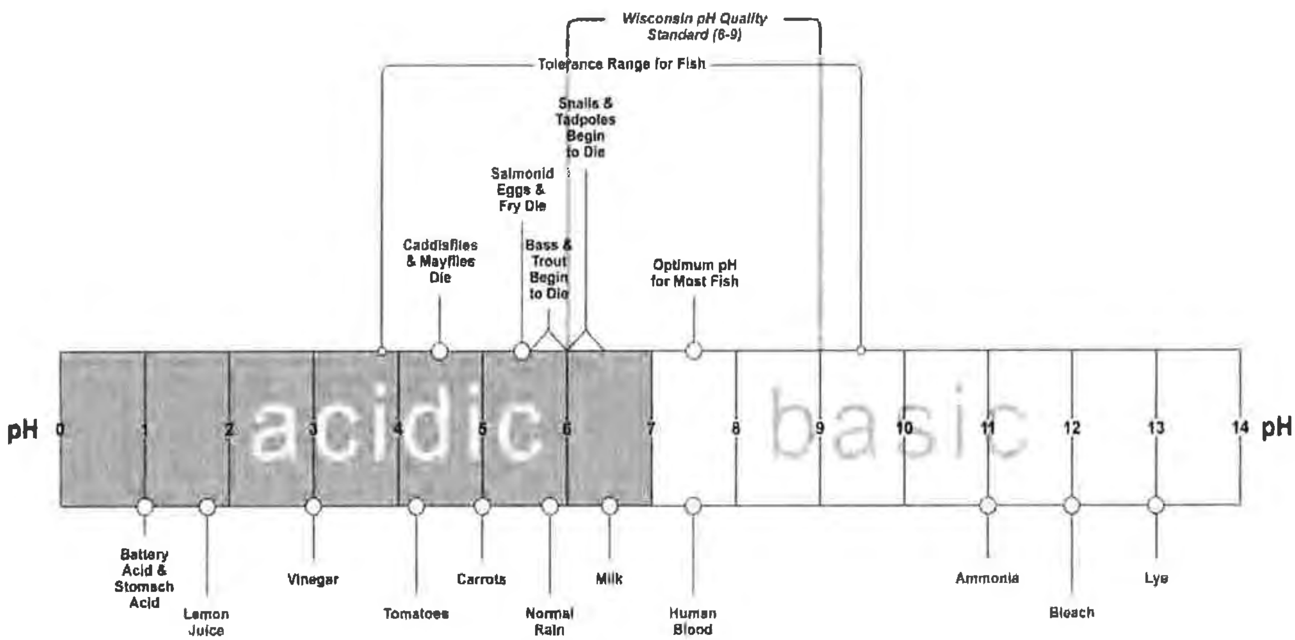
Very High DO	Moderately high DO	Low DO
	ANIMALS	
Brook or rainbow trout	Brown trout	Carp
Mottled sculpin	Redbelly dace	Green sunfish
	Bass	Fathead minnow
	PLANTS	
Much plant variety	Moderate plant variety	Little plant variety

Source: Dane County Water Watchers

pH

pH is a measure of the hydrogen-ion activity of water and is expressed as a logarithmic unit that ranges from 1 to 14 Standard Units. That means for every 1 pH unit change, there is a tenfold change in the activity of hydrogen ions. Waters with high hydrogen-ion activity have low pH and are considered acidic. The presence of dissolved carbon dioxide, carbonic acid, bicarbonate ions and carbonate ions strongly influence the pH of freshwater systems. Much of Wisconsin has bedrock that is composed of limestone and other rock that is rich in bicarbonate and carbonate. These types of rock can minimize impacts of acid rain or other acidic inputs to the water. In northern Wisconsin, bedrock is composed of granite which is not rich in bicarbonates and carbonates, and thus those rocks are less able to buffer or offset the impacts of acid rain or other acid inputs to the waters. In poorly buffered waters, pH may change a lot in the course of a 24-hour period based on photosynthesis (which uses carbon dioxide) and respiration (which releases carbon dioxide) by aquatic plants and algae. In other parts of the state which are well buffered, pH may not change much over a 24-hour period. Dissolved metal ions tend to increase with increased acidity and as a result, pH is an important factor influencing toxicity of metals. pH also affects the concentration of un-ionized ammonia, a form of nitrogen that is extremely toxic to aquatic life. Wisconsin has adopted a pH standard that incorporates a range from 6 to 9 units to protect and support aquatic life use.

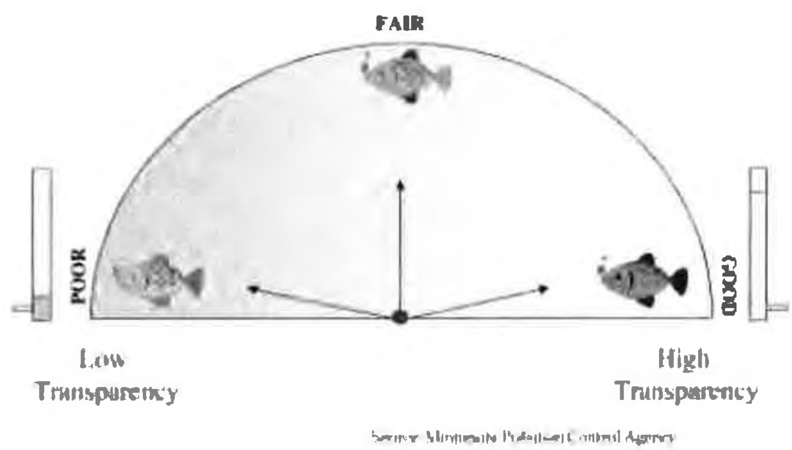
This figure shows the WI pH quality standard along with some reference points for aquatic organisms and everyday substances. Is your site's pH fairly static or does it vary over time?



Transparency

Stream water transparency is a measure of water clarity made with a transparency tube. The transparency tubes used by Level 2 Stream Monitors are 120 centimeters (cm) long and have a black and white disc at the bottom. Transparency is measured by determining the maximum depth of water in the tube that still allows the black and white disc to be visually detected from above. Transparency is measured in centimeters. Since the maximum tube depth is 120 cm, when the disc is visible with a full tube of water, the exact transparency is not measurable, but is greater than or equal to 120 cm. High transparencies indicate good water quality (Figure below).

Low Water Transparency Influences Fish Health



Transparency measurements are affected by both the presence of suspended particles, such as soil particles and microscopic organisms, and by water color, which is caused by certain dissolved substances. Transparency is an easily made measurement that can be correlated with turbidity, although the two measurements are not directly comparable.

Turbidity is a somewhat more difficult measurement that is often made in a lab. Turbidity has been a commonly used measurement in water quality studies and its relationship to the health of fish and other aquatic life has been established.

Turbidity is a measure of water clarity or "cloudiness" caused primarily by the presence of suspended particulate matter. It is basically an optical measurement of the amount of light scattering caused by fine organic or inorganic particles and to a lesser extent some dissolved substances in the water. These small particles of soil, algae or other materials generally range in size from microscopic to about one millimeter (about the thickness of a pencil lead). More suspended particles cause greater turbidity resulting in less light penetration through the water. This hinders photosynthesis, necessary for healthy aquatic plant growth and production of dissolved oxygen. With increased turbidity, water also becomes warmer because the suspended particles absorb heat. Since warmer water holds less dissolved oxygen than cold water, oxygen levels are also affected by turbidity. Extremely high levels of turbidity may also impair aquatic organism survival, for instance, by blocking gas exchange in membranes used for respiration, interfering with filter feeding mussels, or by restricting predation by sight-feeding fish. In general, turbidity increases with increasing river flow due to erosional processes and bad sediment resuspension. Sources of turbidity include:

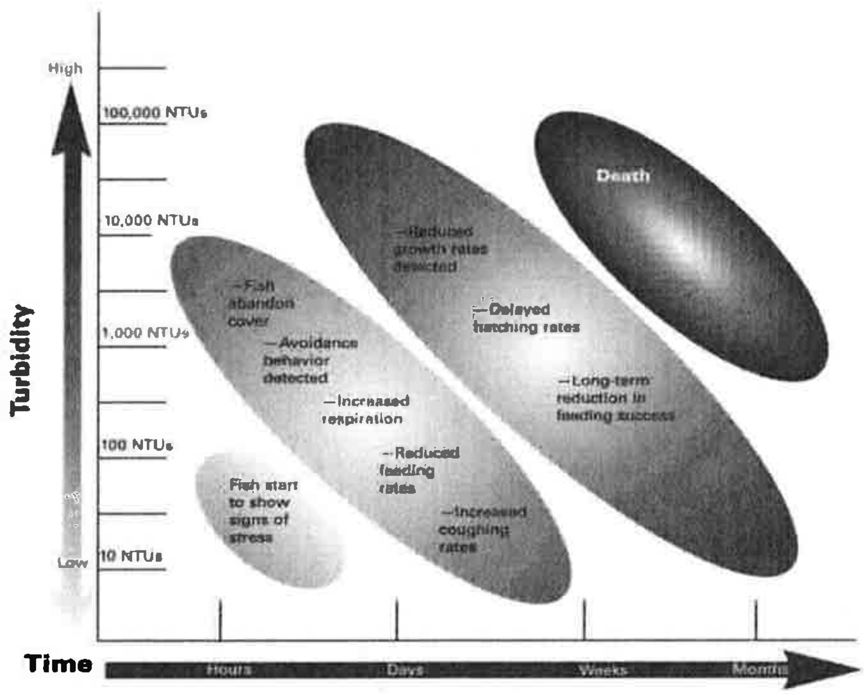
- erosion from fields, construction sites
- urban runoff from rainstorms and melting snow
- eroding stream banks
- decaying plant matter
- large number of bottom feeders (such as carp) which stir up bottom sediments
- algae
- wastewater discharges

All streams have background or normal levels of water clarity. Fish and aquatic life that inhabit particular streams are adapted to those background levels of water clarity. Time is probably the most influential factor in determining how turbidity affects the aquatic environment. The longer the water remains at unusually high values of turbidity, the greater effect it has on fish and other aquatic life. Fish in particular become very stressed in waters that remain highly turbid for a long time. Signs of stress include increased respiration rate, reduced growth and feeding rates, delayed hatching and, in severe cases, death. Fish eggs are ten times more sensitive to changes in turbidity than adult fish.

Since transparency is a surrogate measurement of turbidity and the two measurements are correlated, the table to the right can be used to covert transparency values to approximate turbidity values. The figure below can be used to further understand how the resultant turbidity values and exposure times impact fish.

Transparency (cm)	Turbidity (NTUs)
<6.4	>240
6.4 to 7.0	240
7.1 to 8.2	185
8.3 to 9.5	150
9.6 to 10.8	120
10.9 to 12.0	100
12.1 to 14.0	90
14.1 to 16.5	65
16.6 to 19.1	50
19.2 to 21.6	40
21.7 to 24.1	35
24.2 to 26.7	30
26.8 to 29.2	27
29.3 to 31.8	24
31.9 to 34.3	21
34.4 to 36.8	19
36.9 to 39.4	17
39.5 to 41.9	15
42.0 to 44.5	14
44.6 to 47.0	13
47.1 to 49.5	12
49.6 to 52.1	11
52.2 to 54.6	10
>54.7	<10

* Nephelometric Turbidity Units (NTU) are units of particle dispersion (suspended particles) providing a measure of turbidity using a *nephelometer.*



Water Temperature

Water temperature is an important physical property that influences the growth and distribution of aquatic organisms. It is also an important factor regulating chemical and biochemical reactions in aquatic animals and plants. Surface water temperature is strongly influenced by solar radiation, local climate and groundwater inflows.

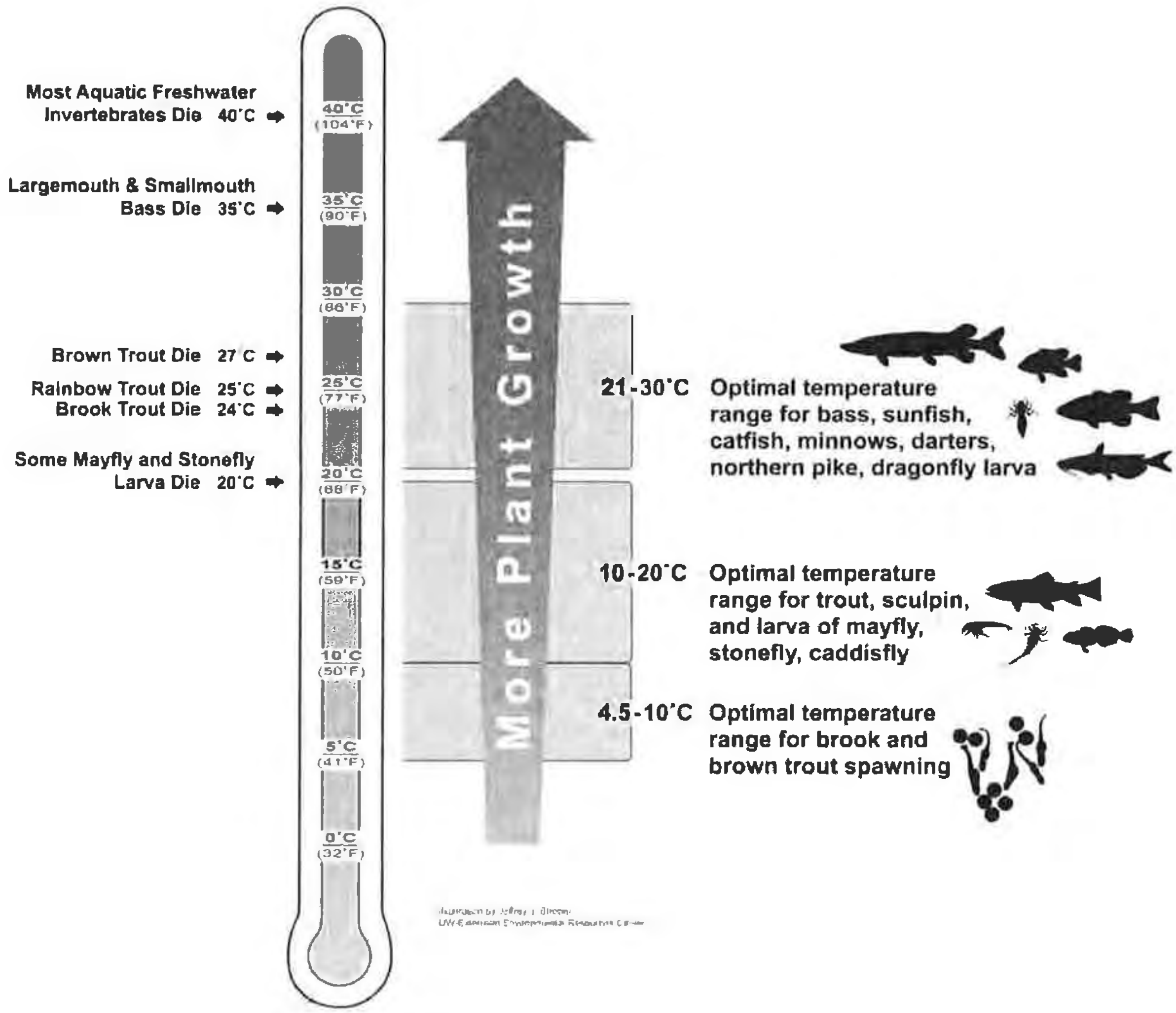
Wisconsin uses water temperature as an important variable in the designation of fish and aquatic life uses for surface waters. Use designations are utilized to classify waters of the state into certain categories so that management decisions can be made to protect the quality of those water resources.

Long-term water temperature data are useful for interpreting temporal variations. The WDNR uses temperature data averaged over months or seasons to calculate effluent limits. By setting effluent limits to surface waters, aquatic life present in the streams being monitored can be protected.

The WDNR also classifies streams by their water temperatures, indicating if they are cold, cool, or warm water streams (Table below).

Thermal regime	Maximum instantaneous temperature	Maximum daily mean temperature
Cold water stream	<25 °C (77 °F)	< 22 °C (72 °F)
Cool water stream	25-28 °C	22-24 °C
Warm water stream	>28 °C (82 °F)	> 24 °C (75 °F)

These classes of streams support different types of fish species. The best quality coldwater streams have relatively few species of fish as compared to warm water streams. Salmonids such as brook trout dominate the fish populations in the best quality coldwater streams, while brown trout, an exotic salmonid species, dominate coldwater streams that have slightly less pristine water quality. Bass, darter and sucker species are more prevalent in warmwater streams than in coldwater streams. Different species of fish have different temperature requirements. Trout need cool temperatures, while fish species such as bass can live in waters with higher temperatures (see figure 3 on following page).



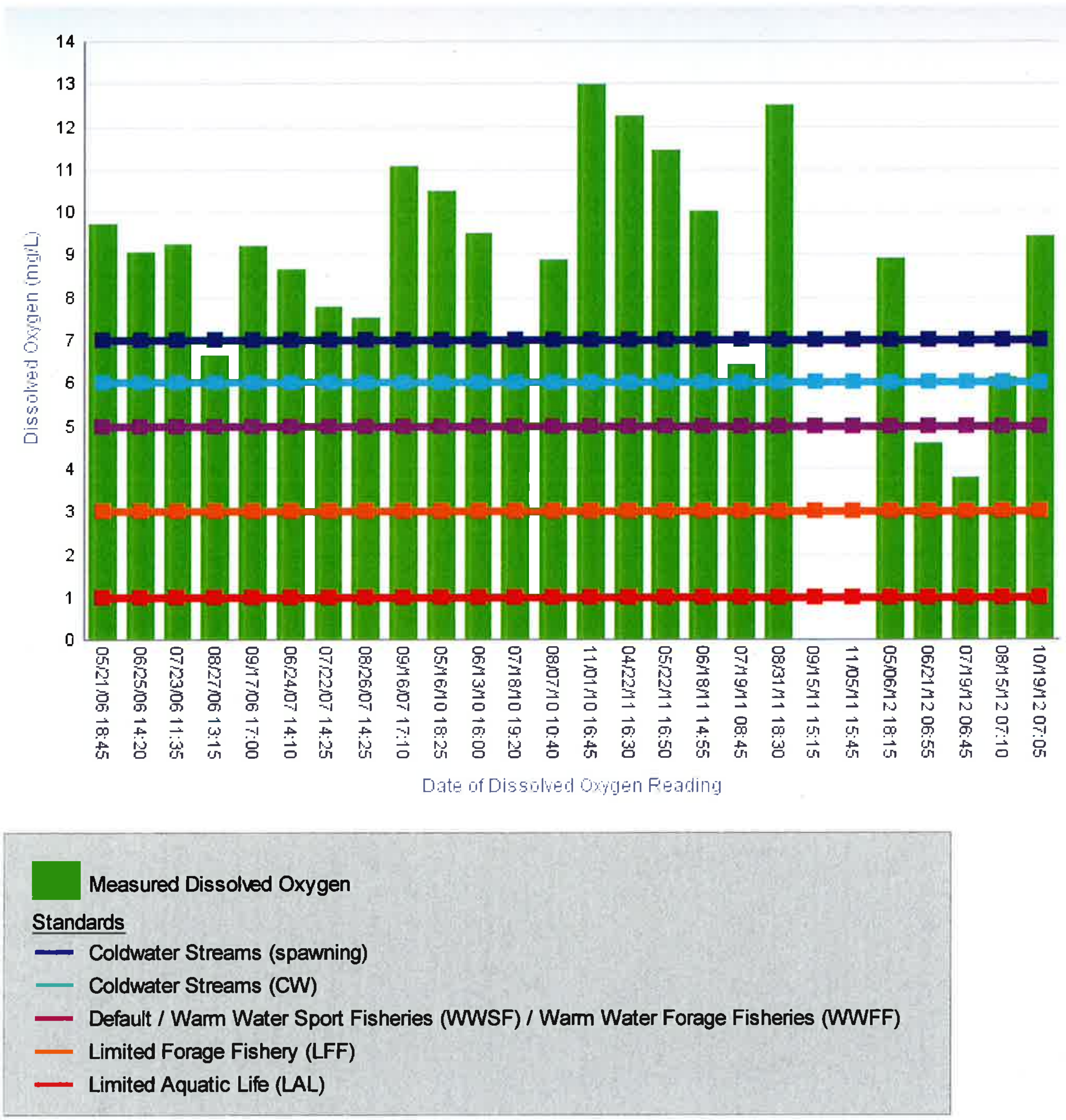
Based on the table above and your site's minimum, maximum and mean water temperatures for each month (see next page), how would you classify your stream based on its temperature over time? Coldwater, coolwater, or warmwater? If you monitor macroinvertebrates, how do your findings for macroinvertebrates and temperature compare with their temperature tolerances as listed in Figure 3? Do you find many plants at your monitoring site? Does their presence make sense in relation to average water temperatures?

The following pages summarize the results of monitoring on Milwaukee River - South Of Estabrook Park Dam, 10012616.

Dissolved Oxygen (Instantaneous Data) at Milwaukee River - South Of Estabrook Park Dam, 10012616

Instantaneous dissolved oxygen was gathered at this station 25 times during the period of monitoring, from 05/21/06 to 10/19/12. Dissolved oxygen values are displayed in the Graph 1 below and reflect the following values:

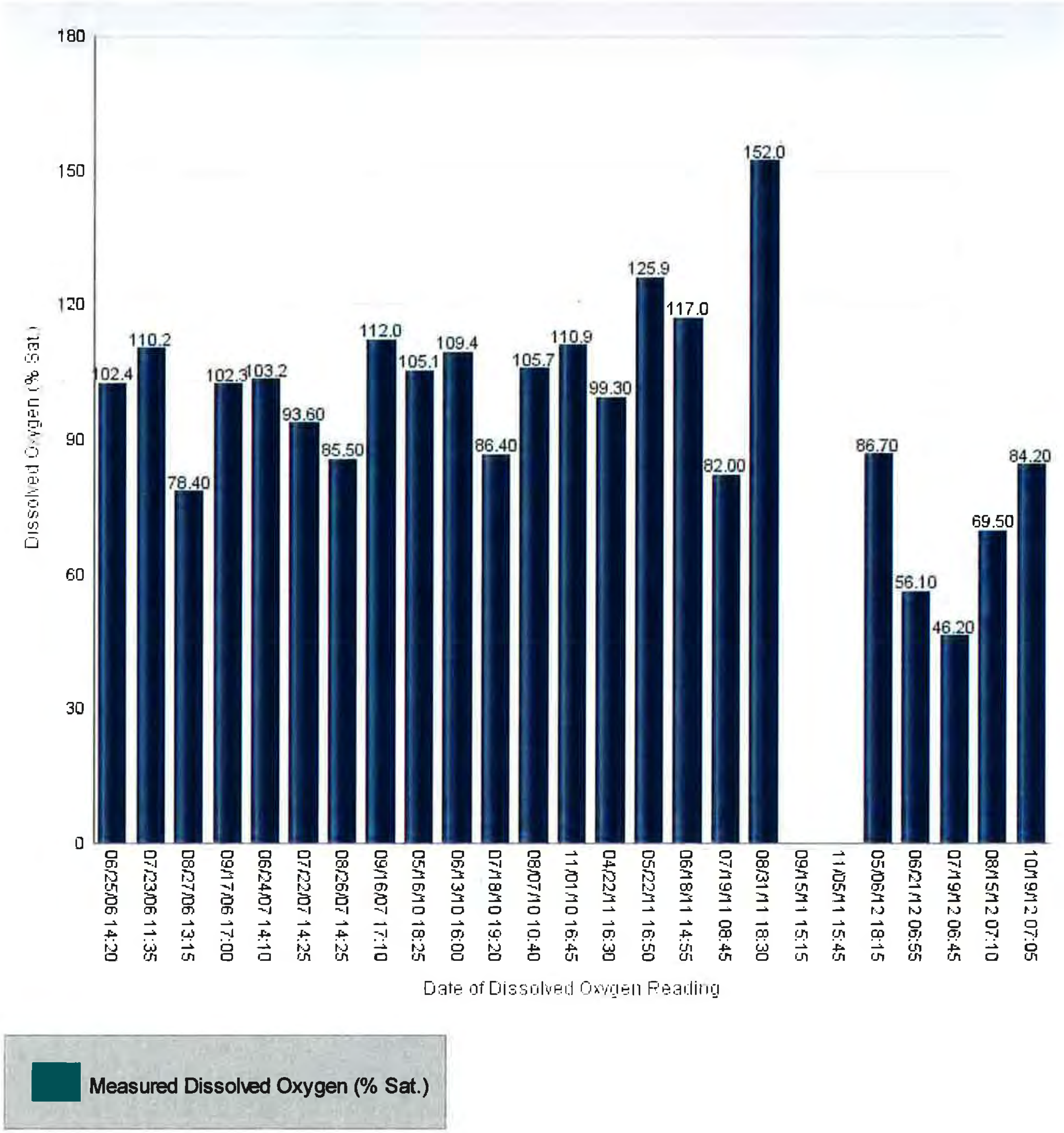
Instantaneous D.O. minimum: 3.77 mg/l
Instantaneous D.O. maximum: 12.93 mg/l
Instantaneous D.O. mean: 8.76 mg/l
Instantaneous D.O. median: 9.04 mg/l



Dissolved Oxygen, Percent Saturation (Instantaneous Data) at Milwaukee River - South Of Estabrook Park Dam, 10012616

Instantaneous dissolved oxygen percent saturation was gathered at this station 24 times during the period of monitoring, from 06/25/06 to 10/19/12. Dissolved oxygen percent saturation values are displayed in the Graph 2 below and reflect the following values:

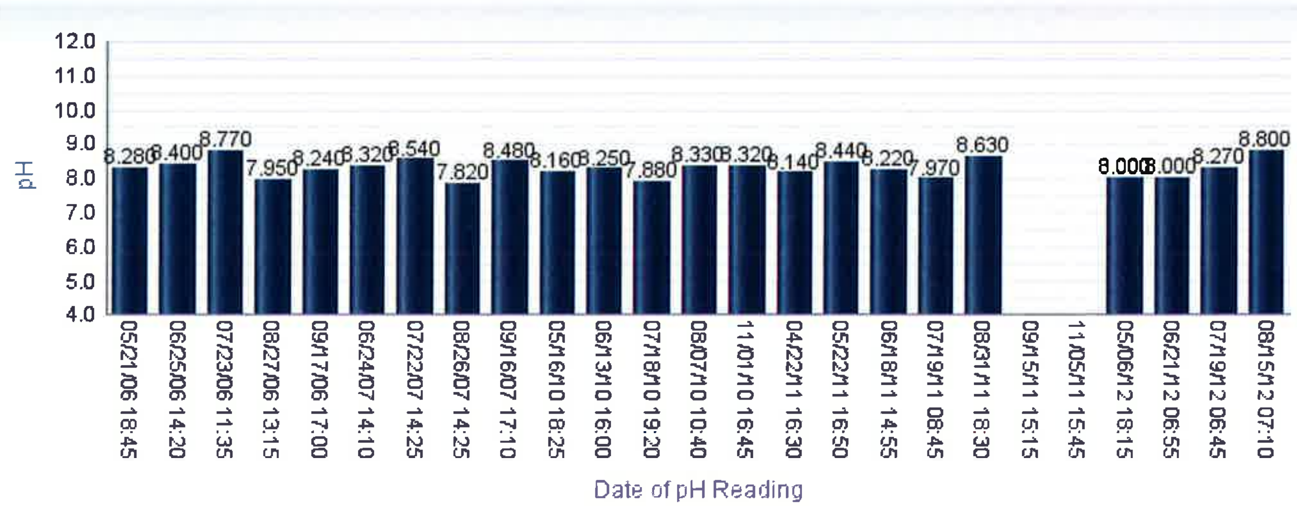
Instantaneous D.O. percent saturation minimum: 46.2 % Saturation
Instantaneous D.O. percent saturation maximum: 152 % Saturation
Instantaneous D.O. percent saturation mean: 96.08 % Saturation
Instantaneous D.O. percent saturation median: 100.8 % Saturation



pH (Instantaneous Data) at Milwaukee River - South Of Estabrook Park Dam, 10012616

Instantaneous pH was gathered at this station 24 times during the period of monitoring, from 05/21/06 to 08/15/12. pH values are displayed in the Graph 3 below and reflect the following values:

Instantaneous pH minimum: 7.82
Instantaneous pH maximum: 8.8
Instantaneous pH mean: 8.26
Instantaneous pH median: 8.26



Average Transparency (cm)

