



**US Army Corps
of Engineers®**
Detroit District

SECTION 905(B)
PRELIMINARY ANALYSIS OF FLOOD RISK MANAGEMENT and
ENVIRONMENTAL RESTORATION PROJECTS
WAUWATOSA, WISCONSIN and
GREATER MILWAUKEE WATERSHEDS, WISCONSIN

July 2012

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- A. Source Document Abstracts
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- C. Initial Project Screening

1 Study Authority

This document reports the results of a Reconnaissance Study of watershed conditions in the Greater Milwaukee Watersheds, Milwaukee County, authorized by Section 4100 of the Water Resources Development Act (WRDA) 2007 (P.L. 110-114). Section 4100 directs the Secretary of the Army to “conduct a study to determine the feasibility of carrying out a project for flood damage reduction and environmental restoration, Menomonee River and Underwood Creek, Wauwatosa, Wisconsin, and greater Milwaukee watersheds, Wisconsin.” This study was conducted in accordance with Section 905(b) of WRDA 1986.

Funds in the amount of \$94,500 have been appropriated for this study in FY 2010.

2 Study Purpose

The purpose of the Reconnaissance Study is to identify flood-prone and environmental impairment areas in Milwaukee County, Wisconsin, and to determine if there is a potential Federal Interest in addressing identified impairment and flood-prone areas through future studies or projects. Flood risk and impairment areas that may be addressed in the study include, but are not limited to:

- Identification of potential flood risk management areas;
- Beneficial Use Impairments (BUIs) within the Milwaukee Estuary Area of Concern (AOC) as identified by the United States Environmental Protection Agency (USEPA). The USEPA lists the following BUIs in the Milwaukee Estuary AOC:
 - Restrictions on fish and wildlife consumption,
 - Eutrophication or undesirable algae,
 - Degradation of fish and wildlife populations,
 - Beach closings,
 - Fish tumors or other deformities,
 - Degradation of aesthetics,
 - Bird or animal deformities or reproduction problems,
 - Degradation of benthos,
 - Degradation of phytoplankton and zooplankton populations,
 - Restriction on dredging activities, and
 - Loss of fish and wildlife habitat.

Actions identified in this study may contribute to the delisting of these BUIs.

- Further USEPA-identified priorities in the Milwaukee Estuary AOC, such as elimination of Combined Sewer Overflows and Sanitary Sewer Overflows, nonpoint source pollution control, and habitat restoration; and
- Additional issues identified by local stakeholders, including dam constraints for fish passage, low water levels, storm water runoff, nutrient balance, and bank erosion impacting aquatic habitat.

The Reconnaissance Study includes a preliminary determination of Federal Interest, costs, benefits and recommendations. The analyses conducted were based on existing, readily available data and studies, and professional and technical judgment. This report was prepared by the Detroit District.

3 Location of Study, Non-Federal Partner and Congressional Districts

The study area includes the Milwaukee River, Menomonee River, and Kinnickinnic River Watersheds, and the Underwood Creek subwatershed (part of the Menomonee River watershed) in southeastern Wisconsin within Milwaukee County. See Figure 1. This Reconnaissance Study focused on the portions of the Milwaukee, Menomonee and Kinnickinnic River Watersheds that are located in Milwaukee County. The study area is located in the most densely and intensely urbanized area in Wisconsin, and includes the entirety or portions of 15 municipalities as shown in Table 1.

Figure 1: Geography of the Greater Milwaukee Watersheds

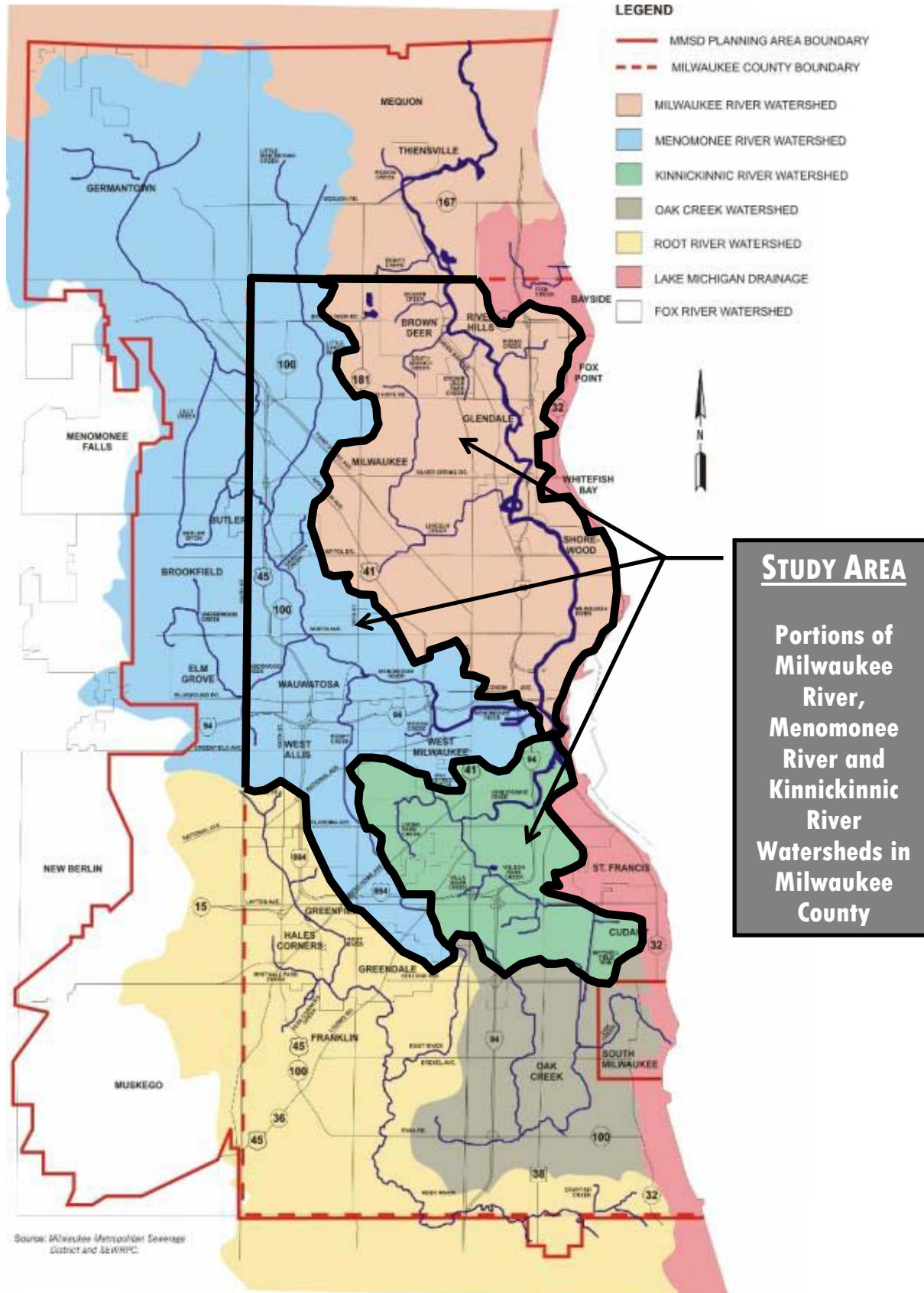


Table 1: Municipal and Watershed Geography

Milwaukee County Municipality	Milwaukee River Watershed	Menomonee River Watershed	Kinnickinnic River Watershed
City of Glendale	●		
City of Milwaukee	●	●	●
Village of Bayside	●		
Village of Brown Deer	●		
Village of Fox Point	●		
Village of River Hills	●		
Village of Shorewood	●		
Village of Whitefish Bay	●		
City of Greenfield		●	●
City of Wauwatosa		●	
City of West Allis		●	●
Village of Greendale		●	●
Village of West Milwaukee		●	●
City of Cudahy			●
City of St. Francis			●

The Milwaukee Metropolitan Sewerage District (MMSD) is identified as the Non-Federal Partner of this Reconnaissance Study. MMSD is a regional government agency that provides water reclamation and flood management services for approximately 1.1 million people in 28 communities in the Greater Milwaukee Area. The agency serves a region of 411 square miles that covers all or segments of six watersheds. The MMSD has actively completed numerous studies, plans and projects for flood risk management, water quality improvement and habitat restoration in the Greater Milwaukee Watersheds, and actively participated in identifying priority projects for this study. In developing goals, objectives, programs and projects in southeastern Wisconsin, MMSD has worked closely with many agencies – such as the Wisconsin Department of Natural Resources (DNR), USEPA, U.S. Army Corps of Engineers (USACE), and the Southeastern Wisconsin Regional Planning Commission (SEWRPC) – and with numerous non-governmental organizations and individuals.

The study area lies within three Congressional Districts:

- Paul Ryan – (R) - First Wisconsin District
- Gwendolyn Moore – (D) - Fourth Wisconsin District
- James Sensenbrenner – (R) - Fifth Wisconsin District

4 Prior Studies, Reports and Existing Water Projects

Numerous reports, plans and studies for water resources in southeastern Wisconsin were reviewed as part of this Reconnaissance Study. The reports and documents were drawn from Federal, state, local and non-governmental sources; a complete annotated bibliography is included in Appendix A: Source Document Abstracts. Key documents used in characterizing existing conditions, developing planning objectives and evaluating potential watershed projects are summarized below.

Milwaukee River Watershed Studies

- *The State of the Milwaukee River Basin.* (Wisconsin DNR and the Milwaukee River Basin Land and Water Partners Team and other stakeholders, August 2001). This report provides an overview of land and water resource quality, identifies challenges facing these resources, and outlines actions the Wisconsin DNR and its many partners can take over the next few years to protect and restore natural resources throughout the Milwaukee River Basin.
- *Changing Habitat and Biodiversity of the Lower Milwaukee River and Estuary.* (Wisconsin DNR, August 2005.) This report discusses the biological investigation conducted by the Wisconsin DNR that documents changes in fish assemblages in the former dam impounded area. Improvements in the riverine habitat following dam removal increased biological diversity several fold in the former impounded area.
- *The State of the Milwaukee Watershed.* (MMSD, 2005.) This report provides a summary of the current conditions of water quality indicators in the Milwaukee River Watershed and summarizes how the indicators – dissolved oxygen, habitat, nutrients and fecal coliform bacteria – perform in relation to the water quality standards.
- *A Watercourse System Plan for the Milwaukee River in Milwaukee County Upstream of the Milwaukee Harbor Estuary* (SEWRPC, December 2010.) This document presents and evaluates three alternative plans for flood control in the Sunny Point neighborhood in Glendale. Alternatives include acquisition and demolition of structures in the 1% probability floodplain; floodproofing, elevating and acquiring structures; and constructing a levee. The study recommends an alternative combining floodproofing, elevating and acquisition as the most cost-effective means of addressing repeat flooding in this area. The report identifies key potential projects for MMSD.

Menomonee River Watershed Studies

- *Menomonee River Phase 1 Watercourse Management Plan.* (MMSD and Camp Dresser & McKee, August 2000.) This plan provides updated hydrologic and hydraulic models, identifies structural damages caused by out-of-bank flooding, and analyzes potential solutions for the structural damages anticipated to occur during a 100-year flood event (1% chance of annual recurrence).
- *Sediment Transport Study of the Menomonee River Watershed, Final Study Report.* (MMSD, February 2001.) This study provides a plan for the necessary alterations to the channel and floodplain for improved flood conveyance to rehabilitate the aquatic habitat and set the stage for future rehabilitation efforts.

- *Menomonee River Phase 2 Watercourse Management Plan, Volume I - III, Project Report, Appendix A – Selected Photographs, Appendix B – Stakeholder Meeting Presentation Handouts, Appendix C – Low Water Entry Flooding Analysis, Appendix D – Floodplain Maps, Appendix E – Hydrologic/Hydraulic Model Data, Appendix F – Floodplain Profiles, Appendix G – Channel Cross Sections, Appendix H – Floodplain Tabular Data.* (MMSD and Tetra Tech MPS, July 2002.) The Menomonee River Phase II Watercourse Management Plan Volume I - III extrapolates from the Phase I Plan written in 2000 that identified the flood prone areas. It evaluates and develops project-specific alternatives to correct flooding in these high impacted areas. This plan includes the Menomonee River watercourse index map with the 1% probability floodplain maps, hydrologic/hydraulic model data, channel cross sections, and floodplain tabular data for the Menomonee Watershed.
- *The State of the Menomonee Watershed.* (MMSD, 2005.) This report provides a summary of the current conditions of water quality indicators in the Menomonee River Watershed and summarizes how the indicators – dissolved oxygen, habitat, nutrients and fecal coliform bacteria – perform in relation to the water quality standards.
- *Water Quality in the Menomonee River Watershed.* (MMSD District, 2008.) This educational booklet provides a summary of the known issues regarding water quality in the Menomonee River and outlines how pollutants affect water quality and what the MMSD is doing to address water quality problems.
- *Menomonee River Watershed Restoration Plan.* (MMSD, April 2010.) This plan identifies goals and specific actions to be implemented to improve water quality by 2015 within the Menomonee River Watershed. It also presents general recommendations for the future based upon effectiveness, science, regulatory considerations and stakeholder goals.

Kinnickinnic River Watershed Studies

- *Kinnickinnic River Phase 1 Watercourse Management Plan.* (MMSD and Camp Dresser & McKee Inc., 2000.) This Management Plan identifies flood prone areas, the number of structures and estimated total cost associated with a 100-year flood, and flood control alternatives in the five major watercourses of the Kinnickinnic Watershed.
- *Kinnickinnic River Phase 2 Watercourse Management Plan, Volume I - III, Project Report, Appendix A – Interim Design Rainfall, Appendix B – Hydrologic and Hydraulic Analysis, Appendix C – Alternative Cost Estimates, Appendix D – Floodplain Maps and Appendix E – Floodplain Profiles.* (MMSD and MWH Americas, Inc., May 2005). The Management Plan Volume I - III extrapolates from the Phase I Plan written in 2000 that identified the flood prone areas. It evaluates and recommends flood damage mitigation measures in the five watercourses of the Kinnickinnic Watershed. This plan provides floodplain maps and profiles, hydrologic/hydraulic model data, channel cross sections, and floodplain tabular data for the watercourses.
- *The State of the Kinnickinnic Watershed.* (MMSD, 2005.) This report provides a summary of the current conditions of water quality indicators in the Kinnickinnic River Watershed and summarizes how the indicators – dissolved oxygen, habitat, nutrients and fecal coliform bacteria – perform in relation to the water quality standards.
- *Water Quality in the Kinnickinnic River Watershed.* (MMSD, 2008.) This educational booklet provides a summary of the issues known regarding water quality in the Kinnickinnic River and outlines how pollutants affect water quality and what the MMSD is doing to address water quality problems.

- *Kinnickinnic River Corridor Neighborhood Plan.* (MMSD and Sixteenth Street Community Health Center, December 2009.) This plan studies a 2.5 mile stretch of the Kinnickinnic River between S. 27th and S. 6th Streets. The plan discusses the historical, cultural, and social issues of flooding and potential design strategies that will address river channel rehabilitation and flood management.
- *Kinnickinnic River Watershed Restoration Plan.* (MMSD, April 2010.) This plan identifies goals and specific actions to be implemented to improve water quality by 2015 within the Kinnickinnic River Watershed. It also presents general recommendations for the future based upon effectiveness, science, regulatory considerations and stakeholder goals.

Multi-Watershed Studies

- *Milwaukee Estuary Remedial Action Plan: A Plan to Clean Up Milwaukee's Rivers and Harbors.* (USEPA and Partners, March 1991.) The Remedial Action Plan (RAP) identifies management strategies and partnerships to control existing sources of water pollution in portions of the Greater Milwaukee Watersheds, an AOC in the Lake Michigan Basin. The RAP describes specific goals and objectives for resolving Milwaukee estuary water quality problems and restoring beneficial uses. The goals and objectives provide the standards for determining the short- and long-term pollution abatement and resource management decisions needed to clean up the estuary.
- *Milwaukee Estuary Remedial Action Plan: A Plan to Clean Up Milwaukee's Rivers and Harbors, Progress through 1994.* (USEPA and Partners, January 1994.) This document provides an update on implementation of management strategies outlined in the 1991 plan. The goals and objectives provide the criteria for evaluating the short- and long-term pollution abatement and resource management decisions needed to restore the ecosystems of the estuary. The plan update identifies and describes the existing Federal and state programs that have made considerable progress toward the goals of restoring the Milwaukee estuary. The USEPA lists the following BULs in the Milwaukee Estuary AOC: restrictions on fish and wildlife consumption; eutrophication or undesirable algae; degradation of fish and wildlife populations; beach closings; fish tumors or other deformities; degradation of aesthetics; bird or animal deformities or reproduction problems; degradation of benthos; degradation of phytoplankton and zooplankton populations; restriction on dredging activities; and loss of fish and wildlife habitat.
- *A Regional Water Quality Management Plan Update for the Greater Milwaukee Watersheds.* (SEWRPC, December 2007.) This document refines previous water quality management planning efforts, and addresses land use development; water quality management; outdoor recreation and open space preservation; water control facility development; plan structure and monitoring; and educational and informational programming.
- *Stream Habitat Conditions and Biological Assessment of the Kinnickinnic and Menomonee River Watersheds: 2000-2009.* (SEWRPC, January 2010.) This assessment summarizes the water quality conditions and sources of pollution in the Kinnickinnic and Menomonee River Watersheds. It presents the results of an inventory and analysis of the surface waters, descriptive information pertaining to the historical trends and current status of habitat quality, ecological integrity, bank stability, and potential limitations to water quality and the fishery. It summarizes biological and habitat quality within each watershed; identifies factors potentially limiting that quality; identifies information needs; provides recommended goals, objectives, and actions to address the impairments; recommends a prioritization strategy to maximize project cost effectiveness; and recommends post-project monitoring to assess project success.

Ongoing Planning Studies

Water resources planning is ongoing in southeastern Wisconsin. The MMSD operates within a six-year capital budget for project implementation. This capital budget is updated annually to reflect evolving capital investment priorities and opportunities. Additionally, MMSD is currently engaged in a number of planning processes with various partners (e.g., SEWRPC, Wisconsin DNR). These include:

- *Kinnickinnic River Sediment-Transport Planning Study*
- *Kinnickinnic River Preliminary Engineering: 27th Street – Chase Avenue*
- *Wilson Park Creek Flood Management Planning Study: S. Howell Ave to S. 27th St*
- *A Watercourse System Plan for Beaver Creek in Milwaukee County*

5 Plan Formulation

Principles and Guidelines

The formulation process used in this Reconnaissance Study is consistent with the national objectives as stated in the *Planning Guidance Notebook* (Corps Engineering Regulation 1105-2-100, April 2000). In accordance with the *Planning Guidance Notebook*, flood risk management plans must contribute to the National Economic Development (NED) consistent with protecting the nation's environment. Plans to address the needs in the study area must be formulated to maximize NED benefits while providing a complete, effective, efficient, and acceptable plan of protection. Ecosystem restoration plans must contribute to National Ecosystem Restoration (NER) through restoration of degraded ecosystem structure, function, and dynamic processes to a less degraded, more natural condition. Plans to address the needs in the study area must be formulated with clearly identified outputs. Critical factors in NER plan development include 1) the significance of the outputs; 2) scarcity of the outputs; and 3) risks and uncertainties in achieving the projected outputs.

The NED and NER criteria provide general planning guidance within any study area:

- Completeness is defined in ER 1105-2-100 as the extent to which the alternative plans provide and account for all necessary investments or other actions to ensure the realization of the planning objectives, including actions by other Federal and non-Federal entities.
- Effectiveness is defined as the extent to which the alternative plans contribute to achieve the planning objectives.
- Efficiency is defined as the extent to which an alternative plan is the most cost-effective means of achieving the objectives.
- Acceptability is defined as the extent to which the alternative plans are acceptable in terms of applicable laws, regulations, and public policies.

5a Existing Conditions

This section characterizes existing conditions in the Greater Milwaukee Watersheds. Due to the large geography of the study area, the existing conditions description is divided into four parts; the first is a general characterization of overall conditions throughout the study area, followed by a discussion of the existing conditions in each component watershed.

5a(1) Existing Conditions in the Greater Milwaukee Watersheds

Six drainage basins comprise the Greater Milwaukee Watersheds: Milwaukee River, Menomonee River, Kinnickinnic River, Oak Creek, Root River and the Lake Michigan direct drainage area. Together, the Greater Milwaukee Watersheds include 600 miles of rivers and streams. The Milwaukee, Menomonee and Kinnickinnic River Watersheds are the subject of this Reconnaissance Study. The three rivers join at the Milwaukee estuary in downtown Milwaukee, and flow into Lake Michigan, collectively draining an area of approximately 998 square miles.

Relative to the confluence of the three rivers, the Milwaukee River Watershed is located in the northern portion of the Greater Milwaukee Watersheds; the Menomonee River drains the western portion; and the Kinnickinnic River Watershed is located in the southern portion of the region. The Milwaukee, Menomonee and Kinnickinnic River Watersheds are home to approximately 967,000 people in Milwaukee, Waukesha, Washington, Ozaukee, Fond du Lac, Sheboygan and Dodge counties. In Milwaukee County, the three watersheds are home to 800,287 residents, approximately 84% of all people in the county.

The central areas in the Greater Milwaukee Watersheds are densely urbanized, with lower density development ringing the urban core. Areas of primarily agricultural use are located in the upstream reaches of the Milwaukee and Menomonee drainage areas. Historically, Milwaukee's industry and commerce were located along the main stems of the Milwaukee, Menomonee and Kinnickinnic Rivers. These rivers continue to provide commercial shipping resources, recreational boating, fishing, and other recreation functions.

