100 International Drive, Suite 152, Portsmouth, NH 03801
Tel: 603.431.3937

SCOPE OF WORK

City of Rochester
Sewer System Master Plan Scope of Work and Schedule

August 26, 2021

Background

The City is currently operating under an Administrative Order on Consent (AOC) with the US Environmental Protection Agency (USEPA) where the City is required to conduct a Sewer System Master Plan (SSMP) study that will be conducted over the next few years. As required by the Order, the SSMP shall include a description of flow metering and modelling efforts to fully evaluate and reduce sources of inflow and infiltration in the POTW. The City shall report the findings and recommendations of the SSMP in the Nitrogen Reduction Report. The Order states "the City will submit the scope of work to EPA and to New Hampshire Department of Environmental Services (NHDES) for comments by September 1, 2021." This Scope of Work Memorandum reflects that request. This memorandum remains a working document intended to prioritize early-action items so that we are capturing data under the proper conditions, while remaining prepared to adjust course based on financial, technical, or regulatory factors.

As a means of complying with the Order, the City has authorized a Sewer System Master Plan study that will be conducted over the next few years. The project will be divided into several phases to include flow metering, I/I analysis and prioritization, hydraulic sewer modeling, identification and evaluation of sewer system expansion areas, a pump station upgrade prioritization plan, smoke testing, manhole inspections, and Closed-Circuit Television Inspection (CCTV) of the sewer system. Currently the City has authorized Task Order 2021-01, the first of several phases of the Sewer System Master Plan. The first task order includes the initial investigation efforts for Flow Metering, and subsequent I/I Control and Prioritization Plan and I/I Analysis.

Initial Scope of Services (Spring - Fall 2021):

General:

A. Flow Metering

Coordinated and implemented a flow metering program to gather information on sanitary sewage flows, infiltration flows, peaking factors, and runoff impacts from rain events (inflow). This information, along with rain gauge information, informs the development of residential, commercial, and industrial flow hydrographs and various storm hyetographs of rain intensity versus rain duration.

The information obtained during the flow metering program provides real-time flow and depth parameters within the system for use in calibrating a Base Model to be performed in subsequent phases. Ideally, the objective of the flow metering program is to capture several flow scenarios for evaluation. The challenging flow component to capture is inflow from rain events, as the frequency and intensity of the rain events will vary or could be limited during the flow metering period.

Established a flow metering program conducted during the spring and summer of 2021 with the installation of 21 flow meters in addition to the two (2) currently installed city owned meters. Flow meters were installed approximately every 9,000-28,500 linear feet of gravity sewer, to align with proposed sewer catchments to be used in subsequent tasks, with additional flow meters installed in complex or critical areas. Initiated and managed the flow metering program for 11 weeks as engineering guidelines recommend and based on conditions encountered. This metering period provides an opportunity to collect valuable data during the spring high groundwater period for the infiltration component. This period is expected to also collect inflow data from spring storm events.

As part of the flow metering program and schedule, select existing groundwater monitoring data local to the project area and rain gauge sites were determined to collect groundwater levels and capture rainfall data.

B. Data Analysis

Analyze the data collected to locate and identify specific I/I sources in the sewer system. Estimate peak flow rates, average flow rates and yearly total volume for each source. Categorize the flow from each source by component, recommend the appropriate method to eliminate the infiltration and/or inflow and decide as to whether removal is cost effective or not.

Evaluate data to identify specific sources of inflow and infiltration, categorize the flow into various components.
Analyze data for regular flow patterns during dry and wet weather.
Calculate peak, minimum, and average infiltration rates and the yearly total volume.
Determine direct and delayed total yearly inflow volume.
Calculate peak, minimum, and average inflow rates and the yearly total volume.
Determine peak, minimum, and average sanitary flow rates and the yearly total volume.
Perform a cost effectiveness analysis considering capital cost, maintenance cost and annual operation cost.

Data Analysis Deliverables:
A summary of the data collected, methodology used to collect the different types of data, what data was used for in the analysis and the methodology of the analysis.
Electronic file of all field data including raw and edited version of flow meter data.
Electronic files of all reports.