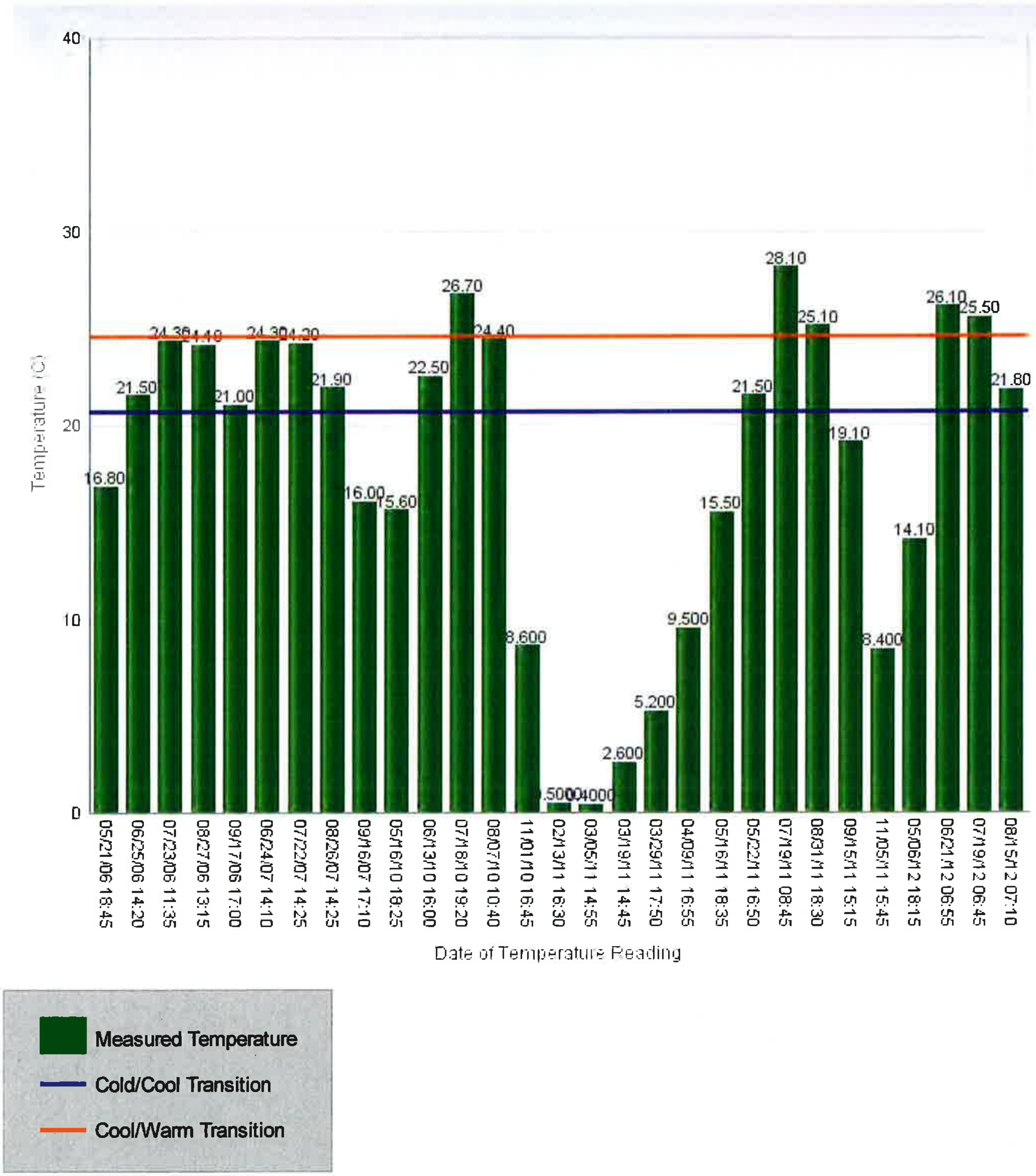
Instantaneous transparency was gathered at this station 24 times during the period of monitoring, from 05/21/06 to 10/19/12. Transparency values are displayed in the Graph 4 below and reflect the following values:

Instantaneous transparency minimum: 16.75
Instantaneous transparency maximum: 102.1
Instantaneous transparency mean: 55.19
Instantaneous transparency median: 53.35

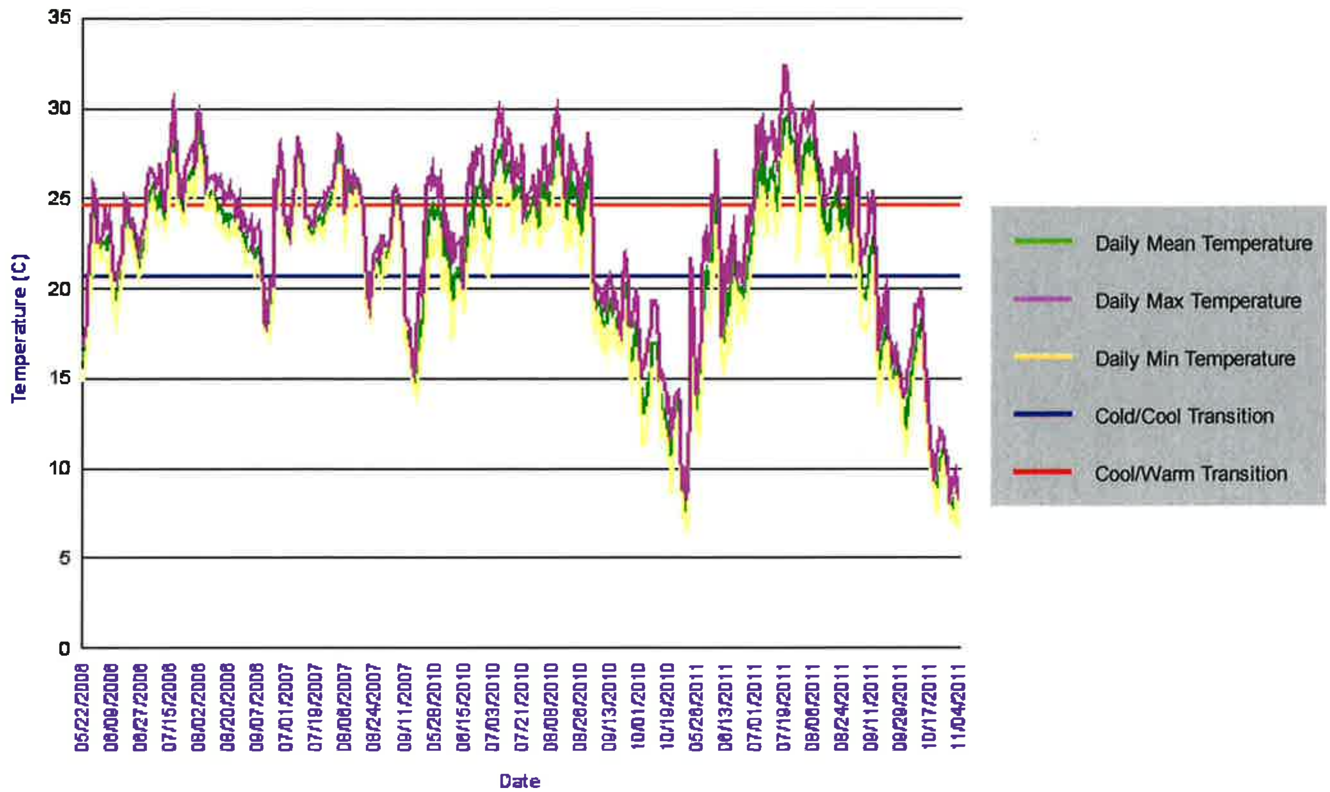
Instantaneous Water Temperature (C)

Instantaneous water temperature was gathered at this station 31 times during the period of monitoring, from 05/21/06 to 08/15/12. Water temperature values are displayed in the Graph 5 below and reflect the following values:

Instantaneous temperature minimum: .4
Instantaneous temperature maximum: 28.1
Instantaneous temperature mean: 18.02
Instantaneous temperature median: 21.5



Mean/Min/Max Daily Temperatures



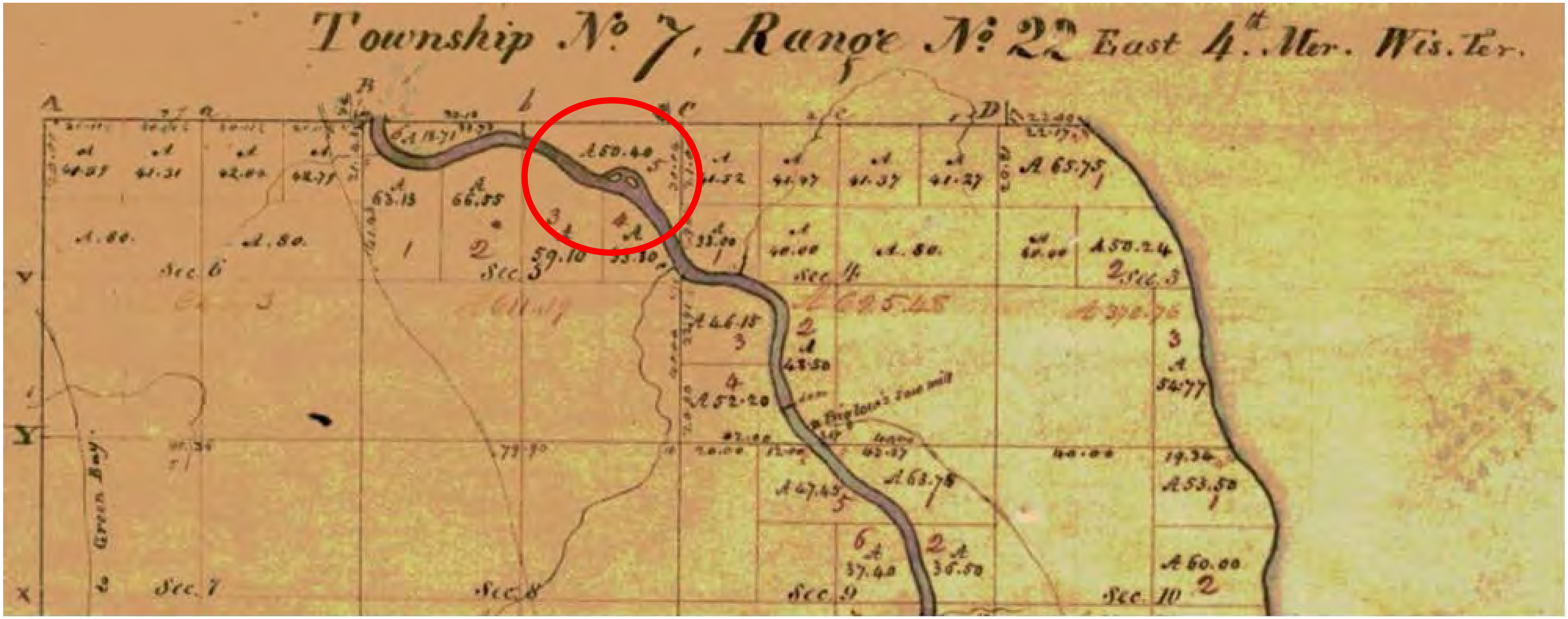
ATTACHMENT 12:

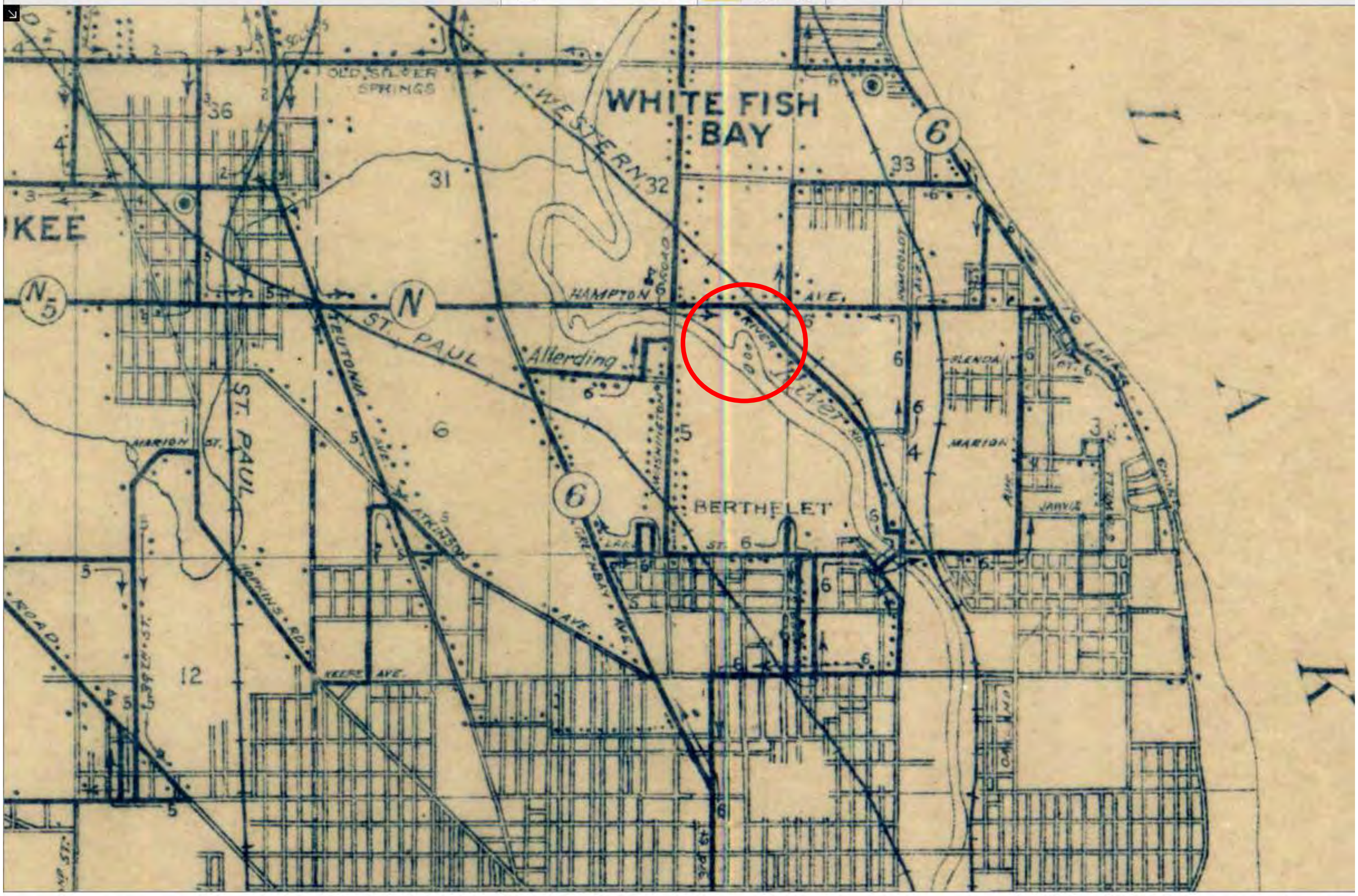
1937 AERIAL PHOTO OF THE DAM AND VICINITY


I want to...
OrthoWithParcels
4849
4841
4833
4830
500
430
420
410
306
222
4848
170
240
198
240
W HAMPTON AVE
E HAMPTON AVE
E HAMPTON RD
249
233
N ESTABROOK PKWY
435
N PORT WASHINGTON RD
4700
4650
4600
400
100
500ft
200m
X:
Y:

ATTACHMENT 13:

HISTORICAL LAND PLAT SURVEY


Township No. 7, Range No. 22d East 4th Mer. Wis. Ter.
Sec. 6
Sec. 5
Sec. 4
Sec. 3
Sec. 7
Sec. 8
Sec. 9
Sec. 10
Green Bay



Title	Milwaukee County (Wisconsin) 1912
Full Title	Map of Milwaukee County, Wis. : showing rural delivery service / Post Office Department
Creator	United States. Post Office Dept.
Publication Date	[1912?]
Map Publisher	Post Office Dept. [Washington, D.C.]
Subject	Rural free delivery--Wisconsin--Milwaukee County--Maps Milwaukee County (Wis.)--Maps
Continent	North and Central America
Country	United States
State/Province	Wisconsin
Region	Southeastern Wisconsin
County	Milwaukee county
City	Milwaukee
Notes	Blue line print.

Type	Image
Scale	[ca. 1: 65,000]
Original Collection	American Geographical Society Library - Maps
Original Item Description	1 map : photocopy ; 84 x 44 cm.
Original Item ID	893-c.M54 D-[1912?]
Language	en
Repository	American Geographical Society Library, University of Wisconsin-Milwaukee Libraries
Digital Publisher	University of Wisconsin-Milwaukee Libraries
Rights	The Board of Regents of the University of Wisconsin System
Digital ID (link)	am001511
Digital Format	image/tif; image/jp2
Date.Digitized	2005-05-31
Digital Collection	American Geographical Society Library Digital Map Collection

ATTACHMENT 14:

BIRDS OF ESTABROOK PARK

Birds of Estabrook Park, Milwaukee County, Wisconsin
166 species (+12 other taxa)
Compiled by Charles Hagner (c_hagner@mac.com)

KEY:
+ Birds seen year-round
* Birds seen year-round or throughout summer
# Birds seen in winter (but not seen year-round or throughout summer)
^ Birds seen in spring and fall

Snow Goose
Cackling Goose
Canada Goose+*
Tundra Swan^ (fly-overs)
Wood Duck*
Mallard+*
Blue-winged Teal^
Northern Shoveler
Redhead
Greater Scaup^
Bufflehead#
Common Goldeneye#
Hooded Merganser^
Common Merganser#
Red-breasted Merganser^
Pied-billed Grebe^
Horned Grebe
Double-crested Cormorant^ (fly-overs)
Great Blue Heron*
Great Egret
Green Heron*
Black-crowned Night-Heron*
Turkey Vulture* (fly-overs)
Osprey*
Sharp-shinned Hawk
Cooper's Hawk+*
Bald Eagle
Broad-winged Hawk
Red-tailed Hawk+*
Sora
American Coot^
Sandhill Crane (fly-overs)
Killdeer*
Spotted Sandpiper*
Solitary Sandpiper^
Wilson's Snipe
American Woodcock^
Ring-billed Gull+*
Herring Gull+*
Caspian Tern
Rock Pigeon+*
Mourning Dove+*
Yellow-billed Cuckoo
Black-billed Cuckoo*
Eastern Screech-Owl
Great Horned Owl*

Barred Owl
Common Nighthawk^
Chimney Swift*
Ruby-throated Hummingbird*
Belted Kingfisher*
Red-headed Woodpecker
Red-bellied Woodpecker+*
Yellow-bellied Sapsucker^
Downy Woodpecker+*
Hairy Woodpecker+*
Northern Flicker*
American Kestrel
Merlin
Peregrine Falcon* (nests at UWM)
Olive-sided Flycatcher^
Eastern Wood-Pewee*
Yellow-bellied Flycatcher^
Alder Flycatcher
Willow Flycatcher
Least Flycatcher^
Eastern Phoebe*
Great Crested Flycatcher*
Eastern Kingbird*
White-eyed Vireo^
Yellow-throated Vireo^
Blue-headed Vireo^
Warbling Vireo*
Philadelphia Vireo^
Red-eyed Vireo*
Blue Jay+*
American Crow+*
Northern Rough-winged Swallow*
Tree Swallow*
Bank Swallow
Barn Swallow*
Cliff Swallow* (nests under Hampton Ave. bridge in Lincoln Park)
Black-capped Chickadee+*
Red-breasted Nuthatch^
White-breasted Nuthatch+*
Brown Creeper^
House Wren*
Winter Wren^
Sedge Wren
Carolina Wren
Blue-gray Gnatcatcher*
Golden-crowned Kinglet^
Ruby-crowned Kinglet^
Eastern Bluebird*
Veery^
Gray-cheeked Thrush^
Swainson's Thrush^
Hermit Thrush#^
Wood Thrush^ (but occasionally heard singing in park in summer)
American Robin+*
Gray Catbird*
Brown Thrasher^

Northern Mockingbird
European Starling+*
Cedar Waxwing+*
Ovenbird^
Louisiana Waterthrush
Northern Waterthrush^
Blue-winged Warbler^
Golden-winged Warbler^
Black-and-white Warbler^
Prothonotary Warbler
Tennessee Warbler^
Orange-crowned Warbler^
Nashville Warbler^
Connecticut Warbler
Mourning Warbler^
Kentucky Warbler
Common Yellowthroat*
Hooded Warbler
American Redstart*
Cape May Warbler^
Northern Parula^
Magnolia Warbler^
Bay-breasted Warbler^
Blackburnian Warbler^
Yellow Warbler*
Chestnut-sided Warbler*
Blackpoll Warbler^
Black-throated Blue Warbler^
Palm Warbler^
Pine Warbler^
Yellow-rumped Warbler^
Black-throated Green Warbler^
Canada Warbler^
Wilson's Warbler^
Eastern Towhee^
American Tree Sparrow#
Chipping Sparrow*
Clay-colored Sparrow^
Field Sparrow^ (but probably around throughout summer)
Savannah Sparrow
Fox Sparrow^
Song Sparrow*
Lincoln's Sparrow^
Swamp Sparrow^
White-throated Sparrow#
White-crowned Sparrow^
Dark-eyed Junco#
Scarlet Tanager^
Northern Cardinal+*
Rose-breasted Grosbeak^
Indigo Bunting*
Red-winged Blackbird*
Rusty Blackbird
Common Grackle*
Brown-headed Cowbird*
Orchard Oriole

Baltimore Oriole*
House Finch+*
Purple Finch# (irruptive)
Common Redpoll# (irruptive)
Pine Siskin# (irruptive)
American Goldfinch+*
Evening Grosbeak
House Sparrow+*

OTHER TAXA:
duck sp.
Greater/Lesser Scaup
hawk sp.
gull sp.
woodpecker sp.
Downy/Hairy Woodpecker
Empidonax sp.
swallow sp.
Catharus sp.
warbler sp.
sparrow sp.
blackbird sp.

ATTACHMENT 15:

US FISH & WILDLIFE TRUST RESOURCE LIST

U.S. Fish and Wildlife Service

Trust Resources List

This resource list is to be used for planning purposes only — it is not an official species list.

Endangered Species Act species list information for your project is available online and listed below for the following FWS Field Offices:

Green Bay Ecological Services Field Office
2661 SCOTT TOWER DRIVE
NEW FRANKEN, WI 54229
(920) 866-1717

Project Name:

Estabrook Dam

U.S. Fish and Wildlife Service

Trust Resources List

Project Location Map:

Project Counties:

Milwaukee, WI

Geographic coordinates (Open Geospatial Consortium Well-Known Text, NAD83):

MULTIPOLYGON (((-87.911927 43.1026634, -87.9111545 43.1020128, -87.9104681 43.1012138, -87.9107364 43.1005793, -87.9125066 43.1006972, -87.9137458 43.1024663, -87.9122331 43.102722, -87.911927 43.1026634)))

Project Type:

Dam

U.S. Fish and Wildlife Service

Trust Resources List

Endangered Species Act Species List (USFWS Endangered Species Program).

There are a total of 1 threatened or endangered species on your species list. Species on this list should be considered in an effects analysis for your project and could include species that exist in another geographic area. For example, certain fishes may appear on the species list because a project could cause downstream effects on the species. Critical habitats listed under the **Has Critical Habitat** column may or may not lie within your project area. See the **Critical habitats within your project area** section below for critical habitat that lies within your project area. Please contact the designated FWS office if you have questions.

Species that should be considered in an effects analysis for your project:

Mammals	Status		Has Critical Habitat	Contact
northern long-eared Bat (*Myotis septentrionalis*) Population:	Proposed Endangered	species info		Green Bay Ecological Services Field Office

Critical habitats within your project area:

There are no critical habitats within your project area.

FWS National Wildlife Refuges (USFWS National Wildlife Refuges Program).

There are no refuges found within the vicinity of your project.

FWS Migratory Birds (USFWS Migratory Bird Program).

The protection of birds is regulated by the Migratory Bird Treaty Act (MBTA) and the Bald and Golden Eagle Protection Act (BGEPA). Any activity, intentional or unintentional, resulting in take of migratory birds, including eagles, is prohibited unless otherwise permitted by the U.S. Fish and Wildlife Service (50 C.F.R. Sec. 10.12 and 16 U.S.C. Sec. 668(a)). The MBTA has no provision for allowing take of migratory birds that may be unintentionally killed or injured by otherwise lawful activities. For more information regarding these Acts see http://www.fws.gov/migratorybirds/RegulationsandPolicies.html.

All project proponents are responsible for complying with the appropriate regulations protecting birds when planning and developing a project. To meet these conservation obligations, proponents should identify potential or existing project-related impacts to migratory birds and their habitat and develop and implement conservation measures that avoid, minimize, or compensate for these impacts. The Service's Birds of Conservation Concern (2008) report identifies species, subspecies, and populations of all migratory nongame birds that, without additional conservation actions, are likely to become listed under the Endangered Species Act as amended (16 U.S.C 1531 et seq.).

For information about Birds of Conservation Concern, go to http://www.fws.gov/migratorybirds/CurrentBirdIssues/Management/BCC.html.

Migratory birds of concern that may be affected by your project:

There are **14** birds on your Migratory birds of concern list. The Division of Migratory Bird Management is in the process of populating migratory bird data with an estimated completion date of August 1, 2014; therefore, the list below may not include all the migratory birds of concern in your project area at this time. While this information is being populated, please contact the Field Office for information about migratory birds in your project area.

Species Name	Bird of Conservation Concern (BCC)	Species Profile	Seasonal Occurrence in Project Area
American bittern (*Botaurus lentiginosus*)	Yes	species info	Breeding
Black tern (*Chlidonias niger*)	Yes	species info	Breeding
Black-billed Cuckoo (*Coccyzus erythropthalmus*)	Yes	species info	Breeding
Bobolink (*Dolichonyx oryzivorus*)	Yes	species info	Breeding
Brown Thrasher (*Toxostoma rufum*)	Yes	species info	Breeding
Canada Warbler (*Wilsonia canadensis*)	Yes	species info	Breeding
cerulean warbler (*Dendroica cerulea*)	Yes	species info	Breeding
Common tern (*Sterna hirundo*)	Yes	species info	Breeding
Golden-Winged Warbler (*Vermivora chrysoptera*)	Yes	species info	Breeding
Least Bittern (*Ixobrychus exilis*)	Yes	species info	Breeding
Marsh wren (*Cistothorus palustris*)	Yes	species info	Breeding
Rusty Blackbird (*Euphagus carolinus*)	Yes	species info	Wintering
Willow Flycatcher (*Empidonax traillii*)	Yes	species info	Breeding

Wood Thrush (*Hylocichla mustelina*)	Yes	species info	Breeding

NWI Wetlands (USFWS National Wetlands Inventory).

The U.S. Fish and Wildlife Service is the principal Federal agency that provides information on the extent and status of wetlands in the U.S., via the National Wetlands Inventory Program (NWI). In addition to impacts to wetlands within your immediate project area, wetlands outside of your project area may need to be considered in any evaluation of project impacts, due to the hydrologic nature of wetlands (for example, project activities may affect local hydrology within, and outside of, your immediate project area). It may be helpful to refer to the USFWS National Wetland Inventory website. The designated FWS office can also assist you. Impacts to wetlands and other aquatic habitats from your project may be subject to regulation under Section 404 of the Clean Water Act, or other State/Federal Statutes. Project Proponents should discuss the relationship of these requirements to their project with the Regulatory Program of the appropriate U.S. Army Corps of Engineers District.

Data Limitations, Exclusions and Precautions
The Service's objective of mapping wetlands and deepwater habitats is to produce reconnaissance level information on the location, type and size of these resources. The maps are prepared from the analysis of high altitude imagery. Wetlands are identified based on vegetation, visible hydrology and geography. A margin of error is inherent in the use of imagery; thus, detailed on-the-ground inspection of any particular site may result in revision of the wetland boundaries or classification established through image analysis.

The accuracy of image interpretation depends on the quality of the imagery, the experience of the image analysts, the amount and quality of the collateral data and the amount of ground truth verification work conducted. Metadata should be consulted to determine the date of the source imagery used and any mapping problems.

Wetlands or other mapped features may have changed since the date of the imagery and/or field work. There may be occasional differences in polygon boundaries or classifications between the information depicted on the map and the actual conditions on site.

Exclusions - Certain wetland habitats are excluded from the National mapping program because of the limitations of aerial imagery as the primary data source used to detect wetlands. These habitats include seagrasses or submerged aquatic vegetation that are found in the intertidal and subtidal zones of estuaries and nearshore coastal waters. Some deepwater reef communities (coral or tuberficid worm reefs) have also been excluded from the inventory. These habitats, because of their depth, go undetected by aerial imagery.