The Milwaukee River Watershed is located in the northeastern portion of the Greater Milwaukee Watersheds and covers approximately 838 square miles. The main stem of the Milwaukee River originates in southeastern Fond du Lac County and flows approximately 101 miles in a southerly and easterly direction to its confluence with Lake Michigan in Milwaukee. The Milwaukee River watershed consists of 22 subwatersheds. The study area for this Reconnaissance Report includes the portion of the Milwaukee River Watershed located in Milwaukee County. Main watercourses in the watershed include the Milwaukee River main stem, Beaver Creek, South Branch Creek, Brown Deer Park Creek, Indian Creek and Lincoln Creek.

The Menomonee River Watershed is located in the west central portion of the Greater Milwaukee Watersheds and covers approximately 140 square miles. The Menomonee River originates in Washington County and flows southeasterly approximately 28 miles through the northeastern corner of Waukesha County and through the western and central portions of Milwaukee County to its confluence with the Milwaukee River. The Menomonee River Watershed consists of 14 subwatersheds. The portion of the watershed in Milwaukee County includes the Menomonee River main stem, Dretzka Park Creek, Little Menomonee River, Grantosa Creek, Underwood Creek and the south branch of Underwood Creek, Honey Creek, Woods Creek, the South Canal and the Burnham Ship Canal.

The Kinnickinnic River Watershed is located in the east central portion of the Greater Milwaukee Watersheds; it is the smallest of those watersheds, and lies entirely within Milwaukee County. The watershed is approximately 25 square miles and contains approximately 25 miles of

perennial streams. The Kinnickinnic River originates in central Milwaukee County and flows approximately eight miles in an easterly direction and empties into the Milwaukee Estuary and Lake Michigan. The watershed includes the Kinnickinnic River main stem, Lyons Park Creek, the 43rd Street Ditch, Villa Man Creek, Wilson Park Creek, Holmes Creek and the Edgerton Channel.

Regarding aquatic and terrestrial habitat in the study area, habitat is considered healthy if it supports a diversity of high quality species; such diversity is directly and adversely affected by habitat degradation. Characteristics of quality riverine aquatic habitat include stable natural banks, natural vegetative cover and tree canopy, streambeds not covered with silt or muck, riffles and pools for fish refuge, and wide vegetated buffer zones to filter polluted stormwater runoff. Areas of riverways with straightened channels and concrete linings exist within each watershed, and are generally found in more urbanized expanses. The three watersheds exhibit this characteristic in numerous areas, particularly in the reaches in and immediately upstream of the Milwaukee River Estuary; in these areas habitat sees substantial negative impacts due to straightened channels, sheet piling, concrete banks, and extensive sediment deposits.

Habitat quality is also directly correlated with land use and intensity of development. As urbanization increases, habitat quality quickly decreases, due to the loss of porous surfaces through residential, commercial and industrial development. Intense development in Milwaukee County has been detrimental to the flora and fauna within the area, as wildlife disappeared due to heavy habitat disruption, pollution and contamination. Some native species have begun to recover as efforts to improve overall habitat and water quality have increased. According to “The State of the Milwaukee River Basin” report completed in August 2001, smallmouth bass are the most abundant species found within the watersheds, while the green sunfish, white sucker, golden redhorse, sandshiner and rock bass species were found to be abundant, as well.

The “Changing Habitat and Biodiversity of the Lower Milwaukee River and Estuary” report from August 2005 reveals that wetland flora in these areas include trees such as ash, maple, birch, elm, cottonwood, willow and box elder. Various shrubs can also be found including dogwood, alder, sedges, ferns, grasses, forbs and cattails. Fauna include several small mammals (muskrat, beaver, opossum), deer, amphibians, wild turkeys, wood and mallard ducks, owls and a number of songbird species. Forested areas within the watersheds include trees such as beech, sugar maple, basswood, red oak, white oak, black oak and bur oak. Fauna frequently found within these areas include deer, various small mammals (squirrels, mice, woodchucks), wild turkeys, grouse, owls and a number of songbird species.

However, aquatic and terrestrial habitat in the watersheds is highly fragmented. The Watershed Restoration Plans completed by MMSD for the Kinnickinnic, Milwaukee and Menomonee Rivers describe the land use within each watershed. The Kinnickinnic River Watershed is heavily urbanized, with 89% of land being used for residential, industrial, commercial and institutional purposes. Only 11% of land within this watershed is designated outdoor recreation, wetlands, woodlands and general open space. The Menomonee River Watershed is about 56% non-urbanized land use, however, urbanization has been increasing rapidly in this area.

The Milwaukee River Watershed has highly urbanized areas in the southern portion of the watershed – including the study area – but 77% of the overall land within this watershed is still non-urbanized (mostly agricultural) land. The project area (Milwaukee County) is located in the southern, more urbanized portion of the Milwaukee River Watershed. In addition, the segments of the Kinnickinnic and Menomonee River Watersheds located within the project area are almost completely built-out and urbanized, resulting in a generally low quality of habitat and low biodiversity throughout the project area.

Historically, flood events in the Milwaukee, Menomonee and Kinnickinnic River Watersheds have been related to extreme storms. Large rainfall events have led to overland flooding, basement backups, Combined Sewer Overflows and other undesirable conditions. Table 2 summarizes selected flood events and related rainfall since 1986.

Table 2: Major Flood Events in the Greater Milwaukee Watersheds

Month and Year of Flood Event	Watersheds	Single Day Precipitation
June 1986	Kinnickinnic River	6.81 inches
June 1997	Kinnickinnic River	4.23 inches
August 1998	Milwaukee and Menomonee Rivers	3.65 inches
June 2008	Milwaukee River	4.93 inches
July 2010	Milwaukee, Menomonee and Kinnickinnic Rivers	7.52 inches

Source: SEWRPC, MMSD, Milwaukee Journal Sentinel

5a(1)a Existing Conditions in the Milwaukee River Watershed

Drainage Area

The Milwaukee River Watershed is located in the northeastern portion of the Greater Milwaukee Watersheds; it drains approximately 838 square miles. The main stem of the Milwaukee River originates in southeastern Fond du Lac County and flows approximately 101 miles in a southerly and easterly direction to its confluence with Lake Michigan in Milwaukee. The study area for this Reconnaissance Report includes the portion of the Milwaukee River Watershed located in Milwaukee County. This portion of the watershed includes:

- Milwaukee River main stem – 16.4 miles
- Beaver Creek – 2.8 miles
- South Branch Creek– 1.5 miles
- Brown Deer Park Creek– 2.1 miles
- Indian Creek– 1.9 miles
- Lincoln Creek – 9.2 miles

In Milwaukee County, the Milwaukee River Watershed drains 64.3 square miles, and includes parts of the cities of Milwaukee and Glendale and the villages of Bayside, Brown Deer, Fox Point, River Hills, Shorewood and Whitefish Bay.

Land Use and Development Controls

Overall, approximately 77% of the land in the Milwaukee River Watershed is comprised of rural or open space uses – including agriculture (48%), woodlands (8%), surface water and wetlands (14%), and other open space (7%). However, the Milwaukee County portion of the watershed is entirely urbanized. It includes large areas of high-density residential development, large-scale transportation uses, industrial corridors and commercial districts, including the majority of Milwaukee's central business district. The area near the mouth of the Milwaukee River has been a focus for redevelopment activities over the last two decades, with industrial areas being converted to residential, commercial and entertainment uses.

All Milwaukee County communities in the watershed control development through zoning. In May 2010, the City of Milwaukee adopted an overlay zoning ordinance applicable to the portion of the Milwaukee River main stem within the city limits. The Milwaukee River Greenway Site Plan Review Overlay Zone is designed to protect the aesthetics and ecology of the river as a recreational resource for the region. The zoning overlay requires additional review, design guidelines for new construction and stricter stormwater management regulations in the river's

primary environmental corridor. Applicable to new construction, the design guidelines include a 50-foot setback from the top of the river bluff, height restrictions, signage restrictions and landscaping standards. The stormwater management standards for this zone include elevated targets for total suspended solids removal and requirements for the use of stormwater Best Management Practices.

Population

Approximately 485,000 people live in the Milwaukee River Watershed. The portion of the watershed that lies in Milwaukee County is home to approximately 362,838 residents.

Watershed Communities

The Milwaukee River Watershed covers all or parts of eight Milwaukee County communities. These communities and their characteristics are summarized in Table 3.

Table 3: Community Characteristics in Milwaukee River Watershed

Milwaukee County Municipality	Population in Watershed	Area in Watershed (sq. mi.)	Equalized Value of All Property in Municipality	Average Annual FEMA Flood Insurance Premium in Municipality
City of Glendale	13,377	6.0	\$2.3 billion	\$1,200
City of Milwaukee	296,307	39.7	\$31.3 billion	\$459
Village of Bayside	4,415	2.3	\$634 million	\$466
Village of Brown Deer	12,170	4.4	\$1.1 billion	\$668
Village of Fox Point	7,012	2.9	\$1.2 billion	\$552
Village of River Hills	1,631	5.3	\$510 million	\$574
Village of Shorewood	13,763	1.6	\$1.5 billion	\$323
Village of Whitefish Bay	14,163	2.1	\$2.0 billion	\$320
<i>Total</i>	<i>362,838</i>	<i>64.3</i>	<i>\$40.5 billion</i>	

Source: URS, Wisconsin Department of Revenue, FEMA

Commercial Navigation

Commercial navigation is currently limited on the Milwaukee River to a number of waterborne tour and sight-seeing operators. Numerous waterfront restaurants and entertainment venues in Milwaukee's central business district maintain docking facilities for pleasure boaters.

Recreation Resources

In addition to pleasure boating on the lower reaches of the Milwaukee River (primarily south of North Avenue and to a much lesser degree in Lincoln Park, upstream of the Estabrook Park Dam), the water resources in the watershed provide numerous recreational opportunities in Milwaukee County and throughout the region. More than 30 species of fish – including many game fish species – inhabit the river, and their range expanded to Shorewood since the North

Avenue Dam was removed in 1997. Hiking and cycling trails line both sides of the river main stem, and a river walk sidewalk system provides access opportunities along the entire length of the river in the central business district. Major parks located along the Milwaukee River, Lincoln Creek and other tributaries throughout the watershed include Havenwoods State Forest, Brown Deer Park, Riverside Park, Estabrook Park and Kletzsch Park. All of these sites offer access to water. The Milwaukee Urban Water Trail is a river recreation initiative sponsored by Friends of Milwaukee's Rivers, the City of Milwaukee, Milwaukee County, the Wisconsin DNR, National Park Service and other agencies. The initiative includes signage, a public information campaign and a comprehensive map of river access points, portages and other information for canoeists and kayakers over a 20-mile segment of the Milwaukee River and shorter segments of the Menomonee and Kinnickinnic Rivers.

Water Quality

Water quality indicators vary with location throughout the Milwaukee River Watershed. "State of the Milwaukee River Watershed," a document published by the MMSD in 2005, reports on three indicators: Dissolved Oxygen (DO), Habitat, Nutrients and Fecal Coliform Bacteria. Summaries of the status of these indicators in the Milwaukee River Watershed are as follows:

- *Dissolved Oxygen.* DO is a measure of a waterbody's ability to support desirable life. Consistently high DO levels represent healthy water. Many factors influence DO levels in water, including sunlight, water temperature, presence of aquatic plants, presence of oxygen-using algae, turbulence and the type and amount of sediment present. Monitoring in the Milwaukee River Watershed indicates that DO levels in the lower reaches of the river meet water quality standards (at least 5 mg/L) most of the time (i.e., 85%). The Indian Creek subwatershed meets standards some of the time (i.e. between 50% and 85%).
- *Nutrients.* Phosphorus and nitrogen are nutrients whose presence indicates the ability of a waterbody to support aquatic plant and algae growth. However, too much of these nutrients may cause excessive plant growth or algae blooms, contributing to DO deficiencies, loss of habitat and noxious odors. Nutrient inputs vary with land use, summer fertilization of crops and lawns, organic material in stormwater runoff (such as grass clippings). USEPA's recommended water quality standard for total phosphorus is 0.08 mg/L; for total nitrogen the recommended standard is 1.59 mg/L. Most locations in the lower Milwaukee River and its tributaries exceed the concentrations for these nutrients more than 50% of the time.
- *Fecal Coliform.* Fecal coliform bacteria are found in human and animal waste, and their presence is an indicator of the potential presence of other disease-cause organisms in water. Higher amounts of fecal contamination normally occur during wet weather as contaminated runoff and sometimes sewer overflows reach waterways. Common sources for bacteria in stormwater include pet waste, gull and geese droppings, and manure spreading on croplands. The water quality standard for fecal coliform in surface water designated for recreation use is 200 counts per 100 ml of water. In the Milwaukee River Watershed, nearly all locations exceed this standard more than 50% of the time.

Historically, toxins and point source pollution have been a great concern in the heavily industrialized Milwaukee River Watershed. The USEPA's 1991 Remedial Action Plan (RAP) for the Milwaukee Estuary AOC noted, for example, that "PAHs (polycyclic aromatic hydrocarbons) heavily contaminate sediments in sites sampled in the Inner Harbor and the Kinnickinnic, Menomonee and Milwaukee rivers. Concentrations of fluoranthene and pyrene, two carcinogens, correspond to concentrations found in sites where fish have high cancer rates." (p. V-6)

In the last decades, numerous efforts have been initiated to address toxins and point source pollution, including the removal of contaminated sediment. The 2009 Regional Water Quality

Management Plan Update produced by SEWRPC, stated: “An evaluation of water quality conditions and sources of pollution that indicates that 1) the MMSD Inline Storage System (deep tunnel), controls on nonpoint source pollution, and treatment of industrial discharges have improved water quality over time and 2) because of advances in point source pollution abatement, nonpoint sources contribute significant proportions of the pollutant load to the streams and rivers of the study area and to Lake Michigan. Thus, the plan considers both point and nonpoint source pollution, but it focuses on abatement of nonpoint source pollution to achieve the greatest improvement in water quality in a cost effective manner.” (p. 4).

Habitat

Habitat is considered healthy if it supports a diversity of high quality species; such diversity is directly and adversely affected by habitat degradation. Characteristics of quality habitat include stable natural banks, natural vegetative cover and tree canopy, streambeds not covered with silt or muck, riffles and pools for fish refuge, and wide vegetated buffer zones to filter polluted stormwater runoff. A stream which exhibits these characteristics for its entire length would be considered to meet habitat quality standards 100% of the time. In the portion of the Milwaukee River Watershed in Milwaukee County, habitat conditions can be generally characterized as heavily impacted by development. The lower reaches of the main stem and all of Lincoln and South Branch Creeks meet standards only some of the time. Indian Creek meets habitat standards less than 50% of the time along half of its length. Areas of riverways with straightened channels and concrete linings exist on Lincoln Creek, Beaver Creek and Indian Creek. Downstream from North Avenue, Milwaukee River Estuary habitat is heavily impacted due to straightened channels, sheet piling, concrete banks, and extensive sediment deposits.

Habitat in the Milwaukee River Watershed may be characterized as fair in Milwaukee County. Conditions become progressively less favorable in the downstream reaches nearing the Milwaukee River Estuary.

Damages in the Floodplain

Flooding and flood damage are high-profile issues in the Greater Milwaukee Watersheds. The most recent major flood event, in June 2010, led to one death and millions of dollars in damage. Since 1978, the Federal Emergency Management Agency (FEMA) has paid out claims for 1,858 losses totaling more \$12 million in the watershed communities. The average loss in that period was \$6,600. In 1999, there were 2,498 structures in the Milwaukee River Watershed floodplain in the MMSD service area. More than 2,000 of these were located in the Lincoln Creek subwatershed on the north side of the City of Milwaukee. Through creek restoration and flood control initiatives, this number has been reduced to 393 residential and commercial structures in the floodplain; all but one are located along the Milwaukee River in Milwaukee and Glendale.

5a(1)b Existing Conditions in the Menomonee River Watershed

Drainage Area

The Menomonee River Watershed is located in the western portion of the Greater Milwaukee Watersheds and covers approximately 136 square miles in four counties. Milwaukee County accounts for 40% of the drainage area. The main stem of the Menomonee River originates in southwestern Washington County and flows approximately 28 miles south and east to its confluence with Lake Michigan in downtown Milwaukee. The study area for this Reconnaissance Report includes the portion of the Menomonee River Watershed located in Milwaukee County. This portion of the watershed includes the following:

- Menomonee River main stem – 15.6 miles
- Little Menomonee River – 11.0 miles
- Honey Creek – 8.9 miles
- Underwood Creek – 8.0 miles
- Grantosa Creek – 1.8 miles

In Milwaukee County, the Menomonee River watershed drains 55.3 square miles and includes parts of the cities of Milwaukee, Wauwatosa, West Allis, Greenfield and the villages of Greendale and West Milwaukee.

Land Use and Development Controls

Overall, approximately 40% of the land in the Menomonee River Watershed is comprised of rural or open space uses, and 60% is urbanized. The study area is located in the southern (downstream) third of the watershed; this area is densely developed. It includes large areas of high-density residential development, large-scale transportation uses, industrial corridors and commercial districts, including part of Milwaukee's central business district.

Historically, much of the region's industry was located in the Menomonee River valley, immediately southwest of downtown Milwaukee. All Milwaukee County communities in the watershed control development through zoning.

Population

Approximately 337,000 people live in the Menomonee River Watershed. The portion of the watershed that lies in Milwaukee County is home to approximately 253,010 residents.

Watershed Communities

The Menomonee River Watershed covers all or parts of seven Milwaukee County communities. These communities and their characteristics are summarized in Table 4.

Table 4: Community Characteristics in Menomonee River Watershed

Milwaukee County Municipality	Population in Watershed	Area in Watershed (sq. mi.)	Equalized Value of All Property in Municipality	Average Annual FEMA Flood Insurance Premium in Municipality
City of Milwaukee	155,260	31.7	\$31.3 billion	\$459
City of Wauwatosa	47,137	13.2	\$5.4 billion	\$826
City of West Allis	35,742	6.8	\$4.4 billion	\$596
City of Greenfield	11,314	0.1	\$3.1 billion	\$517
Village of West Milwaukee	3,356	0.6	\$344 million	\$337
Village of Greendale	201	0.1	\$1.4 billion	\$538
<i>Total</i>	<i>253,010</i>	<i>55.317843</i>	<i>\$45.9 billion</i>	

Source: URS, Wisconsin Department of Revenue, FEMA

Commercial Navigation

The lower Menomonee River was formerly a key navigation route in Milwaukee, as much of the city's heavy industry was located along the waterway. At this time, commercial navigation is limited on the Menomonee River; a principal user is the We Energies Valley Power Plant, an electric power generation station located in the Menomonee Valley. Coal is stored in the Port of Milwaukee and transported to the power station on barges via the Menomonee main stem and the South Canal tributary. The power plant provides electric energy and steam heat to a large area in central Milwaukee, including the central business district.

Recreation Resources

Water resources in the watershed provide limited but improving recreational opportunities in Milwaukee County. Recreation uses are impacted by considerable alteration of the natural channel of the main stem and tributaries. This includes sheet pile retaining walls in the industrial areas, concrete channel lining in numerous locations for flood control, and a 2.3 mile segment of Honey Creek that runs underground beneath the Wisconsin State Fair Park in West Allis. Major park facilities with water access do exist in the watershed, including Hart Park in Wauwatosa and the Milwaukee County Grounds. Recent projects to improve recreation access have recently been completed at the County Grounds and the Hank Aaron State Recreation Trail, which has segments along the Menomonee River main stem between downtown Milwaukee and Miller Park. Streambank restoration projects in this area have led to renewed interest among anglers.

Water Quality

Water quality indicators vary with location throughout the Menomonee River Watershed. Summaries of the status of these indicators appear below, drawn from the "State of the Menomonee River Watershed."

- *Dissolved Oxygen.* Monitoring in the Menomonee River Watershed indicates that DO levels in the lower reaches of the river meet water quality standards (at least 5 mg/L) between 50% and 85% of the time, with some segments showing better results. The segments of the main stem upstream of the confluence with Underwood Creek meet standards more than 85% of the time. Underwood Creek and Honey Creek generally meet DO standards some of the time.
- *Nutrients.* Water quality criteria for nitrogen are met most of the time within the watershed, but the majority of the watershed does not meet criteria for phosphorus more than 50% of the time. This is due to urban stormwater runoff, soil erosion, and fertilizer entering waterways.
- *Fecal Coliform.* In the Menomonee River Watershed, nearly all locations exceed the standards more than 50% of the time. The lower Menomonee River main stem fares somewhat better, meeting standards between 50% and 85% of the time in the area nearest downtown Milwaukee.

Overall, water quality in the Menomonee River Watershed in Milwaukee County is characterized in MMSD planning efforts as poor. Due to the largely urbanized nature of the watershed and large proportion of impervious surfaces (including roadways and parking areas), non-point source pollution is a primary concern. For example, a recent MMSD planning effort determined that 87% of fecal coliform present in the watershed originates from urban stormwater runoff. As noted in the discussion of the Milwaukee River Watershed, according to SEWRPC's most recent Water Quality Management Plan Update, efforts to improve water quality are focused on nonpoint sources, as past efforts at abating point sources have yielded significant success. SEWRPC

notes that chloride concentrations in particular are increasing over time in streams in the watershed, and identifies private water softening systems and run off from road salting operations – both from streets and on private property – as key sources of this contaminant.

Habitat

In the portion of the Menomonee River Watershed in Milwaukee County, habitat conditions are heavily impacted by development. The main stem downstream of the Little Menomonee River meets standards less than 50% of the time, as is the case with all of Honey Creek and most of Underwood Creek. Portions of the Little Menomonee River are heavily silted in and the habitat quality of many reaches is adversely impacted due to straightened channels, sheet piling and concrete banks, and extensive sediment deposits. In all, approximately 6.3 miles of streambank are lined with concrete in the study area. MMSD is currently undertaking a project to remove 1,000 feet of concrete, located on the main stem between Interstate 94 and US Highway 41. The project, underway in 2011, will open up an additional 17 miles of river to game fish and will include stream bank restoration.

Overall, habitat conditions in the Menomonee River Watershed may be characterized as poor in Milwaukee County. Habitat conditions deteriorate progressively in the downstream reaches of the river; passage of aquatic animal species is prohibited by concrete channels and culverts.

