United States and State of Ohio v. Northeast Ohio Regional Sewer District

Consent Decree
Appendix 2

Post-Construction Monitoring Program

Appendix 2 - Post-Construction Monitoring Program

Contents:

2.1 Introduction

The purpose of the Post-Construction Monitoring Program (PCMP) is to verify that projects constructed as part of the Long Term Control Plan (LTCP) meet the Performance Criteria stipulated in Table 1.1 of Appendix 1 and the water quality goals established during the development of the CSO Phase II Facilities Plans for the Easterly, Westerly and Southerly combined sewer Districts. Terms used in this Appendix that are defined herein, or in the Consent Decree or any other Appendix thereto shall have the meanings assigned to them in such documents.

NEORSD developed LTCPs for systems tributary to the Easterly, Southerly and Westerly wastewater treatment plants. NEORSD's CSO program was developed with water quality monitoring and modeling components in order to identify water quality impairments attributable to wet weather discharges from the system. The results of these studies were coupled with extensive hydrologic and hydraulic modeling activities to understand the systems' response to wet weather events. In order to calibrate these models, NEORSD also completed several flow monitoring programs to quantify sewer flows. These monitoring programs, model development and application as well as evaluation of control alternatives to meet water quality goals were completed with specific LTCP project recommendations.

The last series of these studies was completed in March 2002 as required by the CSO NPDES Permits for the Easterly and Southerly combined sewer service areas. Following the submission of these plans NEORSD has continued with the design and construction of some of the recommended facilities including early action projects in the Westerly, Easterly and Southerly Districts, and an initial LTCP project in the Easterly District. In addition, NEORSD engaged in negotiations with the United States and Ohio EPAs and the U.S. Department of Justice to agree upon a consent decree that would govern the scope and implementation schedule of the remaining LTCP recommendations.

The recommended LTCP projects depicted in Appendix 1 (treatment facilities, tunnels, pump stations, relief sewers, etc) comprise "Gray Infrastructure" control measures. In addition, NEORSD will also be developing "Green Infrastructure" control measures for wet weather control providing stormwater inflow reduction and/or detention to reduce overflow volumes. These control measures have not been developed in terms of location and type(s) of Green Infrastructure control measures although the general performance criteria and conditions for the program are outlined in Appendices 3 and 4. It is NEORSD's intent to implement these Green Infrastructure control measures subsequent to a Green Infrastructure Feasibility Study and concurrent with the LTCP projects as a means to provide additional CSO control and provide for credits where Green Infrastructure can be substituted for Gray Infrastructure control measures, in whole or in part, in accordance with the provisions governing Tier 1b and Green for Gray substitutions under the Consent Decree. If this objective is accomplished, the projects selected will complement the LTCP projects and would be integrated into the PCMP monitoring and evaluation for both the Gray and Green Infrastructure components.

The main elements of the PCMP include the following:

- A process to determine whether the CSO control measures are meeting the Performance Criteria identified in Appendix 1.
- A process for assessing environmental benefits attributable to the CSO control measures.
- A monitoring schedule, initial sampling locations, associated monitoring, modeling procedures to collect data related to the Performance Criteria, and the impacts from CSOs on E. coli levels in CSO impacted receiving streams and Lake Erie; and
- Evaluation and analysis of the monitoring data to determine whether CSO control measures are achieving desired outcomes and for reporting progress to the regulatory agencies and general public.

2.1.1 Regulatory Requirements

U.S.EPA requires CSO communities to conduct a post-construction monitoring program during and after LTCP implementation "to help determine the effectiveness of the overall program in meeting [Clean Water Act] requirements and achieving local water quality goals."[1] This program should collect data that measure the effectiveness of CSO controls and their impact on water quality, and should utilize existing monitoring stations used in previous studies of the waterways and sewer system in order to compare results to conditions before controls were put in place. The program should include a map of monitoring stations, a record of sampling frequency at each station, a list of data to be collected, and a quality assurance/quality control (QA/QC) plan.

In U.S.EPA's December 2001 Report to Congress: Implementation and Enforcement of the Combined Sewer Overflow Control Policy, the agency noted the difficulty of establishing a monitoring and tracking program for CSO control programs. "Monitoring programs need to be targeted and implemented in a consistent manner from year to year to be able to establish pre-

[1] *Combined Sewer Overflows, Guidance for Long-Term Control Plan* (EPA 832-B-95-002, August 1995) p. 4-15.

control baseline conditions and to identify meaningful trends over time as CSO controls are implemented," the report said. "In practice, it is often difficult, and in some instances impossible, to link environmental conditions or results to a single source of pollution, such as CSOs. In most instances, water quality is impacted by multiple sources, and trends over time reflect the change in loadings on a watershed scale from a variety of environmental programs." The report also noted that weather conditions and rainfall totals vary significantly from storm to storm and year to year, making comparisons difficult.

2.1.2 Purpose and Scope

The Post-Construction Monitoring Program will collect data needed to document receiving streams and Lake Erie improvements that can be attributed to the implementation of the control measures identified in the LTCP, to evaluate whether CSO control measures have met the Performance Criteria, and whether NEORSD's CSOs comply with the NPDES permits. In order to enable comparisons to historic data, NEORSD will integrate the required CSO post-construction monitoring program into its current monitoring programs. The general scope of the post-construction monitoring program will include preparation and execution of the monitoring plan, as well as evaluation of the effectiveness of CSO control measures. The combined sewer districts included in this plan include the Easterly, Southerly and Westerly Districts. The following receiving waters are covered by this PCMP - Lake Erie, Cuyahoga River, Big Creek, Burke Brook, Doan Brook, Dugway Brook, Euclid Creek, Green Creek Culvert, Kingsbury Run, Morgana Run, Nine Mile Creek, Rocky River, Shaw Brook Culvert, West Creek, Spring Creek and Treadway Creek. The monitoring program has been developed based upon the following scope of work:

- Document Current Baseline Conditions: During the CSO Phase II Facilities Plans for the Easterly, Southerly and Westerly Districts, NEORSD performed a comprehensive assessment of the baseline conditions for CSO frequency and volumes for the "typical year" as well as baseline conditions for water quality within the receiving streams and Lake Erie. These assessments will be used as the baseline conditions for comparing the post-construction performance of the various control measures within the LTCP.

- Identify Parameters of Concern: NEORSD evaluated CSO control measures to analyze their ability to improve receiving streams and Lake Erie water quality for specific parameters of concern. During the development of the LTCPs and subsequent discussions with the U.S. EPA and Ohio EPA, NEORSD identified E. coli bacteria as the main parameter of concern. NEORSD will use E. coli bacteria to measure the effect of its LTCP CSO control measures on its receiving streams and Lake Erie.

- Prepare and Execute Post-Construction Monitoring: The monitoring program will evaluate whether specific CSO control measures are performing as designed and constructed to meet its Performance Criteria. The program will identify how NEORSD will collect data needed to document receiving waters improvements and any pollutant reduction achieved through implementation of these control measures. Sections 2.2 through 2.5 further describe NEORSD's PCMP.

- Report results to State and Federal Agencies: The results of the PCMP will be reported to the U.S. EPA and the Ohio EPA. Upon completion of each CSO control measure, NEORSD will prepare a Control Measure Report that evaluates whether the constructed projects that comprise that Control Measure have achieved the desired results. Section 2.6 presents NEORSD's approach for tracking and reporting on the achievement of Performance Criteria described in Table 1.1 of Appendix 1.

- Provide Public Information on Water Quality: Information from the monitoring program will be available to the general Cleveland area public and interested parties. This information will allow the public to be informed and educated relative to NEORSD's water quality improvement programs and water quality issues.

2.2 Performance Criteria

The Performance Criteria developed during the CSO Control Program by NEORSD were based on number of overflows per a "typical year" as defined in the CSO Phase II Facilities Plans for the Easterly, Southerly and Westerly Districts. The original LTCP recommended numbers of overflows that have been updated through subsequent discussions with the U.S. EPA and the Ohio EPA. Appendix 1 shows the Performance Criteria for the various control measures comprising the current LTCP, design criteria, critical milestones and provides information on outfalls controlled.

2.3 Post-Construction Monitoring and Data Collection

An important element of the PCMP is the type, location and frequency of monitoring. The intent is not to replicate the extent of intense monitoring that was performed during the development of the LTCP. To the extent possible, these monitoring locations will be used again for the performance monitoring. The difference is that density of monitoring locations will be reduced; however, the duration of monitoring will likely be longer on average than what was done during the planning phase. These locations will be reviewed prior to installation of new monitoring for the PCMP. This section describes the various types of monitoring to be performed.

