Metropolitan Water Reclamation District of Greater Chicago
(District)

MAINTENANCE AND OPERATIONS DEPARTMENT

COLLECTION SYSTEM
OPERATION AND MAINTENANCE MANUAL
(Combined Sewer Overflow and Capacity Management Operations and Maintenance Plan)

NPDES No. IL0028088 – O'Brien (North Side) WRP
NPDES No. IL0028053 – Stickney WRP
NPDES No. IL0028061 – Calumet WRP
NPDES No. IL0028070 – Lemont WRP
NPDES No. IL0047741 – Kirie WRP
NPDES No. IL0036137 – Hanover Park WRP
NPDES No. IL0036340 – Egan WRP

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Prepared by
Technical Services Unit

INTRODUCTION

The mission of the District is to protect the health and safety of the public in its service area, protect the quality of the water supply source (Lake Michigan), improve the quality of water in watercourses in its service area, protect businesses and homes from flood damages, and manage water as a vital resource for its service area. The District's service area is 883.5 square miles of Cook County, Illinois. The District is committed to achieving the highest standards of excellence in fulfilling its mission.

Flow within the Chicago Area Waterways System and Lake Michigan diversion flow are controlled by five structures: Wilmette Pump Station, Chicago River Controlling Works and Lock, O'Brien Controlling Works and Lock, Lockport Lock and Dam, and Lockport Controlling Works.

While exercising no direct control over wastewater collection and transmission maintained by cities, towns, and villages in Cook County, the District does control municipal sewer construction by permits in suburban Cook County. It also provides the main trunk lines for the collection of wastewater and treatment thereof. The District also provides facilities to store, treat, and release combined sewage and stormwater runoff within its jurisdiction.

The District is located primarily within the boundaries of Cook County, Illinois. The District serves an area of 883.5 square miles, which includes the City of Chicago and 128 suburban communities. The District serves an equivalent population of 10.35 million people; 5.25 million real people, a commercial and industrial equivalent of 4.5 million people, and a combined sewer overflow equivalent of 0.6 million people. The District's 554 miles of intercepting sewers and force mains range in size from 8 inches to 27 feet in diameter, and are fed by approximately 10,000 local sewer system connections.

The District's Tunnel and Reservoir Project (TARP) is one of the country's largest public works projects for pollution and flood control. One hundred and nine miles (109.4) of tunnels, 8 to 33 feet in diameter and 150 to 300 feet underground, have already been constructed and are in operation.

The District owns and operates one of the world's largest water reclamation plants, in addition to six other plants and 22 pumping stations. The District treats an average of 1.4 billion gallons of wastewater each day. The District's total wastewater treatment capacity is over 2.0 billion gallons per day.

The District controls approximately 76 miles of navigable waterways, which are part of a national system connecting the Atlantic Ocean and the Great Lakes with the Gulf of Mexico. In conjunction with its biosolids recycle and land reclamation program, the District owns over 13,500 acres of land in Fulton County, Illinois.

Beginning in 2005, the District was assigned responsibility for stormwater management for all of Cook County, including areas outside of the District's corporate boundaries. Activities have focused on organization and ordinance development, development of watershed plans and projects as well as implementation of a small stream maintenance program.

1.0 MANAGEMENT

1.1 PURPOSE

The purpose of this manual is to describe the means by which the District accomplishes two of its primary objectives: to avoid contamination of the Chicago Area Waterways (CAWS) and to protect the health and safety of the public in its service area. The District serves an area of 883.6 square miles which includes the City of Chicago and 128 suburban communities. Of the total service area, approximately 375 square miles have combined sewers and 508.6 square miles have separate sewers. Managing combined sewer overflows (CSOs) within the combined areas and separate sewer overflows (SSOs) within the separate areas are key to the District accomplishing its above primary objectives. To this end, this manual describes the Infrastructure Management, End of Pipe Management, Public Outreach and Education, Technology Testing, and associated Standard Operating Practices necessary to achieve our stated objectives.

1.2 ORGANIZATION

The District is governed by a nine-member Board of Commissioners. Commissioners are elected at large and serve on a salaried part-time basis. Three commissioners are elected every two years for six-year terms.

The Executive Director, who reports directly to the Board of Commissioners, manages the District's day-to-day operations. Eight appointed department heads report to the Executive Director.

Under the direction of the Executive Director, three departments undertake the primary responsibility for carrying out the objectives stated above: Maintenance and Operations, Engineering, and Monitoring and Research

- Maintenance and Operations has four divisions: General, North Area, Stickney Area and Calumet Area
- Engineering has three divisions: Infrastructure Management, Process Facilities Design, and Construction
- Monitoring and Research has three divisions: Environmental Monitoring and Research, Analytical Laboratories, and Industrial Waste

1.2.1 Maintenance and Operations (Relevant Division)

The General Division has three relevant sections:

- Waterways Control Section
    1. Administrative Unit
    2. Channels Operations Unit
    3. Channel Control Unit
    4. Lockport Powerhouse Unit
- Collection Systems Section
    1. Collection System Administration Unit

2. North Service Area Unit
3. Central Service Area Unit
4. South Service Area Unit

- Technical Administration Section
    1. Technical Administration Unit
    2. Technical Services Unit
    3. Contract Preparation Unit

1.2.2 Engineering (Relevant Division)

The Infrastructure Management Division consists of four relevant sections:

- Administrative Section
- Collection Facilities/TARP Section
- Local Sewer Systems Section
- Stormwater Management Section

1.2.3 Monitoring and Research (Relevant Divisions)

The Environmental Monitoring and Research Division consists of two relevant sections:

- Analytical Microbiology and Biomonitoring Section
- Aquatic Ecology and Water Quality Section

The Analytical Laboratories Division consists of five relevant sections:

- Stickney Analytical Laboratory
- Industrial Waste Analytical Laboratory
- Calumet Analytical Laboratory
- Egan Analytical Laboratory
- Organic Compounds Analytical Laboratory

The Industrial Waste Division consists of three relevant sections:

- Administrative and Technical Services
- Pretreatment and Cost Recovery
- Field Services (Central, South, North, and Northwest Area Offices)

The responsibilities of each division are described in further detail in subsequent sections of this manual. See the District's current Budget Book on the District's website for an organizational chart and additional information on the Relevant District Departments, Divisions, Sections and Units:

http://pepportal.mwrd.local:50100/irj/portal/anonymous?NavigationTarget=navurl://45687c4bebc14a072052f943c334a50b

2.0 INFRASTRUCTURE MANAGEMENT

2.1 POLLUTION PREVENTION CONTROLS

2.1.1 Local Sewer Systems Section

The Local Sewer Systems Section administers the Watershed Management Ordinance (WMO) to protect public health and the environment by establishing uniform requirements for land development within suburban Cook County and sewer construction within the District's service area through the review and issuance of WMO permit applications. The WMO also requires compliance with the Infiltration/Inflow Control Program, described in Section 2.1.1.1 below.

To protect existing and new developments from increased stormwater runoff and flooding conditions, the WMO requires stormwater management facilities to be installed for new developments and redevelopments that exceed certain acreage limits. The WMO also regulates the design, construction, operation, and maintenance of all public and private sewers that discharge directly or indirectly into District collection and treatment facilities, or into waters within the boundaries of the District.

The Technical Guidance Manual (TGM) provides guidance on how to apply and meet the WMO's requirements for land development and sewer construction, and promotes efficient and consistent permit application submittals and review procedures.

The WMO, TGM, and other related documents can be found on the District's website at http://wmo.mwrd.org.

2.1.1.1 Infiltration/Inflow Control Program

In the District's service area, local sewer systems (satellite systems) are owned, operated, and maintained by local cities, villages, townships, local sanitary districts, and utility companies. These local systems convey flow to the District's intercepting sewers and water reclamation plants (WRPs) for treatment.

The local systems are comprised of both combined sewer areas and separate sanitary sewer areas. The separate sewer area includes separate storm and sanitary sewers. Stormwater runoff is collected and conveyed by a storm sewer or other conveyance system that discharges into a receiving waterway. Wastewater flows are collected and conveyed by a sanitary sewer to the District's WRPs. These sanitary sewer systems are designed and intended to collect and convey only wastewater flow and a limited amount of groundwater infiltration.

In many locations, excessive groundwater infiltration and stormwater inflow (I/I) enter into the sanitary sewer systems through system deficiencies. Sewer system defects that allow groundwater infiltration include pipe cracks, open or off-set joints, pipe-structure connections, and leaking manhole walls. Illegal connections that allow stormwater inflow include downspouts, yard and area drains, footing/foundation drains, sump pumps, driveway and window well drains, and storm sewer direct/indirect cross-connections.

When intense rain events occur excessive I/I can overload sewers causing sanitary sewer overflows, damage to private property through basement backups, loss of conveyance capacity, as well as increased wastewater conveyance and treatment costs. To prevent this from occurring, the District is implementing the Infiltration/Inflow Control Program (IICP) that is applicable to all separate satellite systems that discharge directly and/or indirectly into the District's facilities.

The IICP provides a framework for asset management of separate sewer systems to meeting the following goals:

- Maintain infrastructure to prevent sanitary sewer overflows and basement backups due to sewer surcharging and other adverse sewer system conditions;

- Comply with the District's NPDES permits and all other applicable federal, state, and local laws and regulations;

- Minimize extraneous flows transported to the District's facilities due to defective system components or illegal connections.

Through the implementation of the IICP all satellite entities (local sewer system owners) are required to identify and address I/I sources within the public and private sewer systems. To accomplish this, satellite entities will perform ongoing inspections and conduct maintenance and rehabilitation work on the sanitary sewer system. Additionally, all satellite entities must submit an annual report to the District that includes all work completed and progress made to meet the goals of the IICP.

The Technical Guidance Manual (TGM) provides guidance on how to apply and meet the IICP's requirements for I/I source identification and correction. The IICP, TGM, and other related documents can be found on the District's website at http://pepportal.mwrd.local:50100/irj/portal/anonymous/Infiltration.

2.1.2 Industrial Waste Division Programs

The Industrial Waste Division (IWD) of the Monitoring and Research Department consists of three sections: Administrative and Technical Services, Pretreatment and Cost Recovery, and Field Services. The primary responsibility of IWD is the enforcement of the District's Sewage and Waste Control Ordinance (SWCO) and the User Charge Ordinance (UCO) which can be found on the District's website at

http://pepportal.mwrd.local:50100/irj/portal/anonymous?NavigationTarget=navurl://77736bc1946759617132ba3e6459cb26

IWD is also responsible for the collection, compilation and presentation of data pertaining to industrial user discharges to the District's sewerage system. IWD also carries out the District's responsibility as a primary response agency for hazardous materials emergencies in Cook County.

2.1.2.1 Administration and Technical Services Section

The Administration and Technical Services Section is responsible for the general administration of IWD and for coordination and direction of the work of the Pretreatment and Cost Recovery, and Field Services Sections.

2.1.2.2 Pretreatment and Cost Recovery Section

The Pretreatment and Cost Recovery Section administers the District's federally-approved User Charge program as authorized under the UCO. The Section receives and reviews reports from approximately 3,500 users annually containing calculations of their respective User Charge liabilities under the UCO and documentation corroborating their data. The costs for the administration of the SWCO and the UCO are recovered from industrial users through Minimum Pretreatment Requirements charges, Noncompliance Enforcement charges and User Charge Verification charges. The Pretreatment and Cost Recovery Section is also responsible for the routine administration and enforcement of the SWCO, which incorporates the federal categorical and non-categorical pretreatment regulations and specifies limits for contaminants and other wastes discharged into the sewer system and waterways within the District's boundaries.

2.1.2.3 Field Services Section

The Field Services Section (FSS) of IWD conducts inspections and sampling of wastewater discharges at various industrial and commercial facilities within the District's jurisdiction to determine compliance with the SWCO and for verification of user-provided data as required by the UCO. On average, approximately 2,500 locations are sampled and 3,000 locations inspected each year. Corrective compliance action is taken against facilities that are found in violation of the SWCO.

The FSS is on call 24 hours per day, 365 days per year, to respond to emergency situations or complaints. These calls originate from local municipalities, Police and Fire Departments, the EPA, the Coast Guard, private citizens, or as industrial self-reported incidents involving the discharge or potential discharge of harmful wastes into the sanitary sewers or the waterways of Cook County. The FSS responds to approximately 350 such calls each year.

Additionally, the FSS is responsible for the following activities:

- Monitors the quality of Lake Michigan and the Chicago Area Waterway System in order to detect and reduce the incidence of pollution and to protect the area's source of drinking water.
- Collects samples from groundwater monitoring wells installed in the vicinity of the District's Tunnel and Reservoir Plan (TARP) and at certain District facilities to detect the presence of contaminants from District operations.

- Monitors the wastes brought by chemical toilet service companies for discharge at the Stickney WRP.
- Investigates willful and/or accidental spills and discharges of pollutants and hazardous, toxic, or volatile materials into the sewer systems and waterways, and oversees containment and cleanup activities pertaining to such events.

2.1.2.4 Sewage and Waste Control Ordinance

The SWCO was first adopted in 1969 and has been comprehensively amended to include technically-based local discharge limits and the District's USEPA-approved Pretreatment Program. Its purpose is the protection of the public health and safety by abating and preventing pollution. Through the administration of the SWCO and the Pretreatment Program, the District can control the quantity and quality of sewage, industrial wastes and other wastes discharged to the sewer system and waterways. The result is the protection of the treatment processes at the District's Water Reclamation Plants (WRP), the water quality of the receiving waterbody, and the quality of the biosolids generated at the District, while providing for worker safety. Administration of the SWCO allows the District to achieve compliance with its National Pollutant Discharge Elimination System permits, in addition to producing Exceptional Quality biosolids for final utilization.

2.1.2.5 Pretreatment Program

In 1985, the USEPA granted its approval of the District's Pretreatment Program. Pursuant to the General Pretreatment Regulations that contain the requirements for an approved pretreatment program, the District must require compliance by industrial users with the applicable USEPA categorical pretreatment standards as well as the local limits. Under the provisions of Appendix D to the SWCO, the Pretreatment and Cost Recovery Section issues individual control mechanisms (Discharge Authorizations) to all Significant Industrial Users (SIUs) in order to establish conditions for their discharge of pollutants into the District's sewer system. SIUs are typically those that: a) are subject to categorical pretreatment standards; or b) discharge greater than 25,000 gallons per day of process wastewater. The Discharge Authorizations (DAs) establish pollutant-specific effluent limitations applicable to the specific industry. DA forms can be found on the District's website at

http://pepportal.mwrd.local:50100/irj/portal/anonymous?NavigationTarget=navurl://640af2860c5dc5cf31d3591dc62503dc

The DAs also establish self-monitoring, sampling, reporting, notification and record-keeping requirements including identification of the pollutants to be monitored, sampling points, and sampling frequency. SIUs are required to submit Continued Compliance Reports twice per year. Continued Compliance Report forms can be found on the District's website at

http://pepportal.mwrd.local:50100/irj/portal/anonymous?NavigationTarget=navurl://640af2860c5dc5cf31d3591dc62503dc

Under its Pretreatment Program, the District, at a minimum, must inspect and sample all industrial users subject to categorical pretreatment standards and other significant industrial users at least annually to verify compliance with the applicable standards. During the inspections, Environmental Specialists (ESs) from the FSS routinely make observations of discharge points, process areas, pretreatment systems, generation of sludge and other process residues, maintenance of records, and any other items required by the SWCO. Information is collected pertaining to chemical storage facilities, hazardous waste generation, spill control plans, industrial user self-monitoring techniques (when observed), and industrial user production rates. Professional staff of the IWD have attended and completed a training program in the performance of pretreatment facility inspections. Knowledge gained has been incorporated into the development of the Inspection Check List now being used by the District to document pretreatment program inspections. Wastewater samples are collected from industrial users' discharge points and analyzed for compliance with pollutant concentration limits.

The Enforcement Response Procedure (ERP) is detailed in Appendix F to the SWCO. The ERP has been developed to include a range of enforcement responses available to the District to effectively enforce the terms and conditions of the SWCO. The ERP establishes a framework, the Response Option Matrix, in which the District will assess the degree of noncompliance by an industrial user and may consider both mitigating and aggravating circumstances in determining the appropriate enforcement response. The ERP also establishes minimum response levels for incidents of noncompliance that are deemed critical in nature, including interference with and pass-through of the treatment processes. The following types of enforcement are available to the District in response to incidents of noncompliance:

- Notice of Noncompliance
- Cease and Desist Order
- Show Cause Proceedings
- Court Proceedings
- Civil or Criminal Referrals

When the District determines that an industrial user is in violation of the SWCO, an Order is issued against the non-complying industrial user. Industrial users found in noncompliance are required to submit a written compliance schedule containing specific measures that will be taken to attain compliance along with specific milestone dates for taking these actions. In each case, on-site inspection and sampling is performed by the District to verify an industrial user's claim of compliance. If the inspection and/or sampling confirms noncompliance, the District may determine that Show Cause action is warranted. Show Cause proceedings involve hearings conducted by a Hearing Officer appointed by the Board of Commissioners. At the conclusion of the hearings, the Hearing Officer makes a finding of fact and a recommendation to the Board for action regarding the non-complying industrial user. The recommendation, upon adoption, becomes an Order of the Board (Board Order). An industrial user in significant noncompliance with a Board Order may be recommended for legal action in the Circuit Court of Cook County, to halt the condition of noncompliance either by mandamus or by injunction. Pursuant to Chapter 70, Section 2605/7bb of the Illinois Compiled Statutes, the District may seek a penalty of not less than $1,000.00 nor more than $10,000.00 per day for each day the industrial user remains in noncompliance with a Board Order. The District may also seek to recover reasonable attorney's fees, court costs and other expenses of litigation, and costs for inspection, sampling, analysis, and administration relating to the enforcement action, beginning with the issuance of the initial Order. The SWCO also includes the following enforcement mechanisms, designed to elicit more decisive industrial user action in response to noncompliance issues:

- Administrative civil penalty authority, ranging from $1000 to $2,000 per day of violation
- Late filing fees for required reports, ranging from $100 to $1,000 per day
- Authority to impose liens on a user's property for nonpayment of penalties

2.1.3 Detection and Elimination of Illegal Connections

During routine inspections performed on District-owned interceptors by the Sewer Maintenance Unit, illegal connections are sometimes observed visually or through televised inspections. In the event an illegal connection is suspected, the information is forwarded to the Local Sewers Section, described in 2.1.1, for further investigation and corrective action.

2.1.4 Detection and Elimination of Dry Weather Overflows

Dry weather overflows are detected through routine interceptor sewer and control structure inspections, activation of tide gate alarms, and from observations from other agencies and private citizens. The purpose of the frequent inspections is to be able to detect situations and problems before they cause overflows during dry weather. Sewer Maintenance Unit personnel are available 24 hours per day, 7 days per week to investigate reports of problems. As a result of an inspection, recommendations are made to implement corrective action and eliminate dry weather overflows as soon as possible. Upon verification, all such dry weather bypasses are reported immediately to the IEPA.

In situations where the problem is due to excessive flow from local lines, rather than to the malfunction of the connection to the interceptor or TARP, the owner of the local sewer system and the Engineering Department's Local Sewer Systems representative are notified.

2.2 INFRASTRUCTURE AND FACILITY MAINTENANCE

2.2.1 Overview

The District's interceptor system, extending 554 miles in length, serves an area of 883.5 square miles which includes the City of Chicago and 128 Suburban Communities. Although relatively durable, sewers will deteriorate over time and regular inspections and maintenance schedules are imperative for protecting critical infrastructure and imperative to protecting public health. The 554 miles of District interceptors are inspected, maintained and rehabilitated with joint efforts between the M&O and Engineering Departments. The District sewer systems are constructed using the following materials:

- Vitrified Clay Pipe for smaller pipes (12 to 18 inch)
- Cast in Place Concrete (pre 1950) of various sizes
- Pre-Cast Concrete of various sizes (after 1950)
- Ductile iron or High-Density Polyethylene (Force main)
- Various Liners (Rehabilitated Pipe)

In addition to the extensive network of sewers, the District also owns and maintains various pump and lift stations, reservoirs, outfall points and controlling structures within the Cook County boundaries. Maintenance and inspections of these structures are typically performed by the Sewer Maintenance Units while capital improvement or large rehabilitation projects are administered by the Engineering Department.

Tables 2.1 and 2.2 illustrate the age of the District's interceptor system and a list of physical assets by service basin.

Table 2-1 - Interceptor System Age

Installation Date	Percent of Total Interceptors
1900-1920	6.9
1921-1940	24.0
1941-1960	23.3
1961-1980	36.7
1981-Present	9.1

Table 2-2 – List of Physical Assets by Service Basin

	North	Central	South
Sewer Pipe 4" to 96"	178.5 miles	115.3 miles	167 miles
Sewer Pipe greater than 96"	15.9 miles	64.6 miles	27.9 miles
Local Sewer / Interceptor Connections	580+	900+	440+
Intercepting Structures	821	355	146
Tide Gates	111	273	81
Tarp Control Structures	60	143	99
TARP Shafts (1)	72	135	52
Pumping Stations	7	6	9
Reservoirs	22	4	9

(1) Excludes access or construction shafts

2.2.2 STANDARD INSPECTIONS AND PROCEDURES

The Sewer Maintenance Unit within the M&O Department is responsible for routine inspections of the District's collection system assets and various facilities. Routine inspections of the

District's structures are performed regularly to ensure the integrity of the infrastructure. The M&O Department performs inspections of the following structures and facilities:

- Pump and Lift Stations
- Reservoirs and Dam Structures
- TARP Control Structures
- Tide Gates
- Inverted Siphons
- Drop Manholes and Connecting Structures

Inspection methods and asset descriptions for the various structures examined by the Sewer Maintenance Unit are found in Section 7 of the Collection Asset Management Plan provided in Appendix 2A and described further in section 2.3 of this document.

The District utilizes a Maintenance Management System (MMS) for asset inventory, scheduling maintenance work performed by in-house staff and to track preventative maintenance schedules. Additionally, a GIS database is used as a geographical approach for identifying District assets and categorizing each asset in the District's service area. It is the intent of the District to transfer its maintenance management program to a GIS-enabled application to leverage the geographic tools with results from inspections and rehabilitation programs. This will allow field staff to enter notes, create work orders and document the condition assessment remotely while performing an inspection.

2.2.3 INTERCEPTING CLEANING

Sewer cleaning is the most routine maintenance performed on the District's intercepting system. Debris obstructions or blockages are revealed either through visual manhole inspections or through closed-circuit televising inspections (CCTV). Visual evidence will typically show whether the problem is localized or systematic while CCTV inspection can provide for a better overall condition assessment of the sewer. Typical cleaning methods for sewers include:

- Thorough cleaning by jetting or vacuuming
- Root removal and chemical treatment for prevention of root intrusion
- Repair or replacement of a section of sewer pipe

Sewer cleaning contracts are administered by the Sewer Maintenance Unit through multi-year agreements with a service contractor. If debris build-up, root intrusion or blockages are observed during routine inspections, the condition of the sewer is thoroughly evaluated and cleaning may be necessary as a corrective action. More frequent sewer cleaning and maintenance of problematic areas and emergencies are made on an as-needed basis.

2.3 CAPITAL ASSET MANAGEMENT PLAN (CAMP)

2.3.1 Overview

In 2013, the District replaced the Interceptor Inspection and Rehabilitation Program (IIRP) with the Collection Asset Management Plan (CAMP) to better assess the District's aging sewer system and infrastructure. Under IIRP, the District rehabilitated 45 miles of intercepting sewer to date with another 30 miles worth of rehabilitation identified and either in the pre-construction or planning stages. However, the IIRP program was replaced to provide a broader management framework for prioritizing the rehabilitation of various District structures. Though the objectives remain largely unchanged from IIRP, the District's CAMP provides an updated framework using widely accepted NASSCO standards and other standardized inspection methods while utilizing a risk based approach for prioritizing and scheduling rehabilitation. Under the CAMP, the program assesses District structures such as intercepting sewers, TARP collection structures, sludge and centrate lines, tide gates and other various passive and active structures surrounding District infrastructure.

2.3.2 CAMP

The main objective of the CAMP program is to accurately identify infrastructure rehabilitation needs by performing condition assessments on various structures and accurately prioritize rehabilitation work. Once a condition assessment is made on a structure, the initial conditions are used as a baseline against other structures for prioritization and for future inspections. Therefore, the thoroughness and inspection techniques used for the condition assessments are imperative. The District utilizes the following inspection methods when assessing collection system assets and other various structures:

- CCTV
- Digital Scanning
- Laser Profiling
- Sonar
- Multi-Sensored Technologies
- Pigging
- Manned Entry and Visual Inspections

The District's Sewer Design Section administers multi-year sewer inspection contracts which employs a few of the technologies noted above to identify segments of interceptors that are in need of repair. The inspection results are inventoried to track the sewer's physical condition, repairs, and changes over time.

While the means and methods of obtaining inspection data are important at gathering initial information about the condition of the system, the proper interpretation of the data is even more important so that the condition assessments are consistent and rehabilitation can be correctly prioritized. As such, the District utilizes many standardization inspection programs including the National Association of Sewer Service Companies' (NASSCO) Pipeline Assessment and Certification Program (PACP). The NAASCO PACP is a program which standardizes condition categorization, inspection forms, coding of observations and defects found in pipelines. Also, the Manhole Assessment and Certification Program (MACP), provides similar training for the inspection of manholes. Several District employees are trained in both the NAASCP and MACP programs.

Once a condition assessment is properly categorized for a collection system asset, the asset is placed in a risk matrix and evaluated against other structures. The Sewer Design staff prioritizes the assets and employs one of the various rehabilitation methods for corrective action:

- Point Repair
- Full Structural Replacement
- Cure-in-Place Pipe (CIPP)
- Sliplining
- Spray Applied Products
- Open Cut Removal and Replacement

CAMP also addresses inspections for active and passive structures within the District's collection system. As previously noted, inspections for these assets are typically performed by the Sewer Maintenance Unit within the M&O Department. These assets are examined more frequently than sewer segments due to their vulnerability and inexpensive inspection techniques. The inspection of such assets also require specialized training which many District staff members receive through a variety of sources including in-house training, seminars, conferences and webinars. Offering the appropriate training helps provide guidance for thorough, accurate and consistent visual inspections. Corrective and preventive maintenance schedules are recorded in the District's MMS and repairs are commonly performed by in-house trades. Items typically addressed as part of the corrective and preventive maintenance include:

- Gate/Stem and Mechanical Lubrication
- Replacement and Repair of Hardware
- Testing and Resetting of Communication Alarms
- Cleaning of Screens and Removal of Blockages
- Interior and Exterior Facility Maintenance

3.0 END OF PIPE MANAGEMENT

3.1 WATER QUALITY MONITORING

3.1.1 Ambient Water Quality Monitoring - Quality Assurance Project Plan (AWQM-QAPP)

The goals and objectives of this plan are in part to:

- Monitor the waterways in the District service areas through the collection and analysis of water samples to determine water quality on an ongoing basis and establish a historical record.
- Provide data that will be usable by the IEPA for assessment of water quality.
- Provide data that will be usable to evaluate the impact of District operations and projects including:
  - Water Reclamation Plants (WRPs).
  - Pretreatment Program.
  - Flood and pollution control Tunnel and Reservoir Plan (TARP).
  - Sidestream Elevated Pool Aeration (SEPA) Stations.
- Provide a broad surveillance of significant discharges to the waterways.
- Evaluate the effects of intermittent stormwater releases.
- Evaluate pollutants released from bottom sediments in the waterways.
- Coordinate the waterway monitoring performed by the District with the waterway monitoring performed by the IEPA's Bureau of Water.

The monitoring program consists of 28 sites within 13 bodies of water that extend over 225 river miles. Routine monitoring occurs monthly on four separate weekly sampling events as follows:

- First Monday: Eleven sites in the Des Plaines watershed.
- Second Monday: Four sites on the North Branch and North Shore Channel.
- Third Monday: Six sites on the Chicago River, the South Branch, South Fork and the Chicago and Sanitary Ship Canal.
- Fourth week: Six sites in the Calumet Watershed.
- Weekly: the Lockport Powerhouse Station on the Sanitary and Ship Canal.

When a holiday falls on a Monday, sampling is performed on Tuesday.

See Appendix 3A for the AWQM-QAPP.

3.1.2 Dissolved Oxygen

To comply with requirements in its National Pollution Discharge Elimination System (NPDES) permits, the District continuously monitors the dissolved oxygen (DO) levels at 15 locations in the Chicago Area Waterway System (CAWS). The Continuous Dissolved Oxygen Monitoring (CDOM) Program also covers six locations in wadeable Chicago area waterways. The District's Environmental Monitoring and Research (EM&R) Division maintains DO monitoring equipment and provides staff for the triweekly retrieval of monitors. Monitors are retrieved by the District's

Pollution Control boats at thirteen monitoring stations. Housings for waterway based meters are attached to bridge abutments and serviced from the bow of the boat. Monitors at eight land-based locations are retrieved by a team consisting of two Pollution Control Technicians (PCTs). Land based meter housings are usually attached to bridge abutments and serviced from the top of the bridge. See Appendix 3B for the CDOM QAPP.

Monthly grab waterway samples are also collected for DO analysis at 15 locations in the CAWS, in accordance with NPDES permits for the O'Brien, Stickney, and Calumet WRPs. Sampling is performed at the designated locations by EM&R personnel.

3.1.3 Water Quality Monitoring from Pump Stations and Backflows to Lake Michigan

As specified in the NPDES permit for the O'Brien, Stickney and Calumet Water Reclamation Plants, the District is required to sample all discharges from specified major pumping stations into local waterways. The District additionally samples backflows to Lake Michigan at the Chicago River Controlling Works (CRCW), the Wilmette Pump Station, and the 95th Street Pump Station. The pump stations and their respective receiving waterway are listed below:

- North Branch Pump Station, North Branch of the Chicago River
- Racine Avenue Pump Station, South Branch of the South Fork of the Chicago River
- 95th Street Pump Station, Calumet River

Automatic sampling equipment as well as grab samples are taken during discharges and sampled for general chemistry parameters. The sampling protocol for discharges at area pump stations is included in Appendix 3C. The sampling protocols for reversals to Lake Michigan are included in Appendix 3D.

3.2 COMBINED SEWER OVERFLOWS (CSOs)

3.2.1 Tunnel and Reservoir Plan (TARP)

There are currently 393 active CSOs owned by the City of Chicago (186), suburban municipalities (168), and the District (39) within the District's 375 square mile combined sewer service area. The District's approved long-term control plan to address CSOs within its combined sewer service area is known as the Tunnel and Reservoir Plan (TARP).

On January 6, 2014, the United States District Court for the Northern District of Illinois entered an Order approving a Consent Decree entered into between the District, the United States Environmental Protection Agency and the Illinois Environmental Protection Agency. The Consent Decree provides an enforceable schedule for implementing TARP, which will result in a significant decrease in the volume of water discharged to the waterways from CSOs in Cook County, along with dramatically reducing the potential for flooding. There is also a section of the Consent Decree designed to foster the use of green infrastructure controls. The District is committed to executing this work as quickly as possible.

A copy of the District's Consent Decree is available on the District's website at http://pepportal.mwrd.local:50100/irj/portal/anonymous/Home

Additionally, the most recent TARP Status Report is included in Appendix 3E.

3.2.2 CSO Monitoring and Reporting

The NPDES permits for the Stickney, Calumet, O'Brien, Kirie, and Lemont WRPs require that the District monitor the duration and frequency of each discharge from select, representative CSOs authorized in the permits and all other CSOs connected to TARP, for which the District has the ability to monitor through telemetry. The District has the capability to monitor 220 CSOs (56 percent of all CSOs). Proximity switches on the monitored tide gates along with pump operation records are used to verify CSO discharges. On average, there is one monitored outfall for every 1.8 square miles of the combined sewer service area and for every half mile of TARP tunnel length. The District's Representative Monitoring and Reporting plans are available on the District's website at

http://pepportal.mwrd.local:50100/irj/portal/anonymous/overview

Additionally, the list of the monitored and unmonitored CSOs is included in Appendix 3F.

Monitoring of CSOs can be done either locally or remotely. However, it is typically accomplished remotely using the Remote Terminal Unit (RTU) system that communicates, via radio or hard-wired telephone lines, to workstations at the Stickney, Calumet, and Kirie WRPs. When a CSO flow exits to the outfall, it pushes open a tide gate which triggers an alarm. The tide gate alarm signal is then transmitted to the workstation and recorded in the system with details such as location, open time, close time, and duration of alarm. Not every alarm is a confirmed CSO, however. Communication failure, sensor malfunction, obstruction, or power loss can cause a false tide gate alarm. The Treatment Plant Operator (TPO) typically notifies the Sewer Maintenance Unit to confirm any suspicious tide gate alarms unless maintenance personnel are known to be on-site testing communications, performing maintenance, or conducting repairs. Usually, these activities occur during dry weather. When a crew is on-site, the TPO is notified and records the date, time, and activity in a log book. False dry weather alarms would therefore be confirmed.

Precipitation is monitored by a number of rain gauges located throughout the TARP watershed area. Precipitation readings are transmitted to a workstation at the Waterway Control Center located in the Main Office Building on Erie Street in Chicago. Because the network of telemetered CSOs operated by the District is representative of the entire TARP watershed and because the District operates, maintains and monitors the telemetry, the IEPA has allowed the local municipalities, served by TARP, to use the District's monitoring and reporting data to fulfill the requirements of their respective NPDES permits.

CSO discharges and precipitation readings are initially reported as soon as possible. After verification, updates or revisions will be provided on the District's website. The District will continue to provide monitoring and reporting as specified in the NPDES permits.

When there is a CSO, an email and/or text message notification of the CSO discharge is sent to interested parties and directs them to pertinent web pages, including a map showing the location of the CSO discharge. Please refer to Section 4.2 for additional details on this topic.

3.2.3 Watershed Monitoring for Compliance with Consent Decree

Pursuant to the Consent Decree, the District submitted a post construction monitoring plan of the Calumet River Watershed basin for monitoring water quality when the Thornton Composite TARP reservoir became operational. The post construction monitoring plan was established to evaluate discharges from CSO outfalls in the Calumet TARP System. The post construction monitoring plan includes the following elements:

i. CSO Outfall monitoring location, frequency, duration and estimated volume;
ii. Identification of water quality standards parameters of concern;
iii. In stream water quality monitoring relating to applicable water quality standards;
iv. Determination of whether MWRD's CSOs are in compliance with the then-effective Calumet NPDES Permit, including applicable water quality standards incorporated therein; and
v. The minimum duration of such monitoring.

In preparation for the monitoring plan, the District performed pre monitoring of the Calumet Watershed Basin to represent baseline water quality conditions. The plan also includes additional sample locations throughout the Calumet Watershed for comparing conditions during wet weather events.

A post construction monitoring plan will also be developed for the McCook Reservoir.

3.3 WATERWAY MAINTENANCE

3.3.1 Boat Operations and Floatable Debris Removal in Waterways

The Channel Maintenance Unit, under the direction of an Administrative Unit, is primarily responsible for navigable waterway debris removal operations. The Channel Maintenance Unit, on a year round basis, services 76 miles of navigable waterways that include:

- The Chicago downtown area: Chicago River (North and South Branches)
- North Shore Channel
- Chicago Ship and Sanitary Canal
- Cal-Sag Channel

The 76 miles of navigable waterways are maintained by the Channel Maintenance Unit.

Debris removal operations concentrate on areas of high visibility and where health and safety are a concern. The crews respond to service calls; provide assistance to other District facilities; participate in special events and projects in cooperation with the City of Chicago, Chicago Ward Offices and other municipalities.

Debris can enter the waterway from various sources:

- Wind transported litter
- Debris discarded by people
- Fly dumping
- Rain events which transport debris

3.3.1.1 Floatables Collection for Compliance with Consent Decree

Pursuant to Appendix B of the District's Consent Decree, the District is required to perform special operations for removing CSO floatables succeeding a storm event. The District is required to deploy its debris and collection boats within 24 hours after the conclusion of a storm event that triggers a CSO to collect floatables and other debris. Depending on the location of the CSO, the Channel/Small Streams Maintenance personnel will dispatch its staff to the appropriate work zone for debris collection.

3.3.2 Channel Maintenance Vessels

The District owns and operates one 33-foot pusher boat (DB1), equipped with a 50-foot barge and crane. DB1 is operated by a crew of four workers (one pilot, one crane operator and two laborers). The boat operates year round and is used to remove large debris such as trees, logs, portions of seawalls, dock sections, and other large debris from the waterways. This vessel is not used for small-type debris cleanup, due to its lack of maneuverability. DB1 transverses the waterways from Wilmette (North Shore Channel) to the O'Brien Locks (Cal-Sag Channel). Traveling this distance can take approximately 12 hours. With 76 miles of waterway to service, the debris boat crew requires ample time to effectively respond to any change in assignment. The North Branch takes up the majority of time spent in debris removal. The Cal-Sag Channel is serviced on average once a year.

The District also owns and operates two skimmer boats which are smaller vessels that enable District crews to remove debris. Each pontoon boat is operated by a crew of two workers (one pilot and one laborer). These boats are placed in service seasonally, from mid-April to mid-October, to service the downtown area. Routine coverage includes the waterway from Goose Island (North Branch) to the Amtrak Bridge (South Branch) and the South Fork of the South Branch of the Chicago River. Skimmer boats are also dispatched to other areas for debris removal on an as-needed basis.

The debris typically removed during pontoon boat runs consists of smaller floatable debris including paper, plastic bottles, Styrofoam cups, dead fish, and numerous other small objects. If larger debris is encountered, it will be towed to a safe drop off point and the debris boat notified to pick up said debris as their schedule permits.

Daily logs are filled out by the pilots of each vessel. Additionally, a floatables log is generated on a daily basis containing the waterway serviced, type of debris collected, and photos. These daily reports are compiled monthly and used to compile a floatables summary report.

3.3.3 Fish Kill Procedure

Whenever a CSO occurs at one of the District's pumping stations, WRP operations personnel contact Channel Maintenance Unit personnel. Two days following a pumping event (or on the Monday following a weekend), the Channel Maintenance supervisor will direct the pontoon boats to initiate a fish kill reconnaissance. Inspections are conducted downstream of the pumping stations to determine if the CSO discharge has resulted in a fish kill. If a fish kill has been observed, the pontoon boat crews will perform a clean up after M&R has inspected the site and released it for clean-up. The fish kill is also reported orally to the IEPA as soon as possible, with a written follow-up report on the results of the District's subsequent investigation, within five days.

3.3.4 Sidestream Elevated Pool Aeration (SEPA) and Instream Aeration Stations

SEPA Stations are used to provide additional aeration to the District waterways. The SEPA station concept involves pumping a portion of water from a stream into an elevated pool. The water is then aerated by flowing over a series of cascades or waterfalls, returning to the stream. At five separate sidestream elevated pool aeration (SEPA) stations, water from the channel is lifted 12 to 15 feet and allowed to drop over a series of weirs to create a waterfall and add oxygen to the waterway.

Instream Aeration Stations are located at Devon Avenue and Webster Avenue to improve Dissolved Oxygen (DO) level in the North Shore Channel and the North Branch of the Chicago River, respectively. DO levels of the North Shore Channel used to control the Devon station are monitored by the O'Brien WRP by the DO probe installed at Fullerton Avenue. Similarly, DO levels of the North Branch of the Chicago River used to control the Webster station are monitored at the O'Brien WRP by the DO probe installed at the Ohio Street Bridgehouse over the Chicago River.

The maintenance of the stations is performed by the M&O Department. Staff routinely inspects and monitors the lift pumps, DO probes, and checks for oil leaks and monitors the intake and exit screens for blockages. The stations are typically operated between April 1st and November 1st.

4.0 PUBLIC EDUCATION AND OUTREACH

4.1 COMBINED SEWER OVERFLOW (CSO) PUBLIC NOTIFICATION PLAN

The District has utilized various methods for educating the public about the occurrence and impacts of CSOs. Many of these were implemented in response to the requirement for a CSO Public Notification Plan as specified in the NPDES permits for the Stickney, Calumet, and O'Brien Water Reclamation Plants (WRPs).

It was important in developing the CSO Notification Plan to solicit input and feedback from the affected public. The District considered the affected public to be a variety of groups which included governmental organizations, civic groups, recreational groups and any public citizen with an interest in or responsibility for the condition of the Chicago Area Waterway System (CAWS). The District identified the following organizations to be among the affected public:

- USEPA
- IEPA
- The City of Chicago
- All municipalities located adjacent to the CAWS
- The Friends of the Chicago River
- NeighborSpace
- The Openlands Project
- The Sierra Club
- The Civic Federation
- The Prairie Rivers Network
- The Lake Michigan Federation (now the Alliance for the Great Lakes)
- Other environmentally based organizations

Other groups which were specifically identified include the recreational and commercial users of the CAWS such as canoe or kayak clubs, high school or collegiate rowing teams and owners of marinas. Interested parties of the Use Attainability Analysis that has been underway for the CAWS were also identified and included in the District's efforts to include the public in the development of the CSO Plan.

The identified affected public was invited to a public meeting held on January 20, 2004 where the District presented its CSO Public Notification Plan. The public was notified about this meeting via the District's webpage, through news media alerts to all local print and electronic media, and direct notification (email and mail) when possible. Comments and feedback were solicited at that time and were incorporated into the finalized CSO Notification Plan as appropriate. The CSO Notification Plan includes informing the public of CSO events via email and/or text message notification, the webpage, posting signage at CSO locations, and informing the appropriate agencies when river reversal to Lake Michigan occurred. See the District's website at http://pepportal.mwrd.local:50100/irj/portal/anonymous/overview

4.2 CSO NOTIFICATION

The District has implemented an email and text message notification system whereby anyone who wants can receive an email and/or text message from the District of a CSO occurrence. An electronic "Address Book" has been developed which contains a list of email addresses and/or phone numbers of interested parties, i.e. previously identified stakeholders. Also, members of the public are able to sign up to receive e-mail and/or text message notification of CSO discharges by accessing the District's website

http://pepportal.mwrd.local:50100/irj/portal/anonymous/overview

These parties will be sent an email and/ or text alert in the event of a CSO or diversion to Lake Michigan. The email directs the recipient to the pertinent web pages, including a map showing the location of the CSO discharge. The Address Book will be updated on an as-needed basis as other members of the affected public are identified.

4.3 SIGNAGE AT DISTRICT CSO LOCATIONS

The District has installed signage at CSO outfall locations owned by the District and in public areas adjacent to the river on District property. These signs are two-sided and weatherproof. There are two types of signs that have been installed. One type has been posted near all of the 39 District-owned CSO outfalls, which identifies the outfall by number and cautions the public that the outfall may discharge sewage contaminated rainwater. The other sign has been installed approximately every 660 feet (+/- 40') along the waterways. Installation locations also include streets which end at the waterways and obvious/easy access points such as bridge abutments and overpasses. These signs caution the public that the waterway is not suitable for activities such as wading, swimming, jet skiing, water skiing, tubing, or any activity which involves body contact with the water. A copy of these signs may be viewed on the District's website at

http://pepportal.mwrd.local:50100/irj/portal/anonymous/overview

Copies of the signs have been made available to the TARP municipalities, including the City of Chicago, for their use in producing their own signs as required.

4.4 NOTIFICATION OF POTABLE WATER SUPPLY AGENCIES

The District continues to notify suppliers of potable water of CSO occurrences that result in a reversal of the waterways into Lake Michigan at Wilmette Harbor, the Chicago River and Controlling Works, and the O'Brien Lock.

4.5 DIRECT MAILINGS

Upon acceptance of the CSO Public Notification Plan by the IEPA, the District informed various entities of this via a letter. The letter transmitted the approved CSO Notification Plan to the TARP municipalities, District property lessees, and Water, Health and Public Safety Government

Organizations. The letter also informed these entities of the availability of the District's notification process. It also encouraged the municipalities and government organizations to link to the District's website.

4.6 SANITARY SEWER OVERFLOW (SSOs)

Based on historical inspections/observations, the District is currently aware of one location within its collection system that is prone to the occurrence of SSOs (Village of Worth Manhole near the District's Palos Hills Pumping Station). District staff continuously monitors this location during wet weather, secures and cleans the area when SSOs occur, and notifies the IEPA and local municipalities (verbally and in writing) after the occurrence of a SSO event. The District believes that future SSO occurrences at this location will be minimized after the completion of the TARP Composite Reservoir. If any other SSOs are observed within the District's collection system, they will be handled in a similar manner.

Additionally, see Section 2.1.1.1 for a description of the District's Infiltration/Inflow Control Program. The goal of this program is to minimize the occurrence of SSOs and basement backups in the District's separate sewer service area.

4.7 TELEPHONE HOTLINE

The District has a telephone hotline number (1.800.332.DUMP) which the public can call when a CSO discharge during dry weather or any SSO is observed. District personnel are then able to investigate the CSO or SSO and determine and rectify the cause of the discharge. This hotline number is posted on the CSO signs that have been installed at the District's CSO outfall locations.

APPENDIX 2A

COLLECTION ASSET MANAGEMENT PLAN (CAMP)

1 Introduction

The Metropolitan Water Reclamation District of Greater Chicago (District) is located primarily within the boundaries of Cook County, Illinois. The District serves an area of 883.6 square miles, which includes the City of Chicago and 128 suburban communities. The District serves an equivalent population of 10.35 million people, a population of 5.25 million people, a commercial and industrial equivalent of 4.5 million people, and a combined sewer overflow equivalent of 0.6 million people. The District's 554 miles of intercepting sewers and force mains range in size from 8 inches to 27 feet in diameter, and are fed by approximately 10,000 local sewer system connections.