Damages in the Floodplain

Since 1978, FEMA has paid out claims in 1,681 losses totaling nearly \$14 million in the watershed communities. The average loss per claim in that period was \$8,100. In 1999, there were 369 structures in the floodplain in the MMSD service area in the Menomonee River Watershed. More than 240 of these were located in the Hart Park and Valley Park districts between Miller Park and the central business district of the City of Wauwatosa. Currently, there are 100 structures in the floodplain; the bulk of these are located in the western end of the City of Milwaukee.

5a(1)c Existing Conditions in the Kinnickinnic River Watershed

Drainage Area

The Kinnickinnic River Watershed is located in the central portion of the Greater Milwaukee Watersheds and covers approximately 33 square miles in Milwaukee County. The main stem of the Kinnickinnic River originates on the southwest side of the City of Milwaukee and flows approximately eight miles north and east to its confluence with Lake Michigan in downtown Milwaukee, about one-third of a mile south of the point where the Milwaukee River enters the lake. The Kinnickinnic River Watershed is the smallest by area of the six Greater Milwaukee Watersheds. Waterways in the study area for this Reconnaissance Report include:

- Kinnickinnic River main stem – 8.0 miles
- Wilson Park Creek – 6.1 miles
- 43rd Street Ditch – 1.1 miles
- Villa Mann Creek – 0.8 miles
- Lyons Park Creek – 1.3 miles
- Holmes Creek – 1.2 miles
- Edgerton Channel – 0.4 miles

The Kinnickinnic River watershed includes parts of the cities of Milwaukee, Cudahy, Greenfield, St. Francis, West Allis and the Village of West Milwaukee.

Land Use and Development Controls

The Kinnickinnic River Watershed is entirely urbanized. It includes large areas of high-density residential development (26%), large-scale transportation uses (46%), industrial corridors (6%), and commercial districts (3.5%).

The large proportion of land in the drainage area devoted to transportation uses is accounted for by the presence of General Mitchell International Airport and the Port of Milwaukee. All Milwaukee County communities in the watershed control development through zoning.

Population

Approximately 184,500 people live in the Kinnickinnic River Watershed.

Watershed Communities

The Kinnickinnic River Watershed covers all or parts of seven Milwaukee County communities. These communities and their characteristics are summarized in Table 5.

Table 5: Community Characteristics in Kinnickinnic River Watershed

Milwaukee County Municipality	Population in Watershed	Area in Watershed (sq. mi.)	Equalized Value of All Real Estate in Municipality	Average Annual FEMA Flood Insurance Premium in Municipality
City of Milwaukee	133,211	21.1	\$31.3 billion	\$459
City of Cudahy	17,578	4.5	\$1.3 billion	\$429
City of Greenfield	7,739	2.3	\$3.1 billion	\$517
City of South Milwaukee	1,873	0.8	\$1.4 billion	\$633
City of St. Francis	1,873	0.8	\$663 million	\$271
City of West Allis	8,661	2.5	\$4.4 billion	\$596
Village of West Milwaukee	14,532	1.7	\$344 million	\$337
<i>Total</i>	185,467	33.7	<i>\$41.1 billion</i>	

Source: URS, Wisconsin Department of Revenue, FEMA

Commercial Navigation

The lower Kinnickinnic River was historically -- and continues to be -- a key navigation route in Milwaukee. The Port of Milwaukee is located at the junction of the Kinnickinnic River and Lake Michigan, and is a key center for commercial shipping on the Great Lakes and a major intermodal transfer point for Wisconsin. The port serves approximately 225 vessels annually, and receives and ships cargo around the country and the world via the Great Lakes-St. Lawrence Seaway and

inland river barge routes.. The Port of Milwaukee has facilities for bulk materials, shipping containers and oversize cargo; approximately 3.2 million tons of goods were shipped through the port in 2008. Key products include salt for roads, cement and coal. Commercial navigation extends as far upstream on the Kinnickinnic River as S. Kinnickinnic Ave. (approximately 0.45 miles upstream from the port), the site of a cement company terminal and elevator. Facilities for recreational boating extend another one-third mile upstream, to E. Becher Street.

Recreation Resources

The water resources in the Kinnickinnic River Watershed provide limited recreational opportunities. Recreation uses are impacted by considerable alteration of the natural channel of the main stem and tributaries. This includes sheet piling retaining walls in the industrial areas and around the Port of Milwaukee, concrete channel lining in numerous locations for flood control, and several segments of tributaries that run underground. These features limit access and degrade habitat. Two major park facilities with water access do exist in the watershed: Wilson Park and Jackson Park in the City of Milwaukee. The E. Bruce Street Ramp is a major put-in point for boaters entering the Milwaukee Estuary. It is located at the confluence of the Kinnickinnic and Milwaukee Rivers.

Water Quality

Water quality indicators vary with location throughout the Kinnickinnic River Watershed. Summaries of the status of water quality indicators follow, taken from the publication "State of the Kinnickinnic River Watershed."

- *Dissolved Oxygen.* Monitoring in the Kinnickinnic River Watershed indicates that DO levels in most watershed locations meet water quality standards (at least 5 mg/L) between 50% and 85% of the time. The area in the harbor fares better, meeting standards at least 85% of the time. The main stem at S. 1st Street meets standards less than 50% of the time.
- *Nutrients.* With the exception of the headwaters of the 43rd St. Ditch, the watershed does not meet the standard for nitrogen loading more than 85% of the time. For total phosphorus loads, the watershed meets standards less than 50% of the time. These excessive nutrient loads are largely due to urban stormwater runoff, soil erosion, and fertilizer entering waterways.
- *Fecal Coliform.* In the Kinnickinnic River Watershed, nearly all locations exceed this standard more than 50% of the time. The lower Kinnickinnic River main stem fares somewhat better, meeting standards between 50% and 85% of the time in the harbor.

Overall, water quality in the Kinnickinnic River Watershed in Milwaukee County is characterized as poor in MMSD planning documents. Due to the urbanized nature of the watershed, nonpoint source pollution is a particular concern, as noted in the Milwaukee and Menomonee watersheds. For example, 86% of fecal coliform bacteria and 81% of phosphorus in the watershed may be traced to urban stormwater runoff, according to a recent MMSD study. SEWRPC's Regional Water Quality Management Plan Update notes that contaminated sediment remains a major problem in the Kinnickinnic Watershed, and estimates that implementation of the Kinnickinnic River Environmental Restoration Project will result "in the removal of up to 170,000 cubic yards of sediments contaminated with polycyclic aromatic hydrocarbons (PAHs) and polychlorinated biphenyls (PCBs), removing up to 90 percent of the PCB mass in the project area."

Habitat

Throughout the Kinnickinnic River Watershed, habitat conditions are heavily impacted by development; natural channels, vegetative cover and/or riffles are found in few, if any, river segments. Many segments of the Kinnickinnic River and its tributaries have been straightened and lined with concrete – approximately 2.9 miles in all – and substantial portions of Wilson Park Creek and the 43rd Street Ditch are buried underground in conduit. Streambanks in the area in and around the harbor are largely modified with sheet piling and seawalls.

Habitat in the Kinnickinnic River Watershed in general may be characterized as very poor. The passage of aquatic organisms is severely hampered by the presence of concrete-lined channels and long culverts.

Damages in the Floodplain

Flooding and flood damage are high-profile issues in the Greater Milwaukee Watersheds. Since 1978, FEMA has paid out claims in 1,681 losses totaling nearly \$10 million in the watershed communities. The average loss per claim in that period was \$6,600. In 1999, there were 563 structures in the floodplain in the MMSD service area in the Kinnickinnic River Watershed. Since that time, only one of these structures has been removed from the floodplain. Three-hundred and thirty structures are located along the Kinnickinnic River main stem, 190 along Wilson Park Creek, and the remaining are concentrated along Lyons Park Creek.

Study Area Existing Conditions - Summary

Water resources in the study area exhibit characteristics common to highly urbanized watersheds, including recurring flood damage, the presence and/or deterioration of dams and drop structures, excessive concrete channelization of streambeds, eutrophication, impacts of combined and sanitary sewer overflows, nonpoint source water pollution, and habitat degradation. These conditions are summarized in Table 6.

Table 6: Study Area Watershed Characteristics

Characteristic	Milwaukee River Watershed	Menomonee River Watershed	Kinnickinnic River Watershed
Overall Drainage Area	838 sq. miles	136 sq. miles	33.3 sq. miles
Drainage Area in Study Area	64.3 sq. miles	55.3 sq. miles	33.3 sq. miles
Approximate Main Stem and Tributary Watercourse Length in Study Area	34 miles	37 miles	19 miles
Land Use in Study Area	Dense urban development	Dense urban development	Dense urban development
Number of Communities in Study Area	8	6	7
Meets Standards for Dissolved Oxygen	More than 85% of the time	50% - 85% of the time	50% - 85% of the time

Meets Standards for Nutrient Loading	Less than 50% of the time	Less the 50% of the time	Less than 50% of the time
Meets Standards for Fecal Coliform Loading	Less than 50% of the time	Less than 50% of the time	Less than 50% of the time
Meets Standards for Quality of Habitat	50% - 85% of the time	Less than 50% of the time	Less than 50% of the time
Structures in the Floodplain ¹	393	100	562

Sources: URS, MMSD State of the Watersheds Booklets, MMSD Technical Services Division

¹ Does not include garages

5a(2) Expected Future Conditions

The study area includes the portions of the Milwaukee River, Kinnickinnic River and Menomonee River Watersheds that are located in Milwaukee County. The study area is significantly and densely urbanized. Conditions are not expected to improve for the foreseeable future, as major changes in population, population density, urban infrastructure and other factors are not foreseen.

Flooding

Flooding has been a high-profile issue throughout the Greater Milwaukee Watersheds for the last two decades. Major flood events have occurred as recently as 2010, and may be reasonably expected to continue without the implementation of measures to reduce flood risk. The most recent major flood event caused millions of dollars' worth of damage throughout the watersheds, concentrated in the Milwaukee River Watershed in Milwaukee County. Transportation systems (including freight rail) were disrupted by the flood event, which also led to the loss of one life in the Milwaukee River Watershed.

Climate Change

Also of concern are the anticipated effects of climate change on the land and water resources of the Greater Milwaukee Watersheds and its population. Current science-based predictions indicate that climatic changes in this region may include higher temperatures in summer and winter with potentially less annual rainfall, but more intensive precipitation events when they do occur. Higher summer temperatures and periods of drought would generate greater rates of evaporation, less groundwater flow and recharge, and less direct runoff to the streams and rivers. This would result in lower stages and flows, increasing the potential for decreased dissolved oxygen and warmer water temperatures – which would negatively impact the aquatic habitat.

Higher summer temperatures raise the threat of migration northward of warm-weather invasive terrestrial species, while warmer water temperatures likely will change the ecosystem composition in the region's rivers. The potential migration of both floral and faunal invasive species could threaten the viability of watershed ecosystems and endanger potential ecosystem restoration projects. Higher winter temperatures would reduce stream ice cover and potentially result in more bank scour and erosion during rainfall/snowmelt episodes.

Decreases in overall annual precipitation could endanger aquatic and riparian ecosystems and threaten groundwater supplies that provide the base flow for these rivers. The potential threat to aquatic ecosystems from sustained drought conditions would be increased for all watersheds in the greater Milwaukee area. Increased intensity of transitional-season rainfall events would raise

the risks of flash flooding in the Kinnickinnic and Milwaukee River watersheds and increase the frequency of channel-modifying, bank full flows – flows that lead to bank instability, armoring and channel instability. Riparian resources throughout the basin could be threatened by these larger in-bank flows and their effects on the stream channel environment.

Ecosystem Degradation

The aquatic ecosystems in the Greater Milwaukee Watersheds are degraded, severely so in many areas. Key habitat is fragmented by concrete channelization, dams and other urban development. Water quality is compromised, fisheries potential is limited, and recreation uses are curtailed.

5a(3) Problems and Opportunities

Federal, state and local agencies have engaged in numerous water resource planning efforts over the foregoing decade. The studies detailed in Section 4 included major public involvement efforts to identify issues, opportunities and concerns for water resources in southeastern Wisconsin. In addition, numerous stakeholders have been invited to provide input into this Reconnaissance Study (see appendix B).

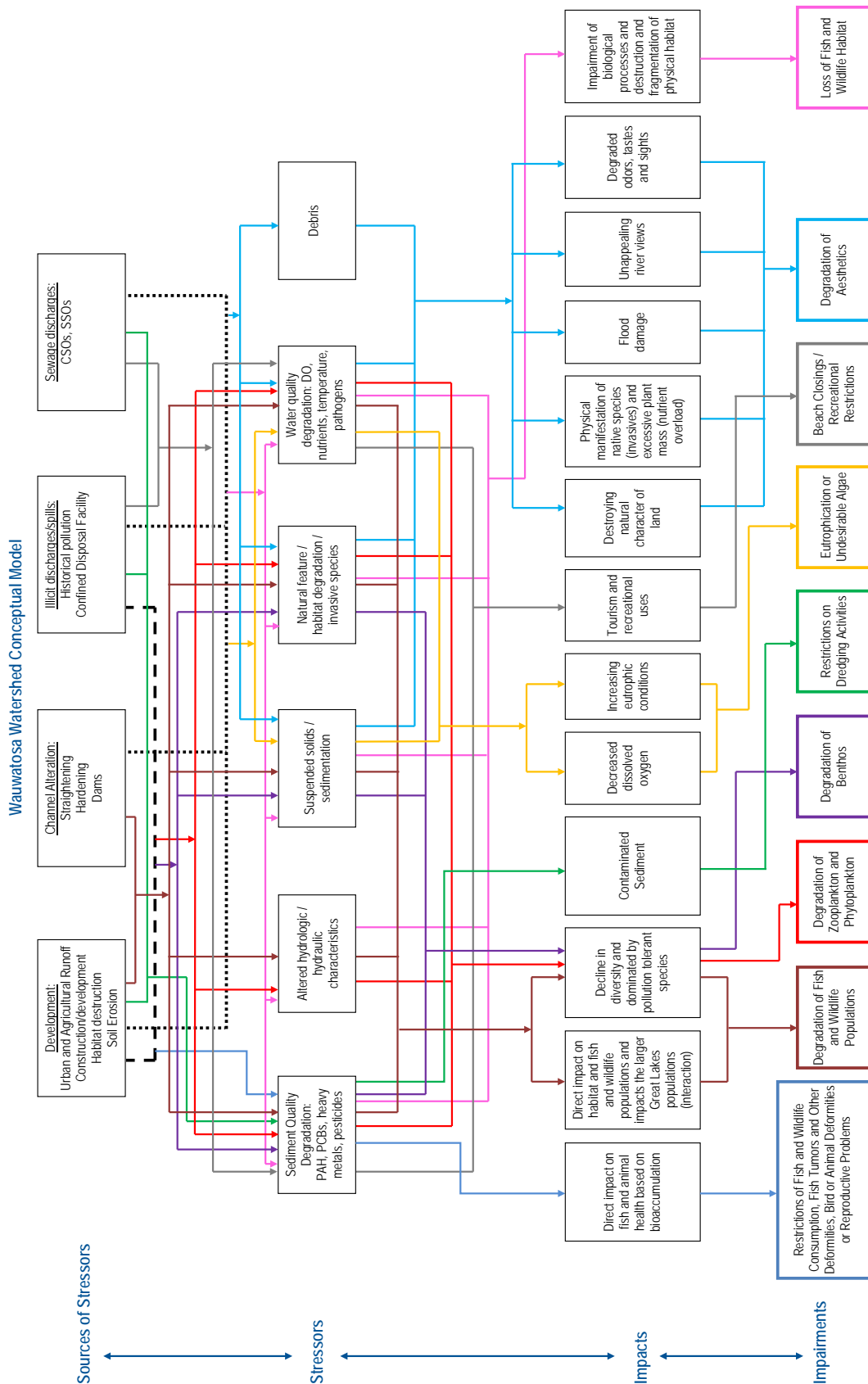
Water resources problems in the Greater Milwaukee Watersheds are typical of highly urbanized areas. This section provides a concise description of the issues facing the Milwaukee, Menomonee and Kinnickinnic River Watersheds, and opportunities to improve the ecosystem health, recreational opportunities and quality of life.

Watershed Conceptual Model

The conceptual model flow chart (Figure 2) graphically demonstrates the inter-relationships between and among pollutant sources, stressors, impacts and impairments; those listed are of medium to high concern within the three watersheds in the study area. To provide a detailed yet concise representation of the relationships, similar sources are grouped. Each pollutant or pollution source contributes to multiple stressors, impacts and impairments. The colored lines indicate how stressors relate to impacts and impacts relate to impairments. These relationships are the graphical representation of the conceptual model of how sources cause degradation to physical and chemical characteristics that impact aquatic and terrestrial life in the Greater Milwaukee Watersheds.

The primary sources that contribute to degradation in the watershed are common occurrences in large urbanized areas and reflect the impacts of infrastructure necessary to support large populations of people in urban/ suburban settings. These impacts cause physical changes to the river (e.g., channelization, straightening, hardening, damming), and impact the quality, diversity and availability of habitat. Water quality impacts (e.g., high nutrient, sediment and toxic compound loadings) may result as well, compromising the system's ability to support a diverse population of aquatic and terrestrial life. Sources depicted in the conceptual model flow chart impact the physical and chemical characteristics of the river. Multiple stressors can result from these sources leading to specific impacts and impairments.

Figure 2: Watershed Conceptual Model



Problems - Watershed Concerns

Water quality, habitat and water flow conditions in the Greater Milwaukee Watersheds are consistent with those typical of highly urbanized watersheds. Problems associated with this type of watershed include variable flow rates due to large areas of impervious surface, concrete channelization of some segments of rivers and streams, property damage due to flooding during storm events, fragmented habitat, combined sewer overflows, elevated fecal coliform bacteria levels and variable water quality due to nonpoint source pollution. These problems are discussed in detail in the following sections.

- *Development in the Floodplain.* The Milwaukee area has suffered severe flooding in the past two decades, with the most recent significant flood event occurring in 2010. Decades of development, along with associated increases in impervious surfaces, have led to flood events resulting in thousands of flooded structures, hundreds of millions of dollars in property damage, injuries and several fatalities. The MMSD and other agencies have been actively addressing flood damage mitigation. Over the past decade, efforts have focused on acquisition of threatened properties; creation of surface and underground storage for stormwater during rain events; and the acquisition, preservation and restoration of key wetland areas. As of 2009, MMSD had protected 2,454 structures within the floodplain in the Greater Milwaukee Watersheds; however, approximately 1,100 structures remain susceptible to flood inundation.
- *Degradation of Habitat and Loss of Aesthetics.* Both physical features and water quality factors are of concern as they affect aquatic habitat. Key impediments to habitat health identified in planning documents include concrete channelization of streams; straightened streams (meander removal); dams and concrete channels serving as barriers to fish passage and inhibitors of natural sediment movement; impervious surfaces in riparian corridors; increased flashiness in stream flow; increased nutrient loads; and low levels of DO. Many miles of the main stem rivers and tributary streams in the urban areas of the watersheds have been straightened, deepened, lined with concrete, or enclosed in concrete pipes to mitigate flooding. In many lined stream reaches, portions of the concrete lining are failing. These areas are characterized by inhibited aquatic function; compromised ecological and aesthetic features; degraded water quality; and loss of fish and wildlife habitat. Consequently, the recreational value to the community is severely limited. *Deterioration of Water Quality.* Numerous interrelated factors degrade water quality. Primary factors cited in water resource planning documents in the Greater Milwaukee Watersheds include:
 - *Point source pollution.* In particular, sanitary sewer system and combined sewer system overflows have generated high levels of concern over the last decade. During wet weather events, excess flow in sewer systems has been released into basements, streets and to surface water. SEWRPC's most recent Water Quality Management Plan for the region's watersheds notes that efforts to address point sources have reduced these impacts over the last decades, particularly the MMSD "deep tunnel" inline storage system and industrial pollution abatement efforts.
 - *Nonpoint source pollution.* While rural nonpoint pollution is a concern throughout the watersheds, urban sources of polluted runoff are of particular importance for the portion of the Milwaukee Watersheds located in Milwaukee County, due to dense urbanization and proportions of impervious surfaces. Pollutants such as copper, sediment, nitrogen and phosphorus are noted issues in SEWRPC's 2009 Regional Water Quality Management Plan Update, as well as bacteria and pathogens from animal waste and other sources. The issue of elevated bacteria levels and their relationship to public health impacts – particularly at beaches and other recreational areas in the Greater Milwaukee Watersheds – is a high-profile concern. Increased frequency of water quality testing during the summer months and improved public

notification of water quality issues have contributed to raising awareness of this issue.

Opportunities and Objectives

Based on the key water resource problems identified by stakeholders, a number of overarching opportunities and objectives were developed. These objectives respond to the issues raised in the Scope of Work for this Reconnaissance Report, and are stated in a manner to allow either quantitative or qualitative measurement. The following opportunities will be used to assess the ability of potential projects to meet the most pressing water resources needs in the Greater Milwaukee Watersheds:

- Reduce potential for flood damage by decreasing the number of structures likely to sustain damage in a 100-year storm event while producing additional floodplain storage area (helping to reducing flashiness in stream flows) and increasing the amount of public greenspace to provide greater access to waterways for recreation.
- Improve biodiversity and populations by creating a net increase in area of aquatic and terrestrial habitat, improving habitat quality, and removing obstructions to aquatic and terrestrial organism movement through the corridor.
- Improve water quality by increasing the area of natural filtering and runoff-slowng buffer strip between roads and private properties and the river
- To increase the number of stormwater best management practices in use in watershed, including public education and involvement (rain barrels, rain gardens, etc).

These opportunities and objectives formed the basis for the screening of the preliminary project locations discussed in the following sections.