Flow and activation monitoring will be performed for a one-year post-construction monitoring period following "Achievement of Full Operation" for each control measure as indicated in Table 2.1 and discussed in Section 2.3.1, and CSO activation monitoring will again be performed for a one year period following implementation of all Control Measures for each district (Easterly, Southerly, Westerly).

In-stream monitoring will be performed on a continued system-wide basis for the duration of the LTCP implementation beginning at the Achievement of Full Operation of the first control measure to monitor stream improvements over time, as discussed in Section 2.3.2.

General performance criteria and monitoring approaches for the green infrastructure projects will be integrated into the PCMP during planning of the green infrastructure projects as discussed in Appendices 3 and 4.

2.3.1 Flow Monitoring

Numerous temporary flow monitors were installed during the development of the CSO LTCP to calibrate the hydraulic models. These monitors have since been removed. NEORSD will install flow and/or activation monitors at numerous locations and utilize, where applicable, existing permanent flow meters to validate and calibrate the models, as described in Section 2.4.1, during the post-construction phase of the CSO control measure implementation. These locations were considered to reflect overflow monitoring in all priority outfall locations, including at least one CSO location within each control measure and represent the CSOs contributing 86% of the current baseline CSO volume and 96% of the CSO volume expected following implementation of the CSO controls required by this Consent Decree. These locations are listed in Table 2.2. CSOs not monitored have remaining volumes less than 1 MG each.

The flow meter locations listed in Table 2.2 are identified by outfall. However, the actual flow monitors would be placed within the new diversion structures that divert flow to either the associated control facility (i.e., tunnel, storage tank, etc.) or the CSO outfall if the capacity of the control measure is exceeded. These diversion structures are situated downstream of the combined sewer regulator structures, on the outfall conduits. When the control facility exceeds its capacity, these structures divert overflow to this existing conduit, and a flow monitor would be placed within this structure to measure these overflows. For some outfalls, such as the Dugway Brook (CSO-230), multiple diversion structures would be constructed upstream of the permitted outfall location diverting flow to the control facility. In these cases, each diversion structure would be equipped with a flow monitor to measure the total overflow activation event in a cumulative manner. These locations will be confirmed and additional monitoring will be performed as deemed necessary as the program design advances to ensure that the appropriate data to validate and/or calibrate the model and subsequently prove achievement of the Performance Criteria is collected. Augmentation of the monitoring locations will proceed with approval from Ohio EPA and U.S. EPA.

Planning, design and construction of the control measures will take place over several years. Consequently, the dates for "Achievement of Full Operation" will vary by project. Table 2.1 summarizes the Achievement of Full Operation for these control measures, which is the year that would initiate the post-construction monitoring for each control measure, and how the CSO control measures in Appendix 1 will be assessed. NEORSD will perform this evaluation by collecting precipitation and CSO outfall monitoring data for a one-year post-construction monitoring period following Achievement of Full Operation of each CSO control measure as identified in Appendix 1. Following collection system hydraulic model validation using the selected monitoring data, a "typical year" simulation will determine performance relative to the overflow frequency for each control measure.

2.3.2 In-stream Monitoring

NEORSD performed an analysis of water quality conditions, for baseline conditions and for conditions after the implementation of the recommended LTCP projects. This analysis was performed to establish levels of CSO controls that would result in water quality benefits. The

analysis was performed primarily through the simulation of fecal coliform bacteria loads in the receiving streams, rivers and lake. The analysis involved the following streams: Big Creek, Burke Brook, Doan Brook, Dugway Brook, Euclid Creek, Green Creek Culvert, Kingsbury Run, Mill Creek, Morgana Run, Nine Mile Creek, Rocky River, Shaw Brook Culvert, West Creek, Spring Creek and Treadway Creek. These streams were modeled and the outputs from these models were used to estimate impacts on either the Cuyahoga River or Lake Erie, or both, depending on which is the downstream receiving water.

The LTCP identified fecal coliform bacteria loads for dry weather, storm water and CSOs. This was done to document the specific contribution of CSOs to violations of the in-stream bacteria standards. Through discussions with the U.S. EPA and Ohio EPA, E. coli bacteria were identified as the pollutant of concern to measure during the post-construction monitoring period. NEORSD will measure E. coli bacteria counts in order to identify trends in water quality. Biological and other monitoring data (to the extent that these are already being collected by NEORSD) can be used as a check since NEORSD is already routinely monitoring the lake and points along tributary rivers and streams. NEORSD has performed several special lake monitoring projects. Among these are fish tissue sampling, which contributed to the State's basis for issuing safe fish consumption advice, and the ongoing daily sampling at two area beaches for bacteriological analysis, which provides the State's basis for posting safe swimming advice at these locations.

Based on the requirements of the CSO permits issued to NEORSD, in-stream monitoring of biological water quality indicators in Big Creek, Doan Brook, Euclid Creek and Mill Creek have been collected for use in establishing baseline conditions prior to implementation of the recommended CSO LTCP. NEORSD will continue to monitor for E.coli in these streams. NEORSD proposes additional sites for E. coli monitoring in the Cuyahoga River, Dugway Brook, Nine Mile Creek, Ohio Canal, Rocky River, Shaw Brook, Spring Creek, West Creek and Treadway Creek. These sites are appropriate for the purposes of the Post-Construction Monitoring Program to document achievement of Performance Criteria and to document improvements to water quality over time. These sites are listed in Table 2.2 and illustrated in Figure 2.2. NEORSD may add, modify, remove or relocate monitoring stations, as necessary, during or after implementation of control measures to address any changes that may be necessary as a result of planning, design and construction, provided NEORSD obtains approval from the U.S. EPA and Ohio EPA.

2.3.3 Outfall Monitoring for Activations

Pursuant to the EPA's CSO permit and EPA's CSO Nine Minimum Controls Guidance, NEORSD provides public notification of CSO occurrences at various CSO locations. NEORSD monitors CSO activations on a continuous basis at these locations. NEORSD will continue to monitor and collect this type of data at the relevant locations which are listed in Table 2.2 as "activation only" and illustrated in Figure 2.1 Following implementation of all control measures for each district (Easterly, Southerly, Westerly), NEORSD shall conduct one year of activation monitoring at all CSO monitoring locations listed in Table 2.2. These data will be used to validate the models and demonstrate achievement of the Performance Criteria.

2.3.4 Outfall Monitoring for CSO Treatment Facilities

The current list of projects includes Chemically Enhanced High Rate Treatment (CEHRT) facilities at the Easterly and Westerly WWTPs to control CSO-001 and CSO-002, respectively. The monitoring plan for these projects will be developed separately and used to demonstrate effectiveness of the CEHRT facilities. These facilities will include monitoring systems to measure E. coli, total suspended solids and chlorine residual in the treated effluent to demonstrate achievement of their respective Performance Criteria. In addition, these facilities will monitor the overflows that exceed the peak treatment capacity of the CEHRTs. For informational purposes, NEORSD will also measure CBOD, nitrogen, and phosphorus.

2.3.5 Wastewater Treatment Plant Monitoring

Routine WWTP monitoring will be used to demonstrate compliance for control measures that require increased secondary capacity in order to eliminate primary effluent bypasses (PEB) (in a typical year). PCMP compliance of the increased secondary treatment capacity can be performed within the normal plant monitoring contained in their respective NPDES permits. NEORSD will continue to flow monitor the PEB.

2.3.6 Rainfall Monitoring

NEORSD currently maintains a rain gauge network within the service area. Table 2.3 and Figure 2.3 show these existing rain gauges. These rain gauges will be utilized in each Control Measure post-construction monitoring period and in the district-by-district post-construction monitoring periods to measure rainfall within the service area for each CSO control measure. If required, additional rain gauges will be installed to ensure accurate measurement of rainfall, and NEORSD will consider the use of radar-rainfall measurements to improve accuracy of rainfall estimates, and particularly where rain gage coverage is not adequate or difficult to implement.