The District's first sewer system was built in 1906 and, since then, the District has expended billions of dollars on sewer construction. Although relatively durable, sewers will deteriorate over time and some of the District's sewers have been in service for more than a century. Failures of aging sewers have cost the District millions of dollars over the years as expensive emergency repairs are made to correct catastrophic failures. The District has gradually adopted a more economical preventive maintenance practice that seeks to rehabilitate aging sewers to prevent failures and simultaneously extend the expected service life of the sewer.

As the sewer systems continue to age, repair and rehabilitation costs will only increase. Since the District's collection system is composed of critical infrastructure crucial to protecting public health, it is imperative to continue on the path of preventive maintenance and avoid costly and potentially dangerous failures. Given that sewer systems are below grade structures, problems are not usually visible on the surface until it is much too late. In order to fully assess and rehabilitate the sewer system, a comprehensive inspection and rehabilitation program is required.

In 1991, the District adopted the Interceptor Inspection and Rehabilitation Program (IIRP) to address the inspection and rehabilitation needs of the aging infrastructure. The intent of this document is to provide an updated framework for a comprehensive inspection, condition assessment and rehabilitation plan for the collection system assets discussed in this document. Mechanical and electrical components of the collection system, and their associated structures, are specifically excluded from this document and will continue to be addressed under current procedures by the M&O Department. The Engineering Department will assess conditions of the remaining assets and prioritize the rehabilitation based upon observed condition with consideration given to associated risk factors, such as public health and safety. The document will also outline the general guidelines for selection of rehabilitation methods for intercepting sewers, TARP tunnels, TARP connecting sewers, sludge and centrate lines, sewer force mains, and various structures described below. For the purpose of this document, the terms sewers, sewer system, or collection facilities will be used to describe all of these assets.

2 Inventory of Assets

2.1 Background and Description of Assets

2.1.1 Interceptor Sewers

The District's intercepting sewer system consists of 554 miles of sewers ranging in size from 8 inches to 27 feet in diameter and originally constructed of various materials including, but not limited to, reinforced concrete, brick, and ductile iron pipe. Construction of the intercepting sewer system began in 1906 and continued throughout the following century. Approximately one third of these intercepting sewers have been in service for over 50 years. A complete list of the District's intercepting sewers can be found in Appendix 1.

Over the past two decades, all of the District's intercepting sewers have been inspected under IIRP. These inspections have resulted in rehabilitation projects for numerous intercepting sewers and force mains. Under IIRP, approximately 45 miles of sewers have been rehabilitated to date with another 30 miles worth of rehabilitation identified and either in the pre-construction or planning stages.

2.1.2 TARP Tunnels

Phase I of the Tunnel and Reservoir Plan (TARP) included construction of 109 miles of concrete lined tunnel excavated in rock. Construction of the TARP tunnels began in the late 1970s and was completed in 2006. While it is not expected that there would be significant wear in the newer tunnels, the oldest of tunnels is approaching the age at which condition assessments are justified. Manned entry into the live tunnels has been very limited since TARP has gone online, and remote inspections have not been performed due to cost and degree of difficulty; however, the limited experiences suggest that the condition of the tunnel liners are relatively good. Nonetheless, it is recommended to take a proactive approach to stay ahead of the inevitable deterioration of the tunnel system and include the TARP tunnels in the asset management plan. A complete list of the District's TARP Tunnels can be found in Appendix 2.

2.1.3 TARP Connecting Sewers

TARP connecting sewers are typically high level sewers that convey flow from TARP connecting structures or junction structures to the TARP drop shafts. These sewers are not part of the interceptor system but act as gravity sewers feeding the deep tunnel system. Previous inspection and rehabilitation plans have not included the TARP connecting sewers; however, as the early segments of TARP have now been in service in excess of thirty years, it is appropriate to begin including these sewers in the plan for inspection and preventive maintenance. Most of the TARP connecting sewers are short runs between the connecting structures and the drop shafts, but there are some sewers that are thousands of feet in length. Failures of these sewers could prevent an interceptor or outfall sewer from relieving to TARP, potentially causing flooding and combined sewer overflows. A complete list of the District's TARP connecting sewers can be found in Appendix 3.

2.1.4 Sludge and Centrate Lines

Sludge and centrate lines are force mains that convey sludge or centrate byproducts from one of the District's water reclamation plants (WRP) to another District location. These lines are unique for two reasons: 1) they are pressurized force mains and so do not flow by gravity and 2) they convey higher strength waste with higher solids content compared to the sanitary and combined sewers. A complete list of the District's sludge and centrate lines can be found in Appendix 4.

2.1.5 Sewer Force Mains

In addition to the aforementioned sludge and centrate lines, the District operates a number of sewer force mains that convey sanitary and combined sewage. While the District's network of force mains pales in comparison to the extensive network of gravity sewers, ensuring that the force mains are maintained in good condition is equally vital. A complete list of the District's sewer force mains can be found in Appendix 5.

2.1.6 Various Structures

Various passive structures (manholes, drop structures, inverted siphons, etc.) and active control structures (contain gates, valves, pumps, etc.) are a part of the collection system. The inline, passive structures can be inspected concurrently with their associated sewer or tunnel and can be rehabilitated on an as needed basis or along with the associated sewer or tunnel, depending on the severity of the situation observed. Control structures, pump stations, and other structures that contain mechanical and electrical equipment are specifically excluded from the scope of this document. Such structures require more specialized inspection and maintenance and are better addressed by the Maintenance & Operations Department (M&O).

2.2 Asset Management Tools

2.2.1 GIS Database

A systematic approach will be used to identify and categorize each asset in the District's collection system and establish an inventory. The District has recently developed a comprehensive GIS system to catalog and locate assets District wide, which can be used to cross-check the inventory. The TARP computer models developed by the University of Illinois can also be used to cross-check the inventory.

It is intended to eventually utilize the GIS system for execution of the asset management plan and to document and record results from the inspection and rehabilitation program. The risk based prioritization score assigned to each segment, discussed in Section 4, can be input in tabular form into GIS to allow for a graphical representation of the data. Such a graphical representation will assist in planning and timing of rehabilitation work and minimizing disruptions to residents by avoiding a concentrat in one area.

2.2.2 MMS Database

Currently, all District assets are catalogued and identified in the District's Maintenance Management System (MMS) which is administered by M&O. The MMS database tracks maintenance and repair work for all District assets and the currently assigned asset numbers will be used to track inspections and repairs.

The database will be used to identify previously repaired segments of sewers as well as repair prone sewer segments. This historical data can aid in the categorization and prioritization of the rehabilitation work.

3 Condition Assessment Program

3.1 Goals

The goal of the condition assessment program is to provide an accurate evaluation of the current condition of the District's collection facilities in order to adequately prioritize rehabilitation and repair work, while minimizing costs and service disruptions resulting from failures. Such failures are costly and disruptive and can also pose a real risk to public safety through exposure to sewage and the development of sink holes. Eliminating sudden and catastrophic failures through an effective asset management plan while also extending the service life of existing sewers is an economical way to protect the public interest and preserve the District's assets.

3.2 Inspections

3.2.1 Frequency of Inspection

In order to fully assess the condition of the sewer system, and to accurately prioritize rehabilitation work, it is necessary that a complete evaluation be done on the entire system. The initial evaluation will set the baseline conditions of the system, to be used in the initial condition assessment and for comparison with subsequent inspections.

Previous efforts have called for an aggressive initial inspection schedule but neglected the value of the existing information compiled from previous inspections. The District's sewers have proven to be relatively resilient with most defects deteriorating slowly. To the extent possible, recent video inspection data can be used for completing the new evaluation methods and classifications; thereby reducing the cost and effort of the initial evaluation. Since there is existing data documenting known problem sewers, those sewers previously marked as priorities, as well as those generally known to be in poor condition, will be inspected under an aggressive three year inspection process. Unless information is available to the contrary, those sewers that have recently been rehabilitated under the old IIRP are assumed to be in good condition and will not be inspected again as part of the initial evaluation. The remaining sewers requiring inspection will be prioritized based upon the age and construction type of each sewer.

Upon completion of the initial condition assessment and prioritization of required rehabilitation, the sewer system will be placed on a regular inspection cycle. Sewers that are marked as priorities due to potential failures will be inspected on a three year cycle until such time that the defects are corrected or the entire sewer is lined. Sewers with minor defects or defects that are not expected to compromise the integrity or operation of the sewer in the foreseeable future will be inspected on a 5 to 10 year cycle.

3.2.2 Inspection Methods

The most commonly used method for sewer inspections around the world is closed-circuit television (CCTV). CCTV is a relatively inexpensive inspection method with a high production rate and is satisfactory for most of the inspections that will be required during the initial assessment and follow-up inspections. For priority sewers, or those found to be in very poor condition via CCTV inspection, advanced inspection technologies may be appropriate. These technologies include digital scanning, laser profiling, sonar, electro-scanning, and multi-sensor technologies. Each advanced technology has advantages over CCTV for certain types of inspections and can be applied based upon the needs and concerns of each individual sewer. Due to access difficulties, the deep tunnels may require unique methods of inspection which will be discussed below.

3.2.2.1 CCTV

CCTV is the most common inspection method due to both its low cost and its versatility. CCTV allows for the inspection of virtually any size and material pipe greater than 6" in diameter. The technology allows the user to locate defects and create a video record of the inspection for permanent files and comparative use in subsequent inspections. CCTV can successfully locate sags and deflections, joint separations, root intrusion, sediment and debris build-up, cracks and leaks, and service connections. The drawback of CCTV is that it cannot observe the condition of the pipe below the waterline. While there are instances of corrosion and other problems below the water line, the majority of pipe failures occur in the upper portions of the pipe. A sewer found to be in very poor condition through CCTV inspection can be subsequently inspected with a supplementary technology if greater detail below the water line is required. Recent CCTV work performed for the District under various contracts has cost approximately $1.50 per linear foot.

3.2.2.2 Digital Scanning

Digital scanning is a relatively new inspection method. The inspection is carried out the same way as CCTV, with the instrument being transported through the sewers on self-propelled crawlers. Rather than using a single lens video recorder, as is used in CCTV, digital scanning instruments use high resolution digital cameras with wide angle lenses. The instrument may contain one or two cameras, as needed, with one typically in the front and one in the back of the instrument. The wide angle lenses take digital photographs on preset intervals that can be later viewed individually or digitally stitched together to provide a continuous view of a section of pipe. Viewing the photographs individually provides results comparable to CCTV while viewing the stitched photographs, also called the "unfolded" view, provides a continuous view of the length of the pipe. Like CCTV, though, digital scanning is limited to the pipe above the waterline.

In addition to the option for either standard or unfolded views, digital scanning is advantageous because it produces higher resolution images and can be performed with much greater rates of production than CCTV. The high production rate is due to the fact that there is no identification of defects on-site during the inspection. Defects are identified and coded later in the office using the associated software and a complete record of the entire pipe is stored electronically for viewing in the future. CCTV records are limited to the operator's panning and tilting to inspect perceived defects and do not necessarily cover the entire pipe.

While digital scanning can be used with any pipe material, the quality of the digital results declines with pipe size. This technology is improving as manufacturer's improve software and lighting technologies; however, the District should consider this technology for sewers no greater than 40 inches at this time.

Additionally, since this technology is only an incremental improvement over traditional CCTV in terms of quality of results, it would not be an appropriate supplemental technology but can be used in place of CCTV.

3.2.2.3 Laser Profiling

Laser profiling is an inspection technology that can detect changes in shape of the sewer pipe. The laser scanner projects laser images on the pipe walls and those images are detected by a camera to create a profile of the pipe. Like CCTV and digital scanning, the laser profiling technology cannot scan portions of the pipe below the waterline.

There are two types of laser scanning: 2-D and 3-D (LADAR) technologies. The 2-D laser scans are the more common and basic types of laser scans, but this technology has drawbacks. Because the scanner typically projects a circular image on the pipe wall, the calibration of the laser and its position along the longitudinal axis of the sewer can affect the quality of the results. Poor calibration can yield inaccurate results and deviations from the axis can suggest pipe deformations that do not really exist. The 3-D or LADAR technology uses point lasers, rather than a circular image, and has a built in receiver and two way transmitter that can develop accurate profiles and cross sections regardless of the alignment on the longitudinal axis. It is generally recommended that the 2-D laser technology be limited to 36” diameter pipes.

This type of technology can be employed as a supplemental technology, or performed in conjunction with other technologies (see multi-sensor technologies section) to obtain profiles of the sewers believed to be subject to deformation based upon CCTV results. Since CCTV does not yield profiles or cross sections, any perceived deformation can be verified and quantified using laser based technology. This technology may also be appropriate for the verification and final inspection of newly lined sewer.

3.2.2.4 Sonar

Sonar, also called ultrasonic technology, is different from the previously described CCTV, digital scanning, and laser profiling inspection methods in that it is used to inspect those portions of pipe below the water line. Sonar is effective in sewers greater than 12” in diameter and provides information on pipe geometry, pipe wall deflections, pits, voids, and cracks.

Like CCTV, digital scanning, and laser profiling, this technology can be used on any material pipe but, unlike the others, this technology can also be used in force mains. The ability to deploy the instrumentation without having to depressurize the force mains and take them out of service makes sonar technology a valuable tool for such inspections.

Fine tuning of the sonar technology for each individual sewer is required as there are various frequencies that can be used with sonar technologies. The varying frequencies can yield different information and should be selected depending on the type of information that is sought, pipe materials, pipe size, and levels of suspended solids in the pipe. For example, a higher frequency sensor, such as 2 MHz, will provide greater accuracy when depicting pipe geometry and/or sediment build up. The same high frequency sensor would provide less accurate information about pipe wall integrity since the high frequency signals do not penetrate the pipe walls as effectively as a lower frequency sensor, such as 650

KHz. One option that allows for a more complete sonar scan is to utilize instrumentation equipped with multiple sonar sensors each operating at different frequencies.

This type of technology is best suited for use in force mains, sewers that run full or nearly full and for which bypassing would be extremely difficult, and sewers expected to have high sedimentation levels. This technology may also be appropriate for use in conjunction with other technologies (see multi-sensor technologies section) to obtain information below the water line while other technologies examine the areas above the water line.

3.2.2.5 Multi-Sensor Technologies

In order to capitalize on the strengths of the various technologies, and to avoid their shortcomings, multi-sensor platforms have been established and combined, technologies like CCTV, laser, and sonar scanning. Depending on the individual make-up of the sewer, as well as the desired result, these robotic platforms can be fitted with multiple technologies in order to provide the best possible results in a single inspection.

While the individual technologies commercially used in these multi-sensor units are not brand new, the combination of them into one unit has really only taken off in the past decade. These units, though innovative, still have the same challenges as other technologies and the District's experience with one application has had only limited success. The use of these systems is generally cost prohibitive as the large amount of data generated requires expensive post-processing efforts before the data is useful.

3.2.2.6 Pigging

For cases in which force mains cannot be diverted or shut down, the use of pigging can be an effective tool for force main inspections. Though "pigging" is a generic term, there are various types of pipeline inspection gauges (pigs), which can be run through a pipe to provide useful condition data. The types of pigs include simple cleaning pigs that scour the pipes, caliper pigs that detect deformation, ultrasonic pigs to detect leakage, and magnetic flux leakage pigs that detect cracks, pitting, and weld defects.

Despite the advance in pigging technologies, the use of pigging has physical limitations. Installing the pigs can be tricky if the pipelines contain only 90 degree cleanout ports. Wye connections or dedicated pigging ports are more appropriate. Also, force mains containing valves that do not maintain the clear opening of the full pipe diameter will interrupt the passage of the pigs and may make pigging impossible. A review of the condition of the force mains to be inspected will be required to determine if pigging is feasible and/or desired or if other means should be investigated.

3.2.2.7 Manned Entry

In the event that the previously described technologies do not provide sufficient information for the accurate assessment of the sewer's conditions, particularly in the cases of larger sewers, it may be necessary to perform manned entry inspections. Manned entry inspections generally consist of a visual examination of the condition of a sewer, looking for telltale signs of deterioration. While use of a sounding hammer or other small tools is typical of a manned entry inspection, it may be necessary to employ more detailed testing. These tests can be either non-destructive, such as ground penetrating radar (GPR) or can be of the destructive nature, in which a sample of the sewer is taken by coring and then evaluated later in a laboratory.

3.3 Condition Assessment

While the means and methods of obtaining inspection data are the usual focus of sewer inspection discussions, the proper gathering, categorizing, and interpreting of data obtained are extremely important aspects of the sewer inspection process. Over the years many different means for categorizing and interpreting data have been developed, most of which are developed by and for specific utilities. Such fragmentation throughout the industry creates inefficiencies in the development of new technology as equipment manufacturers are developing repair methods that address specific needs of individual agencies rather than focusing their efforts on improving a single system. There are also inefficiencies as contractors who implement rehabilitation work identified by inspections are forced to operate with different information from different utilities operating in close proximity to one another.

Another problem with this fragmentation is that agency turnover ensures that each new generation of engineers and technicians will interpret data differently and categorize and prioritize it according to their interpretation. Understanding that these sewer systems are designed for 50 to 100 year life spans, the idea that the reviewers and interpretations of data from the inspections will change countless times over the facilities life should be a cause for concern. Standardized categorization techniques and interpretation of inspection data will provide agencies with the ability to confidently evaluate historical information for use in evaluating trends and the current integrity of the sewer systems.

One such standardization that has been adopted across Europe and is being widely implemented across the United States is the National Association of Sewer Service Companies' (NASSCO) Pipeline Assessment and Certification Program (PACP). The NAASCO PACP is a program which standardizes condition categorization, inspection forms, and coding of observations and defects found in pipelines. There is also the MACP, or Manhole Assessment and Certification Program, which provides similar training for the inspection of manholes.

NASSCO offers training courses for the PACP and MACP in order to ensure that the reviewers of the inspection data know what to look for and catalog and categorize defects properly. It is recommended that two or three staff members, as well as the supervisor, obtain the required training, and maintain it current, to perform the condition assessments in order to ensure redundancy and to allow for rotation of staff into various responsibilities within the group. This type of redundancy and rotation prevents staff from becoming burned out due to continued observation of video tape and other inspection results.

The sewer inspection contractor will utilize NASSCO type inspection forms (Appendix 6) to document the defects and conditions identified during the inspection. The District's NASSCO trained staff will review the results of the various inspection methods and classify and categorize the observed defects per NASSCO guidelines in order to ensure a uniform and consistent review of inspection data. The results of this classification will be considered along with any prioritization information to develop a prioritization hierarchy for sewer rehabilitation. NASSCO addresses issues like prioritization by allowing for the introduction of modifiers when determining the overall needs of the pipeline/manholes. The District will use a means of prioritization as the “modifier” and this prioritization will be introduced in the following chapter.

4 Categorization and Prioritization

4.1 Categorization

For the purposes of categorizing both the severity of a defect and the condition of the pipe, NASSCO's PACP defect codes provide a good outline of the different conditions. The PACP defect coding includes five levels of defects: Immediate Action, Poor, Fair, Good, and Excellent. In addition to categorizing the severity of defects found, these codes also offer a glimpse into the expected remaining life of the sewers without some type of repairs or rehabilitation. The following are descriptions of the different defect codes and what can be expected for each category.

Immediate Action - Defects/pipelines identified for immediate action are generally scored a five (5) on the point scale. As the title suggests, these defects/pipelines require immediate attention to either correct a failure that has already occurred or an expected imminent failure. Often times these issues are discovered when it is too late and a visible failure has occurred.

Poor – Defects/pipelines identified as poor are those which are anticipated to deteriorate to Immediate Action status in the foreseeable future and are likely to fail within 5-10 years. These defects/pipelines require prompt attention to prevent further deterioration and eventual failure. A score of four (4) is generally given to these defects/pipelines.

Fair – Defects/pipelines identified as fair are generally in moderate condition. Failure to rehabilitate the sewer will allow the progression of defects and the overall condition to deteriorate to Poor and eventually Immediate Action status, with pipe failure expected to occur sometime within 10 to 20 years. These defects/pipelines should be addressed when possible, but are not likely to immediately fail as a result of a lack of rehabilitation. A score of three (3) is generally given to these defects/pipelines.

Good – Defects/pipelines identified as good are generally in a good enough condition that defects and the overall condition are not anticipated to progress in the foreseeable future. Defects are present, but they have not begun to deteriorate and are not anticipated to pose a failure risk to the pipeline within the next 20 years. No immediate action is required on these sewers. A score of two (2) is generally given to these defects/pipelines.

Excellent – Defects/pipelines identified as excellent are generally in like-new condition. The pipeline may contain minor defects with failure of the pipe not anticipated within the foreseeable future. These sewers require no action. A score of one (1) is generally given to these defects/pipelines.

The categories and scores assigned to defects must be taken into context of the entire pipe segment. Where some pipelines may have a few immediate action defects, they may otherwise be in good condition. This is a stark contrast to a pipeline that is generally in poor condition throughout. The urgency and rehabilitation efforts for the two pipelines may vary significantly as a result of not only the severity of the defects, but the extensiveness as well. NASSCO provides various ways to assign pipe ratings to overall segments to ensure that an accurate accounting of the entire segment is considered during investigation.

4.2 Prioritization

Categorizing pipelines by the observed condition is an important step in the development of a rehabilitation program, but it is only one of the factors that must be considered. In order to establish a reliable, economically feasible, and practical rehabilitation plan, one must utilize a risk based approach to prioritize the pipelines as well. Each of the sewer segments will be evaluated and assigned a consequence of failure score based upon the consequences associated with a potential failure. The determined score will be based on a number of factors including, but not necessarily limited to, location of the sewer (proximity to major roads, waterways, passing beneath structures, etc.), visibility and impact of an eventual failure, public safety, accessibility for repairs and importance to the function of the overall system.

In considering the consequence of failure score associated with an individual sewer segment's failure, the user is allowed to assign either greater or lesser importance to the condition of a sewer based on the assigned score. Giving consideration to the sewer segments' consequence of failure scores will allow the District to prioritize rehabilitation work in a more practical manner. For instance, a sewer in very poor condition that runs beneath a stretch of undeveloped property may be given a lower overall priority than a sewer in slightly better condition that happens to run adjacent to residential properties. While the first sewer would score higher during the assessment phase, there would be less of an impact due to a failure of that sewer than the one adjacent to the residential properties. In a perfect world any sewer in poor condition would immediately be slated for rehabilitation; however, the reality of time and budget constraints often necessitate tough decision making. Considering the whole picture of condition versus consequences aids in that decision making and promotes economically and socially responsible decisions.

In a typical risk assessment, a matrix is developed that includes both the probability of failure of an asset and the consequence of such a failure. In this case, the probability of failure is established during the condition assessment phase, also taking into account factors such as age and construction type, and is assigned a numerical score from one to five. The consequence of failure is determined by considering additional factors such as location, importance to the function of the overall system, public safety, accessibility for repairs, etc..., and is also assigned a numerical score from one to five. Consideration of these two factors generates an overall risk score utilizing the following formula:

Risk = Probability of Failure x Consequence of Failure

Use of such a risk based system is consistent with other recent evaluations performed by the District for the TARP system and pump stations and would provide consistency in our approach towards inspection and evaluation of sewer system conditions.

5 Rehabilitation Methods

5.1 Point Repair Methods

For larger sewers, typically those greater than 60” in diameter, it may be necessary or desirable to perform point repairs in response to the identification of a problem. For sewers with a high consequence of failure, or in cases where sewer integrity problems have caused sink holes or settlement issues, there may not be sufficient time to allow for the development of a full rehabilitation project for the relevant section of sewer. In these instances, a temporary point repair is required in order to ensure that the sewer will maintain its integrity until a full rehabilitation can be performed on the affected section. The point repair method also allows for the prompt repair of any affected streets, sidewalks, landscaping, or other structure that may have been damaged or undermined by the sewer failure.

While point repairs can take many forms, a typical point repair on a large sewer would consist of an application of chemical grout to the hole or crack, which would then be secured by a steel plate. See Table 1 for a more detailed list of repair methods for specific situations.

5.2 Full Structural Replacement

5.2.1 Cured in Place Pipe (CIPP)

Cured in place pipe, or CIPP, is a relatively non-invasive trenchless technology for rehabilitation of sewer and water pipes. The technology consists of inserting a resin impregnated felt tube, or bag, into the damaged pipe creating a pipe-within-a-pipe. The felt bag is typically installed in an upstream manhole or insertion pit and inverted, or pulled, downstream to another manhole or access point. The bag is inverted through the host pipe using either water or air pressure and is then cured by one of various methods including, steam, hot water, ambient air, or even UV light.

Aside from the non-invasive qualities of CIPP, other benefits of this method include a seamless and jointless installation, a range of application from 4” to approximately 72” in diameter, and full structural replacement of the host pipe, The structural properties of a CIPP liner can be designed for the desired application but are typically such that the liner itself can carry the full structural load of the original pipe, without assistance from the host pipe. Care must be taken during installation to prevent wrinkling of the bag and it is often required that alternate lining methods be used on bends and turns, as the bag cannot turn corners without becoming wrinkled and misshapen. Full flow bypass is required during CIPP lining, which adds to the complexity of the installation.

5.2.2 Sliplining

Sliplining is another trenchless rehabilitation technology that is minimally invasive. The process consists of inserting a new smaller pipe into the existing host pipe. The annular space between the new and existing pipe is then grouted and the ends are sealed. This method can theoretically be used to rehabilitate any size pipe, provided sufficient access is available for the pipe’s insertion. While this method is relatively cost effective and requires no specialized equipment or labor, a major drawback of this method is the significant reduction in cross-sectional area of the sewer upon completion. This technology is better suited to larger sewers with sufficient capacity to absorb the loss of cross-sectional area.

Sliplining can be performed either continuously or segmentally. Continuous sliplining requires the use of flexible pipes, such as HDPE or PVC, that can be fused together at the surface and pulled into the host pipe in one continuous length. For larger sections, segments of pipe can be installed within the host pipe. These segments can be made of various materials, including GRP panels from companies like Channeline or centrifugally cast fiberglass reinforced polymer mortar (CCFRPM) panels from Hobas Pipe.

5.2.3 Spray Applied Products

Another approach to trenchless rehabilitation is the use of spray applied materials. Various types of materials are available for this method including shotcrete, epoxy, and urethane resins. These materials can be hand applied or centrifugally cast by mechanical means. The optimal materials and application techniques depend on various factors such as the size of the sewer or structure, sewer conditions, and available access to the sewer. Spray applied materials are attractive in that they generally require less staging area and, as many of the technologies use truck based installation, the staging areas are easily broken down at the end of a shift, minimizing the impacts to the public. Spray applied products are also particularly useful in rectangular or irregularly shaped sewer structures and in non-round sewer installations, as their use is not dependent upon any particular host pipe shape.

5.2.4 Open Cut Removal and Replacement

If a particular section of sewer is found to be in such condition that lining or other rehabilitation methods cannot be employed, the pipe may be excavated and replaced within the existing trench. It may be possible to construct new portions of pipe adjacent to the areas where the most damage exists, acting as a bypass around the original damaged section. Total replacement of the sewers will only be considered as the method of last resort when no other methods can be practically employed due to the high cost and disruptions created by the excavation.

6 Implementation of Rehabilitation Projects

6.1 Emergency Work / Spot Repairs

During the condition assessment phase, there may be times when a sewer defect is found that is so substantial and carries a high enough consequence of failure score that an emergency spot repair may be warranted. These instances may be discovered during CCTV or other types of inspections, or may be identified by sink holes or other settlements above and adjacent to a particular sewer. The District's normal contracting procedure for sewer rehabilitation projects is not conducive to performing emergency repair work, as the lengthy process can span many months; therefore, it is imperative to maintain an avenue for the prompt performance of emergency spot repairs.

Emergency contracts or Job Order Contract (JOC) task orders are the most efficient means for addressing emergency repairs. Developing and awarding an emergency contract or JOC task order can be done relatively quickly. The District could simultaneously negotiate the emergency contract or JOC task order with the contractor and obtain ROW in order to save time. Most JOC work is pre-priced, so the costs for such work would be relatively stable; however, the uniqueness of each emergency repair or failure could potentially add significant dollars to pre-priced items. Emergency contracts are normally expensive and are not subject to receiving bids. A major disadvantage of utilizing JOC is that the District actually has to maintain a JOC contract. The District has maintained a JOC contract on and off over the past decade, but adopting this option as the plan for emergency work would require the District to maintain JOC contracts for the long-term.

6.2 Large Scale Rehabilitation Projects

The intent of the condition assessment program is to identify problem areas within the sewer and TARP system and have them addressed as soon as possible, with emergency repairs being made as necessary along the way. As the sewers are inspected and graded based upon both their condition and failure consequences, the risk score that is developed will provide a prioritization of rehabilitation projects. It is the District's intent to line entire sewer segments, where possible, rather than perform piecemeal repair work. While it may make sense logistically to focus on one particular area of the District at a time, utilizing the prioritization should also prevent the District from performing too much work in one area and burdening the local residents with extensive road closures and extended construction activities.

The projects will be developed in the normal long form contract format. The projects will be developed with the intent of rehabilitating entire sewer segments; however, consideration will be given to ensure that a single project's costs do not become so extensive as to create budgetary problems. In these cases, individual segments may be broken into separate projects to allow for multiple projects to be ongoing at once so that the worst sewer segments are always being worked on.

APPENDIX 3A

AMBIENT WATER QUALITY MONITORING – QUALITY ASSURANCE PROJECT PLAN

AMBIENT WATER QUALITY MONITORING QUALITY ASSURANCE PROJECT PLAN

Revision 2.6
Effective Date: April 1, 2019

Organization: Metropolitan Water Reclamation District
of Greater Chicago
Monitoring and Research Department

Address: Stickney Water Reclamation Plant
6001 West Pershing Road
Cicero, Illinois 60804

Telephone: (708) 588-4063

GROUP A: PROJECT MANAGEMENT

A1: Approval Sheet

[signature] Date 4/8/19

Jennifer Wasik
Project Manager
Principal Environmental Scientist
Environmental Monitoring and Research Division

P. Grunwald Date 4/8/19

Pawel Grunwald
Quality Assurance Officer
Supervising Environmental Chemist
Analytical Laboratories Division

A2: Table of Contents

A3: Distribution List

A copy of this Quality Assurance Project Plan (QAPP) will be distributed to each person signing the approval sheet and each person involved with project tasking identified in Section A4. A copy of this QAPP shall be available on request to any person participating in the project from any of the personnel listed in Section A4. Persons not employed by the Metropolitan Water Reclamation District of Greater Chicago (District) may obtain a copy of this QAPP from the Director of the Monitoring and Research (M&R) Department.

As this document will be updated periodically, the reader is advised to check with the Project Manager for the latest revision if his copy is more than one year old. Revision 2.6 has been prepared following the United States Environmental Protection Agency (USEPA) guidance document EPA QA/R-5 titled "EPA Requirements for Quality Assurance Project Plans," March 2001.

A4: Project/Task Organization

The responsible persons for Project Management are:

<u>Project Director</u>:
Edward W. Podczerwinski, P.E.
Director of Monitoring and Research

<u>Project Manager</u>:
Jennifer Wasik
Principal Environmental Scientist
Environmental Monitoring and Research Division

<u>Quality Assurance Officer</u>:
Pawel Grunwald
Supervising Environmental Chemist

<u>Environmental Monitoring Manager</u>:
Nicholas Kollias
Aquatic Biologist

<u>Stickney Analytical Laboratory Manager</u>:
Tricia Stefanich
Supervising Environmental Chemist

<u>Calumet Analytical Laboratory Manager</u>:
John McNamara
Supervising Environmental Chemist

Industrial Waste Analytical Laboratory Manager:
Rebecca Rose
Supervising Environmental Chemist

Egan Analytical Laboratory Manager:
Victor Olchowka
Supervising Environmental Chemist

Analytical Microbiology Laboratory Manager:
Geeta K. Rijal
Principal Environmental Scientist

Organic Compounds Analytical Laboratory Manager:
Anna Liao
Instrument Chemist IV

Laboratory Information Management System (LIMS) Manager:
Ashley Jesernik
Senior Environmental Chemist

SAS® Database Manager:
Zainul Abedin
Biostatistician

IEPA Project Manager:
Gregg Good
Surface Water Section Manager

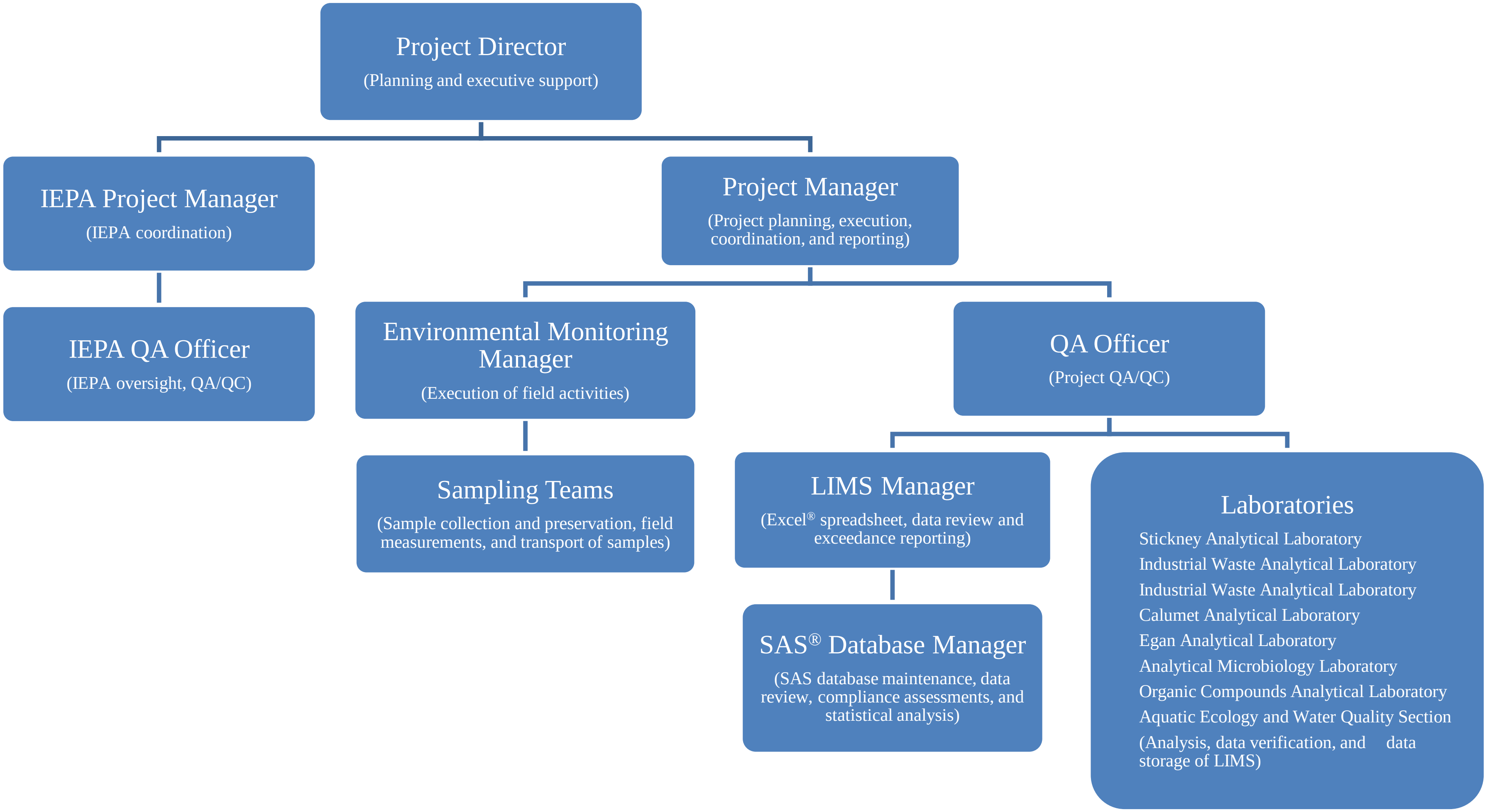
Illinois Environmental Protection Agency Quality Assurance Officer:
Michelle Rousey
Quality Assurance Officer, Bureau of Water

Figure 1 is the organization chart for the project. Primary lines of communication are shown as dashed lines. However, within the District, communication between any of the project participants may occur and is, in fact, encouraged as questions or issues arise.

The Project Director is responsible for executive oversight of the entire project and ensuring funding and resources are available to execute the project. The Project Manager plans and revises the scope of the project to ensure that it meets regulatory requirements and other objectives, evaluates and communicates the resources required to execute the project, reviews data submittals and reports, coordinates project activities, and completes QAPP revisions. The Quality Assurance (QA) Officer is responsible for oversight of quality control for the project.

The Illinois Environmental Protection Agency (IEPA) Project Manager coordinates the efforts of both agencies to ensure that project data will be usable by the IEPA for assessment of

FIGURE 1: AMBIENT WATER QUALITY MONITORING PROJECT ORGANIZATION CHART



water quality. He is assisted by the IEPA QA Officer, who oversees project activities and project quality control.

The Environmental Monitoring Manager is responsible for the execution of field activities and laboratory information management system (LIMS) set-up and maintenance for the project. He also assists with data analysis and QAPP revisions. The sampling teams collect and preserve samples, make field measurements, and transport the samples to the District laboratories. Several District laboratories analyze project samples. Participant laboratories include the Stickney Analytical Laboratory (SAL), the Egan Analytical Laboratory (EAL) the Industrial Waste Analytical Laboratory (IWAL), the Calumet Analytical Laboratory (CAL), the Analytical Microbiology Laboratory (AML), the Organic Compounds Analytical Laboratory (OCAL), and the Aquatic Ecology and Water Quality Section (AEWQ).

The LIMS Manager is responsible for collection of project test results and data verifications for SAL, IWAL, EAL, and CAL data. The Statistical Analysis Software (SAS®) Database Manager maintains the project database in SAS® and assists Project Manager with data analysis and reporting.

A5: Background

The District routinely collects and analyzes water samples from the District service area waterways. "Waterways" as used in this document will mean natural and modified rivers or streams, and man-made canals. This monitoring has been undertaken by the District to determine water quality on an ongoing basis and establish a historical record. A historical water quality database exists back to project inception in 1970.

The Illinois Pollution Control Board (IPCB) designates District service area waterways based on their recreational and aquatic life use potential. Recreational use designations in these waterways include: General Use, Primary Contact, Incidental Contact, Non-Contact, Non-Recreational, and Secondary Contact. Aquatic Life Uses are General Use, Chicago Area Waterway System (CAWS) Aquatic Life Use A, CAWS Aquatic Life Use B, and Indigenous Aquatic Life Use.

The IPCB has established separate water quality standards to support the designated uses for each waterway. Comprehensive assessments of the Ambient Water Quality Monitoring (AWQM) data from this project are made annually using all applicable water quality standards established by the IPCB.

The AWQM data collected from this project have been used, often in conjunction with data from other monitoring studies, to evaluate the impact of District operations and projects, including the water reclamation plants (WRPs), the pretreatment program, the flood and pollution control Tunnel and Reservoir Plan, the Sidestream Elevated Pool Aeration Stations, and the Instream Aeration Stations.

The AWQM data provide a broad surveillance of significant discharges to the waterways. The data also may have potential use for evaluation of other factors affecting water quality, including intermittent stormwater releases and release of pollutants from bottom sediment in the waterways.

Another goal of this project is to coordinate the waterway monitoring performed by the District with the waterway monitoring performed by the IEPA's Bureau of Water. The District will review key aspects of its program, including sampling locations, sampling frequency, sampling methods, parameters analyzed, and analytical capability, to determine how to best provide water quality data usable by both agencies.

This QAPP will address how to conduct the monitoring of the waterways in a manner that will efficiently utilize available resources and produce water quality data that will meet or exceed the measurement quality objectives for all intended uses of the data.

A6: Project/Task Description

Monitoring is conducted on 13 waterbodies at 29 sampling stations. The total number of river miles monitored is approximately 225. The following rivers, creeks, man-made channels, and a canal are monitored for water quality.

Des Plaines River System:

- Higgins Creek.
- Salt Creek.
- Des Plaines River.
- West Branch DuPage River.

Chicago River System:

- North Branch Chicago River.
- North Shore Channel.
- Chicago River.
- South Branch Chicago River.
- South Fork South Branch Chicago River.
- Chicago Sanitary and Ship Canal.

Calumet River System:

- Grand Calumet River.
- Little Calumet River.
- Calumet-Sag Channel.

Figure 2 is a map showing the waterways in the Chicago metropolitan area and the current sampling locations.

A description of the 29 monitoring stations is provided in Tables 1, 2, and 3. Table 1 lists all current and discontinued sampling locations with their station identification number and IPCB use classifications. Table 2 shows the latitude and longitude of each sampling station. Table 3 shows the United States Geological Survey quadrant, township, range, section, and quarter section of each sampling station.

All locations are sampled monthly, except Lockport Powerhouse and Lock (92) which is sampled weekly. Grab samples taken at the surface are collected at each sample location for the analysis of most measured analytes. These water samples are analyzed for a wide range of parameters, including alkalinity, solids, ammonia, nitrate, phosphorus, total or dissolved metals, cyanide, phenol, fecal coliform, and organic priority pollutants. A special sampling device is used to collect samples at a depth of 3 feet for bacterial analysis. Water temperature, pH, and dissolved oxygen are measured onsite at each sampling location.

Following collection, the samples are transported to the Lue-Hing Research and Development (R&D) Complex at the Stickney WRP and the OCAL at the John E. Egan WRP for login. After login, fluoride, chloride, and sulfate samples are transported to EAL, low level mercury samples are transported to CAL, and the rest of the samples are analyzed at SAL. All project data are maintained in the District LIMS database.

A7: Quality Objectives and Criteria for Measurement Data

Many analytes measured for this project are present in low concentrations throughout the waterway systems. Analyte concentrations will vary as discharged effluents and stormwater runoff are introduced into the waterways. All analytes are subject to chemical, biological, and physical processes that will alter their presence in the waterway. It is the intent of this project to employ methods of measurement that will detect and quantify all analytes of interest wherever possible.

Although there are several intended and potential uses of the data, minimum measurement criteria will be established at the lowest analyte concentration required for actual uses of the measurement data. Where no minimum measurement criteria can be identified, the water samples will be analyzed to the lowest concentration readily achievable by District laboratories.