Constraints

Flood risk management alternatives that satisfy area needs and objectives are partially limited by economic, environmental, and technical constraints:

- Improvements for flood risk management purposes shall have benefits in excess of estimated costs;
- Plans cannot unreasonably impact environmental or cultural resources;
- The projects must be feasible (from an engineering standpoint) and cost effective, using proven technology;
- Identified alternatives must be within the authority of the Corps and/or the non-Federal partner to implement;
- There must be a reasonable assurance that a public entity (i.e., state or local unit of government) is capable and willing to participate as a non-Federal partner in a cost-shared feasibility study.
- Federal funding limitations may result in incomplete or inconsistent funding.

Ecosystem restoration alternatives that satisfy area needs and objectives are also partially limited by economic, environmental, and technical constraints:

- Plans may not negatively impact critical historic or archaeological resources;
- Plans must be consistent with state and local land use regulations;
- Plans should employ some type of accepted methodology and demonstrate a reasonable chance of success.

5b Alternative Plans

Potential alternative plans or projects in the Greater Milwaukee Watersheds were compiled from planning documents provided by MMSD, SEWRPC, USEPA and non-governmental organizations. These projects were screened for their ability to meet USACE objectives for flood risk management and habitat restoration. The projects were then prioritized based on input from MMSD staff, and records of agency and citizen stakeholders. High-value, high-priority project locations were selected for more detailed evaluation for a determination of Federal Interest. A “No (Federal) Action” alternative will be included in a specific feasibility study of any of the potential projects listed below. The probable non-Federal sponsor for the projects is expected to be proactive and engaged, and implement many, if not all, of the listed projects, where possible. The non-Federal sponsor also agrees that the “No Action” alternative is not desirable, given that flood risk and degraded habitat in the study area are at unacceptable levels and will remain that way indefinitely without action.

Screening of Proposed Measures to Manage Flood Risk and Restore Habitat

As part of the initial screening, previous reports completed by the aforementioned agencies and stakeholders were reviewed. Thirty-two project locations that focused on flood risk management, environmental restoration, and other beneficial impacts to the watershed were selected for screening, and preliminary cost estimates were subsequently developed. The projects were then screened to determine if they met USACE criteria for implementation, and to determine if they provided other benefits such as stakeholder support, public safety and/or improved water quality. Through this screening process, the potential project location list was reduced to seven primary projects that appeared to meet all criteria.

The list of primary project locations was further prioritized in collaboration with MMSD to select projects that best meet objectives based on magnitude of benefits and stakeholder support. Four project locations were selected for detailed evaluation of potential Federal Interest. These project locations are strongly supported by MMSD and other stakeholders and have been identified in collaborative watershed planning processes. Alternatives for the project locations are in various states of development, and construction cost estimates are available for each. . A detailed explanation of the screening process is included in Appendix C: Initial Project Screening. The four projects selected for further evaluation are detailed in the following section.

Priority Project Locations

The projects selected for evaluation are shown on Figure 3 and summarized in Table 7. Three of these projects are designed to meet both flood risk management and ecosystem restoration objectives; one project is designed to meet flood risk management objectives. The projects are in various stages of development, with more data and project details available for some projects than for others. Descriptions of each potential project follow the table and, where available, include updated data and figures.

Figure 3: Priority Project Locations

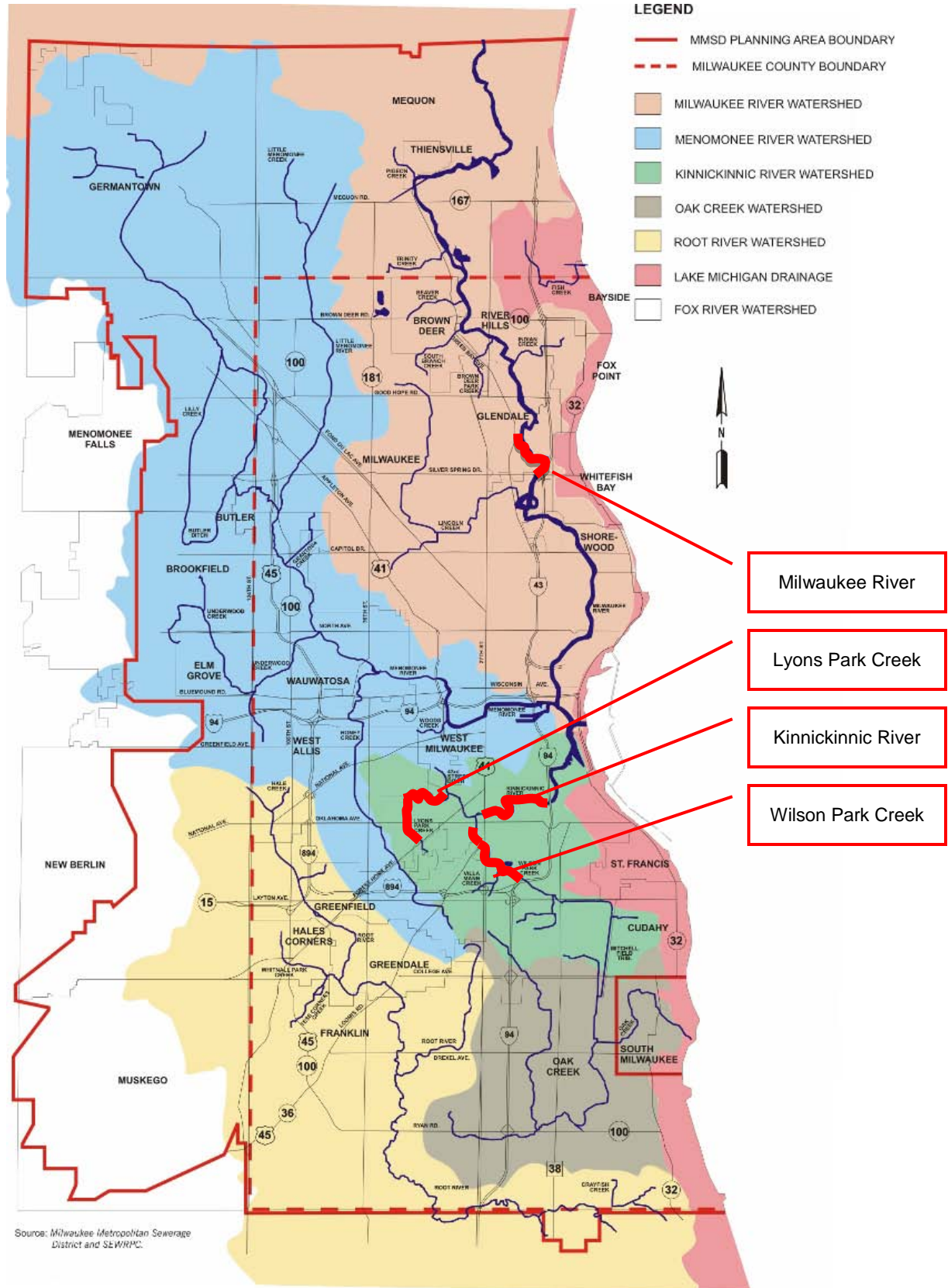


Table 7: Priority Water Resource Project Locations

Project	Location	Watershed	Primary Project Purpose
Lyons Park Creek and Kinnickinnic River Reach 4	Outlet east of S. 43 rd St to Lyons Park Creek; Lyons Park Creek from KK River Pkwy to Forest Home Ave, Milwaukee	Kinnickinnic	Flood Risk Management, Habitat Restoration
Kinnickinnic River Reach 2	S. 6th St. to S. 27th St., Milwaukee	Kinnickinnic	Flood Risk Management, Habitat Restoration
Wilson Park Creek Reach 2	W. Euclid Ave to Canadian Pacific Railroad east of S. 13 th Street	Kinnickinnic	Flood Risk Management, Habitat Restoration
Milwaukee River	Neighborhood near Sunny Point Ln, Glendale	Milwaukee	Flood Risk Management

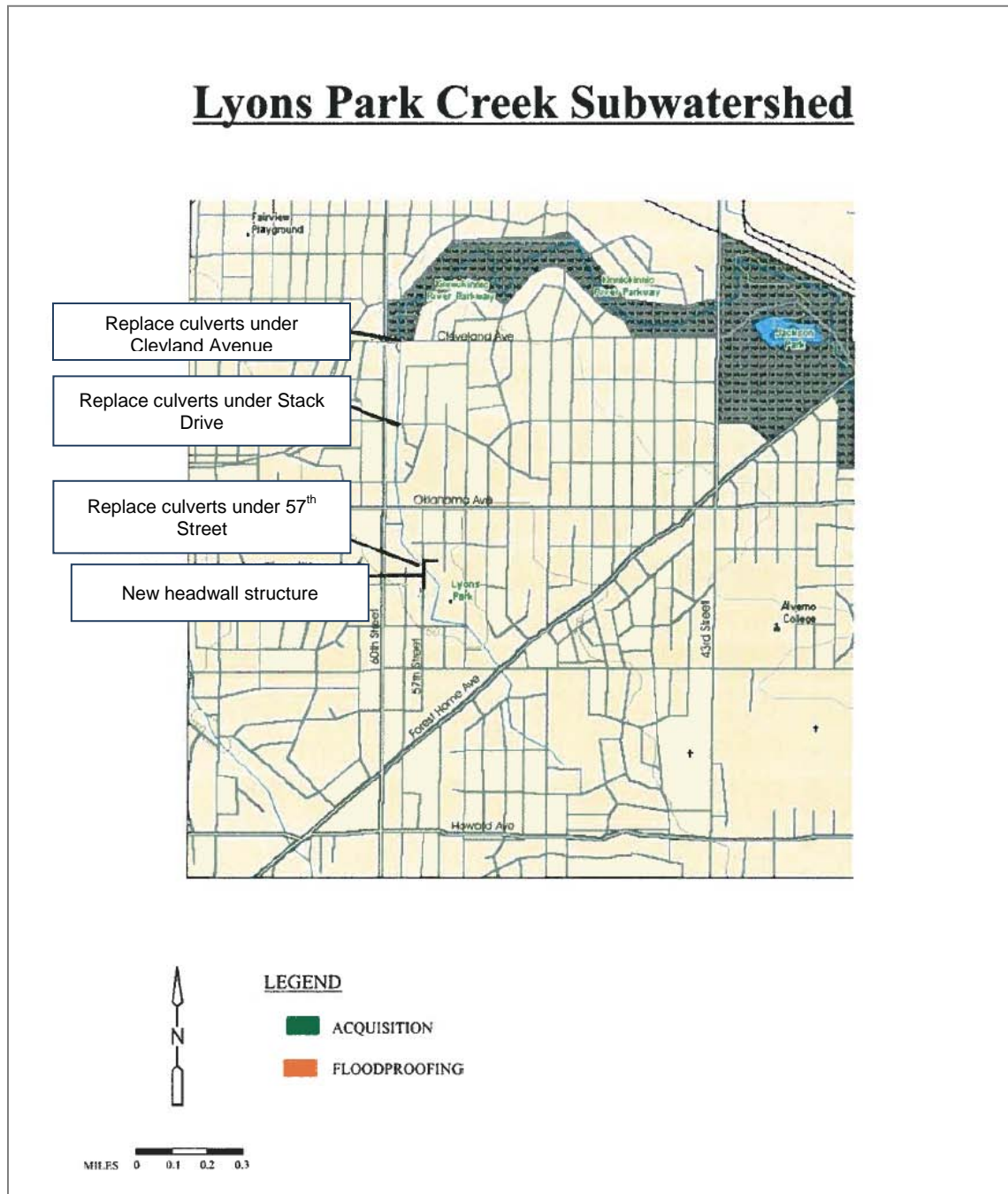
Project Location: Lyons Park Creek and Kinnickinnic River Reach 4

This project in the Kinnickinnic River Watershed is a flood risk management project to address structures located in the 1% probability floodplain, and includes the removal of a concrete lined channel, channel rehabilitation, streambank stabilization and buffer enhancements to improve ecosystem health. The Lyons Park Creek subwatershed encompasses an area of 1.3 square miles and is completely urbanized. Past actions (e.g., channel deepening, straightening, lining with concrete), have been undertaken in an attempt to accommodate increased flows due to development and, in so doing, have degraded the overall aquatic environment, destroying habitat and leading to a loss of benefits, including recreational benefits. An evaluation undertaken by MMSD in 2005 (Kinnickinnic River Phase II Watercourse Management Plan) identified 40 properties with 20 residential and commercial structures that would be flooded in a 1% annual probability flood event, with roadways overtopped in three locations. That study estimated the costs of a 1% probability flood in the Lyons Park Creek subwatershed to be approximately \$1.2 million (2005 dollars). That planning effort included evaluation of storage, conveyance, levees and acquisition and floodproofing alternatives to reduce flood risk. It recommended a combination of actions as described below.

This proposed action for this project location was developed in the 2005 study and other planning efforts by MMSD. It combines flood risk reduction actions recommended in the watercourse management plan and streambank stabilization actions from a forthcoming sediment transport study, along with concrete removal and channel rehabilitation for ecosystem restoration. The upstream limit of the project is on Lyons Park Creek at W. Forest Home Ave. The project extends downstream along the creek to the confluence with the Kinnickinnic River, and continues east along the Kinnickinnic to S. 43rd St in Milwaukee. Currently, the existing culverts are not sufficient to convey flood flows through the project reach, creating increased flood stages behind these structures as well as overflow routes around them. The flood risk reduction actions include the redesign and replacement of three culverts in the project area and the redesign of a headwall structure on S. 57th Street. The floodplain limits in the project area were recently updated by the Southeastern Wisconsin Regional Planning Commission. Increasing the capacity at the three culverts will significantly lower the risk and impact of a 100-year flood event. These actions would reduce flood risk for 46 residential and commercial structures and an additional 18 garages in the

updated 1% probability floodplain. In total, 203 properties lie in the affected 1% probability floodplain in the project area. See Figure 4 for a depiction of the locations of proposed flood risk reduction improvements.

Figure 4: Proposed Flood Risk Management Actions for Lyons Park Creek



Source: Milwaukee Metropolitan Sewerage District, Kinnickinnic River Watercourse Management Plan (Phase II), 2005.

The project would also include the stabilization of areas of significant erosion along the bed of Lyons Park Creek upstream of the concrete channel lining and along the stream banks of the KK River along Reach 4, as recommended in the KK River Sediment Transport Study. It would also

include removing approximately 3,000 linear feet of existing concrete channel lining and replacing it with a rock lined channel along Lyons Park Creek (not shown in figure 4). In 2009, the MMSD undertook an emergency bank stabilization repair project at multiple locations within the Kinnickinnic River Reach 4.

Project benefits from the proposed concrete removal and channel rehabilitation include:

- Reduce flood risk for 46 residential and commercial structures and 18 garages.
- Improvements to aquatic habitat. These improvements are expected to primarily benefit benthic organisms, as fish passage from the downstream reaches of the Kinnickinnic River is unlikely due to the existence of a 650 foot long underground culvert on the Kinnickinnic River in Jackson Park.
- Improvements to water quality. The locations of bank and bed erosion within this project are primary sources of sediment within the Kinnickinnic River Watershed. Addressing these areas will significantly reduce turbidity and sediment deposition within downstream project reaches, including the Kinnickinnic River flushing tunnel outlet and the proposed channel rehabilitation along the river from the I-94 bridge to Jackson Park.
- Improvements to fish and wildlife habitat. A vegetative riparian buffer will be constructed along the channel, connected to riparian buffer zones within Lyons Park.

The MMSD is currently preparing a Request for Proposals for a flood management planning study which will address the flood risk reduction and habitat restoration in this project area. It is anticipated that this study will begin during the summer of 2011 and is scheduled to be completed in the summer of 2012. The study will reevaluate the recommended alternative from the Kinnickinnic River Watercourse Management Plan (Phase II) with the updated SEWRPC flood flows and determine if project recommendations in that document are still appropriate or if additional alternatives should be evaluated. A stakeholder group consisting of local elected officials, local and regional government agencies, regulatory agencies, local non-governmental organizations (NGOs), and area business and neighborhood groups will be assembled to provide input into this planning effort.

The total construction cost for this proposed project is estimated to be \$5,884,500. Costs are itemized in Table 8.

Table 8: Estimated Construction Costs for Lyons Park Creek and Kinnickinnic River Reach 4 Project

Construction Element	Estimated Cost
Phase II Flood Management Recommendations (adjusted for inflation from 2005 estimate)	\$ 969,500
KK River Sediment Transport Study Recommendations	\$ 1,315,000
Concrete Removal & Channel Rehabilitation (estimated \$ 1,200/lin.ft.)	\$ 3,600,000
<i>Total Construction Contract Costs</i>	<i>\$ 5,884,500</i>

Project Location: Kinnickinnic River Reach 2

This project in the Kinnickinnic River Watershed is a flood risk management project with associated ecosystem benefits, and addresses structures located in the 1% probability floodplain. The project entails the removal of a concrete lining and widening of the river channel through a residential area. In addition to flood risk reduction actions, it includes channel rehabilitation, streambank stabilization and buffer enhancements to improve ecosystem health. The Kinnickinnic River main stem watershed encompasses an area of 10.6 square miles and is completely urbanized. The Kinnickinnic River drains directly into Lake Michigan in the Milwaukee Harbor, and is located in the USEPA's Milwaukee Estuary AOC. Past actions such as channel deepening, straightening and lining with concrete have been undertaken in an attempt to accommodate increased flows due to development; these actions have degraded the overall aquatic environment, destroyed habitat and led to loss of benefits, including recreational benefits.

The Kinnickinnic River has a highly engineered drainage system. The adjacent residential areas are in close proximity to the channel. SEWRPC developed revised flood flow estimates for the Kinnickinnic River main stem in April 2008. The updated 1% probability flows will not be contained within the concrete channel as it is currently configured and will cause significant flood damage through the project area from S. 16th Street to S. 6th Street. Peak flows nearly as large as the 1% probability flow have occurred on the Kinnickinnic River in 2000 and 2006 and, most recently in a June 2008, event. While the first two events were contained within the constructed channel, the June 2008 event exceeded the channel limits in several locations between South 6th St. and South 16th St. and flooded approximately 55 residential properties and businesses.

The most severe flooding on the Kinnickinnic River occurred in 1986 when an unusual storm produced flows exceeding the SEWRPC April 2008 1% probability flood flows. More frequent storms cause the water levels to rise rapidly and unexpectedly. The flood flow velocities in the project area can reach 20 feet per second, creating extremely unsafe conditions – more dangerous than typical stream flooding situations. The unusually high velocities and steep channel banks have contributed to several drowning deaths on the Kinnickinnic River over several decades.

The Kinnickinnic River Flood Management and Steam Channel Rehabilitation project limits are S. 6th Street upstream to S. 27th Street on the south side of the City of Milwaukee. The purpose of the project is to remove the existing concrete channel liner from approximately 12,000 linear feet of the main stem of the Kinnickinnic River. The channel will be widened from the existing 60 foot cross section to a cross section ranging between 150 and 200 feet in width to create storage for flood water. The channel's side slopes will have less steep grades than the existing channel, and the streambanks will be stabilized with vegetation. The new channel will be bioengineered and will include a low flow stream, pools and riffles, and a connected vegetative floodway. The project will also replace five vehicle and four pedestrian bridges and will create floodwater storage in a naturalized and restored river channel, reducing the risk of flooding for approximately 388 residential and commercial structures and an additional 217 garages.

The proposed project is the centerpiece of and catalyst for an ambitious neighborhood redevelopment planning effort involving collaboration among numerous stakeholders. The MMSD has worked extensively with project stakeholders to address potential constraints such as the neighborhood's vision for its future, significant real estate acquisition, and aesthetic and access improvements. The MMSD has completed the preliminary engineering phase of the project and has determined a feasible alternative that meets MMSD and stakeholder objectives. The alternative was evaluated based on total project cost, impacts on flood water elevations, number of property acquisitions required, and hydrologic and hydraulic modeling. The MMSD was assisted by a Technical Review Committee consisting of representatives from the Wisconsin DNR, SEWRPC, Milwaukee County Parks Department, City of Milwaukee departments (City Development, Public Works), Friends of Milwaukee's Rivers, Sierra Club, the University of Wisconsin-Milwaukee and a community stakeholder group comprised of representatives from

local nonprofit organizations and agencies, neighborhood community groups and individual residents. The group has been meeting on regular basis since project inception.

The recommended alternative consists of the acquisition of up to 84 structures between 6th Street and 16th Street to allow for a wider, more biologically and hydraulically functional stream channel that will improve public safety and reduce the risk of flooding. This project has potential to create wetlands connected to the reconstructed low flow channel, improving stream hydraulics. The project will require the relocation of utilities, pedestrian and auto bridge modifications, and alterations to County Park land. Proposed features include overlooks, a “river paseo” or walking pathway to improve access, and public gardens. Figure 5 shows a representation of a portion of these improvements in plan and section.

Figure 5: Proposed Kinnickinnic River Reach 2 Project Rendering



Source: Kinnickinnic River Corridor Neighborhood Plan, 2000

Project benefits include:

- Reduce the flood risk for the 1% probability (100-year) flood event for approximately 505 residential and commercial structures (including garages).
- Improve public safety (minimize drowning risk) by designing for slower and shallower floodwater at floodplain edge.

- Improve passive and active recreation opportunities by enabling better viewing of and access to a naturalized river environment and by restoring the sport fishery.
- Improve the aesthetics of the river channel by creating a “green” river corridor to provide an asset to the neighborhood.
- Improve the environment through fish passage and the restoration of aquatic habitat by providing in-stream aquatic habitat by removing drop structures and adding pools and riffles.
- Provide green space and investment in green space infrastructure to promote economic development for the local community.

The MMSD plan details ecosystem benefits resulting from the project, which will restore fish access to, and a recreational sport fishery along 12,000 linear feet of river channel; enhance aquatic habitat; and mitigate safety hazards. Restored recreational fishing opportunities will include trout, salmon, northern pike and walleye.