Table 2.3 NEORSD's Rain Gauges

Site ID	
RNT	North Olmsted
RWF	Westlake
RST	Strongsville
ROA	Oakwood
RJA	James Rhodes H.S.
RBT	Brook Park
RSG	Shaker Heights
RNR	North Royalton
ROL	Olmsted Falls
RBC	Brecksville
RIN	Independence
RMA	Maple Heights
RJO	John Marshall H.S.
RPM	Parma
RSY	Southerly WWTP
RMY	Mayfield
RBH	Beachwood
RDA	Division Ave P.S.
RDR	Dille P.S.
RWK	Wade Park
RCL	Cleveland Heights
REA	Easterly WWTP
RMN	Moreland Hills
RMD	Macedonia P.S.
RSO	South Euclid

2.3.7 Data Management

NEORSD currently maintains its data within various data management systems for the collection system and its three wastewater plants. Considering the number of monitoring locations and types of data that are being collected, the retrieval, record keeping and analysis of the data is essential in maintaining an effective monitoring program. Field procedures and QA/QC approaches to ensure that the collected data are suitable for the intended analysis are also a critical component of this program. This PCMP will use the existing NEORSD data management systems to store the data. The effectiveness of the CSO control measures will be evaluated using appropriate modeling tools. The PCMP will be designed to ensure collection of appropriate data; establish consistency of sampling methods and data acquisition; and define performance standards for maintaining data integrity. All measures necessary will be taken to validate, track, store and manage the collected data to ensure that monitoring objectives are achieved.

Sampling and modeling protocols will be administered and conducted by experienced personnel responsible for the existing database and model. As data are generated during the PCMP, the program may need to be revised to accommodate alternative data collection techniques or data evaluation approaches to meet monitoring objectives. Any revisions or additions to the data retrieval or management aspects of the PCMP will be submitted to the U.S. EPA and Ohio EPA for review and approval.

2.4 Performance Assessment

2.4.1 Model-Based Approach to Assessing Compliance

Under the model based approach to demonstrate compliance, NEORSD plans to update and utilize the various CSO models that were prepared during the development of the LTCP. The models will be used to perform appropriate simulations to demonstrate compliance with the performance criteria for each CSO control measure identified in Appendix 1. Models will also be used in conjunction with monitoring data to assess the performance of Green Infrastructure control measures installed pursuant to Appendices 3 and 4. This approach is outlined in the following steps:

1. Collect selected rainfall and CSO outfall data for the post-construction monitoring period of each CSO control measure upon completion, and rainfall data and activation data for all selected CSO outfalls following implementation of all control measures for each district (Easterly, Southerly, Westerly).

2. Perform quality assurance and quality control of the data collected in Step 1.

3. Utilize the appropriate LTCP CSO model and rainfall data collected during the monitoring period to run simulations of CSO discharges for the post-construction monitoring period.

4. Adjust precipitation/runoff information used in the model to take into account the effects of green infrastructure implementation, reflecting green infrastructure monitoring data.

5. Compare the simulation outputs to the CSO monitoring data for the post-construction monitoring period to determine whether re-calibration of the hydraulic model is required. Model re-calibration will not be required if the model-predicted activations are not less than the monitored CSO activations for each remaining CSO outfall for the post-construction monitoring period. Otherwise, model re-calibration will be required in accordance with Steps 6 -8 below.

6. For re-calibration, select two or more appropriate rainfall events from the post-construction monitoring period.

7. Develop an initial data set for use with the model and perform successive applications of the model with appropriate parameter adjustments until the degree of agreement between the model output and the CSO monitoring data for the post-construction monitoring period meets the criteria set forth in Step 5, above. In making re-parameterization adjustments, NEORSD will consider the inherent variability in both the collection system model and in

flow monitoring data, and will exercise sound engineering judgment and best industry practices so as to not compromise the overall representativeness of the model.

8. Upon completion of Step 7, NEORSD shall run an additional continuous simulation for the entire post-construction monitoring period to verify the recalibrated model. Thereafter, NEORSD shall compare the continuous simulation outputs to the CSO monitoring data described in Step 5 to determine whether additional recalibration is needed. If so, NEORSD shall conduct recalibration in accordance with steps 6 through 7 until the model achieves the criteria described in Step 5, above.

9. Overflow frequency performance criterion is based upon a "typical year" developed as part of the CSO Phase II Facilities Plans. The "typical year" was comprised of actual rain events recorded at Cleveland Hopkins Airport based on an analysis of 46 years of rainfall recorded at this site. Table C-1 - Storm Events for Typical Year Continuous Year Simulation from the *CSO Facilities Planning Summary Report, March 2005* is attached to the PCMP. This table lists all the typical year storms, the dates, the hour, duration, depth and intensity of rainfall.

10. NEORSD will utilize the validated, and/or re-calibrated, hydraulic models to run the "typical year" to determine whether the CSO control measures have achieved the Performance Criteria identified in Appendix 1. If the modeled overflow frequency exceeds this level for any of the CSO control measures, NEORSD shall submit an analysis that will include: (1) the factors causing the additional overflow frequency, (2) any impact on water quality from the additional overflow frequency, (3) control options, including green infrastructure improvements, to reduce the overflow frequency to meet the Performance Criteria levels, (4) associated costs from the additional control options, (5) any expected benefits from such control options and (6) a recommendation of additional control measures necessary to meet water quality requirements.

2.4.2 Evaluating the Performance of Green Infrastructure CSO Control Measures

NEORSD will submit its proposed Tier 1 green infrastructure post-construction monitoring program in accordance with Appendix 3. NEORSD may also submit proposals to substitute green infrastructure CSO control volumes for gray infrastructure control volumes in accordance with Appendix 4. Once approved by U.S. EPA and Ohio EPA, NEORSD shall perform green infrastructure post construction monitoring (GIPCM) for the green infrastructure control as described in Appendices 3 and 4.

2.4.3 Control Measures Reports

Following Achievement of Full Operation of each CSO Control Measure listed in Appendix 1, NEORSD shall submit a Control Measures Report to the U.S EPA and Ohio EPA for their approval. The Control Measures Report will be submitted within 24 months of the date of Achievement of Full Operation for each control measure. The reports will include information for the completed control measures implemented and data related to the following:

- Description of the area served by the particular CSO Control Measure, affected receiving waters, and CSO Control Measures being evaluated
- CSO Monitoring and Rainfall Monitoring Results
- Evaluation of the CSO Control Measures
- Significant Variances and Impacting Factors (with regard to verification of level of control)
- Re-evaluation and Corrective Actions as outlined in section 2.4.4 (if necessary)

The green infrastructure improvements schedule for Control Measure reporting would be developed as part of the Green Infrastructure Feasibility Study and would be reviewed and approved upon completion of the study. NEORSD can submit the Control Measures Report for the Big Creek Tunnel System as part of the Final Post Construction Monitoring Program Report pursuant to section 2.6.1.

2.4.4 Corrective Action Plans

If, following post construction monitoring, the analysis conducted pursuant to Sections 2.4.2and 2.4.3 above fails to demonstrate that the CSO control measures, combined with any Green for Gray substitutions if applicable, have met the pertinent performance criteria in a typical year set forth in Appendix 1, NEORSD shall submit to EPA and Ohio EPA for their approval, a Corrective Action Plan ("CAP") as part of the Control Measure Report. The CAP shall describe: (1) the specific measures to be carried out to address performance shortcomings and ensure the performance criteria in Appendix 1 are met; (2) a schedule, as expeditious as possible, for implementation of the corrective measures and (3) how the improvements when fully constructed shall be evaluated in accordance with this Appendix. The corrective measures described in the CAP shall achieve the performance criteria set forth in Appendix 1.

U.S. EPA and Ohio EPA shall review each CAP submitted by NEORSD. The Agencies may request clarifications or supplemental information to make informed decisions on each CAP. Upon the conclusion of reviews of the CAP, the Agencies will approve the CAP, approve with conditions, or disapprove the CAP. If a CAP is disapproved, NEORSD must submit a revised CAP addressing the deficiencies identified by U.S. EPA and Ohio EPA in the initial CAP. NEORSD shall implement those measures set forth in the approved CAP in accordance with the schedule in the approved CAP

2.4.4.1 Green Infrastructure Measures Implemented Pursuant to Appendix 4

Proposals to substitute green infrastructure control measures for gray infrastructure control measures will include a description of post-construction monitoring and modeling to be performed to determine whether the performance criteria set forth in Appendix 1 will be met upon completion and implementation of the control measures outlined in the Proposal. NEORSD shall implement the post-construction monitoring of green and gray infrastructure as described in approved proposals. If green infrastructure post-construction monitoring does not demonstrate that constructed green infrastructure components are meeting the performance criteria in a typical year on which the substitution was based, NEORSD may implement early corrective measures to address identified deficiencies. Early correction actions may include

measures such as constructing additional green infrastructure capacity or increasing the size and/or capacity of gray infrastructure control measures. Stipulated Penalties will not accrue and become payable if an individual green infrastructure control measure is not meeting the criteria on which the substitution was based beginning at the time the green infrastructure control measure begins operation. However, stipulated penalties will accrue and become payable as of the date of Achievement of Full Operation as defined in Appendix 1 if at the time the pertinent green and gray control measures together are not meeting the performance criteria for a typical year.