The analysis shall include a study that culminates in the completion of a report suitable for use as an Infiltration/Inflow (I/I) Control and Prioritization Plan and an I/I Analysis.

Scope of Work:

1. Subarea Delineation & Preliminary Field Investigations

1.1 Based on the assumed roughly 500,000 linear feet (lf) of gravity sewer, existing GIS records were utilized, as well as general system maps, to delineate subareas of approximately 9,000-28,500 lf each. This resulted in 23 subareas, this depended on pump station/force main locations and other delineation factors.

1.2 Given the 23 subareas that make up the City's existing wastewater collection system, 21 meters in addition to the two (2) currently installed city owned meters were utilized to isolate various areas of the city. Other areas will be estimated using pump station operating data depending on the size and location of the subarea.

1.3 Conducted field investigations to open sewer manholes and confirmed connections to the existing sewer manholes and direction of the wastewater flow. Updated existing mapping with the information obtained under this task and implemented a nomenclature system for known sewer GIS infrastructure, agreed upon by the City.

2. Flow Metering

2.1 There are 23 subareas and /or catchments that make up the City's existing wastewater collection system. Utilized up to 21 meters in addition to the two (2) currently installed city owned meters to isolate various areas of the city.

2.2 Utilized a flow metering subconsultant to provide all labor, materials, and equipment required to furnish, install, calibrate, maintain, and monitor the 23 total temporary installations of continuous flow meters at various locations. The temporary meters collected depth and velocity data for a period of eleven (11) weeks. Flow monitoring at the meters included a pressure depth sensor and ultrasonic depth sensor with a transit time velocity probe recording at fifteen (15) minute intervals.

2.3 Furnished, installed, calibrated, maintained, and monitored five (5) temporary rainfall gauges installed in the city. The gauges utilized are remote tipping bucket style rain gauges. Data collection included the recording of rainfall in one-tenth of an inch increments during the eleven (11) week monitoring period. This task was conducted in conjunction with the flow meter installation.

3. Flow Metering Analysis

3.1 Perform an analysis of the meter data to estimate flow and I/I quantities. The analysis shall include a study that culminates in the completion of a report suitable for use as an Infiltration/Inflow (I/I) Control and Prioritization Plan and an I/I Analysis and will provide estimates of separate infiltration and inflow contributions per subarea. Summaries will also be provided by subarea showing the gallons per day per inch-mile (GPDIM) of infiltration and inflow.

4. Reporting

4.1 Draft a letter report summarizing the flow metering results. The report will identify areas that appear to contribute excessive I/I and provide estimates of peak I/I and estimates of average annual I/I. The report will include detailed conclusions and recommendations and will rank all subareas based on their estimated inflow and infiltration (separate rankings for each).

4.2 Review the flow metering results, as provided to the city, and other pertinent information to develop an understanding of the qualification and quantification of I/I in the sewer subareas. Based on review of the

data, develop recommendations for future investigations and incorporate this into an I/I Control and Prioritization Plan and I/I Analysis Report suitable for submittal to the EPA and NHDES for review in accordance with the AOC.

Subsequent Phases/ Scope of Services (Beginning Fall/Winter 2021)

The following subsequent scope of services is a general outline of proposed services that are considered major tasks associated with the SSMP along with a preliminary schedule. The Scope of Work may be subject to changes due to the findings, data analysis and results of the Flow Metering and I/I Control and Prioritization Plan.

General:

1. Map Development

Utilizing the city's existing GIS data and base plans, develop mapping for the project. Update mapping features such as structure location, structural connectivity, flow direction, pipe sizes, and missing manholes or invert information in accordance with information obtained during field investigations. An updated electronic version of the map will be delivered at the conclusion of each major SSMP component.

2. Inventory of Existing Conditions/Data Collection

Prepare an Inventory of Existing Conditions to gather available information on the sewer system. Review available existing reports and record drawings, collect institutional knowledge from city relative to historic problem areas or known areas of surcharging, areas understood to have limited or no remaining hydraulic capacity, locations and data from permanent flow meters, and other items to gather information about the sewer system.