U.S. Fish and Wildlife Service

Trust Resources List

Precautions - Federal, state, and local regulatory agencies with jurisdiction over wetlands may define and describe wetlands in a different manner than that used in this inventory. There is no attempt, in either the design or products of this inventory, to define the limits of proprietary jurisdiction of any Federal, state, or local government or to establish the geographical scope of the regulatory programs of government agencies. Persons intending to engage in activities involving modifications within or adjacent to wetland areas should seek the advice of appropriate federal, state, or local agencies concerning specified agency regulatory programs and proprietary jurisdictions that may affect such activities.

The following wetland types intersect your project area in one or more locations:

Wetland Types	NWI Classification Code	Total Acres
Freshwater Forested/Shrub Wetland	PFO1/EMBg	0.5422
Freshwater Forested/Shrub Wetland	PFO1Bg	4.4097
Riverine	R2UBH	662.8964

ATTACHMENT 16:

WDNR TIME EXTENSION CORRESPONDENCE

MILWAUKEE COUNTY PARKS

CHRIS ABELE, MILWAUKEE COUNTY EXECUTIVE
JOHN DARGLE, JR., DIRECTOR OF PARKS, RECREATION AND CULTURE

December 23, 2014

Ms. Tanya Lourigan, PE
Water Management Engineer
Wisconsin Department of Natural Resources
3911 Fish Hatchery Road
Fitchburg, WI 53711

Subject: Time Extension for Actions related to Field File 40.08, Estabrook Dam, Milwaukee County, Wisconsin

Dear Ms. Lourigan:

Milwaukee County hereby requests a time extension for actions related to Estabrook Dam. The County has been actively evaluating alternatives to Estabrook Dam including removal and repair. The following information is provided to update the Wisconsin Department of Natural Resources (WDNR) on the timeline history and proposed activities for the project.

On July 28, 2009, the WDNR sent Milwaukee County an Administrative Order to Repair or Abandon Estabrook Dam (Order). The Order was required to protect public health and safety and to ensure the dam meets acceptable design standards.

In a letter dated October 9, 2012, the County requested and received an extension for dam repair until December 31, 2014. The extension was requested to allow dam repairs to be constructed concurrent with the upstream sediment clean-up project (Lincoln Park Phase II).

At the direction of the Bureau of Land Management (BLM), Milwaukee County started an Environmental Assessment for Estabrook Dam in the Fall of 2013 to evaluate alternatives. During 2014, the County hosted two public meetings and presented a number of updates to the Milwaukee County Parks, Energy, and Environment Committee. The technical findings and public input favored removal of the dam based on environmental and financial factors. Subsequently, the Milwaukee County Board endorsed removal of Estabrook Dam during the development of the 2015 County Budget without funding.

Meanwhile, a lawsuit has been filed against Milwaukee County for delays in taking action to remove or repair Estabrook Dam. On December 5, 2014, Judge Foley determined that he would decide the outcome (repair or removal) of Estabrook Dam during a trial scheduled the week of July 20, 2015.

Milwaukee County hereby requests a time extension to December 31, 2016 to abandon or repair Estabrook Dam. If you have any questions regarding these matters, please contact Jim Keegan, Chief of Planning & Development, at 414-257-7726.

Sincerely,

John Dargle, Jr
Director

Copy: County Executive Chris Abele
Marina Dimitrijevic, Chairwoman, County Board of Supervisors
Sup. Gerry Broderick, Chair, Parks, Energy & Environment Committee
Sup. Theo Lipscomb, Sr., County Supervisor, District 1
James Keegan, Chief of Planning & Development
Meg Galloway, WDNR Madison
Paul Bargren, Corporation Counsel

State of Wisconsin
DEPARTMENT OF NATURAL RESOURCES
3911 Fish Hatchery Road
Fitchburg WI 53711-5397

Scott Walker, Governor
Cathy Stepp, Secretary
Telephone 608-266-2621
Toll Free 1-888-936-7463
TTY Access via relay - 711

IP-SE-2009-41-06757

January 12, 2015

John Dargle, Jr., Director
Milwaukee County Parks, Recreation and Culture
9480 Watertown Plank Road
Wauwatosa, WI 53226-3560

Subject: Time Extension for Estabrook Dam (Field File 40.08, Milwaukee County)

Dear Mr. Dargle:

Thank you for your December 23, 2014 letter which provides an update on Milwaukee County's actions related to Estabrook Dam and requests a time extension to the Administrative Order to Repair or Abandon the Estabrook Dam (Order). The Department of Natural Resources (Department) is extending the deadline in the Order with several conditions described below.

Timeline History

On July 28, 2009, the Department issued the Order which was required to protect public health and safety and to ensure the dam meets acceptable design standards. The County adopted a capital budget project in 2010 for structural repairs. If the County chose to repair the dam, the repairs were to be completed by July 27, 2012. To account for the typical construction season, the Department extended the timeline to October 31, 2012. The Department then extended the timeline to December 31, 2014 to coordinate repairs with the Lincoln Park Phase II Sediment Remediation Project.

Your letter states that Milwaukee County has made progress on actions related to the dam and is now endorsing removal. However, you are requesting the Department extend the timeline to December 31, 2016 due to the uncertainty of an open lawsuit.

Extension and Conditions

The Department is extending the deadline for repair or removal to accommodate the Milwaukee River sediment remediation schedule, open lawsuit, limited construction seasons, and Milwaukee County's efforts to secure grants. By December 31, 2016, the County shall complete the following:

- Submission of final plans, specifications, and a copy of the draft Environmental Analysis for either repair or removal. Documentation of access easements also needs to be included.
- If removal is selected, you will also need to submit an application for a permit to abandon the dam pursuant to Section 31.185, Wis. Stats. Milwaukee County shall remain responsible for the dam until a permit to abandon the dam is issued and all conditions of that permit have been met.
- Selection of competent contractor(s) to complete the repair or removal project.
- Structural repairs and removal of debris and co-mingled sediment or removal of the Estabrook Dam.

Please note that other requirements in the Administrative Order still apply. The County shall maintain the current drawn down condition of the impoundment by keeping all gates fully open and secured in place. The dam shall remain drawn down until all conditions within the Order are in compliance. The Department will need to provide written authorization that requirements of the Order are complete.

In addition, the County shall continue to inspect the dam to ensure that no additional materials are placed in the structure that would obstruct flow, and shall promptly remove any such obstructions. Obstructions could include debris trapped on the ice breakers or unauthorized activities to re-impound water.

Grants

Estabrook Dam is included on the priority ranking list of eligible applicants for Wisconsin's 2011 Municipal Dam Grant Program. The County's application was originally for a repair project. If the County has decided that their grant application type will now be a removal project, you will need to request a variance as considered by Wis. Admin. Code, Chapter NR 335.15. Please include a brief description of good cause and/or special circumstances that make such a variance in the best interest of the dam grant program. The documentation for dam abandonment and removal as listed in Wis. Admin. Code, Chapter NR 335.07(2)(f) will also need to be submitted.

You sent a written request on December 23, 2014, asking that costs associated with the Milwaukee River Phase II Sediment Remediation Project be considered a grant eligible expense. The Department is still reviewing your request. You will also need to request a variance from Wis. Admin. Code, Chapter NR 335.08(2)(c) which states that construction costs incurred prior to the grant award are ineligible.

The Estabrook Dam project is also eligible for funding transferred from the Stewardship Fund for dam maintenance, repair, modification or removal.

Kari Beetham, Grant Manager can be contacted at (608) 264-9207 or kari.beetham@wisconsin.gov. If you have any other questions, please contact me at (608) 275-3287 or Tanya.Lourigan@wisconsin.gov.

Sincerely,

Tanya L Lourigan

Tanya L. Lourigan, P.E.
Water Management Engineer
Fitchburg Service Center

cc: Don Pirrung, P.E., Senior Engineer – AECOM (email)
Anthony Jernigan – Army Corps of Engineers (email)
Michael Hahn, P.E., Deputy Director – Southeastern Wisconsin Regional Planning Commission (email)
Bill Sturtevant, P.E., State Dam Safety Engineer – DNR GEF II, WT/3 (email)

ATTACHMENT 17:

DAM PHOTOGRAPHS

Estabrook Dam Aerial View, with Features

Ice Breakers

Gated Spillway Section

Island

Upstream Pool

Overflow Spillway Section


3. 28. 2005

Dam Structure Inspection

AECOM

Dam Structure Inspection

78-Year Old Dam

Repair stairs at both ends of gated spillway

Photo 7/8/10

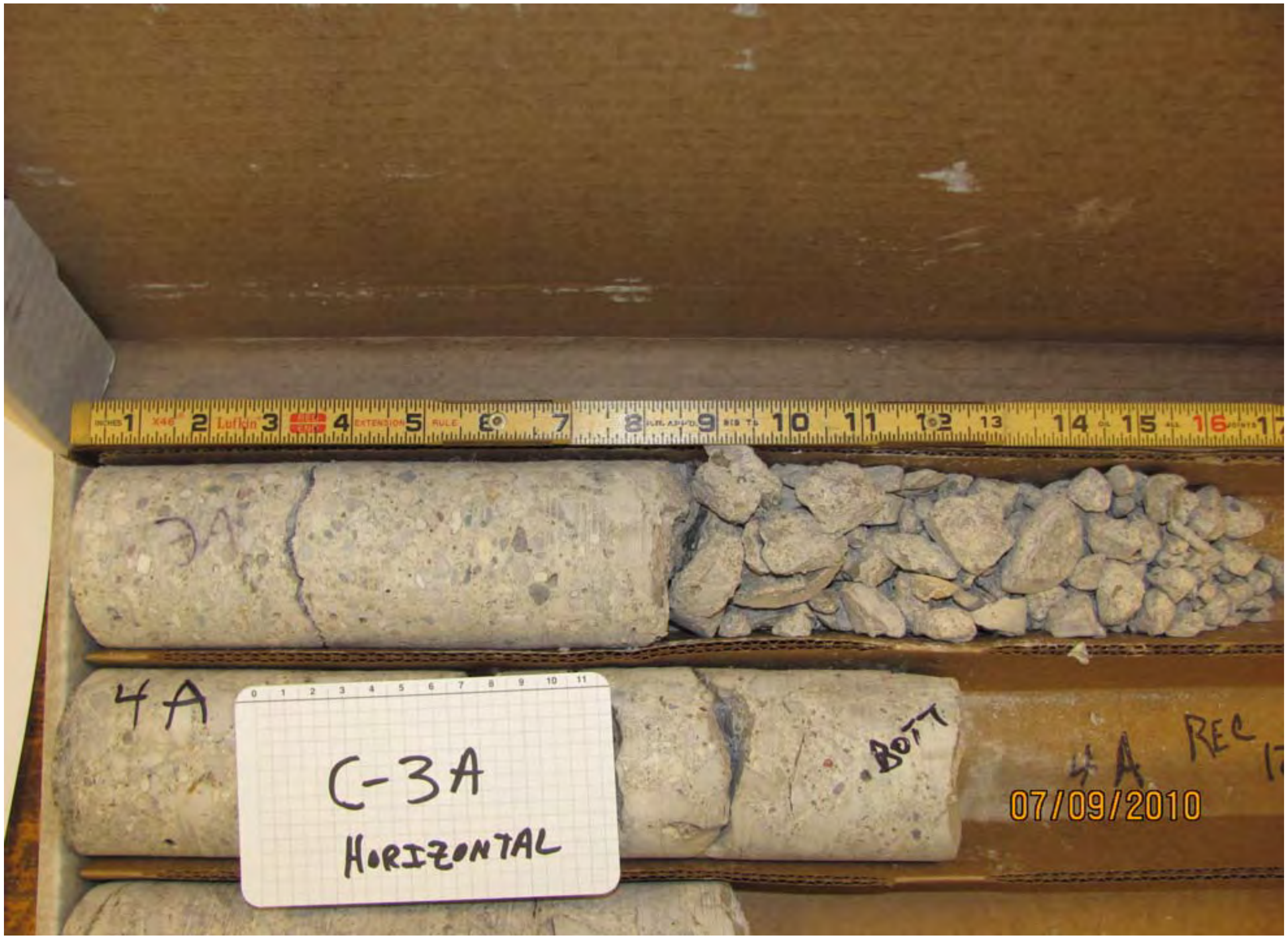
Repair deterioration below water line at gate piers

Photo 8/8/10

AECOM

Concrete Core

Concrete Core of Pier



AECOM

Dam Structure Inspection

Wall of the south abutment stairs with severe cracking

AECOM

Dam Structure Inspection

Upstream side of Pier 1 (left), Pier 2 (center), and Pier 3 (right) in 2010

AECOM

Dam Structure Inspection

View of the upstream face of Pier 2 in 2015 with spalling of the concrete at the tip of the pier. Refer to photo on page 8 for comparison to 2010 observed condition.

Dam Structure Inspection

- Fixed crest spillway, spalling concrete and shotcrete.

AECOM

ATTACHMENT 18:

STATE HISTORICAL PRESERVATION OFFICER CORRESPONDENCE

Pirrung, Don

From: Jernigan, Anthony D MVP <Anthony.D.Jernigan@usace.army.mil>
Sent: Friday, February 08, 2013 7:34 AM
To: Pirrung, Don
Subject: SHPO document for Estabrook (UNCLASSIFIED)
Attachments: SHPO signed.pdf

Classification: UNCLASSIFIED
Caveats: NONE

Don,

Attached is the document you requested. Please note that this determination is for the project as described in the original application. If changes are made to the design (e.g. fish passage, removal), will likely need to go through this process again. Let me know if you have any questions.

Anthony

Anthony Jernigan, CHMM, PG
Physical Scientist/ Project Manager
US Army Corps of Engineers
St. Paul District
Regulatory Branch
20711 Watertown Rd., Suite F
Waukesha, WI 53186
Phone: 262-717-9544
Fax: 262-717-9549

Classification: UNCLASSIFIED
Caveats: NONE

RECEIVED

HP-05-07 (8/15/03)

For SHPO Use Only. Case # 12-0990/MI

REQUEST FOR SHPO COMMENT AND CONSULTATION ON A FEDERAL UNDERTAKING

Submit one copy with each undertaking for which our comment is requested. Please print or type. Return to:

Wisconsin Historical Society, Division of Historic Preservation, Office of Preservation Planning, 816 State Street, Madison, WI 53706

RECEIVED
OCT 31 2012
DIV HIST PRES

Please Check All Boxes and Include All of the Following Information, as Applicable:

I. GENERAL INFORMATION

☒ **This is a new submittal.**
☒ **This is supplemental information relating to Case #:__________ and title:__________**
☐ **This project is being undertaken pursuant to the terms and conditions of a programmatic or other interagency agreement. The title of the agreement is __________**

a. Federal Agency Jurisdiction (Agency providing funds, assistance, license, permit): US Army Corps of Engineers

b. Federal Agency Contact Person: Anthony Jernigan Phone: 262-717-9544

c. Project Contact Person: Donald Pirrung Phone: 920-451-2822

d. Return Address: 20711 Watertown Road., Suite F, Waukesha, WI Zip Code: 53186

e. Email Address: anthony.d.jernigan@usace.army.mil

f. Project Name: Estabrook Dam

g. Project Street Address: see attached map

h. County: Milwaukee City: Milwaukee Zip Code: 53208

i. Project Location: Township 7 N, Range 22 E, E/W (circle one), Section 16, Quarter Sections ______

j. Project Narrative Description—Attach Information as Necessary.

k. Area of Potential Effect (APE). Attach Copy of U.S.G.S. 7.5 Minute Topographic Quadrangle Showing APE.

II. IDENTIFICATION OF HISTORIC PROPERTIES

NOV 21 2012

☑ Historic Properties are located within the project APE per 36 CFR 800.4. Attach supporting materials.
☐ Historic Properties are not located within the project APE per 36 CFR 800.4. Attach supporting materials.

III. FINDINGS

☐ No historic properties will be affected (i.e., none is present or there are historic properties present but the project will have no effect upon them). Attach necessary documentation, as described at 36 CFR 800.11.
☑ The proposed undertaking will have no adverse effect on one or more historic properties located within the project APE under 36 CFR 800.5. Attach necessary documentation, as described at 36 CFR 800.11.
☐ The proposed undertaking will result in an adverse effect to one or more historic properties and the applicant, or other federally authorized representative, will consult with the SHPO and other consulting parties to resolve the adverse effect per 36 CFR 800.6. Attach necessary documentation, as described at 36 CFR 800.11, with a proposed plan to resolve adverse effect(s).

Authorized Signature: Bradley Johnson for Date: 10/26/2012

Type or print name: Todd Vesperman

IV. STATE HISTORIC PRESERVATION OFFICE COMMENTS

☒ Agree with the finding in section III above.
☐ Object to the finding for reasons indicated in attached letter.
☐ Cannot review until information is sent as follows: __________

Authorized Signature: Sherm Berg Date: 11-14-12

AECOM

Memorandum

To	File	Page	1
CC			
Subject	State Historical Society Historic Preservation Officer Estabrook Dam Project		
From	Don Pirrung		
Date	August 13, 2015	Project No.	60181463

On February 13, 2015, Leslie Eisenburg, State Historic Preservation Officer, phone 608.264.6507, email leslie.eisenberg@Wisconsinhistory.org, called me regarding the Estabrook Dam project status. I indicated that I attempted multiple times to contact Sherman Banker in 2014 to obtain a response to my April 14, 2014, letter to him about the project. He did not reply. She indicated that Mr. Banker is no longer with the organization. Leslie is the new officer. She said the County should contact her office when a final decision is made on the selected alternative.

We discussed the alternatives in general terms. A Historic American Engineering Record (HAER) study of Estabrook Dam may be needed if the selected alternative significantly changes the dam.

AECOM

AECOM
4135 Technology Parkway
Sheboygan, Wisconsin 53083
www.aecom.com

920 458 8711 tel
920 458 0537 fax

April 14, 2014

Mr. Sherman Banker
State Historic Preservation Officer
Wisconsin Historical Society
816 State Street
Suite 300
Madison, WI 53706

Subject: **Estabrook Dam**
City of Milwaukee and City of Glendale
Milwaukee County, Wisconsin

Dear Mr. Banker:

AECOM is conducting an Environmental Analysis of the potential impacts created by the removal, rehabilitation, or replacement of the Estabrook Dam on the Milwaukee River, in Milwaukee County (located in the north ½ of the northeast ¼ of Section 5, Township 7 North, Range 22 East). The dam was constructed, in the 1930's, with adjustable gates to control water flow. Figure 1 shows an aerial view of the dam. The gates could be opened to reduce the risk of flooding during storm events and closed during low water to provide an impoundment above the dam for recreational use. The dam has deteriorated, structurally, creating public safety issues. Milwaukee County owns and operates the Estabrook Dam and is considering alternatives for the project in order to comply with an Administrative Order to repair or abandon Estabrook Dam by December 31, 2014. As part of the Environmental Assessment process, AECOM is requesting your input, from a historic perspective, on the alternatives being considered for the project.

- Alternative 1 – Rehabilitate the existing dam; repairing structural issues and ensuring public safety.
- Alternative 2 – Abandonment (removal) of the dam. This alternative comprises complete removal of the existing structure and allowing the river to return to a free-flowing stream.
- Alternative 3 – Replace the existing dam with a new structure that would operate in a fashion similar to the existing dam.
- Alternative 4 – Removal of the dam with the inclusion of a 4-foot or 5.5-foot rock ramp to maintain some amount of impoundment upstream.

As seen above, all but the first alternative require the removal of the existing dam. AECOM would like to request input from the Wisconsin Historical Society/State Historic Preservation Office as to the historical significance of the Estabrook Dam and the impacts of its potential removal. Please respond with any comments and advise whether any further correspondence with SHPO will be required for this project. If you have any questions, please contact Don Pirrung at 920-458-8711 or DON.PIRRUNG@aecom.com.

Sincerely,

AECOM Technical Services, Inc.

Donald F. Pirrung

Donald F. Pirrung, PE
Senior Engineer

Enclosure: Figure 1

c: Karl Stave, Milwaukee County
James Keegan, Milwaukee County
Kevin Haley, Milwaukee County
Joe Jolie, Himalayan Consultants
Jerry Krueger, AECOM

AECOM

LOCATION MAP

ESTABROOK DAM
MILWAUKEE COUNTY, WISCONSIN

DRN	PROJECT NO.	DATE	
CFF	60135722	4/15/2014	FIGURE 1

4/11/2014
2:48:12 PM

C:\Projects\Estabrook Dam\Figure 1.dgn

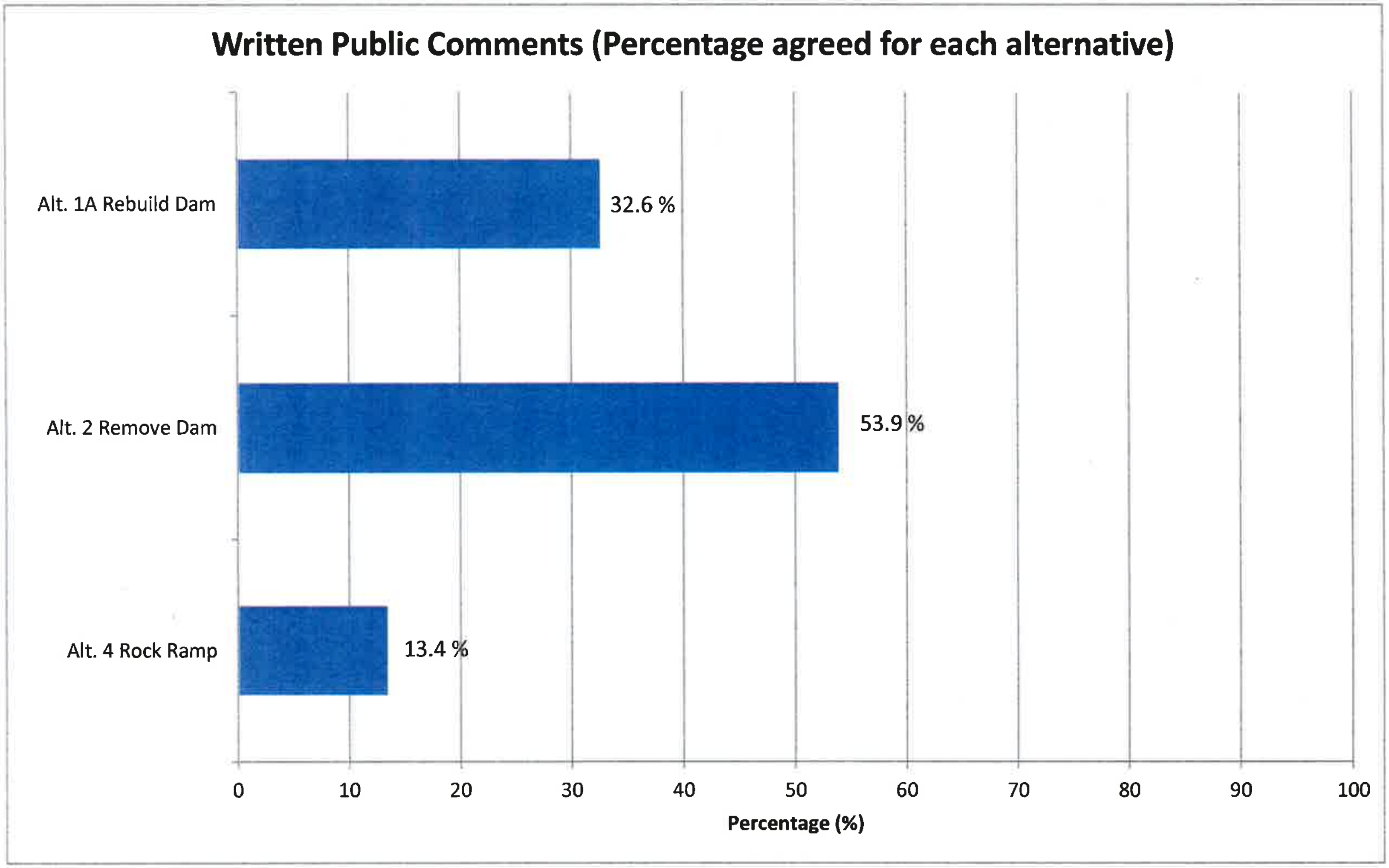
ATTACHMENT 19:

PUBLIC INPUT

ATTACHMENT 19
PUBLIC INPUT

Prepared by Don Pirrung, AECOM

Representative public input is provided. Additional public input was received through letters, emails, and the County's website questionnaire.



85 Responses

June 5, 2014

Estabrook Dam Public Scoping Meeting
Sign-In Sheet

	Name	Home or/ email address	Representing
1	Don Pirrung	don.pirrung@aecom.com	AECOM
2	JOHN RENNPFERD	—	—
3	Karen Schapiro	karenschapiro@gmail.com	counsel for Milwaukee Riverkeeper
4	Dan Lewis	daniel_the_great@live.com	resident
5	Al Godshaw	algod@EARTHlink.net	resident
6	John Hacker	John@JohnHacker.com	resident
7	Carol Grundman	cgrundma@blm.gov	BLM
8	RANDALL ANDERSON	r35ander@blm.gov	BLM
9	Stewart Cogswell	stewart_cogswell@fws.gov	FWS
10	Don & Clark Blackley	clmgirl@yahoo	Resident
11	BOB ORVIS		Resident
12	MATT AHO	maho@co.ozaukee.wi.us	OZAUKEE COUNTY
13	MIKE HAHN	mhahn@sewrpc.org	SEWRPC
14	Josh Murray	jmurray@sewrpc.org	SEWRPC
15	Gloria McCutcheon		Self
16	Rich Weber	rhweber395@yahoo.com	—
17	Beverly Mioskowski	bmioski@mac.com	Resident
18	Sonya Baime	artbysonya@wi.rr.com	Resident
19	Rick Frye		"
20	Gail Epping Overholt	gail.overholt@ces.uwex.edu	UWEX
21	Tom Slawski	tslawski@sewrpc.org	SEWRPC
22	Steve Adams	sadams@sewrpc.org	SEWRPC
23	Jennifer Bolger	jennifer@milwaukeeriverkeeper.org	Milwaukee Riverkeeper

6-5-14

(2)

	Name	Home OR email Address	Representing
24	Demaris Kenwood	pandimai@yahoo.com	Milwaukee Riverkeeper
25	Glen Goebel	ggoebel1@wi.rr.com	self
26	Patrick Doornat	pdoorna sbcglobal.net	Self
27	John Mulher	berjohm@milwpc.com	self
28	MIKE KUHR	MIKEK.TROUT@YAHOO.com	TROUT UNLIMITED
29	Melanie Jeff Goulee	jgoulee1@wi.rr.com	Self MRPA
30	DAVE DORNER	DDORNER@AOL.Com	RIPARIAN OWNER
31	DAN BUSS	Danfbuss@gmail.com	CDM
32	Harold Schmidt	SCHMIDHO@yahoo.com	FOE
33	Jay Blaeske	jblaeske@sbcglobal.net	
34	Phyllis Santacroce	phyllis.santacroce@gmail.com	
35	Mike Nuskiewicz	nuskalunge@hotmail.com muskalunge@yahoo	self
36	WILLIE JOHNSON JR	WILLIE.JOHNSON@MILWAUKEECOUNTYWI.GOV	Milw. Co. Supervisor
37	JANICE STARAL	janice.STARAL@cuw.edu	
38	Joe Shaffer (terri)	joeshaffer@wi.rr.com	self
39	Beth Stapleton Robert Thompson	RRTBMS @Gmail.com	ourselves.
40	Richard Bensman	rbensm@sbcglobal.net	"
41	LARRY WIRCH	Big Bend Wi 53103	
42	Joy Apple	6245 N. Sunny Point Rd Milwaukee 53217	Riparian
43	Richard Bub[illegible]	600 W. [illegible] Rd 53217	
44	Kim Kosmitis	Riverwestoutdoors@gmail.com	ROE
45	Sean Nerley	Samerley@gmail.com	SEWTU
46	Jesse Jensen	jesse.jensen@wi.gov	DNR
47	Brian Kreuziger	tabla-brain@Att.net	Liberty
48	Lori Spielman	lspielman@usa.net	self