2.5 Quality Assurance/Quality Control

An important component of any CSO quality sampling effort includes sample preservation, handling, and shipping; chain of custody documentation; and quality assurance and quality control (QA/QC) procedures. The QA/QC procedures are essential to ensure that data collected in environmental monitoring programs are useful and reliable. NEORSD will employ quality control procedures to ensure consistent delivery of quality work and products for all aspects of the PCMP. The quality control procedures include documentation for the following:

- Monitoring and field measurement activities
- CSO outfall monitoring activities including installation activities, calibration records, field truthing equipment and maintenance, and data downloads
- Field sampling activities
- Laboratory analysis activities
- Rainfall monitoring activities
- Data retrieval, management and analysis activities
- Quality control reviews of all internal and external deliverables

Flow Monitoring Data

Data will be reviewed continually throughout the monitoring program by a data analyst to identify data gaps, questionable data, estimate uncertainty in flow data, and monitor service or gage maintenance needs. The data will be reviewed for the following items:

- consistent diurnal patterns, as applicable
- consistent flow vs. level patterns
- consistent level vs. velocity patterns (i.e., scatter graphs)
- correspondence with field points and wet weather responses to rainfall

Questionable data will be flagged and the raw data will be converted into final data by editing questionable data, where possible.

Upon installation and activation of each flow meter, field crews will take manual depth and velocity readings (when there is a reasonable amount of flow present) using independent instrumentation to confirm that the monitor in-situ yields data representative of actual field conditions, and to quantify uncertainty in the instrument's measurement of flow. All measurements, adjustments, and efforts undertaken during site visits will be logged. In addition to the manual measurements taken at installation, routine calibrations will be performed throughout the flow monitoring period including at least two wet weather calibrations. These routine calibrations will provide an independent confirmation that the meters are working properly.

Water Quality Data

The NEORSD Analytical Services Quality Manual and associated Standard Operating Procedures are on file with Ohio EPA. The Quality Assurance Officer at Analytical Service will send updates, revisions and any information on document control to Ohio EPA as needed.

2.6 Progress Reporting and Final Post Construction Monitoring Procedures

The post-construction monitoring program will evaluate whether CSO control measures are achieving the Performance Criteria. It will also assess water quality conditions in CSO receiving waters within the NEORSD combined sewer service areas against the baseline conditions identified in the CSO Phase II Facilities Plans for the Easterly, Southerly and Westerly districts. This section discusses how progress will be reported to the U.S. EPA, Ohio EPA and the public.

2.6.1 Final Post-Construction Monitoring Program Report

Within three years following Achievement of Full Operation for all of the LTCP projects, NEORSD shall submit a Final PCMP Report to the U.S. EPA and Ohio EPA for their approval, containing a consolidation of all of the information identified in Section 2.4.3 for each control measure, the results of the final district-by-district rainfall and activation monitoring of all CSOs listed in Table 2.2, a re-validation of the collection system models using the aforementioned CSO activation monitoring results for the outfalls listed in Table 2.2 for each District, water quality monitoring results, effluent testing results, plus any additional relevant information

collected since submittal of the Control Measures Reports. The purpose of the Final PCMP Report shall be to evaluate and document the performance of NEORSD's fully implemented LTCP CSO control measures on a system-wide basis (based upon CSO activation data and water quality monitoring). The report shall include an assessment of whether the improvements are meeting the Performance Criteria in accordance with Appendix 1 (CSO activation frequencies, bypass frequencies) and water quality based numeric and/or narrative effluent limitations applicable to CSO discharges in NEORSD's NPDES Permits. NEORSD shall also provide a further assessment of the long-term trends in water quality of NEORSD's receiving waters. If the Final PCMP Report fails to demonstrate that the Performance Criteria are met, NEORSD shall include in the report whatever further re-evaluation or corrective action necessary to meet the Performance Criteria as well as a schedule for such re-evaluation or corrective action. NEORSD shall then implement any further re-evaluations or corrective actions in accordance with the approved Final PCMP Report.

2.6.2 Progress Reports to Public

Public involvement, information and education is an important part of the overall LTCP Program development approach recommended by U.S. EPA's CSO Control Policy and utilized by NEORSD in the development of the control program. As part of the PCMP, public outreach activities will continue with periodic updates using various media available to NEORSD. Available media will include the NEORSD website, local newsprint, radio and television. Updates will include status of remaining construction projects, improvements or trends in monitored water quality parameters any available anecdotal evidence from public's interaction with the waterways.

2.7 Summary

NEORSD's Post-Construction Monitoring Program will determine the effectiveness of the CSO control program in achieving its performance requirements and water quality objectives. The program includes the following elements:

- Implementation of a defined monitoring program designed to measure reductions in overflow activations and changes in steam water quality
- Analysis and assessment of monitoring data and/or model simulation results to determine whether implemented CSO Control Measures are meeting the Performance Criteria in Appendix 1
- Analysis and assessment of in-stream monitoring data to establish trends in stream improvements
- Preparation of Control Measures Reports and a Final PCMP Report to document the success of the LTCP implementation or identify any shortcomings and necessary corrective action
- Dissemination of information on the LTCP implementation to NEORSD's rate payers and Cleveland area general public

NEORSD's Post-Construction Monitoring Program addresses the U.S. EPA and Ohio EPA requirements for monitoring the performance of the CSO control measures. NEORSD will use the Performance Criteria in Appendix 1 as performance measures to determine the effectiveness

of the overall LTCP CSO control measures, augmented by any additional green infrastructure improvements. NEORSD will use existing monitoring systems, augmented as necessary, to collect and evaluate data. This includes flow and/or activation monitoring, in-stream sampling, plant sampling and rain gauge monitoring. NEORSD shall also use the appropriate LTCP CSO hydraulic models to measure performance of the CSO control measures as described in Section 2.4. NEORSD shall submit Control Measures Reports to the U.S. EPA and Ohio EPA, as required, to demonstrate performance and achievement of LTCP objectives. In addition, NEORSD shall prepare public information reports to educate the public on the advancement of the program and the effectiveness of the control measures being implemented.

Table 2.1 – Post-Construction Performance Tracking

District	Control Measure	CSOs Controlled	Achievement of Full Operation Year (Commencement of Data Collection)	Expected Typical Year Performance (Overflow Frequency by Control Measure)	Post-Construction Performance (Overflow Frequency by Control Measure)	Overflow Frequency Criteria Achieved (Yes/No)
	Easterly Plant					
Easterly	Treatment and Disinfection of CSO 001 using CEHRT	Outfall 001	Dependent on the approved pilot program schedule.	2 partially treated overflows/year		
	Westerly Plant					
Westerly	Treatment and Disinfection of CSO 002 using CEHRT in all 6 Quadrants (quads).	Outfall 002	Dependent on the approved pilot program schedule.	3 partially treated overflows/year		
	Southerly Plant					
Southerly	Increase Secondary Treatment Capacity and Treat Primary Effluent Bypass with CEHRT	PEB	Dependent on the approved pilot program schedule.	1 or less		
	Easterly CSO Projects					
Easterly	Euclid Creek Tunnel/Dugway Storage System	Outfalls 206, 208, 209, 210, 211, 212, 214, 230, 231, 232, 239, 242	2020	2 or less		
Easterly	Shoreline Tunnel System	Outfalls 093, 094, 095, 096, 097, 098, 200, 201, 202, 203, 204, and 205	2027	2 or less		
Easterly	Doan Valley Tunnel System	Outfalls 073, 217, 218, 219, 220, 221, 222, 223/224, 226, and 234	2021	Priority outfalls = 2 or less; Nonpriority = 3 or less		
Easterly	Superior Avenue Pump Station Upgrade	Outfalls 090, W. 11th/Superior Pump Station CSO	2016[2]	2 or less		
Easterly	Stones Levee Pump Station Upgrade	Outfalls 235, Stones Levee Pump Station CSO; surcharging relief	2017	3 or less		
Easterly	Canal Road In-Line Storage	Outfalls 090, 235; Additional storage capacity and flow attenuation	2018	3 or less		
	Westerly CSO Projects					
Westerly	Westerly Tunnel System	Outfalls 074, 075, 080, 087	2024	Priority outfalls = 2 or less; Nonpriority = 3 or less		
Westerly	Columbus Road Storage Tank	Outfall 078	2019	0		
Westerly	Center Street Storage Tank	Outfall 076	2024	0		
Westerly	West Third Street Storage Tank	Outfall 082	2025	4 or less		
Westerly	Mary Street Pump Station Upgrade	Outfall 086	2017	4 or less		

[2] Commencement of first flow monitoring for control measure and system-wide in-stream monitoring.