FIGURE 2: AMBIENT WATER QUALITY MONITORING PROGRAM
WATERWAY SAMPLE STATIONS

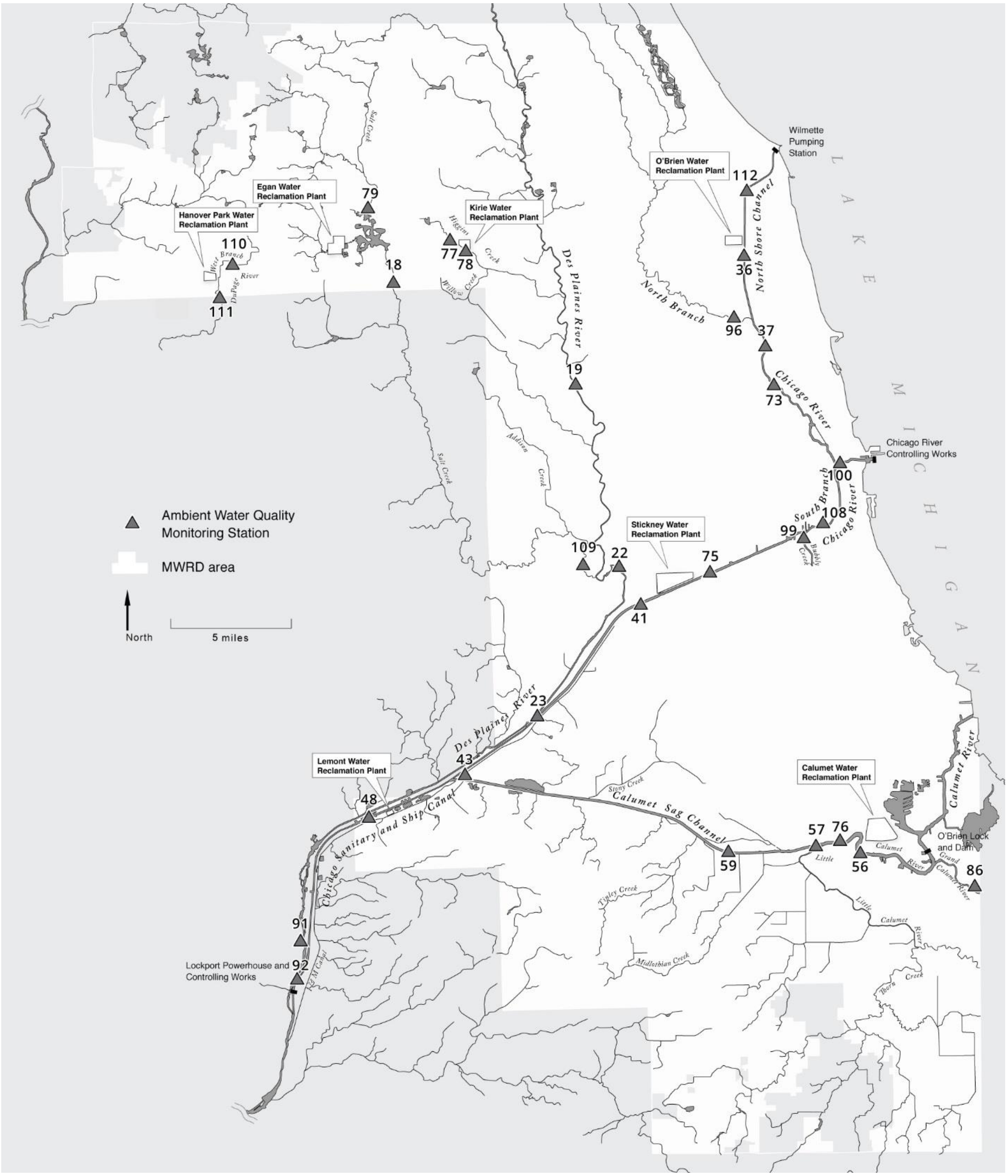


TABLE 1: SAMPLING LOCATIONS

Station	Location	IEPA Classification
	Chicago River System	
106	Dundee Road, West Fork North Branch of Chicago River	General Use
103	Golf Road, West Fork North Branch of Chicago River	General Use
31	Lake-Cook Road, Middle Fork North Branch of Chicago River	General Use
104	Glenview Road, Middle Fork North Branch of Chicago River	General Use
32	Lake-Cook Road, Skokie River	General Use
105	Frontage Road, Skokie River	General Use
34	Dempster Street, North Branch of Chicago River	General Use
96	Albany Avenue, North Branch of Chicago River*	General Use
35	Central Street, North Shore Channel	CAWS A/ICR
112	Dempster Street, North Shore Channel*	CAWS A/ICR
102	Oakton Street, North Shore Channel	CAWS A/ICR
36	Touhy Avenue, North Shore Channel*	CAWS A/PC
101	Foster Avenue, North Shore Channel	CAWS A/PC
37	Wilson Avenue, North Branch of Chicago River*	CAWS A/PC
73	Diversey Parkway, North Branch of Chicago River*	CAWS A/PC
46	Grand Avenue, North Branch of Chicago River	CAWS A/PC
74	Lake Shore Drive, Chicago River	General Use
100	Wells Street, Chicago River*	General Use
39	Madison Street, South Branch of Chicago River	CAWS A/PC
108	Loomis Street, South Branch of Chicago River*	CAWS A/PC
99	Archer Avenue, South Fork South Branch of Chicago River*	IAL/SC
40	Damen Avenue, Chicago Sanitary and Ship Canal	CAWS B/ICR
75	Cicero Avenue, Chicago Sanitary and Ship Canal*	CAWS B/ICR
41	Harlem Avenue, Chicago Sanitary and Ship Canal*	CAWS B/ICR
42	Route 83, Chicago Sanitary and Ship Canal	CAWS B/ICR
48	Stephen Street, Chicago Sanitary and Ship Canal*	CAWS B/NR
92	Lockport Powerhouse Forebay*	CAWS B/NR
	Calumet River System	
49	Ewing Avenue, Calumet River	CAWS A/NCR
50	Wolf Lake, Burnham Avenue	General Use
55	130th Street, Calumet River	CAWS A/ICR
86	Burnham Avenue, Grand Calumet River*	CAWS A/ICR

TABLE 1: SAMPLING LOCATIONS

Station	Location	IEPA Classification
	Calumet River System (Continued)	
56	Indiana Avenue, Little Calumet River*	CAWS A/PC
76	Halsted Street, Little Calumet River*	CAWS A/PC
52	Wentworth Avenue, Little Calumet River	General Use
54	Joe Orr Road, Thorn Creek	General Use
97	170th Street, Thorn Creek	General Use
57	Ashland, Little Calumet River*	General Use
58	Ashland Avenue, Calumet-Sag Channel	CAWS A/PC
59	Cicero Avenue, Calumet-Sag Channel*	CAWS A/PC
43	Route 83, Calumet-Sag Channel*	CAWS A/PC
	Des Plaines River System	
12	Lake-Cook Road, Buffalo Creek	General Use
13	Lake-Cook Road, Des Plaines River	General Use
17	Oakton Street, Des Plaines River	General Use
19	Belmont Avenue, Des Plaines River*	General Use
20	Roosevelt Road, Des Plaines River	General Use
22	Ogden Avenue, Des Plaines River*	General Use
23	Willow Springs Road, Des Plaines River*	General Use
29	Stephen Street, Des Plaines River	General Use
91	Material Service Road, Des Plaines River*	General Use
110	Springinsguth Road, West Branch of DuPage River*	General Use
89	Walnut Lane, West Branch of DuPage River	General Use
111	Arlington Drive, West Branch of DuPage River*	General Use
79	Higgins Road, Salt Creek*	General Use
80	Arlington Heights Road, Salt Creek	General Use
18	Devon Avenue, Salt Creek*	General Use
24	Wolf Road, Salt Creek	General Use
109	Brookfield Avenue, Salt Creek*	General Use
77	Elmhurst Road, Higgins Creek*	General Use
78	Wille Road, Higgins Creek*	General Use

TABLE 1: SAMPLING LOCATIONS

Station	Location	IEPA Classification
	Fox River	
90	Route 19, Poplar Creek	General Use

*Current sampling location as of April 2019.
PC = Primary Contact.
ICR = Incidental Contact Recreation.
NCR = Non-Contact Recreation.
NR = Non-Recreational.
SC = Secondary Contact.
IAL = Indigenous Aquatic Life.

TABLE 2: LATITUDE AND LONGITUDE OF CURRENT SAMPLING LOCATIONS

Station	Description	North Latitude	West Longitude
96	North Branch Chicago River @ Albany Ave.	41° 58.475'	87° 42.375'
112	North Shore Channel @ Dempster St.	42° 02.460'	87° 42.583'
36	North Shore Channel @ Touhy Ave.	42° 00.690'	87° 42.600'
37	North Branch Chicago River @ Wilson Ave.	41° 57.891'	87° 41.834'
73	North Branch Chicago River @ Diversey Ave.	41° 55.920'	87° 40.940'
100	Chicago River Main Stem @ Wells St.	41° 53.259'	87° 38.045'
108	South Branch Chicago River @ Loomis St.	41° 50.752'	87° 39.642'
99	South Fork, South Branch Chicago River @ Archer Ave.	41° 50.331'	87° 39.849'
75	Chicago Sanitary & Ship Canal @ Cicero Ave.	41° 49.169'	87° 44.616'
41	Chicago Sanitary & Ship Canal @ Harlem Ave.	41° 48.263'	87° 48.104'
48	Chicago Sanitary & Ship Canal @ Stephen St.	41° 40.750'	88° 00.683'
92	Chicago Sanitary & Ship Canal @ Lockport Powerhouse Forebay	41° 34.256'	88° 04.704'
86	Grand Calumet River @ Burnham Ave.	41° 37.870'	87° 32.352'
56	Little Calumet River @ Indiana Ave.	41° 39.136'	87° 35.828'
76	Little Calumet River @ Halsted St.	41° 39.440'	87° 38.476'
57	Little Calumet River @ Ashland Ave.	41° 39.099'	87° 39.633'
59	Calumet-Sag Channel @ Cicero Ave.	41° 39.282'	87° 44.284'
43	Calumet-Sag Channel @ Route 83	41° 41.790'	87° 56.480'
19	Des Plaines @ Belmont Ave.	41° 56.236'	87° 50.975'
22	Des Plaines River @ Ogden Ave.	41° 49.256'	87° 48.654'
23	Des Plaines River @ Willow Springs Rd.	41° 44.135'	87° 52.901'
91	Des Plaines River @ Material Service Rd.	41° 35.794'	88° 04.112'
110	West Branch DuPage River @ Springinsguth Rd.	42° 00.495'	88° 07.142'
111	West Branch DuPage River @ Arlington Drive	41° 58.500'	88° 08.316'
79	Salt Creek @ Higgins Rd.	42° 01.880'	88° 00.679'
18	Salt Creek @ Devon Ave.	41° 59.546'	87° 59.924'
109	Salt Creek @ Brookfield Ave.	41° 49.370'	87° 50.494'
77	Higgins Creek @ Elmhurst Rd.	42° 01.287'	87° 56.436'
78	Higgins Creek @ Wille Rd.	42° 01.120'	87° 56.201'

TABLE 3: QUADRANT, TOWNSHIP, AND RANGE OF CURRENT SAMPLING LOCATIONS

Station	Description	Quadrant	TWP	Range	Sec.	¼ Sec.
96	North Branch Chicago River @ Albany Avenue	Chicago Loop	40N	13E	12	SW
112	North Shore Channel @ Dempster Street	Evanston	41N	13E	14	SE
36	North Shore Channel @ Touhy Avenue	Evanston	42N	13E	26	SE
37	North Branch Chicago River @ Wilson Avenue	Chicago Loop	40N	13E	13	NE
73	North Branch Chicago River @ Diversey Avenue	Chicago Loop	40N	14E	30	SW
100	Chicago River Main Stem @ Wells Street	Chicago Loop	39N	14E	9	SW
108	South Branch Chicago River @ Loomis Street	Englewood	39N	14E	28	NW
99	South Fork, South Branch Chicago River @ Archer Avenue	Englewood	39N	14E	29	SW
75	Chicago Sanitary & Ship Canal @ Cicero Avenue	Englewood	38N	13E	3	NW
41	Chicago Sanitary & Ship Canal @ Harlem Avenue	Berwyn	38N	12E	7	NW
48	Chicago Sanitary & Ship Canal @ Stephen Street	Romeoville	37N	11E	20	NW
92	Chicago Sanitary & Ship Canal @ Lockport Powerhouse	Joliet	36N	10E	27	SW
86	Grand Calumet River @ Burnham Avenue	Lake Calumet	36N	15E	5	SW
56	Little Calumet River @ Indiana Avenue	Lake Calumet	37N	14E	34	SW
76	Little Calumet River @ Halsted Street	Blue Island	37N	14E	33	NW
57	Little Calumet River @ Ashland Avenue	Blue Island	37N	14E	32	SW
59	Calumet-Sag Channel @ Cicero Avenue	Blue Island	37N	13E	34	NW
43	Calumet-Sag Channel @ Route 83	Calumet-Sag Bridge	37N	11E	14	SE
19	Des Plaines @ Belmont Avenue	River Forest	40N	12E	22	SE
22	Des Plaines River @ Ogden Avenue	Berwyn	38N	12E	1	NE
23	Des Plaines River @ Willow Springs Road	Calumet-Sag Bridge	38N	12E	33	SW
91	Des Plaines River @ Material Service Road	Joliet	36N	10E	22	SW
110	West Branch DuPage River @ Springinsguth Road	Streamwood	41N	10E	26	SW
111	West Branch DuPage River @ Arlington Drive	West Chicago	40N	10E	6	SE
79	Salt Creek @ Higgins Road	Palatine	41N	11E	20	NW
18	Salt Creek @ Devon Avenue	Elmhurst	41N	11E	33	SW
109	Salt Creek @ Brookfield Avenue	Berwyn	39N	12E	35	SW
77	Higgins Creek @ Elmhurst Road	Arlington Hts.	41N	11E	25	NW
78	Higgins Creek @ Wille Road	Arlington Hts.	41N	11E	25	NW

Currently, except for the IPCB water quality standards, there are no other specified minimum measurement criteria for waterways monitoring data. Therefore, this project will use the most restrictive water quality standard applicable to waterways within the District's service area to establish the minimum measurement criteria for each parameter. The minimum measurement criteria will apply for all samples irrespective of the IPCB waterway designation in order to maintain uniform measurement objectives for the project.

The monitored parameters and the established minimum measurement criteria are shown in columns 1 and 3 of Attachment A. Analytes not subject to an IPCB water quality standard will not have specified minimum measurement criteria. The minimum measurement criteria will be adjusted accordingly when IPCB water quality standards are changed or as dictated by other planned uses of the data.

Column 2 of Attachment A gives the Reporting Limits (RLs) for the project, which are established by ALD. RLs are mathematically derived from MDLs. For parameters where RLs are not applicable, such as pH, solids, temperature, and dissolved oxygen, the minimum measurement criteria shown in column 3 of Attachment A are the sensitivities, to be obtained by the measurement method. Sensitivity of a method shall be defined as the difference in concentration that can be distinguished by measurement.

A8: Special Training/Certification

1. Sample collection personnel shall be trained in proper sample collection methods by the Environmental Monitoring Manager.

2. Microbiological analyses are performed in the Illinois Department of Public Health (IDPH) certified Analytical Bacteriology Laboratory by analysts who have successfully completed the source water bacteria testing Demonstration of Capability.

3. Each section of ALD has successfully maintained accredited status as certified by the IEPA following The NELAC Institute (TNI) standard.

A9: Documents and Records

1. The District Project Manager and IEPA QA Officer shall retain copies of all updates and revisions of this QAPP.

2. The Analytical Laboratory Managers and QA Officer for the District shall retain copies of all analytical procedures used for analysis of project samples.

3. The Project Manager shall retain copies of all laboratory analytical reports and correspondence with the laboratories.

4. The Project Manager shall retain copies of all communications to and from outside agencies and other interested parties.

5. All the records and reports listed above will be retained for 10 years at the Lue-Hing R&D Complex located at the Stickney WRP.

GROUP B: DATA GENERATION AND ACQUISITION

B1: Sampling Process Design (Experimental Design)

Selection of Sampling Locations. The 29 sampling locations have been previously identified in Tables 1, 2, and 3. Criteria for selecting sampling locations include:

1. Downstream of the point at which major tributaries enter the District's service area.

2. Near the intake control structures where water is diverted into the waterways from Lake Michigan.

3. Upstream and downstream of District facilities, including WRPs, aeration stations, and pumping stations.

4. At the confluence of significant waterway branches.

5. At the Lockport control facility where most flow from the District service area leaves the waterways system.

6. Near the downstream end of a reach designated by the IEPA as a waterbody segment or assessment unit.

Sampling locations must be readily accessible and judged safe for all sampling activities. Bridges over the waterways have provided ideal sampling locations. For locations where bridge access or height will not allow for safe sampling, samples may be collected by boat. Occasionally, if a bridge is under construction or if the sampling schedule required it, water samples that are normally collected by bridge may also be sampled by boat, in accordance with the procedures described in Appendix 1.

The IEPA utilizes water quality data to prepare its biannual water quality report as required by Section 305(b) of the Clean Water Act. For this purpose, the IEPA assesses conditions for waterbody segments and has defined these segments for all waters in the state.

Sampling locations may be added or removed from the monitoring network based upon periodic assessments of monitoring needs and resources available.

Sampling Frequency. All 29 sampling locations are monitored monthly, except Lockport Powerhouse and Lock (92), which is sampled weekly. The sampling frequency for each parameter is shown in Attachment B. This schedule provides sampling through seasonal changes and a sufficient number of samples to adequately characterize water quality annually and to identify long-term trends over many years. Monthly sampling may also detect an abrupt degradation of water quality, allowing the opportunity for the District to respond appropriately.

Water quality samples are collected weekly at the Lockport Powerhouse and Lock because this facility controls the release of water from the Chicago Sanitary and Ship Canal, which contains, at that location, the combined flow from the Chicago and Calumet River Systems. The treated wastewater from four District WRPs covering most of the District's service area flows through the Lockport Powerhouse and Lock.

Sampling frequency may be modified temporarily if there is a specific need to acquire additional data.

Selection of Parameters for Monitoring. Parameters selected for analysis are those that have IPCB water quality standards, and other parameters that have been used to characterize instream water quality. Certain parameters may only be analyzed in waterways with a particular designated use category. These are identified in Attachment A. Periodically, the parameters monitored are reviewed. A parameter may be removed from monitoring if the parameter is found to be non-essential for the goals of the project. If parameters are needed for a monitoring purpose, they will be added to the project.

B2: Sampling Methods

Manual sampling from a bridge or boat is conducted on each Monday of the month. When a Monday is a District paid holiday the sampling will be performed on the following Tuesday. Two person teams, each comprised of Pollution Control Technicians or available trained AEWQ Section personnel, perform the sampling under the direction of the Environmental Monitoring Manager.

The eleven locations on the Des Plaines River System are sampled on the first Monday of each month. The four most northern sampling locations on the Chicago River System are sampled on the second Monday of each month. The remaining six locations on the Chicago River System are sampled on the third Monday of each month. The six sampling locations on the Calumet River System are sampled on the fourth Monday of each month. The Lockport sampling location on the powerhouse forebay catwalk is sampled weekly.

The surface water grab samples are collected using a stainless steel bucket. Before the samples are collected using the stainless steel bucket, a calibrated dissolved oxygen probe is lowered into the waterway to a depth of three feet on the upstream side of the bridge at the most central location of the waterway and a field measurement is taken and recorded on the sample collection sheet. The bucket is then lowered into the waterway at the same location as the dissolved oxygen probe. The sampling time is recorded on the sample collection sheet (Appendix II). The bucket is submerged, filled, and then raised to the top of the bridge. The water temperature and pH are measured immediately from the stainless steel bucket using a calibrated pH/temperature probe and recorded on the sample collection sheet. The contents of the bucket are then discarded and the bucket is lowered and refilled as necessary to acclimate the bucket and provide sample for the individual sample aliquots. The sterile sample container for bacterial analysis is filled separately using a special sampling device in the waterway to prevent contact of the sample with non-sterile surfaces.

There are exceptions to sampling from bridges. Stephen Street (48) is sampled from the District's Pollution Control Boat in the center of the waterway, since the bridge no longer exists. Water samples are also routinely collected from the boat for safety reasons at Cicero Avenue (75) and Harlem Avenue (41) on the Chicago Sanitary and Ship Canal, Route 83 on the Cal-Sag Channel (43), and Ashland Avenue on the Little Calumet River (57). Occasionally, other stations may also be sampled by boat for logistical reasons, including bridge construction or coordination with other special sampling activities.

The individual sample containers are filled in accordance with the sampling procedures described in Appendix I. The individual containers for sample collection are prepared by the laboratory performing the sample analysis. Chemical preservatives as necessary are placed in the containers by the laboratory of origin before sample collection. Specific information regarding sample containers and chemical preservatives is found in Table 4.

Preprinted adhesive sample labels with unique LIMS identification numbers are placed on each container prior to filling. The sampling team completes the sample collection sheet (Appendix II) in the field as each sample is collected.

B3: Sample Handling and Custody

All sample containers are chilled in an ice-filled cooler immediately after collection and kept in ice during transport to the laboratories except for low level mercury samples.

All water samples are transported to the SAL after collection accompanied by sample collection sheets. The laboratory physically receives the samples from the Industrial Waste Division transporter. An Environmental Chemist, or a Laboratory Technician under the direct supervision of an Environmental Chemist, "receives" the samples into the District's LIMS using a barcode scanner. Each sample is inspected against the laboratory's sample receiving checklist for proper container, proper labeling, sufficient volume, and general appearance. Any missing samples or aliquots are noted on the sample receiving checklist. Sample arrival temperatures are measured using an infrared thermometer calibrated against a NIST traceable certified thermometer ("NIST" is the National Institute of Standards and Technology, United States Department of Commerce), and recorded. Since the time between sampling and arrival at the laboratory is only a few hours, samples may not always reach the 0.1 to 6 degrees Celsius (°C) required for thermal preservation. Samples are acceptable if "evidence of chilling" has begun. Samples that require thermal preservation are refrigerated after sample acceptance in the laboratory. Samples for biological and metals analyses are then routed to the appropriate laboratories at the Lue-Hing R&D Complex. Samples for organics analysis are transported to the OCAL at the John E. Egan WRP. The remaining samples for inorganic analysis are received by the SAL. Following sample transfer in LIMS at the SAL, the samples for fluoride, chloride, and sulfate analyses are transported to the Egan Laboratory, and the aliquot for low level mercury analysis is transported to the CAL within 24 hours.

TABLE 4: SAMPLE CONTAINERS AND FIELD PRESERVATION

Parameter	Container and Field Preservation
1. Fecal coliform	125-mL square polypropylene bottle, sterilized and sealed with 0.45 mL of 15% disodium salt of EDTA adjusted to pH of 6.5, and 0.15 mL of 10% sodium thiosulfate. Chill sample with ice. See Appendix I page AI-4 and AI-5 for the correct procedure.
2. General chemistry[1] (see footnote for parameters)	1-gallon polyethylene bottle. Chill sample with ice.
3. Metals, total	250-mL polyethylene bottle with 2.5 mL conc. HNO_3 to adjust $pH < 2$.
4. Metals, dissolved	900-mL certified clean polyethylene bottle. Chill sample with ice. (Sample filtered in laboratory with 0.45 μm membrane filter into a 250-mL certified clean polyethylene bottle and acidified with 2.5 mL of conc. HNO_3.)
5. Chromium, hexavalent	900-mL certified clean polyethylene bottle. Chill sample with ice.
6. Mercury (low level)	Four 40-mL vials, each with 200 μL BrCl. Do not put sample on ice.
7. Cyanide, total and chlorine amenable	½-gallon plastic bottle with 5 mL 50% NaOH to adjust $pH > 12$. Chill sample with ice.
8. Phenol	1-quart glass bottle with 2 mL of conc. H_2SO_4 to adjust $pH < 2$. Chill sample with ice.
9. n-Hexane extractable materials	Two 1-quart glass bottles. Chill sample with ice.
10. Alkalinity	250-mL polyethylene bottle. Chill sample with ice.
11. Sulfate, chloride, and fluoride	250-mL polyethylene bottle. Chill sample with ice.
12. Total phosphorus, total Kjeldahl nitrogen	250-mL polyethylene bottle with 0.3 mL of concentrated 50% sulfuric acid to acidify sample. Chill sample with ice.

TABLE 4 (Continued): SAMPLE CONTAINERS AND FIELD PRESERVATION

Parameter	Container and Field Preservation
13. Ammonia, NO_2+NO_3	250-mL polyethylene bottle, preserved with 0.3 mL of concentrated 50% sulfuric acid upon collection.
14. Carbon, total organic	250-mL polyethylene bottle with 1 mL H_2SO_4 to adjust pH < 2. Chill sample with ice.
15. Chlorophyll *a*	1-liter HDPE Nalgene amber, wide-mouth bottle with 1 mg powdered $MgCO_3$. Chill sample with ice.
16. Volatile organics, BETX (benzene, ethyl benzene, toluene, and xylenes)	Three 40-mL vials with Teflon-lined septum screw caps, each with 25 mg ascorbic acid, filled to top with minimal overflow and no air bubbles. Chill sample with ice.
17. Base/neutral and acid extractable compounds, pesticides, PCBs, OPPs	1-gallon glass with 0.7 mL of 50% sodium thiosulfate solution. Chill sample with ice.

[1]General chemistry parameters include total dissolved solids, total suspended solids.

Each laboratory receives the samples by logging them into the laboratory logbook and/or laboratory LIMS. Maximum holding times before analysis, as stated in applicable laboratory method standard operating procedures (SOPs), are adhered to. Parameters of particular concern, because of short maximum holding times, include: bacterial analysis (six hours) and hexavalent chromium (must be preserved within 24 hours).

Copies of the sample collection sheets, along with the sample receiving checklist, are retained by the SAL. The pH, temperature, and dissolved oxygen for each field sample are entered into the LIMS by AEWQ Section personnel.

The original sample collection sheets are returned to Environmental Monitoring Manager for review. The Environmental Monitoring Manager is responsible for the execution of field operations and corrective actions for field related quality control problems or other nonconformance issues.

B4: Analytical Methods

The analytical methods shown in Table 5 have been selected to meet the minimum measurement criteria presented in Attachment A. Column 1 of Table 5 gives the analytes to be measured, column 2 shows the method to be used by the laboratory, and column 3 the method reference. Except for chlorophyll *a*, all methods used by the District are USEPA approved methods listed in 40 CFR Parts 136, 141, and 145. Approved USEPA methods are not available for the determination of chlorophyll *a*.

Table 6 shows laboratory preservation and maximum holding time from the time of sampling for each analyzed parameter. Column 2 of Table 6 gives the laboratory preservation requirements. The maximum holding time for each parameter is given in column 3 of Table 6. Refrigeration of samples that require thermal preservation is maintained at 4°C, but temperatures in the range of 0.1 to 6°C are considered acceptable. Preservation and maximum holding times are in accord with those given in 40 CFR Part 136.

The laboratory where each analysis will be performed is identified in column 2 of Table 7. Column 3 of Table 7 identifies the laboratory method SOP. The analytical method SOPs are incorporated into this QAPP by reference in column 3 of Table 7. SOPs for analytical methods are available from the responsible Laboratory Manager identified in Section A4.

Attachment A compares the minimum measurement criteria against the RL achieved by the designated District laboratory. All analytes meet the minimum measurement criteria.

All data collected for this project will be reported to the analyte RL. Test results less than the RL will be reported as either zero or as less than the numerical value of the RL.

TABLE 5: ANALYTICAL METHODS

Parameter	Method	Method Reference
Dissolved oxygen	Electrode	SM 4500-O H
Temperature	Electrode	SM 2550 B
pH	Electrode	SM 4500-H^+ B
Ammonia nitrogen	Colorimetric	EPA 350.1R.2.0
Ammonia nitrogen, un-ionized[1]	Calculation	
Nitrate and nitrite nitrogen	Colorimetric	EPA 353.2 R.2.0
Kjeldahl nitrogen	Colorimetric	EPA 351.2 R.2.0
Phosphorus, total	Colorimetric	EPA 365.4
Sulfate	Ion Chromatography	EPA 300.0
Total dissolved solids	Gravimetric	SM 2540 C
Suspended solids	Gravimetric	SM 2540 D
Volatile suspended solids	Gravimetric	SM 2540 E
Alkalinity	Titration	SM 2320 B
Chloride	Ion Chromatography	EPA 300.0
Fluoride	Ion Chromatography	EPA 300.0
Organic carbon, total	UV-Oxidation	SM 5310 C
Phenol	Colorimetric	EPA 420.2
Cyanide, total	Colorimetric	EPA Kelada-01
Cyanide, chlorine amenable	Colorimetric	SM 4500-CN G
Barium, total	ICP-MS	EPA 200.8
Boron, total	ICP-MS	EPA 200.8
Calcium, total	ICP-OES	EPA 200.7
Chromium, trivalent[2]	ICP-MS	EPA 200.8
Chromium, hexavalent	Colorimetric	EPA 218.6
Magnesium, total	ICP-OES	EPA 200.7
Manganese, total	ICP-MS	EPA 200.8
Mercury, low-level, total; General Use	Cold vapor AFS	EPA 1631 E
Selenium, total	ICP-MS	EPA 200.8
Silver, total	ICP-MS	EPA 200.8
Arsenic, dissolved	ICP-MS	EPA 200.8
Cadmium, dissolved	ICP-MS	EPA 200.8
Chromium, dissolved	ICP-MS	EPA 200.8
Copper, dissolved	ICP-MS	EPA 200.8
Iron, dissolved	ICP-MS	EPA 200.8
Lead, dissolved	ICP-MS	EPA 200.8
Nickel, dissolved	ICP-MS	EPA 200.8
Silver, dissolved	ICP-MS	EPA 200.8
Zinc, dissolved	ICP-MS	EPA 200.8
Fecal coliform	Membrane	SM 9222 D

TABLE 5 (Continued): ANALYTICAL METHODS

Parameter	Method	Method Reference
n-Hexane extractable materials	Gravimetric	EPA 1664, Rev. A
Chlorophyll *a*	Colorimetric	SM 10200 H
BETX (benzene, ethyl benzene, toluene, xylenes)	Purge and trap GC/MS	EPA 624
Organic Priority Pollutants		
Volatile organic compounds	Purge and trap GC/MS	EPA 624
Base/neutral and acid-extractable compounds	GC/MS	EPA 625
Pesticides	GC/ECD	EPA 608
PCBs	GC/ECD	EPA 608

[1]Calculated from pH, temperature, and ammonia nitrogen.
[2]Trivalent chromium measured as total chromium.

TABLE 6: LABORATORY PRESERVATION AND MAXIMUM HOLDING TIME

Parameter	Laboratory Preservation[1,2]	Maximum Holding Time
Dissolved oxygen	NA	NA[3]
Temperature	NA	0.25 hours
pH	NA	0.25 hours
Ammonia nitrogen	(a) Refrigerate, (b) with H_2SO_4 to pH < 2	24 hours, 28 days
Ammonia nitrogen, un-ionized[4]	NA	NA
Nitrate and nitrite nitrogen	(a) Refrigerate, (b) with H_2SO_4 to pH < 2	24 hours, 28 days
Kjeldahl nitrogen	(a) Refrigerate, (b) with H_2SO_4 to pH < 2	24 hours, 28 days
Phosphorus, total	(a) Refrigerate, (b) with H_2SO_4 to pH < 2	24 hours, 28 days
Sulfate	Refrigerate	28 days
Total dissolved solids	Refrigerate	7 days
Suspended solids	Refrigerate	7 days
Volatile suspended solids	Refrigerate	7 days
Alkalinity	Refrigerate	14 days
Chloride	None required	28 days
Fluoride	None required	28 days
Organic carbon, total	Refrigerate, H_2SO_4 to pH < 2	28 days
Phenol	Refrigerate, H_2SO_4 to pH < 2	28 days
Cyanide, total	Refrigerate, NaOH to pH > 12	14 days
Cyanide, chlorine amenable	Refrigerate, NaOH to pH > 12	14 days
Chromium, hexavalent	(a) Refrigerate, (b) with $(NH_4)_2SO_4 + NH_4OH$ solution and NaOH to pH 9.3–9.7	24 hours, 28 days
Metals, total (excluding mercury)	HNO_3 to pH < 2	6 months
Mercury, low-level, total	BrCl	90 days
Metals, dissolved (excluding mercury)	Filter, HNO_3 to pH < 2	6 months
Fecal coliform	Refrigerate	6 hours
n-Hexane extractable materials	Refrigerate, H_2SO_4 to pH < 2	28 days
Chlorophyll *a*	Refrigerate	30 days

TABLE 6 (Continued): LABORATORY PRESERVATION AND MAXIMUM HOLDING TIME

Parameter	Laboratory Preservation[1,2]	Maximum Holding Time
BETX (Benzene, ethyl benzene, toluene, xylenes)	Refrigerate	7 days
Organic priority pollutants	Refrigerate	7 days

NA = Not applicable.
[1]All samples stored in ice after collection and in transport to laboratory except for low-level mercury.
[2]Refrigeration at 4ºC.
[3]Dissolved oxygen measured in situ.
[4]Calculated from pH, temperature, and ammonia nitrogen.

TABLE 7: RESPONSIBLE LABORATORIES AND METHOD STANDARD OPERATING PROCEDURE IDENTIFICATION

Parameter	Laboratory	Method SOP ID
Dissolved oxygen	Field measurement	HQd Oper. Instr.
Temperature	Field measurement	YSI Pro10 Oper. Instr.
pH	Field measurement	YSI Pro10 Oper. Instr.
Ammonia nitrogen	SAL	ST-NH3
Ammonia nitrogen, un-ionized[1]	Calculation	NA
Nitrate and nitrite nitrogen	SAL	ST-NO3/NO2
Kjeldahl nitrogen	SAL	ST-TKN
Phosphorus, total	SAL	ST-TP
Sulfate	EAL	JE-ANIONS
Total dissolved solids	SAL	ST-TDS
Suspended solids	SAL	ST-TSS/VSS
Volatile suspended solids	SAL	ST-TSS/VSS
Alkalinity	SAL	ST-Alk-Visco
Chloride	EAL	JE-ANIONS
Fluoride	EAL	JE-ANIONS
Organic carbon, total	IWAL	IW-TOC
Phenol	IWAL	IW-PHENOL-A
Cyanide, total	IWAL	IW-CN-AUTO
Cyanide, chlorine amenable	IWAL	IW-CN-AMEN
Chromium, hexavalent	IWAL	IW-CR6
Metals, total and dissolved (except mercury)	SAL	ST-ICPMS
Mercury, Low-Level	CAL	CaLLHg
Fecal coliform	AML	
n-Hexane extractable materials	IWAL	IW-FOG-SPE
Chlorophyll *a*	AEWQ	
Benzene, ethyl benzene, toluene, xylenes	OCAL	SOPEPA624
Organic priority pollutants	OCAL	SOPEPA624[2] SOPEPA625[3] SOPEPA608[4]

[1]Calculated from pH, temperature and ammonia nitrogen.
[2]Volatile organic compounds.
[3]Base/neutral and acid extractable compounds.
[4]Pesticides and PCBs.

B5: Quality Control

Field blanks will be used to evaluate the potential for contamination from a source not associated with the sample collected. Each sampling team will prepare field blanks for the appropriate parameters at a sampling location on the day of sampling. AEWQ will review the field blank test results. Whenever significant contamination (greater than twice the reporting limit of any constituent) is found, AEWQ will initiate an investigation and implement the necessary corrective actions.

The individuals responsible for verification that proper procedures are followed in matters concerning sampling methods, sample preservation, and sample custody to the delivery of samples to the SAL will be the Environmental Monitoring Manager and his/her supervisor. For more information please see sections B2: Sampling Methods, B3: Sample Handling and Custody, and C1: Assessment and Response Actions. For any quality control or other nonconformance issue, the Environmental Monitoring Manager will submit an investigation and corrective action report to the Project Manager, who will send copies to the persons listed on the approval page.

It shall be understood that all measurements, regardless of the sample concentration, must have known and satisfactory accuracy and precision. Because various analytical procedures will be employed for sample analysis, specific criteria for accuracy and precision will not be provided in this document. Rather, satisfactory accuracy and precision shall be considered to be that which is consistent with the USEPA approved methods used to analyze the samples. All measurements must be derived in an environment of an adequate quality control program including statistical process control wherever applicable. The laboratory Quality Assurance Manuals (QAMs) and laboratory SOPs should be referred to for specific information relating to quality control. The AML and each section of ALD have successfully maintained accredited status as certified by the IDPH and/or the IEPA following TNI standards.

The individuals responsible for verification that analytical methods and other laboratory procedures are being properly executed are the Laboratory Managers. The Laboratory Managers are also responsible for the reliability of project analytical data. For any quality control or other nonconformance issue that may have affected the reliability of project data, the responsible Laboratory Manager will submit an investigation and corrective action report to the Project Manager, who will send copies to the persons listed on the approval page.

B6: Instrument/Equipment Testing, Inspection, and Maintenance

All instrumentation and equipment used in the laboratory are maintained as required by the manufacturer's manuals and the laboratory SOPs.

Each laboratory is responsible for maintaining an adequate supply of spare parts to perform normal maintenance procedures. The three regional WRPs, at which the participating laboratories are located, maintain storerooms where frequently used supplies and consumables are inventoried. Major laboratory instrumentation is covered by maintenance/service contracts with qualified service representatives. Each laboratory also has an account to purchase any needed parts or consumables not inventoried in the WRP storeroom or in an emergency or other unforeseen situation.

The YSI Model Pro10 handheld pH/temperature meters and HACH Model HQ30d handheld dissolved oxygen meters (or similar model) used for field measurements are maintained by the AEWQ Section and routine maintenance is performed as needed. These instruments are calibrated for pH and dissolved oxygen in the laboratory before use. Calibration records are kept by the AEWQ laboratory. Sample collection personnel sign out a calibrated instrument on the day of sampling and return it on the same day after sampling. The meter operation and calibration are checked when each instrument is returned to the laboratory. The temperature calibration is verified at least annually against a NIST traceable thermometer. The SAL is responsible for securing service from qualified service representatives as needed.

B7: Instrument Calibration and Frequency

All instrumentation used for testing shall be calibrated each day of use as directed by manufacturer's manuals and laboratory SOPs. General guidelines and requirements regarding calibration of laboratory equipment are contained in the laboratory SOPs. Laboratories that participate in an accreditation program also will comply with the requirements for calibration maintained by the accreditation program.

All instrumentation is uniquely identified by serial number or other means. Wherever possible, NIST traceable standards are used for calibration of instruments. Calibration records are kept each time laboratory instrumentation and equipment are calibrated, and the calibration records and quality control samples are unmistakably identified for each batch of test results.

B8: Inspection/Acceptance of Supplies and Consumables

Supplies and consumables shall be inspected by the laboratories and accepted in accordance with all laboratory procedures and specifications contained in laboratory QAMs or SOPs. The laboratory section supervisors are responsible for verifying that supplies and consumables meet the specifications contained in the method SOPs.

B9: Non-direct Measurements

Non-direct measurements are not required for this project.

B10: Data Management

The District maintains several networked servers. The network may be accessed by personal computers and workstations from any District facility. Computer software used for this project includes a fully networked LIMS and Excel® software and SAS® software on selected workstations. The Thermo LabSystems SMW (SampleManager for Windows) version 10.2.0.0 is customized to incorporate procedures employed at District laboratories. The District LIMS supports numerous features including: barcode usage, prelogging of samples by either the sample submitter or laboratory personnel, label generation, sample login, sample receiving of prelogged samples, sample batching, instrument interfacing, manual data entry, automated calculations, control limit checking for each laboratory control sample, control chart maintenance, National Pollutant Discharge Elimination System (NPDES) limit checking, industrial waste limit checking, facilitated data handling, and data reporting. The LIMS is utilized by all laboratories participating in this project.

Most Ambient Water Quality Monitoring (AWQM) analytical data have resided in the District LIMS since 1996. Historical data back to 1970 are stored in Excel® spreadsheet files and SAS® files.

As the waterways are sampled routinely, the samples are prelogged into the District's LIMS. The Environmental Monitoring Manager generates sample labels for sample containers before sample collection. The labels contain information including sample location, sample type, and unique sample ID with barcode. Each sample container has a unique sample ID comprised of the sample number and aliquot designation.

The AML, AEWQ, and the OCAL follow documented procedures for sample login, sample acceptance, analysis, and data verification. Test data from the AML and AEWQ are manually entered into LIMS, while OCAL data is automatically uploaded from instrument to LIMS.

While the SAL employs the most computerized system for sample tracking and data handling, all participating laboratories follow similar procedures. The analyst assigned to receive the samples in the SAL uses a barcode scanner to log as received the "general chemistry" samples. All samples are checked and any missing sample containers are noted in the sample log. The analyst checks to make certain that sample acceptance criteria, including appropriate sample containers and thermal preservation, are satisfactory.

After the laboratory receives the samples, sub-samples are poured as required. The samples are then distributed to the appropriate analytical sections for analysis. As analyses are completed, the test results are entered into the LIMS generally by data file upload from the laboratory instrument. Test results are reviewed and verified by each analytical section supervisor.

Retesting for analytes is only done for a confirmed Quality Assurance/Quality Control (QA/QC) problem in the execution of analysis. No retesting will be performed on the basis of exceeding regulatory limits without consulting first with the sample submitter for information about any unusual conditions that would corroborate the test results. When such information is not available and a retest is requested, the sample submitter's authorization to conduct the retest should be in writing for documentation purposes. In those instances where retesting is performed for reasons other than a QC failure, then the highest confirmed value is reported unless otherwise specified above.

As sample analyses in the AML and ALD Laboratories are completed, the approved test data are collected from the LIMS database and transferred into an Excel® spreadsheet on a monthly basis. The Excel® spreadsheet includes all parameters, except for organics data, which are compiled in separate spreadsheets. Generally, analytical data from any month is expected to be completed and available to data users within 30 days after the end of that month.

The quarterly spreadsheet from the AML and ALD laboratories is checked by the LIMS Manager for completeness and atypical test data. When atypical test data are found, they are reported to the Project Manager for further investigation.

Annually, following final approval of all project data from the previous year, an Excel® spreadsheet file is sent to the SAS® Database Manager who creates a SAS® file from the Excel® spreadsheet. SAS® is the statistical analysis software used to analyze the data.

The Project Manager will ensure that an Excel® spreadsheet containing all approved project data from the previous year will be posted on the District's website by April 1 of the following year. The IEPA Division of Water Pollution Control Permit Section Manager will be notified by letter when this data is available online.

Project data will also be submitted on a biannual basis to the IEPA Quality Assurance Officer for their 305b Integrated Water Quality Report analysis. The Project Manager will consult the IEPA's website in order to comply with the data submittal due date and format requirements.

GROUP C: ASSESSMENT AND OVERSIGHT

C1: Assessment and Response Actions

Random surveillance of a sampling team is conducted by the Environmental Monitoring Manager to verify that water samples are being collected properly and sampling procedures are followed. The results of each surveillance are documented by the Environmental Monitoring Manager. As stated in Section B5, the Environmental Monitoring Manager and his/her supervisor will submit investigation and corrective action reports for all quality control and other nonconformance problems dealing with field procedures to the Project Manager with copies to the persons listed on the approval page of this QAPP.

All laboratories maintain internal quality control programs that are described in their QAMs. The ALD Laboratories maintain statistical process control for most analytical procedures. Laboratory assessment activities require investigation and corrective actions for all quality control problems and other nonconformance issues. As stated in Section B5, when the reliability of project data may have been affected by a quality control problem or other nonconformance issue, the responsible Laboratory Manager will submit a copy of the investigation and corrective action report to the Project Manager with copies to the persons listed on the approval page of this QAPP.

Also, the responsible Laboratory Manager shall make certain that the project data associated with any quality control or other nonconformance issue is made available to data users with the appropriate data qualification. When data previously released to data users may have been affected by a quality control problem or other nonconformance issue, the Manager shall notify data users of the problem and put in the appropriate data qualifiers in databases used by the District for storage of project data.

The SAL, CAL, EAL, and IWAL participate in two proficiency-testing studies each year. These proficiency studies are the semi-annual Water Pollution Study where data from the first study is combined with the National Pollutant Discharge Elimination System (NPDES) Discharge Monitoring Report Quality Assurance (DMR-QA) Study. The AML participates in Water Supply (WS) performance test samples that are analyzed every 12 months for fecal coliform bacteria to maintain IDPH certification and as part of the NPDES permit required DMR-QA microbiology study. Systematic investigations are conducted for all unacceptable results. The investigation and corrective action reports prepared by the Laboratory Manager and his/her staff are reviewed by the Assistant Director of M&R, by the QA Coordinator, and often by the Director of M&R.

The Organic Compounds Analytical Laboratory participates in two proficiency-testing studies each year and conducts investigations for unacceptable results in a manner similar to that followed by the other ALD Laboratories.

The AML is certified by the IDPH and must successfully pass a biannual on-site audit conducted by the IDPH.

All ALD laboratories as a requirement of their accreditation are audited annually by their Quality Assurance Coordinator and biannually by the IEPA.

C2: Reports to Management

The Project Manager will receive all investigation and corrective action reports concerning quality control problems and other nonconformance issues from field personnel and participating laboratories.

Project-related systems audits or special data quality assessments are undertaken on a random basis.

GROUP D: DATA VALIDATION AND USABILITY

D1: Data Review, Verification, and Validation

The laboratory data are reviewed and verified as described in Section B10, Data Management. The SAS® Database Manager also reviews the data after it is transferred into the SAS® software. If errors are discovered, he reports them to the Project Manager for investigation and resolution.

D2: Verification and Validation Methods

Sample collection records can be verified by the Environmental Monitoring Manager identified in Section A4. Laboratory data shall be verified as necessary by the LIMS Manager identified in Section A4 and the Laboratory Manager of the laboratory that produced the data. All field and laboratory records will be kept for a minimum of five years. Laboratory records that are stored include calibration data, raw data, bench records, and data for quality control samples.

When verification of data results in a change to the project-related data, the Project Manager shall inform data users of the problem and make certain that all databases known to contain the affected data are corrected as necessary.

The person designated as the Project Manager (Section A4) has all calculations used for checking applicable IPCB water quality standards. She should be consulted regarding any questions pertaining to compliance with water quality standards and the reporting of data.

The Project Manager and the QA Officer shall be informed of all situations where data integrity has been found compromised by errors including storage of incorrect data or the corruption of stored data. All responsible persons identified in Section A4 and all known data users shall be informed of data problems when they are discovered and the corrective action taken. The QA Officer shall prepare the disclosure report for distribution.

D3: Reconciliation with User Requirements

The QAPP shall govern the operation of the project at all times. Each responsible person shall adhere to the procedural requirements of the QAPP and ensure that subordinate personnel do likewise.

This QAPP shall be reviewed annually by the Project Manager to ensure that the project will achieve all intended purposes. The annual review shall address every aspect of the program including:

1. The adequacy and location of sampling stations.

2. The adequacy of sampling frequency at each location.

3. Sampling procedures.

4. The appropriateness of parameters monitored.

5. Changes in data quality objectives and minimum measurement criteria.

6. Whether the data obtained met minimum measurement criteria.

7. Analytical procedures.

8. Annual data submittal to IEPA and posting on-line.

9. Corrective actions taken during the previous year for field and laboratory operations.

10. Coordination of the project with the IEPA.

11. Review of other user requirements and recommendations.

It is expected that from time to time, ongoing and perhaps unexpected changes will need to be made to the project. Significant changes or deviations in project operation shall not be made without authorization by the Project Director. The Project Manager should be consulted if an operational change is necessary. Data users and other interested persons may also suggest changes to the project to the Project Manager.

The Project Manager shall evaluate the need for the change, consult with other responsible persons as appropriate, and make a recommendation to the Project Director for approval of significant changes (such as changes in sampling locations or frequency). The Project Manager shall, in a timely manner, inform the appropriate project personnel of approved changes in project operation. The Project Manager shall be responsible for the implementation of changes to the project and shall document the effective date of all changes made.

Following Project Director approval, a memorandum documenting each authorized significant change shall be prepared by the Project Manager and distributed to those on the approval list, as well as the Assistant Directors of the M&R Department. Approved changes shall be considered an amendment to the QAPP and shall be incorporated into the QAPP when it is updated.

The Project Manager will prepare a QAPP update if major changes have taken place.

REFERENCES

Standard Methods for the Examination of Water and Wastewater. Prepared jointly by the American Public Health Association, the American Water Works Association, and the Water Environment Federation. Published online at https://smww.aphapublications.org/. Accessed October 26, 2018.

State of Illinois Rules and Regulations, Title 35: Environmental Protection, Subtitle C: Water Pollution, Chapter I: Pollution Control Board. Published online at https://pcb.illinois.gov /SLR/IPCBandIEPAEnvironmentalRegulationsTitle35. Accessed November 1, 2018.

