Metropolitan Water Reclamation District of Greater Chicago

MONITORING AND RESEARCH DEPARTMENT

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ENVIRONMENTAL MONITORING AND RESEARCH DIVISION

2012

ANNUAL REPORT

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Metropolitan Water Reclamation District of Greater Chicago
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ENVIRONMENTAL MONITORING AND RESEARCH DIVISION

2012

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Monitoring and Research Department
Thomas C. Granato, Director

December 2013

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ACKNOWLEDGMENTS

This 2012 Annual Report is the result of the efforts of not only the scientists, microbiologist and biologists, who perform the monitoring and research initiatives of the Department, but also the impressive efforts of support staff and other personnel who contribute their valuable time, energy, and know-how to the production of the report. These individuals deserve special recognition and thanks. Special thanks are due to Bettina Gregor for her immaculate typing, zealous adherence to the Monitoring and Research Department formatting guidelines, responsiveness to turnaround times, and dedication to moving the report forward.

DISCLAIMER

The mention of trade names of specific products does not constitute endorsement of them by the Metropolitan Water Reclamation District of Greater Chicago.

STRUCTURE AND RESPONSIBILITIES OF THE ENVIRONMENTAL MONITORING AND RESEARCH DIVISION

The Environmental Monitoring and Research Division (EM&RD) has 64 employees, and is comprised of five Sections. These are illustrated in Figure 1 and Appendix V. The five Sections are:

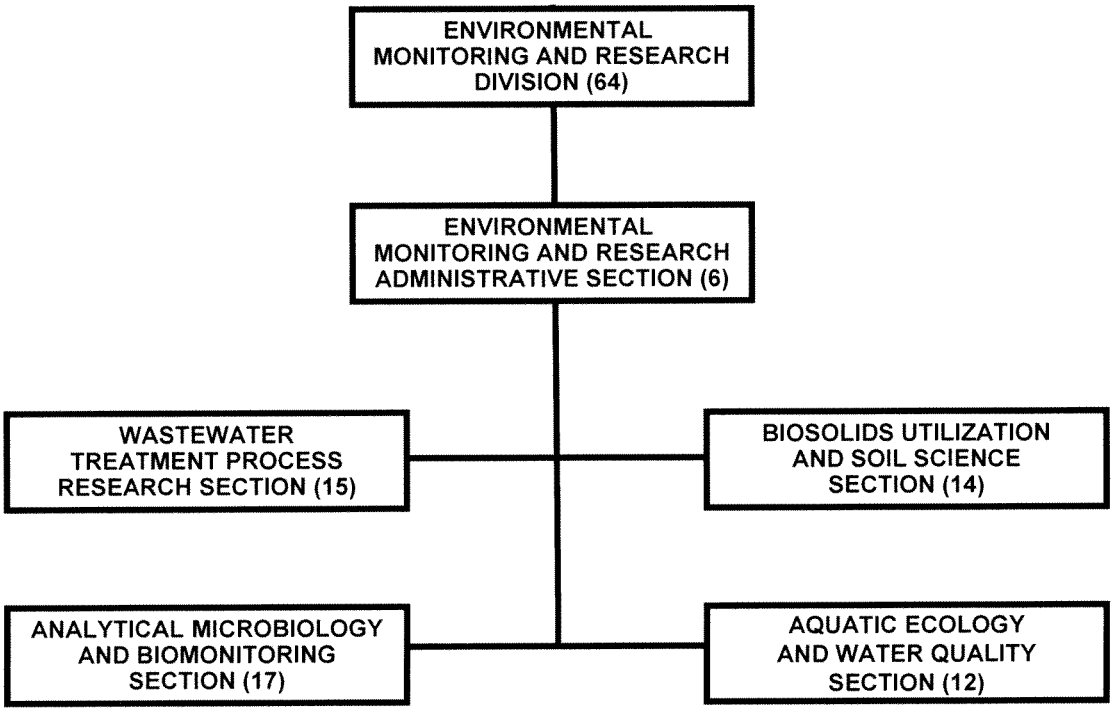
1. Administrative
2. Wastewater Treatment Process Research
3. Biosolids Utilization and Soil Science
4. Analytical Microbiology and Biomonitoring
5. Aquatic Ecology and Water Quality

The major areas of focus of the Division were as follows:

- Monitoring the environmental quality of Lake Michigan, area rivers and canals, and the Illinois River to document the effectiveness of the Metropolitan Water Reclamation District of Greater Chicago's (District) wastewater treatment program.
- Assisting in the resolution of sewage treatment and solids management operation problems.
- Providing technical assistance to other departments and agencies with respect to issues related to wastewater treatment; combined sewer overflow (CSO) management; waterways management; and solids processing, utilization, and marketing.
- Conducting operations and applied research to achieve improvement and cost reductions in District wastewater treatment, waterways management, and solids processing and biosolids utilization activities.
- Assessing the impacts of new or proposed regulations on District activities. Notably in 2012, the Division continued formulating the District's case in the Illinois Pollution Control Board (IPCB) Rulemaking R08-9 Chicago Area Waterway System (CAWS) Use Attainability Analysis.
- Generating and submitting environmental monitoring reports to regulatory agencies to ensure compliance with requirements of Tunnel and Reservoir Plan (TARP), water reclamation plant (WRP) National Pollutant Discharge Elimination System (NPDES), and biosolids processing and utilization permits.

FIGURE 1

ENVIRONMENTAL MONITORING AND RESEARCH DIVISION ORGANIZATION CHART



During 2012, EM&RD participated in numerous Meetings and Seminars (Appendix I), presented several papers, PowerPoint presentations, and poster presentations (Appendix II), and also published several papers (Appendix III).

OVERVIEW OF SECTIONS OF THE ENVIRONMENTAL MONITORING AND RESEARCH DIVISION

Administrative Section

The Administrative Section provides technical guidance, scientific review, and administrative support for the work being carried out by EM&RD staff. The Section also organizes a monthly seminar series, open to all District employees and interested public individuals through prior registration, which presents information on areas of interest to the District operations. In 2012, 1,622 people attended these seminars. A list of the seminar topics is shown in Appendix IV.

In addition to the overall administrative and supervisory functions performed by the Administrative Section, the Experimental Design and Statistical Evaluation Group and Radiochemistry Group, which are part of the Administrative Section, provided support to the rest of the EM&RD.

Experimental Design and Statistical Evaluation Group. The Experimental Design and Statistical Evaluation Group (EDSEG) is responsible for providing assistance in the design of laboratory and full-scale experiments, collection of appropriate data, development of guidelines for data collection methodology, and statistical analyses. Personnel in this Group also develop multistage automation programs to interconnect different software programs such as LATEX, Visual Basic, SAS, Access, Excel, Outlook, and PowerPoint. This computer automation has enabled the Group to produce reports, tables, and texts in suitable format more efficiently.

During 2012, the EDSEG provided statistical and computing support to various projects. The following is a description of some of the activities.

1. The EDSEG provided data management support to the Biosolids Utilization and Soil Science (BU&SS) Section to produce quarterly reports on the District's solids management areas in accordance with Illinois Environmental Protection Agency (IEPA) permit requirements. Groundwater and biosolids monitoring reports were produced for the Harlem Avenue, Lawndale Avenue, Ridgeland Avenue, 122 and Stony Island Avenue, Calumet East, and Calumet West Solids Management Areas. Quarterly monitoring reports are also generated for the Hanover Park Fischer Farm.

2. Statistical support was provided to a BU&SS research project on effect of biosolids application for mine land reclamation on groundwater quality.

3. Statistical support was provided to the Wastewater Treatment Process Research (WTPR) Section for the evaluation of a polymer reduction project.

4. Continuous support is being provided to the Aquatic Ecology and Water Quality (AEWQ) Section on the production of Continuous Dissolved Oxygen (DO) Monitoring Reports (Deep-Draft, and Wadeable) annually.

5. Statistical support was provided to the AEWQ Section on the study of fish abundance in the District's waters.

6. Two Ambient Water Quality Monitoring Exceedance Reports were produced by this Group for the first two quarters of 2012.

7. Numerous statistical analyses and data summaries were prepared to address IEPA regulations.

8. Statistical support and consulting were provided on data management, automation of reports, etc. to various sections in the Division.

9. Summarized results of the District's Ambient Water Quality Monitoring program for the CAWS. Surface water quality data for 2011 and 2012 were evaluated regarding compliance with water quality standards set by the IPCB. In 2012, a total of 67 water quality parameters were analyzed and reported.

Radiochemistry Group. The Radiochemistry Group is responsible for the radiological monitoring of waters, and wastewaters, and the maintenance of radiation safety at the District. It also performs any special tasks involving the use of ionizing radiation and radioisotopes.

Radiation Safety. The Radiochemistry Group maintains a radiation safety program for the District. The District possesses a radioactive material license from the Illinois Emergency Management Agency, Division of Nuclear Safety (IEMA-DNS). The radiation protection program is conducted in accordance with the license conditions and regulatory requirements of IEMA-DMS. The program includes:

- Maintaining the IEMA-DNS radioactive material license;
- Managing low-level radioactive waste;
- Monitoring personnel for radiation exposure;
- Testing the operation of radiation survey meters;
- Leak testing the radioactive sealed sources; and
- Maintaining a physical inventory of licensed radioactive materials.

The Illinois Low-Level Radioactive Waste Management Act requires all generators and brokers of low-level radioactive waste in Illinois to file an annual survey with the IEMA-DNS. In 2012, the survey was completed and submitted to the IEMA-DNS.

In 2012, all radioactivity chemicals previously used in the radiochemistry laboratory were surrendered to IEMA-DNS. Therefore, the District is now in possession of only sealed sources of radioactivity which are associated with the following instruments:

- Four Troxler surface moisture/density gauges used by the Construction Division of the Engineering Department.

- Six Ni-63 detectors on three gas chromatographs at the Organic Compounds Analytical Laboratory.

- Chemical Warfare Detector (APD 2000) and an X-ray fluorescence paint analyzer owned by the Safety Section of the Human Resources Department.

Routine activities conducted in accordance with the license and applicable regulations include the following:

- Monitoring of District staff for radiation exposure using badges and finger ring dosimeters. These are Engineering Department (Engineering) staff who use the Troxler moisture/density gauges.

- Quarterly operational checks of radiation survey meters.

- Leak test of the radioactive sealed sources at intervals not to exceed six months.

- A physical inventory of the radioactive sealed sources possessed by the District was carried out twice in 2012. A record of this inventory was maintained as per license requirements.

Wastewater Treatment Process Research Section

The WTPR Section's mission is to provide technical support to the Maintenance and Operations Department (M&O) and Engineering Department, to conduct applied research on both current treatment processes and new technologies, to conduct regulatory required monitoring, and to review, and develop technical information for pending regulations. Technical assistance is provided to M&O for solving WRP operating problems. The investigation of current operations may be done to address WRP problems or to generate new information on wastewater treatment processes. Plans and specifications are also reviewed at the request of Engineering to optimize process design criteria. The Section is responsible for conducting research aimed to solve problems and evaluate wastewater and sludge treatment processes currently utilized by the District. This Section also investigates innovative treatment processes

for potential future use. Studies of new technologies address maximizing the operation and cost efficiencies of existing processes or the development of new processes. Investigations are performed through surveys, literature reviews, laboratory bench-scale testing, pilot-plant studies, full-scale testing, or special analyses.

Biosolids Utilization and Soil Science Section

The role of the BU&SS Section is the application of science for continuous improvement in the cost effectiveness of the District's biosolids management program and environmental stewardship through:

1. Research, technical assistance, and public outreach;
2. Contribution to formulation of relevant regulations;
3. Compliance with applicable regulatory requirements;
4. National leadership in biosolids management;
5. Assistance on the District's green initiatives.

The long-range goals of the BU&SS Section are:

1. To conduct environmental monitoring and reporting to comply with permits and regulations governing the District's biosolids management program and the TARP.
2. To conduct applied research aimed at evaluating the benefits and environmental impacts of land application of biosolids.
3. To promote the beneficial use of biosolids and biosolids compost through dissemination of information, demonstrations, public relations, and technical support to users.
4. Monitor and review regulations and relevant issues to evaluate the impacts on the District's operations and assist with the development of technically sound regulations.
5. To provide technical support on green initiatives relevant to the District's operations.

Analytical Microbiology and Biomonitoring Section

The Analytical Microbiology and Biomonitoring Section (AMBS) mission is to provide on-time, high quality, cost-effective microbiological monitoring and research services to support

the M&R's five program goals. These five goals correspond to the EM&RD mission to protect and improve the District's facilities and operations and to protect the environment and public health. The AMBS's role is to:

- Conduct microbiological monitoring of liquid and solids for operational control and regulatory reporting requirements and to assess the environmental impacts of District operations.

- Address and provide monitoring support to the District's sustainable operation improvements (disinfection, nutrient, biosolids and storm water control) to fulfill the emerging regulatory development in meeting the CAWS recreational use attainment and environment improvement.

- Promote employee self-development, education, public awareness, and participate in the District's outreach activities.

The AMBS is equipped with the latest technologies and highly knowledgeable professionals and technical staff, and is organized into the following five separate laboratories:

1. Analytical Bacteriology Laboratory (ABL)

2. Wastewater Microbiology Laboratory (WML)

3. Parasitology Laboratory (PL)

4. Virology Laboratory (VL)

5. Molecular Microbiology Laboratory (MML)

As part of EM&RD's reorganization, the biomonitoring program was transferred from the AMBS to the AEWQ Section in 2011.

During 2012, the AMBS performed the following activities goals to improve it's operations and achieve it's goals:

- Maintained its Illinois Department of Public Health (IDPH) certification of the ABL, Registry No. 17508, for the examinations of: 1) Heterotrophic bacteria, heterotrophic plate count (HPC); 2) Total coliform (TC) with *Escherichia coli* (EC) broth verification examination of water from public water supplies and their sources (membrane filtration [MF] and multiple tube fermentation [MTF]); 3) Fecal coliform (FC) examination of water from public water sources (MF and MTF); 4) TC and EC examination of samples of water from public water supplies and their sources (minimal medium, orthonitro-phenyl-β-D-galactopyranoside-4-methylumbelliferyl-β-D-glucuronide [MMO-MUG]).

- Ensured that laboratory personnel are trained by completing the demonstration of capability, which enables them to perform analyses according to the laboratory Standard Operating Procedures (SOPs) and Quality Assurance Plan (QAP).

- Amended the bacteriological test procedure for the Ambient Water Quality Monitoring Program (AWQM) by discontinuing the EC monitoring in order to reduce monitoring costs.

- Monitored the routine operational performance of the laboratory through participation in appropriate performance evaluation and/or inter-laboratory testing programs and to provide for corrective actions as necessary.

- Updated SOPs and QAP, and implemented QA policies and essential applicable QC procedures to assure test validity.

- Increased the number of analyses that can be performed to more efficiently support the District's monitoring and research programs.

- Fostered a "zero defects" commitment or course of action for all staff. This commitment seeks to produce analytical data and services of the highest quality.

During 2012, the AMBS laboratories provided microbiological analytical and technical support to various projects under all EM&RD program goals. Table 1 shows a summary of the number of analyses provided under each program.

Aquatic Ecology and Water Quality Section

The mission of the AEWQ Section is to provide scientific and technical support to assess the waterways impacted by the District's wastewater treatment operations. The goals of the section are to:

1. Assess the water and sediment quality in waterways in the District's service area and in other waterways impacted by flow from this service area in order to inform policy, guide and assess regulatory developments, and support and improve operations.

2. Conduct biological and physical habitat monitoring in order to evaluate the health of waterways and assess changes in waterway conditions over time, especially those associated with District operations.

3. Conduct Whole Effluent Toxicity (WET) tests on District effluents in accordance with NPDES permits to monitor and evaluate the final effluents for any adverse effects to aquatic life.

TABLE 1: TOTAL NUMBER OF ANALYSES PERFORMED BY THE ANALYTICAL MICROBIOLOGY LABORATORY IN 2012

Program	Total Coliform, Fecal Coliform, HPC[1], *E. coli*	Pathogens[2]	Microbiological Assessment[3]	Quality Control[4]
4652 Liquid Monitoring	678	--[a]	--	2,641[b]
4653 Solids Monitoring	44	38	--	375[c]
4666 Sewage & Waste Control	4	--	--	--
4672 Waterways Monitoring	585	--	6	--
4674 Groundwater Monitoring	472	--	--	--
4681 Assistance to Maintenance and Operations	--	--	1,110	--
4682 Assistance to Others	62	9	--	8,321[d]
4684 Engineering Process Design Support	713	--	--	--
4690 Operations & Applied Research	--	--	124	38[e]
Total	2,558	47	1,240	11,375

[1]HPC-Heterotrophic Plate Count;
[2]Includes *Salmonella* spp., enteric virus (EV) and *Ascaris ova* (Helminth Ova-HO);
[3]Includes coliphages, filament, ammonia & nitrite oxidizing bacteria, and phosphorus accumulating organisms;
[4]Includes annual performance evaluation sample testing required by USEPA and Illinois Department of Public Health Certification and method specific quality control analyses;
[a]No Analyses;
[b]Includes Quality Control analyses for liquid monitoring;
[c]Includes Quality Control analyses for solids monitoring;
[d]Includes Quality Control analyses for Illinois Department of Public Health certification;
[e]Includes Quality Control for coliphage analyses.

4. Perform laboratory analysis of chlorophyll for the samples collected at Ambient Water Quality Monitoring stations in accordance with the SOP.

5. Design and conduct research projects to address potential changes in District operations, such as effluent disinfection and phosphorus (P) removal.

6. Design and conduct research projects to explore emerging issues in water quality and treatment.

7. Participate in regulatory review of water-quality related standards and documents, including attendance at regulatory hearings and stakeholder meetings that concern District operations.

8. Cooperate with other governmental and non-governmental agencies and academic institutions to develop water quality and aquatic ecology research projects.

9. Review plans for stormwater improvement construction projects on small streams and recommend biologically sound implementations. Monitor before and after construction events to document biological effects.

SUMMARY OF ENVIRONMENTAL MONITORING AND RESEARCH DIVISION ACTIVITIES DURING 2012

During 2012, the EM&RD performed activities under the following five program goals:

Goal 1: Operations Monitoring (4650) - Monitor liquid and solids process trains for operational control and regulatory reporting requirements and compliance.

Goal 2: Waste Monitoring (4660) - Monitoring and control of waste discharged into District's sewage collection system.

Goal 3: Environmental Monitoring (4670) - Monitor the environmental impacts of District operations to assess compliance with all regulations and properly assess the impacts of District operations in a cost efficient manner.

Goal 4: Technical Assistance (4680) - Evaluate process control and monitoring information to improve process efficiency, inform design and support effective regulatory developments.

Goal 5: Operations and Applied Research (4690) - Conduct applied and operations research to achieve improvement and cost reductions in District wastewater treatment, waterways management, and solids processing activities.

Goal 1: Operations Monitoring

Levels of Radioactivity in Raw and Treated Wastewaters. Radiological monitoring of raw wastewater and final effluent samples from the District's seven WRPs continued in 2012. Data from the monitoring serves as a measure of present-day radioactivity levels in comparison to levels in past years. The IPCB has established General Use Water Quality Standards for radioactivity in the waters of Illinois. According to IPCB regulations, (Title 35, Chapter 1, Section 302.207) gross beta concentration shall not exceed 100 pCi/L, and the strontium-90 concentration must not exceed 2 pCi/L. The annual average radium-226 and 228 combined concentration must not exceed 3.75 pCi/L in General Use waters. There are no IPCB or USEPA radioactivity standards for raw sewage or final effluents. However, the District uses the IPCB General Use waters limits for radioactivity as the reference for monitoring WRP effluent.