District	Control Measure	CSOs Controlled	Achievement of Full Operation Year (Commencement of Data Collection)	Expected Typical Year Performance (Overflow Frequency by Control Measure)	Post-Construction Performance (Overflow Frequency by Control Measure)	Overflow Frequency Criteria Achieved (Yes/No)
Westerly	Jefferson Avenue Separation	Outfall 240	2028	0		
Westerly	West 3rd St/Quigley Parallel Storage System	Outfall 089	2021	2 or less		
	Southerly CSO Projects					
Southerly	Southerly Tunnel System	Outfalls 033, 035, 036, 039, 040, and 072	2030	3 or less		
Southerly	Big Creek Tunnel System	Outfalls 043, 044, 049, 050, 051, 053, 054, 055, 056, 057, 058, 059, 233, 238, & Cooley Avenue	2035	Priority outfalls = 3 or less; Nonpriority = 4 or less		
Southerly	CSO-045 Storage Tank	Outfalls 045, 088	2023	4 or less		

Table 2.2
CSO and Stream Monitoring

Site ID	Location	Receiving Stream	Rationale	Real-time Discharge	Water Quality	Monitoring Frequency (during compliance)	Monitoring Protocols
Easterly System CSOs							
CSO-001	Easterly WWTP	Lake Erie	Priority CSO Point, CSO Treatment Facility Effluent	x		Continuous	Flow, Level, Velocity, Onset, Duration
					x	During discharge	E.Coli, TSS
CSO-098	North of E. 33rd St. & Lakeside Ave.	Lake Erie	Non-priority CSO within Shoreline Tunnel System	x		Continuous	Flow, Level, and activation
CSO-206	North end of E. 156th St. @ Lake Erie	Lake Erie	Priority CSO within Euclid Creek/Dugway Storage System	x		Continuous	Flow, Level, and activation
CSO-209	West side of Euclid Creek & Lake Shore Blvd.	Euclid Creek	Priority CSO within Euclid Creek/Dugway Storage System	x		Continuous	Flow, Level, and activation
CSO-210	East of Nottingham R. and St. Clair Ave	Euclid Creek	Priority CSO within Euclid Creek/Dugway Storage System	x		Continuous	Flow, Level, and activation
CSO-211	Nine Mile Creek east of Coit Rd.	Nine Mile	Priority CSO within Euclid Creek/Dugway Storage System	x		Continuous	Flow, Level, and activation
CSO-230	Dugway Brook approx. 600-ft from Lakeshore Blvd.	Dugway Brook	Priority CSO within Euclid Creek/Dugway Storage System	x		Continuous	Flow, Level, and activation
CSO-232	East of Eddy Rd. @ Shaw Brook	Shaw Brook	Priority CSO within Euclid Creek/Dugway Storage System	x		Continuous	Flow, Level, and activation
CSO-239	Lakeshore Blvd. @ Euclid Creek	Euclid Creek	CSO currently monitored tributary to the Euclid Creek/Dugway Storage System	x		Continuous	Activation only
CSO-242	E. 142nd St. & Lakeshore Blvd.	Lake Erie	CSO currently monitored tributary to the Euclid Creek/Dugway Storage System	x		Continuous	Activation only
CSO-090	End of Superior Avenue @ Cuyahoga River	Cuyahoga River	Non-priority CSO controlled by Superior Avenue Pump Station Upgrade and Canal Road In-line Storage	x		Continuous	Flow, Level, and activation
CSO-200	North of E. 40th St. & King Ave.	Lake Erie	Priority CSO within Shoreline Tunnel System	x		Continuous	Flow, Level, and activation
CSO-202	E. 55th St. & Lake Erie	Lake Erie	Priority CSO within Shoreline Tunnel System	x		Continuous	Flow, Level, and activation
CSO-204	West of E. 72nd St. @ Lake Erie	Lake Erie	Priority CSO within Shoreline Tunnel System	x		Continuous	Flow, Level, and activation
W. 11th/Superior P.S.	End of Superior Avenue @ Cuyahoga River	Cuyahoga River	Non-priority CSO controlled by Superior Avenue Pump Station Upgrade	x		Continuous	Flow, Level, and activation

Table 2.2
CSO and Stream Monitoring

Site ID	Location	Receiving Stream	Rationale	Real-time Discharge	Water Quality	Monitoring Frequency (during compliance)	Monitoring Protocols
Stones Levee P.S.	W. 3rd at Canal East Side of River	Cuyahoga River	Non-priority CSO controlled by Stones Levee Pump Station Upgrade	x		Continuous	Flow, Level, and activation
CSO-073	Giddings Brook @ Doan Brook NE of Baldwin Rd. & Fairhill Rd.	Doan Brook	Priority CSO within Doan Valley Tunnel System	x		Continuous	Flow, Level, and activation
CSO-221	E. 105th St. & Hough Ave	Doan Brook	Priority CSO within Doan Valley Tunnel System	x		Continuous	Flow, Level, and activation
CSO-222	E. 105th St. & Doan Brook	Doan Brook	Priority CSO within Doan Valley Tunnel System	x		Continuous	Flow, Level, and activation
Westerly System CSOs							
CSO-002	Westerly WWTP	Lake Erie	Priority CSO Point, CSO Treatment Facility Effluent	x		Continuous	Flow, Level, Velocity, Onset, Duration
					x	During discharge	E.Coli, TSS
CSO-067	West of 3870 Rocky River Dr., northwest corner of Kamm's Plaza	Rocky River	CSO currently monitored within Westerly Tunnel System	x		Continuous	Activation only
CSO-069	Upper Edgewater Park, approx. 300 yds. west of beach	Lake Erie	CSO currently monitored within Westerly Tunnel System	x		Continuous	Activation only
CSO-071	Harborview Dr. & W 117th St., behind 11644 Harborview Dr.	Lake Erie	CSO currently monitored within Westerly Tunnel System	x		Continuous	Activation only
CSO-075	River Rd. & Elm St.	Cuyahoga River	CSO currently monitored within Westerly Tunnel System	x		Continuous	Activation only
CSO-076	Center St, & Cuyahoga River	Cuyahoga River	Non-priority CSO controlled by Center Street Storage Tank	x		Continuous	Flow, Level, and activation
CSO-078	Columbus Rd. & Cuyahoga River	Cuyahoga River	Non-priority CSO controlled by Columbus Road Storage Tank	x		Continuous	Flow, Level, and activation
CSO-080	SE of Scranton Rd. @ University Rd.	Cuyahoga River	Priority CSO within Westerly Tunnel System	x		Continuous	Flow, Level, and activation
CSO-082	Under Bridge @ W. 3rd St. & Cuyahoga River	Cuyahoga River	Non-priority CSO controlled by West Third Street Storage Tank	x		Continuous	Flow, Level, and activation
CSO-086	Mary St. east of W. 3rd St. @ Cuyahoga River	Cuyahoga River	Non-priority CSO controlled by Mary Street Pump Station Upgrade	x		Continuous	Flow, Level, and activation
CSO-089	East of W. 3rd St. Pump Station	Cuyahoga River	Non-priority CSO controlled by West 3rd St./Quigley Parallel Storage System	x		Continuous	Flow, Level, and activation
Southerly System CSOs							
CSO-035	Burke Brook @ Cuyahoga River	Burke Brook	CSO currently monitored within Southerly Tunnel System	x		Continuous	Activation only
CSO-036	West of Campbell Rd. & Independence Intersection	Cuyahoga River	Priority CSO within Southerly Tunnel System	x		Continuous	Flow, Level, and activation