AMBIENT WATER QUALITY MONITORING PROJECT
QUALITY ASSURANCE PROJECT PLAN

APPENDIX I

SAMPLING PROCEDURES

WATERWAY SAMPLING

Bridge Sampling Procedures

1. Before sample collection day, scrub the stainless steel sampling bucket, stirrers, and DO sampling device with a solution of noninterfering residue-free critical cleaning liquid detergent and water. Rinse with de ionized water.

2. Samples should be collected from the upstream side of the bridge.

3. Before lowering any object such as a probe or bucket into the waterway, look both upstream and downstream to ensure there are no recreators, boats, or other obstructions below or approaching the bridge.

    a. When encountering recreators on the water, wait for them to pass. Allow them to clear the area with enough space so there is no risk of collision before attempting to take a sample.

    b. Give a warning blast with the provided air horn to alert possible recreators that you will be lowering an object into the waterway.

4. Samples may be collected from the District's Pollution Control (PC) boats if approved by the Environmental Monitoring Manager, when circumstances deem necessary. Boat sampling should not be performed in areas where sediment could be disturbed. When sampling from a District PC boat, the following steps should be followed:

    a. Ensure the PC boat is in the correct location and the engines/motors are in idle.

    b. Communicate with the Patrol Boat Operator to ensure it is safe to collect the sample.

    c. Collect the sample from the side of the PC boat, away from the propellers and exhaust.

5. Take the samples from a representative location at the center of the river at the deepest point. <u>DO NOT SAMPLE FROM THE BANK OF THE WATERWAY</u>.

6. If boat traffic is encountered when sampling from a navigable body of water, delay sampling until the unnatural turbulence caused by the vessel's wake subsides. Indicate in the "Remarks" section of the sample collection sheet that sampling was interrupted due to a passing vessel.

7. Upon arrival at each prescribed sampling location, the following steps should be followed:

    a. Collect samples routinely collected from pail. See Section A.

   b. Collect DO and bacterial samples with modified DO sampler. See Section B.

   c. When required, collect field blanks from pail. See Section C.

   d. When required, collect organics samples from pail. See Section D.

8. Complete the sample collection sheet as appropriate at each sampling location.

   a. Sample collection date.

   b. Sampler's name(s).

   c. Weather conditions during sampling (Example: Clear, Cloudy, Rain, Snow, Air Temperature, if possible).

   d. Type of aliquots obtained.

   e. Time aliquots were obtained.

   f. Sample dissolved oxygen as obtained with the handheld meter.

   g. Sample pH as obtained with the handheld meter.

   h. Sample temperature as obtained with the handheld meter.

   i. Sample storage temperature.

   j. In the "Remarks" column, describe visual observation of sample (Clear, Semi Clear, Lt. Sed., etc.), indicate if there was any passing boat traffic and any unusual observations of the waterway quality, such as oil, discoloration, or debris. Also provide the LIMS number.

   k. At the bottom of the collection sheet, a space is available for additional remarks.

9. Upon completion of the sampling assignment, immediately transport the samples to the laboratory for analysis.

10. Upon relinquishing the samples to the laboratory analyst, record the following pertinent information on the sample collection sheet to complete chain of custody requirements (Appendix II).

    a. Signature of transporter.

    b. Signature of the person who relinquished the sample.

    c. Signature of the laboratory analytical staff member who received the sample.

d. Time sample relinquished.

Section A: Routine Samples Collected in Pail

1. Using the handheld dissolved oxygen meter, lower the probe into the river/stream. Allow the probe to acclimate for one minute before obtaining a dissolved oxygen reading.

2. Properly identify (label) each sample container and arrange in order specified on sample trays.

3. Lower the clean stainless steel bucket into the river/stream water. Retrieve the bucket and immediately obtain a pH and temperature reading with the handheld meter.

4. Empty the bucket, lower and retrieve it two more times rinsing thoroughly to acclimate it to the waterway.

5. When sampling during precipitation events (rain or snow), cover the sample bucket at all times with the lid provided, except when the bucket is being raised or lowered from the bridge.

6. Whenever the sampling bucket is being raised or lowered from the bridge, give special attention to insure there is no contact with the bridge structure. If there is contact, discard the sample and start over. Also, make sure that the rope does not come in contact with the ground. Place the rope into the gray, plastic container.

6. Only after acclimating the sampling bucket three times should the actual sample be obtained. After the sample is obtained, stir the sample with the stirring rod 5x in one direction and then 5x in the other direction. Pour it into the individual sample aliquot bottles filling the aliquot bottles half way from right to left. Then stir the sample water in the bucket with the same procedure as above to ensure a homogeneous distribution of suspended solids and finish filling the bottles from left to right.

7. Samples to be collected and order in trays:

   a. General chemistry sample: 1 gallon (wide mouth plastic) container.

   b. Alkalinity, chloride sample: plastic 250 mL container, fill to shoulder.

   c. Cyanide sample: fill the plastic half gallon container (containing 5 mL of 50% NaOH preservative) to shoulder.

   d. Phenol sample: fill the glass sample bottle to the shoulder; exercise CAUTION as bottle contains 2 mL of sulfuric acid as a preservative. Do not breathe the vapors that may be emitted by the sulfuric acid preservative.

   e. Dissolved metals sample: fill a 900 mL certified clean, plastic bottle.

f. Total organic carbon: fill a 250 mL plastic bottle.

g. Trace metals sample: fill 8 oz. plastic bottle. Leave approximately l/4 inch air space at top of bottle. NOTE: The bottle contains 2 mL of nitric acid. (Overfilling may cause a loss of preservative.)

h. Sulfate: fill a 250 mL square plastic bottle.

i. Total Phosphorus, Total Kjeldahl Nitrogen: fill a 250 mL plastic bottle to the shoulder; exercise CAUTION as bottle contains 0.3 mL sulfuric acid as a preservative. Do not breathe the vapors that may be emitted by the sulfuric acid preservative

j. Fluoride: fill a 250 mL plastic bottle to the shoulder.

k. Ammonia, NO2+NO3: fill a 250 mL polyethylene bottle to the shoulder; exercise CAUTION as bottle contains 0.3 mL sulfuric acid as a preservative. Do not breathe the vapors that may be emitted by the sulfuric acid preservative.

l. Chlorophyll *a*: fill an opaque, brown 1 liter bottle (obtained from Room LE213). Leave approximately 1/2 inch air space at top of bottle.

m. n-Hexane extractable materials sample: fill two glass quart jars.

8. After all the sample aliquots have been poured off, rinse the sample bucket and stirring rod with deionized water.

9. Place each sample aliquot into the 72-quart thermal ice chest filled from 1/3 to 1/2 full of ice cubes. Insure the sample bottles are surrounded in ice.

Section B: Bacterial Samples

The bacterial sample is collected using a specialized sampler that has been modified to hold the bacterial sample container. The bacterial sample is collected as follows:

1. The bacterial container is a sterilized 4 oz. plastic bottle with foil covered plastic screw cap.

2. Do not open bacterial bottle until sampling, and replace foil covered plastic cap as soon as possible.

3. Care should be taken not to touch the neck or the mouth of the bacterial bottle, or the inside of the plastic cap to prevent contamination of the sample.

4. Insert bacterial bottle into the compartment attached to the outside of the sampling device making sure not to allow the top of the bottle to touch any part of the sample can.

5. Slowly lower the sampling device with the bacterial bottle into the waterway to the depth of approximately 3 feet from the surface.

6. Raise the sampling device when all the air bubbles have stopped rising.

7. Remove the bacterial bottle from the sampling device.

8. Obtain a second bacterial bottle, label, and then remove the foil-covered cap without removing the foil from the cap.

9. Care should be taken not to touch the neck or the mouth of the bottle, or the inside of the plastic cap to prevent contamination of the sample.

10. Pour the aliquot obtained with the sampling device into the second bacterial bottle. Fill the bottle approximately 80 percent full. DO NOT OVERFILL.

11. Close the bottle with the foil-covered cap and place the sample into the cooler on ice

12. Return the bacterial bottle used to collect the sample to the Microbiology Laboratory.

13. Place the sample into the cooler on ice.

14. Complete appropriate entries on sample collection sheet.

Section C: Field Blanks

Field blank assessments will be conducted on a quarterly basis at sampling locations at the end of each sampling trip as determined by the Environmental Monitoring Manager. A minimum of one sample for each sampling trip will be collected. Field blanks are used to verify the proper decontamination of field sampling equipment between sampling locations. Field blanks will be analyzed, and any sample result that is greater than twice the reporting limit will be considered to have significant contamination. Following a result of significant contamination, an investigation to determine the source of the contamination will be conducted by the Environmental Monitoring Manager, and corrective action will be taken. Field blanks are prepared as follows:

1. Properly identify (label) each sample container and arrange in order specified on sample trays.

2. Fill the stainless steel bucket two-thirds full with reagent water obtained from the laboratory.

3. Proceed with the filling of the sample containers as is done in Section A, refilling the bucket as necessary to fill all sample containers.

4. Place samples into cooler on ice.

5. Complete sample collection sheet as appropriate.

Section D: Organics Samples

Organic priority pollutants (OPP) and BETX (benzene, ethylbenzene, and total xylenes) samples are collected as follows:

1. The amber-colored glass containers provided by the OCAL must be used for BETX and OPP samples. These containers contain a preservative and should not be rinsed prior to filling.

2. OPP samples require one (1) gallon bottle and three (3) vials per sampling location.

3. BETX samples require three (3) vials per sampling location.

4. Each sampling team will transport a clearly marked, "Trip Blank" sample, consisting of two (2) amber vials filled with Milli-Q de-ionized water, with the other organic samples collected during the sampling trip.

5. Obtain a water sample in the stainless steel pail and fill sample containers.

6. When filling the containers care should be taken to minimize air bubbles in the sample container. Gallons and vials are to be filled to the top with minimal overflow. A slight bulge of water at the neck of the container caused by surface tension should be evident at the time the cap is tightened to insure elimination of excess air.

7. Place samples into cooler on ice.

8. Complete sample collection sheet as appropriate.

9. After transport to the laboratory, store the samples in the laboratory cooler for later transportation to the Organic Compounds Analytical Laboratory by the afternoon transporter.

Section E: Low Level Mercury Samples

Low level Mercury (LLHg) samples and equipment blanks are collected as follows:

1. Obtain the labeled LLHg sampling kit provided by CAL. The sampling kit contains four pairs of clean gloves, four 40 mL sample vials, two empty 40 mL equipment blank vials, and three 40 mL equipment blank vials filled with reagent water.

2. Do not expose the sample to anything that may contain significant amounts of mercury. Potential contamination sources: Sampling equipment, bailers, sampling tubing (including peristaltic pump tubing), gloves, clothing, bottles, exhaled breath from mercury amalgam fillings, precipitation, dirt, dust and airborne vapor.

3. Collect LLHg samples according to the following procedure:

    a. Obtain a water sample in the stainless steel pail.

    b. Sampler #1: Put on clean gloves and sufficient protective clothing to ensure dust and debris is not transferred from the person to the sample.

    c. Sampler #2: Put on clean gloves and sufficient protective clothing to ensure dust and debris is not transferred from the person to the sample. Do not touch anything that may contaminate your gloves.

    d. Sampler #1: Set up sampling equipment, open cooler, remove double bagged bottle kit from cooler and its bubble pack bag, open outer bag and hold it open so sampler #2 can reach inside.

    e. Sampler #2: Do not touch the outer bag. Open the inner bag, remove one 40 mL vial from the bag, remove the cap and fill with water sample to the top, screw cap onto vial and return filled vial to the innermost bag. There is no need to rinse the bottle or add a preservative. Repeat until 4 vials have been filled from the same sampling point. Close the zip lock seal most of the way, squeeze the inner bag to expel most of the air, complete the seal, push the inner bag inside the outer bag.

    f. Sampler #1: Close the outer bag zip lock seal most of the way, squeeze the bag to expel most of the air, complete the seal. Place the double bagged bottle kit in the bubble pack bag, remove the adhesive strip cover and seal the bubble bag closed. Place the kit in the cooler. NOTE: LLHg samples should <u>not</u> be placed on ice.

4. Collect LLHg equipment blanks according to the following procedure:

    a. Sampler #1: Put on clean gloves and sufficient protective clothing to ensure dust and debris is not transferred from the person to the sample.

b. Sampler #2: Put on clean gloves and sufficient protective clothing to ensure dust and debris is not transferred from the person to the sample. Do not touch anything that may contaminant your gloves.

c. Sampler #1: Open cooler, remove double bagged kit labeled equipment blank bottle kit from cooler and its bubble pack bag, apply client label to the outer zip lock bag, open outer bag and hold it open so the clean hands person can reach inside.

d. Sampler #2: Do not touch the outer bag. Open the inner bag, remove one full 40 mL vial from the bag, and one empty 40 mL vial, remove the caps and pour the reagent water from one vial into the other under the same conditions to which regular samples were exposed, screw caps onto vials and return filled vial to the innermost bag discard the empty vial. There is no need to rinse the bottle or add a preservative. Repeat until 2 vials have been filled. There is an extra filled reagent water vial in case a spill occurs, discard if not needed. Close the zip lock seal most of the way, squeeze the inner bag to expel most of the air, complete the seal, push the inner bag inside the outer bag.

e. Sampler #1: Close the outer bag zip lock seal most of the way, squeeze the bag to expel most of the air, complete the seal. Place the double bagged bottle kit in the bubble pack bag, remove the adhesive strip cover and seal the bubble bag closed. Place the kit in the cooler. NOTE: LLHg equipment blanks should not be placed on ice.

5. Complete sample collection sheet as appropriate.

Materials Required for Sampling

1. Labels: generated adhesive-backed labels with identifying LIMS barcode.

2. Bottles (per station; note: a field blank will require an additional set of sample containers a through l).

   a. Gallon (polyethylene) – General chemistry.

   b. 250 mL rectangular (polyethylene) – Alkalinity, chloride.

   c. 1/2 Gallon (polyethylene) – Cyanide.

   d. Quart (glass) – Phenol.

   e. 900 mL (polyethylene – certified clean) – Dissolved metals.

f. 250 mL rectangular (polyethylene) – Total organic carbon.

g. 8 oz. (polyethylene) – Trace metals (total).

h. 250 mL rectangular (polyethylene) – Sulfate and Fluoride.

i. Two quarts (glass) – n Hexane extractable materials (2).

j. 250 mL rectangular (polyethylene) Total Phosphorus, Total Kjeldahl Nitrogen, Ammonia, NO2+NO3.

k. Mercury Kit (General Use waters only; see Appendix I, Section E).

l. 1 liter brown, opaque (plastic) – Chlorophyll *a*.

m. Two 4 oz. (polypropylene w/foil covered stopper) – Fecal coliform.

n. Three 40 mL vials (amber colored glass) – BETX.

o. Three 40 mL vials (amber colored glass); and 1 gallon (glass) – Organic priority pollutants.

3. Sampling Devices.

   a. 13-quart stainless steel bucket and lid.

   b. Stainless steel special sampling device. Attached to this device is a stainless steel holder for a bacti bottle.

   c. Portable handheld electronic dissolved oxygen meter.

   d. Portable handheld electronic pH and temperature meter.

   e. Sufficient length of 3/8 inch nylon rope (approximately 100 feet).

4. Miscellaneous.

   a. Waterway Field Collection Sheet, for locations to be sampled.

   b. 72 quart ice chests as needed.

   c. Ice.

   d. Gray plastic container for storage of sampling rope during sampling events.

   e. Wood tray to hold sample bottles with each compartment labeled with name of the sample bottle in the order the aliquot will be poured off.

   f. Stainless steel stirring rod.

   g. Two carboys of reagent water.

Safety

1. Always wear appropriate personal protective equipment while sampling such as:

   a. Gloves, eye protection, long pants, closed-toed shoes, personal flotation device, and high-visibility vest.

2. Use proper lifting technique to avoid injury. Take breaks when necessary and work as a team to distribute work evenly.

3. Be prepared for the weather conditions and dress appropriately.

   a. Drink plenty of water

   b. Apply sunscreen.

   c. Wear light clothes during hot weather and dress in warm layers during cold weather (District-issued uniform).

   d. Wear rain gear during wet weather.

4. Be aware of road conditions and take necessary precautions to avoid accidents.

5. When sampling during winter months, do not attempt to sample if the waterway is frozen. Do not walk on the ice. Indicate the circumstances on the sample collection sheet.

6. When sampling from a bridge, be aware of the following safety concerns:

   a. DO NOT park District vehicle on a bridge. Attempt off-road parking, if possible.

   b. Use rotating lights on the vehicle when stopped.

   c. When parking on the road, use safety cone markers.

7. When sampling from one of the District's Patrol boats, be aware of the following safety concerns:

   a. Adhere to all the Section 126 rules regarding PC boat crew safety.

   b. Wear the issued personal floatation device.

   c. Be aware of deck conditions. Spray from the boat can cause the deck to become wet and slippery in during warm weather and icy during cold weather.

8. Sampling may be cancelled due to road/bridge closures or if weather conditions are determined to be dangerous such as: extreme heat, extreme cold, icy conditions, excessive fog, or any other conditions determined by the Environmental Monitoring Manager.

AMBIENT WATER QUALITY MONITORING PROJECT
QUALITY ASSURANCE PROJECT PLAN

APPENDIX II

SAMPLE COLLECTION SHEET

#3 WEEK 1

Des Plaines River Watershed

DATE COLLECTED: ____________________ COLLECTED BY: ____________________ WEATHER: ____________________

DATA CODE	LOCATION	TIME	TEMPERATURE	GEN. CHEM.	F.O.G.	ALK / CL	CYN.	PHEN.	T.M.	SOL. T.M.	Cr+6	BACT	D.O.	RAD.	TOC	PRIORITY POLL.	SO4	CHLOROPHYLL a	LACHAT	LOW LEVEL Hg	pH	REMARKS
79	Salt Creek, Upstream of Egan WRP at Higgins Road																				6.5-9.0	LIMS#
18	Salt Creek at Devon Ave																				6.5-9.0	LIMS#
110	West Br. DuPage Riv. at Springinsguth Rd. Upstream of Hanover WRP																				6.5-9.0	LIMS#
	EQUIPMENT BLANK																					LIMS#
111	West Br. DuPage River at Arlington Rd Downstream of Hanover WRP																				6.5-9.0	LIMS #
																					6.5-9.0	LIMS #

STORED AT 4°C YES ______ NO ________ IN CUSTODY OF ____________________ METER # ____________
TRANSPORTED BY: ____________________ VEHICLE # ____________
RELINQUISHED BY: ____________________ DATE: ____________ TIME: ____________
RECEIVED BY LABORATORY: ____________________ DATE: ____________ TIME: ____________
RELINQUISHED BY SAL LAB: ____________________ RECEIVED BY: ____________

ATTACHMENT A: LABORATORY REPORTING LIMITS AND ILLINOIS POLLUTION CONTROL BOARD MINIMUM MEASUREMENT CRITERIA

Parameter	Reporting Limit (RL)	Minimum Measurement Criteria
Dissolved oxygen	NA	0.1 mg/L[1]
Temperature	NA	0.1 degree C[1]
pH	NA	0.1 pH unit[1]
Ammonia nitrogen	0.3 mg/L	15.0 mg/L
Ammonia nitrogen, un-ionized[2]	NA	0.1 mg/L[3]
Nitrate and nitrite nitrogen	0.25 mg/L	No standard
Kjeldahl nitrogen	1 mg/L	No standard
Phosphorus, total	0.15 mg/L	No standard
Sulfate	1.0 mg/L	500 mg/L
Total dissolved solids	25 mg/L	No standard
Suspended solids	4 mg/L	No standard
Volatile suspended solids	NA	No standard
Alkalinity	10 mg/L	No standard
Chloride	1.0 mg/L	500 mg/L
Fluoride	0.1 mg/L	15 mg/L[4]
Organic carbon, total	1 mg/L	No standard
Phenol	0.005 mg/L	0.1 mg/L
Cyanide, total	0.005 mg/L	0.1 mg/L[3]
Cyanide, chlorine amenable	0.001 mg/L	0.022 mg/L
Arsenic, total	0.001 mg/L	0.36 mg/L[3]
Barium, total	0.001 mg/L	5.0 mg/L[3]
Boron, total	0.005 mg/L	40.1 mg/L[5]
Calcium, total	0.5 mg/L	No standard
Chromium, trivalent[6]	0.002 mg/L	1.0 mg/L[3]
Chromium, hexavalent	0.003 mg/L	0.016 mg/L
Magnesium, total	0.5 mg/L	No standard
Manganese, total	0.001 mg/L	1.0 mg/L[3]
Mercury, total	0.0002 mg/L	0.0005 mg/L[3]
Mercury, low level, total	0.0005 µg/L	0.012 µg/L[7]
Selenium, total	0.002 mg/L	1.0 mg/L
Silver, total	0.002 mg/L	0.005 mg/L
Arsenic, dissolved	0.001 mg/L	340 µg/L
Cadmium, dissolved	0.001 mg/L	19.5 µg/L[4]
Chromium, dissolved	0.002 mg/L	968 µg/L[4]
Copper, dissolved	0.001 mg/L	27.3 µg/L[4]
Iron, dissolved	0.010 mg/L	0.5 mg/L[3]

ATTACHMENT A (Continued): LABORATORY REPORTING LIMITS AND ILLINOIS POLLUTION CONTROL BOARD MINIMUM MEASUREMENT CRITERIA

Parameter	Reporting Limit (RL)	Minimum Measurement Criteria
Lead, dissolved	0.001 mg/L	160 µg/L[4]
Mercury, dissolved	0.2 µg/L	1.2 µg/L
Nickel, dissolved	0.001 mg/L	148 µg/L[4]
Silver, dissolved	0.002 mg/L	11.4 µg/L[4,8]
Zinc, dissolved	0.005 mg/L	215 µg/L[4]
Fecal coliform	10 cfu/100 mL	200 cfu/100 mL[5]
n-Hexane extractable materials	3 mg/L	15 mg/L[3]
Chlorophyll *a*	1 µg/L	No standard
Benzene	2 µg/L	310 µg/L
Ethyl benzene	2 µg/L	150 µg/L
Toluene	2 µg/L	2,000 µg/L
Xylenes	3 µg/L	920 µg/L
Organic priority pollutants[10]	Variable[11]	No standards

NA = Not applicable.
[1]Required sensitivity.
[2]Calculated from pH, temperature, and ammonia nitrogen. Significant figures for pH, temperature, and ammonia nitrogen allow calculation to 0.01 mg/L.
[3]Indigenous Aquatic Life Use water quality standard only.
[4]Calculated standard based on a minimum water hardness of 200 mg/L as $CaCO_3$.
[5]General Use water quality standard only.
[6]Trivalent chromium measured as total chromium.
[7]Human Health Standard.
[8]CAWS A and B Aquatic Life Use water quality standard only.
[9]RL varies with total solids concentration of the sample
[10]Organic priority pollutants are identified in 40 CFR Part 122, Appendix D, Table II as amended.
[11]The RLs will be provided in the data report.

ATTACHMENT B: SAMPLING FREQUENCY

Station	Description	General Sampling[1]	n-Hexane Extractable Materials	BETX[2]	OPPs
96	Albany Avenue, North Branch Chicago River	Monthly 2nd Mon.		Bimonthly	Semiannually
112	Dempster Street, North Shore Channel	Monthly 2nd Mon.		Bimonthly	Semiannually
36	Touhy Avenue, North Shore Channel	Monthly 2nd Mon.		Bimonthly	Semiannually
37	Wilson Avenue, North Branch Chicago River	Monthly 2nd Mon.		Bimonthly	Semiannually
73	Diversey Parkway, North Branch Chicago River	Monthly 2nd Mon.		Bimonthly	Semiannually
100	Wells Street, Chicago River	Monthly 3rd Mon.		Bimonthly	Semiannually
108	Loomis Street, South Branch Chicago River	Monthly 3rd Mon.		Bimonthly	Semiannually
99	Archer Avenue, South Fork South Branch Chicago River	Monthly 3rd Mon.	Monthly 3rd Mon.	Bimonthly	Semiannually
75	Cicero Avenue, Chicago Sanitary & Ship Canal	Monthly 3rd Mon.		Bimonthly	Semiannually
41	Harlem Avenue, Chicago Sanitary & Ship Canal	Monthly 3rd Mon.		Bimonthly	Semiannually
48	Stephen Street, Chicago Sanitary & Ship Canal	Monthly 3rd Mon.		Bimonthly	Semiannually
92	Lockport Powerhouse Chicago Sanitary & Ship Canal	Weekly Every Mon.		Bimonthly	Semiannually

ATTACHMENT B (Continued): SAMPLING FREQUENCY

Station	Description	General Sampling[1]	n-Hexane Extractable Materials	BETX[2]	OPPs
86	Burnham Avenue, Grand Calumet River	Monthly 4th Mon.		Bimonthly	Semiannually
56	Indiana Avenue, Little Calumet River	Monthly 4th Mon.		Bimonthly	Semiannually
76	Halsted Street, Little Calumet River	Monthly 4th Mon.		Bimonthly	Semiannually
57	Ashland Avenue, Little Calumet River	Monthly 4th Mon.		Bimonthly	Semiannually
59	Cicero Avenue, Calumet-Sag Channel	Monthly 4th Mon.		Bimonthly	Semiannually
43	Route 83, Calumet-Sag Channel	Monthly 4th Mon.		Bimonthly	Semiannually
19	Belmont Avenue, Des Plaines River	Monthly 1st Mon.		Bimonthly	Semiannually
22	Ogden Avenue, Des Plaines River	Monthly 1st Mon.		Bimonthly	Semiannually
23	Willow Springs Road, Des Plaines River	Monthly 1st Mon.		Bimonthly	Semiannually
91	Material Service Road, Des Plaines River	Monthly 1st Mon.		Bimonthly	Semiannually
110	Springinsguth Road, West Branch DuPage River	Monthly 1st Mon.		Bimonthly	Semiannually
111	Arlington Drive, West Branch DuPage River	Monthly 1st Mon.		Bimonthly	Semiannually

ATTACHMENT B (Continued): SAMPLING FREQUENCY

Station	Description	General Sampling[1]	n-Hexane Extractable Materials	BETX[2]	OPPs
79	Higgins Road, Salt Creek	Monthly 1st Mon.		Bimonthly	Semiannually
18	Devon Avenue, Salt Creek	Monthly 1st Mon.		Bimonthly	Semiannually
109	Brookfield Avenue, Salt Creek	Monthly 1st Mon.		Bimonthly	Semiannually
77	Elmhurst Road, Higgins Creek	Monthly 1st Mon.		Bimonthly	Semiannually
78	Wille Road, Higgins Creek	Monthly 1st Mon.		Bimonthly	Semiannually

[1]The parameters included in the general sampling performed monthly include temperature, pH, dissolved oxygen, fecal coliform, total metals, soluble metals, hexavalent chromium, ammonia nitrogen, combined nitrate and nitrite nitrogen, Kjeldahl nitrogen, total phosphorus, total cyanide, cyanide amenable to chlorination, phenol, alkalinity, chloride, fluoride, turbidity, total dissolved solids, total suspended solids, total organic carbon, and chlorophyll *a*. General sampling excluded oil and grease, *E. coli*, BETX, and priority organics.

[2]BETX = benzene, ethyl benzene, toluene, and xylenes.

APPENDIX 3B

CONTINUOUS DISSOLVED OXYGEN MONITORING PROGRAM – QUALITY ASSURANCE PROJECT PLAN

CONTINUOUS DISSOLVED OXYGEN MONITORING QUALITY ASSURANCE PROJECT PLAN

Revision 2.1

Effective Date: July 1, 2016

Organization:	Metropolitan Water Reclamation District of Greater Chicago Department of Monitoring and Research
Address:	100 East Erie Street Chicago, Illinois 60611-2803
Telephone:	(312) 751-5190

GROUP A: PROJECT MANAGEMENT

A1: Approval Sheet:

_______________________________ Date 3/31/16
Thomas Granato
Director of Monitoring and Research

_______________________________ Date 3-28-16
Thomas Minarik
Senior Aquatic Biologist
Monitoring and Research

_______________________________ Date 3/28/16
John McNamara
Quality Assurance Coordinator
Monitoring and Research

A2: TABLE OF CONTENTS

A3: Distribution List

A copy of this Quality Assurance Project Plan (QAPP) will be distributed to each person signing the approval sheet and each person involved with project tasking identified in Section A4. A copy of this QAPP shall be available on request to any person participating in the project from any of the personnel listed in Section A4. Persons not employed by the Metropolitan Water Reclamation District of Greater Chicago (District) may obtain a copy of this QAPP from the District website under the "M&R Data and Reports" section.

As this document will be updated periodically, the reader is advised to check with the Network Coordinator for the latest revision if the version is more than one-year old. Revision 2.1 has been prepared following the United States Environmental Protection Agency guidance document EPA QA/R-5 titled "EPA Requirements for Quality Assurance Project Plans," March 2001.

A4: Project/Task Organization

The responsible persons for project management are:

Project Director:
Thomas Granato
Director of Monitoring and Research

Project Manager:
Thomas Minarik
Senior Aquatic Biologist

Network Coordinator:
Jennifer Wasik
Supervising Aquatic Biologist

Field Operations Manager:
Nick Kollias
Assistant Aquatic Biologist

Quality Assurance Officer:
John McNamara
Quality Assurance Coordinator

Figure 1 is the organization chart for the project. Primary lines of communication are shown as dashed lines. However, within the District, communication between any of the project participants may occur and is in fact encouraged as questions or issues arise.

Overall, project planning, including the selection of monitoring locations, is performed jointly by the Project Director, the Project Manager, and the Network

Coordinator. The Project Director is responsible for project staffing, funding, and the proper execution of the entire project. The Network Coordinator oversees the execution of routine project activities, resolves major deviations from procedures, assists in the final review of project reports and the QAPP.

The Project Manager coordinates day-to-day project activities, resolves minor deviations from procedures and ordinary quality control problems, supervises the data review, statistical analysis, management of the project database, preparation of project reports, and prepares and updates the QAPP.

The Field Operations Manager is responsible for the execution of field activities. A field team deploys the monitors, collects and preserves samples, makes field measurements, and transports the retrieved monitors and collected samples to the Aquatic Ecology and Water Quality Section. These activities are primarily done by boat, but certain monitoring stations require a land-based team. Two days each week are scheduled to retrieve and deploy the monitors at various monitoring stations.

The Aquatic Ecology and Water Quality Section maintains and calibrates the water quality monitors, downloads collected data from the monitors, and assists in the cross-sectional dissolved oxygen (DO) profiling performed at each monitoring location each spring, summer and fall. The Project Manager oversees the fabrication, installation, and maintenance of the protective housing needed for field deployment of the water quality monitors. An aquatic biologist (biologist) oversees field deployment and retrieval of the water quality monitors, reviews monitoring data for abnormalities, prepares time series plots of DO data, and directs the laboratory's quality control program.

The Quality Assurance (QA) Officer is responsible for oversight of quality control for the project and reviewing the QAPP.

A5: Problem Definition/Background

The Chicago Area Waterway System (CAWS) was designed in the 19th century to convey Chicago's sewage and stormwater away from Lake Michigan, Chicago's primary source of drinking water. This was accomplished by the construction of the Chicago Sanitary and Ship Canal (CSSC) and the reversal of the flow in the Chicago River and South Branch Chicago River. Instead of flowing into Lake Michigan, the Chicago River and South Branch Chicago River now flow into the CSSC. The CSSC collects the area's treated sewage effluents and stormwater runoff and carries it into the Des Plaines River at the canal juncture south of Lockport. Major waterways in the CAWS include the North Shore Channel, the Chicago River, the North and South Branches of the Chicago River, the CSSC, Calumet River, Grand Calumet River, Little Calumet River, and the Calumet-Sag Channel. The District service area, including the CAWS is shown in Figure 2.

The data from this project will be used in conjunction with other District projects to determine overall water quality of the waterway system. These other projects include the Ambient Water Quality Monitoring project, which analyzes inorganic and organic parameters at 28 monitoring locations, and a biological survey project that assesses biological health by monitoring the diversity of biological species and their abundance at various locations in the waterway system.

The continuous DO monitoring data from the CAWS are also provided to the Illinois Environmental Protection Agency (IEPA) on a quarterly basis, as required by the District's National Pollutant Discharge Elimination System (NPDES) permits for the O'Brien and Calumet Water Reclamation Plants (WRPs).

A6: Project/Task Description

Currently, DO and water temperature is monitored at 19 locations in nine Chicago area waterways. The monitored waterways include the following rivers, man-made channels, and canals:

Chicago Waterway System
- North Shore Channel
- North Branch Chicago River
- South Branch Chicago River
- Bubbly Creek (South Fork South Branch Chicago River)
- Chicago Sanitary and Ship Canal

Calumet Waterway System
- Little Calumet River
- Calumet-Sag Channel

Des Plaines Waterway System
- Des Plaines River
- Salt Creek

The CDOM program was initiated at 20 locations during the summer of 1998. These monitoring locations were concentrated on the North Shore Channel, the North Branch Chicago River, the Chicago River, the South Branch Chicago River, Bubbly Creek, the CSSC, and the Calumet-Sag Channel. The monitoring location on the Des Plaines River at Jefferson Street, Joliet, and the location on the Chicago River at the Chicago River Lock and Michigan Avenue were added in 2000. An additional 11 monitoring locations were added in 2001. These included additional locations on the Calumet-Sag Channel and locations on the Grand Calumet River, the Little Calumet River, and the Calumet River. An additional Bubbly Creek monitoring location at 36th Street was added in 2002. During 2004 a monitoring location was added at Foster Avenue on the North Shore Channel. During 2005 an additional 11 monitoring locations were added. These locations monitor Salt Creek and additional reaches of the Des Plaines River, Grand Calumet River, Little Calumet River, and North Branch Chicago River. During 2011, the CDOM program was reassessed and reduced to a total of 18 stations, 13 in the deep draft and five in wadeable locations. In 2014 the deep draft location at Cicero Avenue on the Calumet-Sag Channel was reactivated.

Descriptions of all monitoring locations, both active and inactive, are provided in Tables 1, 2, and 3. Table 1 lists all monitoring locations and service history. Table 2 shows the latitude and longitude of each monitoring location. Table 3 gives the IPCB waterway classification and IPCB DO water quality standard at each monitoring location. Figure 2 is a map showing the active monitoring locations.

The locations of the monitoring stations are reviewed at least annually. Monitoring location changes may occur over time for logistical or safety reasons, or to respond to different monitoring objectives that may arise.

A7: Quality Objectives and Criteria for Measurement Data

Measurement data must be accurate enough to determine compliance with the applicable IPCB DO water quality standards. The DO standards are stated to tenths of a milligram per liter (mg/L). Therefore, measurements of DO should be accurate to ± 0.1 mg/L.

The IPCB water quality standards for temperature specify the maximum allowable water temperature and maximum allowable temperature rises resulting from, for example, the discharge of heated effluents. These standards are stated in degrees Fahrenheit (°F), or to tenths of degrees Celsius (°C) following conversion of the standard from degrees F to degrees C. While these standards are presently not a primary concern of this project, temperature measurements to ± 0.5°C or less are necessary to ensure the accuracy of the recorded DO measurements, as these measurements are affected by temperature.

A8: Special Training/Certification

The tasking of the project has been assigned to personnel with appropriate job classifications. Project personnel are trained on the job to perform their assigned technical activities. No additional special training or certifications are required for the project.

A9: Documents and Records

Project Data and Reports

The Network Coordinator maintains the following project records and reports:

1. Monitoring data are stored in a custom designed Microsoft® SQL Server 2014 database. The DO database is backed up weekly.

2. Field observations performed during monitor retrieval and deployment are stored electronically in an Excel® spreadsheet.

3. Laboratory calibration and maintenance records are stored electronically in an Excel® spreadsheet.

4. Seasonal cross-sectional DO surveys at each monitoring station are stored electronically in an Excel® spreadsheet.

5. Statistical summary tables and graphs depicting hourly data are prepared weekly with Excel® software.

Other Reports and Communications

1. The Network Coordinator shall retain copies of all correspondence related to the transmittal of project data to the IEPA and retain electronic copies of data transmittals.

2. The Project Manager and Network Coordinator shall retain copies of annual M&R reports pertaining to continuous DO monitoring.

3. The Network Coordinator and QA Officer shall retain copies of all annual updates and revisions of this QAPP.

4. The Network Coordinator shall retain copies of all sampling procedures and analytical procedures used for collection and analysis of project samples.

5. The Network Coordinator and Project Manager shall retain copies of all laboratory analytical reports and correspondence with other laboratories.

6. The Project Manager and Network Coordinator shall retain copies of all management reports pertinent to continuous DO monitoring.

7. The Project Manager and Network Coordinator shall retain copies of all communications pertinent to continuous DO monitoring to and from outside agencies and other interested parties.

All of the records and reports listed above will be retained for a minimum of ten years at the Cecil Lue-Hing Research and Development Complex located at the Stickney WRP.

GROUP B: DATA GENERATION AND ACQUISITION

B1: Sampling Process Design (Experimental Design)

Selection of Monitoring Locations

Forty-eight locations have been selected for DO monitoring in the Chicago area waterways (Table 1) since the inception of this project. Of these, 19 are currently actively monitored. The criteria used to select these locations were:

1. A history of low DO levels,

2. Above and below the confluence of major waterways,

3. Proximity to an artificial aeration station,

2. Above and below the major WRPs,

5. Below pumping stations, such as the North Branch and Racine Avenue, and below discretionary Lake Michigan diversion locations,

6. Proximity to ambient biological monitoring locations.

To ensure the suitability of a sampling location, cross-sectional DO profiles are made at each site to verify the uniformity of DO concentrations. Uniform cross-sectional DO at a monitoring location is necessary to ensure that representative DO measurements could be obtained from a single DO monitor. Cross-sectional DO profiles are routinely repeated three times each year (spring, summer, and fall) at each monitoring location to verify that cross-sectional uniformity of DO concentrations has been maintained.

Monitoring locations may be added or removed from the monitoring network based upon periodic assessments of monitoring needs and available resources. Table 1 shows the monitoring history of monitoring locations used for this project.

Measurement Frequency

The DO concentration at any point in a waterway is subject to many influences. Measurements taken at infrequent intervals, such as weekly or even daily, may be insufficient to adequately characterize fluctuations that may occur during wet weather events or diurnal fluctuations that may occur in wadeable waterways. Previous monitoring has shown that hourly measurements will record these changes and allow for a more comprehensive understanding of DO behavior in the Chicago area waterways. After CDOM has been conducted for a suitable amount of time at a given station, it may not be necessary to continue such intensive monitoring until conditions change in that waterway due to operational upgrades, completion of reservoirs, or changes in lake diversion amounts, for instance.

Parameters Measured and Information Monitored

When DO measurements are taken, it is important to record water temperature since the DO saturation concentration will increase as temperature decreases. Specific conductivity is also measured at continuous monitoring locations. Available information related to lake water diversions, precipitation, and recorded CSOs into the waterways, is also used to interpret the collected DO data.

B2: Sampling Methods

The water quality monitors used for this project are programmed to record DO, specific conductivity, and temperature measurements at hourly intervals. The alkaline batteries used by the monitors (AA or C cells) generally allow field deployment a period of at least three weeks. The monitors are exchanged in prescheduled batches, on Tuesdays and Wednesdays. Rarely, usually because of inclement weather, monitors may be in the field for extended periods during which they will continue to collect measurement data until the batteries are exhausted. In one instance, monitors were found to be operational after having been under ice for two months.

The monitors are secured in eight-inch stainless steel pipes to protect them from marine vessels, debris, and vandalism. The monitors are typically deployed inside a 12- to 15-foot pipe vertically mounted on the side of a suitable bridge abutment, dolphin, or seawall. The monitors are generally positioned two to three feet below the water surface. These pipes have numerous two-inch openings in the pipe wall to allow water to flow freely through the housing and around the monitor, thereby ensuring accurate water quality measurements.

B3: Sample Handling and Custody

The newly prepared and calibrated monitors are transported to the monitoring stations in coolers that contain enough tap water to saturate the air inside the cooler with humidity. The monitors that are retrieved from the waterway are placed in the same coolers for transport back to the laboratory. When the monitors arrive in the Aquatic Ecology and Water Quality Section Laboratory, they are suspended vertically in a water-filled tank referred to as the "receiving tank."

When a monitor is deployed at a sampling location, a calibrated hand-held DO meter is used to measure DO and temperature in situ just prior to deployment at the same depth and location. The results are recorded on the field data sheet.

B4: Analytical Methods

Each DO monitor utilizes a DO probe, conductivity probe, and a thermistor to measure water temperature. The DO probes utilize optical DO sensors. The optical DO sensor measures the lifetime of the luminescence, which is inversely proportional to the amount of oxygen present. The DO probe calibration is performed with a single point adjustment to 100 percent DO saturation. The conductivity sensor measures the voltage drop between the electrodes and converts it to specific conductance. Temperature is measured with a thermistor that changes in proportion to resistance with temperature variation.

For this project, the water in the monitor storage tank is used as the reference sample for monitor performance evaluations. The DO of the storage tank water is determined using the Winkler method as given in Standard Methods, Method 4500-O C, "Azide Modification" (Standard Methods, 2005). The monitors used for the project automatically compensate for temperature-induced changes. The use of monitors to obtain in situ DO measurements eliminates errors associated with sample handling and storage when grab samples are collected for wet chemistry DO analysis.

Independent DO readings are taken with a calibrated DO meter at each monitoring location when freshly calibrated monitors are deployed for corroborating DO analysis in the laboratory.

B5: Quality Control

Daily performance checks of the DO probes are made while the monitors are maintained in a ready state in the laboratory prior to field deployment.

Monitors are recalibrated whenever the monitor DO is not within ± 0.2 mg/L of the Winkler DO measurement of the storage tank water.

The automatic collection of DO and temperature data does not lend itself to the use of quality control measures that would normally be employed in the laboratory analysis of samples. Therefore, great care is exercised in the calibration of monitors and verification that each monitor has maintained its calibration after deployment.

To verify that data collected by each monitor is accurate, the following quality control measures are employed:

1. Verification of the accuracy of each monitor after retrieval against a 100 percent DO saturation check.

2. Checking the last field DO measurement made by each monitor against a calibrated handheld portable DO meter reading taken in the waterway next to the deployed monitor.

If acceptance criteria for these measurement verifications are not met, the data collected by that monitor may be rejected. Sections B10 and D1 detail these verification procedures.

B6: Instrument Testing, Inspection, and Maintenance

In addition to the monitors that are at all times deployed at the active monitoring sites, a number of monitors are kept in controlled storage in the laboratory after being prepared for deployment the following week. Other monitors that are not deployed, or are not being prepared for deployment, are available to replace those monitors that require servicing that cannot be performed in the laboratory.

The monitors are maintained as required by the manufacturer's manuals and the laboratory SOPs (Vick, 2016; YSI, 2011; Manta, 2015). Inventoried parts and supplies include batteries, o-rings, wiper assemblies, calibration standards for the conductivity sensors, and temperature/conductivity sensors.

When the monitors are returned to the laboratory, the field data is downloaded (see Section B10), and the monitors are cleaned of surface debris. The monitor probes are cleaned and inspected for damage with a 5-40 power microscope.

The thermistor in each monitor is checked annually against a certified thermometer traceable to a National Institute of Standards and Technology (NIST) standard. When the error of the thermistor exceeds 0.5°C, the temperature/conductivity sensor is changed. If the temperature measurement is still beyond the acceptance range, the monitor is returned to the manufacturer for service.

B7: Instrument Calibration and Frequency

Monitors awaiting field deployment are stored in the Aquatic Ecology and Water Quality Section Laboratory in water-filled, stainless steel holding tanks. While suspended vertically in these tanks, each DO sensor is checked at least once daily, Monday through Friday, against the Winkler DO measurement of the water in the holding tank. A monitor is recalibrated to 100 percent DO saturation whenever the sensor DO is more than $\pm$ 0.2 mg/L from the Winkler DO.

Monitors that are scheduled for deployment are checked twice on the day before deployment. On the day of scheduled deployment the DO sensor is calibrated to 100 percent DO saturation.

B8: Inspection/Acceptance of Supplies and Consumables

Supplies and consumables shall be inspected by a technician in the Aquatic Ecology and Water Quality Section and accepted only if they satisfy all specifications for the intended use.

B9: Non-direct Measurements

Non-direct measurements are not required for this project.

B10: Data Management

Every three weeks the 19 deployed water quality monitors are exchanged with cleaned and newly calibrated monitors. The retrieved monitors are brought back to the Aquatic Ecology and Water Quality Laboratory and placed in the receiving tank. The following morning, each monitor is checked for accuracy by verification to a 100 percent DO saturation check. While still in the receiving tank, the DO, temperature, and conductivity data collected during the deployed period are downloaded from each monitor data logger into the project Microsoft® SQL Server 2014 database by a laboratory technician. The DO measurements are corrected for initial error and instrument drift using the observed errors from the 100 percent DO saturation calibration taken on the morning of deployment and the 100 percent DO saturation check taken the morning after retrieval (Wagner, 2006). Sensor drift is assumed to be linear over deployment period, and the DO correction is calculated for each hourly measurement.

A biologist prepares a hard copy of the hourly DO data recorded at each monitoring station in service during the past deployment and a summary of the temperature and specific conductivity. A biologist reviews the hourly DO data and summarized temperature and specific conductivity data for inconsistent measurements and highlights them for later review by a second biologist.

A biologist then transfers the hourly DO values for all monitoring stations from the Microsoft® SQL Server 2014 database into an Excel® application using Access®. A statistical summary table of the week's data is then prepared for the monitoring stations in each waterway system. The summary table prepared for a monitoring station lists the number of DO measurements, the mean, the minimum recorded DO, the maximum recorded DO, and the percent of DO measurements above the applicable DO water quality standard (Appendix I). A biologist also prepares a graph of the hourly DO measurements for each monitoring station (Appendix II).