The analysis of radioisotopes was conducted on 24-hour composite samples of raw sewage and final effluent collected monthly at all WRPs. The samples were analyzed by Environmental, Inc. Midwest Laboratory, Northbrook, Illinois (EIML). The data are presented in the 2012 Annual Report entitled "Radiological Monitoring of the Raw Sewage, Final Effluent,

Sludge, and Biosolids of the Metropolitan Water Reclamation District of Greater Chicago" (Monitoring and Research Department [M&R] Report No. 13-25).

The results show that the amount of gross alpha, gross beta, combined radium-226 and radium-228, and strontium-90 radioactivity in the final effluent of all the WRPs, except for combined radium-226 and radium-228 in the Lemont WRP, is less than the allowable contaminant levels in drinking water standards set by the United States Environmental Protection Agency (USEPA) National Primary Drinking Water Regulations 40 Code of Federal Regulations Part 141. The concentration of radioactivity in the final effluent, with the exception of combined radium-226 and radium-228 in the Lemont WRP, is also less than the General Use Water Quality Standards established by the IPCB. The monitoring data indicate that the discharge of the final effluent from the seven WRPs is not likely to have any adverse effect on the radiological quality of the District's receiving streams.

John E. Egan Water Reclamation Plant Profile Sampling. A DO and NH_3-N profile evaluation was performed on a quarterly basis in the North and South aeration batteries at the Egan WRP as part of an ongoing support to M&O plant operations. Based on the results of this monitoring, it was determined that NH_3-N was completely removed by mid-tank length in spring 2012 for both the North and South Batteries. In late spring/early summer 2012, the Egan WRP experienced upset conditions which resulted in elevated turbidity in the secondary effluent. The WTPR Section initiated emergency profile sampling during June and July 2012. The results of profile sampling indicated slower NH_3-N removal as compared to normal operating conditions (Nitrification was not achieved until the end of aeration tanks). Also, a higher specific oxygen uptake rate (SOUR) was observed in the beginning of the tanks in both the North and South batteries, most likely due to higher than usual ammonia loads to the plant. During fall 2012, similar sub-optimal nitrification and SOURs were observed compared to the special upset sampling, but NH_3-N removal and SOUR improved and returned to optimal conditions during winter 2012.

Fulton County Environmental Monitoring. The Fulton County Land Reclamation Site consists of 6,122.5 hectares (15,264.5 acres) of land the District owns in Fulton County, Illinois. The site is used to recycle biosolids for the purpose of reclaiming mine soil and fertilizing agricultural crops. To satisfy the IEPA permit requirements for operation of the site, the District established an environmental monitoring program to ensure that the land application of biosolids would not adversely affect surface water, groundwater, soils, and crops. The last application of biosolids at the site was done in 2004. As of 2007, all monitoring and reporting for soil, crop, and surface and groundwater at the site was terminated as approved by the IEPA until biosolids application resumes.

On a discretionary basis, samples of soil, plant tissue, groundwater, and surface water from a few locations at the site are collected every two years to add soil and plant tissue samples to the repository and add data to the historical database for the site. The M&O staff located at the Fulton County site assists EM&RD staff with the sampling. The water samples are analyzed, but soil and plant tissue samples are stored without analysis.

Hanover Park Fischer Farm. The Hanover Park Fischer Farm is a 48-hectare (120 acres) site located on the south side of the Hanover Park WRP, which utilizes all biosolids generated at the WRP. The farm has seven gently sloping fields, each surrounded by a berm to control surface runoff. Anaerobically digested biosolids are applied by subsurface injection. The IEPA operating permit (No. 2007-SC-2951-1) for the site limits the annual biosolids application rate to 56 dry Mg/ha (25 dry tons/acre). An underground tile drain system collects surface and subsurface drainage, which is returned to the Hanover Park WRP for treatment. Groundwater monitoring is required by the IEPA operating permit. Monitoring wells on the farm are sampled quarterly, except Well No.7, which is monitored monthly. The 2012 groundwater monitoring data were submitted to the IEPA in the quarterly monitoring reports (Report Nos. 12-12, 12-21, 12-38, and 12-51).

Groundwater Quality Monitoring at Solids Management Areas. Groundwater quality is monitored at the solids management areas (SMAs) where paved cells are used for air-drying of lagoon-aged or centrifuge cake biosolids to a solids content of 60 percent or greater. Following a request to the IEPA to reduce the monitoring frequency for groundwater quality at the SMAs, beginning January 2010, monitoring frequency was modified to quarterly for all lysimeters, except three, which are monitored monthly. The SMAs include the following six sites.

- John E. Egan Water Reclamation Plant Solids Management Area – This SMA is no longer used. The IEPA operating permit (No. 2010-AO-0266) does not require groundwater monitoring or reporting unless drying resumes at the site.

- Calumet Water Reclamation Plant Solids Management Area – This SMA consist of the Calumet West and Calumet East SMAs. The IEPA operating permit (No. 2010-AO-0265) requires sampling of lysimeters for groundwater monitoring. The 2012 groundwater monitoring data were submitted to the IEPA in the quarterly reports for the Calumet West SMA (Report Nos. 12-08, 12-20, 12-37, and 12-50) and the Calumet East SMA (Report Nos. 12-07, 12-19, 12-36, and 12-49).

- Lawndale Avenue Solids Management Area – The IEPA operating permit for this site (No. 2010-AO-0267) requires sampling of groundwater monitoring wells and lysimeters. The 2012 groundwater monitoring data were submitted to the IEPA in quarterly reports (Report Nos. 12-10, 12-23, 12-40, and 12-53).

- Ridgeland Avenue Solids Management Area – Currently, biosolids drying is not done on this site. Under the IEPA operating permit for this site (No. 2010-AO-0267) sampling of groundwater monitoring lysimeters has been terminated, except for lysimeter L-2N. The 2012 groundwater monitoring data were submitted to the IEPA in quarterly reports (Report Nos. 12-11, 12-24, 12-41, and 12-54).

- Harlem Avenue Solids Management Area – The IEPA operating permit for this site (No. 2009-AO-2715-1) requires sampling of monitoring lysimeters.

The 2012 groundwater monitoring data were submitted in quarterly reports to the IEPA (Report Nos.12-09, 12-22, 12-39, and 12-52).

- 122nd and Stony Island Solids Management Area – Currently, biosolids drying is not done on this site. Under the IEPA operating permit for this site (No. 2010-AO-0267) sampling of groundwater monitoring lysimeters has been terminated, except for lysimeter L-1. The 2012 groundwater monitoring data were submitted to the IEPA in quarterly reports (Report Nos.12-13, 12-18, 12-42, and 12-55).

Monitoring and Reporting for the Biosolids Management Program. The Division conducted the following activities under the District's biosolids management program:

- Biosolids Monitoring Under Process to Further Reduce Pathogens Certification – The District maintains certification of a site-specific process to further reduce pathogens (PFRP) for biosolids processing trains at the Stickney and Calumet WRPs, as awarded by the USEPA. In this certification, the District's air-dried biosolids generated according to a codified operation is designated as Class A according to pathogen standards under the USEPA 40 Code of Federal Regulations Part 503 Rule (Part 503). The monitoring program for this certification includes pathogen analysis of biosolids and annual reporting to the USEPA. The operation of PFRP-codified biosolids processing trains at the Stickney and Calumet WRPs and the Analytical Microbiology Laboratory, which conducts the pathogen analysis, were audited in 2012. The laboratory operations are in compliance with Part 503 methodology requirements for bacteria and pathogen analysis. The PFRP certification was renewed in 2012 and the certification period increased from two years to five years.

- Pathogen monitoring – The District's utilizes its exceptional quality (EQ) lagoon-aged, air-dried biosolids in the Chicago metro area under a Controlled Solids Distribution (CSD) program under a permit issued by IEPA. The AML conducted analyses of biosolids for FC bacteria, viable *Ascaris* ova (Helminth Ova-HO), and culturable enteric viruses (EV) as required to demonstrate compliance with the 40 CFR Part 503 regulations for Class A pathogen criteria of the EQ standard. During 2012, biosolids analysis under the program included 44 samples for FC and 19 samples for HO and culturable EV analyses.

In 2012, EM&RD prepared the following regulatory reports under the biosolids management program:

1. The 2011 Biosolids Management Report to the USEPA - This report (Report No.12-05) was prepared to satisfy the reporting requirements of the Part 503 regulation.

2. Three monthly (October, November, and December 2011) and three quarterly (first, second, and third quarters of 2012) reports for the CSD permit were submitted to the IEPA (Report Nos.12-02, 12-03, 12-04, 12-16, 12-43, and 12-47). In 2012, the reporting frequency was changed from monthly to quarterly as approved by IEPA. The reports document the biosolids users, project descriptions and locations, and biosolids analyses.

3. The semi-annual report (12-14) for the PFRP certification for the July – December 2011 period was submitted to USEPA. Based on the new five-year certification issued in 2012, future pathogen analysis data will be reported in the Annual Biosolids Management Report to the USEPA.

National Pollutant Discharge Elimination System Effluent Monitoring.

- Biomonitoring – Under the special conditions of the District WRPs NPDES permits, the following acute tests were conducted: a) Fish (Fathead minnows)-96 hour Static LC50 Bioassay; and b) Invertebrate (*C. dubia*)-48 hour Static LC50 Bioassay, known as the WET tests, to monitor and evaluate the District WRP's effluents for toxicity to aquatic life. One acute WET test on the Egan WRP effluent and one acute WET test on the Lemont WRP effluent were conducted for NPDES permit compliance. No acute toxicity was observed. The acute WET test method and procedures were in accordance with the USEPA's established protocol following an approved SOP and QAPP (EPA, 2002)[1]. For each test performed, ongoing laboratory quality performance was evaluated by performing reference toxicant tests (RTT) using sodium chloride. All RTTs were performed using the laboratory control water under test conditions identical to NPDES permit required tests. Laboratory staff maintains quality control charts using RTT data from the most recent twenty tests. All twenty RTTs conducted were valid. The Aquatic Ecology Laboratory participated in the Discharge Monitoring Report Quality Assurance Program, established by the USEPA, by conducting toxicity tests of unknown samples. The results were within the acceptable ranges.

- Fecal coliform monitoring – Membrane filtration analyses of FC bacteria was conducted to monitor the District's WRP effluents as required by their respective NPDES permits and to guide treatment operations. This included FC bacteria monitoring (one day/week/WRP) of the final treated effluent samples from each of the District's seven WRPs. The Hanover Park, James C. Kirie (Kirie) and John E. Egan (Egan) WRPs have a seasonal disinfection requirement from May 1 through October 31. During the seasonal disinfection period, FC bacteria are analyzed five days/week from these three District WRPs. The ABL performed FC analyses on a total of 678 samples

[1] Methods for Measuring the Acute Toxicity of Effluents and Receiving Waters to Freshwater and Marine Organisms, EPA/821-R-02-012, Fifth Edition, October 2002.

from the District's seven WRPs (Table 1). The FC analysis results were reported to M&O. NPDES permits also require additional monitoring when rain storm events cause excess flow above the design maximum treatment capacities of the WRPs. These storms can cause the WRPs to discharge untreated effluent to the receiving streams. The Division performs FC bacteria analyses on these excess flow discharge events. There was no storm-related excess flow monitoring in 2012.

Goal 2: Waste Monitoring

The ABL analyzed four industrial waste survey samples for FC bacteria to track the pollution sources and investigate the compliance of discharge quality of industrial users with the Industrial Waste Control Ordinance.

Goal 3: Environmental Monitoring

Estimation of Emission of Hazardous Air Pollutants. Part A, Title I, of the Clean Air Act, states that a publicly owned treatment works (POTW) is considered a major source of hazardous air pollutants (HAPs) if it emits or has the potential to emit ten tons per year or more of any single HAP or 25 tons per year or more of any combination of HAPs. Samples of the influent sewage to each of the District's WRPs are collected twice per year and analyzed for 65 of the HAP compounds of concern to POTWs. Emissions of these HAPS from the wastewater treatment process units (grit chamber, primary settling tanks, aeration tanks, and secondary settling tanks) are estimated using the BASTE computer model developed by CH2M Hill. The average concentration of each HAP detected in the influent sewage and the annual running average operating conditions were used as input to the model. The physical properties, such as vapor pressure and molecular weight of the individual compounds, were taken from the USEPA database for use in the model as well. During 2012, influent samples were collected in January and July 2012. The average influent concentrations and estimated emissions of the HAPs are presented in Table 2 for the three largest District WRPs (Calumet, O'Brien, and Stickney).

According to the BASTE model, all the individual HAP emissions were less than the ten tons/year criterion. Toluene was the predominant compound emitted from the wastewater treatment processes at the Stickney and Calumet WRPs. Tetrachloroethene was the predominant compound emitted from the wastewater treatment processes at the O'Brien WRP. The total measured HAP emissions were substantially less than the 25 tons/year threshold at each of the three WRPs. Therefore, the wastewater treatment process units at the District's WRPs are not considered major sources of HAPs. Additionally, the annual HAPs report was filed as part of the IEPA's Environmental Emissions Reduction Market System.

TABLE 2: INFLUENT CONCENTRATIONS AND ESTIMATED EMISSIONS OF HAZARDOUS AIR POLLUTANTS AT THE CALUMET, STICKNEY AND TERRENCE J. O'BRIEN WATER RECLAMATION PLANTS IN 2012 [1]

Hazardous Air Pollutant Organic Compound	Influent Concentrations (µg/L)			Emissions (tons/yr)		
	Stickney	Calumet	O'Brien	Stickney	Calumet	O'Brien
Dichloromethane	0.1	0.0	1.7	0.01	0.00	0.02
Chloroform	2.2	0.0	2.7	0.19	0.00	0.05
Trichloroethene	0.8	0.0	0.96	0.00	0.00	0.05
Benzene	0.0	2.1	0.0	0.00	0.07	0.00
Tetrachloroethene	0.6	0.0	0.4	0.14	0.00	2.48
Toluene	11.7	69.9	2.8	0.91	2.15	0.04
Carbon disulfide	0.7	0.4	0.0	0.10	0.02	0.00
Methyl ethyl ketone	0.8	0.0	0.0	0.01	0.00	0.00
Styrene	4.0	0.4	0.0	0.24	0.01	0.11
Xylene (total)	0.9	0.0	0.0	0.07	0.00	0.00
Cresol (total)	2.8	23.7	12.1	0.01	0.02	0.00
Acetophenone	0.0	14.1	0.0	0.00	0.01	0.00
Cumene	0.0	14.1	0.0	0.00	0.45	0.00
2,4-D, salts and esters	0.0	0.0	0.0	0.00	0.01	0.00
Acetaldehyde	6.0	0.0	0.0	0.15	0.00	0.00
Propionaldehyde	4.0	0.0	0.0	0.18	0.00	0.00
1,4-Dioxane	13.9	0.0	0.0	0.01	0.00	0.00

[1] Average results of the two influent samples collected in January and July 2012.
ND = No data.

John E. Egan Water Reclamation Plant Air Quality Permit. As part of the Egan WRP's Federally Enforceable State Operating Permit, the monthly hydrogen sulfide (H_2S) monitoring performed at the facility's compressor room was recorded. The monthly permit limit for the digester H_2S is 1,000 parts per million by volume (ppmv). In 2012 there was no permit violation with respect to H_2S concentration in the Egan WRP digester gas; however, a plant upset during late spring/early summer 2012 triggered H_2S levels very close to the permit limit. An investigation into the source of the problem through the evaluation of the sulfur species in Egan and Kirie WRP sludge streams was initiated in 2012 with completion scheduled for 2013.

Tunnel and Reservoir Plan Groundwater Monitoring. The IEPA requires groundwater monitoring for the District's six TARP systems, which includes the Mainstream, Calumet, Des Plaines, and Upper Des Plaines (UDP) Tunnel Systems, the Gloria Alitto Majewski Reservoir, and the Thornton Transitional Flood Control Reservoir. For each storm event resulting in filling of the reservoirs, the reservoirs are sampled after the fill event and weekly during the period that the storm water remains in the reservoir. The groundwater monitoring program includes over 150 groundwater wells adjacent to the tunnel and reservoirs to monitor potential for groundwater contamination through extrusion of stormwater. The wells are monitored six to twelve times per year and all samples for general chemistry are analyzed by the Analytical Laboratories Division and FC by the AML.

Lake Michigan Monitoring. Monitoring of Chicago's harbors are conducted when river backflow to Lake Michigan occur due to heavy rainfall in the Chicagoland area. During the river backflow events, the Division conducts water quality monitoring to assess the impact of the release of CAWS water to Lake Michigan. In 2012, there was no backflow to Lake Michigan.

Drinking Water Monitoring. The Division analyzes drinking water at District facilities on an as-needed basis. During 2012, nine samples associated with new pipe construction projects at the Stickney WRP and ten samples from Lockport Powerhouse facility were collected. All samples were examined for the presence of TC and EC, which are indicators of fecal contamination. The Heterotrophic Plate Count was also conducted, which is an indicator of the general bacteriological content of the water. The analyses, quality control, and recordkeeping procedures were done according to the AML Illinois Department of Public Health certification. The results were reported together with safety instructions and recommendations where applicable.

Ambient Water Quality Monitoring Program. The AWQM program includes monthly sampling for water quality analysis, including FC analysis, at 59 stations on 21 waterways reaches within the District's service area (Figure 2). Analytical results are compared to applicable water-quality standards in an annual summary report. In August 2012, we decreased the number of sampling stations to 28. Figure 3 is a map of the stations that were sampled between August through December, 2012.