Table_2 2_CSO_and_Stream_Monitoring_2010_1110.xlsx

Table 2.2
CSO and Stream Monitoring

Site ID	Location	Receiving Stream	Rationale	Real-time Discharge	Water Quality	Monitoring Frequency (during compliance)	Monitoring Protocols
CSO-038	600' Southwest of E 26th St. & Independence Rd.	Cuyahoga River	CSO currently monitored within Southerly Tunnel System	x		Continuous	Activation only
CSO-040	Kingsbury Run @ Cuyahoga River - North of Jefferson Rd.	Cuyahoga River	Priority CSO within Southerly Tunnel System	x		Continuous	Flow, Level, and activation
CSO-043	East of Intersection of Tarlton Ave. & W. 15th St.	Treadway Creek	CSO currently monitored within Big Creek Tunnel System	x		Continuous	Activation only
CSO-044	North of Intersection of Irving Ave. & South Hills Dr.	Treadway Creek	CSO currently monitored within Big Creek Tunnel System	x		Continuous	Activation only
CSO-045	Northeast of Intersection of Jennings Ave. & Valley Ave.	Big Creek	Non-priority CSO controlled by CSO-045 Storage Tank	x		Continuous	Flow, Level, and activation
CSO-051	Brookside Dr. at mouth of triple culvert	Big Creek	CSO currently monitored within Big Creek Tunnel System	x		Continuous	Activation only
CSO-055	Under Bridge East of Bellaire Rd. & Kensington Rd.	Big Creek	CSO currently monitored within Big Creek Tunnel System	x		Continuous	Activation only
CSO-056	Under Bridge East of Bellaire Rd. & Kensington Rd.	Big Creek	CSO currently monitored within Big Creek Tunnel System	x		Continuous	Activation only
CSO-057	Under Interstate @ Memphis & I-71	Big Creek	Priority CSO within Big Creek Tunnel System	x		Continuous	Flow, Level, and activation
CSO-058	W. 114th St. & Peony Ave.	Big Creek	Priority CSO within Big Creek Tunnel System	x		Continuous	Flow, Level, and activation
CSO-059	Spring Rd. @ Jennings Rd.	Spring Creek	CSO currently monitored within Big Creek Tunnel System	x		Continuous	Activation only
CSO-063	Southeast of Brookpark R. & W. 10th St. Intersection	West Creek	Priority CSO within Southerly Tunnel System	x		Continuous	Flow, Level, and activation
Stream Monitoring							
EM1	Big Creek mile 0.15. Approximately 330 feet downstream of Jennings Road (41.4460, -81.6865)*	Big Creek	Track receiving water conditions downstream of CSO control measures		x	Following significant rainfall events	E. coli
EM2	Cuyahoga River mile 0.25. River left, approximately 200 feet downstream of railroad bridge (41.5002, -81.7100)	Cuyahoga River	Track receiving water conditions downstream of CSO control measures		x	Following significant rainfall events	E. coli
EM3	Doan Brook mile 0.75. Approximately 170 feet downstream of St.Clair Avenue (41.5330, -81.6296)	Doan Brook	Track receiving water conditions downstream of CSO control measures		x	Following significant rainfall events	E. coli
EM4	Dugway Brook mile 0.37. Approximately 200 feet downstream of culvert opening (41.5497, -81.6088)	Dugway Brook	Track receiving water conditions downstream of CSO control measures		x	Following significant rainfall events	E. coli
EM5	Euclid Creek mile 0.55. Approximately 500 feet downstream of Lake Shore Blvd. (41.5833, -81.5594)	Euclid Creek	Track receiving water conditions downstream of CSO control measures		x	Following significant rainfall events	E. coli

Table_2 2_CSO_and_Stream_Monitoring_2010_1110.xlsx

Table 2.2
CSO and Stream Monitoring

Site ID	Location	Receiving Stream	Rationale	Real-time Discharge	Water Quality	Monitoring Frequency (during compliance)	Monitoring Protocols
EM6	Edgewater Beach East (41.4893, -81.7392)	Lake Erie	Track receiving water conditions downstream of CSO control measures		x	Routinely during recreation season	E. coli
EM7	Euclid Beach East (41.5843, -81.5686)	Lake Erie	Track receiving water conditions downstream of CSO control measures		x	Routinely during recreation season	E. coli
EM8	Villa Angela Beach East (41.5851, -81.5677)	Lake Erie	Track receiving water conditions downstream of CSO control measures		x	Routinely during recreation season	E. coli
EM9	Nine Mile mile 0.40. Approximately 325 feet upstream of Lake Shore Blvd. (41.5575, -81.5991)	Nine Mile	Track receiving water conditions downstream of CSO control measures		x	Following significant rainfall events	E. coli
EM10	Ohio Canal at the bridge at Kurtz Broz access road, approximately 275 feet southwest of intersection of Canal Road and East 49th Street (41.4213, -81.6559)	Ohio Canal	Track receiving water conditions downstream of CSO control measures		x	Following significant rainfall events	E. coli
EM11	Rocky River mile 2.40. Approximately 230 feet upstream of Hilliard Road bridge (41.4705, -81.8238)	Rocky River	Track receiving water conditions downstream of CSO control measures		x	Following significant rainfall events	E. coli
EM12	Shaw Brook mile 0.10. Approximately 100 feet upstream of Lake Shore Blvd (41.5554, -81.6018)	Shaw Brook	Track receiving water conditions downstream of CSO control measures		x	Following significant rainfall events	E. coli
EM13	Spring Creek mile 0.30. Approximately 650 feet downstream of CSO 059 outfall (41.4378, -81.6801)	Spring Creek	Track receiving water conditions downstream of CSO control measures		x	Following significant rainfall events	E. coli
EM14	West Creek mile 1.95. Upstream side of Lancaster Road Bridge (41.4148, -81.6655)	West Creek	Track receiving water conditions downstream of CSO control measures		x	Following significant rainfall events	E. coli
EM15	Treadway Creek mile 0.40. Approximately 285 feet east of intersection of Tarlton Avenue and West 15th Street (41.4409, -81.6902)	Treadway Creek	Track receiving water conditions downstream of CSO control measures		x	Following significant rainfall events	E. coli

* Latitude and longitude coordinates are taken from hand-digitized GIS maps and are not surveyed.