Following each storm event, the Maintenance and Operations Department (M&O) prepares a storm report that details the rainfall amount, pumping station overflows, and back flows to Lake Michigan. The storm report is available to laboratory staff via Microsoft Outlook®.

M&O personnel also compile the daily flow information for Lake Michigan discretionary diversion. The discretionary diversion data is transmitted to the Aquatic Ecology and Water Quality Section on a monthly basis.

A biologist assesses the total rainfall recorded at rain gauges throughout the District's service area in order to determine whether a storm event occurred in a specific geographic area during the monitoring period. Overflows at the North Branch, Racine Avenue, and 125th Street Pumping Stations are evaluated by a biologist to interpret the impact at monitoring stations on the North Branch of the Chicago River, CSSC (above the Stickney WRP outfall), and the Little Calumet River, respectively. A biologist reviews the daily discretionary diversion flows at the Wilmette Pumping Station, Chicago River Controlling Works, and O'Brien Lock to determine the effects at monitoring stations on the North Shore Channel (above the North Side WRP outfall), South Branch Chicago River, and the Little Calumet River, respectively.

Then a biologist reviews and verifies the field DO data following the guidance provided in the IEPAs Standard Operating Procedure for Continuous Monitoring of Water Quality (IEPA, 2014). The criteria used to review and validate the DO data are stated in Section D1. The biologist also considers the rain and flow information as well as best professional judgment when verifying the DO data. All DO data that fail the review criteria and are considered to be erroneous are marked as data lost in the database. Following the data review process, the biologist revises the weekly DO summary tables and DO hourly plots as necessary.

GROUP C: ASSESSMENT AND OVERSIGHT

C1: Assessment and Response Actions

Routine assessments are not used in this project.

C2: Reports to Management

The Project Manager and all those on the approval list will receive from the Network Coordinator all investigation and corrective action reports concerning quality control problems and other non-conformance issues from field personnel and participating laboratories.

Project related systems audits or special data quality assessments are not undertaken.

GROUP D: DATA VALIDATION AND USABILITY

D1: Data Review, Verification, and Validation

A biologist reviews and verifies the field DO data. The field data from any water quality monitor may be rejected following review of these quality control checks:

1. Accuracy of Retrieved Monitors

   The monitor in the laboratory receiving holding tank is given a post calibration check to 100 percent DO saturation. A difference of more than 0.4 mg/L is used as a rejection criterion for the batch of field collected data. This check is done to evaluate inaccuracies due to calibration drift.

2. Comparison of Monitor DO Measurement with Meter Measurement

   A DO meter reading is taken in close proximity to the protective enclosure during the exchange of monitors by a calibrated handheld DO meter. The DO measured from the meter is compared with the last DO measurement of the retrieved monitor. The relative percent difference is calculated and if it is greater than 20 percent and the absolute magnitude is greater than 0.3 mg/L, this will alert the biologist of a possible problem and may result in the rejection of the entire batch of field data. If evidence suggests that there were conditions in the waterway at the time of the meter measurement that can explain a difference greater than 20 percent, the reviewers may accept the data. This check is done to evaluate total inaccuracies attributed to fouling drift and calibration drift.

Additional review of the field data is necessary to verify continuous monitoring data. Situations can arise where portions of a batch of data may need to be rejected if, for example, the equipment malfunctioned in the middle of a deployment, the monitor experienced a period of time out of the water due to a draw down or vandalism, or the monitor recorded momentary spikes in the data. The reviewers will use best professional judgement, the rain data, diversion data, and CSO data to help make these decisions. An electronic file is kept to record all deployment dates and justifications for lost data.

D2: Verification and Validation Methods

The Project Manager and the QA Officer shall be informed of all situations where data integrity has been found compromised by errors, including storage of incorrect data or the corruption of stored data. All responsible persons identified in Section A4, and all known data users shall be informed of data problems when they are discovered and the corrective action taken. The QA Officer shall prepare the disclosure report for distribution.

D3: Reconciliation with User Requirements

The QAPP shall govern the operation of the project at all times. Each responsible person listed in Section A4 shall adhere to the procedural requirements of the QAPP and ensure that subordinate personnel do likewise.

This QAPP shall be reviewed annually to ensure that the project will achieve all intended purposes. All the responsible persons listed in Section A4 shall participate in the review of the QAPP. The annual review shall address every aspect of the program including:

1. The accuracy of the information contained in the QAPP and incorporation of changes made since its completion.
2. The adequacy and location of monitoring stations.
3. The adequacy of measurement frequency at each location.
4. Sampling procedures.
5. Analytical procedures.
6. The appropriateness of parameters monitored.
7. Changes in data quality objectives and minimum measurement criteria.
8. Whether the data obtained met minimum measurement criteria.
9. Corrective actions taken during the previous year for field and laboratory operations.
10. The adequacy of quality control procedures.
11. All interim reports and annual project report.
12. Review of other user requirements and recommendations.

The project will be modified as directed by the Project Director. The Project Manager shall be responsible for the implementation of changes to the project and shall document the effective date of all changes made.

It is expected that, from time to time, ongoing and perhaps unexpected changes will need to be made to the project. Significant changes or deviations in the operation of the project shall not be made without authorization by the Project Director. The need for a change in project operation should be conveyed to the Network Coordinator. Data users and other interested persons may also suggest changes to the project to the Network Coordinator.

The Network Coordinator shall evaluate the need for the change, consult with the Project Manager and others as appropriate, and make a recommendation to the Project Director for approval. The Network Coordinator shall, in a timely manner, inform the appropriate project personnel of approved changes in project operation.

Following approval, a memorandum documenting each authorized change shall be prepared by the Network Coordinator and distributed to all the responsible persons listed in Section A4. Approved changes shall be considered an amendment to the QAPP and shall be incorporated into the QAPP when it is updated.

Following the annual QAPP review, the Project Manager will prepare an updated version of the QAPP with the assistance of the QA Officer.

REFERENCES

Illinois Environmental Protection Agency, Bureau of Water. Document Control number 202. Standard Operating Procedure for Continuous Monitoring of Water Quality. Revision No. 1. June 26, 2014.

Manta 2, Sub 2, and Sub 3, Water Quality Multiprobe Manual, Eureka Water Probes, February, 2015.

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FIGURE 1: CONTINUOUS DISSOLVED OXYGEN MONITORING PROJECT ORGANIZATION CHART

```
|---Project Director
|    (Planning, decision making, staffing, and
|          ultimate execution of project)
|
O----Project Manager
|   | (Project planning,, execution, and reporting,
|   |  troubleshoot database issues, QAPP preparation,
                and supervise data review)
|   |
O----O---QA Officer
|   |   | (Project QA/QC, review of QAPP)
|   |   |
O----O---O- Network Coordinator
    |  |  | (Coordination of project activities, review
    |  |  |                of M&R reports, review of monitoring data,
    |  |  |                review of QAPP, provide data to IEPA)
    |  |  |
    |  O--O-- Field Operations Manager
    |  |  |   (Execution of field activities by field team)
    |  |  |          |
    |  |  |    Field Team
    |  |  |    | (Monitor deployment, field measurements, and
    |  |  |    |  transport of monitors and samples)
    |  |  |
    |  O--O—-
    O------O-- AEWQ Laboratory Technicians and Biologists
                           (Analysis of DO water samples, calibrate DO
                           sensors, clean and maintain water quality
                           monitors, download data from monitors,
                           conduct cross-sectional DO surveys, review of monitoring
                           data, preparation of statistical summaries and DO graphs,
                           and collection of auxiliary information.)
```

FIGURE 2: CURRENTLY ACTIVE CONTINUOUS DISSOLVED OXYGEN MONITORING STATIONS

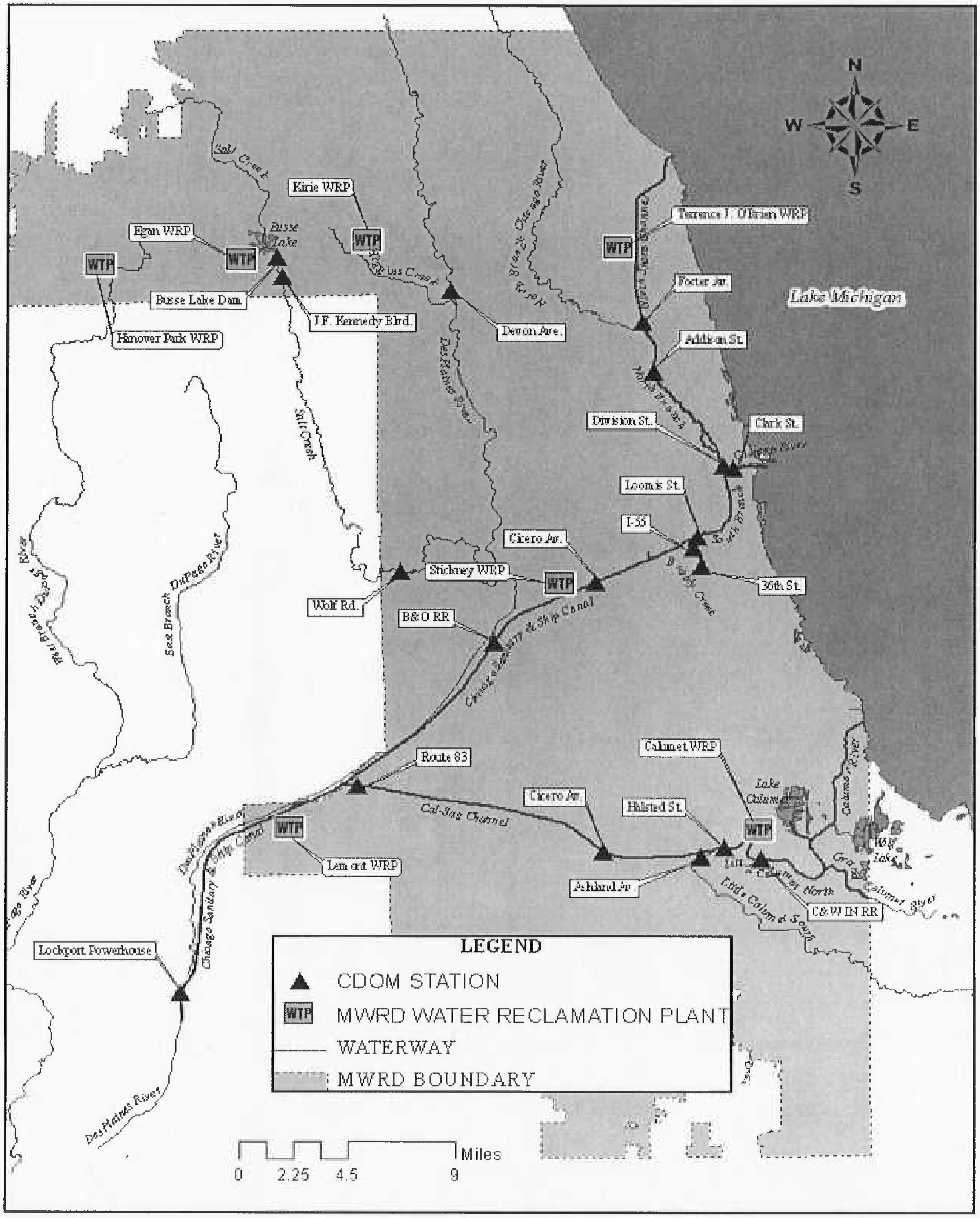


TABLE 1: SAMPLING HISTORY AT EACH MONITORING LOCATION

Loc. ID	Continuous DO Monitoring Location	Time Period DO Measured Hourly at Location	Status
1	Linden St., North Shore Channel	August 1998 - March 2004	Inactive
2	Simpson St., North Shore Channel	August 1998 - March 2004	Inactive
3	Main St., North Shore Channel	August 1998 - Dec. 2010	Inactive
4	Devon Ave., North Shore Channel	August 1998 - January 2001	Inactive
57	Foster Ave., North Shore Channel	August 2004 – Present	Active
66	Central Park Ave., North Branch Chicago River	July 2005 – April 2013	Inactive
5	Lawrence Ave., North Branch Chicago River	August 1998 - January 2001	Inactive
6	Addison St., North Branch Chicago River	August 1998 – Present	Active
7	Fullerton Ave., North Branch Chicago River	August 1998 - Dec. 2010	Inactive
8	Division St., North Branch Chicago River	August 1998 – March 2004, June 2013 – Present	Active
9	Kinzie St., North Branch Chicago River	August 1998 – June 2013	Inactive
21	Chicago River Controlling Works, Chicago River	March 2000 - March 2004	Inactive
22	Michigan Ave., Chicago River	March 2000 - March 2004	Inactive
10	Clark St., Chicago River	August 1998 – Dec. 2010, May 2012 – Present	Active
11	Jackson Blvd., South Branch Chicago River	August 1998 - March 2004	Inactive
12	Loomis St., South Branch Chicago River	August 1998 - January 2001, April 2003 – Present	Active
49	36th St., Bubbly Creek	June 2002 – Present	Active
13	I-55, Bubbly Creek	August 1998 - January 2001 April 2002 – Present	Active
14	Cicero Ave., Chicago Sanitary & Ship Canal	August 1998 – Present	Active
15	B&O Central RR, Chicago Sanitary & Ship Canal	August 1998 – Present	Active
16	Route 83, Chicago Sanitary & Ship Canal	August 1998 - Dec. 2010	Inactive
17	River Mile 302.6, Chicago Sanitary & Ship Canal	August 1998 - March 2004	Inactive
18	Romeoville Rd., Chicago Sanitary & Ship Canal	August 1998 - March 2004	Inactive
19	Lockport Powerhouse, Chgo. Sanitary & Ship Canal	August 1998 – Present	Active
58	Devon Ave., Des Plaines River	October 2005 – Dec. 2010, May 2011 – Present	Active
62	Irving Park Rd., Des Plaines River	July 2005 – May 2011	Inactive
63	Ogden Ave., Des Plaines River	July 2005 - Dec. 2010	Inactive
64	Material Service Rd., Des Plaines River	October 2005 - Dec. 2010	Inactive
23	Jefferson St., Des Plaines River	March 2000 - Dec. 2010	Inactive
31	130th St., Calumet River	July 2001 - March 2004	Inactive
67	Hohman Ave., Grand Calumet River	July 2005 - April 2008	Inactive
32	Torrence Ave., Grand Calumet River	July 2001 - Dec. 2010	Inactive
33	Conrail RR, Little Calumet River	July 2001 - March 2004	Inactive
34	C&W Indiana RR, Little Calumet River	July 2001 - Present	Active
35	Halsted St., Little Calumet River	July 2001 - Present	Active
65	Wentworth Ave., Little Calumet River	July 2005 - Dec. 2010	Inactive
36	Ashland Ave., Little Calumet River	July 2001 - Present	Active
37	Division St., Calumet-Sag Channel	July 2001 - March 2004	Inactive
38	Kedzie Ave., Calumet-Sag Channel	July 2001 - March 2004	Inactive
39	Cicero Ave., Calumet-Sag Channel	July 2001 – Dec. 2010, March 2014 – Present	Active

TABLE 1 (Continued): SAMPLING HISTORY AT EACH MONITORING LOCATION

Loc. ID	Continuous DO Monitoring Location	Time Period DO Measured Hourly at Location	Status
40	River Mile 311.7, Calumet-Sag Channel	July 2001 - November 2004	Inactive
41	Southwest Hwy., Calumet-Sag Channel	July 2001 - March 2004	Inactive
42	104th Ave., Calumet-Sag Channel	July 2001 - October 2010	Inactive
20	Route 83, Calumet-Sag Channel	August 1998 - Present	Active
68	Busse Woods Main Dam, Salt Creek	October 2005 - Present	Active
59	J. F. Kennedy Blvd., Salt Creek	July 2005 - Present	Active
60	Thorndale Ave., Salt Creek	July 2005 - March 2009	Inactive
61	Wolf Rd., Salt Creek	July 2005 - Present	Active

TABLE 2: LATITUDE AND LONGITUDE OF MONITORING LOCATIONS

Loc. ID	Continuous DO Monitoring Location	Latitude	Longitude
1	Linden St., North Shore Channel	42° 04.390'	87° 41.140'
2	Simpson St., North Shore Channel	42° 03.350'	87° 42.400'
3	Main St., North Shore Channel	42° 02.010'	87° 42.570'
4	Devon Ave., North Shore Channel	41° 59.820'	87° 42.610'
57	Foster Ave., North Shore Channel	41° 58.5660'	87° 42.2860'
66	Central Park Ave., North Branch Chicago River	41° 58.3790'	87° 42.0882'
5	Lawrence Ave., North Branch Chicago River	41° 58.100'	87° 42.020'
6	Addison St., North Branch Chicago River	41° 56.790'	87° 41.720'
7	Fullerton Ave., North Branch Chicago River	41° 55.520'	87° 40.450'
8	Division St., North Branch Chicago River	41° 54.210'	87° 39.430'
9	Kinzie St., North Branch Chicago River	41° 53.440'	87° 38.330'
21	Chicago River Lock, Chicago River	41° 53.280'	87° 36.580'
22	Michigan Ave., Chicago River	41° 53.340'	87° 37.370'
10	Clark St., Chicago River	41° 53.241'	87° 37.893'
11	Jackson Blvd., South Branch Chicago River	41° 53.911'	87° 38.135'
12	Loomis St., South Branch Chicago River	41° 50.747'	87° 39.662'
49	36th St., South Fork South Branch Chicago River	41° 49.071'	87° 39.437'
13	I-55, South Fork South Branch Chicago River	41° 50.648'	87° 39.878'
14	Cicero Ave., Chicago Sanitary & Ship Canal	41° 49.169'	87° 44.616'
15	B&O RR Bridge, Chicago Sanitary & Ship Canal	41° 46.990'	87° 49.540'
16	Route 83, Chicago Sanitary & Ship Canal	41° 42.420'	87° 55.750'
17	River Mile 302.6, Chicago Sanitary & Ship Canal	41° 41.240'	87° 58.470'
18	Romeoville Rd., Chicago Sanitary & Ship Canal	41° 38.450'	88° 03.549'
19	Lockport Powerhouse, Chicago Sanitary & Ship Canal	41° 34.277'	88° 04.711'
58	Devon Ave., Des Plaines River	41° 59.7633'	87° 51.5629'
62	Irving Park Rd., Des Plaines River	41° 57.1905'	87° 51.2461'
63	Ogden Ave., Des Plaines River	41° 49.2501'	87° 48.6311'
64	Material Service Rd., Des Plaines River	41° 35.7913'	88° 04.1275'
23	Jefferson St., Des Plaines River	41° 31.489'	88° 05.155'
31	130th St., Calumet River	41° 39.619'	87° 34.195'
67	Hohman Ave., Grand Calumet River	41° 37.4546'	87° 31.0777'
32	Torrence Ave., Grand Calumet River	41° 38.652'	87° 33.542'
33	Conrail RR, Little Calumet River	41° 38.345'	87° 33.955'
34	C&W Indiana Harbor Belt RR, Little Calumet River	41° 39.026'	87° 36.695'
35	Halsted St., Little Calumet River	41° 39.431'	87° 38.450'
65	Wentworth Ave., Little Calumet River	41° 35.1058'	87° 31.7625'
36	Ashland Ave., Little Calumet River	41° 39.110'	87° 39.625'
37	Division St., Calumet-Sag Channel	41° 39.160'	87° 40.250'
38	Kedzie Ave., Calumet-Sag Channel	41° 39.120'	87° 41.920'
39	Cicero Ave., Calumet-Sag Channel	41° 39.345'	87° 44.313'
40	River Mile 311.7, Calumet-Sag Channel	41° 40.626'	87° 47.532'
41	Southwest Hwy., Calumet-Sag Channel	41° 40.812'	87° 48.642'

TABLE 2 (Continued): LATITUDE AND LONGITUDE OF MONITORING LOCATIONS

Loc. ID	Continuous DO Monitoring Location	Latitude	Longitude
42	104th Ave., Calumet-Sag Channel	41° 41.352'	87° 53.052'
20	Route 83, Calumet-Sag Channel	41° 41.810'	87° 56.480'
68	Busse Woods Main Dam, Salt Creek	42° 01.0089'	88° 00.0289'
59	J. F. Kennedy Blvd., Salt Creek	42° 00.3152'	87° 59.7498'
60	Thorndale Ave., Salt Creek	41° 59.0307'	87° 59.4212'
61	Wolf Rd., Salt Creek	41° 49.5759'	87° 54.0781'

TABLE 3: ILLINOIS POLLUTION CONTROL BOARD USE CLASSIFICATION AND DISSOLVED OXYGEN STANDARD AT EACH MONITORING LOCATION

Loc. ID	Continuous DO Monitoring Location	IPCB Classification	DO Standard
1	Linden St., North Shore Channel	CAWS ALU A	3.5-5.0[1]
2	Simpson St., North Shore Channel	CAWS ALU A	3.5-5.0[1]
3	Main St., North Shore Channel	CAWS ALU A	3.5-5.0[1]
4	Devon Ave., North Shore Channel	CAWS ALU A	3.5-5.0[1]
57	Foster Ave., North Shore Channel	CAWS ALU A	3.5-5.0[1]
66	Central Park Ave., North Branch Chicago River	General Use	3.5-6.0[2]
5	Lawrence Ave., North Branch Chicago River	CAWS ALU A	3.5-5.0[1]
6	Addison St., North Branch Chicago River	CAWS ALU A	3.5-5.0[1]
7	Fullerton Ave., North Branch Chicago River	CAWS ALU A	3.5-5.0[1]
8	Division St., North Branch Chicago River	CAWS ALU A	3.5-5.0[1]
9	Kinzie St., North Branch Chicago River	CAWS ALU A	3.5-5.0[1]
21	Chicago River Lock, Chicago River	General Use	3.5-6.0[2]
22	Michigan Ave., Chicago River	General Use	3.5-6.0[2]
10	Clark St., Chicago River	General Use	3.5-6.0[2]
11	Jackson Blvd., South Branch Chicago River	CAWS ALU A	3.5-5.0[1]
12	Loomis St., South Branch Chicago River	CAWS ALU A	3.5-5.0[1]
49	36th St., South Fork South Branch Chicago River	Indigenous ALU	4.0
13	I-55, South Fork South Branch Chicago River	Indigenous ALU	4.0
14	Cicero Ave., Chicago Sanitary & Ship Canal	CAWS ALU B	3.5-4.0[3]
15	B&O RR, Chicago Sanitary & Ship Canal	CAWS ALU B	3.5-4.0[3]
16	Route 83, Chicago Sanitary & Ship Canal	CAWS ALU B	3.5-4.0[3]
17	River Mile 302.6, Chicago Sanitary & Ship Canal	CAWS ALU B	3.5-4.0[3]
18	Romeoville Rd., Chicago Sanitary & Ship Canal	CAWS ALU B	3.5-4.0[3]
19	Lockport Powerhouse, Chicago Sanitary & Ship Canal	CAWS ALU B	3.5-4.0[3]
58	Devon Ave., Des Plaines River	General Use	3.5-6.0[2]
62	Irving Park Rd., Des Plaines River	General Use	3.5-6.0[2]
63	Ogden Ave., Des Plaines River	General Use	3.5-6.0[2]
64	Material Service Rd., Des Plaines River	General Use	3.5-6.0[2]
23	Jefferson St., Des Plaines River	CAWS ALU B	3.5-4.0[3]
31	130th St., Calumet River	CAWS ALU A	3.5-5.0[1]
67	Hohman Ave., Grand Calumet River	CAWS ALU A	3.5-5.0[1]
32	Torrence Ave., Grand Calumet River	CAWS ALU A	3.5-5.0[1]
33	Conrail RR, Little Calumet River	CAWS ALU A	3.5-5.0[1]
34	C&W Indiana Harbor Belt RR, Little Calumet River	CAWS ALU A	3.5-5.0[1]
35	Halsted St., Little Calumet River	CAWS ALU A	3.5-5.0[1]
65	Wentworth Ave., Little Calumet River	General Use	3.5-6.0[2]
36	Ashland Ave., Little Calumet River	General Use	3.5-6.0[2]
37	Division St., Calumet-Sag Channel	CAWS ALU A	3.5-5.0[1]
38	Kedzie Ave., Calumet-Sag Channel	CAWS ALU A	3.5-5.0[1]
39	Cicero Ave., Calumet-Sag Channel	CAWS ALU A	3.5-5.0[1]

TABLE 3 (Continued): ILLINOIS POLLUTION CONTROL BOARD USE CLASSIFICATION AND DISSOLVED OXYGEN STANDARD AT EACH MONITORING LOCATION

Loc. ID	Continuous DO Monitoring Location	IPCB Classification	DO Standard
40	River Mile 311.7, Calumet-Sag Channel	CAWS ALU A	3.5-5.0[1]
41	Southwest Hwy., Calumet-Sag Channel	CAWS ALU A	3.5-5.0[1]
42	104th Ave., Calumet-Sag Channel	CAWS ALU A	3.5-5.0[1]
20	Route 83, Calumet-Sag Channel	CAWS ALU A	3.5-5.0[1]
68	Busse Woods Main Dam, Salt Creek	General Use	3.5-6.0[2]
59	J. F. Kennedy Blvd., Salt Creek	General Use	3.5-6.0[2]
60	Thorndale Ave., Salt Creek	General Use	3.5-6.0[2]
61	Wolf Rd., Salt Creek	General Use	3.5-6.0[2]

[1]The Chicago Area Waterway System Aquatic Life Use A (CAWS ALU A) waters require that during the period of March through July, DO shall not be less than 5.0 mg/L at any time, and that during the period of August through February, DO shall not be less than 4.0 mg/L as a daily minimum averaged over seven days, or less than 3.5 mg/L at any time.

[2]The General Use Standard requires that during the period of March through July, DO shall not be less than 5.0 mg/L at any time, or less than 6.0 mg/L as a daily mean averaged over seven days, and that during the period of August through February, DO shall not be less than 3.5 mg/L at any time, or less than 4.0 mg/L as a daily minimum averaged over seven days, or less than 5.5 mg/l as a daily mean averaged over 30 days.

[3]The Chicago Area Waterway System Aquatic Life Use B (CAWS ALU B) waters require that DO shall not be less than 4.0 mg/L as a daily minimum averaged over seven days, or less than 3.5 mg/L at any time.

CONTINUOUS DISSOLVED OXYGEN MONITORING
QUALITY ASSURANCE PROJECT PLAN

APPENDIX I

EXAMPLE OF A WEEKLY DISSOLVED OXYGEN SUMMARY TABLE

TABLE AI-1: DISSOLVED OXYGEN VALUES IN THE NORTH SHORE CHANNEL, NORTH BRANCH CHICAGO RIVER, AND CHICAGO RIVER DURING THE PERIOD FEBRUARY 26, 2015 THROUGH MARCH 5, 2015[1]

Monitor Location	Waterway	IPCB Standard	Number of DO Values	DO Concentration (mg/L)			Percent of DO Values Above Standard
				Min	Max	Mean	
Foster Avenue	North Shore Channel	3.5/5.0	168	6.5	8.3	7.7	100
Addison Street	North Branch Chicago River	3.5/5.0	169	5.6	8.0	7.2	100
Division Street	North Branch Chicago River	3.5/5.0	169	6.1	9.1	7.2	100
Clark Street	Chicago River	3.5/5.0	168	8.9	13.1	11.6	100

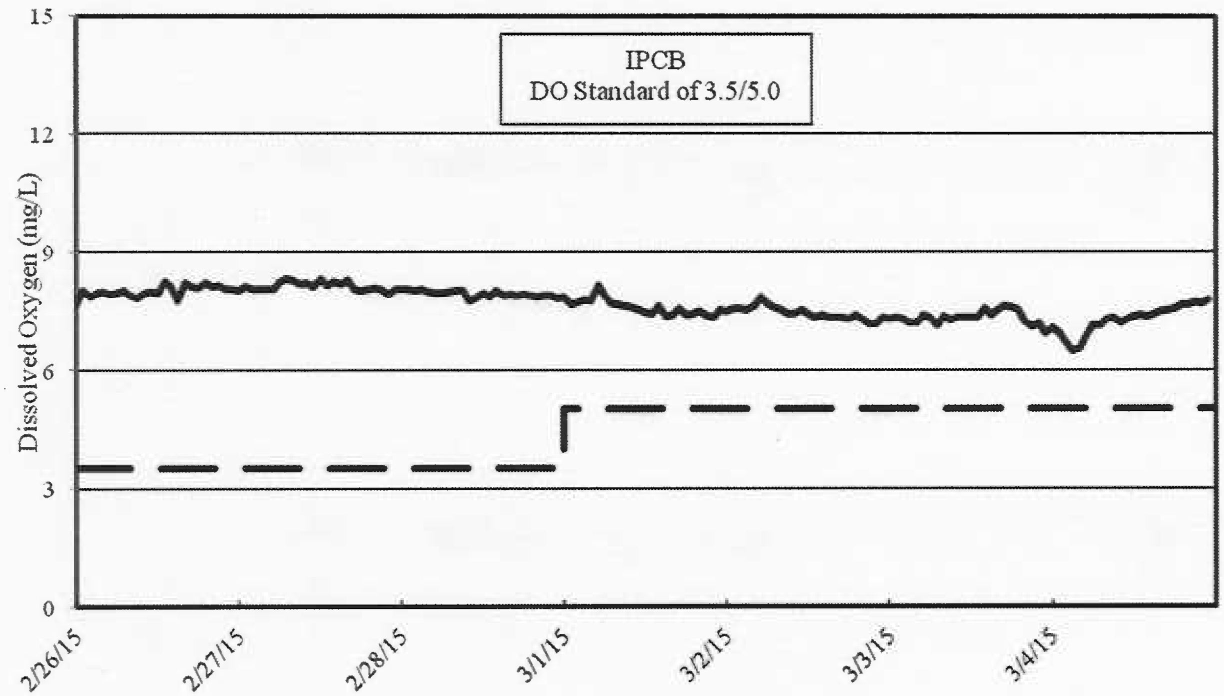
[1]Parameter was measured hourly using a YSI or Eureka brand continuous water quality monitor.

CONTINUOUS DISSOLVED OXYGEN MONITORING
QUALITY ASSURANCE PROJECT PLAN

APPENDIX II

EXAMPLE OF AN HOURLY DISSOLVED OXYGEN PLOT

FIGURE AII-1: DISSOLVED OXYGEN CONCENTRATION MEASURED HOURLY AT FOSTER AVENUE IN NORTH SHORE CHANNEL, FEBRUARY 26, 2015 THROUGH MARCH 4, 2015



APPENDIX 3C

PUMP STATION SAMPLING PROTOCOLS

PROTOCOL FOR SAMPLING
NORTH BRANCH PUMPING STATION
(NPDES PERMIT REQUIREMENTS)

Purpose of Sampling Program

As part of its National Pollutant Discharge Elimination System (NPDES) permit for the O'Brien Water Reclamation Plant (OWRP), the Metropolitan Water Reclamation District of Greater Chicago (District) is required to sample all discharges from the North Branch Pumping Station (NBPS) into the North Branch of the Chicago River.

Personnel from the Industrial Waste Division (IWD) North Office will be assigned to sample these discharges.

Program Start Date and Duration

This program will commence March 1, 2002 and continue, year round, until further notice.

Notification of a Sampling Event

Upon activation of the first storm pump at NBPS, the OWRP Operating Engineer will notify the Systems Dispatcher. The Systems Dispatcher will notify the Area Supervisor, or his designee, who will assign IWD-North personnel to sample the NBPS.

NBPS Sampling Point

A District Medeco key must be taken from the North office key box to gain entry to the NBPS.

Samples will be obtained from the automatic sampler unit located at the south wall of the lower level of the NBPS building.

A silent intrusion alarm will be activated upon entry to NBPS. Contact the OWRP Operating Engineer at (847) 568-8380 or –8381 (x88380 or x88381) to identify the sampling crew and your purpose at the NBPS.

Upon arrival, the automatic sampler tubing is to be purged for at least 20 seconds. Sample is to be pumped through the sampling unit into a waste bucket and then the line is to be purged again for at least 30 seconds. The NPDES sample will then be pulled through the sampling unit and into the sample bottle.

PROTOCOL FOR SAMPLING
NORTH BRANCH PUMPING STATION
(NPDES PERMIT REQUIREMENTS)

Samples Obtained

Sampling consists of a single, one-gallon grab for general chemistry. The sample must *not be obtained any earlier than 30 minutes*, or later than 2 hours, after activation of the first storm pump.

One sample will be collected for each 24-hour period of an event. If an event continues for more than 24 hours, an additional sample will be obtained to document the next 24-hour period of the event. Subsequent sampling will be conducted as close to the start of each 24-hour period as practical.

Information regarding this sample will be recorded on a standard IWD grab logsheet, a copy of which is attached.

LIMS

The sample will be identified with a LIMS label. The label is created via use of option "$TLS" (Create Sample Using Template). The NBPS template is identified as "NPD-NBPS."

Sample Analyses

Monitoring and Research (M&R) Analytical Laboratory Division personnel at the Lue-Hing R&D Complex will report the sample results for BOD5 and SS to the Technical Services Section for permit reporting purposes.

Report Completion of Sampling

Prior to departing the NBPS, notify the OWRP Operating Engineer (telephone number listed above) and advise that the NPDES sample has been obtained and to reset the intrusion alarm upon departure of the sampling crew.

Sample Transport

The sample must be refrigerated until it is received at the Lue-Hing R&D Complex Analytical Laboratories. The sample must arrive within 24 hours of collection.

PROTOCOL FOR SAMPLING
NORTH BRANCH PUMPING STATION
(NPDES PERMIT REQUIREMENTS)

Reporting

Submit the completed sample logsheet to the Area Supervisor. Following each event, the Area Supervisor will send an e-mail to the Field Services Section Supervisor indicating the date/time/location of the samples obtained.

Program Number

All costs associated with this sampling program shall be documented under Program Number 4681—Assistance to M&O Department.

Prepared by Frank Kody, PCO III, 3/18/02. Rev 5/10/05, 11/3/05, 4/14/06, MPB, 9/23/13, GY

PROTOCOL FOR SAMPLING THE
95TH STREET PUMPING STATION
(NPDES PERMIT REQUIREMENTS)

Purpose of Sampling Program

As part of the NPDES permit for the Calumet Plant (CWRP), the District must sample all discharges from the 95th Street Pumping Station (95SPS) into the Howard Slip on the Calumet River.

Personnel from the IWD-South Office will be assigned to sample this discharge.

Notification of a Sampling Event

Upon activation of the first storm pump at the 95SPS, the CWRP Operating Engineer will notify the Systems Dispatcher. The Systems Dispatcher will notify the Area Supervisor, or his designee, who will assign IWD-South personnel to sample the 95SPS.

95SPS Sampling Point

Samples will be obtained from the 95SPS pump discharge well. The floor of the men's washroom and the adjacent room to the west at the 95SPS forms the ceiling over the discharge well. Access for sampling the channel is provided by a marked 18-inch square, hinged cover in the floor at the southeast corner of the described room west of the men's washroom. The area is located between 2 large (approx. 24-inch diameter) curved pump discharge pipes on the east wall of the room.

A CWRP Operating Engineer will staff the 95SPS whenever the pumps are activated. If the Operating Engineer is not available, access to the pump station is achieved by using a District hydraulic key. A silent intrusion alarm will be activated upon entry to the 95SPS if it is unmanned. Contact the CWRP Operating Engineer at (773) 256-3540 or -3539 (x63540 or x63539) to identify the sampling crew and your purpose at 95SPS.

Samples Obtained

Sampling consists of a single, one-gallon grab for general chemistry. The sample must not be obtained within the first 30 minutes of pumping or later than 2 hours after the pumps have been activated. A single sample will be collected for each pumping event; if a single pumping event continues from one day to the next, one sample will be obtained for each day of the event.

Information regarding this sample will be recorded on a standard IWD grab logsheet, a copy of which is attached. The logsheet must contain the temperature (deg C) and pH of each sample obtained.

LIMS

The sample will be identified with a LIMS label. The label is created via use of option "$TLS" (Create Sample Using Template). The 95SPS template is identified as "NPD-95PS", the sampling point in LIMS is designated "NPD-95PS", and the test schedule is NPD-PS.

Sampling Analyses

The sample will be analyzed for BOD5 and SS. R & D Laboratory personnel at the Stickney Plant will report the sample results to M&O for permit reporting purposes.

Report Completion of Sampling

Prior to departing the 95SPS, notify the CWRP Operating Engineer on duty at the pump station (or telephone number listed above) and advise that the NPDES permit sample has been obtained. Ask to reset the intrusion alarm upon departure of the sampling crew, if the station was unmanned during the sampling event.

Sample Transport

The sample must be packed on ice and/or refrigerated until it is received at the Cecil Lue-Hing Research and Development Complex Analytical Laboratories. The sample must arrive within 24 hours of collection.

Reporting

Submit the completed sample logsheet to the Area Supervisor. Following each event, the Area Supervisor, or his/her designee, will send an email to the Field Operations Supervisor indicating the date/time/location of the samples obtained.

Program Number

All costs associated with this sampling program shall be documented under Program Number 4681—Assistance to M&O Department.

APPENDIX 3D

LAKE MICHIGAN BACKFLOW SAMPLING PROTOCOLS

95th STREET BACKFLOW PROCEDURES
(APPENDIX 3D)

A backflow from the Calumet River into Lake Michigan occurs when the pumps at the 95th Street Pumping Station are activated. The Field Services Section will receive a call from the Systems Dispatcher when the pumping begins. The pumps discharge into the Howard Slip on the river. Samples are obtained upstream of Howard Slip at the Ewing Avenue Bridge and downstream at the 95th Street Bridge.

One general chemistry grab sample and one bacteria (*E. coli* or fecal coliform) sample will be collected within 24 hours of the onset of the backflow. The temperature (°C) must be taken and logged for each sample obtained. Bacteria samples need to be transported to the Stickney Microbiology Laboratory as soon as possible (i.e., within 6 hours.)

I. Samples will be collected from the following sample points during the backflow; contact the Systems Dispatcher by radio to determine when the pumps have been deactivated. Follow the latest bacteriological sampling procedures. The first sample to be collected with a backflow event for the season should include a field blank.

Ewing Avenue Bridge—LD-CALHBR1

95th Street Bridge—LD-CALHBR2

II. One post-backflow bacteria sample will be collected by land-based crews within 24 hours of the cessation of the backflow at the following locations, which are highlighted on the attached map (Figure 4D.4): (Note: These samples will only be collected during the Chicago Park District's Beach Recreation Season: Memorial Day through Labor Day).

Rainbow Beach—LD-CALHBR5

Calumet Beach—LD-CALHBR4

Iroquois Landing—LD-CALHBR3

These samples are to be collected at "mid-beach" locations, 10' to 20' from the water's edge at a 1' to 2' depth. Iroquois Landing samples should be collected at the south edge of the mouth of the Calumet River at the Lake, as there is no "beach" at this location.

IWD personnel performing backflow sampling should work in teams of two at each bridge. The Microbiology Laboratory at 8-3637 should be contacted and notified of the number of bacteria samples that will be delivered. Consult the latest storm event call-out listing of Environmental Monitoring and Research Division personnel and the Microbiology Laboratory personnel for available personnel. If no one is present in the Microbiology Laboratory (LC243 – LC245) to receive bacteria samples, they should be stored in the laboratory refrigerator with a copy of the LIMS receipts and sample logs.

This updated sampling plan calls for conducting sampling during the regular working periods, i.e. Monday through Friday between the hours of 7:00 a.m. and 3:30 p.m. except for holidays. For holiday, weekend or late night storm related backflow, the sampling will be scheduled on the following regular work day.

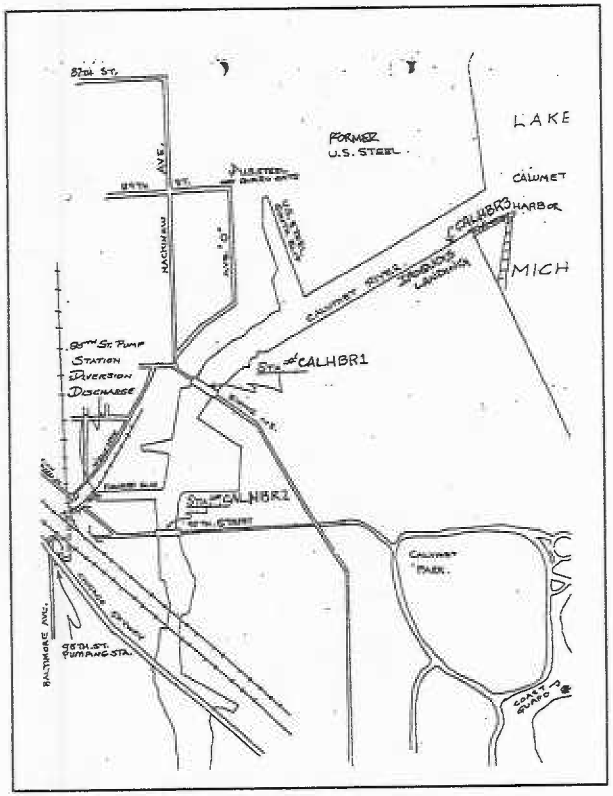
<u>LIMS labels and receipts:</u>

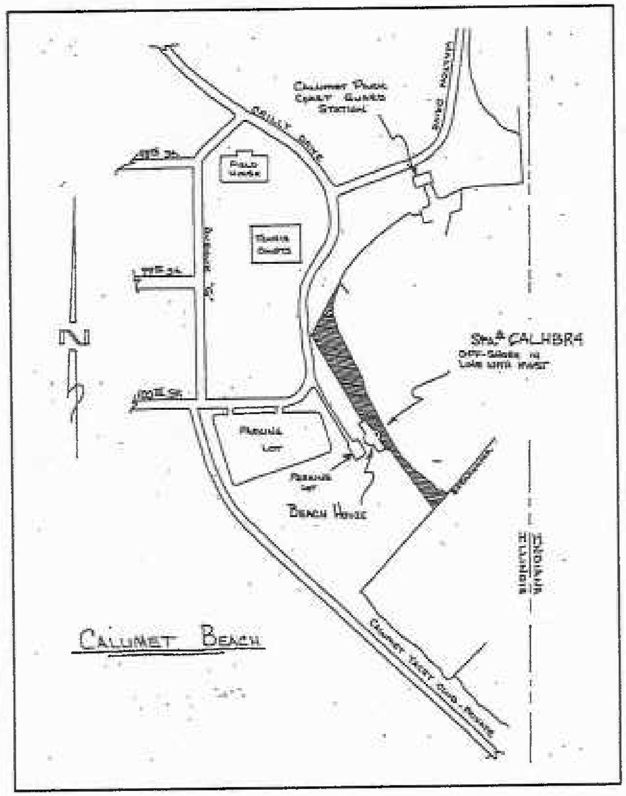
Use this procedure to create labels for backflow and post-backflow samples.

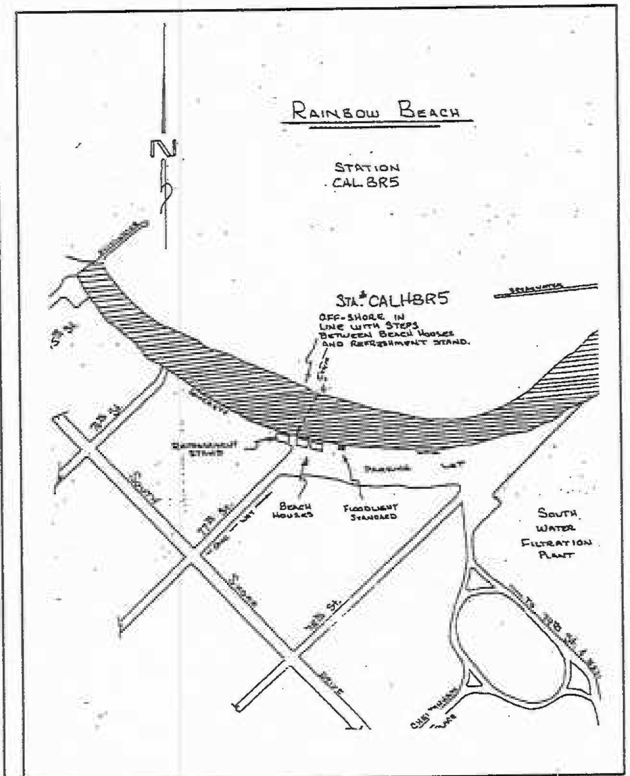
- Log into Sample Manager (LIMS)
- At the top tool bar, click on the "Samples" tab
- Place cursor over "Login," then over "Template" and click
- In the "Samples Logged In" window, type "**LD-CAL**" in the "Sample Template" box
- Enter the number of samples needed to be logged in the "Repeat Count" box
- Click on the "Login…" button
- Fill in the appropriate field for the sample point, collector's name, sample ID, time collected, etc. The test schedules for the bridges are **RIV-DIV** *(General Chemistry and Bacteriology)* and **LAKE-DIVO***)*. The test schedule for the beaches is **LAKE-DIVFC** *(Bacteriology sample.)* Samples will print out automatically
- To print a receipt, go to Sample Manager main page. At the top tool bar, click on the "MWRDGC" tab. Then place cursor over "IWD," then "Field Office," then click on "Print Sample Receipt." Enter the dates and your name, and click in the drop down box for "sample schedule" to indicate "yes" you wish a sample receipt.

A report must be submitted to the Assistant Directors of Monitoring and Research by the Area Supervisor, or their designee, within two weeks following backflow and post-backflow sampling. It must contain a brief summary narrative, event chronology, and sampling log sheets.