FIGURE 2: AMBIENT WATER QUALITY MONITORING AND CONTINUOUS DISSOLVED OXYGEN MONITORING SAMPLE STATIONS

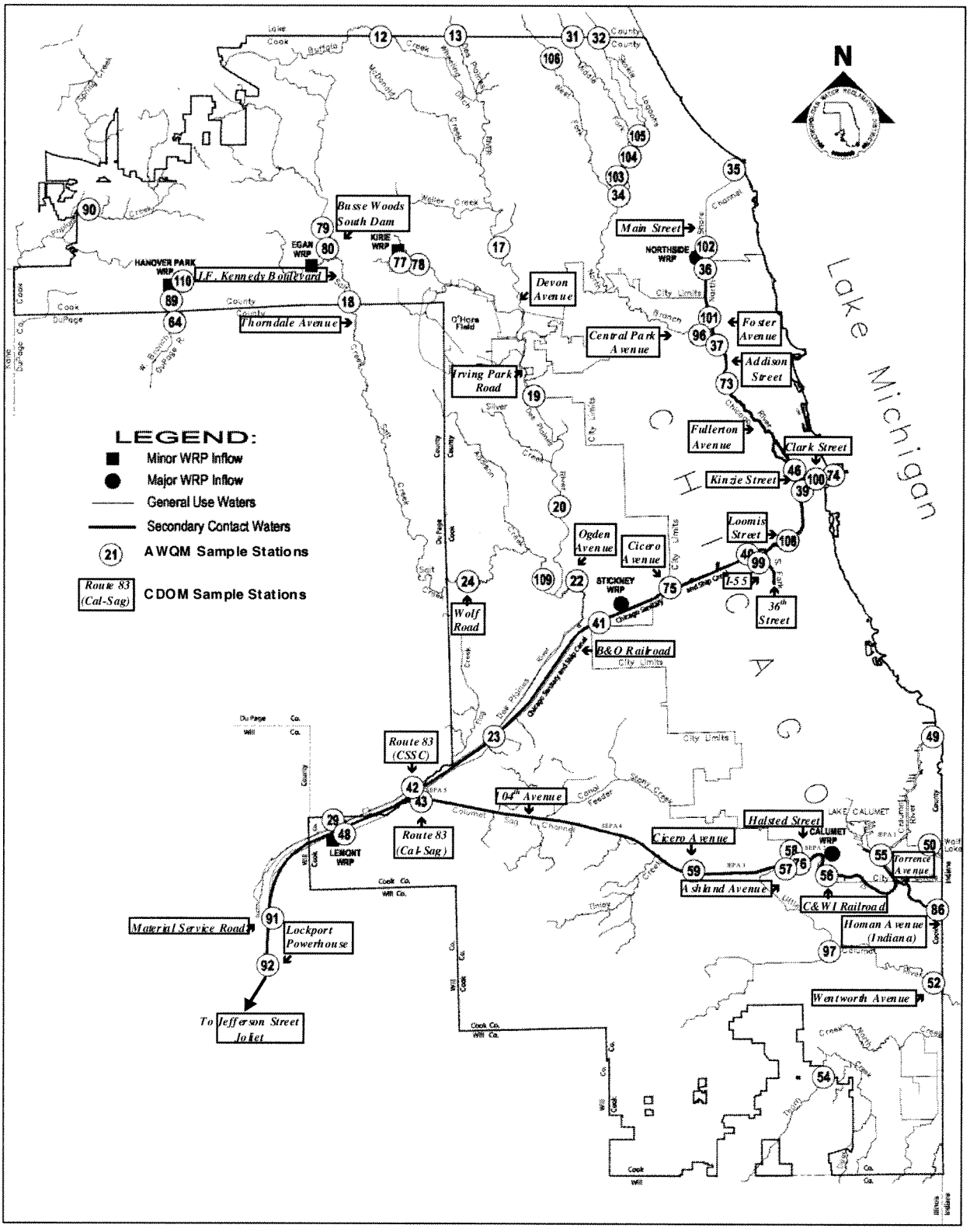
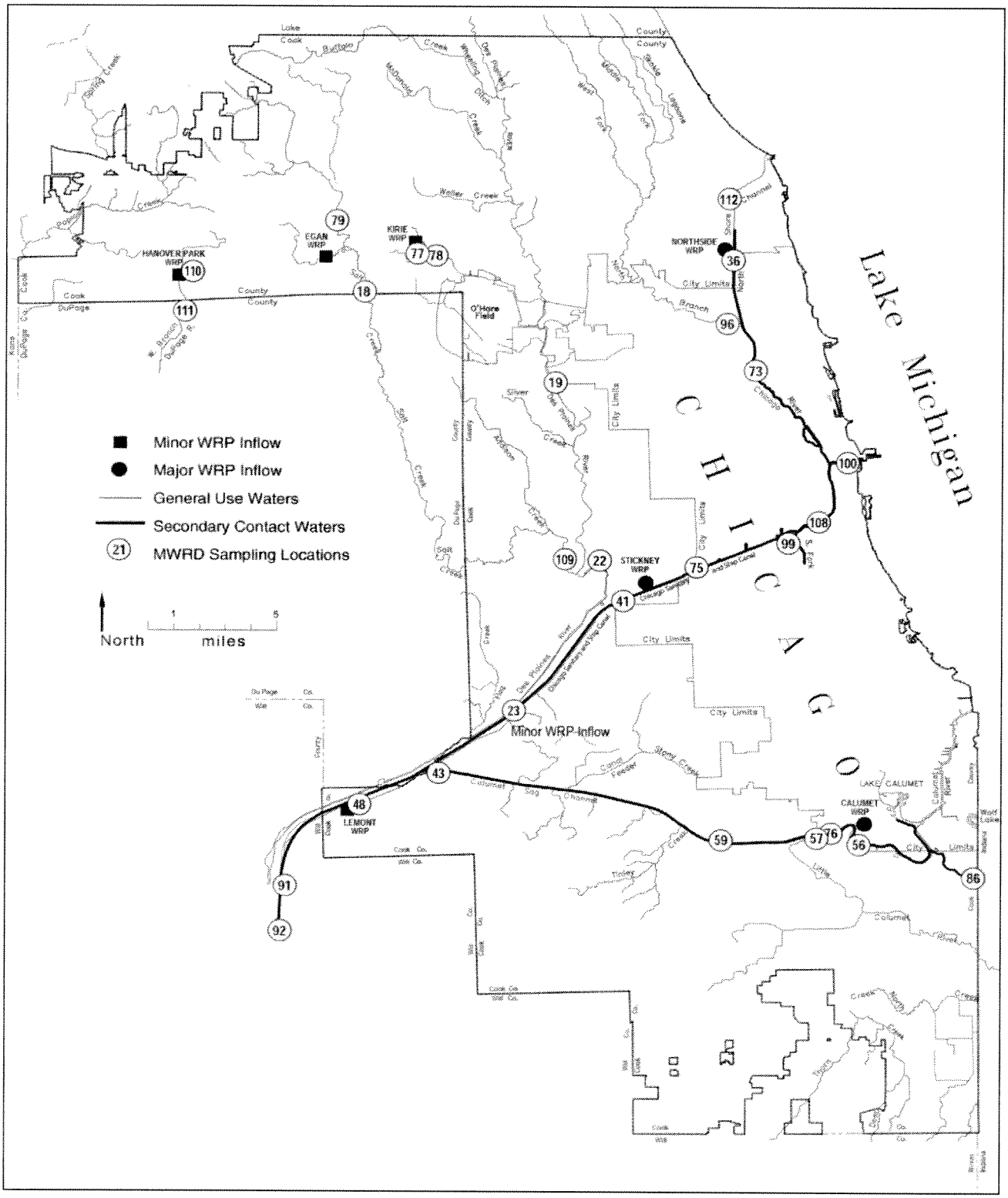


FIGURE 3: REVISED AMBIENT WATER QUALITY MONITORING SAMPLE STATIONS AS OF AUGUST, 2012



The samples were analyzed for gross alpha and gross beta radioactivity by EIML. The levels of radioactivity in all samples analyzed were well within the USEPA Drinking Water Standards of 15 pCi/L for gross alpha (excluding radon and uranium), and 50 pCi/L (screening level) for gross beta particle activity minus the naturally occurring potassium–40 beta particle activity.

The biological monitoring program, which runs in conjunction with the AWQM program, includes chlorophyll monitoring, the study of fish communities, and the characterization of physical habitat. The primary objective of the monitoring program is to provide scientific data to the District and the IEPA regarding the biological condition of the CAWS and Chicago Area General Use waterways. The IEPA uses the data to assess waterways in the District's service area for attainment of Clean Water Act goals.

The AEWQ Section performs biological monitoring at 15 of the 59 sampling stations annually and the remaining 44 stations once every four years. From June through September of 2012, fish were collected by electrofishing and seining at 23 biological monitoring stations on the CAWS. In 2012, a total of 10,695 fishes comprised of 41 species and 2 hybrid species, were identified, weighed, and measured for length. The fishes were also examined for parasites and disease. Five stations were sampled multiple times during 2012. Ogden Avenue, on the Des Plaines River, was sampled four times, including one time with a small electrofishing boat. The stations at Devon Avenue, in Salt Creek, Ashland Avenue, in the Little Calumet River, Harlem Avenue and Lockport, in the Chicago Sanitary and Shipping Canal, were sampled 3 times during 2012.

Data from these collections are shown in Table 3. The most abundant species in the deep-draft waterways included gizzard shad, western mosquitofish, bluntnose minnow, pumpkinseed sunfish, emerald shiner, and bluegill. In the wadeable waterways, green sunfish, bluegill, blackstripe topminnow, bluntnose minnow, gizzard shad, and common carp were the most abundant.

As a photosynthetic component of all algae cells, chlorophyll *a* is a surrogate for quantifying algal biomass in lakes and streams. The District began monitoring chlorophyll on a monthly basis in August 2001 as part of the AWQM Program. In August 2012, the program was reduced from 59 to 28 stations. Chlorophyll *a* results for 2012 were reported in M&R Report No. 13-40, "Annual Summary Report on Water Quality Within the Waterway System of MWRDGC".

Continuous Dissolved Oxygen Monitoring. The AEWQ Section developed a comprehensive Continuous DO Monitoring program beginning in August 1998 in

TABLE 3: FISH COLLECTED FROM WATERWAYS DURING 2012

Waterway	Number of Fish Collected	Weight (kg) of Total Catch	Number of Fish Species	Number of Game Fish Species	Most Abundant Fish Species
CHICAGO RIVER SYSTEM					
North Shore Channel	517	86.2	13	4	Gizzard shad
North Branch Chicago River	37	0.2	4	2	Blackstripe topminnow
Deep-Draft North Branch Chicago River	279	18.0	5	2	Gizzard shad
Chicago Sanitary and Shipping Canal	2,354	117.8	14	5	Gizzard shad
CALUMET RIVER SYSTEM					
Calumet River	535	51.5	18	7	Bluntnose minnow
Deep-Draft Little Calumet River	525	30.4	17	8	Gizzard shad
Calumet–Sag Channel	657	94.6	12	4	Gizzard shad
DES PLAINES RIVER SYSTEM					
Higgins Creek	96	0.5	6	2	Bluntnose minnow
Buffalo Creek	72	1.7	8	5	Green sunfish
Des Plaines River	621	21.9	28	10	Green sunfish
Salt Creek	342	34.8	19	8	Bluegill
West Branch DuPage River	93	0.8	7	4	Green sunfish
FOX RIVER SYSTEM					
Poplar Creek	187	0.2	10	4	Creek chub

the Chicago River System and July 2001 in the Calumet River System to evaluate the oxygen dynamics in deep-draft sections of the CAWS. The DO monitoring in wadeable Chicago area waterways, particularly in the Des Plaines River System, began in July 2005. Figure 2 shows continuous DO monitoring locations.

The DO results for 2012 are included in the reports entitled, "Continuous Dissolved Oxygen Monitoring in Chicago Area Wadeable Streams During 2012" (M&R Report No. 13-24) and "Continuous Dissolved Oxygen Monitoring in the Deep-Draft Chicago Waterway System During 2012" (M&R Report No. 13-35).

Goal 4: Technical Assistance

Calumet and Terrence J. O'Brien Water Reclamation Plants Disinfection Task Force. The WTPR Section, in conjunction with the Engineering and M&O Departments, formed a Disinfection Task Force, which evaluated available disinfection technologies, reviewed operating data for the Calumet and O'Brien WRPs, and performed a triple bottom line analysis to provide recommendations on the best disinfection alternatives for installation at the both WRPs. The recommendations of the Task Force included chlorination and dechlorination disinfection for the Calumet WRP and ultraviolet (UV) radiation disinfection for the O'Brien WRP. The Disinfection Task Force drafted three technical memorandums detailing this comprehensive evaluation. Technical Memorandum 1 included available disinfection technologies and the short list of technologies evaluated in detail. Technical Memorandum 2 included historic plant flows, water quality data, and other relevant test results. Finally, Technical Memorandum 3 included the evaluation matrix ratings and results. All three technical memorandums are located on the District website under M&R Data and Reports.

Calumet Water Reclamation Plant Chlorine Disinfection Tests of Secondary Effluent. Since the Calumet WRP being designed for an effluent chlorination disinfection process, the WTPR Section conducted disinfection bench tests on Calumet WRP secondary effluent samples to evaluate the chlorine dose-FC response with an emphasis on secondary effluent with elevated NH_3-N concentrations and low temperatures. The elevated NH_3-N concentrations and low temperature bench tests were designed to simulate the worst-case conditions usually observed in March, with NH_3-N concentrations at the maximum daily NPDES permit limit of 8.0 mg/L.

Six secondary effluent samples were collected and analyzed for NH_3-N, suspended solids (SS), and FC prior to testing, as reported in Table 4. Chlorination disinfection bench testing was performed on these samples with and without NH_3-N spikes, as summarized in Table 5. The samples with initially low NH_3-N concentrations were spiked with 1,000 mg/L of NH_3-N from a stock ammonium chloride (NH_4Cl) solution. The nominal chlorine doses ranged from 0.5 to 8.0 mg/L, but the actual chlorine doses are shown in Table 5.

TABLE 4: INITIAL CALUMET WATER RECLAMATION PLANT SECONDARY EFFLUENT WASTEWATER CHARACTERISTICS FROM CHLORINATION TESTING STUDY

Collection Date	NH_3-N (mg/L)	SS (mg/L)	Initial FC[2] (CFU/100 mL)		
			Sample 1	Sample 2	Geo. Mean
7/19/2012	1.48	NA[1]	23,000	30,000	26,268
8/20/2012	<0.10	<4	4,300	4,800	4,543
8/27/2012	<0.10	9	9,500	7,600	8,497
9/04/2012	<0.10	7	6,600	8,200	7,357
9/11/2012	<0.10	4	8,600	8,100	8,346
9/12/2012	0.13	<4	12,000	14,000	12,961

[1]NA denotes the data not available.
[2]Two analyses performed per sample.

TABLE 5: CALUMET WATER RECLAMATION PLANT SECONDARY EFFLUENT CHLORINATION BENCH TEST TREATMENTS

Collection Date	NH_3-N (mg/L)	Test Temperature Range (°C)	Cl_2 Dose Range (mg/L)
7/19/2012	1.48	22.5–23.3	4.32–8.65
8/20/2012	<0.10	19.4–20.4	0.96–3.84
8/20/2012	2.06[1]	19.7–21.4	0.96–4.80
8/28/2012	<0.10	19.3–20.8	0.48–2.40
8/28/2012	2.03[1]	20.7–22.9	0.48–2.40
9/04/2012	<0.10	20.7–21.4	0.50–3.96
9/04/2012	4.00[1]	20.9–21.5	0.50–3.96
9/11/2012	<0.10	12.5–13.7	0.50–3.96
9/11/2012	8.06[1]	12.7–14.6	0.50–3.96
9/12/2012	0.13	13.2–13.6	0.50–4.00
9/12/2012	7.64[1]	12.7–13.9	0.50–4.00

[1]Denotes that secondary effluent sample was spiked with ammonium chloride to achieve the elevated concentration.

For each test, chlorine was added to the samples with mixing for 30 seconds and allowed 15 minutes of quiescent contact time. At the end of the contact time, an aliquot was poured into a prepared container with a chlorine-quenching agent and analyzed for FC concentration. At the end of the contact time the total residual chlorine (TRC) was determined with a Hach AutoCat 9000 analyzer using the forward TRC method.

The results of the chlorine dose-FC response bench tests are shown in Figure 4. The chlorine dose-FC response curves in all bench tests indicate that a chlorine dose of 3.0 mg/L sufficiently disinfected secondary effluent samples to meet a FC concentration of less than of 200 CFU/100 mL. A comparison of the results of the samples spiked with NH_4Cl and those without indicated that increased NH_3-N concentrations will not negatively influence disinfection. However, this was based on the spiked NH_3-N concentration treatments and not the high NH_3-N concentration in the initial secondary effluent sample, which occurred only on July 19, 2012.

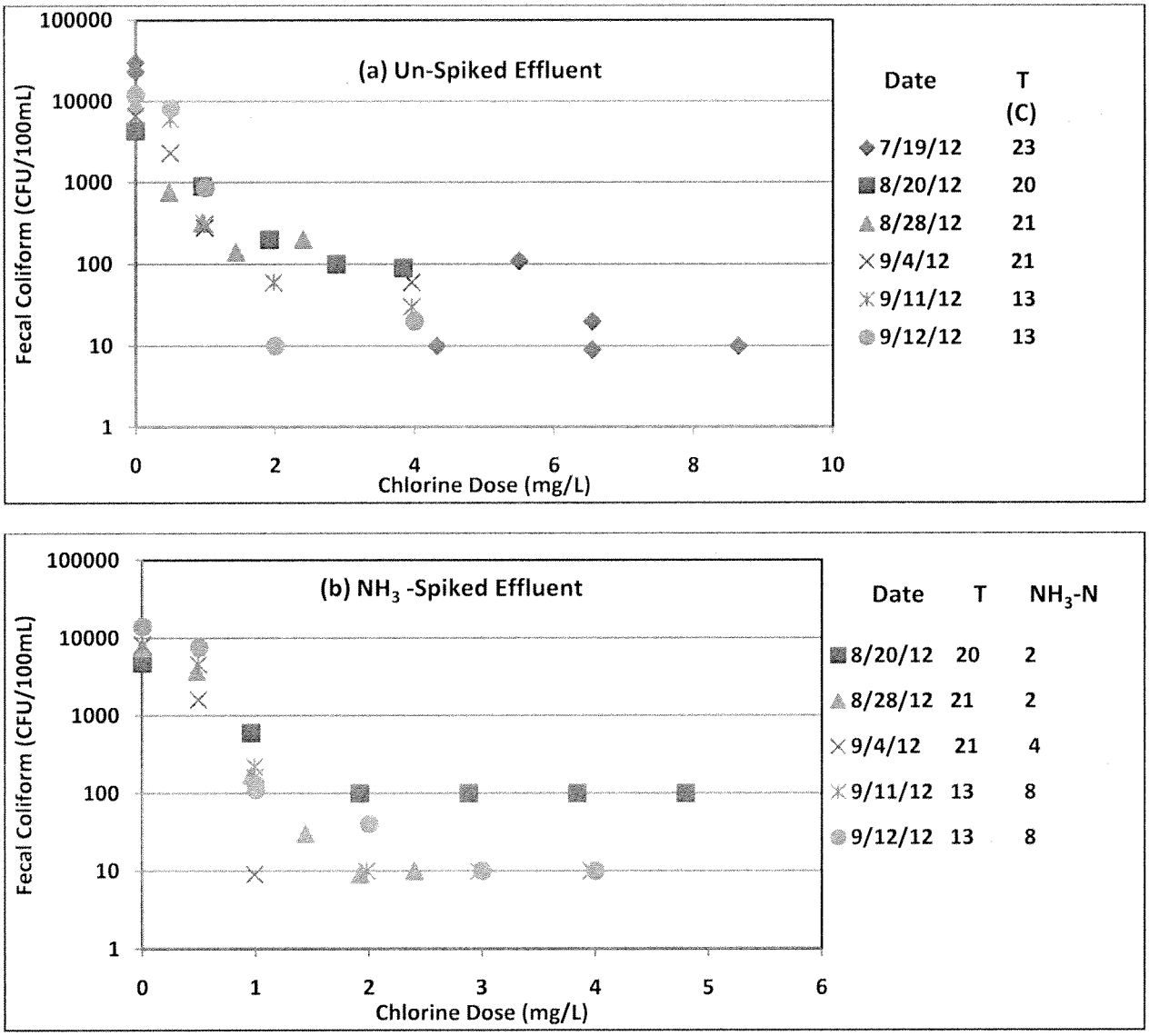
Calumet Water Reclamation Plant Dechlorination Tests of Secondary Effluent. Since the Calumet WRP is being designed for an effluent chlorination disinfection process, the WTPR Section conducted dechlorination jar tests on Calumet WRP secondary effluent samples to determine the sodium bisulfite to chlorine mass ratio ($NaHSO_3$:Cl_2) required to meet a potential final effluent NPDES permit maximum TRC of 0.05 mg/L.