MMSD indicates that habitat restoration improvements in the project area will spur related economic development activity and community benefits. By increasing the area available to anglers taking salmon and steelhead trout during their runs up the Kinnickinnic River, the long-term economic benefits of this project, in combination with other fisheries restoration efforts, could add significantly to the economy of the Milwaukee metropolitan area. According to the Economic Policy Institute and U.S. Fish and Wildlife Service, each \$1 million investment in fish passage improvements creates between 20 and 54 jobs. This project would create between 40 and 108 full-time equivalent jobs in various disciplines such as civil engineering, survey, biology, project management, non-metallic mining, landscaping, and construction. Ancillary benefit would include increased residential property values for properties adjacent to the restored river corridor. Research indicates that a typical property value increase is in the range of 2-3%, rising to 4-6% if a trail is associated with the corridor. Neighborhood redevelopment plans based on the proposed action include the development of a comprehensive trail system, along with parkland and community space.

The preliminary engineering estimate for construction and acquisition cost is \$56.6 million (including a 20% contingency). Of that cost, acquisition and deconstruction of the property and structures necessary for construction of the new channel is estimated to be \$15 million. Acquisition and deconstruction is currently underway, and the MMSD has spent just under \$3.5 million to date. Total construction cost is therefore estimated to be \$41.6 million.

Project Location: Wilson Park Creek Reach 2

This project in the Kinnickinnic River Watershed is a flood risk management and ecosystem restoration project to address structures located in the 1% probability floodplain, and includes the removal of a concrete lined channel through a residential area. The Wilson Park Creek subwatershed encompasses an area of 9.9 square miles and is completely urbanized. Past actions such as channel deepening, straightening and lining with concrete have been undertaken in an attempt to accommodate increased flows due to development; these actions have degraded the overall aquatic environment, destroyed habitat and led to loss of benefits, including recreational benefits.

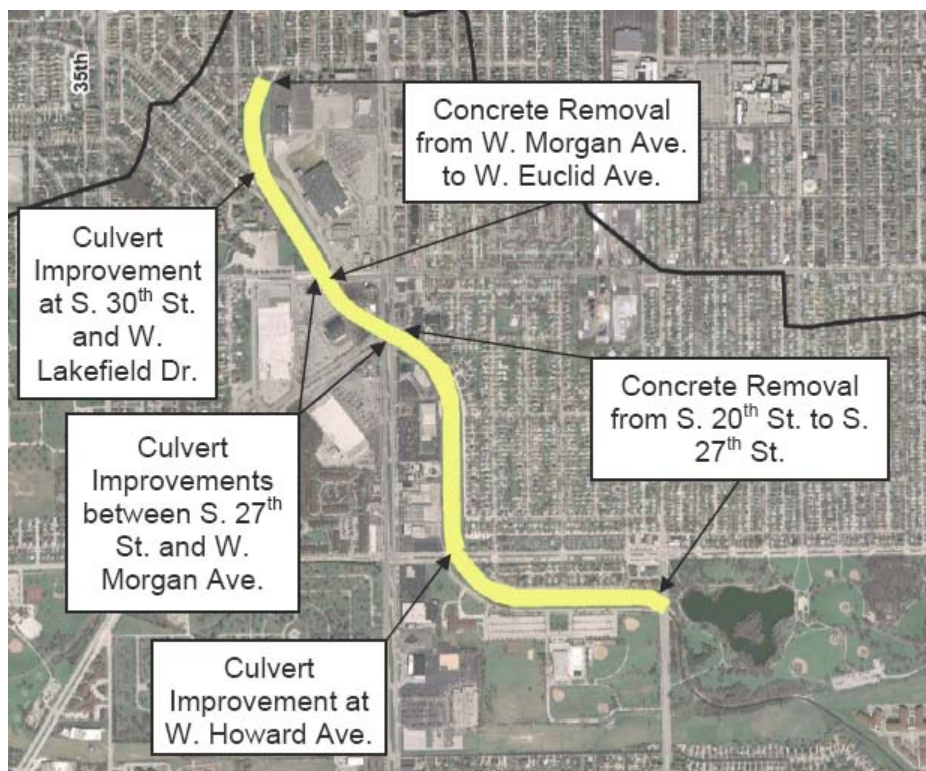
The Wilson Park Creek Reach 2 project is a flood management and channel rehabilitation project which extends along Wilson Park Creek between W. Euclid Ave and the Canadian Pacific (CP) Railroad (RR) east of S. 13th St in Milwaukee, WI. The primary objectives of this project include:

- Reducing the flood risk for 175 residential and commercial structures (333 structures when including garages) located in the 1% probability floodplain which was recently updated by SEWRPC.
- Removing approximately 6,500 linear feet of existing concrete channel lining and rehabilitating the channel with a rock lined channel and vegetated floodplain.

The recommendations for this project location consist of increasing the capacity of three culverts and replacing the existing concrete lined channel with a rock lined channel with vegetated side slopes (See Figure 6). Currently, the existing culverts are not sufficient to convey flood flows through the project reach, creating increased flood stages behind these structures as well as overflow routes around them. A combination of the increased flood stages and the overflow routes produces overland flooding into the homes and business located adjacent to the Wilson Park Creek. The recommendations for increasing the capacity at the three culverts will significantly lower the flood stages and eliminate the overflow routes for the 100-year flood event. In addition, the increased capacity also allows for the removal of the concrete channel and installation of a rock lined channel with vegetated side slopes while maintaining the lowered flood stages.

The project will reconnect severed riparian ecosystem elements and improve waterway aesthetics in this urbanized corridor. One of the culverts to be addressed is approximately 900 feet in length and runs under a parking lot at the Point Loomis Shopping Center. Given that this flood management alternative will convey more flow downstream to the Kinnickinnic River, additional modeling was undertaken to coordinate with Kinnickinnic River projects to ensure that the additional flow was accounted for in their project designs. Note that this project is not to be confused with a similar project on an adjacent reach of Wilson Park Creek for which MMSD applied for Federal funding under Section 206.

Figure 6: Proposed Project for Wilson Park Creek Reach 2



Source: MMSD

A stakeholder group consisting of local elected officials, local and regional government agencies, regulatory agencies, local NGOs, and area business groups provided input into this planning effort. This group will continue to be involved with the project, as with the Kinnickinnic River Reach 2 project.

Benefits of this project include:

- Flood risk reduction to 333 residential and commercial structures, including garages.
- Improvements to aquatic habitat. These benefits will be limited to benthic organisms, as fish passage from the downstream Kinnickinnic River is unlikely due to the presence of a 1,250 foot long underground culvert between Euclid Avenue and the confluence with the Kinnickinnic River;
- The creation of a riparian buffer along the channel.

Construction costs for this project are estimated to be \$21.5 million. Total project costs are itemized in Table 9.

Table 9: Wilson Park Creek Reach 2 Estimated Project Costs

Project Element	Estimated Cost
Preliminary Engineering	\$ 548,867
Design	\$ 1,547,526
Construction	\$ 22,671,299
Construction Contract	\$ 21,464,940
Post Construction	\$ 115,918
Total Project Costs	\$ 24,883,610

Project Location: Milwaukee River Flood Control

This project in the Milwaukee River Watershed is a flood risk management project to address structures in the 1% probability floodplain. Three alternatives were developed for this project in a 2010 study authored by SEWRPC and entitled “A Watercourse System Plan for the Milwaukee River in Milwaukee County Upstream of the Milwaukee Harbor Estuary.” The area in the Milwaukee River Watershed in the City of Glendale has been prone to flooding since at least 1924; a 1970 report mentions “frequent and extensive historic flood damage” in the “Sunny Point Lane Peninsula area.” This area, located on a bend in the Milwaukee River, has medium density residential land uses, institutional uses, limited commercial uses, and some recreational uses in Kletzsch Park on the west side of the river.

In total, 393 structures are located in the floodplain at this project location. Three-hundred-eighty-three residential structures and one commercial structure are located in the 1% probability floodplain in this area. Ten structures are located in the floodplain in the villages of Brown Deer and River Hills and in the City of Milwaukee. In addition to flooded structures, the watercourse planning study notes that streets and other infrastructure are inundated in a 1% probability flood event. SEWRPC estimates that the total estimated damage from such an event is \$12.8 million

dollars, and estimates that the average annual damage due to flooding in this reach of the Milwaukee River is \$674,200.

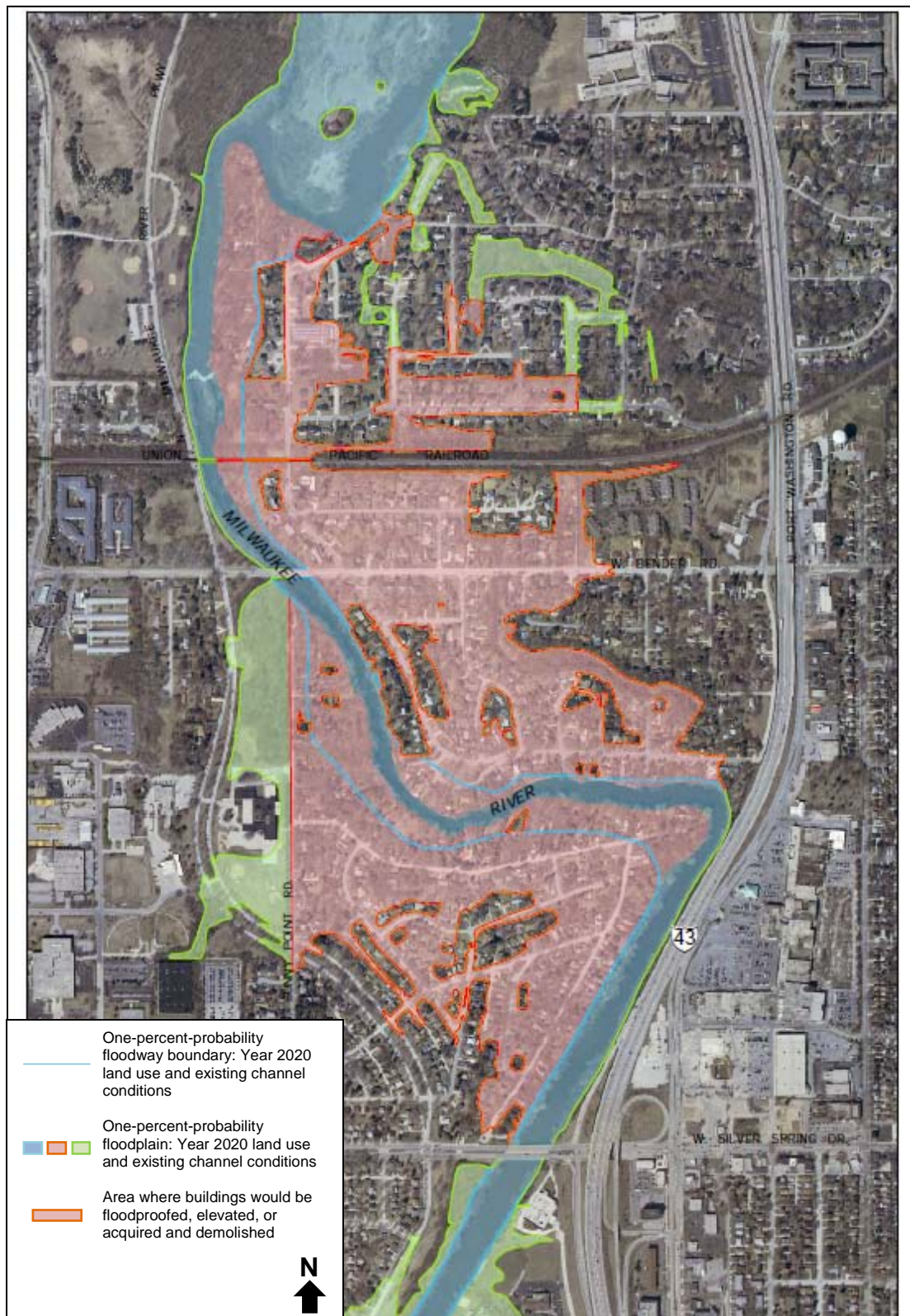
Three alternative plans were proposed to mitigate structural flood damages to 393 structures during the 1% probability flood event. Alternative 1 includes acquisition and demolition of the buildings in the 1% probability floodplain. With this alternative, 393 structures would be demolished and public open space would be created. Implementation of this alternative is estimated to cost approximately \$107.6 million, based on the cost to acquire the property and relocate inhabitants and businesses.

Alternative 2 features floodproofing, elevation and acquisition and demolition of buildings in the 1% probability floodplain. With this alternative, 145 buildings would be floodproofed; 177 buildings would be elevated, and 71 buildings would be demolished, with the creation of new public open space. Total capital cost for Alternative 2 is estimated to be \$38.2 million. Capital cost exclusive of acquisition, demolition and relocation is estimated to be \$18.4 million.

Alternative 3 is based on the construction of levees to protect structures from damages during a 1% probability flood event. Two levees would be constructed: an east bank levee proximately 7,500 feet in length, and a west bank levee approximately 6,500 feet in length. Select buildings currently in the floodway would be acquired and demolished to allow levee construction. The levees would protect 287 structures in the 1% probability floodplain, and select structures would be floodproofed or elevated. Drainage facilities would be constructed on the river side of the levees, including seven pump stations and associated storm sewer improvements. Total capital cost for the alternative is estimated to be \$61.2 million. The levees would be constructed to meet state and Federal requirements and would potentially provide protection in Glendale for structures located in the larger 0.2% probability floodplain. This could provide protection for up to 220 additional structures.

Assuming that a “no-action” alternative is unacceptable to the MMSD and affected municipalities due to likelihood of recurrent flooding in the Milwaukee River Watershed, the SEWRPC study recommends Alternative 2 as the preferred alternative based on effectiveness and relative benefit to cost analysis, as well as the preferences of the city of Glendale. Alternative 2 is identified as the locally preferred plan and is the action evaluated in the following section. A depiction of this alternative is provided in Figure 7. Including garages and other ancillary structures, MMSD estimates that there are a total of 859 structures located in the 1% annual probability floodplain in this location.

Figure 7: Proposed Milwaukee River Flood Risk Reduction Project



Source: SEWRPC and MMSD

5c Preliminary Evaluation of Project Locations

Table 10 summarizes the preliminary evaluation of the alternatives. This evaluation is based on the following assumptions:

- A FY2011 discount rate of 4.125% was used to calculate annual costs. This figure is derived from Water Resources Council's Rules and Regulations (33 F.R. 19170) section 704.39(a). The project life is 50 years.
- Some projects have real estate acquisition costs as well as construction costs. In this evaluation, construction costs are used to allow comparison between projects. Real estate costs for the various alternatives have not been determined due to the preliminary nature of this Section 905(b) Analysis. During the Feasibility Study, a detailed Real Estate Plan will be undertaken and the results will be factored into the economic analysis of the various alternatives.
- Flood risk management benefits are represented by the value of improvements in the 1% probability floodplain.
- Habitat restoration benefits are represented by linear feet of streambank stabilization and channel naturalization. This proxy is used to demonstrate the relative benefits between alternatives; the Kinnickinnic River Reach 2 project has considerable additional ecosystem benefits in that its completion would open up fisheries potential in large areas of the watershed; all projects are located in areas that drain directly to Lake Michigan. These benefits are described in the project descriptions in Section 5b.

Table 10: Preliminary Evaluation of Project Locations

Project	Estimated Construction Cost	Annual Cost ¹	Number of Structures in Floodplain ²	Assessed Value of Structures in Floodplain ³	Habitat Restoration Benefits (feet)
Lyons Park Creek and Kinnickinnic River Reach 4	\$5,884,500	\$280,000	64	\$11,111,400	3,000
Kinnickinnic River Reach 2	\$41,600,000	\$1,978,000	505	\$29,414,000	12,000
Wilson Park Creek Reach 2	\$21,464,940	\$1,021,000	333	\$87,441,200	6,500
Milwaukee River Alt 2 (floodproofing)	\$18,410,000	\$875,400	859	\$68,894,700	0

¹Based on a 50-year project life and interest rate of 4.125%

²Structures in 1% annual probability floodplain, includes garages; based on MMSD data

³Assessed value of improvements in 1% probability floodplain based on MMSD data

Flood risk management benefits are primarily generated by 1) the reduction of flood damage to structures and their contents; 2) the reduction in emergency response costs associated with

flooding events; 3) reduced Federal Insurance Administration costs; and 4) reductions in disruptions to commercial transportation.

The objectives for habitat and ecosystem restoration are to identify alternatives that improve biodiversity and populations by creating a net increase in area of aquatic and terrestrial habitat, improving habitat quality, and removing obstructions to aquatic and terrestrial organism movement through the corridor. With the exception of the Milwaukee River Flood Control project, the projects listed above include the removal of concrete channels and the restoration of streambeds to more natural states, and the reconnection of fragmented aquatic habitat. Additionally, the projects include streambank stabilization and other erosion control measures that are likely to reduce sedimentation of waterways, improving water quality and leading to net increases in high quality habitat.

Project Location Evaluation: Lyons Park Creek and Kinnickinnic River Reach 4

This project would have both flood risk management benefits and habitat restoration benefits in the Kinnickinnic River Watershed. This project would reduce the risk of flooding to 64 structures located in the 1% probability floodplain. With 3,000 linear feet of streambank stabilization and the elimination of a major source of sediment in the Kinnickinnic River Watershed, the project's ecosystem restoration benefits are also likely to be significant, improving conditions for aquatic organisms both in the immediate vicinity of the project and in downstream reaches of the Kinnickinnic River, the Milwaukee Harbor and Lake Michigan. Therefore, it is reasonable to assume that the project will contribute to significant ecosystem restoration objectives in the Greater Milwaukee Watersheds. Furthermore, this project has received support of various agencies and municipalities, and the MMSD is prepared to involve a broad range of stakeholders in future project development, raising the probability of successful implementation.

Of the 11 identified BUIs in the Milwaukee Estuary AOC, the project will directly contribute to delisting the following: degradation of aesthetics; degradation of benthos; degradation of fish and wildlife populations; and loss of fish and wildlife habitat. In so doing, these improved conditions are expected to contribute to enhanced recreational opportunities for local residents.

This project location is recommended for a feasibility phase analysis based on its potential flood risk management and ecosystem restoration benefits.

Project Location Evaluation: Kinnickinnic River Reach 2

The MMSD has worked with a broad coalition of public and private stakeholders to develop this project to address multiple objectives. This project would reduce risk of flooding to 505 structures located in the 1% probability floodplain; however, it is not clear that the project would meet cost-benefit requirements for a flood risk reduction project. The habitat restoration benefits of this project are likely to be highly significant. Habitat in this portion of the Kinnickinnic River is in a greatly degraded state. Restoring 12,000 feet of waterway habitat in this key location immediately upstream of the Milwaukee Harbor will open up a large area of the watershed to sport fishing by allowing fish passage from Lake Michigan and creating in-stream aquatic habitat. Other project benefits – including economic development, public safety and improved water quality – are of great importance to area stakeholders and are also likely to be significant. This project location is likely to have the greatest benefits to ecosystem restoration objectives of all the proposed locations. The project is located immediately upstream of the Milwaukee Estuary AOC, and of the 11 identified BUIs, will directly contribute to delisting the following: degradation of aesthetics; degradation of benthos; degradation of fish and wildlife populations; and loss of fish and wildlife habitat. The project may indirectly contribute to delisting the restrictions on dredging activity BUI.

This project includes significant real estate acquisition. The MMSD undertook a comprehensive alternatives analysis process in cooperation with numerous partners including the City of Milwaukee, the Wisconsin DNR, SEWRPC, and neighborhood organizations. Extensive neighborhood outreach was conducted during plan development, including door-to-door distribution of materials, community surveying and public meetings. All materials and presentations were presented in English and Spanish. MMSD held a special meeting early in plan development with property owners and tenants in flood risk areas to discuss potential property acquisition and to outline MMSD's property acquisition and relocation process. According to the 2009 Kinnickinnic River Corridor Neighborhood Plan, the recommended alternative represents "the smallest area necessary to meet flood conveyance and public safety objectives. A property will only be acquired if it will be directly impacted by the new river corridor or if it is necessary to gain access to the site for construction purposes. No additional homes are slated for acquisition for green space, redevelopment, new structures, roads or alleys. Utility relocation which is required due to the new river alignment will be kept to the greatest extent possible within the area needed for flood management." MMSD is actively working to acquire the identified parcels. Since the plan was adopted, the agency has acquired and deconstructed 24 buildings with 38 parcels acquired in total. By the end of 2013, MMSD intends to have acquired 61 of 83 parcels. Due to the MMSD's comprehensive planning and advanced acquisition efforts, constraints with real estate acquisition are unlikely to hinder the construction of this project.

The project location is recommended for a feasibility phase analysis for its potential ecosystem restoration benefits. This project is not recommended for a feasibility phase analysis for its potential flood risk management benefits.

Project Location Evaluation: Wilson Park Creek Reach 2

This project would have both flood risk management benefits and habitat restoration benefits in the Kinnickinnic River Watershed. The project would reduce the risk of flooding to 333 structures located in the 1% probability floodplain. With 6,500 linear feet of streambank stabilization and habitat restoration, the project's environmental benefits are also likely to be significant, alleviating beneficial use impairments in the immediate vicinity of the project, creating recreation opportunities and improving water quality in downstream reaches of the Kinnickinnic River. Therefore, it is reasonable to assume that the project will contribute to significant ecosystem restoration objectives in the Greater Milwaukee Watersheds. Furthermore, this project has received support of various agencies and municipalities, and the MMSD has involved a range of area stakeholders in project development, raising the probability of successful implementation.

Wilson Park Creek is tributary to the Kinnickinnic River and the Milwaukee Estuary AOC. Of the 11 identified BUIs in the AOC, this project will directly address: degradation of aesthetics; degradation of benthos; degradation of fish and wildlife populations; and loss of fish and wildlife habitat.

This project location is recommended for a feasibility phase analysis for its potential flood risk management and ecosystem restoration benefits.