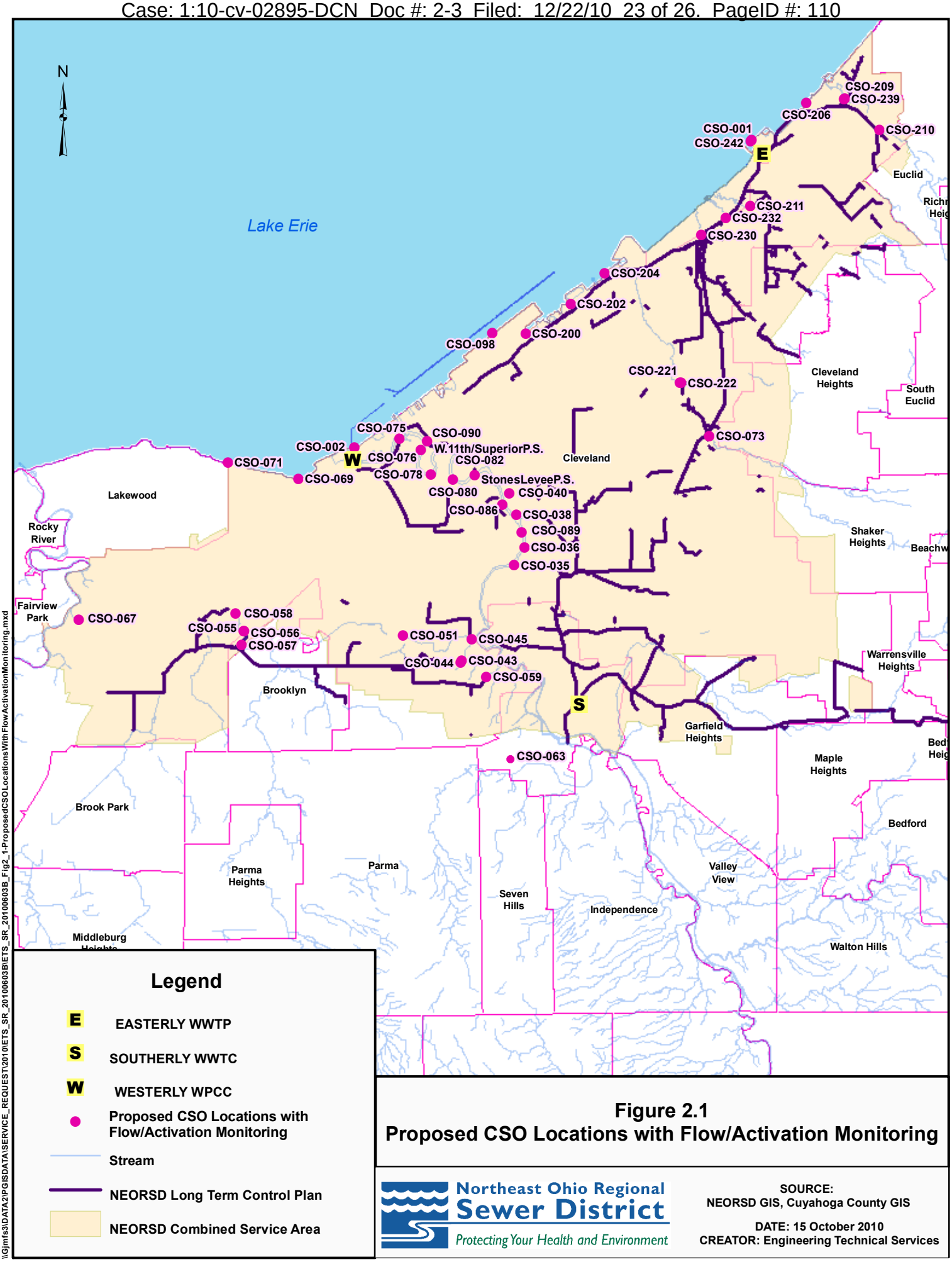

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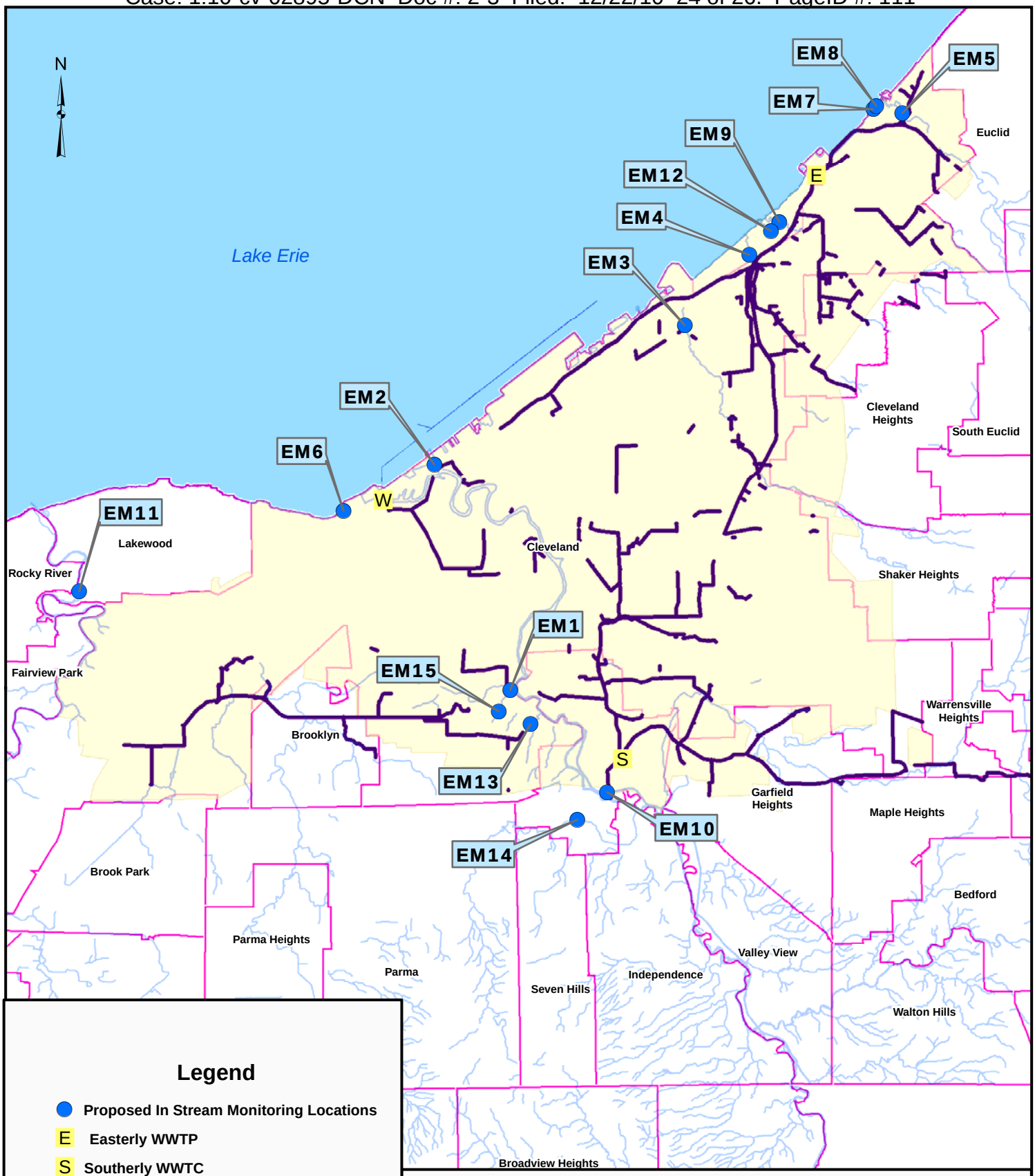
Figure 2.1
Proposed CSO Locations with Flow/Activation Monitoring

Northeast Ohio Regional Sewer District
Protecting Your Health and Environment

SOURCE:
NEORSD GIS, Cuyahoga County GIS

DATE: 15 October 2010
CREATOR: Engineering Technical Services



Legend

- Proposed In Stream Monitoring Locations
- E Easterly WWTP
- S Southerly WWTC
- W Westerly WPCC
- Stream
- NEORSD Long Term Control Plan
- NEORSD Combined Service Area

Figure 2.2
Proposed In Stream Monitoring Locations

Northeast Ohio Regional Sewer District
Protecting Your Health and Environment

SOURCE:
NEORSD GIS, Cuyahoga County GIS

DATE: 05 July 2010
CREATOR: Engineering Technical Services

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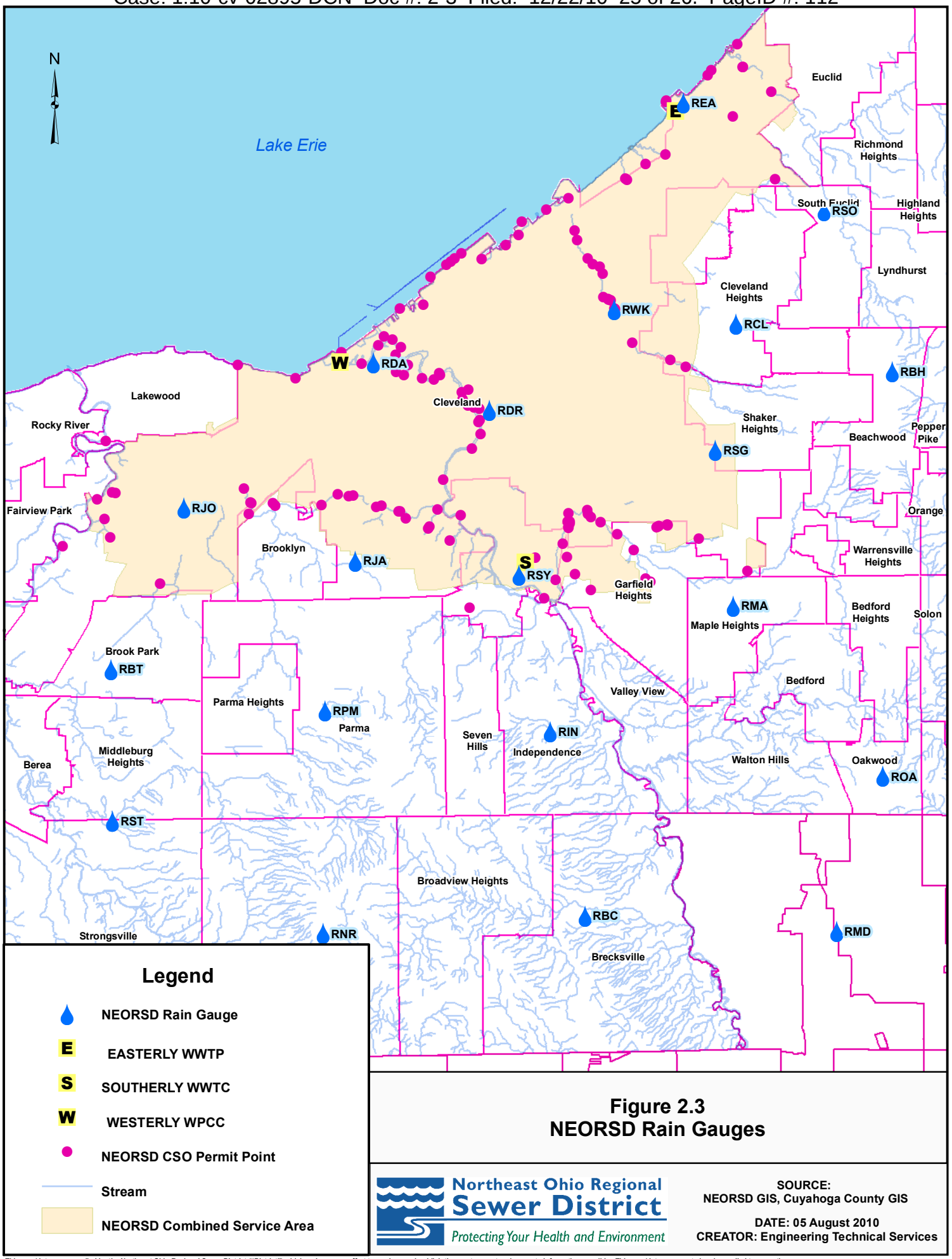