Three Calumet WRP secondary effluent samples were collected and evaluated at target $NaHSO_3$:Cl_2 mass ratios of 1.45, 0.75, and 0.40 at room temperature. The TRC was determined for each sample after adding a 6 mg/L Cl_2 dose and allowing five minutes of chlorine contact time. The $NaHSO_3$ volume required to dose the samples at the $NaHSO_3$:Cl_2 mass ratios was determined and added using a $NaHSO_3$ solution (37 percent $NaHSO_3$ by mass, and specific gravity of 1.34). A summary of the TRCs resulting from the Cl_2 doses prior to dechlorination, the actual $NaHSO_3$ doses, and the average test temperatures for each test day are shown in Table 6.

The results of the three test days for the $NaHSO_3$:Cl_2 mass ratios are shown in Figure 5. The regression lines show a non-linear relationship between the final TRC and the $NaHSO_3$:Cl_2 mass ratios; decreasing TRCs were observed with increasing $NaHSO_3$:Cl_2 mass ratios. It was observed that a sodium bisulfite to chlorine mass ratio of 1.49, the highest ratio tested, was sufficient to reduce TRC to below 0.05 mg/L. This dose ratio is in line with the USEPA recommended ratio of 1.45.

John E. Egan Water Reclamation Plant Chlorine Disinfection Process Control Evaluation. A request to study the Egan WRP 001 Outfall disinfection process was initiated when a FC NPDES permit violation occurred on May 31, 2011. During this violation, the current target TRC of 0.8-1.0 mg/L at the end of the chlorine contact tank (CCT) was not maintained during sudden increases in SS concentration under transient conditions. Chlorine demand may have increased along with the SS concentration resulting in inadequate chlorine available for disinfection. A study was initiated in September 2012 to address the following: 1) Verify the TRC set point range in the clear well (CW) after the CCT that will ensure consistent compliance with the NPDES FC permit, under various operating conditions, particulary

FIGURE 4: CHLORINE-DOSE FECAL COLIFORM RESPONSE FOR CALUMET WATER RECLAMATION PLANT SECONDARY EFFLUENT SAMPLES UN-SPIKED AND SPIKED WITH AMMONIUM CHLORIDE



Notes:

Fecal coliform values of 10 and 100 represent reporting limits of 10 and 100 CFU/100 mL, respectively. Values below 10 CFU/100 mL are actual measured for respective samples.

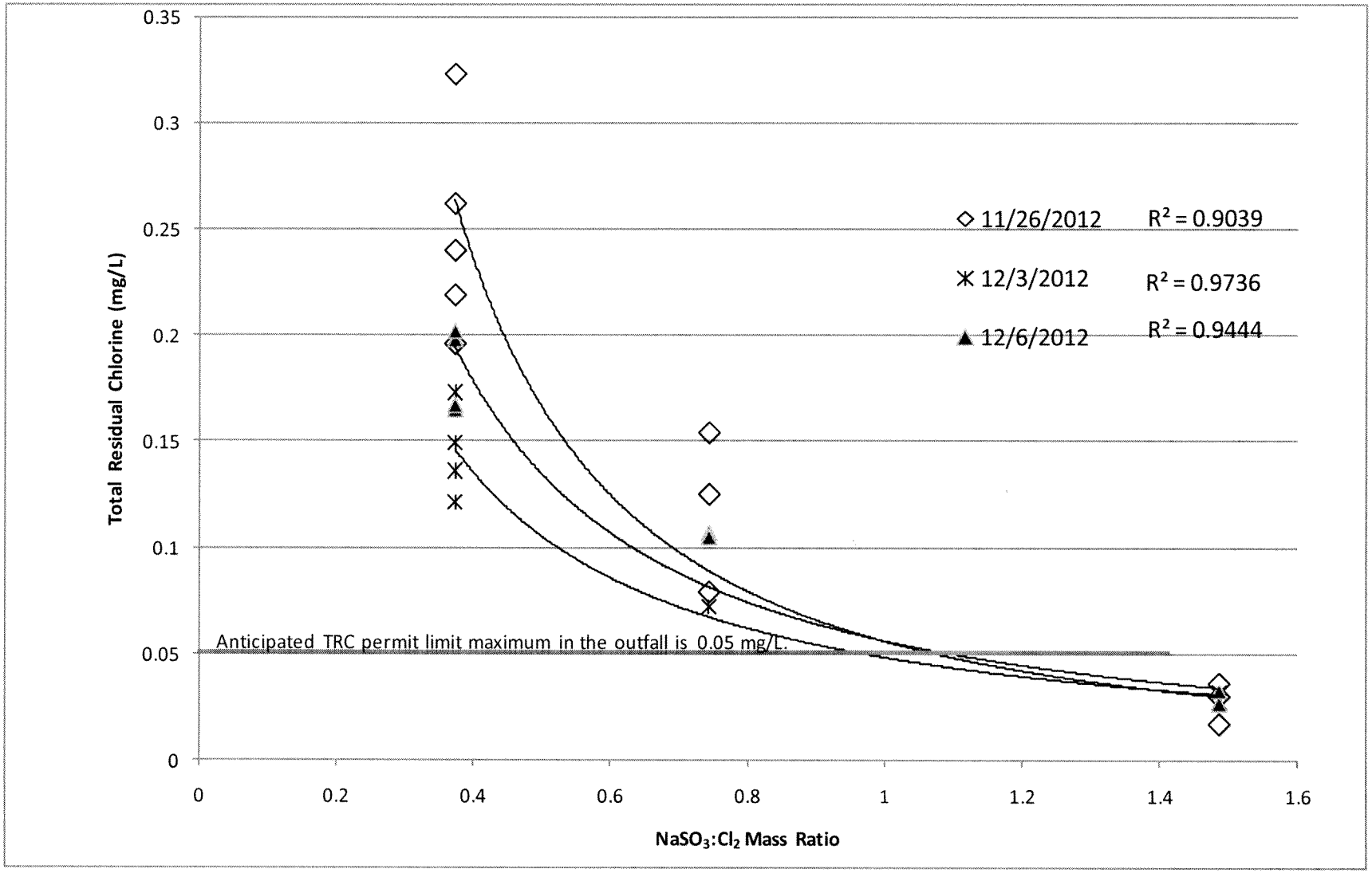
In Un-Spiked samples, NH_3-N concentrations were 1.48 and 0.13 mg/L in 7/19/20 and 9/12/12 samples, respectively, and <0.1 mg/L in all other samples.

TABLE 6: INITIAL TOTAL RESIDUAL CHLORINE, SODIUM BISULFITE-TO-CHLORINE MASS RATIOS, SODIUM BISULFITE DOSES, AND TEMPERATURES OF CALUMET WATER RECLAMATION PLANT SECONDARY EFFLUENT JAR TRIALS

Sample Collection Date	Jar Trial Date	Initial TRC[1] (mg/L)	$NaHSO_3$:Cl_2 Mass Ratio	37% $NaHSO_3$ Solution Doses (mg/L)	Mean Temperature (°C) [standard deviation]
11/26/2012	11/28/2012	2.21	0.40	2.40	22.1 [0.7]
11/26/2012	11/27/2012	2.06	0.74	4.15	21.6 [1.4]
11/26/2012	11/27/2012	2.06	1.49	8.30	21.1 [0.1]
12/03/2012	12/05/2012	3.47	0.37	3.50	20.7 [0.2]
12/03/2012	12/05/2012	3.47	0.74	6.97	20.4 [0.0]
12/03/2012	12/05/2012	3.47	1.49	13.95	20.5 [0.0]
12/06/2012	12/07/2012	2.38	0.37	2.40	20.5 [0.1]
12/06/2012	12/06/2012	2.25	0.74	4.52	21.2 [0.6]
12/06/2012	12/06/2012	2.25	1.49	9.58	21.5 [0.8]

[1]The total residual chlorine after a 6-mg/L chlorine dose and a five-minute contact time.

FIGURE 5: PLOTS FOR BISULFITE DOSE JAR TESTS FOR THE CALUMET WATER RECLAMATION PLANT SECONDARY EFFLUENT SAMPLES TO DETERMINE THE RELATIONSHIP BETWEEN TOTAL RESIDUAL CHLORINE FOR DIFFERENT BISULFITE TO CHLORINE MASS RATIOS



under transient conditions; 2) Investigate a potential correlation between secondary effluent turbidity with SS concentrations to determine whether turbidity can be used as an additional parameter for disinfection process control decisions; and 3) Evaluate a relationship between the TRC concentrations at the beginning and end of the CCT in order to implement cascade control at the Egan WRP in the future.

Five field sampling days were conducted during September and October of 2012, one of which was during wet weather conditions. Nine samples per day were collected at the beginning of the CCT and analyzed immediately for SS. Additionally, the samples were held for a period of time to simulate full scale contact, and then analyzed for TRC and FC. Data for flow out of the CCT, TRC at the beginning and end of CCT, secondary effluent turbidity, and other process parameters were retrieved from the decentralized control system. The only correlation identified was between the secondary effluent turbidity and SS concentration (Figure 6) based on the preliminary data collected so far. Additional testing and analysis will be performed before and after the start of chlorination in the spring of 2013.

Ultraviolet Dose Response Study for the Terrence J. O'Brien Water Reclamation Plant. Since the O'Brien WRP is being designed for an effluent UV radiation disinfection process, the WTPR Section performed a UV dose response study to determine an appropriate UV design dose for future UV disinfection. Regular collimated beam tests were conducted from May through November 2012 using un-disinfected final effluent from the O'Brien WRP over a range of operating conditions to obtain a UV dose response curve for FC in a dose range of 0 to 33 mJ/cm^2. All collimated beam tests were conducted according to the Ultraviolet Disinfection Guidance Manual by the USEPA and the Ultraviolet Disinfection Guidelines for Drinking Water and Water Reuse by the National Water Research Institute. Figure 7 shows the 32 dose response curves generated during this study.

Polymer Testing at the Hanover Park Water Reclamation Plant. As a part of M&O's polymer contract bidding process, the WTPR Section conducted bench-scale polymer testing in May 2012 followed by full-scale testing at the Hanover Park WRP. A total of four polymers from two manufacturers were tested and found to be eligible for bidding for polymer purchase (Table 7). The M&O Department used the test results (Table 7) and the unit cost of the polymers to select Clarifloc CE-6267 as the most cost-effective product for the Hanover Park WRP sludge thickening operations.

Technical Support to Biosolids Management Program. Technical support is provided to projects under the CSD Program in which exceptional quality, air-dried biosolids are used in the Chicago metropolitan area and to the Class B Biosolids Farmland Application Program. The technical support is provided to help biosolids users maximize the benefits they receive from the program and to ensure that the District and the users comply with applicable regulations and permits. The Division also conducts marketing activities to promote the use of biosolids under the CSD Program.

FIGURE 6: SECONDARY EFFLUENT TURBIDITY VERSUS SUSPENDED SOLIDS CONCENTRATION AT THE JOHN E. EGAN WATER RECLAMATION PLANT, SEPTEMBER 18 THROUGH OCTOBER 23, 2012

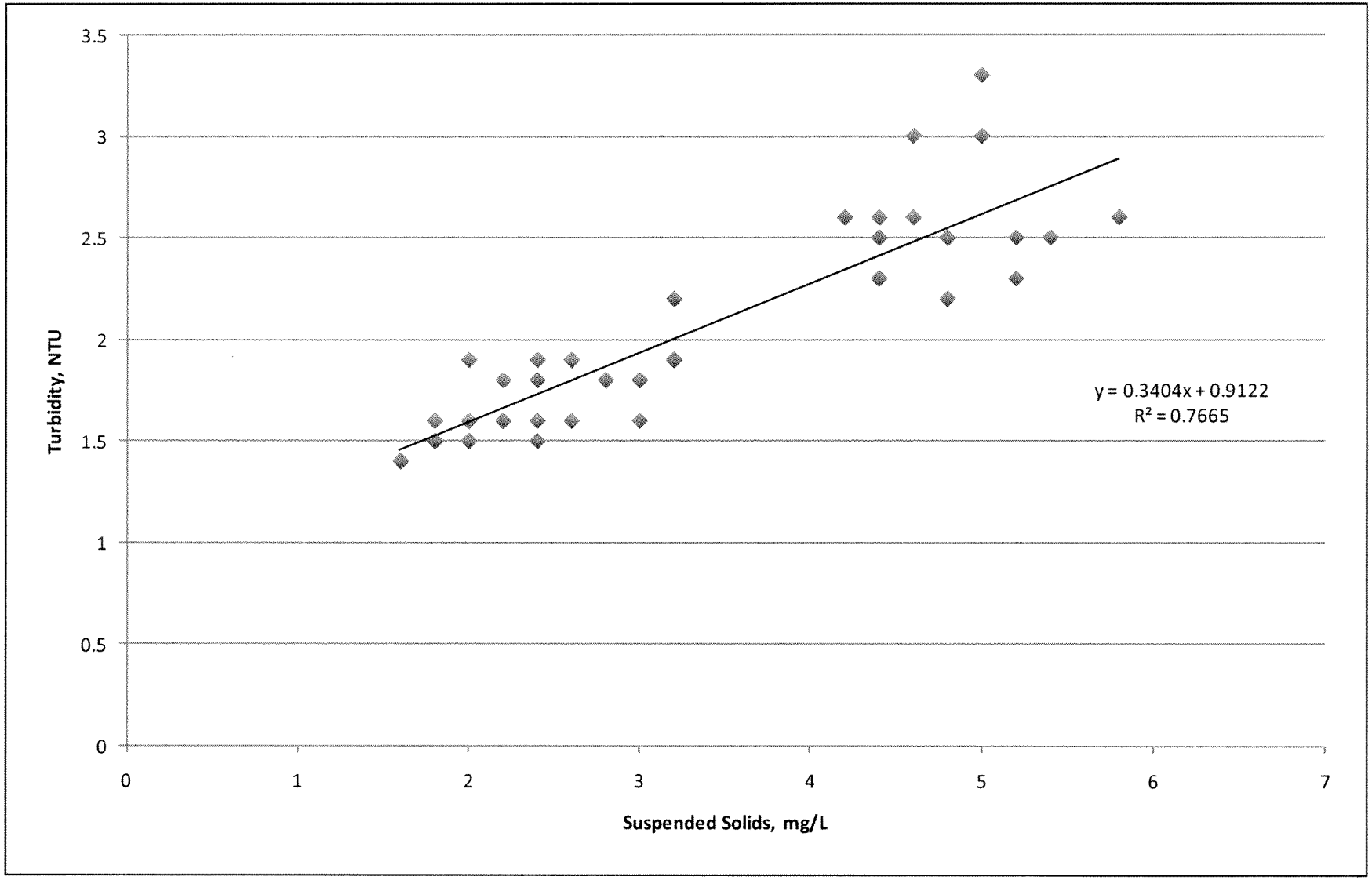


FIGURE 7: ULTRAVIOLET DOSE VERSUS FECAL COLIFORM COUNTS FOR THE TERRENCE J. O'BRIEN WATER RECLAMATION PLANT EFFLUENT SAMPLES USED FOR DISINFECTION DESIGN

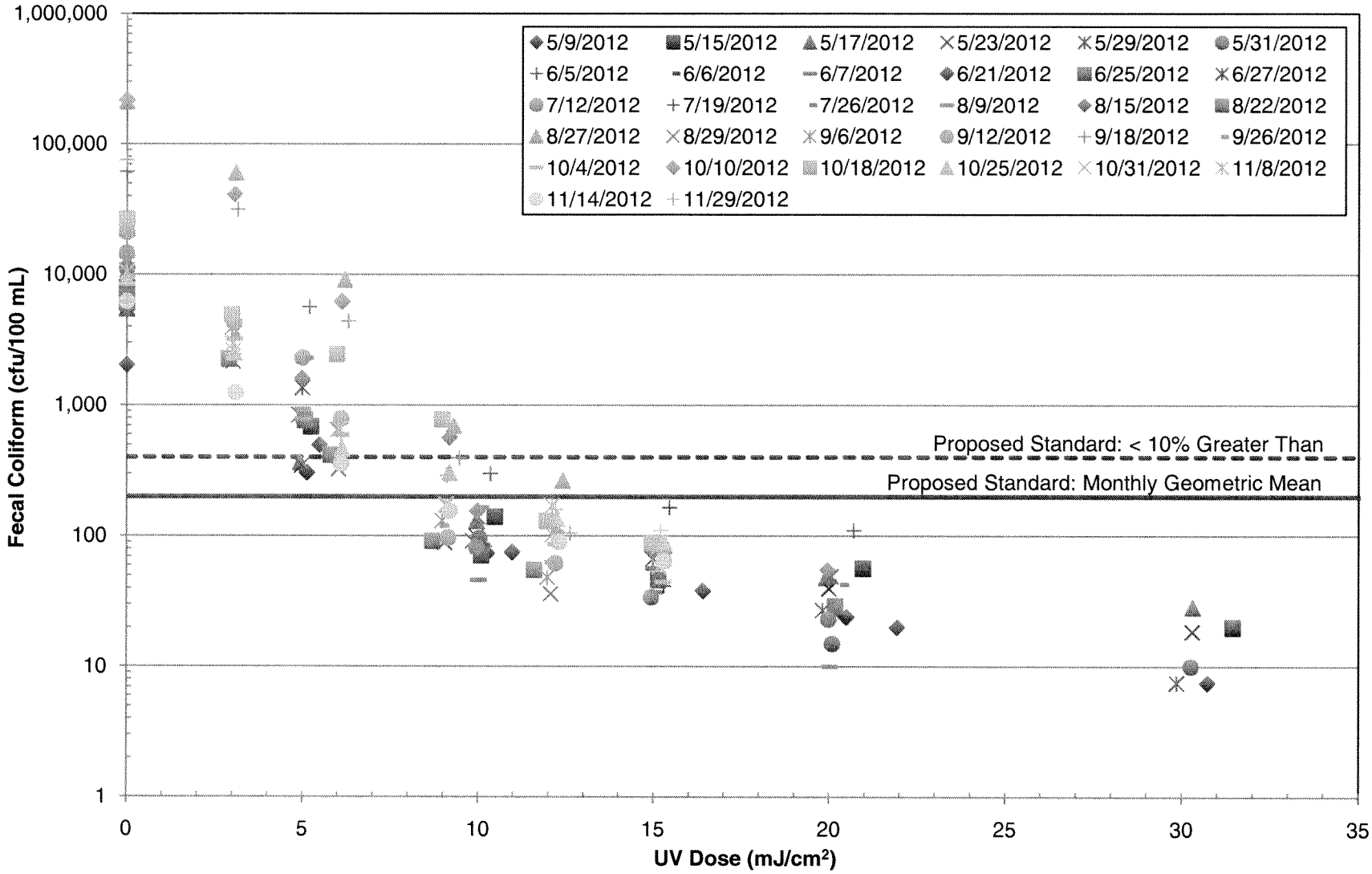


TABLE 7: POLYMER TEST RESULTS AT THE HANOVER PARK WATER RECLAMATION PLANT GRAVITY BELT THICKENER COMPLEX, DURING 2012

Polymer Manufacturer	Polymer Product	Polymer Dose[1] (lbs/dry ton)
Ashland	Praestol-K275FLX	2.92
Ashland	Praestol-K279FLX	4.03
Polydyne	C-6257	3.52
Polydyne	C-6267	3.08

[1]Polymer dosage to obtain a 6.0 percent cake.