6-5-14

3

	Name	Home OR/ email Address	Representing
49	Diane Steigerwald	diane@thomerwald.net	self
50	PAUL SENDAY	SENDAY@SBCGLOBAL.NET	SELF
51	Don Hoehler	GOLDUST82PLUS@GMAIL.COM	SELF
52	Tom Ramstack		Self
53	Aaron Lynch	aachly77@gmail	self
54	Steve Keith		"
55	Theo Lipscomb		Milw. Co D#1
56	Chris Davit		self
57	DOROTHY KRAL	5373 W. [illegible] Glendale	SELF
58	BRADFORD KRAL	bkral2@msn.com	OCCUPANT & OWNER OF 910 W IEULA CT
59	DAN NEUMAN	414 364 1113 JOHN@METROPROPERTY.NET	SELF
60	Herb Oechler		SEWTL
61	Ken Walz		Self
62	Will Govin	william.govin@gmail.com	Self
63	Elsa Krapf	none	Myself
64	Ryan Wendel	rwendel35@gmail.com	self
65	STEVE GUSHO	sgusho@hotmail.com	SELF
66	TODD SCHROCCKENTHALER	KEYSTROKE@W..RR.COM	
67	Diane Wais	dwais03@sbcglobal.net	self
68	Tom Chapman	~~Tel~~ tomchapman3@gmail.com	Self
69	Ruth Vanodo	22 CPCC, Inc LPCC130@peoplepc.com	Self
70	Clayton C. Crain	claytoncrain@gmail.com	self
71	Jim LaRose	larosejc@yahoo.com	Self
72	TANYA O'BRIEN	tanyaobrien@live.com	Self
73	Jeanne Godfrey	JeanneGodfrey@ATT.NET	"
74	TOM SIEHR	TOM.SIEHR@GLOBALRIBER.COM	

6-5-14

	Name	Home or/ email Address	Representing
74			
75	Tammy Blaeske	tblaeske@sbcglobal.net	the community
76			
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ESTABROOK DAM PUBLIC INFORMATION MEETING
SEPTEMBER 3, 2014

Name	Address or email	Representing
Evan Emmons	eemmons414@aol.com 1011 W Montclaire Ave Glendale 53217	Former State Chair of Sierra Club Property owner
CHRIS von BRIESEN	PADDLER890@GMAIL.COM	PADDLE SPORTS
Frank Mayer	5758 N. River Forest	Property owner
Larry Kopperud	lekopperud@gmail.com	Self
SIEGFRIED HAUSMANN	6469 N. SUNNY PT. LN.	SELF
RICHARD BUBLITZ	500 W. BENDER RD #83	SELF
TOM CINTERALIS	830 W. LASALLE	SELF
Burnell CRAIN	6379 N. Sunny Point rd.	Self
Tamara Blaeske	5714 N. River Forest	MRPA/Self
TOM SLAWSKI	SOUTHEASTERN WI Regional PLAN COMMISSION	SEWRPC
Julianne Koch	6400 N. Bittersweet Ln Glendale	
Barbara Frank	10432 N. Hidden Reserve Circle Mequon 53092	self
Vicky & Fa Ross	6265 N Sunny Point Glendale	MRPA/Self
Dwight Morgan	1963 N. Riverwalk Way Milwaukee, WI	SELF
Connie Kruer	1437 W. Lawn Ave Milw WI 53209	SELF
Will Govin	1900 Gebhardt Rd Brookfield WI 53045	Self
Joanne Lipo Zovic	2504 E. Newton Ave. Shorewood, WI 53211	self
Derek Strohl	dstrohl@blm.gov	BLM
Joe Solakian	3403 S. 11 Milwaukee WI 53215	self
Lilith Fowler	2961 N. Marietta Ave Milwaukee WI 53211	self
Tim Wolterstorff	6597 N. Sunny Point LA.	Self

ESTABROOK DAM PUBLIC INFORMATION MEETING
SEPTEMBER 3, 2014

Name	Address or email	Representing
Barbara Maglio	barb.maglio@gmail.com	myself
JOHN [illegible]	JOHN_[illegible]	—
Robert Thompson	1701 W. LAWN AVE.	myself
Beth Stapleton	1701 W. Lawn Ave	myself.
Jack McHugh	5747 W. Amos	MO
Dorothy Kral	5373 N. Edgewater Ln	Myself
MaryLynn Linealis	830 W. La Salle ave	me
Jim LaRose	5830 N Regent Rd	Myself
James Raskob	JRaskob123@aol.com	myself
Angelyn Dries	6400 N. BITTERSWEET LN	MYSELF
[illegible]	8220 [illegible] Ct #138	SEWTU
Tom Gehl	630 W Rock	Res
Alex Colon	MCSO TEU	MCSO TEU
Travis Thompson		
[illegible]	1503 W. LAWN AVE	
Susan Kreuziger	706 W Rock PL Glendale WI	Self
PAUL ZOVIC	2504 E NEWTON SHOREWOOD	SELF
Diane Wais	6110 N. Sunny Point Rd Glendale 53209	self
Kimberly Gleffe	624 W Montclaire ave. Glendale WI 53217	self
Sally Callan	5417 N. Green Bay milw 53209	self

ESTABROOK DAM PUBLIC INFORMATION MEETING
SEPTEMBER 3, 2014

Name	Address or email	Representing
Sam Emmons	1011 W Montclaire Ave. Glendale emmonssamuel@gmail.com	River property owner
John Dargle		Parks
Danis Kelly	5650 N. River Forest Dr. Glendale WI 53209	River
Jon Apple	6245 N. Sunny Point RD Glendale, WI 53217	Riparian
Steven Bussian	7870½ Big Bend Blvd. St Louis 63119	MRPA
FRED LUENEBURG	701 W. MONTCLAIRE AVE GLENDALE, WI 53217	SELF
TANYA O'BRIEN	tanyaobrien@live.com	self
VANCE MAJCI	4054 N. Larkin St SHOREWOOD	self.
Mary Levit	10702 N. [illegible] Mequon	self
Jose Rivers	MHD	MHD
Joe Roth	1123A E Burleigh Milwaukee, WI 53212	Self
Jeff Rumage	jrumage@jrn.com	NOW Newspaper
Brian Koll	briankoll@hotmail.com	Fish
AVNER PORAT	818 W. BENDER RD. GLENDALE 53217	
Don Lewis	850 W. Silver Spring Dr	Self
Kevin Shafer	7721 N. Links Way Fox Point	Self
Chris Liegel	2501 E. Menlo Blvd. Shorewood	Self
Susan Bence	WUWM	Milwaukee Public Radio
Patrick Schuller	5417 N. GREEN BAY AVE	
David Snell	9000 N. White Oak Lane	Self.
Donna Mrugala	3630 N. 51ST BLVD. Milw WI 53216	Self
Lee Bergquist	[illegible]	Milwaukee Journal

ESTABROOK DAM PUBLIC INFORMATION MEETING
SEPTEMBER 3, 2014

Name	Address or email	Representing
Steven C. Davis	corkyloki@yahoo.com	Self
DC Palmer	dcpalmer_53217@yahoo.com	Self
Peter Horgan	peterhorgan@WI.RR.COM	MRPA
Del Clear	dkclear@ATT.NET	Self 1129 W Montclaire
Collin Johnson	c.johnson@glendale-wi.org	City of Glendale
Nathan Zoch	Nathan.Zoch@wi.gov	WDNR
JOHN T MULCAHY	JTMULCAHY@SHOREWEST.COM	REALTORS
Jay Blaeske	8714 N Riverfront Dr	MRPA
MIKE KUHR	MIKEK-TROUT@YAHOO.COM	WI TROUT UNLIMITED
Sister Linda Tan OSF	ltan@lakeosfs.org	SELF
Thomas J Hickey	nightjar10@att.net	SWAN
Betsy Vokac & John Blanchard	betsyandjohn@wi.rr.com	selves
Clayton C Crain	claytoncrain@gmail.com	Self
Paul Sendry	SENDRY@SBCGLOBAL.NET	SELF
Aaron Zeleske	azeleske@riverrevitalizationfoundation.org	River Revitalization Foundation
JIM CIHA	JRJIMCIHA AT GMAIL.ORG	SELF
MUSTAFA EMIR	1734 W. Edward Ln. Glendale WI 53209	—
Jennifer Bolger	2507 E. Beverly Shorewood	Milwaukee Riverkeeper
Ellen Redeker	6601 N. Alberta Ct.	Self
Joshua Pollack	joshpo@gmail.com	Self
Christina Taddy	1814 N 5th St. MKE WI 53212	Milwaukee Riverkeeper
BOB BOUCHER	9070 N RANGE LINE RD RIVER HILLS WI	SELF

ESTABROOK DAM PUBLIC INFORMATION MEETING
SEPTEMBER 3, 2014

Name	Address or email	Representing
Glen Goebel	ggoebel1@wi.rr.com	Self
Phyllis Santacroce	phyllis.santacroce@gmail.com	self
Paula & Gerald Johnson	itsjerryandpaula@gmail.com	Selves
Cheryl Nenn	cheryl_nenn@milwaukeeriverkeeper.org	
Rick Frye	frye2fish@gmail.com	Trout Unlimited
Vivian Corres	chichigris@yahoo.fr	SWAN
Tom Ackes	ackers_5@msn.com	self
Abby Mertz	mertzabby@gmail.com	Trout Unlimited
Theo Lipscomb	theodore.lipscomb@gmail.com	SELF & 1st Dist.
Eric Reep		self - property owner
John G. Mulhern	725 W Fairfield Ct Glendale, Wis	Self
Kevin Duvalle	701 W. Montclaire Ave Glendale WI	self
Daniel Sweeney	6521 N. Sunny Point Ln Glendale WI 53217	self/City of Glendale
Chris Dawd	chris.dawd@gmail.com	Self
Judy Darner	849 W. Montclaire Ave Glendale	Self
Todd Schroedkenthaler	720 W. Rock	Self

ESTABROOK DAM PUBLIC INFORMATION MEETING
SEPTEMBER 3, 2014

Name	Address or email	Representing
[illegible]	[illegible]@yahoo.com	Myself
[illegible]	[illegible] Glendale	"
Jerry Patzwald	jdpatzwald@gmail.com	Riverwest neighborhood
[illegible]	5575 N Shasta Dr Glendale	Self
Sarah Acker	sarahacker[illegible]@gmail.com	Self
Rayna Andrews	Courthouse	County Supv.
SCOTT KUESEL	6365 N. SUNNY POINT RD. 53217	
Melanie Goulee	5764 River Forest DR	Self / MRPA
Jeff Goulee	5764 River Forest	self / MRPA
[illegible]	6405 N Berkeley Blvd Fox Point	self / Milw Riverkeeper
Bruce Braun	1025 W Montclaire	self / Margo
Richard Bensman	rbensma@sbcglobal.net	self
Colleen [illegible]	5673 N River Forest Dr.	self
Andrew Pirrung	1908 E. Webster Pl. Upper Mil. WI 53211	AECOM / self
Jordan Kolata	jordan.kolata@milwaukeecountywi.gov	
Carol 7 Dale	1014 W River Park [illegible] 53209	

ESTABROOK DAM PUBLIC INFORMATION MEETING
SEPTEMBER 3, 2014

Name	Address or email	Representing
James Petri	5134 N. Woodburn whitefish Bay	myself
Dan Christiansen	1049 W. Montclaire Ave. Glendale Wi. 53217	The River
Karen Schapiro	6905 N. Berkeley Milw, Wi 53217	Milw. Riverkeeper
Don Pirrung	don.pirrung@aecom.com	AECOM
Annette Pirrung	pirrung@uwm.edu	Volunteer

ESTABROOK DAM PUBLIC INFORMATION MEETING
SEPTEMBER 3, 2014

Name	Address or email	Representing
DAUG DORNER	DDORNER@AOL.COM	MRPA
Chuck Pessehl	chuck@marchlandscaping.com	Marek Landscapi
Dan Glidden	DGlidden1@Gmail.com	

Pirrung, Don

From: Victoria Ross <victoria.ross@wi.rr.com>
Sent: Friday, September 26, 2014 12:05 PM
To: Pirrung, Don
Cc: 'Tammy Blaeske'; Glen Goebel; Gehl, Tom
Subject: RE: Real Estate Sales People Signing a Statement
Attachments: Realtor's Letter As Of 9 26 2014.pdf

Don –

Please use the updated attachments if you are able in your next EA Draft.

I have included the 2009 document again which is the same I provided before, with 39 Realtor signatures.

The second attachment is new version of the updated 2014 letter which now reflects a total of 59 Realtor signatures.

These two can be regarded as replacements of what I had sent to you on 9/23.

We will keep you in the loop if the list grows further.

Thanks,
Vicky Ross
414-510-2156

From: Victoria Ross [mailto:victoria.ross@wi.rr.com]
Sent: Tuesday, September 23, 2014 9:37 AM
To: 'Pirrung, Don'
Cc: 'Tammy Blaeske'
Subject: RE: Real Estate Sales People Signing a Statement

Thanks for reaching out, Don.
Attached is a letter from 2009 signed by 39 realtors at that time.
Also attached is a recent letter providing updated information on the situation signed by 38 realtors within the past month.

We expect to collect additional signatures in the coming days/weeks.
Is there a deadline you are working toward for another revision?
I will be glad to send you any additional materials we have gathered by that date.

Thanks again, Don.

Vicky
414-510-2156

From: Pirrung, Don [mailto:DON.PIRRUNG@aecom.com]
Sent: Tuesday, September 23, 2014 8:45 AM
To: Victoria Ross (victoria.ross@wi.rr.com); Vicky Ross (vickyross@wi.rr.com)
Subject: Real Estate Sales People Signing a Statement

Vicky, You had mentioned that MRPA had received a statement signed by 26 real estate sales people about real estate values as it relates to the impoundment. Can you provide me with the names and statement so that I can include it in the Environmental Assessment as part of the record? Thank you. .... Don Pirrung

Don Pirrung, PE
Senior Engineer
Environment
D 920.451.2822
don.pirrung@aecom.com

AECOM
4135 Technology Parkway
Sheboygan, WI 53083
T 920.458.8711 F 920.458.0550
www.aecom.com

Milwaukee County Executive, County Board Chairwoman & County Board Supervisors
901 N. 9th Street - Courthouse, Room 306
Milwaukee, WI 53233-1458

Dear Executive Abele, Chairwoman Dimitrijevic and County Supervisors;

We urge you to expedite repairs to the Estabrook Park Dam!

We are real estate professionals who are experienced and working in Milwaukee County and we are very concerned about the Estabrook Park Dam Repair decision made by the County Board of Supervisors in 2009 that has yet to be implemented. In our expert opinion, the dam and the resultant aesthetics and navigation contribute greatly to the property values of the homes located along the river as well as the entire surrounding neighborhoods. If the dam were removed or if it ceased normal operation, and the water level were drawn down, land values and assessments would be significantly reduced by 20%-40% depending on the property. This reduction in land values would result in lower tax revenue for the City, County and State.

Many of us also signed a similar letter in 2009 and since that time our concerns have proven to be valid. There have been 18 listing in the past two years that have NOT been able to be sold because of the prolonged unknown fear of dam removal. Several listings made multiple price reductions but still could not be sold. Homeowners paid a premium price for a view and use of the Milwaukee River. Removing the dam will rob them, Glendale and Milwaukee County of that value. The Milwaukee River Impoundment includes over 200 homes. These yards are all landscaped based on the historical high water level.

Please help save the Milwaukee River and this Inland Lake as we know it and preserve this unique recreational asset of our parks and communities for future generations to enjoy and cherish. Again, we urge you to Repair the Dam, without further delay. Thank you for your consideration.

Respectfully,

Signature	Company / Firm Name	Date
[illegible]	Coldwell Banker	9/9/2014
Paige Schmidt	Coldwell Banker	9/9/2014
[illegible]	Coldwell Banker	9/9/14
Chatera Johnson	Coldwell Banker	Sept 9, 14
Lorie Werthmeier	CBRB	9-9-2014
Larry Weiss	CBRB	9-9-2014
[illegible]	CBRB 71	9-9-2014
[illegible]	" "	9/9-2014
[illegible]	Coldwell Banker	9/9/2014
[illegible]	CBRB	9/9/14
Holly Swingy	CBRB	9/9/14

(over)

Sandra Kent	Coldwell Banker	9/9/2014
Barbara Hayden	Coldwell Banker	9/9/2014
Sarah Kozie[illegible]	Coldwell Banker	9/9/2014
[illegible]	Coldwell Banker	9/9/14
Lora M Bunster	Coldwell Banker	9/9/14
Bobbi Mchugan	Coldwell Banker	9/9/14
Judy Spotta	Coldwell Banker	9/9/14
Marlene Friedman	CB	9/9/14
Brett Timmerman	Cold Well Banker	9-9-14
Kimberly Scott	CB	9-9-14
Jean Read	CBRB	9-9-14
[illegible]	CBR-NS	9-9-14
[illegible]	CBR-NS	9-9-14
Nick Janasik	CBRB	9-9-14
[illegible]	CBRB	9/9/14

Milwaukee County Executive, County Board Chairwoman & County Board Supervisors
901 N. 9th Street - Courthouse, Room 306
Milwaukee, WI 53233-1458

Dear Executive Abele, Chairwoman Dimitrijevic and County Supervisors;

We urge you to expedite repairs to the Estabrook Park Dam!

We are real estate professionals who are experienced and working in Milwaukee County and we are very concerned about the Estabrook Park Dam Repair decision made by the County Board of Supervisors in 2009 that has yet to be implemented. In our expert opinion, the dam and the resultant aesthetics and navigation contribute greatly to the property values of the homes located along the river as well as the entire surrounding neighborhoods. If the dam were removed or if it ceased normal operation, and the water level were drawn down, land values and assessments would be significantly reduced by 20%-40% depending on the property. This reduction in land values would result in lower tax revenue for the City, County and State.

Many of us also signed a similar letter in 2009 and since that time our concerns have proven to be valid. There have been 18 listing in the past two years that have NOT been able to be sold because of the prolonged unknown fear of dam removal. Several listings made multiple price reductions but still could not be sold. Homeowners paid a premium price for a view and use of the Milwaukee River. Removing the dam will rob them, Glendale and Milwaukee County of that value. The Milwaukee River Impoundment includes over 200 homes. These yards are all landscaped based on the historical high water level.

Please help save the Milwaukee River and this Inland Lake as we know it and preserve this unique recreational asset of our parks and communities for future generations to enjoy and cherish. Again, we urge you to Repair the Dam, without further delay. Thank you for your consideration.

Respectfully,

Signature	Company / Firm Name	Date
Karen Catalano	SW Realtors	9-10-14
Caitlin Naegle	SW Realtors	9-10-14
[illegible]	SW Realtors	9-10-14
Theresa [illegible]	SW Realtors	9-10-2014
[illegible]	SW Realtors	9-10-2014
Sara [illegible]	Shorewest Realtors	9-11-2014
Chelsea [illegible]	Shorewest Realtors	9-11-14
[illegible]	Shorewest Realtors	9-12-14
[illegible]	Shorewest Realtors	9-12-14

Milwaukee County Executive, County Board Chairwoman & County Board Supervisors
901 N. 9th Street - Courthouse, Room 306
Milwaukee, WI 53233-1458

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Respectfully,

Signature	Company / Firm Name	Date
[illegible]	Shorewest Realtors	9-23-14
[illegible]	Shorewest Realtors	9-23-14
[illegible]	Shorewest Ilisse Beland	9-23-14
[illegible]	Shorewest	9/23/14
[illegible] Peter Burgelis	Wisconsin Mortgage Corp	9/23/14
[illegible] Leslie Latterell	Shorewest Realtors	9-23-14
[illegible]	Shorewest Realtors	9/23/14
[illegible]	Shorewest Realtors	9/23/14
[illegible]	Shorewest Realtors	9/23/14
[illegible]	SWR	9/23/14
Joyce Michaels [illegible]	SWR SWR	9/23/14 9/24/14

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Respectfully,

Signature	Company / Firm Name	Date
Anne Schwartz	SWR	9-23-14
Mary Sherrod	SWR	9/23/14
Barb Schneck	SWR	9/23/14
Nona Conley	SWR	9/23/14
Mary Kinei	SWR	9/23/14
Julie Reuter	SWR	9/23/14
[illegible]	OGIR	9/23/14
Clifford H. Baker	Shorewest Realtors	9/23/14
Kate Fitts	SWR	9/23/14
Patti Potter	SWR	9-23-14
[illegible]	Shorewest	9/23/14
[illegible]	SWR	9/23/14

Pirrung, Don

From: Steven Bussian <bussiansteve@att.net>
Sent: Wednesday, September 17, 2014 6:02 PM
To: Pirrung, Don
Subject: My investigation to determine true ownership of the Estabrook Dam Island

Don Pirrung,

I helped assist the MRPA (the group supporting fixing Estabrook Dam) the week following Labor Day, researching records and information for Tuesday's meeting with the Milwaukee County Supervisors.

One of the issues with the dam, is whether the island the dam is located on is actually owned by the BLM. The county has claimed during the debate that it is owned by the BLM and any issues involving the dam must be approved by the BLM. Many people involved with the MRPA has suspected this is not true, since the ownership with the BLM complicates the situation with Dam, they have questioned the county parks dept. and always been told that BLM can confirm ownership of the island. The BLM in Wisconsin manages islands in the state that are all part of the public domain, these islands are uncharted islands that were part of the original land surveys. The islands managed by the BLM in the state of Wisconsin have always been public land and never privately owned.

Many people including those in MRPA believe the Estabrook Dam island is a man-made island that was cut-out from the north embankment of the Milwaukee River during the construction of dam and was at one time privately owned by the Milwaukee Cement company and never was a natural island as the BLM claims. A few members had already used old aerial photography (provided by the county) before the dam was built and measured and over-layed and compared it with the current aerial photography of the dam and came to the conclusion that this was indeed the case, but needed real proof.

This is where I came to assist. I have a degree in Cartography from Wisconsin-Madison 83, and I have worked in mapping industry for 30 years including GIS and aerial photography. This is what I do for a living, collecting, analyzing , interpreting aerial imagery for GIS products. I currently work for GIS firm that contracts for the Federal government.

The MRPA was looking for legal proof, some kind of land record for the Milwaukee Cement company, that would prove the present disputed island was at the time before the construction of the dam, not a island but solid land and privately owned. Or put another way, the disputed island never existed in the Milwaukee River in its natural state before the dam was built.

I was going to make a search for land records at the Register of Deeds at the Milwaukee County courthouse, but first I needed a parcel number or Tax Id for the property. I downloaded ERSI ArcMap software on my friends computer (trial version) its $1500 /yr. , it's the software I use at my employer. I accessed the Milwaukee County GIS database (MCAMLIS) and zoomed and panned in a Milwaukee County map until I found the disputed island. I made a visual ID selection of those layers and a ID dialog box appeared giving me the all of the information I needed for register of deeds. I noticed also the two islands and the adjacent Estabrook Park all were part of the same land parcel with the same ID number.

This was the first confirmation, that the Milwaukee County Park system are the present owners of the land and not the BLM. The BLM also owns or manages islands in the Milwaukee River near the intersection of Brown Deer Road and Green Bay Avenue. I did the same thing, I panned , zoomed and made a selection of those islands. Those islands listed the owners as the National Audubon Society and had a unique parcel ID for those islands. That is consistent with a lot of public land managed by the BLM, if the two islands near Estabrook Park were indeed public land or under any trust or a stewardship, they would have a unique parcel ID, and would be a separate land parcel from the Estabrook Park / Milwaukee County parcel.

With the Tax ID / parcel ID in hand, I went to Register of Deeds. I also had a print–out of a screen shot of the 2 Estabrook islands. I explained to the county worker who worked at the records department, I was looking for any reference to any land ownership by any Federal agency and I showed him the screen shot of the 2 islands. The result was 4 deeds of sale (1900 – 1920) for Estabrook Park. One of the four deeds involved the sale of the Milwaukee Cement company to Milwaukee County.

This confirmed what was in Milwaukee County GIS system , the land that is now the Estabrook Dam island at one time was privately owned and not island, but part of the north bank of the Milwaukee River. The deed also contains a legal land survey / description indicating it was all solid land, not a island before construction of the dam.
(These deeds were submitted to the Milwaukee County Parks, Energy, Environmental meeting, Sept 9th by MRPA)

All of the rest of the evidence, proving the island was not a island using aerial photographs and maps and over-lays was done by MRPA. They did a great job, amateur cartographers did this with Google earth and down-loaded maps and charts.

I can confirm everything, this was all straight-forward Cartographic methods and simple air-photo analysis.

I grew up in Milwaukee County and love the Milwaukee County Park system. My family's first home was on the Northwest side of the county, we lived a couple blocks from Dineen Park where I learned to swim at the Dineen Park pool and fished for crabs at the lagoon, my brother and I would tie a piece of liver on string and try to pull up some crawfish into a net. Later my family moved to Tosa, where I swam at the big Hoyt Park pool and biked along the Menomonee Parkway. This past Labor Day weekend, I took my bike on the Oak Leaf Bike Trail, my favorite stretch of the trail is from Lincoln Park to downtown Milwaukee. I would like the see the return of the Lagoon at Lincoln Park as it once was , and for that reason I support keeping the Estabrook Dam.

I recently moved from Wisconsin to St. Louis because of work, but I still try to get back as much as possible to Milwaukee, I still consider Milwaukee my home.

Steven Bussian
Geospatial Analyst

7870 1/2 Big Bend Blvd., #4
St. Louis, MO 63119

Pirrung, Don

From: Dargle, John <John.Dargle@milwaukeecountywi.gov>
Sent: Monday, June 16, 2014 8:21 PM
To: Glen Goebel
Cc: Hahn, Michael G.; Lipscomb, Theodore; Haley, Kevin; Keegan, Jim; Lourigan, Tanya L - DNR; jesse.jensen@wisconsin.gov; Jernigan, Anthony D MVP (Anthony.D.Jernigan@usace.army.mil); Slawski, Thomas M.; don.pirrung@aecom.com >> 'Pirrung; Pirrung, Don; Murray, Joshua A.; dnrsecretry@wisconsin.gov; Sen.taylor@legis.wisconsin.gov; Sen.Darling; Dimitrijevic, Marina; Rep.Barnes; Johnson Jr, Willie; Tammy Blaeske; Barbara Maglio; Peter Horgan; tabla_brain@att.net; Jeff and Mel
Subject: Re: regarding Estabrook Dam scoping
Attachments: MRPA logo blk_lrg.jpg

Thank you for your comments. We will take these into consideration as we continue to work through the process as required.

John Dargle, Jr.
Director, Milwaukee County Parks

> On Jun 16, 2014, at 3:48 PM, "Glen Goebel" <glen@viking-communications.com> wrote:
>
> Please see the attached document which was delivered to John Dargle, Kevin Haley and James Keegan of Milwaukee County Parks Department on Friday June 13th.
>
> It is apparent that the control of Milwaukee County Parks department has acted in contradiction to the order of Milwaukee County Government and has cost the taxpayers many thousands of dollars by delaying and adding unnecessary processes in disregard of orders by our elected officials. We ask that you do everything in your power to re-direct Milwaukee County Parks department to expediently repair Estabrook Dam as they were ordered to do.
>
> On March 28th, we we got a report by Supervisor Lipscomb who met with Parks Director Dargle and County Executive Abele. At that time he wrote...[County Exec Abele]"made it clear that they are working toward the repair policy directive and that there are no caveats." [Parks Director Dargle] "made it clear that his staff know their orders and that he is responsible for what's happened " After seeing the outcome, it appears that a couple of bureaucratic parks employees have leveraged, delayed and misdirected the situation long ago and have retained more command of this matter than our county executive and the entire county board combined.
>
> Estabrook Dam restoration has been supported by Milwaukee County Board of Supervisors, former County Executive Walker, State Senators Darling and Taylor. Expenditures to complete the repair have been budgeted and approved by State and County Governments including a state grant. The project has been delayed and will likely miss yet another deadline extension. The dam was drawn down for most of 2007 and again from 2008 until now, causing life in the area to be disrupted, property values at the time of sale were lost, and recreational use was interrupted since then. This matter has been in the hands of Milwaukee County Parks department for more than 6 years. No action or decision to repair the dam has been yet made by Milwaukee County Parks Department regardless of the order they were given by Milwaukee County Board of Supervisors. We have persistently requested that the parks department take action and were given excuses including:
>
> * They couldn't repair the dam until the sediment was removed. (not true)
> * It would be less expensive to do if the sediment clean up were done simultaneously with dam repair (scoping has delayed the project and the cleanup will likely be done before this project)

> * Scoping of more alternatives was required by other governmental entities. (At the June 5th scoping meeting, Kevin Haleys said scoping was not required but they wanted to do it)
> * Portrayal of new "rock ramp" alternatives did not clearly communicate that flood issues would be exacerbated by that alternative.
> * Portray of new "rock ramp" alternatives did not clearly communicate that summer water elevations would not be deep enough for normal boat traffic in this impoundment.
> * We fear that funding including grants may not be available if this project is delayed too long
> * We fear that Wisconsin DNR may not continue to extend their deadlines (more than 7 repair deadlines for Estabrook Dam have been missed already)
>
> We are sending this email attachment to provide you with a copy of scoping comments supplied by Milwaukee River Preservation Association, who represents the interest of several hundred individuals who use Milwaukee River recreation ally and others who live along the river.
>
> Please help us get the dam restored and usable/safe water levels back
> to the only inland lake in Milwaukee County. Thanks in advance for
> your help in this matter [logo]
>
> Glen Goebel
> Director
> Milwaukee River Preservation Association
> 414-339-0853
>
>
>
>
>
>
> ________________________________
> [http://static.avast.com/emails/avast-mail-stamp.png]
> <http://www.avast.com/>
>
> This email is free from viruses and malware because avast! Antivirus<http://www.avast.com/> protection is active.
>
>
> <MRPA logo blk_lrg.jpg>
> <MRPA scoping comment final.doc>
> <glen.vcf>

Notes for Meeting over Estabrook Dam on September 4, 2014:

The meeting with the Milwaukee River Preservation Association (MRPA) talked about several key issues:

- Due to removal dam, the MRPA was concerned about the river changing courses, creating a greater river flooding risk to the housing committee upstream.
- With the EA report, MRPA stressed the inconsistencies with their own data
- MRPA also was concerned there was no comment box before choosing a position on the dam
- MRPA stressed to bring back alternative one without having the fish passage attached to it
    - Mainly they just want to repair the dam
- MRPA questioned the cost estimates stressing the costs were compared to rural dams and not an urban one, such as the Estabrook dam
- MRPA also stressed EA left out future costs such as property value going down due to flood insurance rates rising, citing 39 real estate agents agreeing with this claim
- MRPA brought to the attention the siltation problem, limiting the reservoir's ability to function properly
- Canoes and kayaks on the river will only be able to travel one direction, argued MRPA
- Want to include in EA the liabilities of upstream costs such as flood insurance

Comments regarding costs of repair of the Estabrook dam 9/4/2014

In looking at the original cost esimate for repair of the dam done by STS Engineering, now part of AECOM, it is apparent that costs have been inflated to make repair of the dam look bad and removal look good. The current cost estimates are almost 70% higher than the original estimate, yet the Inflation index has only risen 16% since then. I had a contractor that builds and repairs dams review the estimates in August of 2009 and felt the repair estimates were legitimate.