3. Sewer System Evaluation Survey (SSES) Investigation Plan Development

Based upon review of the existing information collected in Tasks 1 and 2, prepare a plan to identify I/I sources. Elements of the SSES program may include alternative technologies and some or all of the following components:

- Develop a field investigation plan detailing each of the methods to be used and catchments warranting additional study. The plan shall include a schedule for implementing the various SSES components and the logic for selecting the components for each catchment.
- Prepare a public information program consisting of door hangers, direct mailing and web based to inform residents, businesses, and other stakeholders in the survey area about the project and scheduled field work.
- Incorporate the flow metering program into the SSES and consider the need for future flow isolation, to be conducted during high groundwater conditions.
- Based on the results of previous tasks, propose a future CCTV inspection program.
- Evaluate and propose alternative methods to identify infiltration and inflow entering the wastewater collection system. The methods may include sound testing and electronic scanning.
- Propose a comprehensive field investigation program by catchment area, to locate and determine the specific sources of I/I entering the sewer system. The field investigation program will likely include some combination of manhole inspections, building and site

inspections, dye testing, smoke testing, flow isolation, CCTV inspection program and alternative methods.

4. Sewer Modeling Purpose and Goals

The sewer model objectives are the development and delivery of an operational, calibrated and verified sewer model of select portions of the city's sewer system. The model shall also focus on the inclusion and analysis of existing sewer pump stations. The end goal is the creation of a fully functional calibrated sewer model for the city to build upon and use as a powerful tool to develop design solutions to mitigate peak flows in the sewer system and analyze impacts of development on capacity.

5. Hydraulic Sewer Modeling

Anticipated modeling scope items may include the following:

A. Model Network System Data Collection

Import city GIS into model program.

Identify system connectivity / protocol issues. Issues are defined as system data that does not meet modeling software protocol.

B. Quality Assurance/Quality Control (QA/QC) and Discrepancies:

Provide the model of the combined system, containing all node and conduit features, for review throughout the project and track unresolved discrepancies with a running list to be maintained for discussion and potential edits to the GIS.

C. System Sanitary Flow Component:

Existing sewer system flow components in the Rochester project area consist of:

- Base Sanitary Flow
- Base Infiltration Flow
- RDII – Rainfall Derived Infiltration & Inflow

Preliminary estimate of these flow components will be estimated by reviewing system recordings at all Pump Stations and the WWTF. This information will be used in conjunction with the Flow Metering Program.

D. Model Calibration

Model calibration is a means to confirming the validity and integrity of the data within the model. If the data in the model does not generate flow rate and hydraulic grade line results similar to those observed and documented in the real-world system, then the model is not ready for future utilization by the city. Model calibration requires the modification of model input data as necessary to generate model results.

The objective of calibration is to match model results with those observed in the system though previous investigations such as the flow metering results and supplemental field observations by Weston & Sampson and City Staff.

E. Sewer Model Deliverables

There will be several means of correspondence regarding changes and edits required in the model as the city obtains the missing information required for the model. All documentation will be cataloged for future reference. We will develop a technical memorandum on the model creation process outlining model data and features utilized during the project.

6. Smoke Testing

Conduct smoke testing in select catchments based on the results of the flow metering to identify and document existing connections and identify illicit connections upstream of the sewer system. Smoke testing shall include performing reconnaissance of private and public properties in search of inflow sources revealed by leaking smoke and recording testing results.

Subsequent tasks following the initial smoke testing include determining the estimated drainage areas for each inflow source identified and developing field sketches of the approximate location of each identified inflow source.

7. Dyed-Water Testing/flooding

Perform dyed-water testing/flooding, as necessary, in order to confirm inflow connections identified through smoke testing. Dye testing/flooding involves the introduction of dyed water into a suspected inflow source and the observation of surrounding sewer and drain lines for the emergence of dye. Appearance of dye in the sewer system indicates that the inflow source is connected to the sewer. Perform CCTV inspections in coordination with dye testing/flooding as necessary.