- CSD Program – The activities conducted in 2012 to promote and support the CSD Program include:

    1. Marketing activities and technical support on projects where 11,067 dry tons of biosolids were used as a soil conditioner or fertilizer topdressing by 15 schools, 66 parks and suburban villages, five golf courses, two landscaping companies, one cemetery, and one District property.

    2. Collaboration with the City of Chicago to evaluate and promote the use of biosolids for development of parks and recreational areas in Chicago.

    3. Soil sampling and microbiological investigation at Katherine Legge Memorial Park at the Hinsdale Park District to confirm that biosolids application at site was not a source of disease-causing fungi.

    4. Preparation of biosolids information pamphlets.

    5. Field day at Mid Iron Golf Courses, Lemont, where attendees learn about regulations pertaining to land application of biosolids, benefits of using biosolids for topdressing turf, and watched biosolids topdressing demonstration.

- Class B Biosolids Farmland Application Program – The activities the BU&SS Section conducted in 2012 to support the program include:

    1. Reviewed 301 field information packets for potential application fields under the Class B biosolids Farmland Application Program. This includes reviewing the field location, buffers established for surface water, roads and dwellings, contacts made with neighbors and public officials, and soil pH and liming. Approval or disqualification of the proposed fields is submitted to M&O.

    2. Conducted field inspections and meetings with individuals and community groups and public officials in response to public concerns regarding the program.

    3. Proactively recruited two farmers to use biosolids under the Class B farmland Application Program to promote biosolids use among the farmers and to minimize nuisance related complaints.

Lake Michigan Discretionary Diversion Monitoring. During 2012, the CDOM data was evaluated with respect to discretionary diversion flows, CSOs, and rain events, to develop a basis for more efficient use of the District's allotted discretionary diversion flows. In 2013, AEWQ will suggest various test scenarios for discretionary diversion at the Wilmette Pump Station and analyze the resulting water quality in the CAWS.

Biological Monitoring of Tinley Creek. Contract 10-882-AF is a plan designed to stabilize eroding banks in Tinley Creek. Four sites were selected to conduct biomonitoring pre- and post-project completion to evaluate the ecological effects of this work. The data collected in 2012 was pre-streambank stabilization and will serve as baseline data. Fish were collected twice from the four stations between August and November, 2012. A total of 1,204 fish, comprising 14 species were collected. The most abundant species were green sunfish and bluntnose minnow. In August, 2012, benthic organisms were collected and preserved once at the four stations using the IEPA method to collect aquatic macroinvertebrates from wadeable streams for biotic integrity assessments.

Peregrine Lake Monitoring. In response to public complaints about Peregrine Lake, which is partially located on District property, M&O requested that M&R perform a chemical and biological assessment of the lake. AEWQ performed chemical and physical monitoring at four Peregrine Lake sampling locations on April 18, July 18, and October 17, 2012, and biological monitoring on May 17, 2012. The results and recommendations were summarized in a memorandum to M&O.

Evaluation of Inpact of Sludge Spill at the John E. Egan Water Reclamation Plant. Following spillage from a waste-activated sludge line break between Kirie and Egan WRPs in June 2012, the Division conducted monitoring of the Egan Quarry, Salt Creek, and Busse Woods Lake to evaluate the impact of the spill on water quality at these locations. Three chemical assessments were done on the Egan Quarry. Water samples were collected and analyzed from two discreet depths at 5 locations in the quarry to fulfill monitoring requirements under a Compliance Commitment Agreement with IEPA. The ABL collected and analyzed a total of 23 samples from six locations along the Salt Creek and Busse Woods Lake. A rapid FC (7-hour fecal coliform) test was run in parallel with the standard 24-hour test method, which is applied for NPDES permit required FC analyses. The 7-hour test provided rapid results of less than 200 CFU/100 mL FC levels in Salt Creek upstream and downstream of the sludge line break. The FC results were evaluated against the General Use Water Quality Standards. Rapid investigation and monitoring results showed that there was no impact on the water quality. The results were submitted to M&O for subsequent reporting to IEPA.

Evaluation of Permeable Pavement at the Stickney Water Reclamation Plant. In this project, the District is evaluating porous pavement technology for stormwater management in the Chicago metropolitan area. Three different permeable pavements (paver stone, concrete and asphalt) were established on driving areas and parking slots on the general parking lot at the Stickney WRP. The permeability of the pavements measured in 2012 is shown in Table 8.

TABLE 8: PERMEABILITY OF PERMEABLE SURFACES AT THE PARKING LOT OF THE STICKNEY WATER RECLAMATION PLANT IN 2012, FOUR YEARS AFTER INSTALLATION

Area	Paver Stone	Concrete	Asphalt
	---------- Permeability (inch/sec) ----------		
Driving area	0.08±0.02	0.15±0.09	0.22±0.16
Parking slot	0.21±0.05	0.32±0.09	0.49±0.10

Permeability of different surfaces varied and was in the order of asphalt > concrete > paver stone and was generally lower in the driving area than in the parking area. Periodic site visits during periods of rainfall indicated no visible standing water or runoff on any of the permeable lots during all monitoring seasons. Standing water, and thus runoff, was observed in the impermeable control lot. Detailed results are included in the final project report, "Performance of Permeable Pavements Installed at the Employee Parking Lot at the Stickney Water Reclamation Plant", M&R Report No. 13-49.

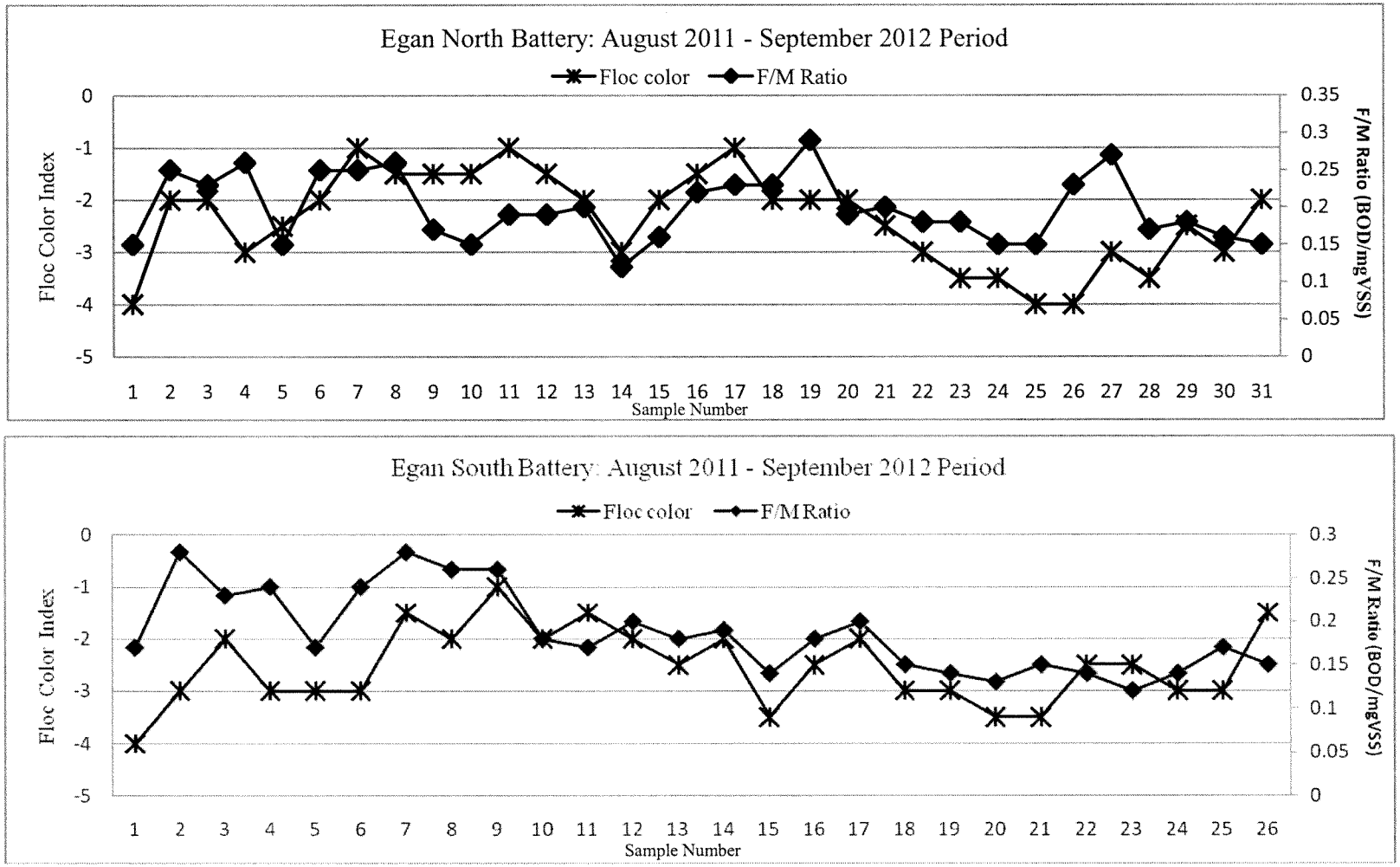
Streetscape and Sustainable Design Program. The District is conducting a collaborative project with Chicago Department of Transportation and United States Geological Survey for evaluating various green infrastructure best management practices (BMPs) to reduce stormwater and pollutant loads to the collection systems. Construction of the BMPs was completed in fall 2012, which consisted of permeable pavers, planter boxes, and bioswales. Immediately after construction of BMPs, the permeability of pavers and soil in the planter boxes and bioswales was measured. Permeabilities of different surfaces were 0.15, 1.02, and 1.79 in/hr for the paver stones, center of bioswales and planter boxes, respectively. Also, permeability within the bioswales varied with lower permeability near curb cut (0.19 in/hr) due to deposition of sediments as compared to center of the bioswales.

Native Prairie Landscaping. During 2012, the Division provided technical support for maintenance of the conventional and native prairie landscaping at the District's facilities.

Wastewater Microbiology Monitoring. Under this program, the WML conducts microscopic examination of mixed liquor samples from the District's seven WRPs to determine the relative abundance of protozoan and metazoan species; identify and quantify filamentous bacteria; and to characterize the health of the biological floc. The results are used to guide research projects and to provide technical guidance to M&O to optimize plant operations and to address treatment system upsets.

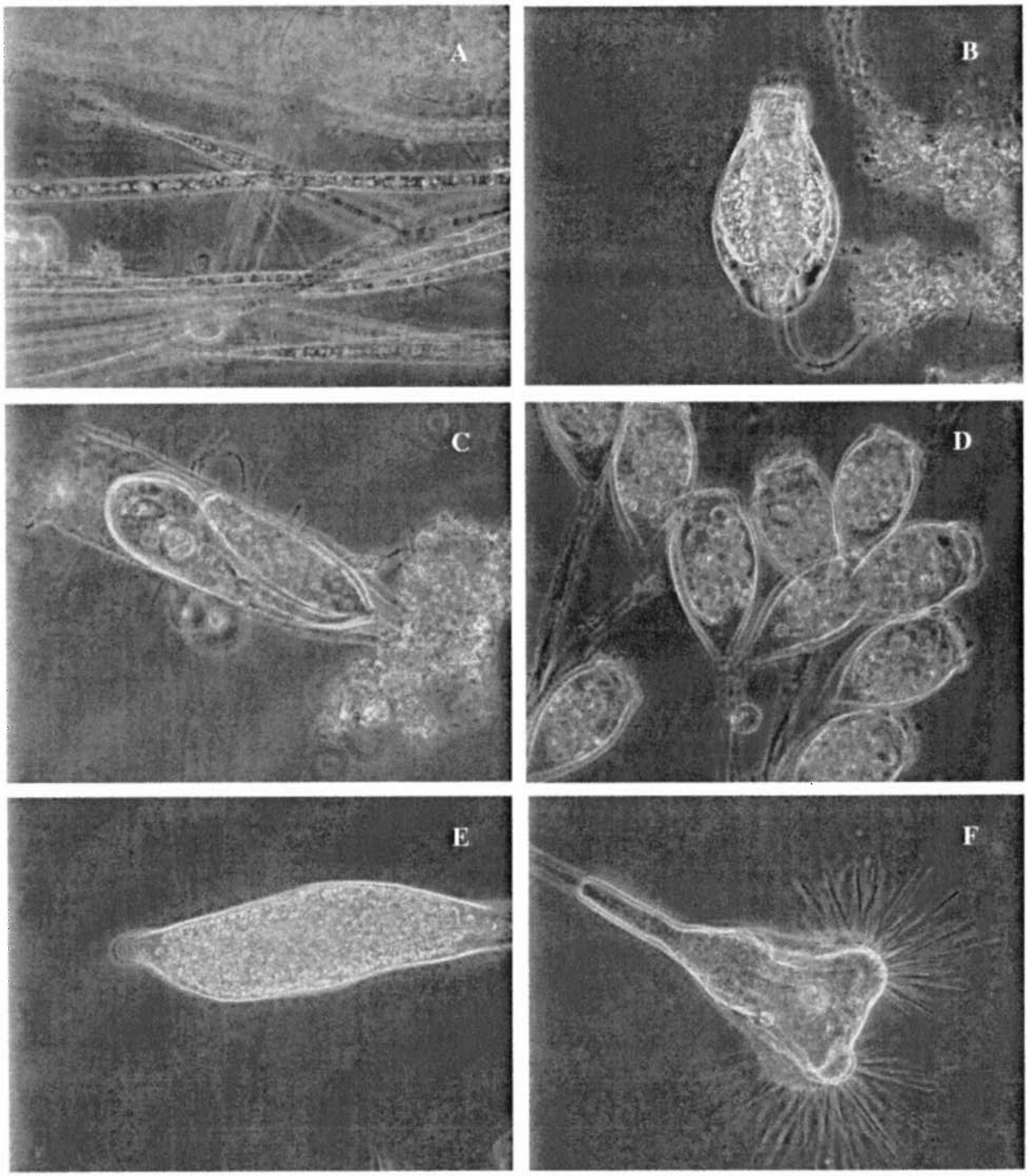
In 2012, detailed assessments of the type, relative abundance, and behaviors of the microorganisms in a total of 370 mixed liquor samples from the District's seven WRPs. Samples from each WRP were done on a rotating bi-weekly schedule. The microscopic examinations included characterizing the dominance and abundance of protozoa, algae and metazoan types, the abundance and types of filamentous bacteria present as well as assessing floc characteristics. The data, recorded as counts per milligram of volatile suspended solids (counts/mg VSS) were compared to WRP process control test parameters. Floc color, was directly related to the food to microorganism (F:M) ratio. Comparisons of the microscopic examination data with the F:M ratio at the Egan WRP is shown in Figure 8 The results were summarized and transmitted to M&O and posted on the District's intranet. Protozoa and metazoa types found in the District's WRP are shown in Figure 9.

FIGURE 8: COMPARISON OF AVERAGE SLUDGE COLOR INDEX WITH THE FOOD TO MICROORGANISM RATIO (F:M) AT THE JOHN E. EGAN WATER RECLAMATION PLANT



Floc Color Index: -5=extreme low food conditions; -4=severe low food conditions; -3=moderately low food conditions; -2=slight low food conditions; -1 to +1=Normal healthy sludge.

FIGURE 9: MICROSCOPIC OBSERVATIONS OF ACTIVED SLUDGE AT THE METROPOLITAN WATER RECLAMATION DISTRICT OF GREATER CHICAGO WATER RECLAMATION PLANTS' ACTIVATED SLUDGE



A variety of microorganisms species is observed in the District's activated sludge (All slides were observed at 40x using phase contrast microscopes): (A) Algal species *Ulothrix*; (B) Shelled rotifer, *Lecane*; (C) *Vaginicola*; (D) Colonial stalked ciliate, *Carchesium*; (E) Free-swimming ciliate, *Litinotus*; and (F) *Suctoria.*

One of the goals of the routine microscopic assessment program is to establish "Operation Action Levels" values that can be used as a proactive operational tool. Baseline values were generated for each WRP based on observations and data collected in 2012. The results of the routine microbiology monitoring are used to help to resolve WRP operational problems and as a baseline reference to determine if the frequency of monitoring should be modified. The data and technical advice were provided to M&O. Based on the data, the monitoring frequency for O'Brien and Calumet WRP's were increased during the winter months in order to closely monitor plant performance during the critical winter operations. In addition, 16 samples were analyzed to address an upset of the Egan WRP.

Regulatory Review. The Division conducts regulatory reviews in response to imminent regulations that can potentially affect District operations. Some of these reviews are requested by professional affiliations or organizations. The following reviews were conducted in 2012:

- Conducted a review of the revised Part 391 Biosolids Rule and generated recommendations to make it consistent with Part 503 Biosolids Rule.

- Provided data and review of the national water quality criteria for bacteria and prepared comprehensive response documents in support of the Illinois Pollution Control Board Rulemaking concerning the CAWS Water Quality Standards and Effluent Limits.

Goal 5: Operations and Applied Research

Effect of Sewer Cleaning on Odors in the James C. Kirie Water Reclamation Plant Interceptor System. The WTPR Section initiated a study in October 2012 to evaluate the effects of sewer cleaning on removing the biofilm, which causes odors and corrosion in Interceptor UDP 20B. A baseline evaluation of the continuous H_2S headspace concentrations and wastewater quality along UDP 14A and UDP 20B occurred between October 16 through November 21, 2012; the monitoring locations along the interceptors are shown in Figure 10. Sewer cleaning occurred in December 2012 between the intersection of Wolf Road and Rand Road and the intersection of Mount Prospect Road and Lincoln Street along UDP 20B. The post-cleaning evaluation of the headspace H_2S concentrations and wastewater quality is scheduled for January 2013. The baseline pre-cleaning H_2S concentrations for each station are summarized in Table 9.

John E. Egan Water Reclamation Plant Centrate Sidestream Deammonification Pilot. The Egan WRP routinely conveys its ammonia-rich centrate stream to the O'Brien WRP for treatment which is believed to be creating odors in the service area. A Deammonification (Demon®) sequencing batch reactor (SBR) suspended growth process pilot was evaluated for five months starting in September 2012 at the Egan WRP to evaluate its ability to remove ammonia from the centrate for odor control and to allow the treated centrate to be recycled to the plant headworks without compromising the plant's mainstream nitrification capacity.