The engineering costs have been increased 210% even though much of the engineering has been done.

It has been determined that the gated structure is anchored to the bedrock as part of the original construction documents. Now you are trying to add an additional anchoring even though there is no indication that the original anchoring is defficient. Your estimate includes a cost of over $28,000 for each of 11 anchors drilled into the bedrock for a total cost of $315,000 plus a 20% contingency. That brings the estimated cost to $378,000 or over $34,000 per anchor. Again, I contacted a contractor that does this kind of work and they stated that unless there some unusual circumstances a cost of $12,000 - $14,000 per anchor would be a reasonable estimate. That seems very excessive to me.

You have estimated a cost of $100,000 for gate labor and river monitoring. I have talked to other dam owners or operators and their budgeted costs are a fraction of this. Remote monitoring if not there already can be added for a small amount especially since the level instrumentation is already there. This appears to be another example of piling on the costs.

The hydraulic analysis for removal of the dam shows that in the 100 year flood there is only a minor difference with the dam in or with the dam removed. However the analysis doesn't come any where near taking into a into account all of the trees that have grown up in the riverbed especially in Lincoln Park and the blockage that has grown right at the rivers entrance to the park. Without his growth remediated there will be enhanced flood potential.

David Dorner
849 W Montclaire Ave
Glendale, WI 53217
414-339-2555
ddorner@aol.com

AECOM Cost Estimate - Estabrook Park Dam

Structural Repair Option - $1,660,000 Budget

[illegible] Note: [illegible]

Opinion of Probable Structural Project Costs

Client: Milwaukee County DPW
Address: 2711 West Wells St, Milwaukee WI

COSTS FROM 7/2006

Description	Units	Unit Cost	Quantity	Total Cost	Total Cost	Comments
1.00 General						
1.1 Mobilization / Demobilization	ls	$37,000.00	1	$37,000	$25,000	segmental barge, small crane, incidental [illegible]
1.2 Erosion Control	ls	$45.00	1	$45	$2,000	silt fence [illegible]
1.3 Site Restoration	ls	$16,000.00	1	$16,000	$2,500	repair pavements, grading, seeding and mulching
1.4 Diversion of water	ls	$31,500.00	1	$31,500	$5,000	Porta dam installation during pier repairs, with stoplogs removed on overflow spillway
2.00 Gated Spillway - Concrete Repairs						
2.01 Concrete surface repairs - abutments and stairs	sf	$90.00	700	$63,000	$42,000	reconstruct stairs, complete abutment surface reconstruction
2.02 Concrete surface repairs - bridge deck and walls	sf	$60.00	600	$40,000	$35,000	partial depth repair of deck, [illegible]
2.03 Pier reconstruction - below el. 37.75	sf	$100.00	2800	$280,000	$196,000	complete surface reconstruction below el. 37.75, all 11 piers
2.04 Concrete surface repairs - pier above el. 37.75	sf	$80.00	800	$64,000	$56,000	partial depth repair above el. 37.75 as needed, all 11 piers
2.05 [illegible] grouted tie down anchors in upstream piers for stability with ice loading at full pool	ls	$316,000.00	1	$316,000	NEW	[illegible]
3.00 Gated Spillway - Gate Repairs						
3.01 Prepare and paint slide gates	ea	$3,700.00	10	$37,000	$25,000	[illegible] in place
3.02 Misc. repairs to gates, guides and seals	ls	$11,000.00	1	$11,000	$3,000	as needed based upon inspection [illegible]
4.00 Ice Breakers - Concrete Repairs					$11,200	
4.01 Concrete surface repairs	ea	$4,000.00	24	$96,000		[illegible] anchors, polymer modified concrete [illegible]
5.00 Overflow Spillway						
5.01 New flashboards	ls	$1,200.00	1	$1,200	$3,000	[illegible] timber, recently replaced with [illegible] - budget for stockpile of new [illegible]
5.02 Repair / replace bent supports	ls	$2,500.00	1	$2,500	$4,000	[illegible] to be repaired
5.03 Concrete surface repairs	sf	$80.00	500	$40,000	$35,000	[illegible], anchors, and polymer modified concrete repair [illegible]
6.00 Slope Protection						
6.01 Riprap	cy	$90.00	600	$54,000	$24,000	24" layer of riprap, left and right banks [illegible] gated spillway
6.02 Geotextile	sy	$4.00	1,600	$6,400	$3,150	
7.00 Debris Removal	ls	$25,000.00	1	$25,000	$40,000	[illegible], not incl. environmental cleanup [illegible]
8.00 Miscellaneous						
8.01 Repair / replace handrails, fences, gates, etc.	ls	$6,000.00	1	$6,000	$3,000	
8.02 Misc. Site Electrical Work	ls	$16,000.00	1	$16,000	NEW	Per Milwaukee County [illegible]

Construction Sub-Total		$1,141,645
Construction Contingency	20%	$228,329
Construction Estimate		$1,369,974
9.00 Engineering		
9.01 Engineering design		$136,997
9.02 Resident engineering and contract administration		$100,000
9.03 Prepare EAP and IOM plans		$15,000
Engineering Subtotal		$251,997
Engineering Contingency	15%	$37,800
Engineering Estimate:		$289,797
Total Project Cost Estimate:		**$1,659,771**

755,820

Information presented on this sheet represents our opinion of probable costs in 2014 dollars, based upon previous unit rates and quantities updated from the 2006 STS Consultants' Cost Estimate. Unit and lump sum prices are based on costs for similar projects, our engineering judgment, and/or published cost data. Actual bids and total project costs may vary based on contractor's perceived risk, site access, [illegible], market conditions, etc. No warranty [illegible] the accuracy of costs presented herein are expressed or implied.

Note: This rehabilitation estimate is to extend the life of the dam structures for 20 years, with some regular maintenance. This estimate is for repairs of existing structural components only, not including the nearby transformer building. Costs for replacement or remodeling of structures is not included.

ELM TREMONT + MONTCLAIRE 1/2 DIFFERENCE

POINT @ RIVERFORREST + RIVERVIEW DR.

1/2" DIFFERENCE

2" DIFFERENCE

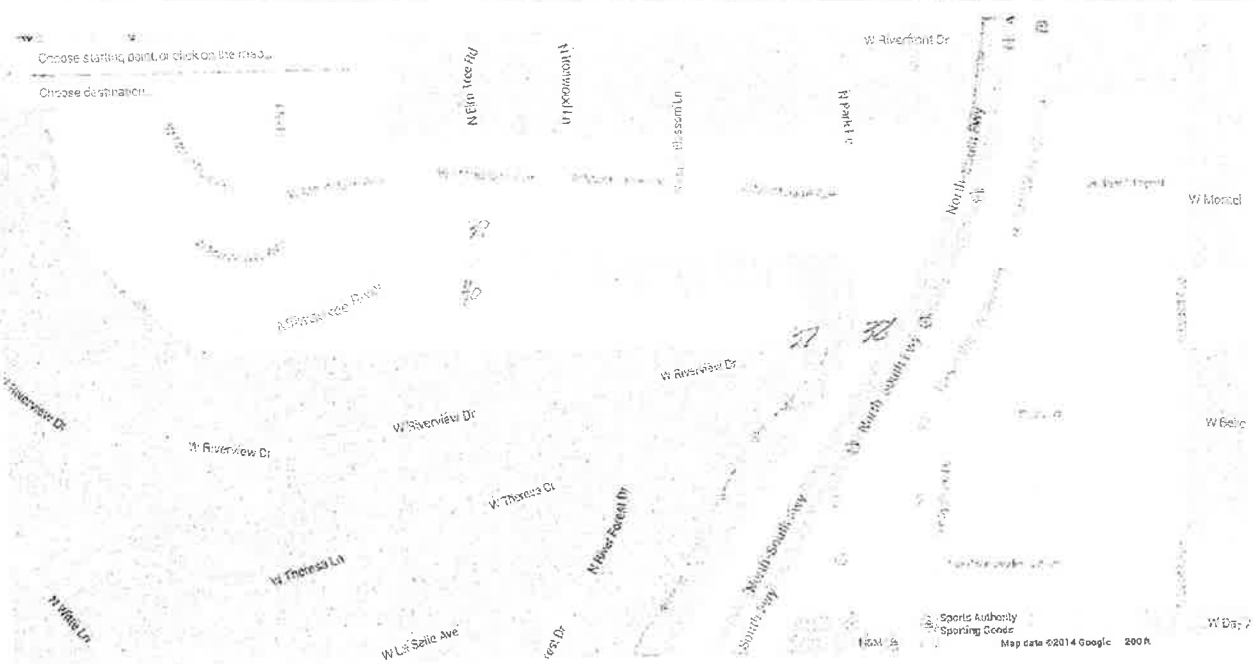
Table 2

Model Reach	River Mile	Description[a]	Invert Elev NGVD29 (ft)	500-Yr Flow Dam Removal W.S. Elev (NGVD29, ft)	500-Yr Flow Exist. Cond. W. S. Elev (NGVD29, ft)	500-Yr Flow Difference (ft)	100-Yr Flow Dam Removal W.S. Elev (NGVD29, ft)	100-Yr Flow Exist. Cond W. S. Elev (NGVD29, ft)	100-Yr Flow Difference (ft)
Milwaukee River - Upper Reach (continued)	9.242	Outfall MkeR-36, left		628.70	628.87	-0.16	626.85	627.02	-0.17
	9.244	Outfall MkeR-37, right		628.71	628.88	-0.16	626.86	627.03	-0.17
	9.376	Outfall MkeR-38, left		629.40	629.54	-0.13	627.53	627.67	-0.14
	9.427	Cross-Section		629.67	629.79	-0.12	627.79	627.92	-0.13
	9.471	Outfall MkeR-40, right		629.82	629.94	-0.12	627.94	628.07	-0.12
	9.476	Outfall MkeR-39, left		629.84	629.95	-0.12	627.96	628.00	-0.12
	9.601	Outfall MkeR-41, left		630.26	630.37	-0.11	628.40	628.51	-0.11
	9.632	Outfall MkeR-42, right		630.36	630.47	-0.10	628.51	628.61	-0.10
	9.669	Cross-Section		630.49	630.59	-0.10	628.64	628.74	-0.10
	9.834	Outfall MkeR-43, right		631.28	631.35	-0.08	629.67	629.73	-0.05
	9.846	Cross-Section		631.32	631.40	-0.08	629.75	629.80	-0.05
	9.854	Outfall MkeR-44, left		631.38	631.46	-0.08	629.82	629.86	-0.05
	9.973	Outfall MkeR-45, right		632.35	632.39	-0.04	630.79	630.82	-0.03
	10.009	Cross-Section		632.64	632.67	-0.03	631.08	631.11	-0.03
	10.015	Outfall MkeR-46, right		632.72	632.75	-0.03	631.14	631.17	-0.03
	10.023	Cross-Section		632.82	632.85	-0.03	631.23	631.26	-0.03
	10.025	Outfall MkeR-48, left		632.82	632.85	-0.03	631.23	631.26	-0.03
	10.036	Outfall MkeR-47, right		632.79	632.82	-0.03	631.20	631.23	-0.03
	10.04	Bender Road							
	10.051	Cross-Section		632.77	632.80	-0.03	631.18	631.21	-0.03
Lincoln Creek - Lower Mainstream	0	Cross-Section		624.45[b]	624.92[b]	-0.47	622.62[b]	623.20[b]	-0.58
	0.03	Cross-Section		624.45[b]	624.92[b]	-0.47	622.62[b]	623.20[b]	-0.58
	0.0303	Outfall LC-1, right		624.45[b]	624.92[b]	-0.47	622.62[b]	623.20[b]	-0.58
	0.14	Cross-Section		624.45[b]	624.92[b]	-0.47	622.62[b]	623.20[b]	-0.58
	0.16	Cross-Section		624.45[b]	624.92[b]	-0.47	622.62[b]	623.20[b]	-0.58
	0.18	Cross-Section		624.45[b]	624.92[b]	-0.47	622.62[b]	623.20[b]	-0.58
	0.181	Outfall LC-2, right	612.1	624.45[b]	624.92[b]	-0.47	622.62[b]	623.20[b]	-0.58
	0.21	Cross-Section		624.45[b]	624.92[b]	-0.47	622.62[b]	623.20[b]	-0.58
	0.33	Cross-Section		624.45[b]	624.92[b]	-0.47	622.67	623.20[b]	-0.53
	0.333	Outfall LC-3, left	614.44	624.45[b]	624.92[b]	-0.47	622.71	623.20[b]	-0.49
	0.4	Cross-Section		624.87	624.92[b]	-0.05	623.50	623.50	0.00
	0.41	Cross-Section		624.89	624.92[b]	-0.03	623.52	623.52	0.00
	0.41	Outfall LC-4, left	614.23	624.89	624.92[b]	-0.03	623.52	623.52	0.00
	0.419	Outfall LC-5, right	616.72	624.89	624.92[b]	-0.03	623.62	623.62	0.00
	0.42	N. Green Bay Avenue							
	0.43	Cross-Section		625.69	625.59	0.00	623.74	623.74	0.00
	0.44	Cross-Section		625.58	625.68	0.00	623.72	623.72	0.00
	0.47	Cross-Section		626.18	626.18	0.00	624.18	624.18	0.00
	0.5	Cross-Section		626.26	626.26	0.00	624.25	624.25	0.00
	0.54	Cross-Section		626.21	626.21	0.00	624.25	624.25	0.00
	0.6	Cross-Section		626.00	626.00	0.00	624.18	624.18	0.00
	0.61	Cross-Section		626.12	625.12	0.00	624.31	624.31	0.00
	0.62	Cross-Section		626.44	626.44	0.00	624.72	624.72	0.00
	0.631	Outfall LC-6, left	614.76	626.51	626.51	0.00	624.78	624.78	0.00
	0.71	Cross-Section		627.05	627.05	0.00	625.05	625.05	0.00
	0.75	Cross-Section		627.13	627.13	0.00	625.15	625.15	0.00
	0.79	Cross-Section		627.23	627.23	0.00	625.25	625.25	0.00
	0.794	Cross-Section		627.25	627.25	0.00	625.28	625.28	0.00

1/4

Decreases in water surface elevation relative to existing dam conditions.

[b] *Water surface elevation determined using backwater from the confluence with the Right Split (west oxbow) of the Milwaukee River.*



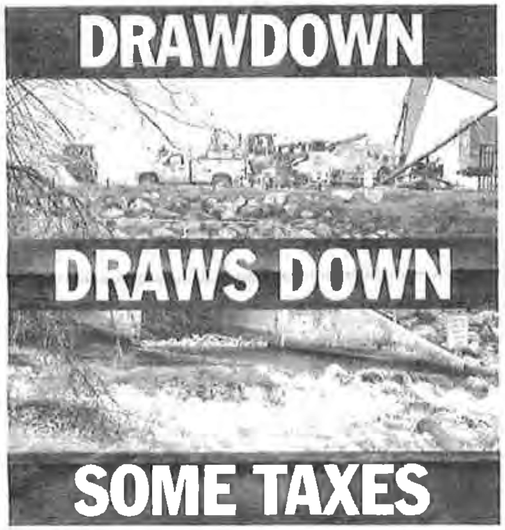
Choose starting point, or click on the map...
Choose destination...
N Elm Tree Rd
N Ironwood Ln
W Riverfront Dr
N Park Ln
North-South Fwy
W Montel
W Riverview Dr
W Riverview Dr
W Riverview Dr
W Theresa Ct
W Theresa Ln
N River Forest Dr
North-South Fwy
W La Salle Ave
N White Ln
Sports Authority
Sporting Goods
Map data ©2014 Google 200 ft

Comparison of riparian and non-riparian land property values in the Estabrook Impoundment according to property tax assessments of the City of Glendale for the year 2010.

Land values of riparian properties, with water frontage, along the Estabrook impoundment are 55.86% higher than land values of non-riparian properties, across the street from the riparian properties. Property values were spot checked again in February of 2014 and all properties checked, still had the same land values.

Riparian			Non-Riparian
Address	Land value ($)	Land value	Address
612 W Rock	75,000	54,000	725 W Rock
616 W Rock	85,500	51,000	729 W Rock
620 W Rock	85,500	49,000	801 W Rock
624 W Rock	85,500	50,000	809 W Rock
630 W Rock	85,000	48,000	4672 N Ironwood
700	85,000	52,000	4673
706	84,500	48,000	4678
712	87,000	54,000	4679
720	87000	49,500	4684
726	84,500	52000	4669
736	85500	48000	4666
802	85000	52000	4658 N Elm Tree
806	85000	49000	4661
810	94000	52000	4662
535 W Montclaire	121000	76000	616 W Montclaire
605	121000	71000	624
611	120000	71000	630
619	121000	71000	704
625	122000	71000	710
635	125000	71000	714
701	120000	71000	724
707	119000	71000	804
715	118000	71000	810
721	121000	71000	818
801	118000	71000	824
807	118000	72000	840
821	121500	72000	846
831	126000	72000	854

Whiting residents on McDill Pond to see property values drop; Stevens Point side stays level



The McDill Pond Dam can be seen from the Plover River on Monday. Crews expect to have the repairs to the dam finished by mid November, and water restored to McDill Pond in the spring.

By B.C. Kowalski | Journal staff

Residents on McDill Pond will be paying different taxes next year depending on what side of the pond they live on.

Residents who live on the Stevens Point side of the pond will pay similar rates to previous years, while those on the Whiting side will pay taxes based on assessments that are reduced as much as 60 percent while the pond is drawn down.

McDill Pond has been drawn down since June 2011, when village of Whiting officials discovered a leak in the McDill Pond Dam. Crews are repairing the dam, and the pond should be refilled by spring 2013.

The difference in taxes represents a difference in taxing philosophy. City Assessor Jim Siebers said Stevens Point chose not to change the assessments for the city's roughly 160 residents on the pond because the pond would eventually be refilled.

Siebers said lowering the values temporarily would mean other taxpayers would have to make up difference.

Values haven't been affected as much as one might think, according to Siebers. Four homes on McDill Pond sold in the last half of 2011,

See MCDILL, Page 7A

Don Hallerstein, 54 of Burlington, (right) and James Pelopale, 31 of Cambridge, fill in concrete as part of the repairs to the McDill Pond Dam on Monday.

McDill

Continued from Page 3A

and another two sold so far this year. Sale prices of those six homes averaged almost $290,000.

Siebers estimates the loss in value for the average lot, if the pond was never refilled, would be about $24,000.

In Whiting, contracted assessor Bill Pauls of B.A. Pauls and Associates said the village will lower assessments for the 29 taxable lots on the pond. He said property values will be lowered 50 to 60 percent to reflect the empty pond.

He said that the assessment was based on the status of the pond on Jan. 1, 2012, and at that point the pond looked like it would still be empty in 2013.

Pauls said since the pond would be filled after Jan. 1, 2013, assessments for those property owners wouldn't return to pre-drawdown levels until 2015.

Changing the assessment means taxes will increase for other Whiting residents, though because only a small number of properties were reassessed, Pauls said it would be minor.

"Anytime you take money off the tax rolls, it has to be made up," Pauls said.

McDill Inland Lake Protection and Rehabilitation District President Jack Negaard said there wasn't much the district could do about the difference in assessments.

Siebers said if the city had lowered the taxes, it likely would have assessed them to similar lots like in the Whitetail Subdivision, meaning the average lot would have been reduced by about $24,000, meaning a loss in value of $3,480,000 in property value.

Follow B.C. Kowalski on Twitter, @BCreporter

This document is made of excerpts from *WISCONSIN CONSERVATION PRIORITIES 2009-2010*, a publication of The Wisconsin League of Conservation Voters Institute. A **shortened** version is online but I've got the original 44 page paper version as well as the full electronic version. It is too large to email

The following quote is from page 5 of the document but if you search with a PDF program it would be page 7

» Long Lake in Waushara County in the Central Sands is one of many lakes primarily fed by groundwater It is suffering from dramatically low lake levels due to lower than normal groundwater levels.[6]

[5] Hey and Associates, Inc *Crystal Lake Water Level Management Plan*, February, 2007

This is from page 8 of the document but if you search with a PDF program it would be page 10

» Responsible management of groundwater resources protects riparian and public rights Low lake levels and dry creeks diminish waterfront properties by reducing value and enjoyment of private property. All Wisconsin citizens lose when the ecological, aesthetic, and recreational values of waterways are compromised In 2007, property assessments around Long Lake in Waushara County were reduced by fifty percent to reflect the nearly dry conditions of the lake [10]

[10] Timm, Larry, Assessor, Town of Oasis, Waushara County, Personal communication, January 15, 2009

Milwaukee County Executive and Board of Supervisors
901 N. 9th Street
Courthouse, Room 306
Milwaukee, WI 53233-1458

Dear Executive Walker , County Board Chairman, and County Supervisors,

We urge you to expedite repairs to the Estabrook Park Dam.

We are real estate professionals who are experienced and working in Milwaukee County, concerned about the Estabrook Park Dam repair/removal decision you will be faced with shortly. In our expert opinion, the dam and the resultant aesthetics and navigation contribute greatly to the property values of the homes located along the river as well as the entire neighborhoods surrounding them. If the dam were removed or it ceased normal operation, and the water level were drawn down land assessment values would be drastically reduced. This reduction in land values would result in lower tax revenue for the City, County and State.

The Milwaukee River Impoundment includes over 200 homes. The yards are all landscaped based on the presence of high water.

Please help save the Milwaukee River as we know it and preserve the river for future generations to enjoy and cherish. Repair the dam. Thank you for your consideration.

Respectfully,

Signature	Real Estate Firm	Date
[illegible]	Shorewest	3/3/09
Richard Schwab	8700 N. Lake Dr F.P	3/3/09
Delia Thomas	ShoreWest Realtors	3/3/09
Jim [illegible]	Shorewest Realtors	3/4/09
[illegible]	Shorewest Realtors	3/5/09
[illegible]	Shorewest Realtors	3/4/09
[illegible]		3/4/09
[illegible]	Shorewest Realtors	3/4/9
[illegible]	[illegible] Mortgage	3 4 9
Nancy [illegible]	Shorewest Realtors	3-4-09
[illegible]	5[illegible] N. [illegible]	3/5/09
[illegible]	Shorewest Realtors	3/5/09
Barb [illegible]	809 E. Glen - SWR	3/5/09
Dennis [illegible]	Shorewest Realtors	3/5/09
[illegible]	Shorewest Realtors	3-5-09

For more information please see MilwaukeeRiverPreservation.org

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Respectfully,

Signature	Real Estate Firm	Date
[illegible]	Shorewest	3/2/09
[illegible]	Shorewest	3/2/09
Marjorie Mallum	Shorewest	3-2-09
[illegible]	Shorewest Realtors	3-2-09
Tom Tomic	Shorewest	3-2-09
[illegible] Mulcahy	Shorewest	3-2-09
[illegible] (MGR)	ShoreWest	3-2-09
[illegible]	Shorewest	3-2-09
Lori Wertheimer	Shorewest	3-2-09
[illegible]	Shorewest	3-2-09
[illegible]	Shorewest	3-2-09
Janice [illegible]	Shorewest	3-2-09
[illegible] (MGR)	Shorewest	3-2-09
[illegible]	Shorewest	3-3-09
[illegible]	American Affiliated Associates	3/6/09

For more informationg please see MilwaukeeRiverPreservation.org

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Signature	Real Estate Firm	Date
Patti Potos	Shorewest	3/5/09
Jodee Japua	Shorewest	3/5/09
[illegible]	Shorewest	3/5/09
Ken Kil	SHOREWEST	3/6/09
Maud Siljestrom	Shorewest	3/6/09
Allie [illegible]	Shorewest	3/6/09
Sarah [illegible]	Shorewest	3/6/09
[illegible]		
[illegible]	Shorewest	3/6/09
[illegible]	Shorewest	3/7/09

For more information please see **MilwaukeeRiverPreservation.org**


terraserver

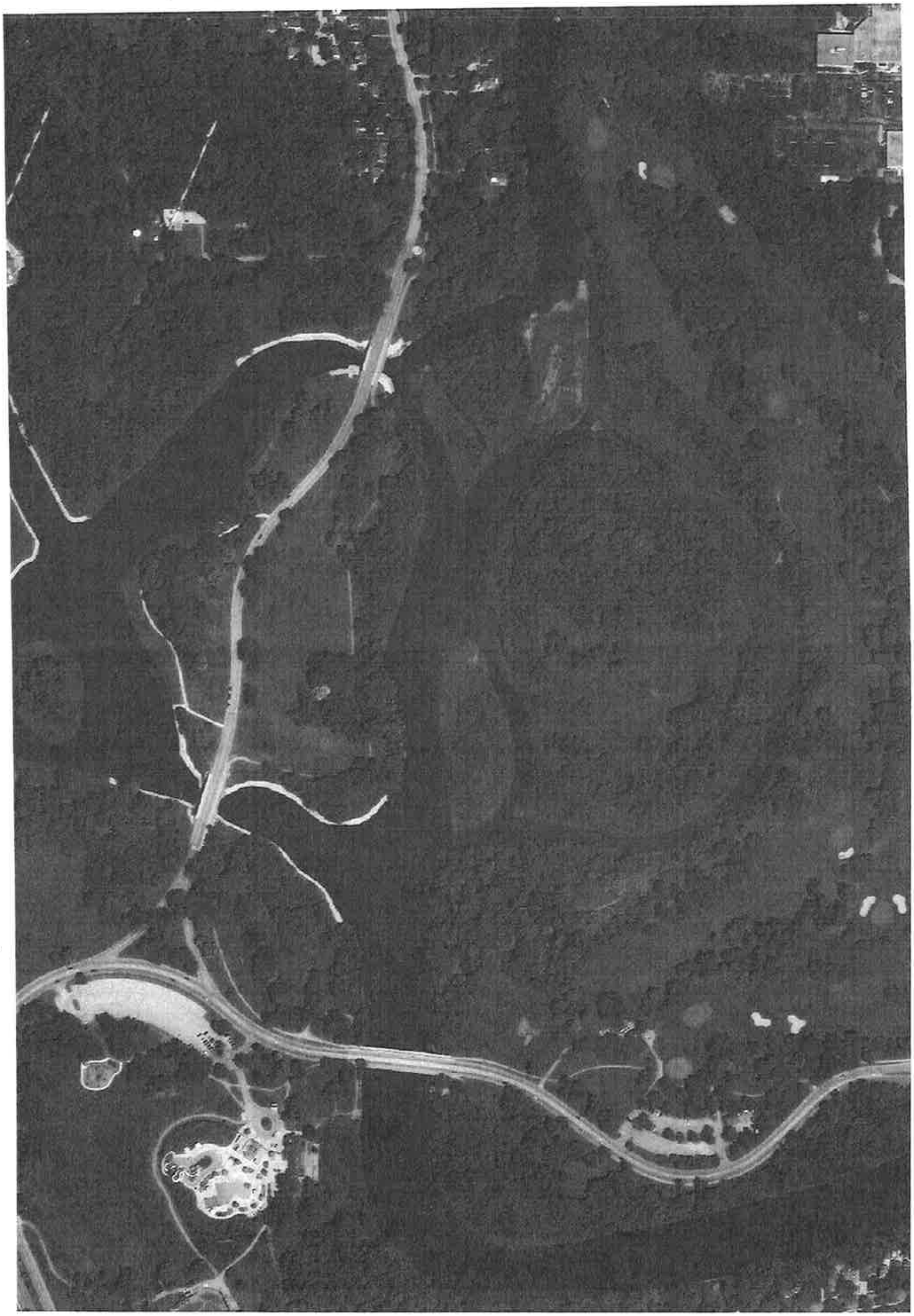



Image © 2014 DigitalGlobe
Google
Imagery Date: 8/8/2005 43°06'30.09" N 87°55'28.77" W elev 617 ft eye alt

Pirrung, Don

From: Dargle, John <John.Dargle@milwaukeecountywi.gov>
Sent: Wednesday, September 17, 2014 6:11 PM
To: Pirrung, Don; Keegan, Jim; Haley, Kevin
Subject: Fw: Estabrook Dam

John Dargle, Jr.
Director
(414) 257-7275 Phone
(414) 257-6466 Fax

Milwaukee County Department of Parks, Recreation and Culture
9480 Watertown Plank Road
Wauwatosa, WI 53226
(414) 257-PARK
countyparks.com

From: Francois Ross <fross@wi.rr.com>
Sent: Wednesday, September 17, 2014 5:54 PM
To: Dargle, John; Keegan, Jim; Haley, Kevin
Subject: Estabrook Dam

Dear County Supervisors;

Please support the REPAIR of the Estabrook Dam – a policy that your Board approved with votes in 2009 and 2010. After vetting the cost estimates of the various alternatives now before us, correcting errors and removing the unnecessary and expensive enhanced fish passage component, it will become clear that this is the lowest cost alternative and still the right answer even though 5 years of delays have transpired.