FIGURE 3D.4: CALUMET RIVER BACKFLOW TO LAKE MICHIGAN SAMPLING LOCATIONS







CHICAGO RIVER BACKFLOW PROCEDURES
(APPENDIX 3D)

When the Field Services Section receives a call from the Systems Dispatcher that backflow to Lake Michigan at the Chicago River Controlling Works has commenced, one general chemistry and one bacteria (fecal coliform or *E. coli*) sample will be collected from the lakeside backflow sampling points within 24 hours. Bacteria samples need to be transported to the Stickney Microbiology Laboratory as soon as possible (i.e., within 6 hours). Transporter personnel must be ready to pick up samples and transport them to the laboratory. Within 24 hours of the cessation of backflow, one bacteria sample will be collected from nearby beaches by land-based crews to identify the extent of bacterial contamination and pollution that were caused by the backflow event. Record collection time and temperature (°C) of all samples on the log sheet.

I. Samples will be collected from the following locations during the backflow; as shown in Figure 4D.1; contact Systems Dispatcher to determine which gates are being used. The first sample to be collected with a backflow event for the season should include a field blank. Follow the latest bacteriological sampling procedure.

DuSable Harbor Sluice Gates -- CHGHBR1

This site is accessed by entering the Chicago Yacht Club at Lake Shore Drive and Monroe Street and driving north along the lakeside bike path. The sluice gates and gatehouse are approximately 1/4 mile north of Randolph Street and the Columbia Yacht Club and are adjacent to the path. Park vehicle on the sluice gate walkway.

Inner Harbor Sluice Gates -- CHGHBRH

This site is accessed by driving east on Illinois Street from Lake Shore Drive and then turning right on Streeter Drive. Pass through two (2) gates with intercoms before reaching the sluice gates and gatehouse.

II. Post-backflow samples will be collected by land-based crews within 24 hours after the backflow ends at the following locations, which are highlighted on the attached map (Figure 4D.2): (Note: These samples will only be collected during Chicago Park District's Beach Recreation Season: Memorial Day to Labor Day).

North Avenue Beach -- CHGHBR3
Oak Street Beach -- CHGHBR4
Monroe Harbor -- CHGHBR5
12th Street Beach (Adler Planetarium) -- CHGHBR6
31st Street Beach -- CHGHBR7

These samples are to be collected at "mid-beach" locations, 10' to 20' from the water's edge at a 1' to 2' depth. Monroe Harbor samples should be collected at the east edge of the harbor bike path, as there is no "beach" at this location.

III. If reverse backflow (returning lake water to the river) occurs, samples should be collected on the opposite side of the gatehouse walkway from which backflow samples are collected. Samples to be collected are identical to the backflow sampling. Sample locations, however, are now designated CHGHBRR (DuSable) and CHGHBRB (Inner). Reverse backflow conditions can be obtained from the Systems Dispatcher.

IWD personnel performing backflow sampling should work in teams of two at each sluice gate site. Life vests must be worn while sampling. Four are stored in the padlocked green box in the IWD sampling room and more are available in the storeroom. The key to the life vest storage box is hanging in the key box (key #R39) in Room IWD 213-B. Contact the Microbiology Laboratory at 8-3637 and notify them of the number of bacteria samples to be delivered. Consult the latest storm event call-out listing of Environmental Monitoring and Research Division personnel for available personnel. If no one is in the Microbiology Laboratory (LC243 – LC245) to receive bacteria samples, store them in the laboratory refrigerator and leave a copy of the LIMS receipts and sample logs.

LIMS Labels/Receipts:

Refer to LIMS procedures to generate the proper labels and receipts.

This updated sampling plan calls for conducting sampling during the regular working periods, i.e. Monday through Friday between the hours of 7:00 a.m. and 3:30 p.m. except for holidays. For any holiday, weekend or late night storm related backflow, the sampling will be scheduled on the following regular work day.

A report must be submitted to the Assistant Directors of Monitoring and Research by the Area Supervisor, or their designee, within two weeks following backflow and post-backflow sampling. It must contain a brief summary narrative, event chronology, and sampling log sheets.

FIGURE 3D.1: CHICAGO RIVER BACKFLOW TO LAKE MICHIGAN SAMPLING LOCATIONS

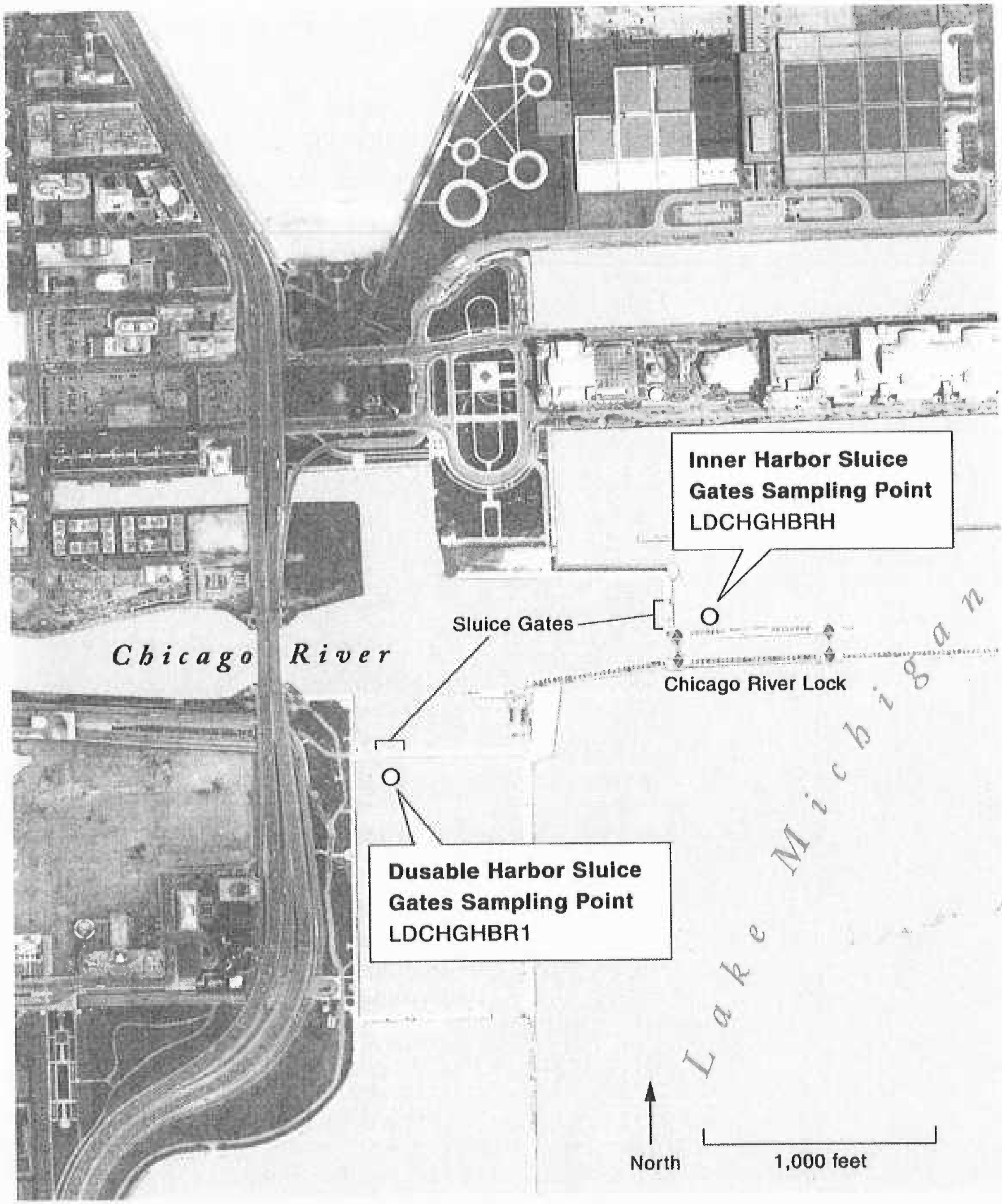
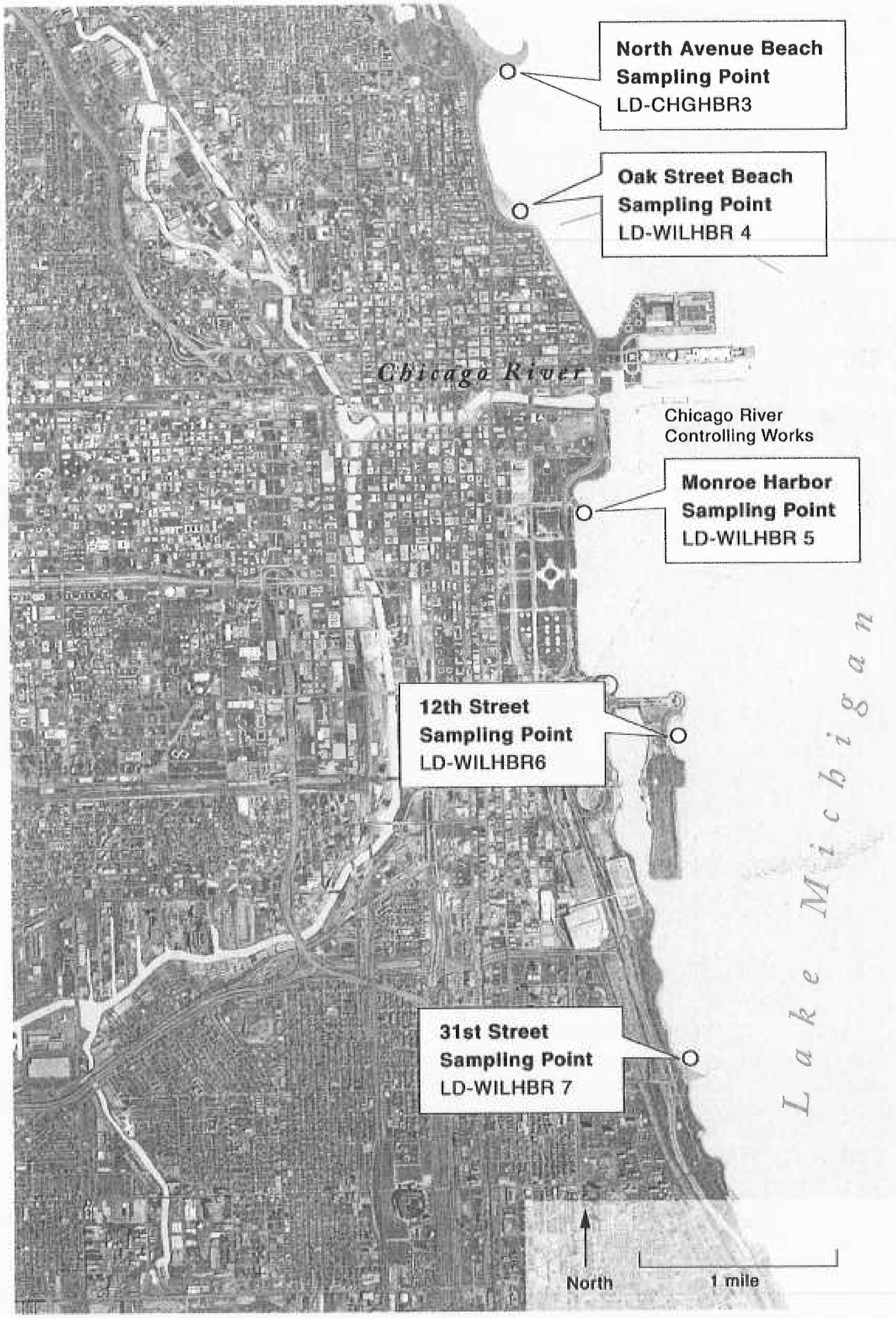


FIGURE 3D.2: LAKE MICHIGAN BEACH SAMPLING LOCATIONS



WILMETTE LOCKS BACKFLOW PROCEDURES
(APPENDIX 3D)

The Systems Dispatcher will notify the IWD-O'Brien Area Supervisor that a backflow event is imminent at the Wilmette Locks. IWD-O'Brien personnel will be assigned upon notification that an Electrical Operator has been dispatched to the site to confirm and oversee the remote operation of the sluice gates.

A minimum of two persons is required for backflow sampling. The sampling crew will sign in at the IWD-O'Brien Office and obtain two vehicles, two radios, two MWRD hydraulic keys (old one and Y1 key) to open the entry gate at the Wilmette Locks and an MWRD Medeco key to open the Pumping Station building and adjacent gate. These keys are located in the IWD-O'Brien key box outside the Area Supervisor's office. All other safety and sampling equipment, including a copy of this protocol, is stored in lockers within the pump station. The lockers are secured with an IWD "507" key, the same key used in other IWD sampling operations and which has been issued to all personnel.

Entry into the Wilmette Pumping Station will trigger a silent intrusion alarm with the Systems Dispatcher. The sampling crew must notify the Dispatcher of its presence and purpose; otherwise, OWRP Police will be dispatched to investigate the alarm. Phone the Dispatcher at (312) 787-3575 and report the IWD personnel on site, the radio call numbers for these personnel, and your purpose (backflow sampling). The telephone number to the Wilmette Pumping Station office is (847) 256-0435.

I. Sampling during the backflow will be conducted at the Wilmette sluice gates (Station LD-WILHBR 1) and Wilmette Harbor Mouth (Station LD-WILHBR-2). See attached sketch (<u>Figure 4D.3</u>). One General Chemistry and one bacteria (fecal coliform or *E. coli*) sample will be collected within 24 hours of the onset of the backflow. The first sample to be collected with a backflow event for the season should include a field blank. Follow the latest bacteriological sampling procedures. Record the temperature (°C) of all samples on the log sheet. Notify the M&R Stickney Analytical Laboratory and the Microbiology Laboratory of the total number of samples and the anticipated time of delivery. Bacteria samples need to be transported to the Stickney Microbiology Laboratory as soon as possible (i.e. within 6 hours).

   If the backflow event is still in progress, record the sluice gate opening measurement at the time of samples collection, in addition to the measurements at the onset of the event. This information will be available from the Electrical Operator on site. Also note that the closure of the sluice gates does not guarantee that the event has ended. If the sluice gates are closed, the Systems Dispatcher or the Area Supervisor can tell you whether or not the event has ended.

The sampling crew will return to the IWD-O'Brien Office to prepare LIMS labels and receipts for all samples. Note that the **LIMS template is LD-WIL**. Please note that these must be separate receipts: one for the general chemistry and one for the bacteriology.

II. The IWD-O'Brien Office will conduct post-backflow beach sampling within 24 hours of the cessation of the event. Obtain bacteria samples for fecal coliform or *E. coli* parameters at the following locations:

Kenilworth Beach	LD-WILHBR-3
Wilmette Beach	LD-WILHBR-4
Gillson Beach	LD-WILHBR-5
Lighthouse Beach	LD-WILHBR-6
Northwestern (Lincoln St.) Beach (if accessible)	LD-WILHBR-7
Dempster Street Beach	LD-WILHBR-8

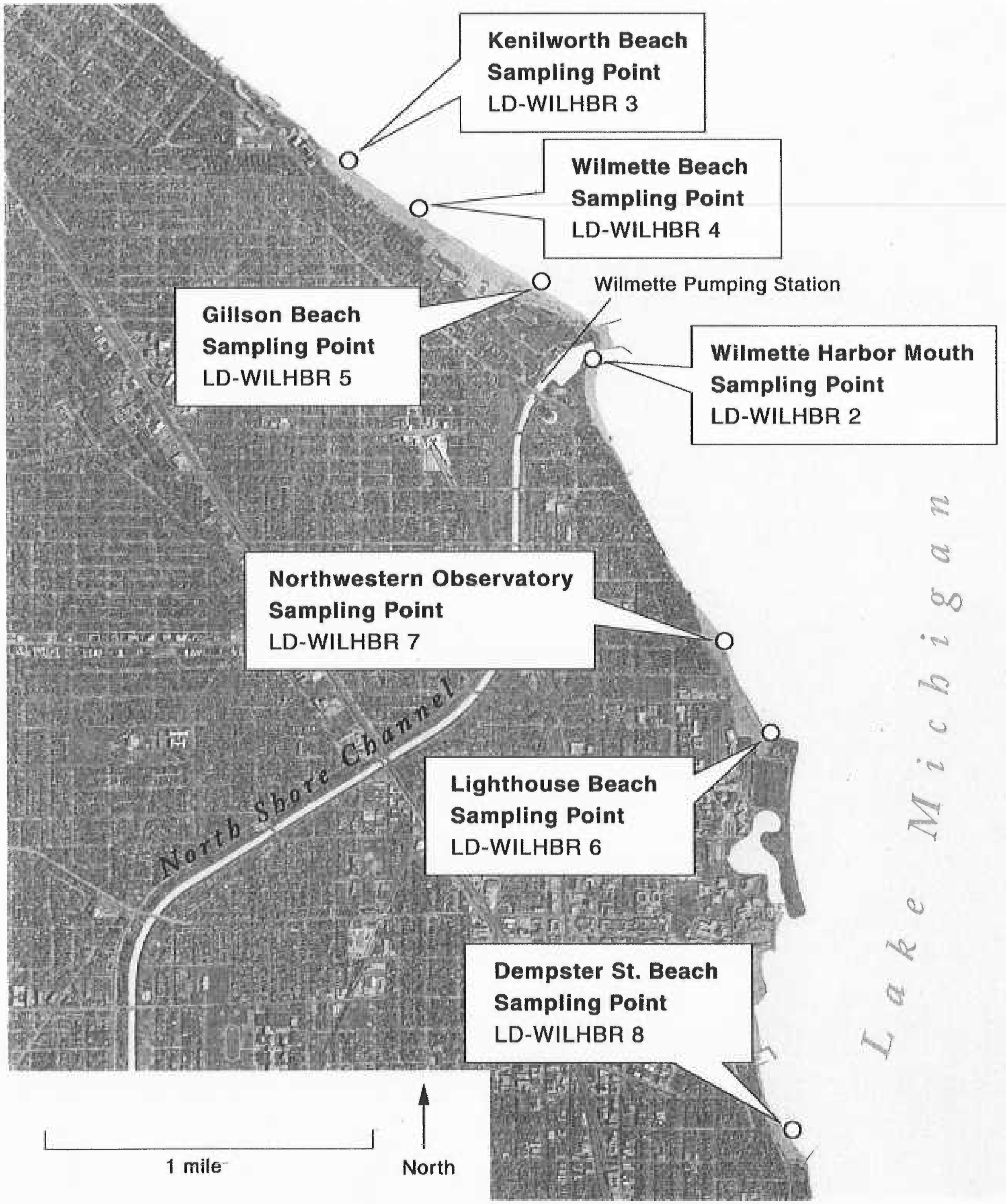
Again, notify the Microbiology Laboratory of the number of samples and the anticipated time of delivery.

This updated sampling plan calls for conducting sampling during the regular working periods, i.e., Monday through Friday between the hours of 7:00 a.m. and 3:30 p.m. except for holidays. For holiday, weekend or late night storm related backflow, the sampling will be scheduled on the following regular work day.

Please note that backflow beach sampling is performed only during the Chicago Park District's Beach Recreation Season: Memorial Day through Labor Day.

A report must be submitted to the Assistant Directors of Monitoring and Research by the Area Supervisor, or their designee, within two weeks following backflow and post-backflow sampling. It must contain a brief summary narrative, event chronology, and sampling log sheets.

FIGURE 3D.3: SAMPLING LOCATIONS FOLLOWING BACKFLOW TO LAKE MICHIGAN FROM WILMETTE PUMPING STATION



APPENDIX 3E

TARP STATUS REPORT

Protecting Our Water Environment

Metropolitan Water Reclamation District of Greater Chicago

100 EAST ERIE STREET CHICAGO, ILLINOIS 60611-3154 312.751.5600

TARP STATUS REPORT AS OF DECEMBER 31, 2020

This report presents construction progress, cost, and State/Federal grant and revolving loan funding information on the Tunnel and Reservoir Plan (TARP). Figures 1 through 4 are maps showing TARP facilities, and Tables I through III contain data on TARP contracts. Project reference numbers appearing in Table II correspond to the numbers shown on Figures 2, 3, and 4.

TARP Phase I

TARP, or "Deep Tunnel," was selected in 1972 as the Chicago area's plan for cost-effectively complying with Federal and State water quality standards with respect to the 375 square mile combined sewer area consisting of Chicago and 51 suburbs. TARP's main goals are to protect Lake Michigan – the region's drinking water supply - from raw sewage pollution; improve the water quality of area rivers and streams; and provide an outlet for floodwaters to reduce street and basement sewage backup flooding. TARP Phase I projects are primarily for pollution control. These projects capture and enable treatment of about 85% of the combined sewer overflow (CSO) pollution from TARP's service area. TARP Phase I includes 109.4 miles of deep, large diameter, rock tunnels. Construction of TARP Phase I was completed in 2006 and the entire system is now in operation. The table below summarizes the tunnel system.

TARP SYSTEM	TUNNEL LENGTH	TUNNEL VOLUME	TUNNEL DIAMETER
Mainstream	40.5 mi.	1,200 MG	8 to 33 ft.
Calumet	36.7 mi.	630 MG	9 to 30 ft.
O'Hare (UDP)	6.6 mi.	70 MG	9 to 20 ft.
Des Plaines	25.6 mi.	405 MG	10 to 33 ft.
TOTALS	109.4 mi.	2,305 MG	8 to 33 ft.

TARP Phase II/CUP

TARP Phase II/CUP consists of reservoirs intended primarily for flood control for the Chicagoland combined sewer area, but it will also considerably enhance pollution control benefits being provided under Phase I. The U.S. Army Corps of Engineers' (USACE) Chicagoland Underflow Plan (CUP), Final Phase I General Design Memorandum of 1986 defined the Federal interest in TARP Phase II based on the Federal National Economic Development Plan criteria. The three reservoirs proposed under TARP Phase II/CUP are the Gloria Alitto Majewski Reservoir, the Thornton Reservoir, and the McCook Reservoir.

Gloria Alitto Majewski Reservoir

As the local sponsor of TARP Phase II/CUP, the Metropolitan Water Reclamation District of Greater Chicago (District) acquired land rights for the reservoir. The USACE designed and constructed the reservoir, which was completed in 1998. The District has since assumed its operation, and to date the reservoir has captured over 7.6 billion gallons of combined sewage over 79 events and prevented flood damages in the three communities it serves.

Thornton Reservoir

On September 18, 2003 the USACE and District signed a Project Cooperation Agreement (PCA) for construction of the Thornton Composite Reservoir where the Corps would construct the reservoir and the District would take it over for operation. However, due to inadequate funding levels by the USACE and the need to have the Composite Reservoir operational, the District, in June 2004, assumed responsibility for the design and construction of the reservoir, and is pursuing reimbursement of funds through the Water Resources Development Act.

The Thornton Reservoir was constructed in two stages. The first stage, a temporary flood control reservoir called the Thornton Transitional Reservoir, was completed in March 2003 in the West Lobe of the Thornton Quarry. This reservoir provides overbank flood relief for 9 communities and has captured more than53 billion gallons of flood water during 75 fill events.

The second stage is a permanent combined reservoir, called the Thornton Composite Reservoir, constructed in the North Lobe of the Thornton Quarry. The Thornton Composite Reservoir provides 7.9 billion gallons of storage. In accordance with an agreement executed in 1998, a local mining company completed the Thornton Composite Reservoir excavation in 2013. Construction continued and the composite reservoir became operational at the end of 2015. The transitional reservoir in the West Lobe will continue to be used to hold Thorn Creek water during storms until 2022, when the West Lobe will be returned to an active quarry. At that time, the Thorn Creek flood water will be diverted to the composite reservoir. The Thornton Composite Reservoir benefits 556,000 people in 14 communities. Since becoming operational, the Thornton Composite Reservoir has prevented more than 39 billion gallons of combined sewage from entering the waterways.

McCook Reservoir

The District owns the land for the McCook Reservoir, which will be built within the Lawndale Avenue Solids Management Area. A PCA with the USACE was signed on May 10, 1999. The USACE is responsible for designing and constructing the reservoir features, and the District is responsible for providing the massive hole for the reservoir. Several construction contracts were completed by the USACE to turn the hole into a reservoir, including construction of a groundwater cutoff wall and grout curtain around the reservoir perimeter, a construction shaft for the connecting tunnel, stabilization of rock highwalls, stabilization of soil and construction of retaining walls, distribution tunnels between the reservoir and the pumping station, main tunnels to connect the reservoir to the existing Mainstream Tunnel, the Final Reservoir Prep Contract to complete the distribution tunnel connection to the reservoir and install an aeration system, and addition of pumps and motors at the pumping station.

In October 2003, the District signed an agreement with a local mining company to mine out the limestone to the limits of the McCook Reservoir. The District completed several contracts to connect the quarry to the reservoir site and procure and construct required mining equipment to crush and convey the rock to the quarry for processing. Overburden removal was completed in 2015. Full production mining at the site began in March 2008 and is expected to take approximately 20 years. In order to receive the partial benefits of Stage 1 sooner, the reservoir was planned to be mined and constructed in two stages. Mining of Stage 1 was completed in 2016, and the first stage of the reservoir was made operational at the end of 2017, providing 3.5 billion gallons for storage of combined sewage. Since becoming operational, Stage 1 of the McCook Reservoir has captured over 66 billion gallons of combined sewage.

With Stage 1 now operational, Stage 2 construction will continue over the next several years while mining progresses. In 2006, the District decided to expand the federally-authorized 3.5 billion gallon capacity of Stage 2 of the reservoir to 6.5 billion gallons. Stage 2 of the reservoir is currently being mined and is approximately 62% excavated and expected to be operational in 2029. The McCook Reservoir is estimated to provide more than $143 million per year in benefits to 3.1 million people in 37 communities.

Reservoir storage volumes are presented in the table below.

PHASE II/CUP RESERVOIR	VOLUME (in billion gallons)
Majewski Thornton McCook	0.35 4.8 * 10.0
TOTAL STORAGE	15.15

* Does not include portion designated for non-TARP overbank flood relief.

TARP/CUP Costs

Current TARP/CUP costs, details of which are provided in Tables I through III, are summarized as follows:

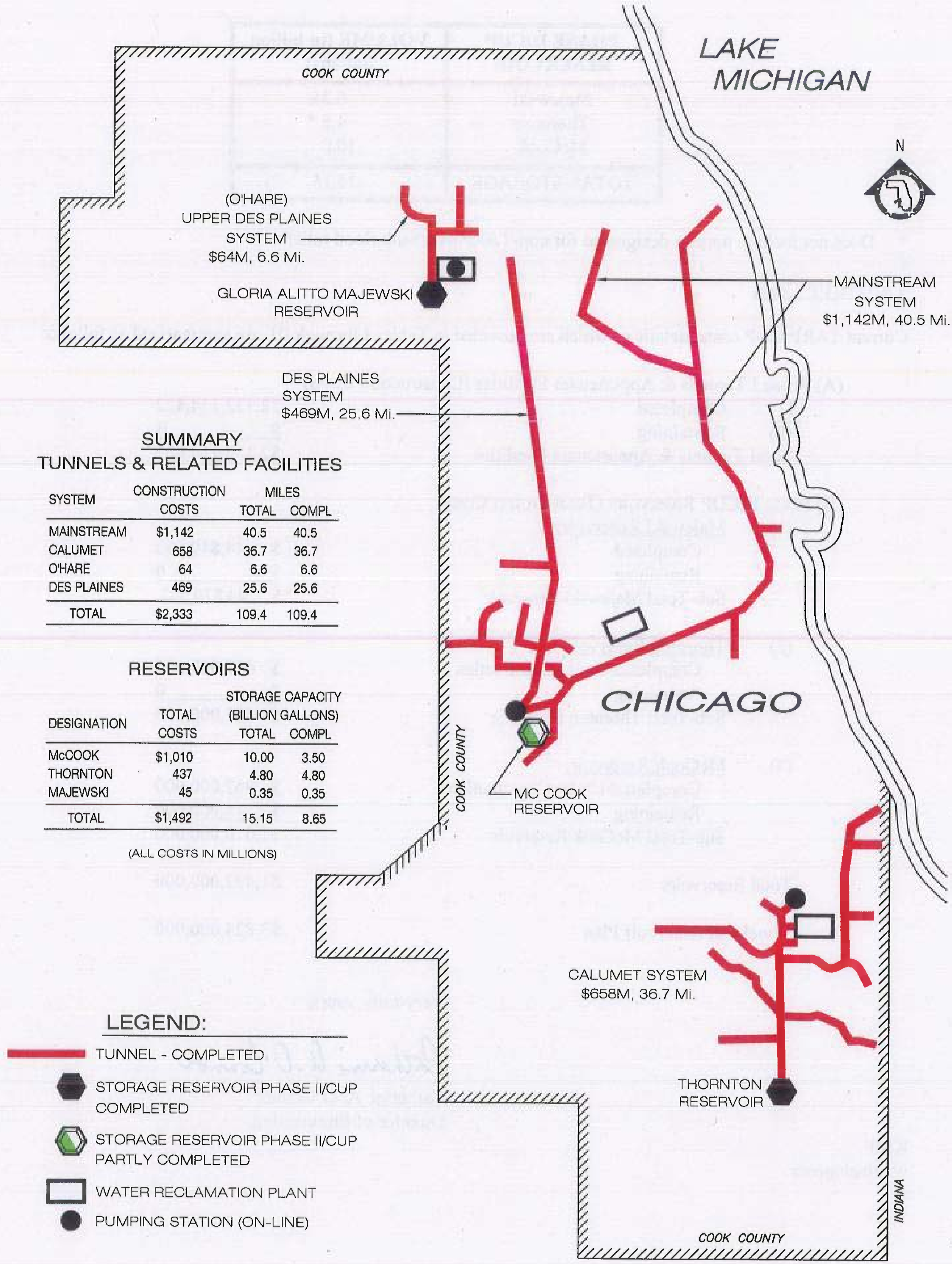
(A) Phase I Tunnels & Appurtenant Facilities (Construction Costs)		
(1)	Completed	$2,332,154,822
(2)	Remaining	$ 0
Total Tunnels & Appurtenant Facilities		$2,332,154,822
(B) Phase II/CUP Reservoirs (Total Project Costs)		
(1)	Majewski Reservoir:	
	Completed	$ 44,810,552
	Remaining	$ 0
	Sub-Total Majewski Reservoir	$ 44,810,552
(2)	Thornton Reservoir:	
	Completed/Under Construction	$ 437,000,000
	Remaining	$ 0
	Sub-Total Thornton Reservoir	$ 437,000,000
(3)	McCook Reservoir:	
	Completed/Under Construction	$ 962,000,000
	Remaining	$ 48,000,000
	Sub-Total McCook Reservoir	$1,010,000,000
Total Reservoirs		$1,492,000,000
Total Tunnel and Reservoir Plan		$3,824,000,000

Very truly yours,

Catherine A. O'Connor

Catherine A. O'Connor
Director of Engineering

KMF
w/attachments



SUMMARY

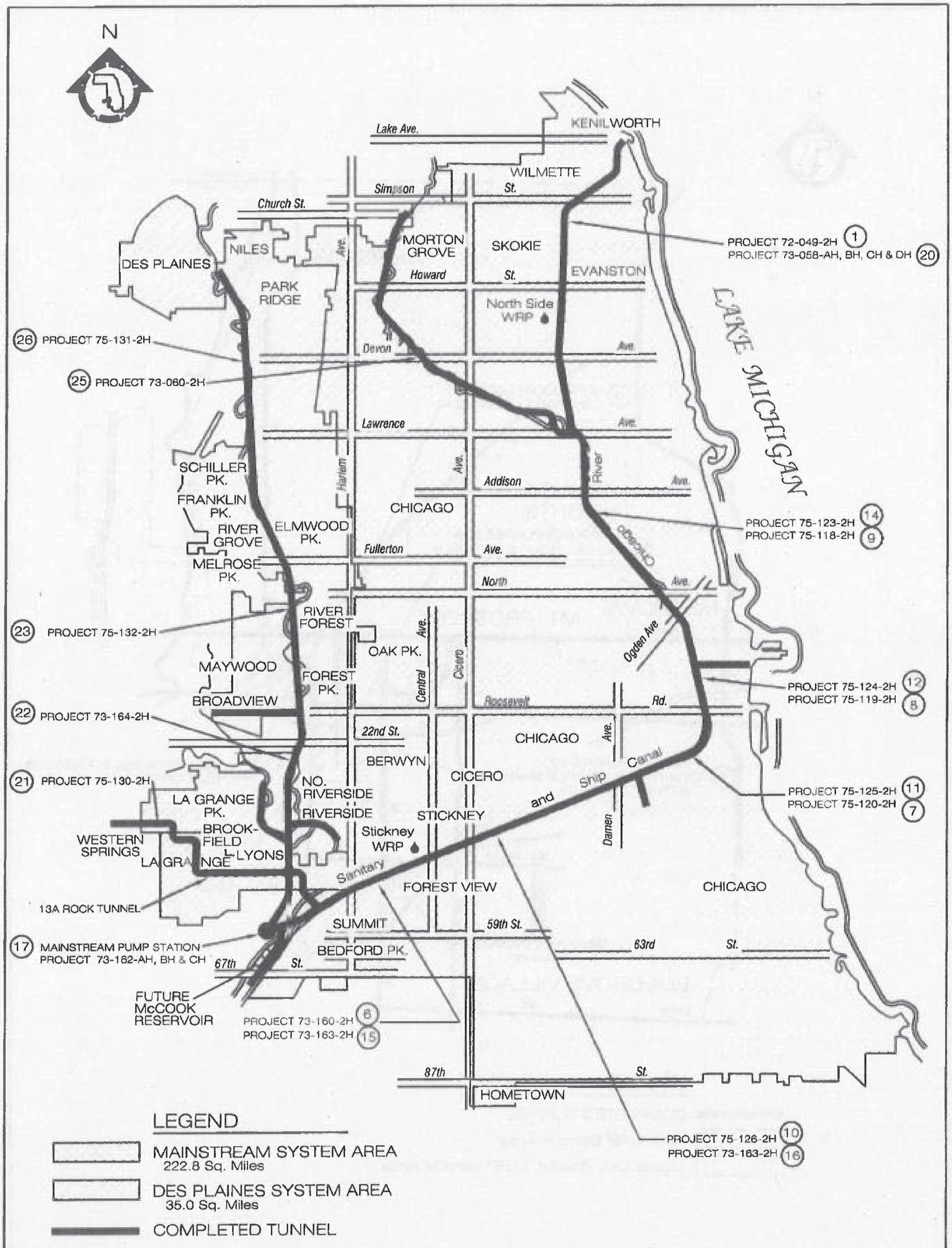
TUNNELS & RELATED FACILITIES

SYSTEM	CONSTRUCTION COSTS	MILES TOTAL	MILES COMPL
MAINSTREAM	$1,142	40.5	40.5
CALUMET	658	36.7	36.7
O'HARE	64	6.6	6.6
DES PLAINES	469	25.6	25.6
TOTAL	$2,333	109.4	109.4

RESERVOIRS

DESIGNATION	TOTAL COSTS	STORAGE CAPACITY (BILLION GALLONS) TOTAL	STORAGE CAPACITY (BILLION GALLONS) COMPL
McCOOK	$1,010	10.00	3.50
THORNTON	437	4.80	4.80
MAJEWSKI	45	0.35	0.35
TOTAL	$1,492	15.15	8.65

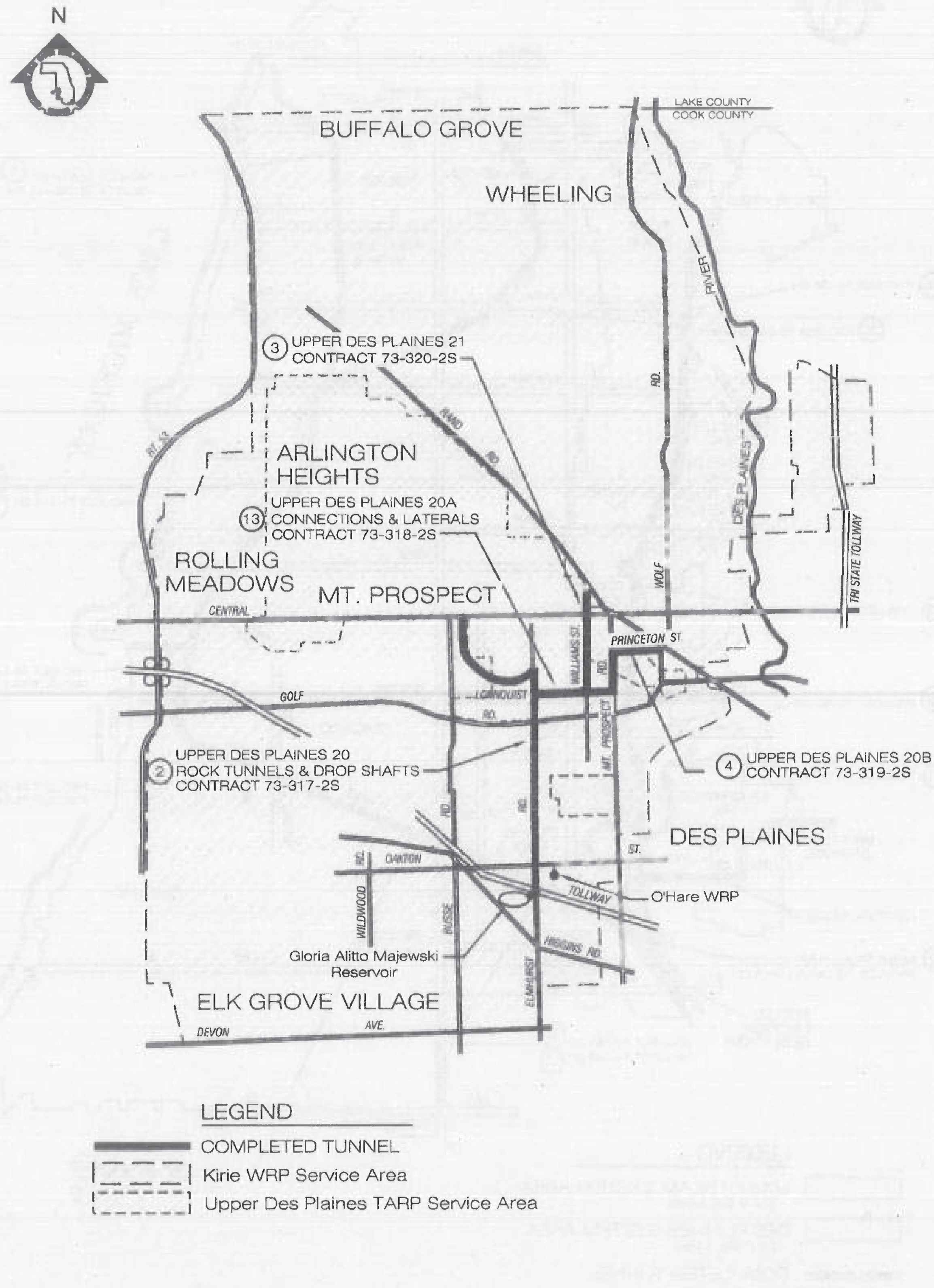
(ALL COSTS IN MILLIONS)



TARP - MAINSTREAM and DES PLAINES SYSTEMS

METROPOLITAN WATER RECLAMATION DISTRICT OF GREATER CHICAGO
ENGINEERING DEPARTMENT
TARP & PROJECT SUPPORT KMF:JJK

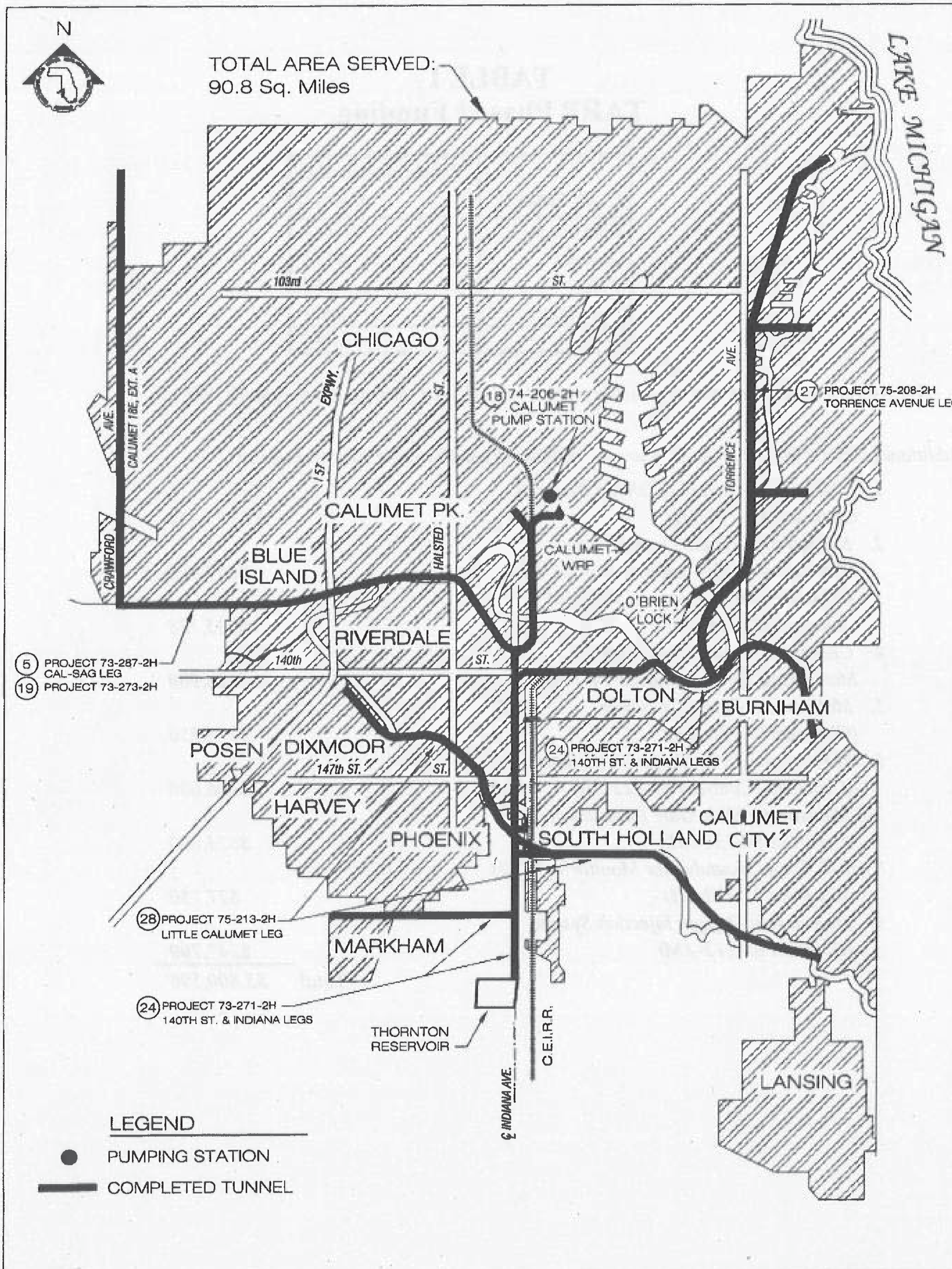
Figure 2



TARP - UPPER DES PLAINES (O'HARE) SYSTEM

METROPOLITAN WATER RECLAMATION
DISTRICT OF GREATER CHICAGO
ENGINEERING DEPARTMENT
TARP & PROJECT SUPPORT KMF:JJK

Figure 3



TARP - CALUMET SYSTEM

METROPOLITAN WATER RECLAMATION
DISTRICT OF GREATER CHICAGO
ENGINEERING DEPARTMENT
TARP & PROJECT SUPPORT KMF:JJK

Figure 4

TABLE I
TARP Phase I Funding

TARP System	*Total Construction Cost (1)*
Mainstream	*$1,142*
Calumet	*$658*
O'Hare	*$64*
Des Plaines	*$469*
Total	*$2,332*

(1) Costs are in millions and represent contract award costs and are not in today's dollars.