FIGURE 10: ODOR MANAGEMENT AND CORROSION CONTROL IN SELECT INTERCEPTORS IN THE JAMES C. KIRIE WATER RECLAMATION PLANT SERVICE AREA

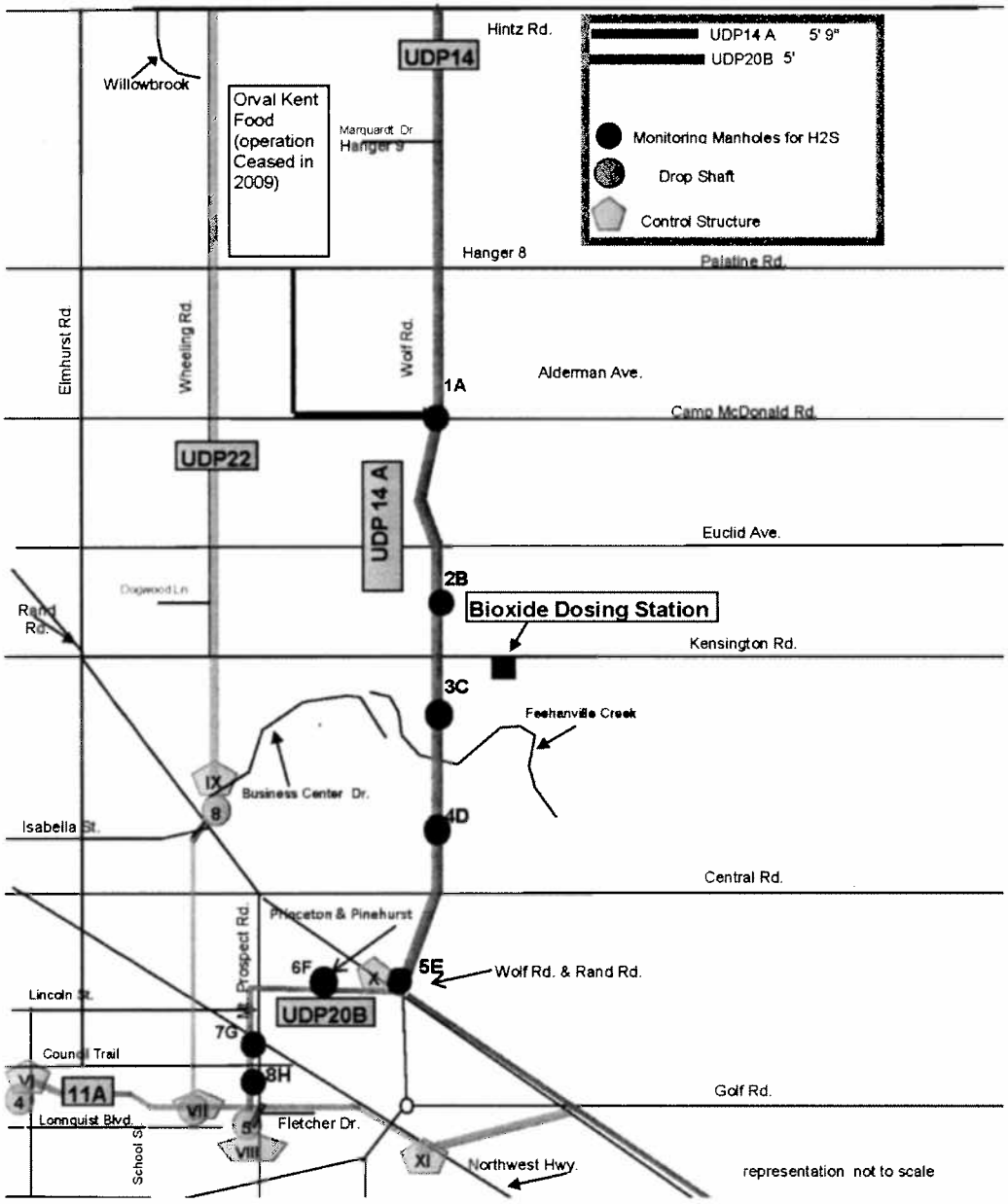


TABLE 9: HYDROGEN SULFIDE CONCENTRATIONS MEASURED BY ODALOGS ALONG INTERCEPTORS UPPER DES PLAINES 14A AND 20B DURING THE PRE-CLEANING PHASE OF STUDY
(OCTOBER 16, 2012 THROUGH NOVEMBER 21, 2012) [1]

Stations	Hydrogen Sulfide (ppmv)	
	Mean[2]	Maximum
1A	<1	37
2B	4	20
3C	1	8
4D	<1	<1
5E	<1	2
6F	<1	13
7G	<1	24
8H	<1	42

[1]Minimum concentration at each location was less than 1 ppmv, which is the detection limit.
[2]Zero is used in the caluations when a value is reported below the detection limit.

In the pilot study, the Demon® process was tested for the process's ammonia removal capacity and efficiency through monitoring of the influent and effluent. Figure 11 illustrates the volumetric loading rate and average NH_3-N removal efficiency with time. The system was typically loaded in the range of 0.5 to 0.6 kg N/m^3-day after the start-up period (September 11, 2012 through October 29, 2012) while maintaining an average NH_3-N removal efficiency of over 92 percent during the stable operation period (October 30, 2012 through December 23, 2012). Alkalinity adjustments to the centrate were needed for effective treatment with a target of 3-3.5 mg/L of alkalinity to 1 mg/L of NH_3-N. With optimal external alkalinity addition, the pilot achieved a volumetric loading rate of 0.58 kg N/m^3-day with an average NH_3-N removal efficiency of 90 percent; without alkalinity addition, the pilot reached a volumetric loading rate in the range of 0.7- 0.9 kg N/m^3-day with an average NH_3-N removal of 44 percent.

It was observed that putting the system in mixing mode (idle) for 72 hours had no noticeable effect on the loading rate and system performance after the system restarted. The pilot study also demonstrated the robustness of the Demon® process with respect to short term elevated nitrite nitrogen concentrations up to 161 mg/L, shock loads of NH_3, and low mixed liquor SS concentrations. Stresses of low temperatures, low alkalinity, and elevated polymer concentrations in the centrate on the pilot system performance will be continued into the winter of 2013.

Enhanced Biological Phosphorus Removal Demonstration Testing. The WTPR Section, in conjunction with the Engineering and M&O Departments, formed a Phosphorus Task Force in order to assess and implement biological P removal and recovery at four District WRPs. As an initial step, the WTPR Section performed a demonstration of enhanced biological phosphorus removal (EBPR) in one battery at the Stickney WRP and one battery at the Calumet WRP using current plant infrastructure. The process was implemented by creating anoxic, anaerobic, and aerobic zones in the test batteries to favor the growth and luxury P uptake of phosphate accumulating organisms (PAOs).

For the Stickney WRP, process optimization of the demonstration battery included three phases in 2012 as shown in Table 10. Phase I (May 1, 2012 through September 12, 2012) was the initial adjustment of the air input to create the anoxic, anaerobic, and aerobic zones. PAO populations for EBPR process were built up during this initial start up phase. Phase II (September 13, 2012 through October 9, 2012) decreased the air input in the anoxic and anaerobic zones. Phase III (October 10, 2012 through December 12, 2012) decreased the air input in the anoxic and anaerobic zones further while maintaining higher mixed liquor SS. Phase III proved to provide the best conditions thus far towards targeting a plant effluent of less than 1 mg/L of TP. The test battery performed better than the other three batteries with respect to P removal in all three phases.

However, Ortho P release in the anaerobic zone was not optimum which may mean the EBPR process is carbon limited. The carbon needs of the Stickney WRP will be determined in 2013. Additionally, process optimization and evaluation of infrastructure needs will continue into 2013.

FIGURE 11: DAILY AVERAGE AMMONIA NITROGEN LOADING RATE AND REMOVAL EFFICIENCY OF THE DEMON® PILOT AT THE JOHN E. EGAN WATER RECLAMATION PLANT

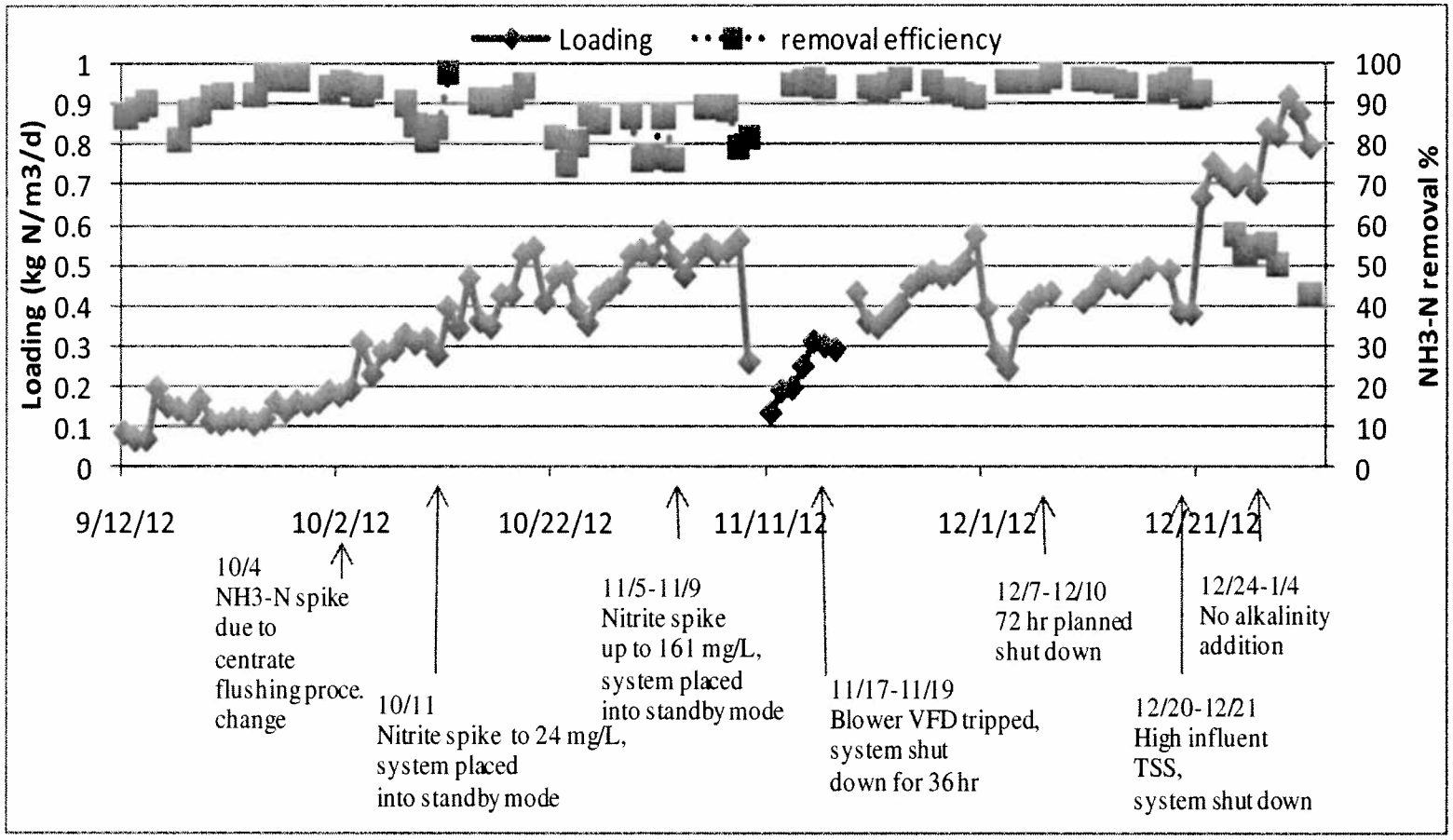


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TABLE 10: STICKNEY WATER RECLAMATION PLANT ENHANCED BIOLOGICAL PHOSPHORUS REMOVAL DEMONSTRATION PROJECT PHASE RESULTS FOR BATTERY D

Parameter	Phase I (5/1–9/12)	Phase II (9/13–10/9)	Phase III (10/10–12/12)
Battery D Effluent TP, mg/L	1.16	1.42	0.90
Influent TP Conc., mg/L	4.91	3.69	4.17
Influent TP Load, lb/day	7,534	3,485	4,006
SRT	6.14	9.58	16.1
Battery D Influent Flow, MGD	193	112	133
RAS Flow, MGD	173	139	128
RAS/Total Flow	0.98	1.24	1.03
Anaerobic Zone HRT (with RAS flow), min	26	39	37
MLSS, mg/L	3,343	2,224	3,227
BOD Load, lb/day	187,802	94,093	119,578
BOD:TP	24.08	26.37	27.2

At the Calumet WRP, a battery was converted to the EBPR process and operated similar to the demonstration at the Stickney WRP. During the three month evaluation period, the test battery did not indicate significant P removal most likely due to a limited carbon source for PAOs; average effluent TP concentrations of 5 mg/L in the demonstration battery was observed. Historic data evaluation also indicated that the Calumet WRP may be carbon limited for the EBPR process due to low BOD to TP ratios in the battery influent. Process optimization and evaluation of infrastructure needs will continue into 2013.

The WML provided analysis and technical support to the project. The WML developed methods and SOPs for staining, identifying and quantifying PAOs in activated sludge samples. Duplicate slides made from each sample were stained using the Sudan Black and the Neisser staining procedures. The PAO results are shown in Table 11.

Evaluation of Potential Reduction of Polymer Consumption Strategies at the Post-Centrifuge Facility at the Stickney Water Reclamation Plant. In order to reduce polymer consumption, the WTPR Section worked with M&O to optimize post-digestion centrifuge operations at the Stickney WRP. A multi-dimensional approach was used in 2012, which consisted of: 1) establishing full-scale baseline centrifuge operations and polymer consumption; 2) evaluating polymer quality; and 3) conducting laboratory tests exploring innovative measures for potential polymer use reduction.

A baseline period from January 1, 2011, through April 30, 2011 was selected for the full-scale baseline centrifuge operation and polymer consumption evaluation. A summary of polymer consumption and sludge processed and performance ranking of the centrifuges is presented in Table 12. The polymer quality evaluation indicated that the raw, active, and dilute polymers on the North- and the South-end of the facility are statistically similar to each other.

The existing practice at the Stickney WRP is to use secondary treated plant effluent for preparing dilute polymer. An alternative is to use city water instead which would have negligible solid concentrations. Capillary suction time (CST) tests were performed on centrifuge feed samples with dilute polymers prepared using both city water and secondary effluent at different dilutions but did not provide convincing evidence that better dewaterability could be achieved with city water.

Lab-scale experiments were also performed to determine whether increased polymer content in centrate would lower surface tension as surface tension in centrate samples is expected to decrease with increased polymer. These tests were conducted with a view to developing a process control parameter that could indicate excess polymer use. Different dilutions of polymer were prepared with different types of water (deionized water, tap water, and secondary treated plant effluent) and tested for surface tension. The average values of the results are presented in Figure 12 with all tested samples ranging between 66 and 73 dynes/cm. These results did indicate a weak trend of decreasing surface tension with increased polymer concentration.

TABLE 11: ABUNDANCE OF PHOSPHORUS ACCUMULATING MICROORGANISMS IN THE STICKNEY AND CALUMET WATER RECLAMATION PLANT ACTIVATED SLUDGE DURING PHASE I OF THE ENHANCED BIOLOGICAL PHOSPHORUS REMOVAL PROJECT

WRP/ Sample Date	PHB[1]		POLY-P[2]	
	Test Battery[3] μm^2/mgVSS[5]	Control Battery[4] μm^2/mgVSS	Test Battery μm^2/mgVSS	Control Battery μm^2/mgVSS
Stickney WRP				
5/16/2012	96,630	34,888	62,831	21,585
6/20/2012	30,321	8,964	19,253	31,664
7/25/2012	132,497	169,242	7,641	15,359
Calumet WRP				
5/22/2012	7,555	9,239	1,621	4,052
6/12/2012	4,556	13,843	1,508	11,232
6/26/2012	NS	NS	6,609	21,793

[1]PHB – Poly-β-hydroxybutyrate –Sudan Black staining procedure.
[2]Poly-P – Polyphosphate granules – stained using the Neisser staining procedure.
[3]The test battery for Stickney WRP is Battery D and for Calumet WRP is Battery E1.
[4]The control battery for Stickney WRP is Battery A and for Calumet WRP is Battery E2.
[5]μm^2/mgVSS - The abundance of phosphorus accumulating microorganisms (PAO) expressed as total area per milligram of volatile suspended solids.
NS=No sample.

TABLE 12: AVERAGE POLYMER CONSUMPTION AND CENTRIFUGE SLUDGE PROCESSING AND PERFORMANCE RANKING OF CENTRIFUGES AT THE STICKNEY WATER RECLAMATION PLANT DURING THE BASELINE PERIOD, JANUARY THROUGH APRIL 2012

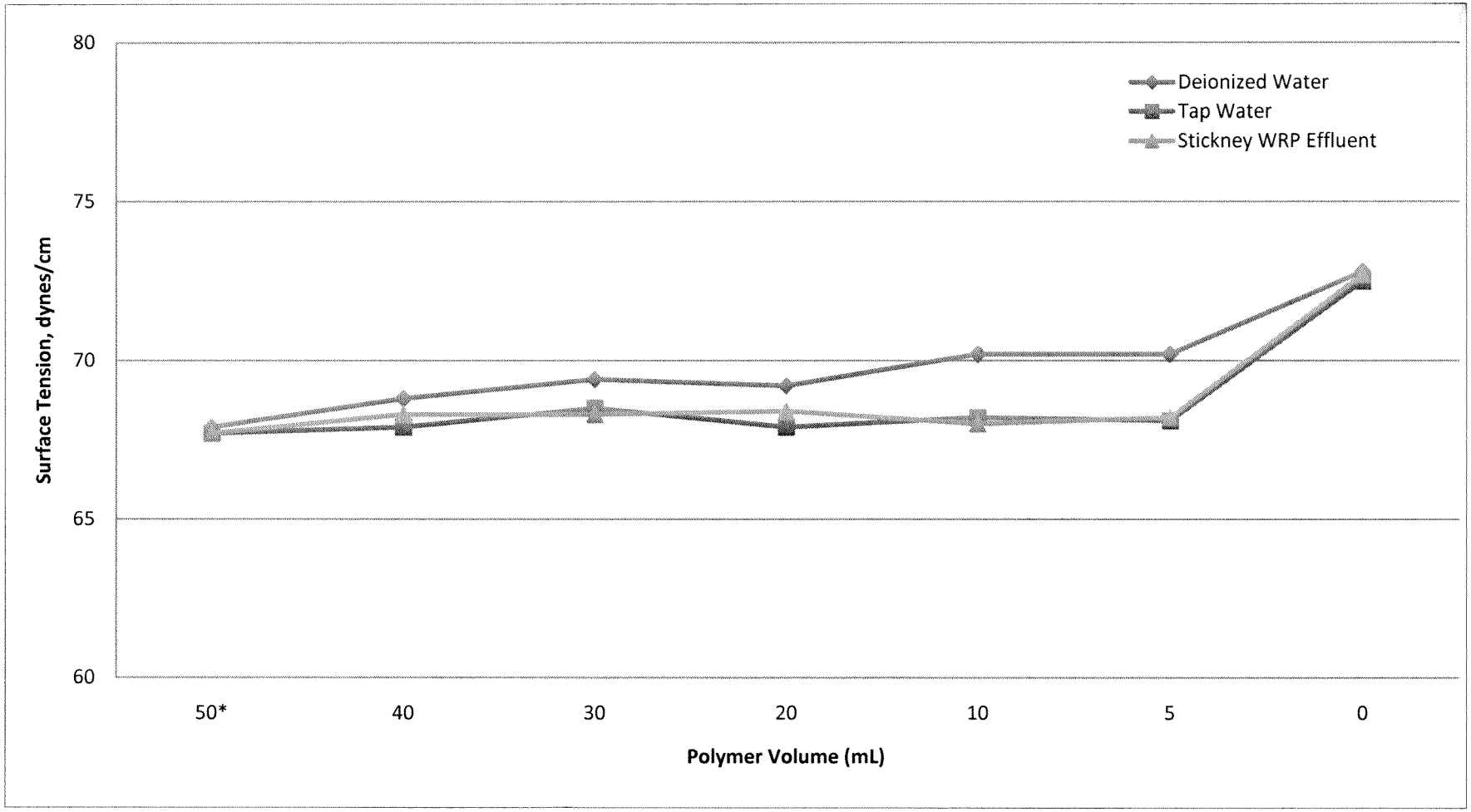
Machine No.[1]	Sludge Flow, gpm	Polymer Flow, gpm	Polymer Flow/ Sludge Flow, gpm/gpm	Cumulative Sludge Processed, gal	Cumulative Polymer Consumed, gal	Polymer Dose, lbs/DT
14	218	9.7	0.044	12,878,280	567,816	516
11	223	10.0	0.045	8,796,540	396,126	446
7	218	10.0	0.046	7,737,480	352,458	454
10	213	9.8	0.046	4,772,100	219,918	438
2	216	10.2	0.047	17,267,604	817,805	511
4	214	10.4	0.049	23,671,560	1,156,748	530
12	211	10.4	0.049	20,931,480	1,030,489	531
3	206	10.3	0.050	15,074,520	753,022	539
8	212	10.6	0.050	10,123,200	503,496	557
9	211	10.8	0.051	19,689,060	996,944	553
20	206	10.4	0.051	10,244,280	515,868	550
13	204	10.6	0.052	9,657,360	501,098	599
16	206	10.8	0.052	11,708,700	612,679	596
17	201	10.4	0.052	4,171,560	215,028	573
19	183	9.8	0.054	9,709,680	525,240	657
6	177	10.6	0.060	5,514,240	331,230	644
21	186	11.1	0.060	12,913,920	772,884	690
5	167	10.6	0.064	10,143,360	648,400	695
15	N/A	N/A	N/A	N/A	N/A	N/A
18	N/A	N/A	N/A	N/A	N/A	N/A
1[2]	380	22.8	0.060	15,114,060	908,137	647
			N/A			
Max	223	11.1	0.064	23,671,560	1,156,748	695
Min	167	9.7	0.044	4,171,560	215,028	438
Sum*	N/A	N/A	N/A	230,118,984	11,825,388	N/A

N/A = Not applicable.