Many of you supervisors are new to the Board since 2009. So let me explain that this stretch of the River was always more of a lake type of environment. It has never been a 'free-flowing' river with only inches of water so when you hear people say, "let's return the river to its natural state" that signals that they have not done their homework on the history of this area. Prior to the 1930's there was a natural ledge that created a Lake (or impoundment). This prompted the development of parks, residences and businesses along the lake but it also resulted in frequent flooding events. As a remedy, the Estabrook Dam was built to preserve the Lake/Impoundment features but to also allow the flexibility of drawing down the water levels to limit ice accumulation over the winter months and to reduce the potential for flooding during early spring heavy flow or extreme summer rain events.

Lincoln Park was designed with a Lake as its central feature. Lincoln Park is really nothing without its Lake, nothing but an eyesore. It strikes me as ironic that the county is struggling with a decision to keep or sell a parking garage that has a bit of a park on top while it is also risking letting the only remaining inland Lake in Milwaukee County slip through its fingers. There used to be many lakes and ponds available for diverse recreational opportunities close to home in Milwaukee county, right within our own urban environment and no need to drive hours to get up North. Lincoln Park Lake is the last remaining vestige of that glorious past making those opportunities accessible to many who would not otherwise have the means to get to a Lake.

While I do live on the river and would love to once again launch my kayak and paddle down, then up and all around to my heart's content – it isn't just about people who live on the river. I live across from Kletzsch Park and I used to see droves of people put in across from my house then happily paddle away. Now it is only a tiny fraction of those numbers who can make that attempt, and only a few weeks of the year, and only if they are willing to get out and drag their boats through the low spots. There are hundreds, if not thousands, who have enjoyed this Lake for generations and wish to do so again with the generations following them if only it can be preserved as what it has always been. Unfortunately, there is no tidy list of these folks since they come and go as they please enjoying fishing, canoeing, kayaking without having to check in or register anywhere. What a shame that just as the river will finally be free of worrisome PCB's we might not have the chance to wade or swim in a place where our parents, grandparents and great-grandparents have treasured memories of just that.

To those who believe that the Riparian owners should pay for the dam I say, we do, always have. Riverfront property assessments are consistently 35% or more higher than like properties across the street. By virtue of that, riparian owners are paying incrementally more in taxes which, in essence, supports the expenses associated with the dam. If the dam is removed, property values drop, tax revenue in turn drops – nothing has been gained except erosion of the tax base – and the loss of Lincoln Park Lake! The unending and unknown scope of steam bank remediation/rehabilitation costs just throughout Lincoln Park is unfathomable – not to mention impacts further upstream of a drastically reduced water level.

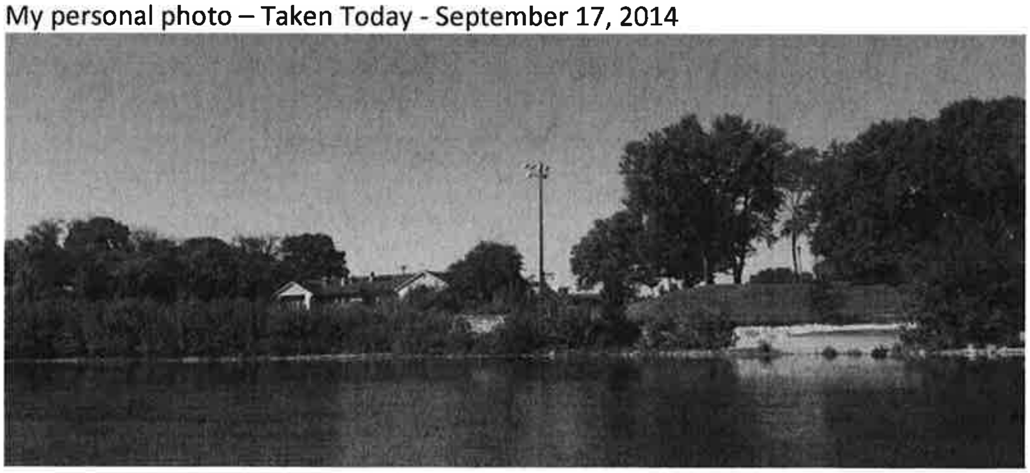
If you are not familiar with Lincoln Park, or have not visited it before and after this protracted draw down, please see the photos I have attached below. This community would like to have it back to what it was before all the chaos and controversy – as you see in the bottom photo of the former Blatz Pavilion Lagoon.

In the state of Wisconsin, if property owners have enjoyed a consistent water level for 20 years or more - purchased property with that as a feature and perhaps made improvements to their property consistent with that water level - they have a right to expect it to be maintained. Milwaukee County therefore has an obligation to do so, which is consistent with the clear and correct policy set by the Supervisors' in 2009 and 2010 to rehabilitate the Estabrook Dam. Please remain steadfast, stand firm and do not be distracted by misinformation and hidden agendas, and please follow through on the commitment to REPAIR the
ESTABROOK DAM and restore LINCOLN PARK LAKE!

Thanks,

Francois Ross

My personal photo – Taken Today - September 17, 2014



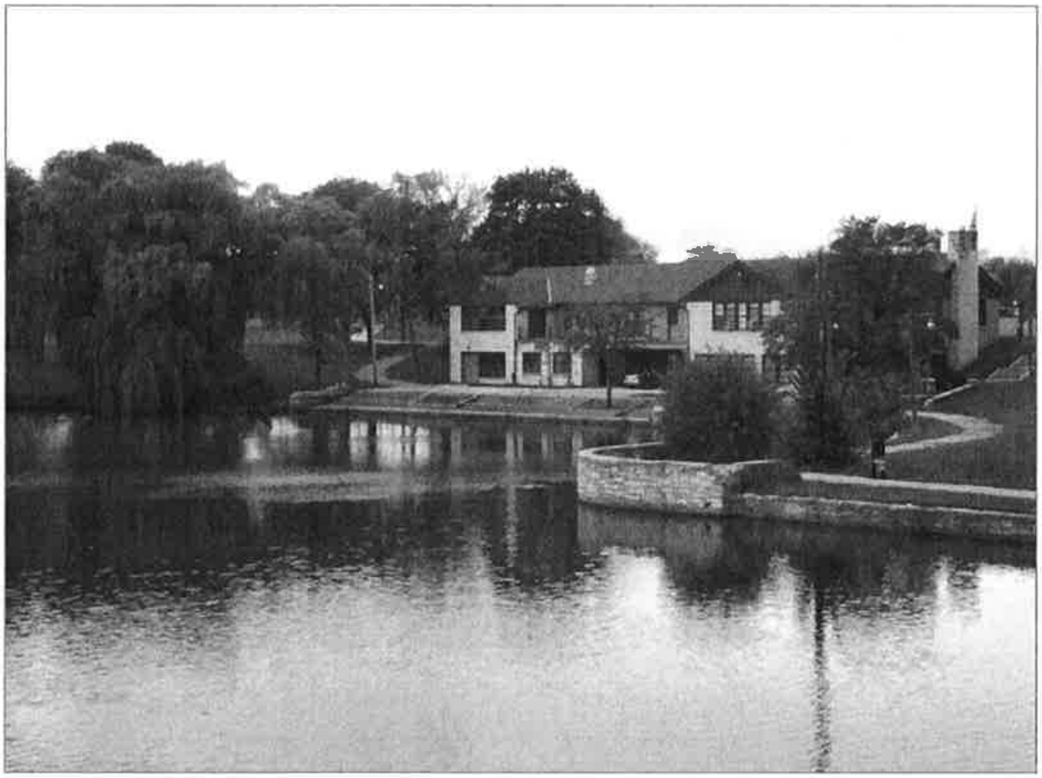
WDNR Cover Page & Photo from 2007

REMEDIAL ACTION OPTIONS REPORT

SITE DESCRIPTION

The Blatz Pavilion Bay area South of Hampton Avenue in Lincoln Park in the City of Milwaukee, Milwaukee County

CURRENT STATE OF THE PROJECT AREA



RESOLUTION 2015 – 08

RESOLUTION EXPRESSING THE VILLAGE OF SHOREWOOD'S SUPPORT FOR THE REMOVAL OF THE ESTABROOK DAM

WHEREAS, The Village of Shorewood's western boundary is the Milwaukee River and the Village lies immediately downstream of the Estabrook Dam; and

WHEREAS, in October 2006 the Village of Shorewood adopted the Milwaukee River Shoreland Ordinance to prevent and control water pollution, protect spawning grounds for fish and aquatic life; regulate building setbacks from the river; and, preserve shore cover and natural beauty along the Milwaukee River; and

WHEREAS, in December 2007 the Village of Shorewood adopted a Comprehensive Outdoor Recreation Plan which called for the stabilization and formalization of the nature path along the side of the Milwaukee River which extends northward from Hubbard Park to Estabrook Park and southward to the City of Milwaukee, and directed the Village to work with adjacent communities to improve the ecological condition of the bluff and river edge environments; and

WHEREAS, in May 2009 the Village of Shorewood approved the B-4 River District Riparian Restoration and Trail Project Plan which provided a trail design and bluff restoration plan along the Milwaukee River which includes rehabilitation of an existing trail along the river's edge and restoring the bluff in terms of stabilization, drainage and vegetation; and

WHEREAS, the 2009 update of the Village of Shorewood Vision 2015 Implementation Plan reaffirmed the Village's goal to protect and enhance public green spaces in ways that increase the number of uses as wells as number of users, including specifically the public spaces along the Milwaukee River; and

WHEREAS, in December 2010 the Village of Shorewood approved a resolution supporting the Milwaukee River Greenway Master Plan and committed to work cooperatively with other partners to coordinate Shorewood's Milwaukee River efforts with the overall efforts to improve the quality of the Milwaukee River corridor; and

WHEREAS, The Estabrook Dam on the Milwaukee River has been in decline for the past several years, and there are numerous outstanding maintenance and repair requirements per State Dam Safety regulations that have not been addressed to date; and

WHEREAS, The dam has major structural issues and is a crumbling "public nuisance" that hasn't operated since a 2008 Wisconsin Department of Natural Resources order to shut it down; and

WHEREAS, The owner of the dam, Milwaukee County, is currently under a DNR order to repair or remove the Estabrook Dam by the end of 2016; and

WHEREAS, There is no viable reason to maintain the dam and keep it permanently open as the short- term repair costs and long-term maintenance costs of that scenario would far exceed removal costs; and

WHEREAS, The dam removal alternative means the complete removal of the dam, including the gated control structure and fixed crest spillway, and the creation of a free-flow condition; and

WHEREAS, Removing the dam would yield the greatest positive impacts on river ecology, flood management, water quality, sediment management, fish and aquatic life, terrestrial wildlife and recreation; and

WHEREAS, Free-flow conditions would support natural wetland hydrology and, therefore, not negatively impact herptiles and invertebrates, and may result in a net gain of wetland acreage; and

WHEREAS, Removal of the dam would also allow for unimpeded passage of both fish and boats; and

WHEREAS, The ecological health created by a free-flowing river offers greater long-term value than maintaining the present water body behind the dam; and

WHEREAS, In 2012, the Milwaukee County Circuit Court declared the Estabrook Dam a public nuisance, and Milwaukee County has an obligation under the Court's order and a civic duty to its residents to abate the nuisance; and

WHEREAS, There is an ongoing lawsuit, Milwaukee Riverkeeper vs. Milwaukee County, Milwaukee County Case Number 2011 CV8784, which seeks removal of the dam; and

WHEREAS, The South East Wisconsin Regional Planning Commission (SEWRPC) has designated the Milwaukee River as a primary environmental corridor; and

WHEREAS, Both Hubbard Park and Estabrook Park are vitally important to community recreation in our Village; and

WHEREAS, Removal of the dam is the only option to permanently abate the public nuisance caused by years of neglect;

NOW THEREFORE, at a regular meeting of the Village Board of the Village of Shorewood, held on the 15th day of June, 2015, a quorum being present and a majority of the Board voting therefore said Board does resolve as follows:

BE IT RESOLVED, that the Shorewood Board of Village Trustees expresses its support for the removal of the Estabrook Dam and urges Milwaukee County and the Wisconsin Department of Natural Resources to pursue the dam removal alternative as soon as practicable; and, be it

Further Resolved, that the Acting Village Clerk shall forward copies of this resolution to Milwaukee County Executive Chris Abele, members of the Milwaukee County Board of Supervisors, and the Wisconsin Department of Natural Resources; and, be it

Further Resolved, that the Village Attorney shall forward a certified copy of this resolution to Milwaukee County Circuit Court Judge Christopher R. Foley.

PASSED and ADOPTED by the Village Board of the Village of Shorewood, Milwaukee County, Wisconsin this 15th day of June, 2015.

Guy W. Johnson
Village President

Attest:

M. Chris Swartz
Acting Village Clerk

MMSD

PARTNERS FOR A CLEANER ENVIRONMENT

Kevin L. Shafer, P.E.
Executive Director

May 18, 2015

County Executive Chris Abele
Milwaukee County Courthouse
901 N. 9th Street, Room 306
Milwaukee, WI 53233

Milwaukee County Board of Supervisors
Milwaukee County Courthouse
901 N. 9th Street, Room 201
Milwaukee, WI 53233

Re: Milwaukee Metropolitan Sewerage District (MMSD) Commission Support for Removal of the Estabrook Dam

Dear County Executive Abele and Members of the County Board of Supervisors:

Attached please find the certified resolution approved today unanimously by the MMSD Commission. If you have any questions, please contact me.

Sincerely,

Kevin L. Shafer, P.E.
Executive Director

Milwaukee Metropolitan Sewerage District
260 W. Seeboth Street, Milwaukee, WI 53204-1446
414-272-5100 www.mmsd.com

Milwaukee Metropolitan Sewerage District

Certified Copy

260 West Seeboth Street
Milwaukee, WI 53204

Resolution: 15-053-5

File Number: 15-053-5

Commission Support for Removal of the Estabrook Dam

WHEREAS, removal of the Estabrook Dam will reduce flood elevations in the Milwaukee River upstream of the Estabrook Dam; and

WHEREAS, a reduction of flood elevations supports the District's goal of removing structures from the 100-year (1% probability event) floodplain; and

WHEREAS, removal of the Estabrook Dam will improve water quality, habitat, fish passage, and river aesthetics and reduce sediment accumulation.

NOW, THEREFORE, BE IT RESOLVED, by the Milwaukee Metropolitan Sewerage Commission, that the Commission supports the removal of the Estabrook Dam as soon as practicable.

I, Anna Kettlewell, Commission Secretary of the Milwaukee Metropolitan Sewerage District, do hereby certify that the above is a true and correct copy of Resolution No. 15-053-5, adopted by the Milwaukee Metropolitan Sewerage Commission at a meeting held on 5/18/2015.

Anna Kettlewell

Anna Kettlewell, Commission Secretary

5-18-15

Date Certified

MMSD

PARTNERS FOR A CLEANER ENVIRONMENT

Kevin L. Shafer, P.E.
Executive Director

September 22, 2014

Chairwoman Marina Dimitrijevic
Milwaukee County Board of Supervisors
Milwaukee County Courthouse
901 North 9th Street, Room 201
Milwaukee, WI 53233

Dear Chairwoman Dimitrijevic:

I am writing in support of the Milwaukee County Parks System's recommendation to abandon and remove the Estabrook Dam (file #14-739; Estabrook Dam Draft Environmental Assessment Alternative 2).

I have reviewed the Estabrook Dam Draft Environmental Assessment and believe that removing the dam is the best option, because it is the least costly alternative while providing the most environmental benefit with the least impacts on structural flooding.

Thank you for providing me with this opportunity to comment on this important issue.

Sincerely,

Kevin L. Shafer, P.E.
Executive Director

c: Milwaukee County Executive Chris Abele
Milwaukee County Parks Director John Dargle, Jr.

WATER PRIZE

From: Ken Leinbach
Sent: Sunday, August 31, 2014 2:07 PM
To: John. Dargle; Kevin.Haley@milwcnty.com; 'Guy. Smith@milwcnty. com'
Cc: Shameka Tyler
Subject: Letter about Estabrook Dam

Hello John, Guy, and Kevin,

In 2009, when the Estabrook Park Dam issue heated up I wrote a letter to the community that had a lot of readership. As things are heating up again I wanted you three to receive it again. Nothing has materially changed from then. My current view is basically the same. I do like the compromise idea if I understand it. The main thing for me is to make sure that the river does not experience the man induced fluctuations of the past as these do not fit into the ecology of either the impoundment or the river. Thus I do not think repairing the existing dam is a good option. Either remove it or do the rock option (which is admittedly a creative solution and one I'd be happy to help try to find some private funding for if a public grant would be enhanced by such a thing.) One thing that I've confirmed in the time since this letter is that the property value argument has no basis in reality. People love living on the river as much as they love living on the impoundment. I might know of some good private sources of funding for the dam removal as well if this were needed. Just wanted to throw my two cents in before I lose internet and cell contact for three weeks. In about 30 minutes I am dropping into the Grand Canyon for a 21 day float trip.
I look forward to seeing what the status is when I get back!

I may send one other, more polished version of this if my assistant can find it.

Ken

Letter From 2009

To all involved with the decision on what to do with the deteriorating Estabrook Dam,

As the Executive Director of the Urban Ecology Center I have received an exceptionally high number of calls related to this community problem. In part because of this community outpouring, in part because we use the river as an educational asset for tens of thousands of students each year, and in part because of friendships I have developed with home owners who live on the impoundment above the dam -- I have looked very closely at this issue. I have seen the incredible ecological rebound first hand since the removal of the North Avenue Dam below Estabrook as well as the amazing recreational asset that a still water system can provide for the community above Estabrook. We use the river more than any group in the City. We teach children and adults alike on both the stretch of river below the dam and above the dam as well. We instruct hundreds of kids each summer how to canoe on the Lincoln park impoundment. I state all of this to make clear that I come with an objective view. Our organization can benefit from either scenario ... dam repaired or dam removed. Most people that I heard speak at the March 24th council meeting had a strong opinion, sighting facts (some well informed, but many stretched) that backed their case. Like you, I listened. At that point in time I was not prepared to make a decision, and said so. Since the meeting I have done some more research and would like to share with you the decision making line of reasoning I would use were I in your shoes.

First, it must be understood that any option considered must first address the known toxins that exist in the sediments above the dam and near Lincoln Creek. No matter what happens to the dam these must be removed and capped, and this must be done with government dollars. Those who own property along the river but had nothing to do with the toxins in the sediment should not be held in any way responsible for the cost associated with cleaning up these sediments (as some have suggested).

There are three options to consider:

1) Do we repair the dam and manage the impoundment with seasonal draw-downs as we are doing now?

2) Do we repair the dam and manage the impoundment differently so it stays as a permanent "lake"?

3) Do we remove the dam entirely?

I'll address these each in order.

1) Do we repair the dam and manage with seasonal draw downs? NO, definitely not. The most important thing to consider for the long term is the ecological impact of any decision we make. If there is anything that I hope we have learned over the past century is that everything is connected. In this case a healthy life sustaining waterway means clean water, a productive fishery, vibrant riparian land, healthy and sustainable parks, positive recreation (instead of crime along abandoned polluted waterways), which in turn connects to life style satisfaction which connects to areas job retention, etc. etc. Thus whatever decision is made must keep a long term healthy natural ecosystem at the fore front of the decision. Our current management of the impoundment above the Estabrook Dam with seasonal drawdowns does not nurture in any way a healthy natural ecosystem. In fact is does just the opposite. Many plants, fish, frogs and other amphibians, dragon flies, crayfish, macro invertebrates (bugs that live in the water) and micro-organisms at the bottom of the food web, cannot adequately adapt to a summer lake and a winter river. It is true that many of these plants and animals do exist with this oscillation, but our current management does not produce anywhere near the diversity or abundance of life that this waterway should have or is capable of supporting. By my logic, this "status quo" option should be off the table.

2) Do we rebuild the existing dam such that it creates a permanent ecologically sound lake? For political and social reasons this is what I would like to be able to advocate for. I believe that an urban area of 1.5 million people is enhanced by a diversity of opportunities and experiences. Having unique parkland that allows for the still water experience of boating, fishing and the "cool" factor of having a park with lake trails and islands to explore is a good thing for the community. The real question is -- can this be accomplished in an ecologically sound manner? Certainly such natural impoundments do exist in nature. With proper design of the dam, accounting for fish movement, ice issues, etc. it seemed that this option should be explored. I have done this for the purpose of forming my own opinion, discussing at length these issues with experts in related aquatic fields. Unfortunately, while I do believe this may be possible, I have yet to figure out a way to make it so. There are two reasons why. Ice and sediments. Ice considerations are real. According to the Estabrook Dam Report engineers state that the current dam is not structurally strong enough to withstand the pressures created from a full and frozen impoundment. It is for this reason, as well as concerns about spring ice break-up, that the impoundment is released each winter. No one that I know of has argued against this. Can we make a structure strong enough to withstand this ice pressure? Perhaps, however we will still have the spring ice break-up to contend with which can complicate flooding in this populated urban area. Then there are the sediment concerns. Prior to human settlement, soil systems were quite stable ... heavy spring rains and floods flowed over deep rooted prairies and strong healthy forests and picked up much less soil than today's rains. The plowing of fields with short rooted crops coupled with significant development that stirs up soils means that spring floods carry significantly more sediment than a century ago. Any impoundment created today fills up at an extremely rapid rate. Thus ... going back to a natural impoundment system is not in fact realistic without significant management (dredging) costs. There may still be social reasons to explore this option, but in this moment this decision should not be made without more time and research, otherwise I fear we will again severely compromise the ecological system of the waterway. I do not believe, due to the deterioration of the existing dam, that this time window for needed research exists.

3) Do we remove the dam entirely? Based on all the information that I have collected to date, this is the solution that I have to advocate for, if somewhat reluctantly. We know, from the experience of the North Avenue Dam removal that, while the process was not without flaws, the end result has been an amazing ecological success. Where once there were barely any fish with only two or three hardy species even recorded, today there are now over 39 species with fish literally jumping out of the water when we take kids down to the river. Within a year the mud flats were blooming with native flowers. There are 160 species of birds now known to migrate through this lush ecosystem and human visitation to the newly acquired parkland has increased ten fold. It worked above the North Avenue Dam, and it can work again above Estabrook. However to do this right will require proper sediment containment, adequate budgeting for planting and riverbank management, and strong design consideration of the entire river from Estabrook to Kletsch park as it relates to fish habitat and small craft navigation. This means that when the decision is made budgets should support equipment and time for rock placement and clearing a channel for canoeing this whole stretch even in low water conditions. Remember this is not in fact a restoration project but is instead creating something new. Let do it right.

From listening to the many comments in support of repairing the dam at the March 24th council meeting I can envision a few questions cropping up from my less than popular conclusion for dam removal.

What about the "historic restoration" argument?

Let's be clear, there is no "historic restoration" involved with this project as some have suggested. Whatever route is chosen is a decision to create a new eco system, a new management plan and a new recreational plan. Over the past century and a half we have manipulated the Milwaukee River, the environment around the river, and the entire watershed that feeds this stretch of urban river to such a degree that there is no way to approximate what it once was. We've filled in wetlands, vastly increased sediment load, changed the river route in some cases, put in dams, blasted away rock outcroppings, increased permeable pavement there by increasing run off, and added toxins by the ton. My point here is that the argument to repair the dam to "restore" the river to its original level, prior to the blasting of the rock outcroppings in the 1930's, as if this is what is needed to restore a once pristine ecological system really does not hold water (pardon the pun). The blasting of this outcropping was one of many thousands of manipulations done to the Milwaukee River. We cannot redo them all, and just redoing one will not in itself solve a problem.

What about property value loss?

This one is hard. I know good people who will be affected by this decision. I heard real estate experts put their name on the line to debunk the River Report's conclusion of minimal property value loss. However, when I look at this one from a personal common sense perspective it becomes pretty clear. I live on a city street with no natural amenity out my back door and only a postage stamp yard. I would trade my home of equal built value with any property owner along the Milwaukee River corridor in a heart beat. In short I would love to have their problem. While it would be great to live on a lake-like impoundment, I would just as gladly move my home along a free flowing natural river, and I know I am not alone in this.

What about flood control? The Dam was indeed created for flood control reasons, however it does not appear to actually have much if any impact on flooding. In short it really didn't work. This has some debate associated with it, but my understanding of the situation talking with experts on river hydrology coupled with my observation of 14 years of watching significant flooding on the river have convinced me that while the dam may have minor impact on small flood events it in truth has no real impact on large flood events. It is a small dam and significant flooding quickly overwhelms its designed intent for control.

In short, while I had hoped to come up with a creative compromise solution that would allow for a healthy ecosystem, happy property owners, and a very cool and permanent amenity for Milwaukee County, I have come to the conclusion that this is not likely. If there were more time, maybe a creative solution is out there. I looked into small hydro electricity generation as a means of diverting some of the public burden, but there does not appear to be a realistic system for this size of a dam, nor does hydro electricity solve the ecological or engineering issues raised above. In my research there was a general consensus among ecologists that in the ideal world this "problem" that we face would not be taken in isolation, but instead should act as a catalyst for an entire Milwaukee River Plan. If there were a way to buy some time on this, I would offer my services to coordinate experts in the field for such dialogue to begin.

While the issue here is controversial and contentious, the not-always-pretty democratic process to arrive at community consensus (and ultimately a decision) is in fact impressive. Thank you for taking your valuable time to have read this and I'd be happy to answer any questions that may have arisen from this letter.

Ken

URBAN ECOLOGY CENTER

Ken Leinbach

Executive Director

Urban Ecology Center

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Milwaukee, WI 53211

(414) 964-8505 x101

kleinbach@urbanecologycenter.org

Dear County Supervisor ________,

I have been working in this wonderful city for the past 17 years, pouring my passion and talents into its improvement through the creation of the Urban Ecology Centers that have spread throughout the city. I am proud of what we have created -- from a small trailer in the down trodden Riverside Park in the early 90's to what we are today with three vibrant environmental community centers that collectively have become a feather in the cap of Milwaukee nationally. It has been fun to be part of, but I have always felt that my gifts to Milwaukee were equally matched by what Milwaukee has given to me. Despite its imperfections, this is a great city in a great county in a great state.

Over the course of the past two decades, I've been exposed to local government in a way I never had been before in my previous life as a high school science teacher. While I will admit that sitting through lengthy committee meetings, where everyone who shows up has a chance to share their views on a given topic, is not necessarily my favorite of activities -- while doing this I have had the chance to see local leadership in action. It's a messy process, but it works. It's as fair as it can be and as a whole, I have been extremely impressed. I see honest people (you) in the line of fire; making the very difficult decisions needed to keep things running. I see you doing the best that you can with the information that you have in front of you. I see you (as a collective) working with the very best of intentions for the people of Milwaukee. I applaud this work and thank you for it, sincerely.