Project Location Evaluation: Milwaukee River Flood Control

This project would have primarily flood risk management benefits. This project would reduce the risk of flooding to 859 structures located in the 1% probability floodplain. It should be noted that SEWRPC undertook a benefit-cost analysis of this alternative in the study entitled "A Watercourse System Plan for the Milwaukee River in Milwaukee County Upstream of the Milwaukee Harbor Estuary" in which the project was conceptually developed. SEWRPC's benefit-

cost evaluation for this alternative yielded a ratio of less than 1.0; however, this evaluation used assumptions that may differ from those in a feasibility phases analysis completed with USACE methodologies.

This project was not developed to meet ecosystem restoration objectives. Benefits to habitat restoration, water quality or the alleviation of other beneficial uses impairments would be ancillary to the project's flood risk management objectives. The main foreseeable ecosystem benefit would be the creation of improved riparian buffers in a primary environmental corridor.

This project is recommended for a feasibility phase analysis for its potential flood risk management benefits. This project is not recommended for a feasibility phase analysis for its potential ecosystem restoration benefits.

6 Federal Interest

The Federal objective of water and related land-resources planning is to contribute to national economic development consistent with protecting the nation's environment, pursuant to national environmental statutes, applicable executive orders and other Federal planning requirements. Contributions to national economic development are increases in the net value of the national output of goods and services, expressed in monetary units. Contributions to national economic development are the direct net benefits that accrue in the planning area and the rest of the nation.

USACE also has a second national objective for National Environmental Restoration (NER). This objective is to contribute to the nation's ecosystems through restoring significant ecosystem function, structure, and dynamic value with contributions measured by changes in the amounts and values of habitat.

Federal Interest is established once it is determined that the potential action being considered under the reconnaissance phase falls under one of the USACE primary mission areas. USACE is authorized to carry out projects in seven mission areas: navigation, flood damage reduction, ecosystem restoration, hurricane and storm damage reduction, water supply, hydroelectric power generation and recreation.

Based on preliminary evaluation of project locations, the Lyons Park Creek and Kinnickinnic River Reach 4 project and the Wilson Park Creek Reach 2 project locations appear to be viable under the flood risk management and ecosystem restoration missions of USACE and thus meet the criteria for Federal Interest. These project locations should be advanced to feasibility phase evaluations.

The Kinnickinnic River Reach 2 project location appears viable under the ecosystem restoration mission of USACE and thus meets the Federal Interest. This project should be advanced to a feasibility phase evaluation.

The Milwaukee River Flood Control project location appears viable under the flood risk management mission of USACE and thus meets the Federal Interest. This project should be advanced to a feasibility phase evaluation.

The MMSD, working with the Wisconsin DNR, SEWRPC, area municipalities and other stakeholders – has completed detailed watershed planning studies for the watersheds in Milwaukee County. The MMSD strongly supports the projects included in this Reconnaissance Report. It is anticipated that the benefits of flood risk management efforts in the Greater Milwaukee Watersheds will exceed the costs. Actions at each of the project locations would significantly reduce flood damages by reducing the frequency and severity of the flood threat that exists today in the Kinnickinnic River and Milwaukee River Watersheds. Evaluation of flooding

problems and potential solutions in the study area illustrates Federal Interest in flood risk management within the watersheds. During the Feasibility Study, flood risk management opportunities at other locations in the watersheds may be identified.

The ecosystem restoration projects identified in this preliminary analysis are also in the Federal Interest. Habitat restoration in the Greater Milwaukee Watersheds has been identified as priority water resource objectives in numerous Federal, state and regional planning efforts. These projects would complement other activities being undertaken through the Federal Great Lakes Restoration Initiative by addressing ecosystem restoration in a major tributary system to Lake Michigan. The Greater Milwaukee Watersheds are ecosystems of recognized significance; their restoration has been the focus of efforts by the Federal government, the State of Wisconsin, and numerous agencies and municipalities.

By restoring aquatic habitat, the projects would reduce habitat fragmentation, support an increase in species diversity, improve water quality and provide improved recreation opportunities in a densely urbanized area. A quantitative evaluation of those benefits is beyond the scope of a reconnaissance study; however benefits of ecosystem restoration for the currently identified projects or future projects identified during the feasibility phase will be evaluated on the basis of Habitat Units or other metrics that account for both quantity and quality of habitat restoration.

7 Sponsor Intent

The MMSD has expressed interest in serving as non-Federal sponsor for flood risk management and ecosystem restoration feasibility studies of the Greater Milwaukee Watersheds. The MMSD has indicated that it understands the feasibility study and construction cost-sharing responsibilities. For feasibility studies, the non-Federal sponsor is responsible for 50% of study funding. For flood risk management features, the non-Federal sponsor is aware that it will be responsible for all lands, easements, rights-of-way, and relocations (LERR) for the project. The non-Federal partner is also aware that it will be responsible for operating and maintaining the project at 100 percent non-Federal expense upon completion of construction.

MMSD's participation in the Feasibility Study phase is contingent upon approval by the MMSD commissioners.

8 Summary of Feasibility Study Assumptions

A number of assumptions have been used that will guide development of the Project Management Plan (PMP) and schedule for the Feasibility Study. These assumptions are listed below.

- Feasibility Studies for flood risk reduction and ecosystem restoration in the Greater Milwaukee Watersheds will be executed.
- The decision document will be an integrated Feasibility Report and a National Environmental Policy Act (NEPA) document, as applicable.
- Based on the Federal Government's and non-Federal partner's fiscal year and budgets, the precise amount of funds available cannot be determined at this time.
- In the feasibility phase, an MCACES (MII) cost estimate will be performed on the project features that comprise the selected plan. The cost of preliminary alternatives' flood reduction

and ecosystem restoration measures will be developed at a lesser level of detail with comparative cost estimating techniques.

- A benefit-cost analysis (flood damage reduction) and incremental costs analysis (ecosystem restoration) will be prepared in accordance with the requirements of ER 1105-2-100 (22 April 2000).

9 Feasibility Phase Milestones

A draft schedule of feasibility study milestones will be prepared in conjunction with the development of a Project Management Plan. A preliminary list of typical tasks is shown in Table 11.

Table 11: Typical Feasibility Phase Milestones

Milestone	Duration in Months
Execute Feasibility Cost Share Agreement	0
Feasibility Study Initiation	3
Notice of Intent	2
Joint Environmental Impact Statement (EIS) /Environmental Impact Report (EIR) Scoping Meeting – Public Workshop	2
Field Investigations	9
Alternative Designs	9
Alternative Formulation and Evaluation	3
Alternative Formulation Report	2
Alternative Formulation Briefing	1
Draft Feasibility Report (DFR), Draft EIS/EIR	3
Comment Period	1
Transmit DFR and DEIS to Division and HQ and distribute to public	1
Comment Period	1
Prepare Final Feasibility Report (FFR) and Final EIS/EIR	2
Transmit FFR and FEIS to Division and HQ	1
Division Commander's Public Notice	3
Total	Approximately 43 months

10 Feasibility Phase Cost Estimate

The costs to complete the Feasibility Studies for project locations detailed in this report will be fully developed with the completion of a PMP. In that process, study costs will be negotiated with the non-Federal sponsor, the MMSD. It is anticipated that the costs to complete each Feasibility Study will fall in the range of \$150,000 to \$500,000, depending on the scope of work developed for each study. Feasibility Study costs will be shared with the non-Federal sponsor at a rate of 50% Federal funding and 50% non-Federal funding.

11 Recommendations

This investigation has demonstrated Federal Interest in flood risk management and ecosystem restoration within the Greater Milwaukee Watersheds.

Flood risk reduction project locations have been developed, and it is anticipated that benefits of flood damage reduction measures would exceed project costs, resulting in net benefits to the NED accounts. There is also significant local support for flood damage reduction and it is expected that a non-Federal project sponsor will be willing and able to cost-share feasibility studies and project implementation. Furthermore, the preliminary ecosystem evaluation of the alternatives has resulted in the identification of several opportunities for ecosystem restoration and enhancement.

It is recommended that this report be approved as the basis for completing a detailed PMP for a cost-shared feasibility phase. The District will coordinate the PMP with the potential local partner as the basis for both parties to enter a partnership and sign a feasibility cost-sharing agreement. The cost-shared feasibility phase should be conducted as a flood risk management and/or ecosystem restoration studies for the following locations in the Greater Milwaukee Watersheds:

- Lyons Park Creek and Kinnickinnic River Reach 4 – recommended for Feasibility Study for flood risk management and ecosystem restoration project
- Kinnickinnic River Reach 2 – recommended for Feasibility Study for ecosystem restoration project
- Wilson Park Creek Reach 2 – recommended for Feasibility Study for flood risk management and ecosystem restoration project
- Milwaukee River in City of Glendale – recommended for Feasibility Study for flood risk management project

The recommendations contained herein reflect the information available at this time and current departmental policies governing formulation of Federal water resource projects. They may not reflect program and budgeting priorities of the Administration. Consequently, the recommendations may be modified before they are transmitted to higher authority for authorization and/or implementation funding.

12 Potential Issues Affecting Initiation of Feasibility Studies

Constraints represent restrictions that may make achievement of planning objectives more difficult. The constraints identified for this study that may affect the initiation and completion of feasibility phase studies include:

- Initiation of feasibility studies and funding for the non-Federal partner cost share must be approved by the MMSD.
- Portions of the riparian corridors in the Greater Milwaukee Watersheds are privately owned. This can make coordination of efforts challenging. Aligning project goals and objectives across a broad range of stakeholders will facilitate implementation.
- The watersheds lie in multiple counties and municipalities, creating a potential for jurisdictional friction. Involving local governments in project development will ease implementation.

- The public may not understand the relationships between flood damage reduction, water quality improvements, and habitat restoration. The public may also not understand both the direct and indirect benefits of any particular project. Developing educational materials in conjunction with projects and execution of successful public outreach will be invaluable in communicating the range of benefits associated with any particular project.
- Inconsistent Federal funding levels may result in delays in the execution of the Feasibility Studies in the Greater Milwaukee Watersheds.

13 Views of Other Resource Agencies (if known)

Seventy-eight Federal, state, regional, municipal and non-governmental agencies with an interest in water resources in the Greater Milwaukee Watersheds were contacted in the course of this Reconnaissance Study. The scoping letter and responses from two municipalities are included in Appendix B.

The projects recommended for Feasibility Studies were developed by the MMSD in cooperation with the Wisconsin DNR, the City of Milwaukee and SEWRPC. The Kinnickinnic River Reach 4 project location plan was developed with extensive involvement from neighborhood and business organizations along with non-governmental organizations. In general, the projects detailed in this report are broadly supported by local stakeholders.

14 Project Area Map

See Figure 1, page 5.

Michael C. Derosier
Lieutenant Colonel, U.S Army
District Engineer

SUPPLEMENTAL APPENDICES

Appendix A: Source Document Abstracts

Appendix B: Contributing Agencies

Appendix C: Initial Project Screening

APPENDIX A: SOURCE DOCUMENT ABSTRACTS

Source Document Abstract

<i>Doc Number</i>	18		
<i>Title</i>	The State of the Milwaukee River Basin		
<i>Author</i>	Department of Natural Resources and the Milwaukee River Basin Land and Water Partners Team and other stakeholders		
<i>Pub Date</i>	August, 2001		
General Summary (document purpose, scope, etc.)			
<p>This report provides an overview of land and water resource quality, identifies challenges facing these resources, and outlines actions the Wisconsin Department of Natural Resources and its many partners can take over the next few years to protect and restore our natural resources throughout the Milwaukee River Basin.</p>			
Document Relevance to Reconnaissance Study			
<p>This document provides information for Section 1: General Settings of the Milwaukee River, Section 2.1.1 overall drainage area, sub-study area in Milwaukee County and Section 3: Output Analyses that provides priorities and action items for improving the Milwaukee River.</p>			
Key Elements for Reconnaissance Study (per Table of Contents)			
<i>Element</i>	<i>Section</i>	<i>Pages</i>	<i>Notes</i>
Section 1: Physical/Natural and Community/Social Conditions by Watershed	Ch:3	32-49	Land Resources of the Milwaukee River Basin: Wetlands Forest, Agricultural land, and recreational opportunities and challenges.
Section 3: Output Analyses	Ch: 4	56-62	Milwaukee River Basin priorities and actions

Source Document Abstract

<i>Doc Number</i>	17		
<i>Title</i>	Changing Habitat and Biodiversity of the Lower Milwaukee River and Estuary		
<i>Author</i>	Wisconsin Department of Natural Resources		
<i>Pub Date</i>	August, 2005		
General Summary (document purpose, scope, etc.)			
<p>This report discusses the biological investigation conducted by the Wisconsin DNR. The DNR developed a sampling protocol to survey and document changes in fish assemblages in the formerly dam impounded area. The objective was to describe the fish community, assess overall biological integrity, and evaluate fish community changes over a period of six years (1996-2001). Improvements in the riverine habitat following dam removal increased biological diversity several fold in the formerly impounded area. The total number of species captured in this section increased from seven species in 1996 to 37 species, overall. The number of native species has increased five-fold. The overall environmental quality measured as the Index of Biotic Integrity (IBI) in the formerly impounded area increased from 20 (Poor) in 1996 to 80 (Excellent) in 2000-2001.</p>			
Document Relevance to Reconnaissance Study			
<p>This document is a specific case study that shows biodiversity improvement when one dam was removed from the Milwaukee River.</p>			
Key Elements for Reconnaissance Study (per Table of Contents)			
<i>Element</i>	<i>Section</i>	<i>Pages</i>	<i>Notes</i>

Source Document Abstract

<i>Doc Number</i>	19		
<i>Title</i>	The State of the Milwaukee Watershed		
<i>Author</i>	Milwaukee Metropolitan Sewage District		
<i>Pub Date</i>	2005		
General Summary (document purpose, scope, etc.)			
The State of the Milwaukee Watershed report provides a summary of the current conditions of the health indicators within the Milwaukee River Watershed.			
Document Relevance to Reconnaissance Study			
This report explains how the health indicators: Dissolved Oxygen, Habitat, Nutrients and Fecal Coliform Bacteria perform in relation to the water quality standards.			
Key Elements for Reconnaissance Study (per Table of Contents)			
<i>Element</i>	<i>Section</i>	<i>Pages</i>	<i>Notes</i>
Existing Conditions	Sec: 1.1		Current health indicators and how they meet the water quality standards.
Current Land Use	Sec: 1.1		Percentage of current land use in the Milwaukee Watershed
General Facts	Sec: 1.1		Current population of the watershed, tributary lengths and watershed geography (size).

Source Document Abstract

<i>Doc Number</i>	24		
<i>Title</i>	A Watercourse System Plan for the Milwaukee River in Milwaukee County Upstream of the Milwaukee Harbor Estuary		
<i>Author</i>	Southeastern Wisconsin Regional Planning Commission		
<i>Pub Date</i>	December 2010		
General Summary (document purpose, scope, etc.)			
<p>This report presents and evaluates three alternative plans for flood control in the Sunny Point neighborhood in Glendale. Alternatives include acquisition and demolition of structures in the 1% floodplain; floodproofing, elevating and acquiring structures; and constructing a levee. The study recommends an alternative combining floodproofing, elevating and acquisition as the most cost-effective means of addressing repeat flooding in this area.</p>			
Document Relevance to Reconnaissance Study			
<p>The alternatives will be included in the Reconnaissance Study as a key project for MMSD.</p>			
Key Elements for Reconnaissance Study (per Table of Contents)			
<i>Element</i>	<i>Section</i>	<i>Pages</i>	<i>Notes</i>
Alternatives descriptions		8-11	Detailed descriptions of alternatives, including number of structures
Evaluation and Tables		11-29	Cost estimates, benefits estimates.

Source Document Abstract

<i>Doc Number</i>	11		
<i>Title</i>	<i>Menomonee River Phase 1 Watercourse Management Plan</i>		
<i>Author</i>	Milwaukee Metropolitan Sewerage District and Camp Dresser & McKee		
<i>Pub Date</i>	August 2000		
General Summary (document purpose, scope, etc.)			
<p>The Menomonee River Phase 1 Watercourse Management Plan provides updated hydrologic and hydraulic models, identifies structural damages caused by out-of-bank flooding and analyzes potential solutions for the structural damages anticipated to occur during a 100-year flood event.</p>			
Document Relevance to Reconnaissance Study			
<p>The Phase 1 document provides a general history of the water management issues in the watershed, a description of the watershed, a hydrologic and hydraulic analysis model that estimates condition flows and stages, and descriptions of flood control alternatives in the watercourses of the Menomonee River.</p>			
Key Elements for Reconnaissance Study (per Table of Contents)			
<i>Element</i>	<i>Section</i>	<i>Pages</i>	<i>Notes</i>
2.0 Description of Menomonee River Watershed	2	2-1:2-14	Watershed description, watercourses, existing and future land use characteristics, topography, soils, wetland storage areas, and precipitation information.
5.0 Issues and Opportunities	5-9		Alternative evaluation and results identify possible solutions to flooded areas
5.0 Issues and Opportunities	ES	Figure ES-1	Recommended flood solutions

Source Document Abstract

<i>Doc Number</i>	15		
<i>Title</i>	<i>Sediment Transport Study of the Menomonee River Watershed, Final Study Report</i>		
<i>Author</i>	Milwaukee Metropolitan Sewerage District		
<i>Pub Date</i>	February 2001		
General Summary (document purpose, scope, etc.)			
The purpose of this document is to better understand the sedimentary budget and sediment transport continuity within the watershed. This report provides a plan for the necessary alterations to the channel and floodplain for improved flood conveyance to rehabilitate the aquatic habitat and set the stage for future rehabilitation efforts.			
Document Relevance to Reconnaissance Study			
This plan presents and evaluates relevant sediment and geomorphic data; identifies existing problem areas and opportunities for improvement; creates a comprehensive database of geomorphic and sediment transport characteristics; offers guidance and prioritization of identified projects; and provides training to the MMSD staff in channel design methods.			
Key Elements for Reconnaissance Study (per Table of Contents)			
<i>Element</i>	<i>Section</i>	<i>Pages</i>	<i>Notes</i>
4.2 Existing Conditions	Results of Investigation		Classification and reach designations, bed and bank stability, wall and channel assessment. See appendices for additional detail.
5.0 Issues and Opportunities	Appendix 6		<i>Stabilization, Rehabilitation and Enhancement Opportunities</i> includes site-specific listing and descriptions of recommended projects to improve channel bed and bank stability, ecological potential, and recreational and aesthetic value, as well as recommendations for further investigations.
	Appendix 7		Channel & Floodplain Cross-Section Surveys

Source Document Abstract

<i>Doc Number</i>	12		
<i>Title</i>	<i>Menomonee River Phase 2 Watercourse Management Plan, Volume I of III, Project Report, Appendix A – Selected Photographs, Appendix B – Stakeholder Meeting Presentation Handouts, Appendix C – Low Water Entry Flooding Analysis</i>		
<i>Author</i>	Milwaukee Metropolitan Sewerage District and Tetra Tech MPS		
<i>Pub Date</i>	July 2002		
General Summary (document purpose, scope, etc.)			
The Menomonee River Phase 2 Watercourse Management Plan Volume I of III extrapolates from the Phase 1 Plan written in 2000 that identified the flood prone areas and further evaluates and develops project-specific alternatives to correct flooding in these high impacted areas.			
Document Relevance to Reconnaissance Study			
Section 2 provides detail on additional hydrologic/hydraulic modeling with specific maps that show actual buildings that would be flooded in areas where roadway flooding was deeper than 18 inches. Sections 3-9 provide the physical features, historical floodplain information, watercourse evaluation, current flood management, and alternatives to address the flooding issues at each of the nine project locations in the Menomonee Watershed.			
Key Elements for Reconnaissance Study (per Table of Contents)			
<i>Element</i>	<i>Section</i>	<i>Pages</i>	<i>Notes</i>
5.0 Issues and Opportunities	ES	Table ES-1, ES-2	Summary of Project Costs and Weighted Benefits for Roadway Flooding Project.
5.0 Issues and Opportunities	1	Table 1-1	Project Prioritization-Weighted Benefit Point System for Flood Management Projects. Good resource for ranking.
5.0 Issues and Opportunities	2-15/16	Table 2-3 a/b	Remaining Flooded Structure List
5.0 Issues and Opportunities	3-9		Detailed alternatives recommended correcting flooding.

Source Document Abstract

<i>Doc Number</i>	13		
<i>Title</i>	<i>Menomonee River Phase 2 Watercourse Management Plan, Volume II of III, Project Report, Appendix D – Floodplain Maps</i>		
<i>Author</i>	Milwaukee Metropolitan Sewerage District and Tetra Tech MPS		
<i>Pub Date</i>	July 2002		
General Summary (document purpose, scope, etc.)			
<p>The Menomonee River Phase 2 Watercourse Management Plan Volume II of III provides the MMSD Menomonee River watercourse index map and 1% probability floodplain maps.</p>			
Document Relevance to Reconnaissance Study			
<p>The 1% probability floodplain maps show the floodplain area and roadways that flood to a depth greater than 18 inches with a 1% probability.</p>			
Key Elements for Reconnaissance Study (per Table of Contents)			
<i>Element</i>	<i>Section</i>	<i>Pages</i>	<i>Notes</i>

Source Document Abstract

<i>Doc Number</i>	14		
<i>Title</i>	<i>Menomonee River Phase 2 Watercourse Management Plan, Volume III of III, Appendix E – Hydrologic/Hydraulic Model Data, Appendix F – Floodplain Profiles, Appendix G – Channel Cross Sections, Appendix H – Floodplain Tabular Data</i>		
<i>Author</i>	Milwaukee Metropolitan Sewerage District and Tetra Tech MPS		
<i>Pub Date</i>	July 2002		
General Summary (document purpose, scope, etc.)			
<p>The Menomonee River Phase 2 Watercourse Management Plan Volume III of III provides the hydrologic/hydraulic model data, channel cross sections, and floodplain tabular data for the Menomonee Watershed.</p>			
Document Relevance to Reconnaissance Study			
<p>These appendixes will serve as additional references to confirm the methodology and data provided in the Phase II report.</p>			
Key Elements for Reconnaissance Study (per Table of Contents)			
<i>Element</i>	<i>Section</i>	<i>Pages</i>	<i>Notes</i>

Source Document Abstract

<i>Doc Number</i>	20		
<i>Title</i>	The State of the Menomonee Watershed		
<i>Author</i>	Milwaukee Metropolitan Sewage District		
<i>Pub Date</i>	2005		
General Summary (document purpose, scope, etc.)			
<p>The State of the Menomonee Watershed report provides a summary of the current conditions of the health indicators with in the Menomonee River Watershed.</p>			
Document Relevance to Reconnaissance Study			
<p>This report explains how health indicators (i.e., Dissolved Oxygen, Habitat, Nutrients, Fecal Coliform Bacteria) perform in relation to the water quality standards.</p>			
Key Elements for Reconnaissance Study (per Table of Contents)			
<i>Element</i>	<i>Section</i>	<i>Pages</i>	<i>Notes</i>
Existing Conditions	Sec: 1.2		Current health indicators and how they meet the water quality standards.
Current Land Use	Sec: 1.2		Percentage of current land use in the watershed
General Facts	Sec: 1.2		Current population of the watershed, tributary lengths and watershed geography (size).