[1]Performance ranking (descending order) of centrifuge machines with respect to volume of polymer consumption per unit volume of sludge processed, and polymer dose; Machine No. 1 is not included in the ranking and is listed last.

[2]Machine No. 1 is included to determine cumulative sludge processed and cumulative polymer consumption by all machines, but is not included in the ranking or to determine "max" and "min" quantities.

FIGURE 12: LABORATORY-SCALE EXPERIMENTAL SURFACE TENSION MEASUREMENTS OF SAMPLES CONTAINING VARIOUS AMOUNTS OF POLYMER IN DEIONIZED WATER, TAP WATER, AND PLANT EFFLUENT



*100 mL water or effluent added to each polymer volume, but 0 mL to 50 mL polymer.

Preliminary study findings accomplished during 2012 indicate that lower polymer use can be achieved through adjusting machine operation as a function of optimizing polymer to sludge flow ratios of 0.033 to 0.045 (gpm/gpm). The WTPR Section formalized centrifuge operational procedures for M&O based on this concept and presented to M&O staff during 2012, along with study-based recommendations for implementation; a full-scale follow-up study in 2013 will be performed.

Corn Fertility Experiment at the Fulton County Site. Since 1973, the District has been conducting a corn fertility experiment on calcareous mine spoil at the Fulton County site. The purpose of this experiment is to evaluate the effect of long-term applications of anaerobically digested biosolids on crop yields, crop chemical composition, and mine spoil chemical composition. The experiment was designed to simulate biosolids application to fields at the site at agronomic and reclamation rates and to provide information that can be used for management of biosolids and crops. In 2010, these plots were abandoned and new plots were established in 2011.

In the new long-term biosolids experiment, we retained the chemical fertilizer treatment, and the annual agronomic rate of biosolids application for two types of biosolids (Class B centrifuge-dewatered biosolids and Class A air-dried biosolids), and modified the reclamation as one time application of various rates. We introduced a new treatment-compost in the annual agronomic and reclamation rate application. Originally, this new treatment was designed for farmyard manure, but it is rather difficult to get this type of material with consistent chemical composition. To this end, there are eight treatments in the revised design (one chemical fertilizer control, two compost references, two types of biosolids for annual agronomic rates, and four treatments of biosolids for land reclamation application). The new long-term biosolids experimental plots were established in Field 83, which consists of unmined land at the Fulton County site. The experiment was designed to obtain more information compared to the information received from the abandoned plots. The experiment will evaluate the effect of unaged biosolids to support the Farmland Application Program and the effect of aged, air-dried biosolids to support the CSD Program. The experiment is also aimed to collect sufficient data to develop the best P management of biosolids as to address future state regulations that may stipulate P-based agronomic rates of biosolids.

No reportable data were obtained from the study in 2012 because the corn plants in several plots were severely damaged by historic drought, and no reliable yield data or samples could be collected.

Biosolids Composting Using Low Rates of High Carbon Materials: Agronomic Evaluation. In 2011, the District initiated a study at the Lawndale Avenue SMA drying beds to evaluate co-composting biosolids with locally available high carbon yard waste. The goal of this study was to determine the mixing ratio of biosolids and yard waste that can be co-composted to produce a nutrient-rich product with low odor potential and minimal modification of the District's current biosolids drying operations. Twelve composts of varying C:N ratio were produced from blending un-aged biosolids (centrifuge cake) or lagoon-aged air-dried biosolids with landscape wastes, tree leaves, and wood chips at various ratios. Nine samples of the

composted materials were also analyzed for *Salmonella spp* and FC to evaluate the effectiveness of the composting process on reduction in pathogen content.

Changes in N status after composting may require accounting for differences in N release characteristics of the composted biosolids when determining the application rate. Thus, in 2012 a greenhouse study was conducted to evaluate relative N phytoavailability of composted biosolids. Corn, ryegrass, and miscanthus were grown for six months in a silty clay loam soil amended with the 12 composted biosolids in addition to four fertilizer treatments.

The 12 composted biosolids were applied at a total N application rate of 400 kg N/ha and fertilizer treatments received 0, 75, 150, and 300 kg N/ha of ammonium nitrate fertilizer. Results from greenhouse study showed relative N phytoavailability of the composted biosolids were lower than those in un-composted biosolids (Table 19). For the short-term N supply to plants, composted biosolids need to be applied at high rate than uncomposted biosolids.

Plant Uptake of Perfluorinated Compounds in Biosolids-Amended Soil. The occurrence of perfluorinated compounds (PFCs) in biosolids and the potential risk of transport of these compounds through the food chain are emerging concerns that have to be addressed to ensure public acceptance and long-term sustainability of biosolids application to farmlands. The District is collaborating with the USEPA, Region 5 and Colorado School of Mines (CSM) to generate data on the uptake of PFCs by plants grown in biosolids-amended soils for an evaluation of exposure risks to humans. As a part of this collaboration, the District initiated a three-year field study and established research plots on the Main Stream Pumping Station ground in 2011. The study consists of plots amended with four rates of biosolids application including, control plots that receive only the recommended dose of commercial fertilizers. All plots are planted with corn and four vegetable crops, i.e., tomatoes, zucchini, carrots, and lettuce. The soil and plant tissue samples are collected at the time of crop maturity and shipped to CSM for analysis of PFCs.

Phosphorus Removal Using Phycoremediation. In this project the District evaluated the potential of phycoremediation to remove P from its WRPs effluent and sidestreams. Inorganic N and soluble P concentrations and molar N:P ratios of effluent and several sidestreams of the District's seven WRPs are presented in (Table 13). The data show that effluent from the Calumet, Egan, and Hanover Park WRPs is limited by N, while effluent from O'Brien, Stickney, and Kirie WRPs is limited by P for algae growth. Centrate from Stickney is P limiting under both scenarios, i.e., before and after the proposed P removal by a struvite based P harvesting technology. Similarly, centrate from Egan which is pumped to O'Brien WRP is P limiting. These data show that the centrate at the District's WRPs offer a great opportunity to evaluate a pilot-scale algae based system.

TABLE 13: MEAN DAILY EFFLUENT FLOW AND CONCENTRATION OF NITRATE-NITROGEN, SOLUBLE PHOSPHORUS, AND POTENTIAL DAILY ALGAE BIOMASS PRODUCTION WITH AND WITHOUT SUPPLEMENTAL NITRATE-NITROGEN FOR THE SEVEN WATER RECLAMATION PLANTS

WRP and Side Stream[1]	Flow mgd	NO_3-N + NH_3-N mg/L	Sol. P mg/L	N (Moles)[2] x 10^3	Sol. P (Moles)[2] x 10^3	N:P ratio	Limiting Nutrient	Potential AB[3] t/d	AB for Complete P Removal[3] t/d	Supplemental N for Complete P Removal t/d
O'Brien	226	8.91	1.0	543.7	27.6	20	P	120.64	97.20	-3.20
Lemont	2.56	16.95	-	-	-		-	2.60	-	-
Stickney	754	8.47	1.0	1724.3	91.9	19	P	382.63	326.34	-8.11
Calumet	263	7.78	2.74	552.5	87.9	6	N	122.59	311.89	27.29
Egan	27.8	15.5	2.5	116.3	8.5	14	N	25.82	30.08	0.62
Hanover P.	9.88	14.48	2.3	38.6	2.8	14	N	8.57	9.83	0.18
Kirie	40.78	8.99	1.2	99.0	6.0	17	P	21.97	21.18	-0.11
Stickney - Sidestreams										
Centrate BPH	1.84	637.2	81.2	316.6	18.2	17	P	70.24	64.67	-0.80
Centrate APH	1.84	610.0	21.0	303.0	4.7	64	P	67.25	16.72	-7.28
O'Brien - Sidestreams										
Egan-Cent to NSP	0.19	967	25	49.6	0.6	83	P	15.33	2.86	-1.80
Calumet Lagoon Decant										
Lagoons D	1.00	300.0	55.0	81.0	6.7	12	N	17.97	23.82	0.84

[1]Centrate BPH = Centrate before P harvest; Centrate APH = Centrate after P harvest.
[2]N (Moles) = daily N (nitrate-N + ammonia-N) loading in grams/14; Sol. P (Moles) = daily soluble P loading in grams/31.
[3]Based on algal N and P concentrations of 63.1 and 8.7 kg/dry ton, respectively, and theoretical molar N:P ratio of 16:1 in algae.

Use Attainability Analysis of the Chicago Area Waterways. The Use Attainability Analysis research on the Chicago Area Waterways was completed in 2012. The epidemiological study titled, "Chicago Health, Environmental Exposure, and Recreation Study (CHEERS)," was conducted in collaboration with a multidisciplinary team at the University of Illinois at Chicago School of Public Health. In 2012, The American Academy of Environmental Engineers presented a grand prize to the CHEERS at the National Press Club in Washington, DC.

Microbial Source Tracking Study of the Chicago Area Waterway System. The AMBS initiated a collaborative research project with Argonne National Laboratory to develop microbial source tracking tools, methodologies, and assessments for the reaches of the CAWS that have been designated for primary contact recreation by the IPCB. The research will take place over a period of seven years (2013 – 2019). The years 2012 – 2014 will represent the pre-disinfection period (Phase I), the years 2015 – 2017 will represent the post-TARP period (Phase II), and the years 2018 – 2019 will examine the post-disinfection period (Phase III).

Monitoring of Biosolids for Coliphages. The AMBS is currently conducting research to evaluate the usefulness of coliphages as an alternative indicator for the presence of enteric viruses in biosolids. Coliphages are viruses that infect EC via receptors on the cell wall. There are two main groups of coliphages: F^+ specific phages (FP) and somatic phages (SP). The USEPA coliphage method 1602: Male-specific (F^+) and Somatic Coliphage in water by a single agar layer (SAL) method was modified and adapted in the AMBS to determine coliphage concentrations in the District's air-dried and centrifuge cake biosolids. Results of these analyses are shown in Table 14.

Nitrifier Identification and Quantification. The AMBS investigated the use of a vermicon Identification Technology (VIT) gene probe kit; developed by vermicon AG (Munich, Germany) called the Nitri-VIT. The kit was used to identify ammonia oxidizing bacteria (AOB) and nitrite oxidizing bacteria (NOB). The Nitri-VIT kit uses fluorescent probes which causes the cells to light up in red or green under a fluorescent microscope. An index based on the amount of fluorescent cells present was used to determine the abundance of AOB or NOB. The VIT index measured in activated sludge samples from the Stickney WRP is presented in Table 15.

Investigation of Endocrine Disrupting Chemicals in the Chicago Area Waterway System. In collaboration with Dr. Heiko Schonefuss of St. Cloud State University, a multi-year study to conduct a comprehensive assessment of the potential for endocrine disrupting chemicals (EDCs) to impact the reproductive potential of fish populations in the CAWS was concluded in July of 2012. The objectives of this study were to determine (1) the spatial and temporal occurrence of EDCs; (2) the occurrence of endocrine disruption in wild fish populations; and (3) the likely sources contributing to any occurrence of endocrine disruption. The study included analysis of waterway and WRP effluent samples, deployment of caged fish, collection of wild fish, and deployment of a mobile exposure laboratory (MELT).

TABLE 14: SOMATIC AND F^+ SPECIFIC COLIPHAGE ANALYSIS OF BIOSOLIDS IN 2012[1]

Biosolids Source	Total Solids (%)	Coliphage MPN/Gram Dry Weight[2,3]	
		Somatic	Male Specific (F+)
Calumet	24.8 – 89.15	<0.11 – 1,600	<0.11 – 37
Stickney	20.28 – 41.75	13 – 530	<0.32 – 730

[1]The coliphages were enumerated according to the USEPA Method 1602: Male-specific (F+) and Somatic Coliphage in water by two-step Enrichment Procedure (EPA/821-R-01-030). The method was modified to increase the sensitivity of the method for biosolids monitoring.
[2]Most Probable Number of Coliphage Based on Dry Weight of 1gram of as-received biosolids.
[3]Failure to detect coliphages in biosolids is recorded as less than (<) the limit of test sensitivity.

TABLE 15: SUMMARY OF THE VERMICON IDENTIFICATION TECHNOLOGY INDEX VALUES FOR AMMONIA AND NITRITE OXIDIZING BACTERIA IN THE STICKNEY WATER RECLAMATION PLANT ACTIVATED SLUDGE

Sample Date	Battery A (VIT Index)[1]		Battery D (VIT Index)	
	AOB[2]	NOB[3]	AOB	NOB
08/27/12	2.8	3.2	2.9	2.8
09/24/12	2.9	3.3	3.0	2.7
10/08/12	NT	NT	3.1	2.3
10/15/12	3.1	2.1	NT	NT
11/26/12	2.8	2.6	NT	NT
12/12/12	3.0	2.6	NT	NT

[1]Vermicon Identification Technology Index.
[2]Ammonia Oxidizing Bacteria.
[3]Nitrite Oxidizing Bacteria.
NT=Not tested.

The study confirmed that estrogenic endocrine active compounds enter the CAWS by several means including WRP effluent, CSOs, and storm water runoff. The fish exposed to these compounds exhibited physiological responses but did not show widespread histopathological changes. A final summary report and three manuscripts were prepared in July 2012.

The mobile exposure laboratory trailer was deployed at the O'Brien WRP in April/May and at the Calumet WRP in October of 2012. The MELT is used to evaluate the relationship between a particular water source and observed endocrine disruption, and the compounds that may be responsible.

Research Collaboration. The Division staff participated in the following collaborative research activities:

- Water Environment Research Foundation Research Projects – The Division staff served on project sub-committees and provided technical review of the research projects and regulatory documents. This included attendance at meetings and evaluation of project proposals and a final report.

- National Association of Clean Water Agencies – Division staff participated as an advisory member of the National Association of Clean Water Agencies' Recreational Criteria Workgroup that conducted review of the USEPA's efforts to develop new recreational water quality criteria. The Division staff focus was on review of the underlying epidemiological studies and on broader policy implications of the criteria for POTWs.

- Lake Michigan Total Maximum Daily Load for Illinois Beaches, USEPA Region 5 and IEPA.

- Michigan State University, Great Lake Research on Forecasting Beach and Near Shore Health Effects Using QMRA.

- Illinois Institute of Technology (IIT) – This project is funded by the National Science Foundation. The project involves cyber physical systems in which intelligent sensor networks and software are applied to achieve more efficient and effective operations by providing real-time response for wastewater treatment should plant upsets occur or performance deteriorate. The IIT project is using the Calumet WRP as a basis for this study. The Division provided plant data for the creation of a process model, technical support, and aided in the collection of DO monitoring data within a test battery.

Outreach Activities

The EM&RD staff continued outreach support activities to promote public awareness and acceptance of District operations. The staff attended and presented at the local and national meetings, and provided support to the following activities.

- Science Fair Participation. Staff participated and judged middle school and high school science fairs. Staff offered encouragement to students and provided insight on research, report writing and the scientific process.

- Wastewater Microbiology Hands-On Workshop. As a member of Water Environment Federation program, staff presented at the Water Environment Federation Technical Exhibition and Conference, sharing knowledge on wastewater microbes in an interactive on-site workshop session. The workshop presented real-life examples covering several different aspects of wastewater process control.

- Laboratory Tours. Laboratory tours conducted as part of the District tours and are encouraged and conducted upon request to any person or group wishing to learn about the EM&RD's laboratory operations. Individual and group tours were provided in 2012.

APPENDIX I

APPENDIX I

MEETINGS AND SEMINARS 2012

January 2012

Asian Carp Regional Coordinating Committee, Technical and Policy Workgroup Meeting (and follow-up meetings throughout the year), Chicago, Illinois.

DuPage River Salt Creek Workgroup, Annual Meeting (and follow-up meetings throughout the year), Downers Grove, Illinois.

Illinois Water Environment Association and Central States Water Environment Association 2012 Government Affairs Conference, Willowbrook, Illinois.

Illinois Water Environment Association, Government Affairs (and follow-up meetings throughout the year), Willowbrook, Illinois.

Midwest Water Analyst Association, Winter Expo 2012 (and follow-up meetings throughout the year), Kenosha, Wisconsin.

Union League Club Environment and Public Affairs Committees and Lake Michigan States Section-Air and Waste Management Association Joint Luncheon Meeting, Chicago, Illinois.

February 2012

Chicago Area Waterway System, Use Attainability Analysis, Physical Habitat Projects Workgroup (and follow-up meetings throughout the year), Chicago, Illinois.

Illinois Chapter of the American Fisheries Society, Annual Meeting, Utica, Illinois.

Water Environment Research Foundation, Research Council Annual Meeting, Alexandria, Virginia.

March 2012

Illinois Association of Wastewater Agencies, Technical Committee Meeting (and follow-up meetings throughout the year), Utica, Illinois.

APPENDIX I

MEETINGS AND SEMINARS 2012 (Continued)

Illinois Chapter of the American Fisheries Society, Age and Growth of Fishes: Modern Techniques and Applications Workshop, Monticello, Illinois.

Illinois Lake Michigan Implementation Workgroup Meeting (and follow-up meetings throughout the year), Chicago, Illinois.

Illinois Section of the American Water Works Association and Illinois Water Environment Association, WaterCon 2012, Joint Conference and Expo, Springfield, Illinois.

University of Illinois at Chicago, College of Urban Planning and Public Affairs, College of Medicine, School of Public Health and College of Engineering, Water Area of Excellence Seminar Series, Chicago, Illinois.

Water Environment Research Foundation Exploratory Committee, Teleconference (and follow-up meetings throughout the year), Cicero, Illinois.

April 2012

American Academy of Environmental Engineers Conference, Washington D.C.

Central States WEA: Leadership Academy and Education Seminar, Madison, Wisconsin.

Conservation Foundation Workshop: Physical and Biological Goals of the Clean Water Act: What Stormwater Professionals Need to Know, Wheaton, Illinois.

TrojanVU Facility Tour, London, Ontario Canada.