Recently, however, I have been saddened and frankly appalled by what I see as a narrow view by a very few getting in the way of what is right for the city and county in regards to the Estabrook Dam. In this case I feel particularly passionate as not only does it affect our community, but it deeply affects those with whom we share the planet, the voiceless creatures of the air and water that ultimately sustain us. This may seem overly dramatic, but it's true.

To be completely transparent, I probably have used the Estabrook impoundment more than just about anyone, excluding those who actually live on it. When it was a working dam I used it during the summer for my own boating pleasure and, through the Urban Ecology Center, we have taught countless Milwaukee students and residents how to canoe on these waters. I even skate and ski on it in the winter. My self-interest would say ... keep the dam. My self-interest, however, should not be the basis of this decision, nor should the self-interest of a very small constituent of loud voices and one very dedicated, adamant and charismatic supervisor.

Here are the facts as I see them:

1) Ecology: The Dam has been operated such that it creates an impoundment in the summer and releases this impoundment in the winter. No ecological system operates under these radical conditions in nature. It is a cycle that is harmful and counterproductive to any long term ecological growth. Sure, there will be fish that survive this kind of annual shift, but the ecology of the whole is severely compromised. If we repair the dam, this same operation will occur because to do otherwise, creates both spring flooding concerns and winter ice concerns. To do the dam right from an ecological perspective (meaning keeping it as a stable lake-like ecosystem through all four seasons), would mean to create a dam strong enough to withstand winter and spring ice and flood pressures. This would cost

the county much more than any current estimates out there for rebuilding and repair. Taking the dam out, completely, however is both the most cost effective option and is for sure the very best for the ecology of the system. Look at what happened when we took out the North Avenue dam in 1996 as a shining example of what can happen. It is because of this, that our community has managed to create the Milwaukee Rotary Centennial Arboretum as well as the Milwaukee Greenway Corridor!

2) Economy: Taking out the Dam costs a fraction of what building a new dam will cost. It's a very old dam, so it is more than just repairs that are needed. Then once the Dam is taken out, there are no more costs. A repaired Dam will require annual dollars to operate not to mention the annual controversy that will occur with every 100 year storm that seems to be ever more common. You know people will blame their property flooding on poor management of the dam whether it is true or not. Also, I know there is money available for dam removal. Why? Because people nationwide know it is the right thing to do. If the county decides to go this route, I will pledge my services (and my national rolodex) to help find these dollars if this is of any assistance to you.

3) Property Values: There is little to no property value difference with either decision. Please do not be fooled by this argument. People like to live on a river just as much as they like to live on an impoundment. I do feel for those who bought a home so they could boat on an impoundment, just I as feel for those who live near a new high rise and lose part of their view. It is part of life, things happen, but they are not losing property dollar value as many have shared.

4) Recreation: The Dam has been released for the past four to six years. There has not been an impoundment in this time. The ecology of the river is coming back. People are using canoes and kayaks to explore the area even more than before! We are still teaching people how to canoe in the area because the river runs slow and deep even without the impoundment. There are beautiful islands to take kids to. It is very beautiful as it is right now, with no impoundment. Have you been there to see it? If not, I'm happy to take you. You should know, first hand, on which you are voting.

This decision in Milwaukee, like that of the Streetcar and the Arena, will be a lasting one for generations to come ... not just for us humans but all of species that share this Milwaukee River ecosystem. The dollars are smaller than the Streetcar and Arena in this case, but we are still talking on the order of millions of dollars.

I am not alone in this view that I share. Here are a few others who have weighed in on the evidence and come to the same conclusion publicly as I -- that it is time to take down the Estabrook Dam:

Kevin Shafer, Milwaukee Metropolitan Sewer District Executive Director

Val Klump, Assoc. Dean of Research UWM Great Lakes Water Institute

Gus Frank, Forest County Potawatomi Community Chairman

Henry Kolz, Wisconsin Council of Trout Unlimited Executive Committee

Kimberly Gleffe, River Revitalization Foundation Executive Director

Jennifer Bolger, Executive Director of Milwaukee Riverkeeper

Ernst Ulrich Franzen, Editorial Page Editor for the Journal Sentinel

Juli Kaufmann, President, Fix Development

Julilly Kohler, President, Kane Place LLC

Lynde B. Uihlein, Founder, Brico Fund

Ian Abston, Founder & Director of Development, Newaukee

Nathan J. Smallwood, Executive Director, Schlitz Audubon Nature Center

Timothy J Ehlinger, Associate Professor, Aquatic Ecology, Stream Restoration and Sustainable Development, University of Wisconsin-Milwaukee

Kristin Gies, Executive Director, Mequon Nature Preserve

Jessica Jens, Executive Director, Riveredge Nature Center

John Gruda, Writer & Historian

I was in attendance at the Parks Energy and Environment Committee meeting where the County Parks Department, the very agency within your system who had been charged with the task of gathering information related to the Dam, shared their well-researched data. From this data they made a strong recommendation to the committee and thus the board to remove the dam. However, through a procedural process that was pushed forward at the very end of this meeting none of their report, or the time taken by the many citizens in the room, was moved forward for board consideration.

I implore you to do what is in your power to make a wise and deliberate decision for the people of this county, for protecting our tax dollars, and for the natural system that sustains us by urging County Supervisor Marina Dimitrijevic to put County Executive Chris Abele's veto on the agenda. By placing it on the agenda, it will allow you to get into the substance of the arguments for why the dam should be removed providing you significant information giving you the opportunity to make this important decision from an informed platform.

Thank you for your time and your service.

Sincerely,

Ken Leinbach
Executive Director
Urban Ecology Center
1500 E. Park Place

Milwaukee, WI 53211
(414) 964 8505
kleinbach@urbanecologycenter.org

Pirrung, Don

From: Dargle, John <John.Dargle@milwaukeecountywi.gov>
Sent: Tuesday, October 21, 2014 9:29 PM
To: Pirrung, Don
Subject: Fwd: Estabrook Dam

John Dargle, Jr.
Director, Milwaukee County Parks

Begin forwarded message:

> **From:** Kimberly Gleffe <kgleffe@riverrevitalizationfoundation.org>
> **Date:** October 21, 2014 at 3:14:54 PM CDT
> **To:** <CountyExec@milwaukeecountywi.gov>
> **Cc:** "'Dargle, John'" <John.Dargle@milwaukeecountywi.gov>
> **Subject: Estabrook Dam**
>
> Dear Chris,
> I am happy to support the recommendation by Milwaukee County Parks to remove the Estabrook Dam and support your budget line item which includes funding for removal. The health of the river, its adjoining lands, and the vitality of the ecosystem and the watershed are of utmost importance for our region. Thank you for taking a stand on this issue and leading by example.
> Respectfully,
> Kimberly
>
> Kimberly A. Gleffe
> Executive Director
> River Revitalization Foundation
> **NEW ADDRESS**: 2134 N. Riverboat Rd.
> Milwaukee, WI 53212
> 414-271-8000
> www.riverrevitalizationfoundation.org

RIVER
REVITALIZATION
foundation

2134 N. Riverboat Rd.
Milwaukee, WI 53212
414-271-8000
www.riverrevitalizationfoundation.org

October 23, 2014

Mr. Chris Abele, County Executive
Milwaukee County Courthouse
901 N. 9th St. #306
Milwaukee, WI 53233

Dear County Executive Abele,

On behalf of the Board of Directors of the River Revitalization Foundation, Milwaukee's urban rivers land trust, I am writing to support the recommendation by Milwaukee County Parks to remove the Estabrook Dam and support your budget line item which includes funding for removal. The health of the river, its adjoining lands, and the vitality of the ecosystem and the watershed are of utmost importance for our region. This action aligns with our mission and the recommendations in the *Riverway Plan* (1991) to make decisions that improve the environmental quality of the Milwaukee River Basin. Thank you for taking a stand on this issue and leading by example.

Respectfully,

Kimberly A. Gleffe

Kimberly A. Gleffe
Executive Director

Enc. Board of Directors list

Cc: County Board of Supervisors
Mr. John Dargle, Parks Director

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The Case for Removing Estabrook Dam
Common Questions and Answers

Brief History & Facts

Milwaukee County built Estabrook Dam in 1937 to elevate water levels for recreation following some blasting of bedrock upstream and river straightening to alleviate flooding. The Dam has 3 parts: a gated section (with "sharks teeth" that capture woody debris and protect dam gates); the spillover section, which acts like a waterfall when the dam is closed; and an island that the gated and spillover sections rest upon. Historically, the Dam was closed during summer months and opened from fall through spring to allow for fish migration.


Estabrook Dam gated section with sharks teeth

Over time, Milwaukee County failed to maintain and repair the Dam per State Dam Safety regulations. Due to hazardous conditions created by the ill-maintained structure, in 2009, the Wisconsin Department of Natural Resources (WDNR) ordered the County to open the Dam gates until repair or abandonment occurred. The original deadline for this work was July 27, 2012, which was subsequently extended by WDNR to December 31, 2014.

Milwaukee Riverkeeper sued Milwaukee County for failure to operate and maintain the Dam in good working condition and in 2012, the Milwaukee County Circuit Court declared Estabrook Dam a public nuisance. The County prepared an Environmental Assessment (EA), which identifies and analyzes the alternatives available to address the Dam, including repair, a rock ramp alternative, or removal of the Dam. The alternative the County chooses must comply with both the WDNR's repair/abandon order and the Milwaukee County Circuit Court's order to remedy the nuisance. If the County chooses an option that does not comply with these Orders, Milwaukee Riverkeeper will go back to the WDNR and the Court to advocate for a remedy that abates the nuisance.

Below are some of the most common questions that we receive regarding the Dam followed by answers detailing our position in favor of dam removal.

1) What is the current status of decision-making on the Estabrook Dam?

The Milwaukee County Parks Department is currently conducting an Environmental Analysis (EA) for this project to identify and analyze a variety of alternatives for the Dam. The Parks Department has narrowed down the range of alternatives to three, including repair, removal and a "rock ramp" alternative. On October 28, 2014, the Parks Department will recommend removal of the Dam as the preferred alternative to the Parks, Energy & Environment Committee (Parks Committee). The Parks Committee will vote on the recommendation and then the decision will go to the full County Board of Supervisors for a vote on November 6, 2014. The County Executive has also included removal of the Dam in his 2015 Annual Budget.

2) Why is an Environmental Assessment being conducted? Can't it be ignored?
The EA is an important step in the process that should not be ignored. Dams are regulated by the WDNR. The WDNR issues an operational order or permit to any dam operator in the state. To issue an operational order, the WDNR is required by law (Chapter 31 of Wisconsin Statutes) to prepare an EA. In other words, regardless of the alternative chosen by the County, the WDNR will need to prepare an EA before issuing an order allowing the County to operate the Dam. In addition, because the Estabrook Dam sits on an island owned by the Bureau of Land Management (BLM), federal law also requires an EA before BLM can grant the County access to make any modifications to the Dam. It should also be noted that Milwaukee County may also need Army Corps of Engineers and FEMA approvals for any major project affecting wetlands or water levels during flooding events, which would also likely require an EA.

3) Why do people want to keep the Dam?
A group of upstream homeowners have formed a group called MRPA or the Milwaukee River Preservation Association, and they are a vocal minority. They believe their housing values will be negatively affected by dam removal. In addition, several homeowners own motorized boats that historically operated on the impoundment. Dam removal would make it difficult to use most motorized boats due to lower water levels. Non-motorized navigation by canoes, kayaks, and other small watercraft would still be possible seasonally, similar to upstream and downstream sections of the Milwaukee River. While the number of affected homes in the impoundment has been stated as around 300 during public meetings, the vast majority of those homeowners would like to see dam removal due to flood risk posed by the Dam and the requirement to purchase expensive flood insurance due to Federal FEMA regulations.

4) What are the benefits of Dam removal versus repair? What harm is the Dam causing?
The Dam causes major water quality problems. Dams impound or back up water upstream, which can increase water temperatures. Warm water holds less oxygen and low oxygen levels harm fish and aquatic life. Warm water, in combination with excess nutrients, exacerbates algae growth. When algae are broken down naturally in the stream by bacteria, more oxygen is consumed, which can exacerbate the problem of low oxygen levels. Sediment is another concern. Dams cause sediment to build up in the impoundment area, which can negatively affect fish and mussels. The lack of sediment moving downstream of a dam starves downstream areas of sediment needed to create riparian habitats, sandbars, floodplains, and other river features. Eventually, an impoundment will fill up with sediment requiring it to be dredged, which is very costly.

Historically, the County operated the Estabrook Dam by opening and closing the gates on a seasonal basis (open in the fall and close in the spring). When the gates were open, large amounts of sediment would be flushed downstream in one big release rather than slowly over time. These large volumes of sediment can cause harm to fish eggs, mussels, and other aquatic life downstream. While some sediment movement is natural and essential to create riparian habitat and to provide nutrients to downstream areas, these large flushes are unnatural and negatively impact the river system. Furthermore, the historic Dam operations created unnatural water level manipulations. These abnormal seasonal fluctuations can cause "dry out" or "freeze out" of amphibians and other aquatic life that live in the impoundment. They lay their eggs along the shallow shoreline area and when that water disappears with the opening of the gates, the eggs or individuals dry and/or freeze.

Sedimentation over the years has made the impoundment very shallow, even prior to 2009 when the Dam was ordered open. This can exacerbate water temperature and oxygen issues, as the depth of water column decreases in the impoundment.

Impediment of fish passage is another harm caused by the Dam. Removal of the Dam would allow fish to swim upstream to spawning habitats. Healthy and sustainable fisheries are important to paddlers, fishermen, and the community at large. Ozaukee County spent over $8 million upstream to improve fish passage, and removal of Estabrook Dam would expand the benefit of those projects.

Motorized boating would not likely be an option in the impoundment with removal of the Dam. However, other recreational opportunities such as paddling and fishing would be improved. Removing the Dam would also restore the natural and wild aspect of the Milwaukee River in the Estabrook and Lincoln Park areas. Overall, the ecological health created by a free flowing river offers greater long term value than maintaining the impoundment.

5) How much does Dam removal cost versus Dam repair? And what is the life expectancy of the Dam?
The table below includes the costs associated with the various options for the Dam. These were taken from the EA developed by AE Comm. The EA states that repairing the Dam now will provide approximately another 20 years of use with proper operation and maintenance, and thus the overall life expectancy of the Dam is probably an additional 20 years from today, assuming it is maintained. The Dam will be nearly 100 years old then, rehabilitation costs are anticipated to grow, and rebuilding of the Dam will likely be the next option.

Alternative	Estimated Capital Cost	Estimated Annual Operations and Maintenance Cost	Total Present Worth Estimated Cost (assuming 20 year life expectancy)
Dam Removal	$1,674,000	$0	$1,674,000
Rock Ramp Option (gate section removal and 6.3 ft. high rock ramp constructed)	$2,419,000	$55,000	$3,318,000
Dam Repair	$2,518,000	$160,000	$5,134,000

The estimates in the table are 3 times higher for repair than to remove the Dam. The operation and maintenance costs for repair do not include administrative costs associated with state and federal permitting or future dredging costs when sediment builds up in the impoundment. The repair option also does not include a realistic cost for fish passage. Just leaving a few gates open, does not mean that the fish will be attracted to those areas or be able to swim upstream through intense flows.

6) Is dredging being considered as part of the costs? Isn't dredging already happening?
The WDNR is just starting the second phase of a dredging project to remove contaminated sediments (from legacy industrial activity) just upstream of the Dam. The first phase of the project was completed several years ago to clean up the lower portion of Lincoln Creek and the western oxbow of the Milwaukee River in Estabrook Park, as well as an earlier cleanup near Blatz Pavillion. These projects were funded by the US EPA as part of the Great Lakes Legacy Program, and concentrated on hot spots of contamination. The dredging was not aimed at increasing depth of water for motorized navigation.

Dredging to enable navigation was not included in the EA. If the Dam were repaired, there would be likely dredging costs for sediment removal in the near future to keep it open for motorized boat recreation. We believe that the costs associated with the continual maintenance and operation of the

Estabrook Dam is a poor use of taxpayer money. The best option is to return the river to a natural, free-flowing state.

7) Aren't you exaggerating the structural and operational problems of the dam?

The most recent repair/abandon order from the WDNR in 2009 goes into significant detail about the structural problems of the dam in the "Findings of Fact" section of the Order, which is what we are relying on. This Order also identifies work that still needed to be done from 1995, 2004, and 2008 Dam Safety Inspection reports. Aside from the structural problems of the Dam, the original design and operational procedures for the Estabrook Dam are not good for the environment. To have exaggerated increases and decreases of water levels on a river or a lake wreaks havoc on the ecosystem as a whole and the flora and fauna. At the time it was constructed, the dam gates were not supposed to be opened and closed each season despite how the County operated it historically. While some seasonal fluctuation in water levels is normal, the water level variability caused by draining of the impoundment was not normal and was harmful. The Dam is an old, outdated structure in the river that does not improve water quality or wildlife habitat.


A picture of the serpentine spillway from 2010, undergoing some emergency repairs.

8) Does the Dam help reduce flooding or cause flooding? Aren't you exaggerating the problems with operating the gates during rainstorms?


June 2008 storm event: water level is almost above top of gate and the same level upstream and downstream of the dam structure.

There is a widespread misconception that the Estabrook Dam helps to prevent flooding upstream; it does quite the opposite. Dams raise water levels upstream. During smaller to medium storms, gates were sometimes opened to drop water levels upstream. This caused biological damage as detailed above, but also posed a major safety concern for paddlers and fishermen, both upstream and downstream of the Dam (the safety sirens cannot be heard very far upstream or downstream from the Dam). During more severe storm events, like the 100-year storm and greater, the Dam gates are generally underwater and not useful for flood management.

A new hydraulic analysis by the Southeast Wisconsin Regional Planning Commission (SEWRPC) has shown that when the dam gates are closed, flood risk increases upstream, and in a 100-year storm, water elevations would be increased by up to 1.5 feet at the Dam. Historically, there was no designated dam operator and there were problems with opening and closing gates in a timely fashion during heavy rains. If

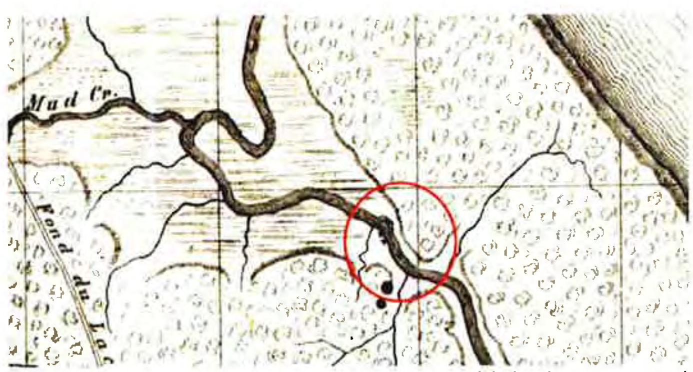

Estabrook Dam on May 11, 2004. Note only two gates were opened.

the County waited too late, it was impossible due to the pressure on the dam gates from the water. WDNR's current operational order requires that when dam gates are opened that only 6 inches of water is drained at a time, but the County did not operate the Dam in that way. Several of the gates have not worked properly for years.

Hypothetically, if the County Board decides that the existing policy to repair the dam will stand, then the County will need an operational order from WDNR. That process will determine how the dam will be operated in the future. It is unlikely the DNR will allow the County to operate the dam the way it did historically due to the damage that gate opening and closing causes to the river and wildlife. In other places in the State, the WDNR has been requiring "full pool" impoundments, meaning the gates would have to remain closed permanently. If the gates were closed permanently, flooding would become an even more significant issue for the homeowners on the impoundment and upstream. Milwaukee County could also be liable for future flood damage, if the Dam gates were not opened in a timely fashion during major storm events. Flood insurance premiums are higher for upstream residents as a result of the Dam. Removal of the Dam would likely decrease those premiums.

While it is easy for the County Supervisors to vote on what they would like the policy of the County to be, it is another thing to implement that policy. The Parks Department has to live with the policy day in and day out. The Parks Department is very understaffed right now and has been for years. The Parks Department is in charge of operating the Dam and running all the parks throughout the system, and has said they cannot ensure that there will be a staff person available during a storm to open the gates. They are calling for removal. The Parks Department has concerns about how the Dam operated in the past and how it will be operated in the future if repair remains the policy. A responsible policy would take into account the limitations of the staff, and the current policy does not. Based on the facts, removal is best for the river and the community as a whole to avoid these issues related to flooding and the operation of the dam.

9) Doesn't keeping the Dam best replicate the original condition of the Milwaukee River?



Increase Lapham map of the project area, published in 1855, and showing Dam area circled with island. This shows extensive filled wetland but not a lake.

Prior to the original construction of the Dam, the river had higher water levels. Blasting of bedrock and straightening of an "S curve" upstream to alleviate flooding decreased the flow of the river around the Dam area. The Dam was constructed to increase water levels; however, no lake existed above the Dam historically. The river was a narrow, deep channel that was surrounded by wetlands that would flood during heavy rains (see pic at left).

Dam removal will not return the river to its original state, but repair doesn't best replicate the original condition of the Milwaukee River either. No alternative currently under consideration by Milwaukee County would do that. Removing the dam will restore the river to a natural condition and a free-flowing river. A natural state that is the most protective of water quality and wildlife habitat includes removal of the dam.

10) If the BLM does not own the island, shouldn't the EA be ignored since they are requiring it?

Original government survey map from 1835, before statehood, showing two islands still in this area today.

We do not agree with claims that the BLM does not own the island that the Dam rests on, and more importantly, the BLM is still asserting their ownership of the island. Maps going back to the original government survey of the area in 1835 show two islands in this location: the "dam" island; and one to the south. Ultimately, this is an issue to be decided by the BLM and Milwaukee County. We do think that this argument is a red herring that is causing undue delay because whether the BLM owns the island should not be a reason to ignore relevant, important, and up-to-date scientific data about the impact of the dam. Regardless of the island ownership issue, the WDNR will also need an EA in order to make their decision on whether or not to issue an operational order for the Dam, should the County decide to repair. In other words, BLM's ownership of the island should not be a reason to ignore the EA.

11) If the dam is removed, what will be done with the sediment that has accumulated in the impoundment and the vegetation that has grown in since the dam was ordered open in 2009?

As mentioned above, the WDNR has done extensive dredging of contaminated sediments as a direct result of the build-up of sediment and has plans to do more dredging directly above the Dam. If the Dam were removed, water levels would not be expected to change significantly from what they are today (and have been since 2009). Efforts to remove non-native invasive vegetation and encourage re-establishment of more desirable native vegetation would likely be required. There are also legacy piles of debris from the Dam that are unsightly and have been stacked next to the dam for years, if not a decade or longer. There are several groups that could help with this effort, as well as funding sources that could help finance this work, but none has been willing to fundraise without knowing the ultimate fate of the Dam. Significant restoration and shoreline restoration should be a component of any project alternative selected.

12) Nearly 80 years of development has been based on the elevated water level created by the Estabrook Dam. Aren't property owners entitled to enjoy the same water level that they have had since dam construction?

It is true that past development has occurred based on the water level created by the dam (which is not the original river water level or river location), but that shouldn't negate taking a hard look at this dam to determine the best outcome. This includes not only the cost to fix it (which is three times higher than removal), the maintenance required (which currently doesn't consider sediment dredging and other costs), and the likelihood that within the next 20 or so years, the County will have to take it out or rebuild it, and incur significant capital costs due to its limited life expectancy. Maintaining the dam will also bring continued environmental impacts and flood risks.

Not every dam can or should be removed, but it makes sense to take a fresh look at the facts and make a reasoned decision. It does not make sense to spend millions to fix this dam, given the maintenance problems that are likely to continue, to only have to spend millions more in the near future on more repair costs, rebuilding, or removal of the dam. Instead, it is best to get on with the restoration work now and try to ameliorate the impacts to existing infrastructure. Restoration will improve access which will increase the area's recreational use as well. Arguably, the water level after removal of the dam will likely be the same as it is today with the gates open. Removal of some of the contaminated sediments will also help with navigation for human-powered craft. We have suggested that the WDNR and County create a deeper channel or thalweg as part of the dredging plan for Phase II, but they were unwilling to do that not knowing the future of the Dam and water level.

13) What about claims that Milwaukee County would be liable for presumed lost property values if the Dam were to be removed?

Property values after a small dam is removed do not decrease. *See* Bill Provencher, Helen Sarakinos and Tanya Meyer, *Does Small Dam Removal Affect Local Property Values? An Empirical Analysis.* Contemporary Economic Policy (ISSN 1074-3529); Vol. 26, No. 2, April 2008, 187-197. This published study included an analysis of various small dam removals and the effect on property values in Wisconsin, and concluded that property values do not decrease with small dam removal. MRPA is making bald assertions about property value loss without any facts or support. This argument is a distraction from the issue at hand and should not be given any weight. The County is currently liable to the WDNR's Order to repair or abandon the dam and the Court's Order declaring the dam a public nuisance that needs to be abated.

14) What about Riverkeeper's lawsuit? What if the County Board decides to repair the Dam?

Repair of the Estabrook Dam will not abate the public nuisance and Milwaukee Riverkeeper would continue to pursue its lawsuit against the County for a remedy that will satisfy the Court's Order. A temporary fix of the Dam is not acceptable because the remedy must permanently abate the nuisance and as explained above, the repairs, as well as the dam structure, have a useful, limited life. Removal is the best alternative for addressing the concerns and issues cited in the WDNR's Order to repair or abandon. Removal is the only option that will abate the nuisance permanently and avoid further litigation costs associated with the current lawsuit. Removal is the only option that would eliminate further operations and maintenance expenses and possible dredging expenses. Removal is the only option that decreases the County's liability with respect to increased flood risk posed by the Dam.

Resources:

Milwaukee Riverkeeper website page: http://www.milwaukeeriverkeeper.org/content/help-us-remove-deadbeat-estabrook-dam

Environmental Assessment for Estabrook Dam. AE Comm. Draft dated August 2014. Available: http://county.milwaukee.gov/ImageLibrary/Groups/cntyParks/Planning/Construction/Estabrook-Dam/Estabrook-Scoping/DRAFT_EstabrookDamEnvAssmnt090.pdf

SEWRPC hydraulic analysis. April 25, 2014. Available: http://county.milwaukee.gov/ImageLibrary/Groups/cntyParks/Planning/Construction/Estabrook-Dam/Estabrook-Scoping/ESTABROOKDAMEAHYDRAULICANALYSI.PDF

Milwaukee County Board of Supervisors contact information can be found here (or on our website): http://county.milwaukee.gov/CountyBoard

Contact the entire Milwaukee County Board at once here: http://county.milwaukee.gov/CommitteeWhole/ContactCBWhole.htm

Pirrung, Don

From: Dargle, John <John.Dargle@milwaukeecountywi.gov>
Sent: Thursday, August 28, 2014 12:35 PM
To: Haley, Kevin; Keegan, Jim; Pirrung, Don
Cc: Schloesser, Laura
Subject: Fwd: follow up

FYI

John Dargle, Jr.
Director, Milwaukee County Parks

Begin forwarded message:

> **From:** "Henry Koltz" <hek@sdelaw.com>
> **Date:** August 28, 2014 at 11:49:27 AM CDT
> **To:** "'Zapfel, John'" <John.Zapfel@milwaukeecountywi.gov>, "'Henry Koltz'" <hek@sdelaw.com>, <CountyExec@milwaukeecountywi.gov>, <John.Dargle@milwaukeecountywi.gov>
> **Cc:** "'Linn Beck'" <chlbeck@att.net>, <mikek.trout@yahoo.com>, <garystoychoff@att.net>, "'Kim McCarthy'" <KMCCARTHY2@new.rr.com>, "'Jim and Jane Wierzba'" <hoke4me@aol.com>, <garystoychoff@att.net>, <flytier@milwpc.com>, <kruser2@new.rr.com>, "'Bill Heart'" <wwheart@centurytel.net>
> **Subject: RE: follow up**
>
> Hi John, et al.
>
> The Executive Committee of the Wisconsin Council of Trout Unlimited has considered the Estabrook Dam issue and has voted whether to take a position regarding it. The votes received unanimously support removal of the dam, and mitigation of toxic sediment impounded behind it. We believe that the dam is an unnatrual impediment to stream flow, greatly restricts or eliminates the natural movement of numerous fish species up and downstream, impounds toxic sediment, and in general negatively impacts the quality of the Milwaukee River system.
>
> Wisconsin Trout Unlimited has 21 Chapters, and over 5,200 members. It's largest Chapter, the Southeast Wisconsin Chapter, has roughly 1,000 members and includes Milwaukee County within its chapter territory. I believe that the Southeast Wisconsin Chapter has, in the past, indicated a willingness to lead or take part in community volunteer workdays to help restore vegetation, etc., in the dam area once it is removed.
>
> I apprecaite your time, and please let me know if there are any quesitons that the Wisconsin Council of Trout Unlimited can answer regarding this matter.
>
> Henry E. Koltz
> Chair, Wisconsin Council of Trout Unlimited
>
> **From:** Zapfel, John
> **Sent:** Friday, August 22, 2014 11:30 AM
> **To:** 'hoke4me@aol.com'
> **Subject:** follow up

Jim,

Following up from our conversation, there is going to be a public open house will be held Wednesday, September 3, 2014 from 6:00 p.m. - 8:00 p.m. at Nicolet High School on the Estabrook Dam Environmental Assessment Draft. At the open house there will be question & answer opportunities as well as public comments on the draft will also be accepted. Details on the open house attached.