Additional TARP Phase 1 related contracts excluded from above for various reasons:

1.	*Mainstream System Bulkhead Removal Contract (82-178-2H)*	*$2,937,462*
2.	*Mainstream System Groundwater Monitoring Wells-Contract (73-162-DH)*	*$674,600*
3.	*Calumet System Bulkhead Removal Contract (82-243-2H)*	*$335,728*
4.	*Calumet System Groundwater Monitoring Wells (Contract 74-206-BH)*	*$128,900*
5.	*Mainstream Pitney Ct. Sewer (Contract 75-120-KH)*	*$278,856*
6.	*Mainstream Drop Shafts-Installation of Louvers (Contract 85-122-2H)*	*$496,600*
7.	*Mainstream Slide Gate Installation (Contract 86-131-2H)*	*$673,000*
8.	*S.W. 13-A Groundwater Monitoring Wells (Contract 73-172-2H)*	*$27,750*
9.	*Mainstream Oxygen Injection System (Contract 85-113-AM)*	*$247,700*
	Total	*$5,800,596*

TABLE II

TARP Phase I Contracts Completed

Ref. No. (1)	Project Name	Project Number	Contractor	Project Cost (2)
	Mainstream System			
1	*Addison-Wilmette Tunnel*	72-049-2H	*Kenny-Paschen, S & M J.V.*	$63,140,480
6	*59th to Central Tunnel*	73-160-2H	*Morrison-Knudsen, S & M, Paschen J.V.*	$86,493,975
7	*Damen to Roosevelt Connecting Structures*	75-120-2H	*Awarded to Various Contractors*	$19,877,570
8	*Roosevelt to Ogden Connecting Structures*	75-119-2H	*Awarded to Various Contractors*	$16,901,774
9	*Ogden to Addison Connecting Structures*	75-118-2H	*Awarded to Various Contractors*	$11,162,159
10	*Central to Damen Tunnel*	75-126-2H	*Healy, Ball, Horn J.V.*	$98,985,250
11	*Damen to Roosevelt Tunnel*	75-125-2H	*Paschen, Morrison-Knudsen, Kenny J.V.*	$107,837,300
12	*Roosevelt to Ogden Tunnel*	75-124-2H	*Shea Inc, P. Kiewit & Sons*	$101,970,680
14	*Ogden to Addison Tunnel*	75-123-2H	*Ball, Healy, Horn J.V.*	$85,205,910
15,16	*59th to Damen Connecting Structures*	73-163-2H	*Awarded to Various Contractors*	$26,440,052
17	*Mainstream Pumping Station Part I*	73-162-AH	*P.Kiewit & Sons, J F Shea, Kenny Cnstr J.V.*	$168,811,300
17	*Mainstream Pumping Station Part II*	73-162-BH	*Healy, Ball, Grow Tunneling Corp J.V.*	$64,755,000
17	*Mainstream Pumping Station Part III*	73-162-CH	*Morrison-Knudsen, Paschen Contractors J.V.*	$28,012,400
20	*Addison-Wilmette Connecting Structures*	73-058-AH	*Granite Construction Co.*	$34,966,450
20	*Addison-Wilmette Connecting Structures*	73-058-BH	*Granite Construction Co.*	$27,613,300
20	*Addison-Wilmette Connecting Structures*	73-058-CH	*Kenny, Paschen J.V.*	$19,571,740
20	*Addison-Wilmette Connecting Structures*	73-058-DH	*G H Ball Co, Dew & Sons J.V.*	$12,220,875

(1) Chronological order of awards
(2) Bid price

TABLE II (cont.)

TARP Phase I Contracts Completed

Ref. No. (1)	*Project Name*	*Project Number*	*Contractor*	*Project Cost (2)*
	Mainstream System (cont.)			
25	*North Branch Chicago River, Tnl & Conn Str.*	*73-060-2H*	*Perini, ICA, O&G J.V.*	*$167,907,130*
	Upper Des Plaines (O'Hare System)			
2	*Upper Des Plaines #20 Tunnel*	*73-317-2S*	*Healy, Ball, Greenfield J.V.*	*$35,749,664*
3	*Upper Des Plaines #21 Tunnel*	*73-320-2S*	*McHugh Construction Co.*	*$21,371,607*
4	*Upper Des Plaines #20B Tunnel*	*73-319-2S*	*Jay-Dee, Kenny J.V.*	*$2,683,943*
13	*Upper Des Plaines #20A Connecting Structures*	*73-318-2S*	*Jay-Dee, Jay-Dee of Illinois*	*$4,598,650*
	Calumet System			
5	*Crawford to Calumet Plant Tunnel*	*73-287-2H*	*Traylor Bros, Ferrera & Resco, Inc J.V.*	*$79,256,370*
18	*Calumet Tunnel And Pump Station*	*74-206-2H*	*Healy, Atlas-Gest International Inc J.V.*	*$54,841,825*
19	*Crawford Ave to Calumet Plant Connecting Str.*	*73-273-2H*	*S. A. Healy Co*	*$19,173,509*
24	*Calumet Tnl Sys,Tnl,Sfts,Con Str,140th St & Ind*	*73-271-2H*	*Kenny, P Kiewit, Shea J.V.*	*$194,530,500*
27	*Torrence Ave.Leg, Tunnels, Shfts & Conn Str.*	*75-208-2H*	*Kenny, P Kiewit, Shea J.V.*	*$140,666,650*
28	*Little Calumet Leg, Tunnels, Shfts & Conn Str.*	*75-213-2H*	*Jay-Dee, Affholder J.V.*	*$168,700,000*
	Des Plaines System			
21	*13A Ext.Tunnel,Shafts & Connecting Structures*	*75-130-2H*	*Kenny Construction Co.*	*$23,292,759*
22	*59th to Cermak,Tunnel,Shafts,& Connecting Str.*	*73-164-2H*	*Morrison-Knudsen, Paschen Contractors J.V.*	*$156,631,000*
23	*Cermak to Fullerton, Tnl, Sfts & Conn Struct.*	*75-132-2H*	*Impregilo, Ebasco, Losinger J.V*	*$147,665,000*
26	*Fullerton to Prairie, Tnl, Sfts & Conn Struct.*	*75-131-2H*	*Kenny, P Kiewit, Shea J.V.*	*$141,120,000*
			Total Phase I Contracts Completed:	***$2,332,154,822***

(1) Chronological order of awards
(2) Bid price

TABLE III
TARP Phase II/CUP
U.S. Army Corps of Engineers Chicagoland Underflow Plan (CUP)

12/31/20

Project Name	*Project Number*	*Design/Construction Status*	*Project Costs (4)*	*Funded by USACE*
O'Hare Reservoir				
I - USACE Contract	*73-315-2S*	*Construction completed in 1998*	*$40,818,858*	*75%*
II - Betterments (1)	*93-339-2F*	*Construction completed in 1998*	*$3,991,694*	*No*
Thornton Reservoir				*See Note 3*
I - Vincennes Avenue Relocation	*77-235-AF*	*Construction completed in 2001*	*$4,398,000*	
II - Transitional Reservoir GW Monitoring Wells	*77-235-CF*	*Construction completed in 2002*	*$529,000*	
III - Transitional Reservoir (2)	*77-235-BF*	*Construction completed in 2003*	*$54,707,000*	
IV - Mining, Land, and Corps Costs	*77-235-2F*	*Mining completed in 2013*	*$65,210,000*	
V - Tollway Dam and Grout Curtain	*04-201-4F*	*Construction Completed in 2015*	*$80,750,000*	
VI - TARP Inlet/Outlet Tunnels and Gates	*04-202-4F*	*Construction Completed in 2015*	*$147,000,000*	
VII - Final Reservoir Preparation	*04-203-4F*	*Construction Completed in 2015*	*$63,479,000*	
VIII - Surface Aeration	*04-203-AF*	*Construction Completed in 2017*	*$1,921,000*	
IX - Odor Control Systems and Decommsisioning TTR	*15-266-4HR*	*Construction to be Completed in 2022*	*$19,000,000*	
McCook Reservoir				
I - Stages 1 and 2 - USACE Contracts, land and engineering	*73-161-2H*	*Stage 1 completed in 2017, Stage 2 underway*	*$618,391,000*	*75%*
II - Site Preparation, Lagoons 1-10	*73-161-BH*	*Construction completed in 2000*	*$889,000*	*$307,000 Credited*
III - 73rd Street Tunnel Relocation	*97-156-2H*	*Construction completed in 2002*	*$15,132,000*	*Credited*
IV - Willow Springs Berm	*96-249-2P*	*Construction completed in 2002*	*$3,593,000*	*No*
V - Vulcan Primary Crusher Furnish and Deliver	*PO3030920*	*Crusher Purchased in 2005*	*$1,626,000*	*No*
VI - Conveyance Tunnel	*73-161-AH*	*Construction completed in 2006*	*$5,428,000*	*No*
VII - Vulcan Mining Trucks and Loaders	*73-161-HH*	*Vehicles delivered in 2007*	*$11,105,000*	*No*
VIII - Vulcan Miscellaneous Mining Vehicles	*73-161-GH*	*Vehicles delivered in 2007 and 2008*	*$4,989,000*	*No*
IX - Conveyance System and Maintenance Facilities	*73-161-FH*	*Construction completed in 2008*	*$32,381,000*	*$1.84 M Credited*
X - LASMA Overburden Removal	*73-161-CH*	*Construction completed in 2010*	*$66,316,000*	*No*
XI - Vulcan Rock Mining Hard Costs Less Royalty	*73-161-EH*	*Mining Stage 2 underway*	*$61,695,000*	*No*
XII - Stage 2 Misc. Overburden Removal	*73-161-JH*	*Construction completed in 2012*	*$6,510,000*	*No*
XIII - Expanded Stage 2 Overburden Removal	*73-161-DH*	*Construction completed in 2016*	*$18,743,000*	*No*
XIV - Des Plaines Inflow Tunnel	*13-106-4F*	*Under Construction*	*$112,237,000*	*No*
XV - Expanded Stage 2 Slope Stabilization	*16-125-4F*	*Completed in 2019*	*$8,897,492*	*No*
XVI - McCook Reservoir Stage 2 Rock Wall Stabilization	*17-131-4F*	*Future*	*$17,300,000*	*53%*
XVII - McCook Reservoir Stage 2 Final Reservoir Prep	*17-132-4F*	*Future*	*$24,800,000*	*69%*
		Total Project Cost	*$1,491,837,000*	

(1) Betterment includes a control building, reservoir outflow control gates, and monitoring system.
(2) Cost shown is total cost of Transitional Reservoir. Facilities that will be re-used for the Thornton Composite Reservoir account for $30,337,000 of the cost.
(3) The District designed and constructed the Thornton Composite Reservoir in anticipation of receiving reimbursement or credits from the Corps.
(4) Includes land, engineering, and construction costs.

APPENDIX 3F

LIST OF COMBINED SEWER OVERFLOWS

Metropolitan Water Reclamation District of Greater Chicago CSO Connections

Owner	Waterway	Monitored or Unmonitored	Outfall #	TARP Connection	Representative Outfall
MWRD	NSC	M	101	DS-M114N	MWRD101
Wilmette	NSC	M	001	DS-M114N-2	WM001
Wilmette	NSC	U	002	DS-M113	MWRD101
Evanston	NSC	U	003	I-109	MWRD102
Evanston	NSC	U	004	DS-M110	MWRD102
MWRD	NSC	M	102	DS-M109N	MWRD102
Evanston	NSC	U	NP	I-108	MWRD102
Evanston	NSC	M	A04	DS-M109S	EVA04
Evanston	NSC	U	005	DS-M106W	EVA07 (DS-M107-2)
Evanston	NSC	M	A07	DS-M107-2	EVA07
MWRD	NSC	U	103	DS-M108	SK003 (DS-M107-1)
Evanston	NSC	U	006	DS-M107-2	SK003 (DS-M107-1)
Evanston	NSC	U	A06	DS-M108	SK003 (DS-M107-1)
Skokie	NSC	M	003	DS-M107-1	SK003
Skokie	NSC	U	004	I-104	SK002 (DS-M105W)
Evanston	NSC	U	A08	DS-M106E	SK002 (DS-M105W)
MWRD	NSC	M	104	DS-M106E	MWRD104
Skokie	NSC	M	002	DS-M105W	SK002
Evanston	NSC	M	009	TG-M105E	EV009
Skokie	NSC	M	005	DS-M104W	SK005 (DS-M104W)

Metropolitan Water Reclamation District of Greater Chicago CSO Connections

Owner	Waterway	Monitored or Unmonitored	Outfall #	TARP Connection	Representative Outfall
Evanston	NSC	M	010	DS-M104E	EV010
Evanston	NSC	U	A10	DS-M104E	EV010
Evanston	NSC	U	011	DS-M103	SK005 (DS-M104W)
MWRD	NSC	U	110	I-102	SK005 (DS-M104W)
Evanston	NSC	U	012	DS-M102	SK005 (DS-M104W)
Evanston	NSC	U	013	DS-M101	EVA13
Evanston	NSC	M	A13	DS-M101	EVA13
MWRD	NSC	M	105	DS-M100	MWRD105
Skokie	NSC	U	001	I-99	EV010
Chicago	NSC	U	039	DS-M99	EV010
Chicago	NSC	U	001	DS-M98	CG002
MWRD / Lincolnwood	NSC	U	106 / 001	I-97	CG003
Chicago	NSC	M	002	DS-M97	CG002
Lincolnwood	NSC	U	002	I-96	CG003
Chicago	NSC	M	003	DS-M97	CG003
Chicago	NSC	U	004	I-95	CG003
Chicago	NSC	U	005	DS-M96	CG002
Chicago	NSC	U	006	DS-M95	CG010
Chicago	NSC	U	007	I-94	CG010
Chicago	NSC	U	008	I-93	CG010

Metropolitan Water Reclamation District of Greater Chicago CSO Connections

Owner	Waterway	Monitored or Unmonitored	Outfall #	TARP Connection	Representative Outfall
Chicago	NSC	U	009	I-92	CG010
Chicago	NSC	M	010	TG-M94	CG010
Chicago	NSC	U	011	DS-M93	CG010
Chicago	NSC	U	012	I-91	CG010
Chicago	NSC	U	038	I-116	CG010
Chicago	NSC	U	233	DS-M92	CG010
Chicago	NSC	U	014	I-89	CG010
Golf	WF-NBCR	U	001	Indirect (DS-N20)	MG002
Morton Grove	NBCR	U	001	DS-N20	MG002
Morton Grove	NBCR	M	002	DS-N19	MG002
Niles	NBCR	M	001	DS-N18	NI001
Niles	NBCR	M	002	DS-N17	NI002
Niles	NBCR	M	003	DS-N16	NI003
Niles	NBCR	U	NP	Indirect (DS-N16)	NI003
Chicago / Niles	NBCR	U	NP	DS-N15	NI003
Niles	NBCR	U	006	DS-N15	NI003
Niles	NBCR	U	007	DS-N15	NI003
Niles / Chicago	NBCR	M	008 / 236	DS-N13R	CG236
Niles	NBCR	M	010	DS-N12	NI010
Niles	NBCR	M	009	DS-N11	NI090

Metropolitan Water Reclamation District of Greater Chicago CSO Connections

Owner	Waterway	Monitored or Unmonitored	Outfall #	TARP Connection	Representative Outfall
Chicago	NBCR	M	017	DS-N10B	CG017
Chicago	NBCR	M	016	DS-N10A	CG016
Chicago	NBCR	M	018	DS-N09	CG018
Chicago	NBCR	U	019	DS-N08	CG020
Chicago	NBCR	M	020	DS-N08	CG020
Chicago	NBCR	M	021	DS-N07	CG021
Chicago	NBCR	M	234	DS-N06	CG234
Chicago	NBCR	M	024	DS-N05	CG024
Chicago	NBCR	U	023	Indirect (DS-N04)	CG026
Chicago	NBCR	M	026	DS-N04	CG026
Chicago	NBCR	M	029	DS-N03	CG029
Chicago	NBCR	M	030	DS-N02	CG030
Chicago	NBCR	U	235	DS-N01	CG030
Chicago	NBCR	U	040	I-88	CG042
Chicago	NBCR	U	035	I-88	CG042
Chicago	NBCR	M	042	DS-LAT	CG042
MWRD	NBCR	M	107	DS-M90 & DS-M91 (NBP	MWRD107
Chicago	NBCR	U	041	I-87	CG042
Chicago	NBCR	U	043	I-86	MWRD107
Chicago	NBCR	U	044	I-85	CG042

Metropolitan Water Reclamation District of Greater Chicago CSO Connections

Owner	Waterway	Monitored or Unmonitored	Outfall #	TARP Connection	Representative Outfall
Chicago	NBCR	U	046	I-82	MWRD107
Chicago	NBCR	U	047	I-83	MWRD107
Chicago	NBCR	U	048	I-81	CG057
Chicago	NBCR	U	049	I-80	CG057
Chicago	NBCR	U	050	I-79A	CG057
Chicago	NBCR	U	051	DS-M89	CG057
Chicago	NBCR	U	052	I-78	CG057
Chicago	NBCR	M	057	DS-M88	CG057
Chicago	NBCR	U	058	DS-M87	CG057
Chicago	NBCR	U	059	I-77	CG057
Chicago	NBCR	U	060	Indirect (DS-M90)	CG231
Chicago	NBCR	M	231	DS-M86	CG231
Chicago	NBCR	U	062	I-76	CG061
Chicago	NBCR	M	061	DS-M85	CG061
Chicago	NBCR	M	063	DS-M84	CG063
Chicago	NBCR	M	238	DS-M83	CG238
Chicago	NBCR	M	064	DS-M82	CG064
Chicago	NBCR	M	065	TG-M81	CG065
Chicago	NBCR	M	067	DS-M80	CG067
Chicago	NBCR	M	068	DS-M79	CG068

Metropolitan Water Reclamation District of Greater Chicago CSO Connections

Owner	Waterway	Monitored or Unmonitored	Outfall #	TARP Connection	Representative Outfall
Chicago	NBCR	U	069	DS-M78	CG070
Chicago	NBCR	M	070	DS-M79	CG070
Chicago	NBCR	U	072	DS-M77	CG073
Chicago	NBCR	M	073	DS-M76	CG073
Chicago	NBCR	M	074	DS-M75	CG074
Chicago	NBCR	U	075	I-75	CG077
Chicago	NBCR	U	076	I-75	CG077
Chicago	NBCR	M	077	DS-M73	CG077
Chicago	NBCR	U	078	I-74	CG077
Chicago	NBCR	U	079	I-73	CG077
Chicago	NBCR	U	080	I-72	CG077
Chicago	NBCR	U	081	DS-M72	CG082
Chicago	NBCR	M	082	TG-M71	CG082
Chicago	NBCR	M	083	DS-M70	CG083
Chicago	NBCR	M	084	DS-M66	CG084
Chicago	NBCR	U	085	DS-M69	CG084
Chicago	NBCR	U	086	I-71	CG083
Chicago	NBCR	U	087	I-70	CG084
Chicago	NBCR	U	088	DS-M65	CG092
Chicago	NBCR	U	090	DS-M67R	CG092

Metropolitan Water Reclamation District of Greater Chicago CSO Connections

Owner	Waterway	Monitored or Unmonitored	Outfall #	TARP Connection	Representative Outfall
Chicago	NBCR	U	091	I-68B	CG092
Chicago	NBCR	M	092	DS-M64	CG092
Chicago	NBCR	U	093	DS-M64	CG092
Chicago	NBCR	U	230	DS-M67R	CG092
Chicago	NBCR	U	094	I-68A	CG092
Chicago	NBCR	U	095	DS-M63	CG092
Chicago	NBCR	U	237	I-67	CG092
Chicago	NBCR	U	096	I-67	CG092
Chicago	NBCR	U	097	I-66	CG103
Chicago	NBCR	U	098	I-65(A&B)	CG103
Chicago	NBCR	U	099	I-64	CG103
Chicago	NBCR	U	100	I-63	CG103
Chicago	NBCR	U	101	I-62	CG103
Chicago	NBCR	M	103	DS-M61A	CG103
Chicago	CR	U	104	DS-M59	CG106
Chicago	CR	U	105	DS-M60	CG106
Chicago	CR	M	106	TG-M60	CG106
Chicago	CR	M	107	DS-M55	CG107
Chicago	CR	U	109	I-59	CG107
Chicago	CR	U	114	I-53	CG107

Metropolitan Water Reclamation District of Greater Chicago CSO Connections

Owner	Waterway	Monitored or Unmonitored	Outfall #	TARP Connection	Representative Outfall
Chicago	CR	U	110	I-58	CG107
Chicago	CR	U	111	I-56	CG107
Chicago	CR	U	112	I-55	CG107
Chicago	CR	U	113	I-54	CG107
Chicago	CR	U	115	I-52	CG107
Chicago	CR	U	116	I-51	CG107
Chicago	CR	U	117	I-49 & I-50	CG107
Chicago	CR	U	118	I-48	CG107
Chicago	CR	U	119	I-47A & I-47B	CG107
Chicago	CR	U	120	I-46	CG107
Chicago	CR	M	121	DS-M54	CG121
Chicago	SBCR	U	123	I-44 & I-45	CG129
Chicago	SBCR	U	124	I-44	CG129
Chicago	SBCR	M	125	Indirect (TG-M53)	CG125
Chicago	SBCR	U	126	I-42	CG129
Chicago	SBCR	U	127	I-41	CG129
Chicago	SBCR	M	129	DS-M52	CG129
Chicago	SBCR	U	128	I-39	CG129
Chicago	SBCR	U	130	I-38	CG129
Chicago	SBCR	U	131	I-35	CG129

Metropolitan Water Reclamation District of Greater Chicago CSO Connections

Owner	Waterway	Monitored or Unmonitored	Outfall #	TARP Connection	Representative Outfall
Chicago	SBCR	M	132	DS-M51	CG132
Chicago	SBCR	U	133	I-33	CG132
Chicago	SBCR	M	134	TG-I32	CG134
Chicago	SBCR	U	137	DS-M50	CG134
Chicago	SBCR	M	136	TG-I28 & I29	CG136
Chicago	SBCR	M	138	DS-M49	CG138
Chicago	SBCR	M	140	DS-M47	CG140
Chicago	SBCR	U	141	DS-M46	CG143
Chicago	SBCR	M	143	DS-M45	CG143
Chicago	SBCR	U	144	DS-M44	CG143
Chicago	SBCR	U	145	DS-M43	CG143
Chicago	SBCR	U	146	I-25	CG143
Chicago	SBCR	U	148	I-24	CG151
Chicago	SBCR	U	147	DS-M42	CG143
Chicago	SBCR	U	149	I-23	CG151
Chicago	SBCR	M	151	DS-M41	CG151
Chicago	SBCR	U	150	Indirect (DS-M41)	CG151
Chicago	SBCR	U	152	I-123	CG151
Chicago	SBCR	U	153	I-21	CG151
Chicago	SBCR	M	154	DS-M40	CG154

Metropolitan Water Reclamation District of Greater Chicago CSO Connections

Owner	Waterway	Monitored or Unmonitored	Outfall #	TARP Connection	Representative Outfall
Chicago	SBCR	U	155	DS-M39	CG154
Chicago	SBCR	M	156	DS-M38	CG156
Chicago	SBCR	U	157	DS-M37	CG156
Chicago	SBCR	U	158	I-20	CG156
Chicago	SBCR	U	159	I-19	CG156
Chicago	SBCR	U	160	I-18	CG156
Chicago	SBCR	U	163	I-15	CG166
Chicago	SBCR	U	165	DS-M36	CG166
Chicago	SBCR	M	166	DS-M35	CG166
Chicago	SBCR	U	167	DS-M34	CG166
Chicago	SBCR	M	168	DS-M25	CG168
Chicago	SBCR	U	169	DS-M23	CG168
Chicago	SBCR	U	170	DS-M23	CG168
Chicago	SFSBCR	U	190	DS-M33	CG194
Chicago	SFSBCR	U	191	DS-M32	CG194
Chicago	SFSBCR	U	192	DS-M31	CG194
Chicago	SFSBCR	U	193	DS-M31	CG194
Chicago	SFSBCR	U	195	I-119	CG194
Chicago	SFSBCR	M	194	DS-M30	CG194
Chicago	SFSBCR	U	196	I-117	CG198

Metropolitan Water Reclamation District of Greater Chicago CSO Connections

Owner	Waterway	Monitored or Unmonitored	Outfall #	TARP Connection	Representative Outfall
Chicago	SFSBCR	M	198	DS-M26	CG198
MWRD	SFSBCR	M	142	DS-M27,DS-M28,& DS-M	MWRD142
Chicago	CSSC	M	172	TG-M22	CG172
Chicago	CSSC	M	173	DS-M21	CG173
Chicago	CSSC	M	174	DS-M20	CG174
Chicago	CSSC	M	176	DS-M19	CG176
Chicago	CC	M	178	TG-I12	CG178
Chicago	CSSC	U	179	DS-M18	CG180
Chicago	CSSC	M	180	DS-M17	CG180
Chicago	CSSC	U	181	I-10	CG184
Chicago	CSSC	M	182	TG-M16	CG182
Chicago	CSSC	M	183	TG-I9	CG183
Chicago	CSSC	M	184	TG-I8	CG184
Chicago	CSSC	M	185	DS-M15	CG185
Chicago	CSSC	M	186	TG-I5	CG186
Chicago	CSSC	M	187	DS-M12	CG187
MWRD	CSSC	M	143	DS-M13	MWRD143
MWRD	CSSC	M	144	DS-M10	MWRD144
Stickney	CSSC	M	001	DS-M09	ST001
MWRD	CSSC	M	145	DS-M09	MWRD145

Metropolitan Water Reclamation District of Greater Chicago CSO Connections

Owner	Waterway	Monitored or Unmonitored	Outfall #	TARP Connection	Representative Outfall
Chicago	CSSC	M	188	DS-M08	CG188
Chicago	CSSC	M	189	TG-NASH	CG189
Forest View	CSSC	U	001	DS-M07	CG189
Summit	CSSC	U	001	DS-M5B	MWRD146
MWRD	CSSC	M	146	TG-13A	MWRD146
Summit	CSSC	M	002	TG-M05	SU002
Summit	CSSC	U	003	Indirect (DS-M03)	MWRD147
MWRD	CSSC	M	147	DS-M03	MWRD147
MWRD	CSSC	U	148	DS-M01	MWRD147
MWRD	CSSC	U	149	DS-M02	MWRD147
MWRD	CSSC	M	002	None	MWRD002
MWRD	DPR	U	109	Indirect (DS-D03R)	DP001
Des Plaines	DPR	M	001	DS-D01	DP001
Park Ridge	DPR	M	005	DS-D02	PR005
Des Plaines	DPR	U	003	DS-D02	PR005
Methodist Campground	DPR	U	NP	DS-D02	PR005
Des Plaines	DPR	U	002	DS-D02	PR005
Des Plaines	DPR	M	005	DS-D03R	DP005
Des Plaines	DPR	U	004	DS-D03R	DP005
Des Plaines	DPR	U	006	None	

Metropolitan Water Reclamation District of Greater Chicago CSO Connections

Owner	Waterway	Monitored or Unmonitored	Outfall #	TARP Connection	Representative Outfall
Park Ridge	DPR	M	002	DS-D05	PR002
Park Ridge	DPR	M	006	DS-D05	PR006
Park Ridge	DPR	M	003	DS-D06	PR003
Park Ridge	DPR	M	007	DS-D06	PR007
MWRD	DPR	M	131	DS-D07	MWRD131
Park Ridge	DPR	M	004	DS-D07	PR004
Park Ridge	DPR	M	008	DS-D07	PR008
MWRD	DPR	M	132	DS-D08	MWRD132
MWRD	DPR	M	133	DS-D09	MWRD133
Chicago	DPR	M	226	DS-D10	CG226
Schiller Park	DPR	M	001	DS-D12I	SL001
Franklin Park	DPR	M	001	DS-D13	FK001
Franklin Park	DPR	U	003	DS-D14	FK004
Chicago	DPR	M	227	DS-D11	CG227
Franklin Park	DPR	M	004	DS-D14	FK004
River Grove / Franklin Park	DPR	M	001 / 002	DS-D15	FK002
River Grove	DPR	M	002	DS-D16	RG002
River Grove	DPR	M	003	DS-D17	RG003
River Grove	DPR	M	004	DS-D17	RG004
River Grove	DPR	M	005	DS-D18	RG005

Metropolitan Water Reclamation District of Greater Chicago CSO Connections

Owner	Waterway	Monitored or Unmonitored	Outfall #	TARP Connection	Representative Outfall
River Grove	DPR	M	006	DS-D20I	RG006
MWRD	DPR	M	134	DS-D19,23	MWRD134
Melrose Park	DPR	M	001	DS-D52	MP001
Maywood	DPR	M	001	DS-D22,24,25	MW002
Maywood	DPR	M	002	DS-D22,24,25	MW002
Maywood	DPR	M	NP	DS-D22,24,25	MW NP (DS-D22, 24, 25)
MWRD	DPR	M	135	DS-D63	MWRD135
Maywood	DPR	M	NP	DS-D21,25	MW NP (DS-D21,25)
River Forest	DPR	M	003	DS-D26	RF003
Maywood	DPR	M	NP	DS-D21,25	MW NP (DS-D21, 25)
Maywood	DPR	M	003	DS-D21,25	MW003
Maywood	DPR	M	NP	DS-D27I	MW NP (DS-D27I)
Maywood	DPR	M	004	DS-D27I	MW004
Maywood	DPR	M	005	DS-D27I	MW005
Maywood	DPR	M	NP	DS-D31	MW NP (DS-D31)
Maywood	DPR	M	006	DS-D31	MW006
River Forest	DPR	M	004	DS-D29,64	RF004
Maywood	DPR	M	007	DS-D32	MW007
Forest Park	DPR	M	002	DS-D28	FP002
Forest Park	DPR	M	001	DS-D30,28	FP001

Metropolitan Water Reclamation District of Greater Chicago CSO Connections

Owner	Waterway	Monitored or Unmonitored	Outfall #	TARP Connection	Representative Outfall
MWRD	DPR	U	136	DS-D34-DI	MW008
Maywood	DPR	M	008	DS-D33	MW008
North Riverside	DPR	M	001	DS-D36	NR001
North Riverside	DPR	M	002	DS-D35	NR002
Riverside	DPR	M	013	DS-D66	RS013
Riverside	DPR	M	010	DS-D44,45	RS010
Riverside	DPR	M	NP	DS-D44,45	RS NP (DS-D44, 45)
Riverside	DPR	M	011	DS-D44,45	RS011
Riverside	DPR	M	012	DS-D41	RS012
Lyons	DPR	M	001	DS-D49	LY001
Lyons	DPR	M	002	DS-D48	LY002
Lyons	DPR	M	003	DS-13A-4 (TG137)	LY003
MWRD	Addison Creek	M	150	DS-D34-AI	MWRD150
LaGrange Park	SC	U	001	DS-13A-53	LP003
LaGrange Park	SC	U	002	DS-13A-53	LP003
LaGrange Park	SC	U	004	DS-13A-54	LP003
Western Springs	SC	U	001	DS-13A-55	LP003
Western Springs	SC	U	002	DS-13A-56	LP003
Brookfield	SC	M	001	DS-D37,38	BF001
LaGrange Park	SC	M	003	DS-D37,38	LP003

Metropolitan Water Reclamation District of Greater Chicago CSO Connections

Owner	Waterway	Monitored or Unmonitored	Outfall #	TARP Connection	Representative Outfall
Brookfield	SC	M	003	DS-D40	BF003
Brookfield	SC	M	008	DS-D62	BF008
Brookfield	SC	M	007	DS-D39,42,46	BF007
Brookfield	SC	M	004	DS-D39,42,46	BF004
Brookfield	SC	M	005	DS-D39,42,46	BF005
Brookfield	SC	M	006	DS-D47,50,51	BF006
Brookfield	SC	M	009	DS-D47,50,51	BF009
LaGrange	SC	M	001	DS-D47,50,51 & DS-13A-	LG001
MWRD	CalR	M	151	cds34	MWRD151
MWRD	CalR	M	152	CDS-28	MWRD152
Chicago	CalR	M	206	CDS-20	CG206
Dolton	LCalR	M	002	CDS-18	DT002
MWRD	LCalR	M	004	TARP Outfall	MWRD004
Chicago	LCalR	M	239	CDS-16	CG239
Dolton	LCalR	M	001	CDS-17	DT001
Chicago	LCalR	U	209	CI-9	CG239
Chicago	LCalR	M	210	CDS-15-5	CG210
Chicago	LCalR	M	211	CDS-14	CG211
MWRD	LCalR	M	153	CDS-13	MWRD153
Riverdale	LCalR	M	002	CDS-15-1	RV002

Metropolitan Water Reclamation District of Greater Chicago CSO Connections

Owner	Waterway	Monitored or Unmonitored	Outfall #	TARP Connection	Representative Outfall
Riverdale	LCalR	M	005	CDS-15-4	RV005
Riverdale	LCalR	U	NP	CDS-15	RV003
Riverdale	LCalR	M	NP	CDS-15-3	RV NP (CDS-15-3)
Riverdale	LCalR	M	003	CDS-15-2	RV003
Chicago	LCalR	M	241	CDS-12	CG241
Chicago	LCalR	U	214	CI-8	RV002
Chicago	LCalR	U	215	CI-7	RV002
Chicago	LCalR	U	216	CI-6	RV002
Dixmoor	LCalR	M	001	CDS-39	DM001
Harvey	LCalR	M	001	CDS-41	HV001
Harvey	LCalR	M	002	CDS-41	HV002
Riverdale	LCalR	M	004	CDS-42	RV004
Harvey	LCalR	M	003	CDS-42	HV003
Harvey	LCalR	M	004	CDS-43	HV004
Harvey	LCalR	M	005	CDS-43	HV005
Harvey	LCalR	M	006	CDS-45	HV006
South Holland	LCalR	M	004	CDS-45	SH004
South Holland	LCalR	M	NP	CDS-45	SH NP (CDS-45)
Harvey	LCalR	M	007	CDS-45	HV007
Phoenix	LCalR	M	001	CDS-45	PO001

Metropolitan Water Reclamation District of Greater Chicago CSO Connections

Owner	Waterway	Monitored or Unmonitored	Outfall #	TARP Connection	Representative Outfall
South Holland	LCalR	M	005	Indirect (CDS-47)	SH003
South Holland	LCalR	M	003	CDS-48	SH003
South Holland	LCalR	M	001	CDS-C-1	SH001
South Holland	LCalR	M	002	CDS-C-1	SH002
Dolton	LCalR	M	003	CDS-51	DT003
Calumet City	LCalR	M	002	CDS-53	CA002
Calumet City	LCalR	M	003	CDS-53	CA003
Lansing / Calumet City	LCalR	M	002 / 005	CDS-55	LS002
Calumet City	LCalR	M	004	CDS-55	CA004
Calumet City	LCalR	M	005	CDS-55	CA005
Calumet City	LCalR	M	006	CDS-55	CA006
Calumet City	LCalR	M	007	CDS-55	CA007
MWRD	CSC	M	154	CDS-11	MWRD154
Chicago / Calumet Park	CSC	M	218/001	CDS-10	CG218
Blue Island	CSC	U	004	CDS-9	BI003
Blue Island	CSC	M	003	CDS-8	BI003
Blue Island	CSC	M	002	CDS-7	BI002
Blue Island / Posen	CSC	M	005 / 001	CDS-6	BI005/PO001
MWRD / Blue Island	CSC	M	156 / 001	CDS-5	MWRD156
MWRD	CSC	M	163	CDS-4	MWRD163

Metropolitan Water Reclamation District of Greater Chicago CSO Connections

Owner	Waterway	Monitored or Unmonitored	Outfall #	TARP Connection	Representative Outfall
Robbins	CSC	U	NP	CI-3	BI005/PO001
Robbins	CSC	U	NP	CI-2	BI005/PO001
MWRD	CSC	M	157	CDS-2	MWRD157
MWRD	CSC	M	158	18E PS	MWRD158
Robbins	CSC	U	NP	CI-1	BI005/PO001
Burnham	GCalR	M	001	CDS-21	BM001
Burnham	GCalR	M	002	CDS-22	BM002
Burnham	GCalR	M	003	CDS-23	BM003
Calumet City	GCalR	U	001	CDS-24	BM003
Markham	CUDD	M	001	CDS-57	MH001
South Holland	CUDD	U	NP	Indirect (CDS-47)	MH001
Mt. Prospect	Feehanville Ditch	M	005	UDP-DS8 (K25-1&K25-2)	MP005
Mt. Prospect	Feehanville Ditch	M	006	UDP-DS8 (K26)	MP006
Arlington Heights	Weller Creek	M	001	UDP-DS1 (K1)	AH001
Arlington Heights	Weller Creek	M	001	UDP-DS1A (K1A)	AH001
MWRD	Weller Creek	M	111	UDP-DS1 (K2-1&K2-2)	MWRD111
Mt. Prospect	Weller Creek	M	NP	None (K3)	MP None (K3)
Mt. Prospect	Weller Creek	M	001	UDP-DS3 (K11)	MP001
Mt. Prospect	Weller Creek	M	002	UDP-DS3 (K14)	MP002
Mt. Prospect	Weller Creek	M	003	UDP-DS4 (K20)	MP003

Metropolitan Water Reclamation District of Greater Chicago CSO Connections

Owner	Waterway	Monitored or Unmonitored	Outfall #	TARP Connection	Representative Outfall
Mt. Prospect	Weller Creek	M	004	UDP-DS6 (K22)	MP004
Des Plaines	Weller Creek	M	007	Indirect (UDP-DS5) (K27)	DP007
Lemont	I&M Canal	U	002	None	
Lemont	CSSC	U	003	None	
Riverside	DPR	U	NP	None	
Riverside	DPR	U	007	None	
Brookfield	DPR	U	NP	DS-DA6	BF006
LaGrange Park	SC	U	005	DS-13A-54	LP003
LaGrange Park	SC	U	006	DS-13A-54	LP003
Skokie	NSC	U	NP	DS-M100	EV010
MWRD	CSC	U*	006	Indirect	
MWRD	CSC	U*	007	Indirect	
MWRD	North Creek	U*	010	see note below	
MWRD	CSC	U*	160	Indirect	

APPENDIX 3G

POST CONSTRUCTION MONITORING PLAN FOR CALUMET TARP SYTEM

Post Construction Monitoring Plan for Calumet TARP System

Background

Portions of the Calumet tunnel system began operation in 1986 and the entire system was completed in 2006. The design storage capacity of the Calumet tunnel system is approximately 630 million gallons. When completed by December 31, 2015, the Thornton Composite Reservoir of the Calumet TARP System will measure approximately 2,500 by 1,600 feet with a maximum water depth of 292 feet and have a total capacity of 7.9 billion gallons (4.8 billion gallons for combined sewerage and 3.1 billion gallons for Thorn Creek floodwater).

The Calumet River System is made up of natural and man-made channels as well as natural waterways upstream of the Chicago Area Waterway System. The Cal-Sag Channel extends upstream from its junction with the Chicago Sanitary and Ship Canal for 16.2 miles to the Little Calumet River. At this point, the waterway becomes the Little Calumet River and extends upstream 6.9 miles, ending at the O'Brien Lock and Dam. The Calumet River extends upstream of the O'Brien Lock and Dam to Lake Michigan. The Grand Calumet River flows from the State of Indiana into the Little Calumet River, and the Little Calumet River South, flows north into the Cal-Sag Channel, also carrying flows from Thorn Creek (Figure 1).

Reaches of the Calumet River System with combined sewer overflows (CSOs) include the Cal-Sag Channel (16 outfalls), the Little Calumet River (41 outfalls, including the 125th Street Pumping Station), the Grand Calumet River (4 outfalls), and the Calumet River (3 outfalls, including the 122nd and 95th Street Pumping Stations). Appendix A is a detailed list of CSOs, including outfall number, TARP connection ID, ownership, and monitoring status.

Objectives

One of the requirements of the Metropolitan Water Reclamation District of Greater Chicago (District) Consent Decree is that a Post Construction Monitoring Plan (PCMP) shall be developed which includes, "in stream water quality monitoring relating to applicable water quality standards," and "determination of whether MWRD's CSOs are in compliance with the then-effective Calumet Water Reclamation Plant (WRP) National Pollutant Discharge Elimination System (NPDES) Permit, including applicable water quality standards incorporated therein." The District's Maintenance and Operations (M&O) Department will be responsible for tracking the frequency, duration, and volume of CSOs within the Calumet River System and the District's Monitoring and Research Department (M&R) will be responsible for implementing the water quality monitoring component of the PCMP. M&R plans to conduct monitoring in the Calumet River System in 2017 and 2018, following completion of the Calumet TARP System's Thornton Composite Reservoir. Pre-and post-completion data under wet and dry weather conditions will be compared to water quality standards to assess the effectiveness of TARP.

The District will conduct ambient water quality monitoring, continuous dissolved oxygen monitoring, and wet weather water quality monitoring during 2017 and 2018 to document water quality under various weather conditions in the Calumet River System following the completion of the Calumet TARP System's Thornton Composite Reservoir. By June 30, 2019, a report will be submitted summarizing and analyzing CSO frequency, duration, and volume, as well as water quality data generated during the post construction monitoring period.

CSO Monitoring

The District intends to utilize its approved CSO Representative Monitoring and Reporting Plan for the Calumet area to track the frequency, duration, and volume of individual CSOs within the Calumet River System (Appendix B). In summary, the District has tide gate monitors installed on 51 of the 67 total outfalls. Unmonitored outfalls are assumed to discharge when select monitored ones discharge because of similar invert elevations. Signals are transmitted to the Calumet WRP when the tide gate is open and assumed to be discharging. These signals are verified by plant staff and then volume estimates are performed via a conservative method which assumes that all rainfall that falls during the period that a tide gate is open, is being discharged to the waterway. These discharge volumes are then compared to two boundary conditions: (1) total area rainfall volume and (2) outfall pipe capacity. The minimum of these three values are used as the final discharge volumes.

Per the Calumet WRP NPDES permit, all individual CSO discharges resulting from the same storm shall be reported as one CSO event. The District compiles the above detailed individual CSO information in order to obtain an annual number of CSO events per waterway reach. Appendix C contains an example of the summary CSO report by reach from 2013.

Water Quality Monitoring

Ambient Water Quality Monitoring

Table 1 shows the ambient water quality monitoring (AWQM) stations on the Calumet River System that will be used to assess the overall impact of Calumet TARP System completion. A map of these stations is presented in Figure 1. AWQM will be conducted on a monthly basis in the Calumet River Watershed on the fourth Monday of each month.

Table 1: AWQM locations that will be assessed in Calumet TARP System monitoring

Location	Waterway	Station Number	GPS Coordinates	
Burnham Ave.	Grand Calumet River	86	41° 37' 52.75"	-87° 32' 20.76"
130th St.	Calumet River	55	41° 39' 33.48"	-87° 34' 21.66"
Indiana Ave.	Little Calumet River	56	41° 39' 01.19"	-87° 37' 01.64"
Halsted St.	Little Calumet River	76	41° 39' 27.05"	-87° 38' 28.13"
Ashland Ave.	Little Calumet River, South	57	41° 39' 06.04"	-87° 39' 38.13"
170th St.	Thorn Creek	97	41° 35' 11.90"	-87° 34' 32.96"
Cicero Ave.	Calumet-Sag Channel	59	41° 39' 19.23"	-87° 44' 17.67"
Route 83	Calumet-Sag Channel	43	41° 41' 46.82"	-87° 56' 10.71"
Wentworth Ave.	Little Calumet River, South	52	41° 35' 06.34"	-87° 31' 46.89"

Monitoring activities will be conducted in accordance with Revision 2.4 of the District's Ambient Water Quality Monitoring Quality Assurance Project Plan, effective September 20, 2013 (Appendix D).

In order to assess effects of CSOs on the Calumet River Watershed after Thornton Composite Reservoir is on-line, the constituents listed in Table 2 will be analyzed. The rationale for inclusion of these constituents is also shown in Table 2.

Table 2: Constituents to be Analyzed in Post Construction Monitoring Plan

Water Quality Constituent	Rationale for Inclusion
Dissolved oxygen (DO)	Current designated use impairment in one or more receiving waterbody
Ammonia	Commonly present in combined sewage
Total Suspended Solids (TSS)	Commonly present in combined sewage
Total Dissolved Solids (TDS)	Current designated use impairment in one or more receiving waterbody
Fecal Coliform (FC)	Current designated use impairment in one or more receiving waterbody
	Commonly present in combined sewage
Five-day Biochemical Oxygen Demand (BOD_5)	Commonly present in combined sewage

Wet Weather Sampling

In addition to the monthly sampling in the AWQM Program, water quality sampling will be conducted during various wet weather conditions at each of the nine sampling locations in the Calumet River System. Constituents listed in Table 2 will be measured during wet weather events.

The USEPA PCMP guidance document (2011) prescribes wet weather sampling to evaluate receiving water impacts under a range of weather conditions. To achieve this, the goal will be to capture five events for each of the following conditions during 2017 and 2018:

1. Dry weather (<0.1 inch precipitation). Dry weather will be defined by antecedent dry conditions for 2 days following a 0.25-0.49 inch event, 4 days following a 0.50-0.99 inch event, and 6 days following a >1.0 inch event (from wet weather limited use analysis done during Chicago Area Waterway System Use Attainability Analysis.

2. Wet weather without CSOs (>0.5 inch precipitation). Water sampling to occur within 12 hours of the end of the rain event.

3. Wet weather with CSOs, including 125th Street Pump Station, if discharging. Water sampling to occur within 12 hours of the end of the rain event.

Average rainfall from the four District rain gages in the Calumet area (Figure 2) will be used to determine the above conditions have been met.

M&R staff will work closely with M&O staff to predict potential wet weather sampling events. The M&O dispatcher will notify M&R staff when wet weather events are forecast for the Calumet area. M&R staff will consult with M&O staff at Calumet WRP to confirm the above wet weather criteria have been met. As soon as a wet weather event is scheduled, lab managers should be notified (See notification flow chart in Figure 3).

Whenever possible, sampling events will be scheduled for weekdays during normal work hours. As the post construction monitoring period progresses, however, if we have not been able to capture enough events for each weather condition, we may require overtime for sampling during off-work hours.

The AWQM and wet weather sampling locations are representative of water quality in the various waterbody reaches receiving CSO flow. The 130th Street on the Calumet River represents "background" upstream conditions, as it is upstream of CSOs with the exception of 95th Street Pumping Station, discharge of which would actually constitute a reversal of flow towards Lake Michigan. The Route 83 station is located at the most downstream location of the

Calumet River System and constitutes well mixed flow from all of the CSOs that discharge into the system upstream. Figure 2 displays CSO locations in the Calumet River System.

M&R will also collect hourly dissolved oxygen data from our Continuous Dissolved Oxygen Monitoring (CDOM) program for use in assessing waterway compliance and impact of CSOs on the Calumet River System.

Table 3 shows the CDOM locations on the Calumet River System that will be used to assess the impact of the Calumet TARP System completion. These stations are also indicated on Figure 1. CDOM stations will be located in the Little Calumet River, north, upstream and downstream of the Calumet WRP; the Little Calumet River South, just upstream of the confluence with LCR, north; and in the Cal-Sag Channel, both immediately downstream of the reach receiving most of the CSO flows, and at the downstream end of the system at Route 83. These station locations will allow us to compare in-stream dissolved oxygen concentrations to applicable water quality standards in waterway reaches receiving CSO flow.