Water Environment Federation, Air & Waste Management Association and Kentucky-Tennessee Water Environment Association, Odors and Air Pollutant 2012 Conference, Louisville, Kentucky.

APPENDIX I

MEETINGS AND SEMINARS 2012 (Continued)

May 2012

Calumet Area Industrial Commission, Lunch and Learn Series, Calumet, Illinois.

Friends of the Chicago River, 8th Annual Chicago River Summit, Chicago, Illinois.

Illinois Environmental Protection Agency, Nutrient Stakeholders Workgroup Meetings (and follow-up meetings throughout the year), Springfield, Illinois.

Society for Freshwater Science Annual Meeting, Louisville, Kentucky.

June 2012

American Society of Microbiology, General Meeting, San Francisco, California.

Peregrine Lake Homeowners Association Meeting (and follow-up meetings throughout the year), Palatine, Illinois.

United States Department of Agriculture, W-2170 Committee Meeting, Tacoma, Washington.

July 2012

United States Army Corp of Engineers, Great Lakes Mississippi River Interbasin Study Meeting, Chicago, Illinois.

August 2012

Addison Underbridge Coordination Meeting, Chicago, Illinois.

APPENDIX I

MEETINGS AND SEMINARS 2012 (Continued)

September 2012

Illinois Association of Wastewater Agencies, Annual Meeting (and follow-up meetings throughout the year), Normal, Illinois.

Illinois Water 2012, Champaign-Urbana, Illinois.

Illinois Water Environment Association, Nutrient Removal and Recovery Workshop, Sandwich, Illinois.

United States Army Corp of Engineers, Bubbly Creek Feasibility Study Workshop, Chicago, Illinois.

Water Environment Federation, Technical Exhibition and Conference, New Orleans, Louisiana.

October 2012

American Society of Agronomy, Annual Meeting, Cincinnati, Ohio.

Great Lakes Beach Association Conference, Mackinac Island, Michigan.

Illinois Water Environment Association, Microbiology Laboratory Seminar, Schaumburg, Illinois.

November 2012

Air and Waste Management Association Lake Michigan States Section, 2012 Air Quality Management Conference, Oakbrook, Illinois.

Illinois Emergency Management Agency Conference, Lisle, Illinois.

Illinois Water Environment Association, Biosolids Seminar, Cicero and Schamburg, Illinois.

APPENDIX I

MEETINGS AND SEMINARS 2012 (Continued)

Industrial Waste, Water and Sewage Group, Monthly Dinner Meeting, Chicago Illinois.

North Central Extension-Industry Soil Fertility Conference, Des Moines, Iowa.

December 2012

Buffalo Creek Clean Water Partnership, Monitoring Meeting, Cicero, Illinois.

Comprehensive Environmental Toxicity Information System Training, Trinidad, California.

Midwest Association of Fish and Wildlife Agency, 73rd Conference, Wichita, Kansas.

Use Attainability Analysis, Habitat Committee Meeting, Chicago, Illinois.

Water Environment Research Foundation and Environmental Protection Agency Experts Meeting on Trace Organics in Biosolids, Washington D.C.

APPENDIX II

APPENDIX II

PRESENTATIONS 2012

January 2012

"Effects of Mechanical Mixing on Full-Scale Digester Performance at Calumet WRP." Presented at the Midwest Water Analyst Association, Winter Expo 2012, Kenosha, Wisconsin, by K. Patel. PP

"The Energy of the Urban Water Cycle in Greater Chicago." Presented at the Illinois Water Environment Association and the Illinois Section of the Central States Water Environment Association 2012 Government Affairs Conference, Willowbrook, Illinois by J.A. Kozak. PP

February 2012

"Current Challenges at the Metropolitan Water Reclamation District of Greater Chicago." Presented at the Northwestern University, Environmental Engineering Class, Evanston, Illinois, by J.A. Kozak. PP

March 2012

"Effects of Solids Content on Stability of Air-Dried Biosolids Stored in Stockpiles." Presented at the Illinois Section of the American Water Works Association and Illinois Water Environment Association, WaterCon 2012, Joint Conference and Expo, Springfield, Illinois, by O. Oladeji, G. Tian, and A. Cox. PP

"Evaluation of Biosolids Composting Using Low Rates of Bulking Materials." Presented at the Illinois Section of the American Water Works Association and Illinois Water Environment Association, WaterCon 2012, Joint Conference and Expo, Springfield, Illinois, by G. Tian, O. Oladeji, L. Hundal, P. Lindo, A. Cox, J. Gawrys and D. Collins. PP

"Overview of Biosolids Composting – The Science, Production and Use in Illinois." Presented at the Illinois Section of the American Water Works Association and Illinois Water Environment Association, WaterCon 2012, Joint Conference and Expo, Springfield, Illinois, by A. Cox, K. Kumar, and J. Hutton. PP

"The Carbon Footprint of the Metropolitan Water Reclamation District of Greater Chicago." Presented at the Illinois Section of the American Water Works Association and Illinois Water Environment Association, WaterCon 2012, Joint Conference and Expo, Springfield, Illinois, by J.A. Kozak. PP

APPENDIX II

PRESENTATIONS 2012 (Continued)

April 2012

"Chicago Health, Environmental Exposure, and Recreation Study (CHEERS)." Presented at the American Academy of Environmental Engineers Conference, Washington, D.C., by G. Rijal. PS and PP

"Green Infrastructure Research at the Metropolitan Water Reclamation District of Greater Chicago." Presented at the Northwestern University, Engineering Design Class, Evanston, Illinois, by J.A. Kozak. PP

"Various Stages of Leadership Throughout Your Career: A Panel Discussion." Presented at the Central States Water Environment Association: Leadership Academy and Education Seminar, Madison, Wisconsin, by J. Moran-Andrews. PP

May 2012

"Environmental Issues Facing the Metropolitan Water Reclamation District of Greater Chicago." Presented at the Calumet Area Industrial Commission, Lunch and Learn Series, Calumet, Illinois, by T.C. Granato. PP

June 2012

"Monitoring and Modeling the Chicago Department of Transportation Streetscape Project." Presented at the Institute of Transportation Engineers, Midwestern District and Urban Street Symposium, Chicago, Illinois, by J.A. Kozak. PP

"Sources and Distribution of Fecal Indicator Bacteria Impacting Chicago's North Shore Channel Water Quality." Presented at the American Society of Microbiology, General Meeting, San Francisco, California, by G. Rijal. PS

July 2012

"Biosolids – The Key Ingredient for Sustainable Farming." Presented at the Natural Resource Conservation Service, Kendall County Soil and Water Conservation District Board Meeting, Yorkville, Illinois, by L.S. Hundal. PP

APPENDIX II

PRESENTATIONS 2012 (Continued)

"Land Application to Ensure Sustainable Farming," Presented at the Natural Resource Conservation Service, Grundy County Soil and Water Conservation District Board Meeting, Morris, Illinois, by L.S. Hundal. PP

August 2012

"Fertilizing with Biosolids to Ensure Long-Term Productivity and Soil Health." Presented at the Stewart Environmental Inc., Field Day, Sheridan, Illinois, by L.S. Hundal. PP

September 2012

"A Case Study of Bacteria Source Tracking in the North Shore Channel." Presented at the Illinois Water 2012, Champaign-Urbana, Illinois, by R. Gore. PP

"Activated Sludge and BNR Process Control: Hands-on in the Real World." Presented at the Water Environment Federation, Technical Exhibition and Conference 2012, New Orleans, Louisiana, by T. Glymph-Martin. PS

"Costs, Operational and Environmental Impacts of Chemical Phosphorus Removal at the Egan Water Reclamation Plant and Projected Impacts on Metropolitan Chicago Water Reclamation Plants." Presented at the Illinois Water 2012, Champaign-Urbana, Illinois, by H. Zhang. PP

"Healthy Soils: The Key Ingredient in Agricultural Sustainability Pie." Presented at the 2nd Annual Urban Resolutions for Bridging African Americans to Natural Environments Conference, Chicago State University, Chicago, Illinois, by L.S. Hundal. PP

"Phosphorus Sources and Loading from Chicago Area Water Reclamation Plants and the Impact of the Loading on the Concentration of Phosphorus in Chicago Area Streams and the Illinois River." Presented at the Illinois Water 2012, Champaign-Urbana, Illinois, by K. Kumar. PP

"Pilot Testing Enhanced Biological Phosphorus Removal at Chicago Water Reclamation Plants Using Existing Infrastructure." Presented at the Illinois Water 2012, Champaign-Urbana, Illinois, by J.A. Kozak. PP

"Unintended Consequences of Phosphorus Removal." Presented at the Illinois Water Environment Association, Nutrient Removal and Recovery Workshop, Sandwich, Illinois by, J.A. Kozak. PP

APPENDIX II

PRESENTATIONS 2012 (Continued)

October 2012

"Groundwater Quality during Thirty-Five Years of Monitoring Mined Land Reclaimed with Biosolids." Presented at the American Society of Agronomy, Annual Meeting, Cincinnati, Ohio, by O. Oladeji, G. Tian, and A. Cox. PP

"The Effect of Long-Term Application of Biosolids on Nitrate Downward Movement in a Midwest Corn Belt Soil." Presented at the American Society of Agronomy, Annual Meeting, Cincinnati, Ohio, by G. Tian, O. Oladeji, A. Cox, T.C. Granato, and C. O'Connor. PP

"Wastewater Microbiology and Process Control." Presented at the Illinois Water Environment Association, Microbiology Laboratory Seminar, Schaumburg, Illinois, by T. Glymph-Martin. PS

November 2012

"Biosolids Composting with the Low Rate of Bulking Materials." Presented at the Illinois Water Environment Association, Biosolids Seminar, Schaumburg, Illinois, by G. Tian. PP

"Effect of Biosolids Application on Plant Available Nutrients." Presented at the North Central Extension-Industry Soil Fertility Conference, Des Moines, Iowa, by L.S. Hundal. PP

"Wastewater Microbiology and Treatment." Presented at the University of Illinois at Chicago, Environmental and Occupational Health Course, Chicago Illinois, by G. Rijal. PP.

December 2012

"Sidestream Nitrogen Removal at the John E. Egan Water Reclamation Plant." Presented at the Water Environment Federation and Water Environment Research Foundation, Leaders Innovation Forum for Technology-Deammonification Workshop, Schaumburg, Illinois, by J.A. Kozak. PP

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*PP=PowerPoint Presentation
PS=Poster Presentation

APPENDIX III

APPENDIX III

PAPERS PUBLISHED 2012

Cox, A., T.C. Granato, and L. Kollias. "Land Application of Biosolids by the Metropolitan Water Reclamation District of Greater Chicago." In chapter Jakobsson (ed) Sustainable Agriculture – Ecosystem Health and Sustainable Agriculture. Baltic University Programme, Uppsala Univ. Uppsala, Sweden. pp. 159-167, 2012.

Hale, R., M. La Guardia, E. Harvey, D. Chen, and L.S. Hundal. "PBDEs in U.S. Biosolids: Temporal/Geographical Trends and Uptake by Corn Following Land Application." *Environmental Science and Technology,* 46(4):2055-2063, 2012.

Hundal, L.S., A. Cox, K. Kumar, G. Tian, and T.C. Granato. "Effect of Biosolids Application on Plant Available Nutrients." Proceeding of 42nd North Central Extension-Industry Soil Fertility Conference. Des Moines, Iowa. pp. 37-44, 2012.

Kumar, K., L.S. Hundal, S. Brown, and A. Cox. "Biosolids, Compost, and Manure are Important Components of Agricultural Sustainability." *BioCycle*. 53(4):57-58, 2012.

Lukicheva I, G. Tian, A. Cox, T.C. Granato, and K. Pagilla. 2012. "Anaerobic and aerobic transformations affecting stability of dewatered sludge during long-term storage in a lagoon. *Water Environment Research*, 84: 17-24.

Oladeji O., G. Tian, A.E. Cox, T. C. Granato, R. I. Pietz, C.R. Carlson and Z. Abedin. "Effect of Long Term Application of Biosolids for Mine Land Reclamation on Groundwater Chemistry: Trace Metals." *Journal of Environmental Quality,* 41: 1445-1451, 2012.

Peak, D., G. Kar, L.S. Hundal, and J.J. Schoenau. "Kinetics and Mechanisms of Phosphorus Release in a Soil Amended with Biosolids or Inorganic Fertilizer." *Soil Science,* 177(3): 183-187, 2012.

APPENDIX IV

METROPOLITAN WATER RECLAMATION DISTRICT OF GREATER CHICAGO
MONITORING AND RESEARCH DEPARTMENT 2012 SEMINAR SERIES

January 27, 2012 — ***Asian Carp and the Separation of the Great Lakes and Mississippi River Watersheds in the Chicago Area***
Mr. Richard Lanyon, Retired Executive Director of the Metropolitan Water Reclamation District of Greater Chicago (District), Chicago, Illinois

February 24, 2012 — ***Tracking Sources of Phosphorus and the District's Action Plan for Sustainable Phosphorus Management***
Mr. Brett Garelli, Deputy Director of Maintenance and Operations, Maintenance and Operations Department and Dr. Kuldip Kumar, Associate Environmental Soil Scientist, Monitoring and Research Department, District, Chicago, Illinois

March 30, 2012 — ***Heritage Park Flood Control Facility: Compensatory Floodplain Storage for Levee 37***
Mr. Joe Kratzer, Senior Civil Engineer, Engineering Department, District, Chicago, Illinois

April 27, 2012 — ***Coal-Tar-Based Pavement Sealcoat, Polycyclic Aromatic Hydrocarbon, Source Tracking and Impacts on Urban Watersheds***
Mr. Peter Van Metre, Research Hydrologist, United States Geological Survey, Austin, Texas

May 18, 2012 — ***Water Scarcity: A Global Perspective***
Dr. Cecil Lue-Hing, Cecil Lue-Hing & Associates, Burr Ridge, Illinois

June 29, 2012 — ***Removal and Recovery of Phosphorus at the Hampton Roads Sanitary District***
Dr. Charles B. Bott, Research and Development Manager, Hampton Roads Sanitation District, Virginian Beach, Virginia

July 27, 2012 — ***The Use of Water Quality Modeling to Inform Decision Making Under Uncertainty***
Professor Ken Reckhow, Duke University, Raleigh-Durham, North Carolina

August 24, 2012 — ***Oxygen Transfer in Wastewater Treatment Processes: Research Perspectives in the 21st Century***
Professor Diego Rosso, Assistant Professor, University of California, Irvine, California

September 28, 2012 — ***Mechanisms of Corrosion and the Impact of Corrosion on the Underground Infrastructure***
Mr. Mark Joyce, Senior Mechanical Engineer, Maintenance and Operations Department and Dr. Ali Oskouie, Senior Environmental Research Scientist, Monitoring and Research Department, District, Chicago, Illinois

October 26, 2012 — ***Fish Response to Varying Dissolved Oxygen Concentrations in Urban Streams***
Mr. Doug Bradley, Senior Project Scientist, LimnoTech, Ann Arbor, Michigan

November 30, 2012 — ***Implications of Pathogen-Biofilm Interactions for Surface Water Quality***
Professor Aaron Packman, Department of Civil and Environmental Engineering, Northwestern University, Evanston, Illinois

December 14, 2012 — ***Complying with National Pollutant Discharge Elimination System Permit Requirements***
Mr. Adam Gronski, Principal Civil Engineer, Maintenance and Operations Department, and Ms. Jennifer Wasik, Supervising Aquatic Biologist, Monitoring and Research Department, District, Chicago, Illinois

RESERVATIONS REQUIRED (at least 24 hours in advance); PICTURE ID REQUIRED FOR PLANT ENTRY
CONTACT: Dr. Heng Zhang, Assistant Director of Monitoring and Research, EM&R Division, (708) 588-4264 or (708) 588-4059
LOCATION: Stickney Water Reclamation Plant, Lue-Hing R&D Complex, 6001 West Pershing Road, Cicero, IL 60804; TIME: 10:00 A.M.
NOTE: These seminars are eligible for Professional Development Credits/CEUs

APPENDIX V

ENVIRONMENTAL MONITORING AND RESEARCH DIVISION

Section 121 - Administrative Section

Zhang, Heng, Assistant Director of Monitoring and Research
Cox, Albert, Environmental Monitoring and Research Manager
Abedin, Zainul, Biostatistician
Gregor, Bettina, Secretary
Khalique, Abdul, Radiation Chemist
Kathleen Quinlan, Administrative Assistant

Section 122 - Wastewater Treatment Process Research

Kozak, Joseph, Supv. Env. Research Scientist
Franklin, Laura, Prin. Office Support Spec.
Oskouie, Ali, Senior Env. Research Scientist
Patel, Kamlesh, Senior Env. Research Scientist
Bernstein, Doris, Assoc. Env. Research Scientist
Qin, Dongqi, Assoc. Env. Research Scientist
MacDonald, Dale, Assoc. Env. Research Scientist
Moran, Judith, Assoc. Env. Research Scientist
Haizel, Anthony, Lab Technician 2
Reddy, Thota, Lab Technician 2
Bodnar, Robert, Lab Technician 1
Byrnes, Marc, Lab Technician 1
Iu, Kim, Lab Technician 1
Kowalski, Shaw, , Lab Technician 1
Robinson, Harold, Lab Technician 1

Section 123 - Biosolids Utilization and Soil Science

Vacant, Supv. Env. Soil Scientist
Vacant, Prin. Office Support Spec.
Hundal, Lakhwinder, Senior Env. Soil Scientist
Tian, Guanglong, Senior Env. Soil Scientist
Kumar, Kuldip, Assoc. Env. Soil Scientist
Lindo, Pauline, Assoc. Env. Soil Scientist
Oladeji, Olawale, Assoc. Env. Soil Scientist
Patel, Minaxi, Assist. Env. Chemist
Mackoff, Ilyse, Lab Technician 2
Tate, Tiffany, Lab Technician 2
Adams, Richard, Lab Technician 1
Vacant, Lab Technician 1
Vacant, Lab Assistant
Horvath, Beverly, Lab Assistant

Section 124-Analytical Microbiology and Biomonitoring

Rijal, Geeta, Supv. Env. Microbiologist
Biron, Marie, Prin. Office Support Spec.
Glymph, Auralene, Senior Env. Microbiologist
Gore, Richard, Assoc. Env. Microbiologist
Shukla, Hemangini, Assist. Env. Microbiologist
Vacant, Lab Technician 2
Jackowski, Kathleen, Lab Technician 2
Kaehn, James, Lab Technician 2
Maka, Andrea, Lab Technician 2
Rahman, Shafiq, Lab Technician 2
DeGutes, Mathew, Lab Technician 1
Hussaini, Syed, Lab Technician 1
Saverson, Amanda, Lab Technician 1
Vacant, Lab Technician 1
Roberts, David, Lab Technician 1
Collins, Rory, Lab Assistant
Vacant, Lab Assistant

Section 126 - Aquatic Ecology and Water Quality

Wasik, Jennifer, Supv. Aquatic Biologist
Maurovich, Coleen, Prin. Office Support Spec.
Minarik, Thomas, Senior Aquatic Biologist
Gallagher, Dustin, Assoc. Aquatic Biologist
Vick, Justin, Assoc. Aquatic Biologist
Kollias, Nick, Assist. Aquatic Biologist
Banal, Marvin, Lab Technician 2
Joyce, Colleen, Lab Technician 2
Schackart, Richard, Lab Technician 2
Whitington, Angel, Lab Technician 2
Lansiri, Panu, Lab Technician 1
Craig Shingles, Lab Technician 1