Source Document Abstract

<i>Doc Number</i>	16		
<i>Title</i>	<i>Water Quality in the Menomonee River Watershed</i>		
<i>Author</i>	Milwaukee Metropolitan Sewerage District		
<i>Pub Date</i>	2008		
General Summary (document purpose, scope, etc.)			
<p>This brief educational booklet provides a summary of the issues known regarding water quality in the Menomonee River, and outlines how pollutants affect water quality and what the MMSD is doing to address associated problems.</p>			
Document Relevance to Reconnaissance Study			
<p>This booklet provides basic background information such as land use facts, types of nonpoint and point source pollutants in the watershed, major water quality issues, and how water quality problems are being addressed by MMSD and individual citizens. The information in this booklet provides a general overview targeted to non-technical audiences.</p>			
Key Elements for Reconnaissance Study (per Table of Contents)			
<i>Element</i>	<i>Section</i>	<i>Pages</i>	<i>Notes</i>

Source Document Abstract

<i>Doc Number</i>	10		
<i>Title</i>	<i>Menomonee River Watershed Restoration Plan</i>		
<i>Author</i>	Milwaukee Metropolitan Sewerage District		
<i>Pub Date</i>	April 2010		
General Summary (document purpose, scope, etc.)			
The Menomonee River Watershed Restoration Plan identifies goals and specific actions to be implemented to improve water quality by 2015 within the Menomonee River and presents general recommendations for the future based upon effectiveness, science, regulatory considerations, and stakeholder goals.			
Document Relevance to Reconnaissance Study			
The most relevant chapters in this document are Chapters 4, 5, 7, and 8. Chapter 4 provides an overview of the habitat conditions within the ten assessment points (subwatersheds): land use; baseline pollutant loading and water quality; and year 2020 pollutant loading and water quality. Chapter 5 identifies solutions and management strategies to address critical areas such as: bacteria/public health; habitat/aesthetics; and nutrients/phosphorus. Chapter 7 identifies priority actions that address public health/bacteria, land-based habitat, and in-stream-based habitat. Chapter 8 identifies implementation strategies.			
Key Elements for Reconnaissance Study (per Table of Contents)			
<i>Element</i>	<i>Section</i>	<i>Pages</i>	<i>Notes</i>
Ongoing Planning	3.3		Table 8-2 Underway (Reports and plans currently being written)
Kinnickinnic River Watershed Sub-Study Area	4.3		Chapter 4: Wildlife habitat characteristics, land use, and water quality
Major projects underway	4.1.11		Table 8-3: Initiated actions (e.g.: Renovating the Menomonee River flushing station and implementing real time monitoring)
Issues and Opportunities	5		Tables 7-1, 7-2, 7-3: Priority actions for public health/bacteria, land-based habitat, and in-stream-based habitat
Issues and Opportunities	5		Table 8-4: Future actions recommended

Source Document Abstract

<i>Doc Number</i>	5		
<i>Title</i>	<i>Kinnickinnic River Phase 1 Watercourse Management Plan</i>		
<i>Author</i>	Milwaukee Metropolitan Sewerage District and Camp Dresser & McKee Inc.		
<i>Pub Date</i>	2000		
General Summary (document purpose, scope, etc.)			
<p>The Kinnickinnic River Phase 1 Watercourse Management Plan identifies the flood prone areas, the number of structures and estimated total cost associated with a 100 year flood, and flood control alternatives in the five watercourses of the Kinnickinnic Watershed.</p>			
Document Relevance to Reconnaissance Study			
<p>The Phase 1 document provides a general history of the water management issues in the watershed, a description of the watershed, a hydrologic analysis model that estimates condition flows and stages, and discussion of possible alternatives to alleviate identified flood impacts in the five watercourses in the Kinnickinnic River.</p>			
Key Elements for Reconnaissance Study (per Table of Contents)			
<i>Element</i>	<i>Section</i>	<i>Pages</i>	<i>Notes</i>
2.0 Study Location Overview 4.0 Existing Conditions	2	1-8	Topography, soils, precipitation, and wetland storage information
5.0 Issues and Opportunities	5-9		Alternative evaluation and results identify possible solutions to flooded areas
5.0 Issues and Opportunities	ES	Figure ES-1	Recommended flood solutions

Source Document Abstract

<i>Doc Number</i>	6		
<i>Title</i>	<i>Kinnickinnic River Phase 2 Watercourse Management Plan, Volume I of III, Project Report, Appendix A – Interim Design Rainfall, Appendix B – Hydrologic and Hydraulic Analysis, Appendix C – Alternative Cost Estimates</i>		
<i>Author</i>	Milwaukee Metropolitan Sewerage District and MWH Americas, Inc.		
<i>Pub Date</i>	May, 2005		
General Summary (document purpose, scope, etc.)			
<p>The Kinnickinnic River Phase 2 Watercourse Management Plan Volume I of III extrapolates from the Phase 1 Plan written in 2000 that identified the flood prone areas and further evaluates and recommends flood damage mitigation measures in the five watercourses of the Kinnickinnic Watershed.</p>			
Document Relevance to Reconnaissance Study			
<p>The Phase 2 document provides a general history of the water management issues in the watershed, a description of the watershed, a hydrologic analysis model that estimates condition flows and stages, and discussion of possible alternatives to alleviate identified flood impacts in the five watercourses in the Kinnickinnic River.</p>			
Key Elements for Reconnaissance Study (per Table of Contents)			
<i>Element</i>	<i>Section</i>	<i>Pages</i>	<i>Notes</i>
5.0 Issues and Opportunities		Tb.4-1 Tb.10-3 Tb.ES-1	Watercourse specific information that quantifies the number of flooded structures and the estimated total cost associated with the one percent probability of flood damage.
2.0 Study Location Overview 4.0 Existing Conditions	2	1-8	Topography, soils, and precipitation information
5.0 Issues and Opportunities	5 – 9		Alternative evaluation and results to identify possible solutions to flooded areas

Source Document Abstract

<i>Doc Number</i>	7
<i>Title</i>	<i>Kinnickinnic River Phase 2 Watercourse Management Plan, Volume II of III, Project Report, Appendix D – Floodplain Maps and Appendix E – Floodplain Profiles</i>
<i>Author</i>	Milwaukee Metropolitan Sewerage District and MWH Americas, Inc.
<i>Pub Date</i>	May 2005

General Summary (document purpose, scope, etc.)
<p>The Kinnickinnic River Phase 2 Watercourse Management Plan Volume II of III provides the floodplain maps and floodplain profiles for the five watercourses of the Kinnickinnic Watershed.</p>

Document Relevance to Reconnaissance Study
<p>The floodplain maps in Appendix D identify the floodplain area and the roadways that flood to a depth greater than 18 inches. The floodplain profiles in Appendix E provide the elevation of the main channels during 2, 5, 10, 50 and 100 year storm events. The combination of these two appendixes will serve as references to evaluate the level of flooding that occurs at a proposed project area.</p>

Key Elements for Reconnaissance Study (per Table of Contents)			
<i>Element</i>	<i>Section</i>	<i>Pages</i>	<i>Notes</i>
5.0 Issues and Opportunities	App. D	All	Maps present greatest flooding areas
5.0 Issues and Opportunities	App. E	All	Profiles correlate with the floodplain maps to identify the elevation of flooding in relations to the streambed and various other stages of flooding for 2 year, 5 year, 10 year 50 year and 100 year storm events

Source Document Abstract

<i>Doc Number</i>	8		
<i>Title</i>	<i>Kinnickinnic River Phase 2 Watercourse Management Plan, Volume III of III, Project Report, Appendix D – Floodplain Maps and Appendix E – Floodplain Profiles</i>		
<i>Author</i>	Milwaukee Metropolitan Sewerage District and MWH Americas, Inc.		
<i>Pub Date</i>	May 2005		
General Summary (document purpose, scope, etc.)			
<p>The Kinnickinnic River Phase 2 Watercourse Management Plan Volume III of III provides the hydrologic/hydraulic model data, channel cross sections, and floodplain tabular data for the five watercourses of the Kinnickinnic Watershed.</p>			
Document Relevance to Reconnaissance Study			
<p>These appendices will serve as additional references to confirm the methodology and data provided in the Phase II report.</p>			
Key Elements for Reconnaissance Study (per Table of Contents)			
<i>Element</i>	<i>Section</i>	<i>Pages</i>	<i>Notes</i>

Source Document Abstract

<i>Doc Number</i>	21		
<i>Title</i>	The State of the Kinnickinnic Watershed		
<i>Author</i>	Milwaukee Metropolitan Sewage District		
<i>Pub Date</i>	2005		
General Summary (document purpose, scope, etc.)			
The State of the Kinnickinnic Watershed report provides a summary of the current conditions of the health indicators with in the Kinnickinnic River Watershed.			
Document Relevance to Reconnaissance Study			
This report explains how health indicators (i.e., Dissolved Oxygen, Habitat, Nutrients, Fecal Coliform Bacteria) perform in relation to the water quality standards.			
Key Elements for Reconnaissance Study (per Table of Contents)			
<i>Element</i>	<i>Section</i>	<i>Pages</i>	<i>Notes</i>
Existing Conditions	Sec: 1.3		Current health indicators and how they meet the water quality standards.
Current Land Use	Sec: 1.3		Percentage of current land use in the watershed
General Facts	Sec: 1.3		Current population of the watershed, tributary lengths and watershed geography (size).

Source Document Abstract

<i>Doc Number</i>	9		
<i>Title</i>	<i>Water Quality in the Kinnickinnic River Watershed</i>		
<i>Author</i>	<i>Milwaukee Metropolitan Sewerage District</i>		
<i>Pub Date</i>	2008		
General Summary (document purpose, scope, etc.)			
<p>This brief educational booklet provides a summary of the issues known regarding water quality in the Kinnickinnic River and outlines how pollutants affect water quality and what the MMSD is doing to address water quality problems. .</p>			
Document Relevance to Reconnaissance Study			
<p>This booklet provides basic background information such as land use facts, types of nonpoint and point source pollutants in the watershed, major water quality issues, and how water quality problems are being addressed by MMSD and individual citizens. The information in this booklet provides a general overview targeted at non-technical audiences</p>			
Key Elements for Reconnaissance Study (per Table of Contents)			
<i>Element</i>	<i>Section</i>	<i>Pages</i>	<i>Notes</i>

Source Document Abstract

<i>Doc Number</i>	3		
<i>Title</i>	<i>Kinnickinnic River Corridor Neighborhood Plan</i>		
<i>Author</i>	Milwaukee Metropolitan Sewerage District and Sixteenth Street Community Health Center		
<i>Pub Date</i>	December 2009		
General Summary (document purpose, scope, etc.)			
<p>The Kinnickinnic River Corridor Neighborhood Plan studies a 2.5 mile stretch of the River specifically between S. 27th and S. 6th Streets. In this plan they discuss the historical, cultural, and social flooding issues and the potential design strategies that will address river channel rehabilitation and flood management.</p>			
Document Relevance to Reconnaissance Study			
<p>This document is a source for historical flood management and proposed design alternatives. Detailed graphics and maps show proposed housing acquisition and recommended river alignment to create new greenway amenities, habitat creation opportunities and public access and safety.</p>			
Key Elements for Reconnaissance Study (per Table of Contents)			
<i>Element</i>	<i>Section</i>	<i>Pages</i>	<i>Notes</i>
Kinnickinnic River Watershed Sub-Study Area	4.3		Historical Flood Management
Issues and Opportunities	5		Neighborhood Design Recommendations – Property Acquisition and property alignment

Source Document Abstract

<i>Doc Number</i>	4		
<i>Title</i>	<i>Kinnickinnic River Watershed Restoration Plan</i>		
<i>Author</i>	Milwaukee Metropolitan Sewerage District		
<i>Pub Date</i>	April 2010		
General Summary (document purpose, scope, etc.)			
<p>The Kinnickinnic River Watershed Restoration Plan identifies goals and specific actions to be implemented to improve water quality by 2015 within the Kinnickinnic River and presents general recommendations for the future based upon effectiveness, science, regulatory considerations, and stakeholder goals.</p>			
Document Relevance to Reconnaissance Study			
<p>The most relevant chapters in this document are Chapters 4, 5, 7, and 8. Chapter 4 provides an overview of the habitat conditions within the ten assessment points (subwatersheds): land use; baseline pollutant loading and water quality; and year 2020 pollutant loading and water quality. Chapter 5 identifies solutions and management strategies to address critical areas such as: bacteria/public health; habitat/aesthetics; and nutrients/phosphorus. Chapter 7 identifies priority actions that address public health/bacteria, land-based habitat, and in-stream-based habitat. Chapter 8 identifies implementation strategies.</p>			
Key Elements for Reconnaissance Study (per Table of Contents)			
<i>Element</i>	<i>Section</i>	<i>Pages</i>	<i>Notes</i>
Ongoing Planning	3.3		Table 8-2 Underway (Reports and plans currently being written)
Kinnickinnic River Watershed Sub-Study Area	4.3		Chapter 4: Wildlife habitat characteristics, land use, and water quality
Major projects underway	4.1.11		Table 8-3: Initiated actions (e.g.: Renovating the KK River flushing station and implemented real time monitoring)
Issues and Opportunities	5		Tables 7-1, 7-2, 7-3: Priority actions for public health/bacteria, land-based habitat, and in-stream-based habitat
Issues and Opportunities	5		Table 8-4: Actions being considered by SWWT and recommended by the Watershed Restoration Plan

Source Document Abstract

<i>Doc Number</i>	1		
<i>Title</i>	<i>A Regional Water Quality Management Plan Update For The Greater Milwaukee Watersheds</i>		
<i>Author</i>	<i>Southeastern Wisconsin Regional Planning Commission</i>		
<i>Pub Date</i>	<i>December, 2007</i>		
General Summary (document purpose, scope, etc.)			
<p>This document refines previous water quality management planning efforts by SEWRPC to address the following planning objects to improve water quality in the greater Milwaukee watersheds: land use development; water quality management; outdoor recreation and open space preservation; water control facility development; plan structure and monitoring; and educational and informational programming.</p>			
Document Relevance to Reconnaissance Study			
<p>This document provides a basic snapshot of the current water quality of the Greater Milwaukee Watersheds and the point and non-point sources of pollution that are responsible. This document will best be used to provide an accurate picture of the health of the watershed. This plan does not provide specific examples of design solutions to mitigate flooding.</p>			
Key Elements for Reconnaissance Study (per Table of Contents)			
<i>Element</i>	<i>Section</i>	<i>Pages</i>	<i>Notes</i>
Study Location Overview	2		Demographics, Land use, Climate, Physiography and topography, Soils, Surface water and groundwater resource, Fish and Wildlife resources, and Environmentally sensitive areas
Existing Conditions	4.1/4.2/4.3		Surface water quality conditions, Biological conditions of the greater Milwaukee watersheds, channel conditions, habitat conditions
Issues and Opportunities	5		Sources of water pollution generic and general point and non-point source

Source Document Abstract

<i>Doc Number</i>	2		
<i>Title</i>	<i>Stream Habitat Conditions and Biological Assessment of the Kinnickinnic and Menomonee River Watersheds: 2000-2009</i>		
<i>Author</i>	Southeastern Wisconsin Regional Planning Commission		
<i>Pub Date</i>	January 2010		
General Summary (document purpose, scope, etc.)			
<p>This document summarizes the water quality conditions and sources of pollution in the Kinnickinnic River and Menomonee River watersheds. It presents the results of an inventory and analysis of the surface waters; descriptive information pertaining to the historical trends and current status of habitat quality; ecological integrity; bank stability; and potential limitations to water quality and fishery resources. It summarizes the biological and habitat quality within each watershed; identifies factors potentially limiting the aquatic community and habitat quality; identifies information needs; provides recommended goals, objectives, and actions to address the impairments; recommends a prioritization strategy to maximize project cost effectiveness; and recommends post-project monitoring to assess project success.</p>			
Document Relevance to Reconnaissance Study			
<p>This document provides information for Section 4: Existing Conditions. The maps and figures in the back of this book will be useful in characterizing conditions and locating high-value areas for improvements.</p>			
Key Elements for Reconnaissance Study (per Table of Contents)			
<i>Element</i>	<i>Section</i>	<i>Pages</i>	<i>Notes</i>
4.0 Existing Conditions	Ch.1	6 & 7	Physical and biological conditions along reaches within the Menomonee and Kinnickinnic River watersheds.
	Ch. 2	17-34	Historical and biological conditions and water quality monitoring information
5.0 Issues and Opportunities	Ch. 3	41-64	Habitat Protection Actions: corridor targets, hydrology, water quality and quantity, and land-based monitoring (issue, key questions, recommended actions, potential measures)
		65-71	Instream Habitat Protection Measures: aquatic organism passage, aquatic habitat, aquatic organisms (issue, key questions, recommended actions, potential measures)
MAPS for Reference	Back of Book		Maps: Riparian Corridor Conditions, Steam Channel and Biological Quality Conditions, Historical Versus Current Steam Channel Alignment, Proposed Priority Protection Areas Map

Source Document Abstract

<i>Doc Number</i>	22		
<i>Title</i>	<i>Milwaukee Estuary Remedial Action Plan: A Plan to Clean Up Milwaukee's Rivers and Harbor</i>		
<i>Author</i>	Wisconsin Water Quality Management Program		
<i>Pub Date</i>	March 1991		
General Summary (document purpose, scope, etc.)			
<p>The Remedial Action Plan identifies management strategies to control existing sources of pollution, correct environmental contamination already present, and restore desired uses in the AOC.</p>			
Document Relevance to Reconnaissance Study			
<p>The Remedial Action Plan identifies specific goals and objectives for addressing water quality issues within the Milwaukee Estuary AOC and restoring beneficial uses. These goals and objectives provide the standards for determining the short- and long-term pollution abatement and resource management decisions needed to clean up the estuary.</p>			
Key Elements for Reconnaissance Study (per Table of Contents)			
<i>Element</i>	<i>Section</i>	<i>Pages</i>	<i>Notes</i>
Chapter 7: Goals and Objectives			This section identifies the desired state of the discussed waterways. Also addressed are the goals for restoration of the waterways and reasons for implementation.

Source Document Abstract

Doc Number	23		
Title	Milwaukee Estuary Remedial Action Plan: A Plan to Clean Up Milwaukee’s Rivers and Harbors		
Author	Wisconsin Water Quality Management Program		
Pub Date	1994		
General Summary (document purpose, scope, etc.)			
The Remedial Action Plan emphasizes an ecosystem approach to restoring beneficial uses within the Milwaukee Estuary AOC.			
Document Relevance to Reconnaissance Study			
The Remedial Action Plan addresses the sources of pollution and the specific goals and objectives for resolving the water quality problems in the Milwaukee Estuary. Also discussed are existing programs to achieve RAP goals and objectives.			
Key Elements for Reconnaissance Study (per Table of Contents)			
Element	Section	Pages	Notes
Chapter 4: RAP Goals and Objectives		4-4, 4-6, 4-7, 4-8	The goals and objectives provide the criteria for evaluating the short- and long-term pollution abatement and resource management decisions needed to restore the ecosystems of the estuary.
Chapter 5: Reaching RAP Goals Through Existing Programs			This chapter identifies and describes the existing Federal and State programs that have made considerable progress toward the goals of restoring the Milwaukee estuary.

APPENDIX B: Contributing Agencies

Letters were sent to 78 federal and state agencies, municipalities and non-governmental organizations requesting comments and input on this Reconnaissance Study. Responses are included below.

City of Greenfield

Village of Brown Deer

Army Corps of Engineers Solicitation



November 9, 2010

Mr. Larry Pawlus
US Army, Corps of Engineers
Chief, Programs & Project Management Office
PO Box 1027
Detroit, MI 48231-1027

Dear Mr. Pawlus:

This correspondence is provided in response to your letter to Mayor Michael J. Neitzke dated October 28, 2010 regarding your new flood mitigation study.

Enclosed for your reference are studies prepared for the City of Greenfield in response to June, 2008 flooding near S. 36th Street and Barnard Avenue (Kinnickinnic River Watershed) and S. 92nd Street and Cold Spring Road (Menomonee River Watershed: GF 2002). Together with areas adjacent to Wildcat Creek (Root River Watershed – not included in your scope) these are the primary areas within Greenfield which experience flooding and basement back-ups.

Greenfield created a storm water utility in 2009. The first flood control project of the new utility was recently completed, a detention basin near 124th and Howard Avenue. In 2011 the City plans to implement a 3 year phased flood management program adjacent to Wildcat Creek.

We would be pleased to provide any specific data upon your request that will assist you in helping us manage flood events in Greenfield.