Table 3: CDOM locations that will be assessed in Calumet TARP System monitoring

Location	Waterway	GPS Coordinates	
C&W Indiana Railroad	Little Calumet River	41° 39' 01.07"	-87° 36' 42.75"
Halsted St.	Little Calumet River	41° 39' 25.95"	-87° 38' 27.86"
Ashland Ave.	Little Calumet River, South	41° 39' 06.64"	-87° 39' 37.27"
Cicero Ave.	Calumet-Sag Channel	41° 39' 20.70"	-87° 44' 18.78"
Route 83	Calumet-Sag Channel	41° 41' 46.68"	-87° 56' 29.29"

Continuous dissolved oxygen monitoring activities will be conducted in accordance with Revision 2.0 of the District's Continuous Dissolved Oxygen Monitoring Program Quality Assurance Project Plan, effective April 1, 2011 (Appendix E).

Deliverables

After it is approved, MWRD will conduct monitoring in accordance with this PCMP through December 2018. The Post Construction Monitoring Report for the Thornton TARP System will be submitted by June 30, 2019. The report will detail receiving water impacts and effectiveness of CSO controls.

Reference

United States Environmental Protection Agency. EPA-833-K-11-001. *CSO Post Construction Compliance Monitoring Guidance*. April, 2011.

Figure 1: Ambient Water Quality and Continuous Dissolved Oxygen Monitoring Stations for Thornton TARP Post Construction Monitoring.

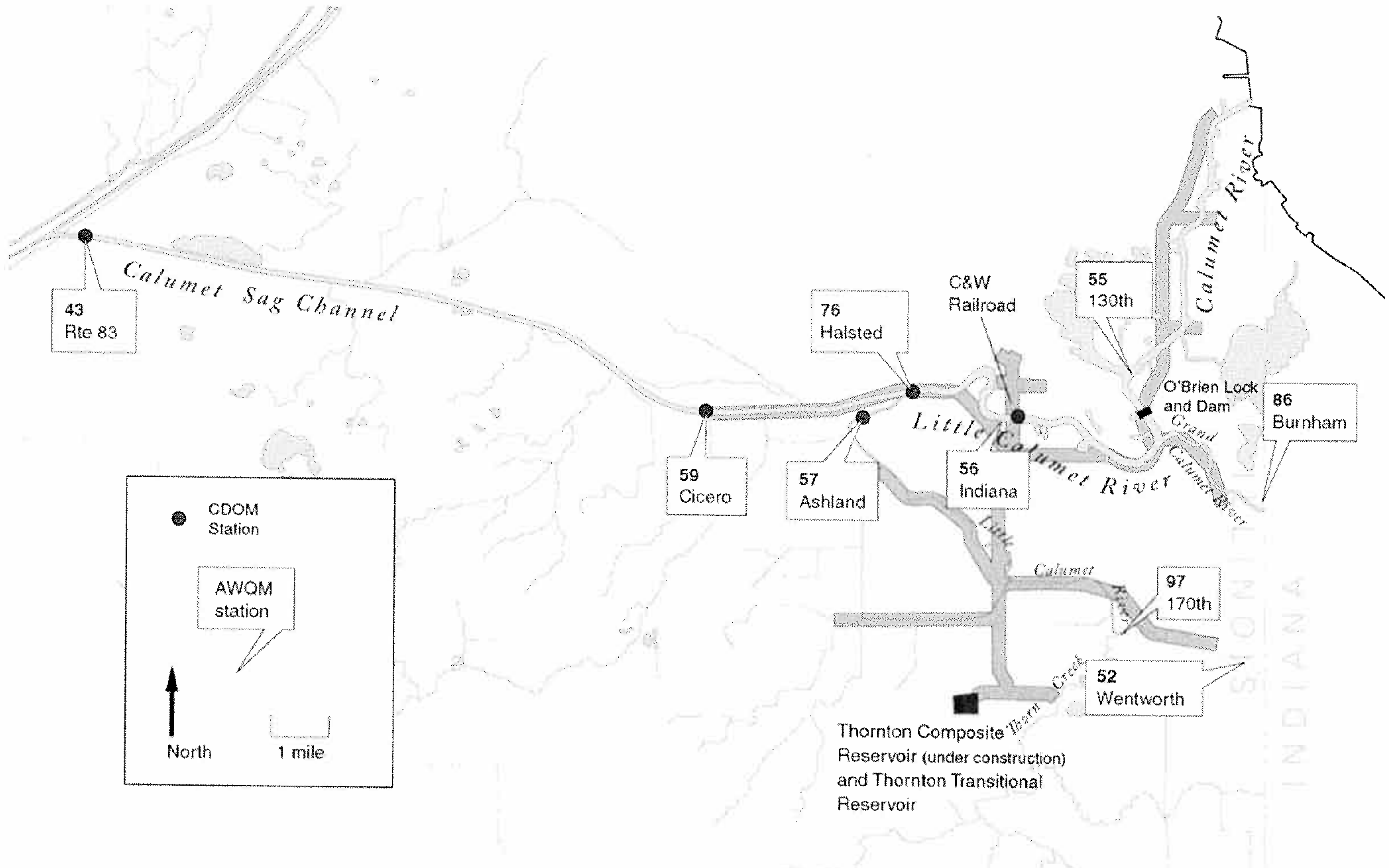


Figure 2: Map of Calumet area Combined Sewer Overflow Outfalls and Precipitation Gages

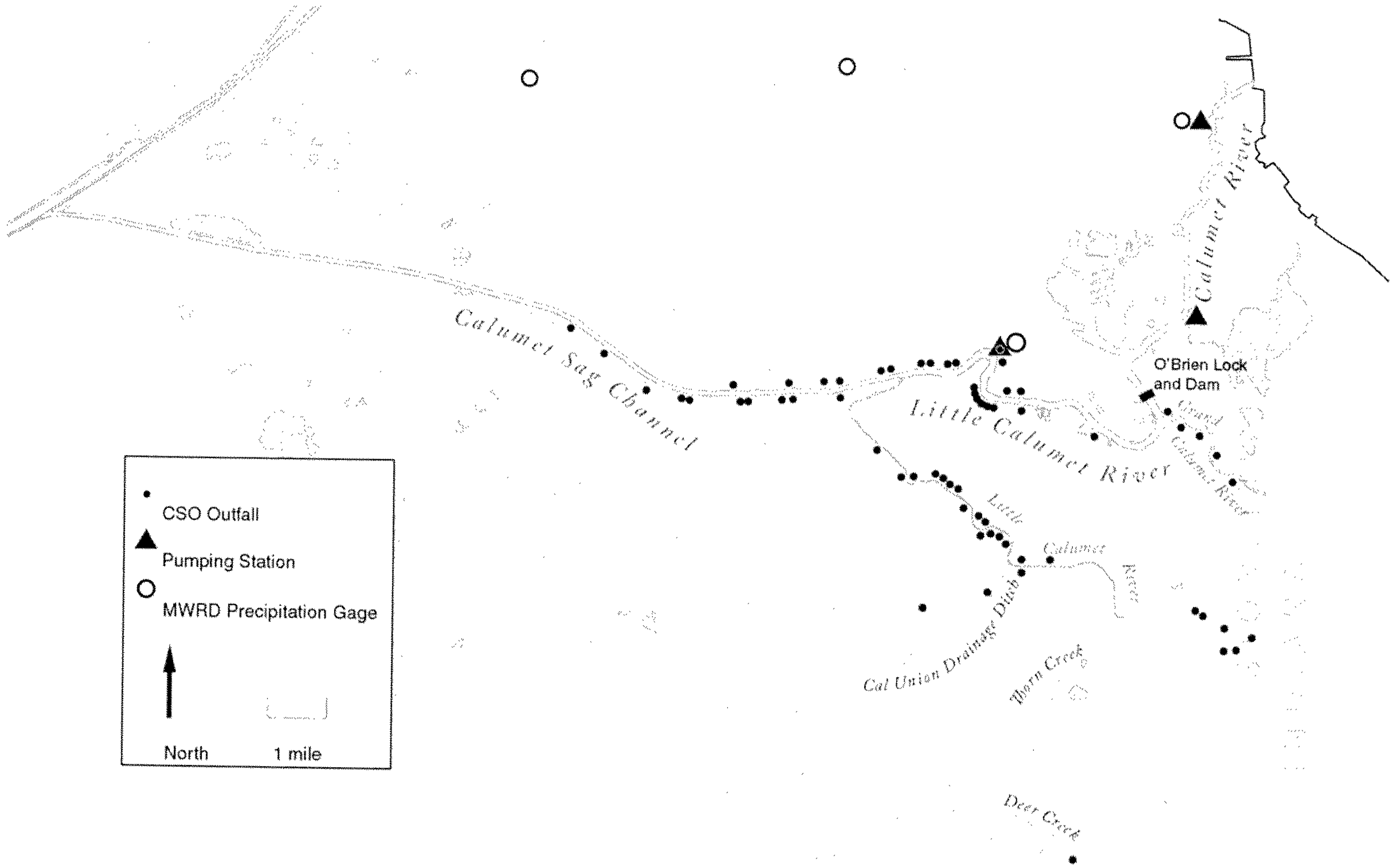
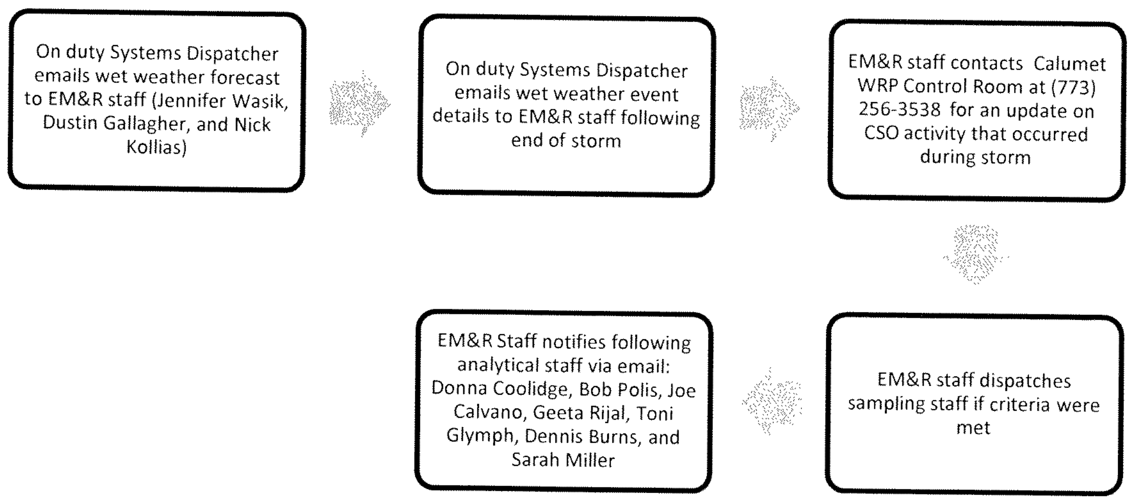


Figure 3: Notification flow chart for Thornton TARP post construction wet weather event sampling



Metropolitan Water Reclamation District of Greater Chicago CSO Connections

Owner	Waterway	Monitored or Unmonitored	Outfall #	TARP Connection	Representative Outfall
MWRD	CalR	M	151	CDS-34	MWRD151
MWRD	CalR	M	152	CDS-28	MWRD152
Chicago	CalR	M	206	CDS-20	CG206
Blue Island	CSC	U	004	CDS-9	BI003
Blue Island	CSC	M	003	CDS-8	BI003
Blue Island	CSC	M	002	CDS-7	BI002
Blue Island / Posen	CSC	M	005 / 001	CDS-6	BI005/PO001
Chicago / Calumet Park	CSC	M	218/001	CDS-10	CG218
MWRD	CSC	M	154	CDS-11	MWRD154
MWRD	CSC	M	163	CDS-4	MWRD163
MWRD	CSC	M	157	CDS-2	MWRD157
MWRD	CSC	M	158	18E PS	MWRD158
MWRD	CSC	U	006		
MWRD	CSC	U	007		
MWRD	CSC	U	160		
MWRD / Blue Island	CSC	M	156 / 001	CDS-5	MWRD156
Robbins	CSC	U	NP	CI-3	BI005/PO001
Robbins	CSC	U	NP	CI-2	BI005/PO001
Robbins	CSC	U	NP	CI-1	BI005/PO001
Markham	CUDD	M	001	CDS-57	MH001
South Holland	CUDD	U	NP	Indirect (CDS-47)	MH001
MWRD	DC	U	010		

Metropolitan Water Reclamation District of Greater Chicago CSO Connections

Owner	Waterway	Monitored or Unmonitored	Outfall #	TARP Connection	Representative Outfall
Burnham	GCalR	M	001	CDS-21	BM001
Burnham	GCalR	M	002	CDS-22	BM002
Burnham	GCalR	M	003	CDS-23	BM003
Calumet City	GCalR	U	001	CDS-24	BM003
Calumet City	LCalR	M	002	CDS-53	CA002
Calumet City	LCalR	M	003	CDS-53	CA003
Calumet City	LCalR	M	004	CDS-55	CA004
Calumet City	LCalR	M	005	CDS-55	CA005
Calumet City	LCalR	M	006	CDS-55	CA006
Calumet City	LCalR	M	007	CDS-55	CA007
Chicago	LCalR	M	239	CDS-16	CG239
Chicago	LCalR	U	209	CI-9	CG239
Chicago	LCalR	M	210	CDS-15-5	CG210
Chicago	LCalR	M	211	CDS-14	CG211
Chicago	LCalR	M	241	CDS-12	CG241
Chicago	LCalR	U	214	CI-8	RV002
Chicago	LCalR	U	215	CI-7	RV002
Chicago	LCalR	U	216	CI-6	RV002
Dixmoor	LCalR	M	001	CDS-39	DM001
Dolton	LCalR	M	002	CDS-18	DT002
Dolton	LCalR	M	001	CDS-17	DT001
Dolton	LCalR	M	003	CDS-51	DT003

Metropolitan Water Reclamation District of Greater Chicago CSO Connections

Owner	Waterway	Monitored or Unmonitored	Outfall #	TARP Connection	Representative Outfall
Harvey	LCalR	M	001	CDS-41	HV001
Harvey	LCalR	M	002	CDS-41	HV002
Harvey	LCalR	M	003	CDS-42	HV003
Harvey	LCalR	M	004	CDS-43	HV004
Harvey	LCalR	M	005	CDS-43	HV005
Harvey	LCalR	M	006	CDS-45	HV006
Harvey	LCalR	M	007	CDS-45	HV007
Lansing / Calumet City	LCalR	M	002 / 005	CDS-55	LS002
MWRD	LCalR	M	004	TARP Outfall	MWRD004
MWRD	LCalR	M	153	CDS-13	MWRD153
Phoenix	LCalR	M	001	CDS-45	PO001
Riverdale	LCalR	M	002	CDS-15-1	RV002
Riverdale	LCalR	M	005	CDS-15-4	RV005
Riverdale	LCalR	U	NP	CDS-15	RV003
Riverdale	LCalR	M	NP	CDS-15-3	RV NP (CDS-15-3)
Riverdale	LCalR	M	003	CDS-15-2	RV003
Riverdale	LCalR	M	004	CDS-42	RV004
South Holland	LCalR	M	004	CDS-45	SH004
South Holland	LCalR	M	NP	CDS-45	SH NP (CDS-45)
South Holland	LCalR	U	005	Indirect (CDS-47)	SH003
South Holland	LCalR	M	003	CDS-48	SH003
South Holland	LCalR	M	001	CDS-C-1	SH001

Metropolitan Water Reclamation District of Greater Chicago CSO Connections

Owner	Waterway	Monitored or Unmonitored	Outfall #	TARP Connection	Representative Outfall
South Holland	LCalR	M	002	CDS-C-1	SH002

Appendix B – Calumet CSO Representative Monitoring and Reporting Plan

Calumet and Lemont WRPs
NPDES Permit Nos. IL0028061 and IL0028070
CSO Representative Monitoring and Reporting Plan
April 10, 2006
Rev. April 21, 2006
Rev. December 15, 2008
Rev. December 1, 2009
Rev. December 1, 2010
Rev. May 18, 2012
Rev. February 1, 2013
Rev. August 1, 2014

In accordance with Special Conditions (SCs) 13.13 and 14.11of the Calumet and Lemont National Pollutant Discharge Elimination System (NPDES) Permit Nos. IL0028061 (effective January 1, 20014) and IL0028070 (effective February 1, 2008), the following plan is approved for monitoring the frequency and duration of the discharge from select representative CSO outfalls authorized in the permits for which the Metropolitan Water Reclamation District of Greater Chicago (District) has the ability to monitor through telemetry. These monitored CSO outfalls represent the remaining unmonitored CSO outfalls, so if the monitored outfalls discharge, it is assumed that the associated unmonitored outfalls also discharge.

The 52 CSO outfalls listed below will be monitored as required in SCs 13.13 and 14.11. They include all CSOs for which the District has the ability to monitor through telemetry. This list has been updated to account for multiple outfalls associated with each dropshaft/TARP structure.

The District will document the frequency and duration of CSOs through the outfalls listed below along with an estimate of storm duration and total rainfall for each storm event. Based on this information, the District will estimate CSO volume (MG), BOD5 loading (pounds), and SS loading (pounds) that accounts for all of the CSO outfalls within the District's service area. The District will continue to monitor these designated CSO outfalls at all times unless the telemetry is out of service due to malfunction or routine maintenance. The results of the monitoring will be submitted to the IEPA on a quarterly basis: February 25, May 25, August 25, and November 25.

Receiving Water: Chicago Sanitary & Ship Canal (total 1)

Discharge No.	TARP Structure	Outfall Location	CSO Outfall Owner(s)
002		Lemont WRP	1 - MWRD

Receiving Water: Cal-Sag Channel (total: 9)

Discharge No.	TARP Structure	Outfall Location	CSO Outfall Owner(s)
005/001	*CDS-6*	*California Avenue & Edward Street*	*1 -Blue Island/Posen*
002	CDS-7	Irving Avenue (N)	1 - Blue Island
003	CDS-8	Division Avenue (S)	1 - Blue Island
001/218	*CDS-10*	*Laflin Avenue (N)*	*1 -Calumet Park/Chicago*
158	18E-PS	Pulaski Road PS (Crawford Ave N)	1 - MWRD
157	CDS-2	Central Park Avenue (N)	1 - MWRD
163	CDS-4	Sacramento Avenue (S)	1 - MWRD
156/001	*CDS-5*	*Francisco Avenue (N)*	*1 -MWRD/Blue Island*
154	CDS-11	Throop Street (N)	1 - MWRD

Appendix B – Calumet CSO Representative Monitoring and Reporting Plan

Receiving Water: Little Calumet River (total: 35)

Discharge No.	TARP Structure	Outfall Location	CSO Outfall Owner(s)
002	CDS-53	River Drive (N)	1 - Calumet City
003	CDS-53	Woodview Avenue (N)	1 - Calumet City
004	CDS-55	Greenbay Ave (N)	1 - Calumet City
005	CDS-55	Burnham Avenue (N)	1 - Calumet City
006	CDS-55	Stanley Boulevard (N)	1 - Calumet City
007	CDS-55	Lincoln Avenue (N)	1 - Calumet City
211	CDS-14	130th Street (E)	1 - Chicago
210	CDS-15-5	Indiana Avenue (E)	1 - Chicago
239	CDS-16	Vernon Avenue & East 134th Street	1 - Chicago
241	CDS-12	Stewart Avenue	1 - Chicago
001	CDS-39	Ashland Avenue (S)	1 - Dixmoor
001	CDS-17	Forest Avenue Ext. (S)	1 - Dolton
002	CDS-18	Dorchester Avenue (S)	1 - Dolton
003	CDS-51	Ellis Avenue (N)	1 - Dolton
001	CDS-41	144th Street (W)	1 - Harvey
002	CDS-41	Center Avenue (E)	1 - Harvey
003	CDS-42	Union Street (W)	1 - Harvey
004	CDS-43	Clinton Street (W)	1 - Harvey
005	CDS-43	Illinois Central Railroad (E)	1 - Harvey
006	CDS-45	147th Street (N)	1 - Harvey
007	CDS-45	149th Street (E)	1 - Harvey
002/005	CDS-55	Burnham Avenue (S)	1 - Lansing
004	TARP Outfall	WRP TARP Bypass (W)	1 - MWRD
153	CDS-13	Edbrook Avenue (125th St. PS)	1 - MWRD
001	CDS-45	9th Avenue Extension & 151st Street	1 - Phoenix
002	CDS-15-1	Penn Central & Dearborn Street	1 - Riverdale
003	CDS-15-2	Wabash Street (S)/Ext. State Street	1 - Riverdale
004	CDS-42	Union Avenue P.S. (N)	1 - Riverdale
005	CDS-15-4	Indiana Avenue (W)	1 - Riverdale
N/A	CDS-15-3	Extended State Street	1 - Riverdale
001	CDS-C-1	South Park (N)	1 - South Holland
002	CDS-C-1	South Park (S)	1 - South Holland
003	CDS-48	Chicago & Eastern Railroad Yard	1 - South Holland
004	CDS-45	152nd Street Extension Structure 1	1 - South Holland
N/A	CDS-45	152nd Street Extension Structure 2	1 - South Holland

Receiving Water: Calumet River (total: 3)

Discharge No.	TARP Structure	Outfall Location	CSO Outfall Owner(s)
206	CDS-20	134th & Brainard	1 - Chicago
152	CDS-28	122nd Street PS	1 - MWRD
151	CDS-34	95th Street PS	1 - MWRD

Appendix B – Calumet CSO Representative Monitoring and Reporting Plan

Receiving Water: Grand Calumet River (total: 3)

Discharge No.	TARP Structure	Outfall Location	CSO Outfall Owner(s)
001	CDS-21	Escanaba Avenue	1 - Burnham
002	CDS-22	138th Place Extension (N)	1 - Burnham
003	CDS-23	142nd Street Extension	1 - Burnham

Receiving Water: Calumet Union Drainage Ditch (total: 1)

Discharge No.	TARP Structure	Outfall Location	CSO Outfall Owner
001	CDS-57	Markham PS	1 - Markham

Summary of Monitored CSO Outfalls:

Chicago San & Ship Canal:	1
Cal-Sag Channel	9
Little Calumet River	35
Calumet River	3
Grand Calumet River	3
Cal-Union Drainage Ditch	1
Total CSO Outfalls	52

	START DATE	NSC UPPER (1)	NSC LOWER (2)	NBCR LOWER (3)	NBCR UPPER (4)	CR (5)	SBCR (6)	SFSBCR (7)	CSSC UPPER (8)	CSSC LOWER (9)	CSSC UPPER LEMONT (10)	CSSC LOWER LEMONT (11)	WC (12)	DP UPPER (13)	DP MIDDLE (14)	DP LOWER (15)	SC (16)	CAL R (17)	GCR (18)	LCR NORTH (19)	LCR SOUTH (20)	CSC (21)	CUDD (22)	AC (23)
	1/10/2013														X									
1	1/11/2013														X									
2	1/27/2013			X																				
	1/29/2013	X		X	X		X	X	X	X					X	X	X							X
	1/30/2013	X		X	X		X	X	X	X		X			X	X	X							X
3	1/31/2013	X			X																			
	3/10/2013	X		X	X		X	X	X	X		X		X	X	X	X		X	X		X		X
	3/11/2013	X		X	X			X	X	X		X		X	X	X	X		X	X		X		X
4	3/12/2013	X			X					X									X			X		
5	4/8/2013	X		X	X																			
6	4/10/2013				X		X																	
	4/11/2013	X	X	X	X		X	X	X	X					X	X	X							X
7	4/12/2013				X																			
	4/17/2013		X	X	X		X	X	X	X		X		X	X	X	X							X
	4/18/2013	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X		X
	4/19/2013	X		X	X			X	X	X		X			X	X	X		X	X	X	X		X
	4/20/2013	X							X							X	X		X	X	X	X		X
	4/21/2013	X			X				X							X	X		X		X			
8	4/22/2013				X										X	X								
	4/23/2013	X		X	X		X	X	X	X					X									
	4/24/2013	X		X	X			X	X	X														
9	4/25/2013				X				X															
	5/9/2013																							
10	5/10/2013											X										X		
	5/20/2013			X	X		X								X									
11	5/21/2013	X		X	X		X	X	X	X					X	X	X		X			X		X
	5/22/2013	X		X	X		X	X	X	X				X	X				X	X	X	X		
12	5/23/2013				X					X									X			X		
13	5/28/2013	X		X	X		X	X	X	X							X			X	X	X		
14	5/29/2013				X			X	X	X							X		X	X		X		
	5/30/2013				X					X					X	X			X	X		X		
15	5/31/2013	X		X	X				X	X				X	X	X	X			X		X		
	6/1/2013	X		X	X		X	X	X	X					X				X	X		X		X
16	6/2/2013	X		X	X			X	X	X									X			X		
17	6/10/2013				X																			
18	6/12/2013														X						X			
19	6/21/2013				X										X						X			
	6/26/2013	X	X	X	X		X	X	X	X				X	X		X							
	6/27/2013			X	X		X	X	X	X					X	X								
20	6/28/2013			X				X		X						X								
21	7/8/2013	X																						
22	7/15/2013													X	X						X			
23	7/19/2013								X						X									
24	7/20/2013								X						X									
25	7/31/2013														X									
26	8/2/2013			X	X										X									
27	8/30/2013			X	X				X															
28	8/31/2013						X	X	X	X														
29	9/15/2013													X										
30	9/18/2013			X	X		X	X	X	X				X	X									
	9/19/2013	X	X	X	X			X	X					X										X
31	9/20/2013				X			X																
32	10/5/2013	X		X	X		X		X	X				X	X									
	10/30/2013																				X			X
33	10/31/2013			X			X	X	X	X		X			X	X	X					X		
34	11/1/2013							X		X				X										
	11/6/2013			X																				
35	11/7/2013													X										
36	11/9/2013						X																	
37	11/10/2013						X																	
	11/17/2013	X		X	X		X	X	X	X				X	X	X	X							X
38	11/18/2013								X						X									
39	12/19/2013				X																			
40	12/20/2013				X																			
	12/28/2013								X															
41	12/29/2013								X															
	TOTAL	**16**	**4**	**21**	**24**	**1**	**18**	**17**	**23**	**18**	**0**	**5**	**1**	**13**	**22**	**9**	**11**	**1**	**7**	**7**	**7**	**10**	**0**	**9**
	Average 05-13	15	5	20	23	2	12	16	18	16	0	5	1	11	21	8	10	0	7	6	8	8	0	6

Average 05-13	35	CSO EVENTS
2013	41	CSO EVENTS

APPENDIX 3H

FISH KILL RESPONSE PROCEDURE

IWD FISH KILL RESPONSE AND REPORTING PROCEDURES

TABLE OF CONTENTS

***NOT LAMINATED**

METROPOLITAN WATER RECLAMATION DISTRICT OF GREATER CHICAGO

Procedures for Reporting Fish Kills and Other Water Pollution Emergencies

All notifications of a fish kill or other water pollution emergency incidents to any District office shall be reported immediately to the Systems Dispatcher at (312) 751-5133. The Systems Dispatcher will then notify the Assistant Director, Maintenance and Operations Department (M&O). The Systems Dispatcher should also notify the appropriate Monitoring & Research (M&R) Department, Industrial Waste Division (IWD) Area Supervisor.

M&O will be responsible for immediate telephone notification of the Illinois Environmental Protection Agency (IEPA) at (847) 294-4000 during normal work hours, or at (800) 782-7860, the IEPA 24-hour emergency number. The IWD Area Supervisor will also initiate an investigation of the incident.

If the incident involves a fish kill, the IWD Area Supervisor shall also notify M&R's Aquatic Ecology and Water Quality Section (8-4223 or 8-3748) and prepare a report of the fish kill incident using the fish kill report form. IWD will collect water quality samples and dead fish if warranted. A copy of the fish kill report and any other pertinent information will be provided to the Aquatic Ecology Section staff as soon as possible. Depending on the severity of the incident, staff from the Aquatic Ecology Section will conduct a field investigation in a timely manner. The Environmental Monitoring and Research Division will then prepare a report on the probable cause of the fish kill. Upon conclusion of a fish kill investigation, IWD shall notify the M&O Channel Maintenance Unit (8-4040) if a waterway cleanup is needed.

The incident shall be reported on the IWD Special Investigation Report Form.

On the next business day, the responder shall complete the electronic Emergency Response Report (ERR) and send it to the Assistant Director of M&R and copy the Field Operations Supervisor. The ERR number can be obtained by going into Outlook/Public Folders/ Monitoring and Research / Emergency Response Report. Select the next number in the sequence for the particular year. The Assistant Director of M&R will save the ERR to this list once it has been sent to the Executive Director, Director of M&O, Director of Engineering and the Director of M&R for District internal notification. The Executive Director shall forward the report to the Members of the Board of Commissioners.

For fish kill incidents and other permit-related operational events, the various M&R Division reports will be forwarded, in a timely manner, to the Director of M&R for transmittal to the M&O Department.

METROPOLITAN WATER RECLAMATION DISTRICT OF GREATER CHICAGO

Procedures for Reporting Fish Kills and Other Water Pollution Emergencies

M&O will combine the M&R reports with other pertinent operational data for transmittal to the IEPA. Copies of the complete report shall be sent to the Executive Director, Chief Engineer, and the Director of M&R.

FISH KILL REPORT

DATE:_______________

INVESTIGATOR'S NAME:____________________

DATE REPORTED:____________

TIME REPORTED:____________

BY WHOM:____

NATURE OF EMERGENCY, TYPE OF SPILL:______________________________
____
____

NAME OF WATERWAY (note if stream, pond, lake, etc. and if any drainage or runoff runs into waterway):
____
____

ARE FISH SWIMMING, LETHARGIC, FLOATING, GULPING, JUMPING (Circle what applies)

LOCATION (note nearest streets or landmarks):
____
____

NUMBER OF FISH SIGHTED (note approximate total number of fish, number of species, size of area that the fish occupy, and number of fish in each species:

Also note if any other aquatic life or birds are affected:________________________________
____
____

SUSPECTED CAUSE OR SOURCE:______________________________________
____
____

WEATHER CONDITIONS (note what the weather pattern has been recently):__________________
____
____

Water Temp.________ pH________ D.O.________ Date & Time________________

Physical condition of water (cloudiness, color, odor, floatable material):____________________
____

M&O will call IEPA Emergency Response (847)294-4000 daytime or 24 hr. emergency 1-800-782-7860. Please send the original to the Asst. Director of M&R and copies to the Aquatic Biology section and the Field Operations Supvr.

TO: ______________________, EXECUTIVE DIRECTOR

MONITORING & RESEARCH DEPARTMENT

INDUSTRIAL WASTE DIVISION

EMERGENCY RESPONSE REPORT

Report No.__________

REPORTED BY:____ TYPE:____________

SPECIAL INVESTIGATION NUMBER:______________

DATE AND TIME REPORTED:____________________

DATE AND TIME OF INCIDENT:__________________

INCIDENT CATEGORY:
☐ WATERWAY SPILL ☐ ROADWAY SPILL ☐ FISH KILL
☐ RAILWAY SPILL ☐ INDUSTRIAL SOURCE SPILL
☐ ILLEGAL SEWER DISCHARGE FROM MOBILE SOURCE
☐ OTHER: ____

DISTRICT ON-SITE COORDINATOR: ____

LOCATION: ☐ WATERWAY ☐ SEWER ☐ WRP: ________________________________

DESCRIPTION:

ACTION TAKEN:

FOLLOW-UP CONCLUSION:

AGENCIES NOTIFIED:

☐ U.S. COAST GUARD
630-986-2155
1-800-424-8802

☐ STATES ATTORNEY'S OFFICE
312-443-5489
312-443-6366

☐ IEPA
847-294-4000
800-782-7860

☐ OTHER: ____________________

APPROVED:________________________ PREPARED BY:______________________________
ASSISTANT DIRECTOR OF M&R

cc: Public Information

Attachment

Description:

Action Taken:

EMERGENCY RESPONSE REPORT PROCEDURES AND INSTRUCTIONS

The purpose of the Emergency Response Report (ERR) is to quickly notify District officials of an emergency situation which may affect District facilities or the waterways within the District's jurisdiction. To insure the ERR is prepared in the timeliest manner, some flexibility in responsibility is required. The determination that an ERR is required can be made by Environmental Specialists (ES)/Pollution Control Officers (PCO) IIIs, Senior Environmental Engineers, or above. Ideally, the ES/PCO most familiar with the situation will prepare the ERR and forward the report through the supervisory chain of command.

1. Upon notification that an ERR is required, the responsible ES/PCO will obtain the required information and prepare the report. The determination that an ERR is required may originate from any supervisor in the ES/PCO's chain of command. If the ES/PCO is unavailable, the responsibility for preparing the ERR moves up the chain of command. Once informed that an ERR is required, the form will be completed immediately.

2. The ERR will be prepared using the ERR form found in the Monitoring and Research folder in the Public Folders of the District's Microsoft Outlook system* or in the Enforcement Section's Forms Library. Once completed, the ERR will be forwarded through the proper chain of command to the Assistant Director of the Monitoring & Research Department, Industrial Waste Division, or his designee, who will then forward the ERR to the Executive Director, with a copy also placed in the Emergency Response Report folder within the M & R Outlook folder. The ERR will be forwarded utilizing the Microsoft Outlook messaging system. The importance of the message containing the ERR will be designated as HIGH.

*Outlook/Public Folders/All Public Folders/Monitoring and Research/ Emergency Response Report.

RR 7/14/2011 ver. 3

METROPOLITAN WATER RECLAMATION DISTRICT OF GREATER CHICAGO

INDUSTRIAL WASTE DIVISION

SPECIAL INVESTIGATION / INCIDENT REPORT

1. SPECIAL INVESTIGATION NUMBER

2. PROGRAM NUMBER | 3. PROJECT NUMBER | 4. DATE COMPLAINT RECEIVED | 5. TIME COMPLAINT RECEIVED | 6. AREA | 7. TYPE

INITIAL CONTACT
8. MAIN OFFICE (NAME TITLE) | 9. DISPATCHER | 10. IWD (NAME TITLE) ☐ DNA
11. OTHER ☐ DNA

IWD ROUTING
12. RECEIVED BY (NAME TITLE) | 13. DISPATCHED TO (NAME TITLE) ☐ DNA
14. DATE DISPATCHED ☐ DNA | 15. TIME DISPATCHED ☐ DNA

COMPLAINANT ☐ UNKNOWN
16. PERSON WHO REPORTED INCIDENT | 17. AGENCY ☐ DNA ☐ UNKNOWN
18. ADDRESS ☐ DNA ☐ UNKNOWN | 19. PHONE ☐ DNA ☐ UNKNOWN
20. DATE INCIDENT OCCURRED ☐ UNKNOWN | 21. TIME INCIDENT OCCURRED ☐ UNKNOWN

TYPE OF POLLUTION OR INCIDENT
22. SEWER (STORM OR SANITARY) ☐ DNA | 23. WATERWAY (DESCRIBE) ☐ DNA | 24. OTHER ☐ DNA
25. LOCATION OF INCIDENT
26. TYPE OF POLLUTION ☐ UNKNOWN | 27. QUANTITY ☐ UNKNOWN

SOURCE ☐ UNKNOWN
28. GIVE NAME , ADDRESS, PHONE AND SPECIFY INDIVIDUAL OR BUSINESS

CRIMINAL DUMPING ☐ DNA
29. OFFENDER'S NAME ☐ UNKNOWN | 30. COMPANY NAME ☐ UNKNOWN | 1. ARRESTING OFFICER ☐ UNKNOWN
32. OFFENDER'S ADDRESS ☐ UNKNOWN | 33. COMPANY ADDRESS ☐ UNKNOWN | 34. POLICE AGENCY
35. OFFENDER'S VEHICLE ☐ DNA YEAR MAKE MODEL | BODY STYLE | COLOR | STATE LICENSE NUMBER | 36. COURT DATE, TIME AND LOCATION
37. VEHICLE SEIZED ☐ YES ☐ NO | 38. SPECIFY IF ANOTHER TYPE OF PORTABLE EQUIPMENT WAS USED | 39. COMPANY PHONE | 40. COMPANY REPRESENTATIVE ☐ DNA

CIRCUMSTANCES ☐ UNKNOWN
41. ACCIDENTAL SPILL (SPECIFY TYPE) ☐ DNA
42. TREATMENT SYSTEM UPSET/BYPASS (SPECIFY) ☐ DNA
43. FIRE, EXPLOSION, OTHER (SPECIFY) ☐ DNA

WITNESSES AND OTHER PERSONS INTERVIEWED ☐ DNA
44. NAME | ADDRESS | AGENCY | PHONE NUMBER
45. NAME ☐ DNA | ADDRESS | AGENCY | PHONE NUMBER
46. NAME ☐ DNA | ADDRESS | AGENCY | PHONE NUMBER

CLEAN-UP ☐ CONTINUED ON NEXT PAGE
47. SPECIFY WHAT TYPE OF CONTAINMENT/CLEAN-UP MEASURES WERE TAKEN BY WHOM AND WHEN

EVIDENCE OBTAINED ☐ YES ☐ NO
48. STATION SAMPLED ☐ DNA | DATE | TIME | SAMPLER | SPECIFY PARAMETERS OBTAINED | 51. PHOTOS ☐ YES ☐ NO
49. STATION SAMPLED ☐ DNA | DATE | TIME | SAMPLER | SPECIFY PARAMETERS OBTAINED | 52. TYPE ☐ 35MM ☐ POL
50. STATION SAMPLED ☐ DNA | DATE | TIME | SAMPLER | SPECIFY PARAMETERS OBTAINED | 53. ATTACHED ☐ YES ☐ NO

AREAS AND TEMS INSPECTED ☐ CONTINUED ON NEXT PAGE
54. SPECIFY THE AREAS/ITEMS INSPECTED TO ASSESS THE IMPACT OF THE POLLUTANT DISCHARGE AND/OR THE SOURCE

BSERVATIONS ☐ CONTINUED ON NEXT PAGE
55. DESCRIBE OBSERVATIONS MADE RELATIVE TO ASSESSING IMPACT AND/OR FIXING RESPONSIBILITY

NARRATIVE ☐ CONTINUED ON NEXT PAGE
56. NARRATIVE (DO NOT DUPLICATE OR REPEAT THE ABOVE INFORMATION - FOR ADDITIONAL INFORMATION ONLY)

57. REVIEWED | 58. SIGNED
59. FIELD REPORT NUMBER | 60. ENFORCEMENT ACTION NUMBER

7/30/03

SAMPLE BOTTLES AND TESTS FOR FISH KILL EVENT

Bottle(s) Needed	**Tests**
2 - 8 oz. plastic trace metals (preserved with HNO_3)	Trace Metals (Egan) Mercury (Calumet)
2 plastic gallon bottles (unpreserved)	General Chemistry (solids and N-series, Conductivity, Cl, turbidity, alkalinity, (BOD_5)
1 – ½ gallon plastic bottle (unpreserved)	MBAS
1 boron bottle (8 oz. pH type bottle, unpreserved)	SO_4
1 boron bottle	Fluoride
1 boron bottle	pH
1 Qt. plastic bottle (certified clean)	Cr +6
1 – ½ gallon plastic bottle (preserved with NaOH)	CN
2 glass Qt. bottles (unpreserved)	FOG
1 glass Qt. bottle (preserved with H_2SO_4)	Phenol
1 – 300 ml glass bottle	Fixed in field dissolved oxygen (see attached sample collection procedure)
1 brown glass BNA gallon + 3 vials (+ 2 additional trip blanks filled with DO water)	Organic series (collect only if warranted)
Plastic bags	For collection of fish species that can't be readily identified – must be stored on ice.

REPLACE BOTTLES IN FISH KILL KIT

DISSOLVED OXYGEN (DO) SAMPLING PROCEDURES

A narrow mouth, 300 ml glass DO bottle with the glass stopper removed is placed in the DO can and the cover of the can replaced so the metal tube is inside the DO bottle. The DO can is submerged under approximately 3 feet of water and should remain there until no more bubbles appear exiting from the can. This should take 15 seconds at the most. Remove the can from the water and take off the cover. Remove the DO bottle from the sampling can. Insert the stopper in the bottle to remove excess water from neck. Remove stopper and add one (1) ml of manganous sulfate solution (reagent bottle #1) and one (1) ml of alkali-iodine solution (reagent bottle #2).

To Use Dispenser Bottles

-Hold bottle upright and **gently** squeeze reservoir bottle until liquid rises into lower part of the dispensing stem. This fills the measuring chamber. **Note: applying too much pressure can send a stream of liquid shooting into the air. Be gentle!**

-Release pressure

-Invert unit completely. The correct amount of liquid will fill the spout. Squeeze the bottle to dispense liquid into DO sample.

-Do not submerge the reagent bottles into the DO sample. Instead, let the reagent run down the inside neck of the DO bottle.

- After filling the DO sample with reagent #1 and #2, replace stopper in bottle and shake thoroughly by holding the stopper and bottle and turning the bottle upside down several times. A floc should form in the bottle. Wait and let floc settle to 50% of the volume of the bottle. Remove the stopper and add one (1) ml of concentrated sulfuric acid (reagent #3) to the bottle. Replace the stopper and shake the bottle until the floc dissolves. A sample with a high concentration of Dissolved Oxygen should be a deep amber color. A sample with low Dissolved Oxygen should be almost clear, or at least in a sewage sample have no other color but the normal color of sewage. Store sample in cooler with ice to protect from sunlight and preserve sample.

SAFETY NOTE: USE GLOVES AND SAFETY GOGGLES WHEN HANDLING & DISPENSING REAGENTS

Metropol f Water Reclamation District of Greater Chicag — Multiple Day Short Composite / Grab Sample Log

Site or Company: ____________________ Station: __________ Study: Fish Kill

Address: ____________________ Section: __________ Pipe Size: __________

City: __________ User #: __________ PCO(s) & PCT(s): __________

SAMPLE DATE	SAMPLE TIME	WEATHER	SAMPLE DESCRIPTION	FLOW	pH	SAMPLES COLLECTED						REMARKS	CREW INITIALS
						CN	FOG	pH	TM	*	SPLIT		
						X	X	X	X	X		* also, all	
												other analyses	
												specified by	
												FISH KILL	

EM&R CALL OUT LIST

AQUATIC BIOLOGY SECTION

Tom Minarik	708-588-4223 (w)
	708-710-2277 (c)
Dustin Gallagher	708-588-4219 (w)
	773-744-7379 (c)

FISH KILL LIMS LABELS

(Organic Samples Only)

In LIMS, go to **SAMPLES – LOGIN – TEMPLATE.** For Sample Template, enter **FISH**, hit the **BROWSE** key.

Sample template is **FISH_ORG.** Scroll and select this template, press **OK.**

Press the **LOGIN** button

Fill in **Sample Time, Sampler, Collector, and Field Office** information – Then press **LOGIN**

Labels (4) will automatically print to your designated label Printer.

For receipt, go to **MWRDGC – IWD – FIELD OFFICE – PRINT SAMPLE RECEIPT**

Obtain receipt as you would any IW receipt. Receipt will print to your designated printer. Receipt will not have any company information on top. Write in FISH KILL and location of incident.

FISH KILL LIMS LABELS

(Excluding Organic Samples)

In LIMS, go to **SAMPLES – LOGIN – TEMPLATE.** For Sample Template, enter **FISH**, hit the **BROWSE** key. Sample template is **FISH_KILL.** Select this template, press **OK.**

Press the **LOGIN** button

Fill in **Sample Time, Sampler, Collector, and Field Office** information – Then press **LOGIN**

Labels will automatically print to your designated label printer

For receipt, go to **MWRDGC – IWD – FIELD OFFICE – PRINT SAMPLE RECEIPT**

Obtain receipt as you would any IW receipt. Receipt will print to your designated printer. Receipt will not have any company information on top. Write in FISH KILL and location of incident.

IWD SAMPLE PROCEDURES FOR FISH KILL EVENT

Each Area Office should have a Fish Kill Response Kit fully stocked with bottles, sampling equipment, log sheets and laminated instructions. Large totes were distributed to all area offices for this purpose. This Response Kit should be kept in an area accessible to and known by all potential responders. When responding to a Fish Kill event, check the kit before leaving to ensure that all necessary equipment is in the kit. There is a list of required bottles in the instruction packet. Fill a large cooler with ice before leaving the plant. All samples must be refrigerated after collection.

Upon arrival at the site of the incident, locate the area where the dead fish are massed. Obtain samples as near as possible to this area. The information packet has a list of sample bottles and the corresponding test(s) associated with that bottle. Obtain samples using either a stainless steel bucket, or in the case of the Dissolved Oxygen (DO) sample, use the DO can. A procedure for obtaining and fixing a DO sample is included in the information packet. **Use gloves and safety goggles when handling and dispensing the DO reagents.** These should also be in the response kit. The responder should also attempt to collect, if it is safe to do so, a few of the dead fish for the Aquatic Biology section to study. These fish can be collected using the stainless steel bucket. Place the dead fish in a plastic bag. Seal the bag and keep the fish on ice. Once all samples have been obtained and placed on ice in the cooler, conduct an investigation as to the possible cause for the fish kill.

Upon return to the plant, generate LIMS labels for all the samples. Procedures to generate LIMS labels should be in the laminated instruction packet. Refer to the **Required Sample Bottles and Tests** sheet in the instruction packet to match the correct label with the appropriate container. Sample delivery should follow normal sample delivery procedures, unless the event is considered an emergency, in which case instructions on sample delivery will be provided to the responder(s). Make all appropriate telephone notifications per the included procedures.