More information and public comment form available at countyparks.com Public comments will be accepted through September 17, 2014 at
http://surveymonkey.com/s/EstabrookDamComments

In addition to the surveymonkey.com, if anyone would like to make written comment, they can send messages to:
County Executive Chris Abele, CountyExec@milwaukeecountywi.gov
John Dargle, Parks Director: John.Dargle@milwaukeecountywi.gov

If you have any questions, please let me know.

John T. Zapfel
Deputy Chief of Staff
Office of Milwaukee County Executive Chris Abele
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Pirrung, Don

From:	Johnson, Collin <C.Johnson@glendale-wi.org>
Sent:	Thursday, March 12, 2015 2:41 PM
To:	Pirrung, Don
Subject:	Estabrook Dam Memo

Mr. Pirrung:

With regard to the memo dated September 8, 2014 that I provided to Milwaukee County regarding the Estabrook Dam, it is important to note that the memo was drafted to summarize the *Environmental Assessment for Estabrook Dam* prepared by AECOM, for the benefit of the Glendale Common Council.

It is important to note that the Council took no action as a result of the memo. Furthermore, the memo expresses my professional opinion as a Certified Floodplain Manager and is in no way reflective of the position or opinions of the Glendale Common Council or the City of Glendale.

Regards,

Collin M. Johnson, CFM
Director of Inspection Services/
Floodplain Administrator
CITY OF GLENDALE

Direct: 414.228.1711
Fax: 414.228.1725
Email: c.johnson@glendale-wi.org
Website: www.glendale-wi.org

City of Glendale
City Services
5909 North Milwaukee River Parkway
Glendale, Wisconsin 53209-3815
(414) 228-1711

Memorandum

To: Richard Maslowski – City Administrator

From: Collin Johnson – Director of Inspection Services

Date: 8/8/2014

Re: Estabrook Dam

On September 18, 2014, the Milwaukee County Board will decide which of the four final alternatives to formally adopt and ultimately proceed with. Since the City of Glendale and a good number of its residents may be impacted by that decision, I felt it was important to advise and inform the Council of the results of that environmental assessment should they choose to take a position regarding the proposed alternatives. I am providing this memo simply to summarize the findings of those studies and subsequent reports in a simpler, condensed format that is hopefully easier to understand.

As you are aware, in 2008, the WI-DNR issued an Administrative Order to Milwaukee County to repair the Estabrook Dam. Separating the dam and spillway is an island that is owned by the Bureau of Land Management. As a result, the BLM required Milwaukee County to conduct a comprehensive environmental assessment to determine what, if any, impacts the work would have on a variety of environmental issues.

The assessment included 13 primary categories detailed on the document titled: *Excerpts from Draft 1 – Environmental Assessment for Estabrook Dam*, which was prepared by AECOM. The Environmental Assessment covered the six remove/repair alternatives listed below:

<u>Identification of Alternatives:</u>

Alternative 1 -	Rehabilitate the Dam
Alternative 1A -	Rehabilitate the Dam and Add Fish Passage
Alternative 2 -	Abandon and Remove Dam
Alternative 3 & 3A -	Abandon and Remove the Dam, Providing a 5.5 Foot Rock Ramp to Facilitate Fish Passage (Alt. 3A includes a 4.0 Foot Rock Ramp)
Alternative 4 -	Gated Spillway Removed, Serpentine Overflow Spillway Lowered, and 6.3-Foot High Rock Ramp Constructed
Alternative 5 -	No Action
Alternative 6 -	New Dam

Of these options, four were deemed feasible after evaluation of their environmental benefits, impacts, and related costs which are detailed below:

Alternative 1A -	Rehabilitate the Dam and Add Fish Passage
Alternative 2 -	Abandon and Remove Dam
Alternative 3A -	Abandon and Remove the Dam, Providing a 4.0 Foot Rock Ramp to Facilitate Fish Passage
Alternative 4 -	Gated Spillway Removed, Serpentine Overflow Spillway Lowered, and 6.3-Foot High Rock Ramp Constructed

SEWRPC then completed a comprehensive hydraulic analysis for each of the four alternatives to determine the potential impact to upstream water depths on the Milwaukee River during both median and flood conditions. Those impacts are detailed on the attached document titled: *Table 6 Maximum Water Depth Under Median Flow Conditions. (It is important to note that these are "medium flow conditions" and not flood flow conditions.)*

The impact each of the four alternatives can generally be associated with those properties located in the River Forest Subdivision and impacted by the current one-percent chance interval flood zone more commonly referred to as the 100-Year Flood Zone. The results of the hydraulic analysis for each of the four alternatives are detailed in the SEWRPC document titled: *HYDRAULIC ANALYSES FOR THE ESTABROOK DAM ENVIRONMENTAL ASSESSMENT*, Dated April 8, 2014 and revised April 25, 2014 of which you have a copy. The impact to the one-percent chance (100-Year) flood elevations for each of the alternatives results are excerpted and highlighted below for reference:

Alternative 1 – **<u>Rehabilitate the Dam and Add Fish Passage</u>**

Alternative 1 water surface elevations are shown in Table 1. As described above, the rehabilitated dam alternative is the same as the existing conditions model. Therefore there is no difference in water surface elevations as compared to existing conditions. Under normal (median) flow conditions, which assume that the Estabrook dam gates are closed, the maximum water depth of the lower reach ranges from 7.4 to 8.7 feet. The maximum depth of the middle reach ranges from 6.3 to 9.2 feet, and the maximum depth of the upper reach ranges from 2.4 to 9.1 feet

Alternative 2 - **<u>Abandon and Remove Dam</u>**

Under 1-percent-probability flood flow conditions, the water surface elevation in the lower reach would decrease between 0.7 and 1.5 feet as compared to existing conditions. The 1-percent-probability elevation in the middle reach would decrease between 0.5 and 0.7 foot, and the 1-percent-probability elevation in the upper reach would decrease by up to 0.5 foot. Under normal (median) flow conditions, the water surface elevation in the lower reach would decrease between 3.7 and 7.5 feet with a maximum water depth ranging between 0.7 and 2.5 feet. The normal elevation in the middle reach would decrease between 4.5 and 5.4 feet with a maximum water depth ranging between 1.6 and 4.5 feet. The normal elevation in the upper reach would decrease between 0.5 and 4.6 feet with a maximum water depth ranging between 0.8 and 4.5 feet.

Alternative 3 - **Abandon and Remove the Dam, Providing a Rock Ramp to Facilitate Fish Passage**

Alternative 3 water surface elevations are shown in Table 3. A 5.5-foot-high rock ramp was modeled in order to maximize the normal impoundment level upstream of the ramp while clearly meeting the definition of a dam that would not be regulated under Chapter NR 333, "Dam Design and Construction," of the Wisconsin Administrative Code. Chapter NR 333 exempts dams with storage capacities of more than 50 acre-feet (as would be the case for an impoundment created upstream of a 5.5-foot-high rock ramp in the River), but a structural height of six feet or less, assuming the dam is not likely to endanger life, health or property. While the 5.5-foot-high rock ramp alternative results in a decrease in water surface elevations for the normal (mean and median) flow conditions analyzed relative to existing conditions, including at each storm sewer outfall, it results in an increase in water surface elevations under each of the flood flow conditions analyzed, including the 1-percent-probability flood.

Alternative 3A - **Abandon and Remove the Dam, Providing a Rock Ramp to Facilitate Fish Passage**

Since Alternative 3 resulted in an increase in the 1-percent-annual-probability flood flow profile upstream of the rock ramp, an additional rock ramp alternative was analyzed. A four-foot-high rock ramp was modeled in order to maximize the impoundment level upstream of the ramp while not causing an increase in the 1-percent-probability flood profile. The rock ramp slopes of this alternative were reduced as compared with Alternative 3 due to the lower height of the crest and the desire to maintain the same design "foot print" and ramp cross-section locations in order to provide water surface elevation comparisons consistent with Alternatives 1, 2, and 3. The four-foot high rock ramp would be expected to result in a decrease in water surface elevations for each analyzed flow condition relative to existing dam conditions, including at each storm sewer outfall. Alternative 3A water surface elevations are shown in Table 4.

Under 1-percent-probability flood flow conditions, the water surface elevation in the lower reach, also defined for this alternative as the reach between the rock ramp and W. Hampton Avenue, would decrease between 0.1 and 0.2 foot as compared to existing conditions. The 1-percent-probability elevation in the middle reach would decrease 0.1 foot, and the 1-

percent-probability elevation in the upper reach would decrease by up to 0.1 foot. Thus, this alternative would meet regulatory requirements set forth in local zoning ordinances and Chapter NR 116 of the *Wisconsin Administrative Code* that do not permit activities which would increase the 1-percent-annualprobability flood stage unless easements were obtained from all affected property owners and a Conditional Letter of Map Revision (CLOMR) were obtained from FEMA prior to any construction.

Under normal (median) flow conditions, the water surface elevation in the lower reach would decrease 3.1 feet with a maximum water depth ranging between 4.3 and 5.3 feet. The normal elevation in the middle reach would decrease between 2.7 and 3.1 feet with a maximum water depth ranging between 3.6 and 6.5 feet. The normal elevation in the upper reach would decrease between 0.5 and 2.7 feet with a maximum water depth ranging between 1.5 and 6.4 feet.

Alternative 4 - **Gated Spillway Removed, Serpentine Overflow Spillway Lowered, and 6.3-Foot High Rock Ramp Constructed**

This alternative was developed to increase the elevation of the impoundment water surface as compared to Alternative 3A, while not causing an increase in the 1-percent-probability flood profile by moving the location of the rock ramp to the site of the removed gated spillway portion of the dam and maintaining the serpentine overflow spillway. Since the overall width of the Milwaukee River is greater at Estabrook Dam than at the location of the rock ramp included under Alternatives 3 and 3A, utilizing both a rock ramp at the gated spillway site and the overflow spillway with a lowered crest in tandem to establish the impoundment level allows for a greater conveyance capacity at a given headwater elevation to pass flood flows as compared to Alternatives 3 and 3A, while enabling establishment of a higher ramp crest to increase the elevation of the impoundment water surface under normal flow conditions. However, under this alternative, both the 6.3-foot-high rock ramp and the serpentine overflow spillway would meet the definition of a dam that would be regulated under Chapter NR 333.

The 6.3-foot- high rock ramp and lowered overflow spillway alternative would be expected to result in a decrease in water surface elevations upstream of the dam for the normal (mean and median) flow conditions and for the 2-, 1-, and 0.2-percent-probability flood flow conditions relative to existing dam conditions, including at each storm sewer outfall. Under the 10-percent-probability flood it would not be expected to result in hydraulically significant differences in water surface elevations. Alternative 4 water surface elevations are shown in Table 5.

> Under 1-percent-probability flood flow conditions, the water surface elevation in the lower reach, would decrease between 0.2 and 0.4 foot as compared to existing conditions. The 1-percent-probability elevation in the middle reach would decrease 0.2 foot, and the 1-percent-probability elevation in the upper reach would decrease by up to 0.2 foot. Thus, this alternative would meet regulatory requirements set forth in local zoning ordinances and Chapter NR 116 of the Wisconsin Administrative Code that do not permit activities which would increase the 1-percent-annual-probability flood stage unless easements were be obtained from all affected property owners and a Conditional Letter of Map Revision (CLOMR) were obtained from FEMA prior to any construction.
>
> Under normal (median) flow conditions, the water surface elevation in the lower reach would decrease 1.2 feet with a maximum water depth ranging between 6.2 and 7.5 feet. The normal elevation in the middle reach would decrease 1.2 feet with a maximum water depth ranging between 5.1 and 8.0 feet. The normal elevation in the upper reach would decrease between 0.4 and 1.2 feet with a maximum water depth ranging between 1.9 and 7.9 feet.

Tables 6 & 7 from the SEWRPC *Hydraulic Analysis for Estabrook Dam Environmental Assessment* detail the effects each of the alternatives would have on the water elevations under both the median and flood flow conditions between W. Silver Spring Drive and W. Bender Road. I reference only this area as it is the only area within Glendale that is impacted by the dam and each of the proposed alternatives. It is referenced as the "subreach of the Upper Reach" area of the Milwaukee River on *Tables 6 & 7.*

Water depth impacts from *Tables 6 & 7* from the SEWRPC document titled: *HYDRAULIC ANALYSES FOR THE ESTABROOK DAM ENVIRONMENTAL ASSESSMENT* are summarized below:

	Median Flow (240 cfs approx.)	1% Flood Flow (14,800 cfs approx.)
Existing Conditions	2.4 to 5.0	
Alternative 1 & 1A	2.4 to 5.0	0
Alternative 2	1.5 to 2.1	0 to -0.3
Alternative 3	1.7 to 3.4	0 to 0.4
Alternative 3A	1.5 to 2.5	0 to -0.1
Alternative 4	1.9 to 3.8	0 to -0.1

As shown on the tables, a drop in water surface elevation during median flow does not correlate to reduced flood elevations as one might think. A 0.3 foot drop in water elevation equates to 3.6 inch drop in flood elevation. It is important to note that this decrease does not apply to the entire upper reach. The water elevation would decrease between 0.0 to 3.6 inches throughout the subreach area (Silver Spring Dr. to Bender Rd.) of the Milwaukee River.

Based on the above comparison, dam removal (Alternative 2) would provide the greatest flood relief to those properties located between N. Silver Spring Drive and W. Bender Road. If the County were to move forward with Alternative 2, the Milwaukee River would remain similar to its current condition.

A nearly four-inch reduction in the 1% Chance Flood Elevation would reduce the 1% Chance Flood Elevation for numerous houses throughout Glendale as well as reduce flood insurance premiums for those that carry flood insurance or are interested in purchasing even a basic coverage policy. Furthermore, floodplain designations and mandated flood insurance costs directly impact the improvability, value and salability of a home and/or property.

As a Floodplain Administrator, it is my obligation to support the alternative that provides the most relief from flooding. As a result, it is my position that Alternative 2 is the only viable option and the only option that should be approved by the County Board. Alternative 2 will provide much needed flood relief, a reduction in flood insurance premiums and is clearly the more sustainable solution both fiscally and environmentally.

While lower water levels may not be desirable to all riparian owners, the overall benefit of reduced flood levels, insurance premiums, and overall salability, impacts a greater proportion of properties and property owners. In my opinion, it would be grossly imprudent for the Milwaukee County Board to disregard the impact removal of the dam would have on countless Glendale property owners.

Realizing that there are additional issues to contemplate regarding the repair or removal of the dam, it is justly imperative to considering the following:

- Historically, Milwaukee County has not been very responsive to Glendale's requests to open the dam gates during flooding conditions. As explained, should the County have to open the gates, they would be limited (currently) to a maximum draw down of six (6) inches at a time. It is unclear whether the DNR would permit a "full gate open" scenario in advance of or during a significant storm or flood event.

  The hydraulic modeling provided assumes that all gates are operational. If just one gate is non-operational due perhaps to debris or ice impeding its operation, it would directly impact flood levels upstream.

  The dam must have electricity in order to operate the gates. During a storm or flood, electricity may not be available. Manual operation is unlikely as electricity is also needed to open the gates manually.

  The passive options (Alternatives 2, 3, 3A & 4) would not require human intervention.

- The impoundment area above the dam has historically been a catch-all for trees and other debris which must be cleared at a cost to taxpayers. With the exception of alternatives 1 and 1A, the other alternatives would generally allow debris to pass through.

  The passive options (Alternatives 2, 3, 3A & 4) would have significantly reduced operating, maintenance and future capital costs to tax payers.

- It is also important to consider expanding development not only in Glendale but upstream as well. The constant placement of new impervious surfaces which direct more stormwater to the Milwaukee River will continue to negatively impact both median and flood level elevations in the future. Tangible reductions in flood levels are an extreme rarity and by no means should they be disregarded.
- Apart from alternatives 1 and 1A, each of the other alternatives allows the river to function in a more natural state.

Attachments: *Table 6 - Maximum Water Depth Under Median Flow Conditions*

Table 7 - Changes In One-Percent-Annual-Probability Water Surface Elevations as Compared to Existing Conditions

Pirrung, Don

From: Dargle, John <John.Dargle@milwaukeecountywi.gov>
Sent: Monday, September 08, 2014 9:28 PM
To: Pirrung, Don; Keegan, Jim; Haley, Kevin
Subject: Fwd: Estabrook Dam

FYI

John Dargle, Jr.
Director, Milwaukee County Parks

Begin forwarded message:

> **From:** "Zapfel, John" <John.Zapfel@milwaukeecountywi.gov>
> **Date:** September 8, 2014 at 2:59:56 PM CDT
> **To:** "Koltun, Raisa" <Raisa.Koltun@milwaukeecountywi.gov>, "Dargle, John" <John.Dargle@milwaukeecountywi.gov>, "Conway, Brendan" <Brendan.Conway@milwaukeecountywi.gov>, "Andrews, Rayna" <Rayna.Andrews@milwaukeecountywi.gov>, "Peterson, Eric" <Eric.Peterson@milwaukeecountywi.gov>, "Abele, Chris" <Chris.Abele@milwaukeecountywi.gov>
> **Subject: FW: Estabrook Dam**
>
> fyi
>
> **From:** David Dunker [mailto:davedunker@zingenbraun.com]
> **Sent:** Monday, September 08, 2014 2:59 PM
> **To:** Zapfel, John
> **Subject:** Estabrook Dam
>
> Dear John,
>
> I have reviewed the different options for the Estabrook dam. My response is strictly from a risk management/insurance prospective. I would be in favor of removing the dam.
>
> If the dam is kept in place the potential of flood damage to property owners up stream is very real. Flood damage is not covered under basic property insurance policies. Flood insurance is available but the coverage is rather limited. The cost of claims is significantly higher than the premiums collected. Claims currently are much higher than the premiums collected, because of this there is a possibility that the high cost of flood insurance may increase as much as 400 to 500%. The increase has been put on hold pending review. In January 2014 the U.S. Senate reached a consent agreement to proceed to consideration of Senate bill 1926 "Homeowners Flood Insurance Affordability Act of 2014". Among other items, the legislation would, for all practical purposes, result in a 4 yr delay of premium increases resulting from Sec 205. This section pertains to the buying and selling of properties. The Biggert-Waters Flood Insurance reform Bill of 2012 called for insurance premiums to be actuarially sound to support flood claims being paid. There is also a Sec 207 regarding properties being owned in flood zones and increase cost for flood insurance.
> Having the dam in place instead of the free flowing of water causes the land upstream to be placed in a flood zone. This will cost the property owners high premiums for insurance. Lenders will not lend

money to property owners without the proper flood and property insurance in force at the time of closing.
The cost of removing the dam would be a one-time expense. There is no ongoing expense to maintain the dam once it has been removed. Plus the potential of having the dam not operate properly especially in spring time snow melt or heavier than usually rain falls which could cost property owners thousands of dollars.
Please let me know if you have any questions.

David M. Dunker
President
Zingen & Braun Insurance Agency, Inc.
262-781-4000

Pirrung, Don

From: Keegan, Jim <James.Keegan@milwaukeecountywi.gov>
Sent: Tuesday, September 16, 2014 8:46 AM
To: Pirrung, Don; Haley, Kevin; Stave, Karl
Subject: Fwd: follow up

FYI

Sent from my iPhone

Begin forwarded message:

> **From:** "Zapfel, John" <John.Zapfel@milwaukeecountywi.gov>
> **Date:** September 16, 2014 at 8:43:21 AM CDT
> **To:** "Keegan, Jim" <James.Keegan@milwaukeecountywi.gov>, "Schloesser, Laura" <Laura.Schloesser@milwaukeecountywi.gov>
> **Subject: FW: follow up**
>
> fyi
>
> **From:** Zapfel, John
> **Sent:** Tuesday, September 16, 2014 8:43 AM
> **To:** Dargle, John
> **Cc:** Conway, Brendan; Koltun, Raisa; Abele, Chris; Andrews, Rayna
> **Subject:** FW: follow up
>
> Below is an email from J. Val Klump, JD, PhD, Professor & Associate Dean of Research, School of Freshwater Sciences in favor removal of the Estabrook Dam.
>
> **From:** J Val Klump [mailto:vklump@uwm.edu]
> **Sent:** Monday, September 15, 2014 2:41 PM
> **To:** Zapfel, John
> **Subject:** RE: follow up
>
> Hi John,
> I apologize for taking so long to respond. Last week was fairly hectic, with the grand opening event, etc.
>
> Wrt the Estabrook dam situation – first of all it is less common than one would like for the least expensive option to be the environmentally most desirable, which I believe is the case here. Removal of the dam would, in my view, be the best option, and apparently the cheapest. Not only does it return the river to a more natural flow condition and state, but it also eliminates the impoundment above the dam. The impoundment itself, frankly, could be the source of problems in the future, in addition to upkeep of the structure. Impoundments, like the Estabrook pool, tend to produce conditions, like quiet backwaters and longer water residence times which enhance algal blooms, encourage species like carp, which do not like running water for spawning, etc. They also act as efficient traps for material either produced

locally or transported from upstream. As they fill in, they often need to be flushed periodically - a maintenance issue. In all likelihood the stuff that will be trapped is not all that attractive, i.e. may be contaminated with low levels of the laundry list of stuff running off the land. Portions of these deposits could also be fairly rich in organic matter rich if algal production is high, and once accumulated tend to consume oxygen as this organic matter decays. All in all, removal appears to be the best option, and I am skeptical of claims that it will reduce property values, but that is not my area, so that's strictly a gut feeling.

regards, Val

J. Val Klump, JD, PhD
Professor & Associate Dean of Research
School of Freshwater Sciences
Great Lakes WATER Institute
University of Wisconsin-Milwaukee
414-382-1700

Pirrung, Don

From: Dargle, John <John.Dargle@milwaukeecountywi.gov>
Sent: Thursday, September 04, 2014 5:50 PM
To: Haley, Kevin; Pirrung, Don; Keegan, Jim
Subject: FW: Estabrook Dam

John Dargle, Jr.
Director
(414) 257-7275 Phone
(414) 257-6466 Fax

Milwaukee County Department of Parks, Recreation and Culture
9480 Watertown Plank Road
Wauwatosa, WI 53226
(414) 257-PARK
countyparks.com

From: Zapfel, John
Sent: Thursday, September 4, 2014 11:28 AM
To: Dargle, John
Cc: Conway, Brendan; Andrews, Rayna; Koltun, Raisa
Subject: Estabrook Dam

John,

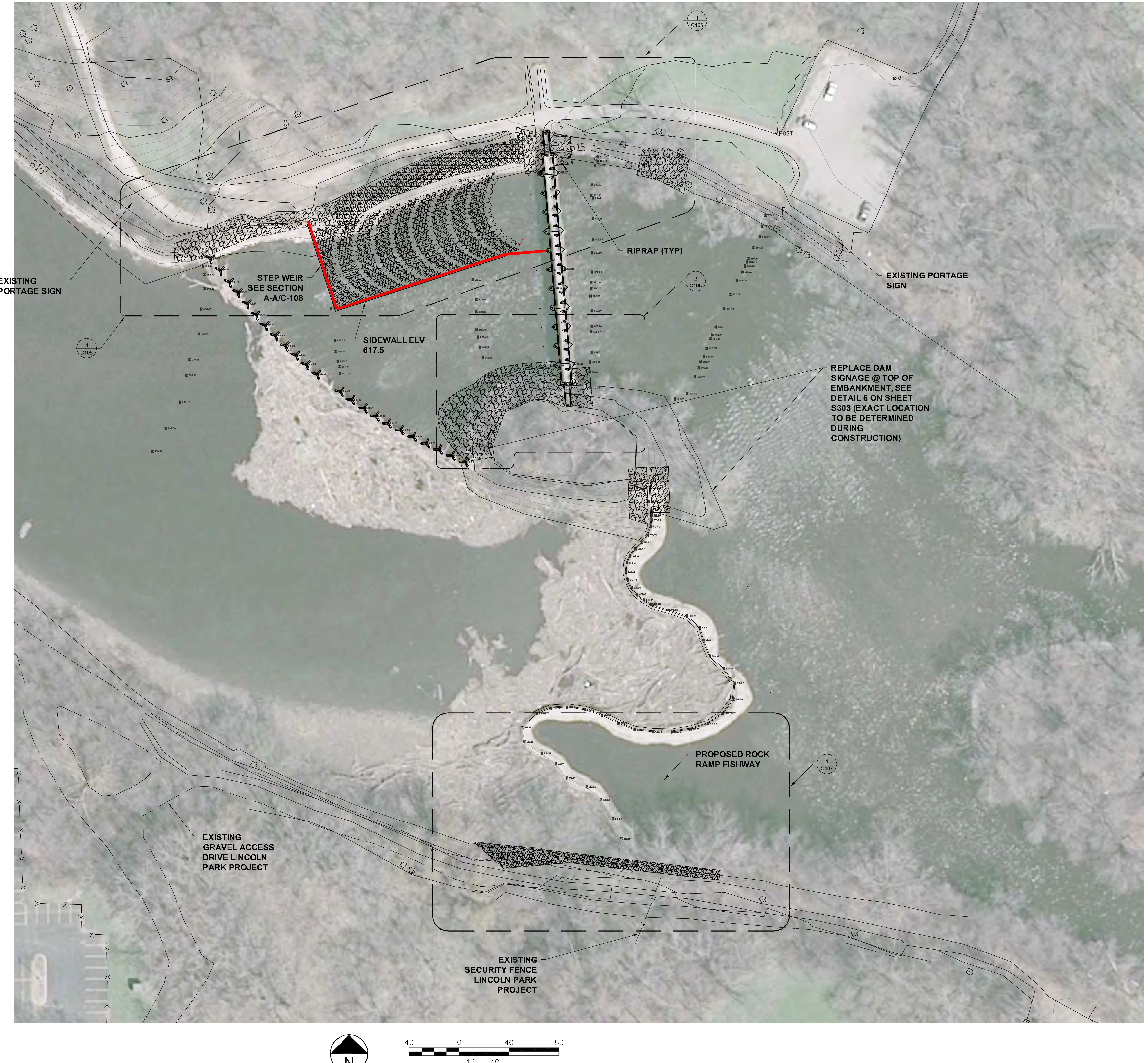
I just spoke with J. Val Klump, Professor, School of Freshwater Sciences and Senior Scientist and Director, Great Lakes WATER Institute (http://www4.uwm.edu/freshwater/people/klumpjv.cfm) who is enroute to a conference on the Estabrook Dam and he recommends removal of the dam and feels removal is the best for the environment and the river.

Dr. Klump will be sending a letter once he returns from his conference next week.

John T. Zapfel
Deputy Chief of Staff
Office of Milwaukee County Executive Chris Abele
Like County Executive Abele on Facebook
Follow County Executive Abele on Twitter

ATTACHMENT 20:

FISH PASSAGE INFORMATION



ESTABROOK DAM REHABILITATION

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

NOT FOR CONSTRUCTION

DATE: 06/05/2015

PROJECT: P063 10605

SITE NO: 687

BUILDING NO: N/A

AECOM
WWW.AECOM.COM
AECOM TECHNICAL SERVICES, Inc.
847-279-2500

PROJECT NUMBER: 60181463

SCALE: AS SHOWN

DRAWN: DJD

CHK'D/APPR'D

WORKING DRAFT

C105

FISHWAY AND SHORELINE PROTECTION OVERVIEW

P:\60181463\900_Work\910-CAD\001_DRAWINGS\SHEETS\G60159452_C105 - C108.dwg ; 7/8/2015 4:41:59 PM ; HILLER, JAREN ; STS_050801.stb