8. Identification and Evaluation of Sewer System Expansion Areas

Evaluate, delineate, and quantify potential areas of sewer system expansion across the city. Incorporate expansion possibilities, and how they may impact the existing sewer system, pump stations, and the WWTF, into the plan. Work will include gathering existing information on potential sewer system expansion areas, water meter data, Planning Department build-out analysis data for subject areas and previous reports relative to WWTF flow and load projections.

9. PS Upgrade Prioritization Plan Update

Evaluate all pump stations for capacity and condition. Based on this evaluation, develop a prioritized set of recommendations for pump station upgrades, including a review of the previously prepared PS Upgrade Prioritization Plan. This update can be expected to include project implementation details such as scope, schedule, and planning level cost estimates.

Review all existing data provided by the city and perform any additional assessment of the pump stations as deemed necessary and agreed upon. It is anticipated that this effort shall include field conditions assessment of the pump station buildings, equipment, dry wells, piping/valves, wetwells,

and perhaps be expanded to assess force mains, to determine condition and operational/failure risk. This work may include the evaluation of materials (i.e., piping, concrete, coatings, steel, asbestos pipe corrosion testing, etc.).

10. Draft & Final SSMP

Incorporate all of the above tasks into a report that also seeks to revisit prior reports, such as the interceptor/Siphon 16B Basis of Design Report and consider modifications or adjustments to these capital plans and report conclusions. This is expected to include several additional sewer model scenarios, and consider overall impacts to the WWTF, compliance with the Great Bay Total Nitrogen General Report, and Administrative Order of Consent and associated, separate, Nitrogen Reduction Report.

The details of the report, and how it is best presented over the course of the SSMP, should be discussed so the city receives report deliverables in a timely and useable manner.

11. Project Meetings & Interim/Progress Reporting

It is expected that regular progress meetings, status reports, and attendance at public or staff meetings shall be required throughout the duration of the SSMP. The frequency of these events and documents shall be commensurate with ongoing activities or city fiscal or regulatory requirements.

SSMP Conceptual Schedule:

Based on the above, please find the below overall conceptual schedule for the SSMP major scope items.

Spring/Summer2021:

- Sewer System Subarea Map Development
- Flow Metering Program

Summer/Fall 2021:

- Flow Meter Data Analysis
- I/I Control and Prioritization Plan and I/I Analysis Report based on Flow Metering

Fall / Winter 2021-22:

- Perform Select PS Evaluations Based on Available Funding
- Perform Select Sewer System Expansion Area Studies Based on Available Funding

Spring 2022:

- CCTV Sewer Assessment & Flow Isolation (initial investigation)
- Manhole Inspections (initial investigation)

Summer 2022:

- Smoke Testing (initial investigation)
- CCTV Review
- Dye Testing & Flooding (as appropriate)
- Perform Select PS Evaluations Based on Available Funding

- Perform Select Sewer System Expansion Area Studies Based on Available Funding

Fall 2022:

- Smoke Testing Reporting
- CCTV Reporting

Spring 2023:

- CCTV Sewer Assessment & Flow Isolation (follow-up investigation)
- Manhole Inspections (follow-up investigation)
- Sewer System Status Map Development
- Sewer System Mapping Discrepancy Resolution (locating, invert collection, & associated manhole inspections)
- Finalize GIS Mapping

Summer 2023:

- Smoke Testing (follow-up investigation)
- Dye Testing & Flooding (as appropriate)
- Sewer Model Development and Calibration (select system components)
- CCTV Review
- Complete PS Evaluations and Update Prioritization Report
- Complete Sewer System Expansion Area Study

Fall 2023:

- Smoke Testing Reporting
- CCTV Reporting

Winter 2023-2024:

- Revisit & Update Siphon BODR
- Run Sewer Model Scenarios

Spring 2024:

- SSMP Development, including Capital Project Development & Prioritization
- CCTV Sewer Assessment (if deemed necessary following above)

Summer 2024:

- Draft SSMP & Present to Stakeholders
- CCTV Review & Reporting (if deemed necessary following above)

Fall 2024:

- Finalize SSMP