Sincerely,

DEPARTMENT OF NEIGHBORHOOD SERVICES

Richard J. Sokol
Director

c: Mayor Michael J. Neitzke (w/out enclosures)
Dan Ewert, Superintendent of Public Works (w/out enclosures)
Debra Jensen, MMSD (w/out enclosures)

7325 W. Forest Home Avenue • Greenfield, WI 53220



COMMUNITY SERVICES DEPARTMENT
4800 West Green Brook Drive
Brown Deer, Wisconsin 53223

November 23, 2010

Charles Uhlarik
Department of the Army
Detroit District, Corps of Engineers
Box 1027
Detroit, Michigan 48231-1027

Dear Mr. Uhlarik,

Thank you for the opportunity to provide comment regarding the reconnaissance level study of the watersheds of Southeastern Wisconsin including the Milwaukee River. The Village of Brown Deer is bordered by the Milwaukee River on its eastern boundary and has three tributaries of the River flowing through its boundaries including Southbranch Creek, Beaver Creek and the Brown Deer Park Creek. Below is a list of issues, opportunities and concerns that the Village has relating to the various waterways in our community:

Beaver Creek

- The culvert at Green Bay Road is a corrugated metal pipe arch. The Village would like to place a liner in this culvert to potentially increase flows to help address upstream flooding.
- The Village would like to naturalize and increase storage capacity along Beaver Creek from the Wisconsin Central/CN Railroad tracks east to Green Bay Road.
- A portion of the Creek was paved over for a parking lot between Green Bay Road and the Milwaukee River. A long term vision includes "daylighting" this section of the Creek.

Southbranch Creek

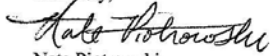
- The stretch of creek from N. Teutonia Avenue to N. 47th Street has erosion issues and the Village would like to expand flood storage in this reach.
- A storage basin exists from N. 47th Street to N. 51st Street and the Village would like to naturalize this area and increase storage capability slightly.
- The Village desires to add BMPs to storm sewer outfalls at N.50th Street and N. Meadowside Court.

Brown Deer Park Creek

- Erosion problems exist near the deteriorated concrete box/bridge crossing of W. Bradley Road.

Also attached to this letter is the Village's condition of waterways report submitted to the Wisconsin Department of Natural Resources for its NR216 report. We appreciate your investigation of these issues and look forward to your report. Should you have any questions please feel free to contact me.

Sincerely,


Nate Piotrowski
Planning and Zoning Specialist

CC: Larry Neitzel, Public Works Superintendent
Jim Buske, Engineering/GIS Manager

Office: 414.371.3061 - FAX: 414.371.3045 - E-Mail: npiotrowski@browndeerwi.org - WWW.BROWNDEERWI.ORG



DEPARTMENT OF THE ARMY

477 MICHIGAN AVENUE
DETROIT, MICHIGAN 48226-2550

October 18, 2010

Programs and Project Management Office

Dear XXXXX,

The US Army Corps of Engineers, Detroit District is conducting a reconnaissance level study within the Milwaukee, Wisconsin Metropolitan area, under the authority of Section 4100 of the Water Resources Development Act of 2007 (P.L. 110-114), dated November 8, 2007. The study area includes the watersheds of the Milwaukee, Menomonee and Kinnickinnic Rivers as well as that of Underwood Creek (Attachment 1).

The purpose of the study is to identify a range of flood risk management and environmental restoration alternatives in the interest of identifying those that are technically sound, environmentally sustainable and economically efficient; and to determine if there is Federal Interest in further addressing the feasibility of carrying out those alternatives using existing Federal authorities.

The study will be a thorough, multi-purpose/multi-objective evaluation of the study area that will integrate existing plans and studies; assess the progress made to date on various programs and projects; and provide public agencies and non-governmental organizations with a "blueprint" that offers a shared vision for the watersheds, long-term solutions to identified problems, and specific program/project recommendations.

As part of the study scoping process, we invite you to identify flood risk management and ecosystem restoration priorities in the study area, and specific programs or projects (underway or proposed) which are important in addressing those priorities. Some key issues identified in past study efforts include flood-prone areas, dams/drop-structures, concrete channel removal, and the multiple Beneficial Use Impairments associated with the Milwaukee Estuary Area of Concern. Other issues include Combined Sewer Overflows/Sanitary Sewer Overflows, illicit connections, failing septic systems, nonpoint source pollution, oil/hazardous material spills, habitat restoration, invasive species, water levels, fish passage and streambank erosion.

We are interested in any concerns or comments that your agency may have at this time regarding the proposed reconnaissance study. Please direct your concerns and comments to me at the address above within 30 days to ensure discussion in the study. Any questions can be directed to Charles Uhlarik, Project Manager, at 313-226-2476 or me at 313-226-6780.

Sincerely,

Larry Pawlus
Chief, Programs & Project Management Office

Attachment

APPENDIX C: INITIAL PROJECT SCREENING

1 INITIAL PROJECT SCREENING

1.1 Introduction

1.1.1 General Information

Previous reports completed by the Wisconsin DNR, MMSD, Milwaukee River Basin Land and Water Partners Team, SEWRPC, and Sweet Water Trust were reviewed. Projects identified in these reports that focused on flood damage reduction, environmental restoration, and other beneficial impacts to the watersheds were entered into a project screening table. Additionally, the MMSD internally gathered and prioritized a list of 25 projects that were added to the prioritization table.

1.1.2 Role of Project Screening in Reconnaissance Study

The role of the project screening table was to compare projects identified by multiple stakeholders in the Greater Milwaukee Watersheds to evaluate and prioritize their potential for flood damage reduction, environmental restoration and cost. The screening process also considered other benefits to the watersheds that are not USACE objectives, such as stakeholder support, public safety and improved water quality.

1.1.3 Expected Outcome of Initial Project Screening

The table of 32 projects was reduced into primary and secondary projects based on the following definitions.

- *Primary Projects.* Greatest flood risk reduction, environmental restoration, stakeholder support, and cost effectiveness benefits. These projects may provide other benefits such as enhanced increased public safety and improved water quality.
- *Secondary Projects.* Limited flood damage reduction, environmental restoration, stakeholder support, and cost effectiveness benefits. These projects may provide other benefits such as enhanced recreation opportunities and improved water quality, but do not specifically meet USACE objectives.

The primary project list was further prioritized to select a number of projects that best meet the objectives based on magnitude of the aforementioned benefits, as well as stakeholder support and cost effectiveness.

1.2 Screening Methodology

1.2.1 Project Sources

The following is a list of agencies (and associated documents) that identified projects that improve flood management and environmental restoration. These projects were included in the project screening table.

Southeastern Wisconsin Regional Planning Commission

- *Stream Habitat Conditions and Biological Assessment of the Kinnickinnic and Menomonee River Watersheds.* This assessment summarizes the water quality conditions, sources of pollution, and actions to address impairments in the Kinnickinnic

River and Menomonee River watersheds. Project actions identified include the following: Men River Phase 2, KK River Reach 2, KK River Reach 3, KK Flushing Station Improvements, Swan & Harmonie Fish Passage Obstructions.

- *A Regional Water Quality Management Plan Update for the Greater Milwaukee Watersheds.* This document refines previous water quality management planning efforts by SEWRPC to address the following planning objects to improve water quality in the greater Milwaukee Watersheds: land use development; water quality management; outdoor recreation and open space preservation; water control facility development; plan structure and monitoring; and educational and informational programming.

Project actions identified include the following: Men River Phase 2, Underwood Creek Reach 2, S. Branch Underwood Creek Reach 1, S. Branch Underwood Creek Reach 2, Honey Creek Reaches 6, 5, 4, and 1, KK River Reach 2 and 3, Lyons Park Creek, Wilson Park Creek Reach 2, 3 and 4, *KK Flushing Station Improvements, and Storm water BMPs.*

Department of Natural Resources & Milwaukee River Basin Land and Water Partners Team

- *The State of the Milwaukee River Basin.* This report provides an overview of land and water resource quality, identifies challenges facing these resources, and outlines actions the Wisconsin DNR and its many partners can take to correct these issues.

Project actions identified include the following: Cedar Creek PCB, Purchase lands Jackson Marsh Wildlife Area and Cedar Creek Stream Bank Protection Area, and Jackson Marsh - Maintenance and Restoration.

Milwaukee Metropolitan Sewerage District

- *KK River Corridor Neighborhood Plan.* This plan discusses the historical, cultural, and social flooding issues and the potential design strategies to address river channel rehabilitation and flood management between S. 27th and 6th Streets. Project actions identified include the following: KK River Reach 2.
- *Watershed Restoration Plan - KK River.* The Kinnickinnic River Watershed Restoration Plan identifies goals and specific actions to be implemented to improve water quality by 2015 within the Kinnickinnic River and presents general recommendations for the future based upon effectiveness, science, regulatory considerations, and stakeholder goals.

Project actions identified include the following: KK River Reach 2 and 3, Lyons Park Creek, Wilson Park Creek Reach 2, 3, and 4, and Stormwater BMPs.

- *Watershed Restoration Plan - Menomonee River.* The Menomonee River Watershed Restoration Plan identifies goals and specific actions to be implemented to improve water quality by 2015 within the Menomonee River and presents general recommendations for the future based upon effectiveness, science, regulatory considerations, and stakeholder goals.

Project actions identified include the following: Men River Phase 2, Underwood Creek Reach 2, S. Branch Underwood Creek Reaches 1 and 2, Honey Creek Reach 1, 4, 5, and 6, 5 Low Head Dams in Menomonee River, and Stormwater BMPs.

- *KK River Watercourse Management Plan Phase I.* The Kinnickinnic River Phase 1 Watercourse Management Plan identifies the flood prone areas, the number of structures

and estimated total cost associated with a 100 year flood, and flood control alternatives in the five watercourses of the Kinnickinnic Watershed. Project actions identified include the following: Lyons Park Creek.

- *KK River Watercourse Management Plan Phase II.* The Kinnickinnic River Phase 2 Watercourse Management Plan Volume I, II and III extrapolates from the Phase 1 plan written in 2000 that identified the flood prone areas and further evaluates and recommends flood damage mitigation measures in the five watercourses of the Kinnickinnic Watershed. Project actions identified include the following: Lyons Park Creek.
- *Menomonee River Watercourse Management Plan Phase I.* The Menomonee River Phase 1 Watercourse Management Plan provides updated hydrologic and hydraulic models, identifies structural damages caused by out-of-bank flooding and analyzes potential solutions for the structural damages anticipated to occur during a 100-year flood event. Project actions identified include the following: Western Milwaukee, Concordia Ave, and Grantosa Parkway.
- *Menomonee River Watercourse Management Plan Phase II.* The Menomonee River Phase 2 Watercourse Management Plan Volume I, II, and III extrapolates from the Phase 1 plan written in 2000 that identified the flood prone areas and further evaluates and develops project-specific alternatives to correct flooding in these high impacted areas. Project actions identified include the following: Western Milwaukee, Concordia Ave., and Grantosa Parkway. *Water Quality Conditions and Sources of Pollution in the Greater Milwaukee Watersheds.* Project actions identified include the following: Men River Phase 2, Underwood Creek Reach 2, S. Branch Underwood Creek Reaches 1 and 2, Honey Creek Reaches 1, 4, 5, and 6, KK River Reaches 2 and 3, Lyons Park Creek, Wilson Park Creek Reaches 2, 3 and 4, and Underwood Creek in Elm Grove.
- *Underwood Creek Rehabilitation and Flood Management Project - Prelim. Eng. Design Project.* Project actions identified include the following: Underwood Creek Reach 2.
- *KK River Sediment-Transport Planning Study - (In progress - Draft not released).* Project actions identified include the following: KK River Reaches 2, 3 and 4, Lyons Park Creek, Villa Mann Creek, Wilson Park Creek Reaches 2 and 3, KK Flushing Station Improvements, Holmes Ave Creek, and S 43rd St Ditch.
- *KK River Preliminary Engineering: 27th - Chase (In progress - Draft not released).* Project actions identified include the following: KK River Reach 2.
- *Wilson Park Creek Flood Management Planning Study: S. Howell Ave to S. 27th St (In progress - Draft not released).* Project actions identified include the following: Wilson Park Creek Reaches 2 and 3.
- *A Watercourse System Plan for the Milwaukee River in Milwaukee County Upstream of the Milwaukee Harbor Estuary (In progress - Draft not released).* Project actions identified include the following: Milwaukee River.
- *A Watercourse System Plan for Beaver Creek in Milwaukee County (In progress - Draft not released).*

1.2.2 Screening Table Development

The definitions of the categories listed in the screening table are detailed in Table C1. The criteria reflect the Study Purpose detailed in Section 2.

Table C1: Screening Table Criteria

Project	Name of Project
Location	Specific location of project or reach of the river
Watershed	Location of project by watershed
Description	A general description of the project.
Cost	Cost estimated to complete the project.
Flood Damage Mitigation	Project will reduce structural flood damage
Concrete Removal	Concrete lined stream banks will be removed
Stream Stabilization	Stream banks will be stabilized with native plantings to reduce erosion
Sediment Mitigation	Action taken to foster natural sediment transport
Habitat	Project will create or restore quality habitat including stable natural banks, natural vegetative cover and tree canopy, streambeds free of silt or muck, riffles and pools for fish refuge, and wide vegetated buffer zones.
Public Safety	Project will improve public safety
Flooded Structures	The number of known structures to be removed from the 1% probability floodplain
Area Impacted	The linear feet of a stream bank or acres of land to be converted to water storage or habitat
Barriers to Implementation	Contentious issues may present a challenge to reaching consensus with all stakeholders
Partners	Supporting agencies.
Reports	Report from which the action items were listed

The full table is shown in Table C2 in the following section.

Table C2: Project Screening

Project No	Project	Location	Watershed	Description	Cost (millions)	Final Management	Concrete Removal	Stabilization	Revegetation	Habitat	Water Quality	Public Safety	Flooded Structures	Area Impacted (Linear Feet or Acres)	Responsible for Implementation	Partners	Reports**	Priority
V10000	Mitauake River	Neighborhood near Sunny Point Lane in Glendale	Mitauake	Flood management project to address concrete-lined channel riparian removal and vegetation restoration to county park, land and mixed residential	\$43.0	X							392			SWRC, SWWT, WDMR	16	
V20007	Western Mitauake	Along State Street between W. 43rd and W. 45th Street	Mitauake	Flood management project to address concrete-lined channel riparian removal and vegetation restoration to county park, land and mixed residential	\$58.9	X							69			SWRC, SWWT, WDMR	11,12	
V20018	Concrete Ave	Neighborhood near Sunny Point Lane in Glendale	Menomonee	Flood management project to address concrete-lined channel riparian removal and vegetation restoration to county park, land and mixed residential	\$14.3	X							17			SWRC, SWWT, WDMR	11,12	
V20021	Ivan River Phase 2	I-94 to Blue Mound Road	Menomonee	Removal of concrete lined channel riparian removal and vegetation restoration to county park, land and mixed residential	\$11.0		X			X						SWRC, SWWT, WDMR	1,2,3,7	
V20007	Underwood Creek Reach 2	Mayfair Road to Jellison	Menomonee	Removal of concrete lined channel riparian removal and vegetation restoration to county park, land and mixed residential	\$13.9		X			X						SWRC, SWWT, WDMR	2,3,4,7	
V20001	S. Branch Underwood Crk Reach 1	Bismarck Road to Babine/Schaeffer Street	Menomonee	Removal of concrete lined channel riparian removal and vegetation restoration to county park, land and mixed residential	\$10.8		X			X		X				SWRC, SWWT, WDMR	2,3,7	
V20002	S. Branch Underwood Crk Reach 2	Bismarck Road to Jellison	Menomonee	Possible daylighting of enclosed culvert to increase stream flow, in a residential neighborhood	\$7.0		X			X		X					2,3,7	
V20002	Henry Creek Reach 6	Harvard Ave. to S. 43rd St.		Flood management project to address concrete-lined channel riparian removal and vegetation restoration to county park, land and mixed residential	\$12.0	X				X		X	7			SWRC, SWWT, WDMR	2,3,7	
V20003	Henry Creek Reach 5	Oklahoma Ave. to Howard Ave.		Flood management project to address concrete-lined channel riparian removal and vegetation restoration to county park, land and mixed residential	\$11.8	X				X		X	6			SWRC, SWWT, WDMR	2,3,7	
V20004	Henry Creek Reach 4	Arthur Ave. to Oklahoma Ave.		Flood management project and removal of concrete-lined channel riparian removal and vegetation restoration to county park, land and mixed residential	\$9.6		X			X		X	2			SWRC, SWWT, WDMR	2,3,7	
V20005	Henry Creek Reach 1	Northwest of Porcino Ave. to W. 43rd St.		Flood management project to address concrete-lined channel riparian removal and vegetation restoration to county park, land and mixed residential	\$11.8				X	X		X				SWRC, SWWT, WDMR	2,3,7	
V20004	Gratiot Play	Gratiot Play between W. Vienna Ave and W. Capitol		Flood management project to address concrete-lined channel riparian removal and vegetation restoration to county park, land and mixed residential	\$3.7	X							2					11,12
W40005	W. River Reach-2	S. 4th St. to S. 27th St.	Kenneshaw	Flood management project to address concrete-lined channel riparian removal and vegetation restoration to county park, land and mixed residential	\$49.8	X	X			X		X	320			SWRC, SWWT, WDMR	1,2,3,5,6,8,13	
W40007	W. River Reach 3	27th Street to Turner Outlet	Kenneshaw	Flood management project to address concrete-lined channel riparian removal and vegetation restoration to county park, land and mixed residential	\$13.1		X					X				SWRC, SWWT, WDMR	1,2,3,6,8	
N/A	W. River Reach 4	W. 43rd St. to W. 45th St.	Kenneshaw	Flood management project to address concrete-lined channel riparian removal and vegetation restoration to county park, land and mixed residential	\$1.9	X			X				2			SWRC, SWWT, WDMR	8	
V10001	Lyon Park Creek	Lyon Park Creek, KC River Park, 1001 1st Street NE	Kenneshaw	Flood management project to address concrete-lined channel in the downstream area, riparian removal and vegetation restoration to county park, land and mixed residential	\$7.7	X	X			X		X	39			SWRC, SWWT, WDMR, MBLWPT	2,3,6,8,9,10	
V10001	Wila Mann Creek	Wila Mann Creek, 1001 1st Street NE	Kenneshaw	Flood management project to address concrete-lined channel in the downstream area, riparian removal and vegetation restoration to county park, land and mixed residential	\$3.1	X	X		X	X		X	3			SWRC, SWWT, WDMR	8	
V10002	Wilson Park Creek Reach 3	CP RR crossing to West Layton Avenue		Flood management project to address concrete-lined channel in the downstream area, riparian removal and vegetation restoration to county park, land and mixed residential	\$13.2	X	X			X		X	22			SWRC, SWWT, WDMR	2,3,6,8,14	
V10003	Wilson Park Creek Reach 2	East to CP RR		Flood management project to address concrete-lined channel in the downstream area, riparian removal and vegetation restoration to county park, land and mixed residential	\$24.9	X	X			X		X	108			SWRC, SWWT, WDMR	2,3,6,8,14	
V10004	Wilson Park Creek Reach 4	Layton Avenue to S. 43rd St.		Flood management project to address concrete-lined channel in the downstream area, riparian removal and vegetation restoration to county park, land and mixed residential	\$8.9		X			X						SWRC, SWWT, WDMR	2,3,6	
M0007	KC Batching Station Improvements	Chase Avenue along the K.C. River	Kenneshaw	Removal of concrete-lined channel riparian removal and vegetation restoration to county park, land and mixed residential	\$4.0			X		X								1,2,8
N/A	Burnham Canal	Along the Burnham Canal	Menomonee	Removal of concrete-lined channel riparian removal and vegetation restoration to county park, land and mixed residential	\$10.0		X			X								3
N/A	Blow Head Dams in Elm Grove	Along the Menomonee River	Menomonee	Removal of concrete lined channel riparian removal and vegetation restoration to county park, land and mixed residential	\$2.9					X						SWRC, SWWT, WDMR	1,7	
N/A	Helmens Ave. Creek	Confidence with Wilson Park Creek to W. Edgerton Ave	Menomonee	Removal of concrete lined channel riparian removal and vegetation restoration to county park, land and mixed residential	\$4.9		X			X		X				SWRC, SWWT, WDMR	8	
N/A	Beaver Creek	S. 43rd St to the Varsity of S. 43rd St.		Perform stream stabilization.	\$0.4			X								SWRC, SWWT, WDMR	8	
N/A	Stormwater BMPs	KC River and Menomonee River	Menomonee & Kenneshaw	Flood management project to address concrete-lined channel riparian removal and vegetation restoration to county park, land and mixed residential	unknown	X							unknown				17	
N/A		Street with Street		BMPs to reduce flashiness and improve WQ	unknown			X			X						2,6,7	
N/A	Cedar Creek PCB	Cedar Creek - Mitauake River	Cedar Creek-Mitauake River Area	Implement the remainder of the Cedar Creek PCB cleanup agreement with up by Mercury Marine and Amcast Corporation	unknown						X					DNR and MBLWPT	18	
N/A	Purchaser lands Jackson Marsh Stream Bank Protection Area	Jackson Marsh State Wildlife Area & Cedar Creek	Cedar Creek-Mitauake River Area	Continue to submit requests to purchase private lands adjacent to Jackson Marsh State Wildlife Area and Cedar Creek, Streambank Protection Area. Try to purchase 10 to 15 acres of private lands adjacent to Jackson Marsh State Wildlife Area, water quality and riparian habitat. Provide riparian habitat and provide riparian habitat opportunities in a riparian area.	unknown		X			X						DNR and MBLWPT	18	
N/A	Jackson Marsh - Maintenance and Restoration	Jackson Marsh State Wildlife Area	Cedar Creek-Mitauake River Area	Provide riparian habitat and provide riparian habitat opportunities in a riparian area. Provide riparian habitat and provide riparian habitat opportunities in a riparian area.	unknown			X		X						DNR and MBLWPT	18	
N/A	Swan & Harmonie 8th Passage Destructions	Shelton Swan Boulevard and Harmonie Avenue	Swan & Harmonie	Remove the vegetation along the Swan Boulevard Harmonie Avenue	unknown					X						SWRC	1	