Legend

- NEORSD Rain Gauge
- E EASTERLY WWTP
- S SOUTHERLY WWTC
- W WESTERLY WPCC
- NEORSD CSO Permit Point
- Stream
- NEORSD Combined Service Area

Figure 2.3
NEORSD Rain Gauges

Northeast Ohio Regional Sewer District
Protecting Your Health and Environment

SOURCE:
NEORSD GIS, Cuyahoga County GIS

DATE: 05 August 2010
CREATOR: Engineering Technical Services

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Table C-1. Storm Events for Typical Year Continuous Year Simulation

Storm Number	Date	Hour	Duration (Hrs)	Depth (In)	Average Intensity (In/Hr)	Maximum Intensity (In/Hr))	Storm Number	Date	Hr	Duration (Hrs)	Depth (In)	Average Intensity (In/Hr)	Maximum Intensity (In/Hr)
1	1/3/91	12	1	0.01	0.01	0.01	62	7/3/93	2	1	0.01	0.01	0.01
2	1/5/91	13	10	0.18	0.02	0.03	63	7/4/93	16	1	0.44	0.44	0.44
3	1/9/91	13	2	0.03	0.02	0.02	64	7/6/93	16	1	0.47	0.47	0.47
4	1/11/91	4	19	0.39	0.02	0.09	65	7/11/93	20	3	0.35	0.12	0.24
5	1/12/91	12	21	0.04	0	0.01	66	7/19/93	14	2	0.14	0.07	0.13
6	1/15/91	24	8	0.33	0.04	0.08	67	7/26/93	6	2	0.04	0.02	0.02
7	1/16/91	19	10	0.17	0.02	0.03	68	7/28/93	17	9	1.08	0.12	0.72
8	1/20/91	13	30	0.53	0.02	0.05	69	7/29/93	20	3	0.67	0.22	0.31
9	1/26/91	7	10	0.03	0	0.01	70	8/2/93	5	2	0.42	0.21	0.41
10	1/27/91	19	4	0.08	0.02	0.03	71	8/3/93	21	10	0.42	0.04	0.2
11	1/29/91	20	11	0.37	0.03	0.1	72	8/6/93	19	4	0.1	0.03	0.06
12	1/30/91	18	1	0.01	0.01	0.01	73	8/7/93	13	1	0.13	0.13	0.13
13	1/31/91	14	1	0.01	0.01	0.01	74	8/10/93	16	2	0.02	0.01	0.01
14	2/5/91	7	1	0.01	0.01	0.01	75	8/11/93	4	4	0.24	0.06	0.23
15	2/6/91	15	9	0.1	0.01	0.02	76	8/12/93	17	1	0.02	0.02	0.02
16	2/10/91	15	20	0.73	0.04	0.09	77	8/16/93	4	1	0.07	0.07	0.07
17	2/13/91	14	59	1.53	0.03	0.16	78	8/20/93	9	1	0.01	0.01	0.01
18	2/16/91	24	14	0.18	0.01	0.04	79	8/28/93	2	1	0.06	0.06	0.06
19	2/18/91	15	13	0.08	0.01	0.04	80	8/31/93	13	6	0.03	0.01	0.02
20	2/19/91	17	7	0.29	0.04	0.1	81	9/2/93	8	21	1.02	0.05	0.67
21	2/26/91	4	40	0.08	0	0.01	82	9/6/93	13	1	0.35	0.35	0.35
22	2/28/91	9	4	0.04	0.01	0.02	83	9/7/93	9	1	0.01	0.01	0.01
23	3/2/91	1	14	0.06	0	0.02	84	9/10/93	1	1	0.01	0.01	0.01
24	3/3/91	13	24	0.7	0.03	0.1	85	9/10/93	13	1	0.01	0.01	0.01
25	3/6/91	6	14	0.83	0.06	0.13	86	9/15/93	20	16	2.38	0.15	0.4
26	3/9/91	18	2	0.07	0.04	0.05	87	9/22/93	24	16	0.12	0.01	0.05
27	3/10/91	12	4	0.08	0.02	0.03	88	9/25/93	16	20	1.63	0.08	0.29
28	3/17/91	21	31	0.5	0.02	0.07	89	9/27/93	13	9	0.15	0.02	0.06
29	3/22/91	6	4	0.32	0.08	0.18	90	9/28/93	10	3	0.23	0.08	0.12
30	3/22/91	24	3	0.14	0.05	0.08	91	9/29/93	10	17	0.97	0.06	0.24
31	3/23/91	24	10	0.23	0.02	0.06	92	10/1/93	10	1	0.01	0.01	0.01
32	3/26/91	13	1	0.02	0.02	0.02	93	10/1/93	23	6	0.58	0.1	0.22
33	3/27/91	24	1	0.62	0.62	0.62	94	10/9/93	6	13	0.43	0.03	0.13
34	3/31/91	19	6	0.07	0.01	0.03	95	10/16/93	22	16	0.6	0.04	0.18
35	4/1/93	23	5	0.16	0.03	0.07	96	10/19/93	15	1	0.04	0.04	0.04
36	4/2/93	17	12	0.06	0.01	0.02	97	10/20/93	15	6	0.04	0.01	0.02
37	4/9/93	14	16	0.77	0.05	0.09	98	10/27/93	22	4	0.15	0.04	0.1
38	4/11/93	16	1	0.09	0.09	0.09	99	10/30/93	10	39	1.67	0.04	0.12
39	4/14/93	19	2	0.03	0.02	0.02	100	11/1/91	17	1	0.01	0.01	0.01
40	4/15/93	23	3	0.34	0.11	0.16	101	11/7/91	9	12	0.12	0.01	0.02
41	4/19/93	17	13	0.27	0.02	0.11	102	11/11/91	2	7	0.69	0.1	0.14
42	4/20/93	16	18	0.61	0.03	0.13	103	11/12/91	11	12	0.21	0.02	0.06
43	4/24/93	12	2	0.03	0.02	0.02	104	11/15/91	1	31	0.62	0.02	0.1
44	4/25/93	8	15	0.46	0.03	0.16	105	11/18/91	17	21	0.3	0.01	0.1
45	4/30/93	1	6	0.1	0.02	0.03	106	11/20/91	17	19	0.46	0.02	0.14
46	5/4/93	13	25	0.63	0.03	0.22	107	11/23/91	20	3	0.24	0.08	0.12
47	5/19/93	4	6	0.15	0.03	0.07	108	11/24/91	17	8	0.03	0	0.01
48	5/23/93	16	1	0.01	0.01	0.01	109	11/25/91	14	1	0.01	0.01	0.01
49	5/24/93	6	6	0.08	0.01	0.04	110	11/28/91	6	8	0.19	0.02	0.05
50	5/28/93	24	2	0.03	0.02	0.02	111	11/30/91	6	1	0.04	0.04	0.04
51	5/31/93	23	2	0.16	0.08	0.08	112	12/2/91	16	17	1.19	0.07	0.29
52	6/3/93	23	2	0.07	0.04	0.04	113	12/3/91	21	11	0.06	0.01	0.02
53	6/5/93	5	6	0.37	0.06	0.25	114	12/12/91	15	17	0.16	0.01	0.06
54	6/7/93	16	9	1.56	0.17	0.67	115	12/14/91	7	6	0.15	0.03	0.12
55	6/9/93	10	1	0.21	0.21	0.21	116	12/15/91	16	16	0.07	0	0.01
56	6/9/93	24	1	0.24	0.24	0.24	117	12/18/91	3	2	0.02	0.01	0.01
57	6/19/93	6	2	0.31	0.16	0.22	118	12/18/91	16	16	0.03	0	0.01
58	6/20/93	13	26	0.54	0.02	0.15	119	12/20/91	22	8	0.22	0.03	0.07
59	6/25/93	20	1	0.08	0.08	0.08	120	12/23/91	7	6	0.1	0.02	0.03
60	6/27/93	18	1	0.94	0.94	0.94	121	12/28/91	22	35	0.26	0.01	0.03
61	7/1/93	21	4	0.05	0.01	0.02	Total				37.51		