

COMPANY PROFILE

Flow Assessment Services, LLC is a wastewater collection system company providing services in the field of sewer system evaluation and flow monitoring. We provide the following services:

- Open Channel Flow Monitoring
(Both temporary and permanent)
- Closed Pipe Flow Monitoring
- Telemetry Systems
- Manhole Inspections
- Flow Isolation
- Smoke Testing
- Dye Water Testing/Tracing
- Mapping Services

The Flow Assessment Services team of experienced personnel have over two hundred years of combined experience performing wastewater collection system studies. All of these studies have been performed within the New England and the mid-Atlantic states, so our local experience is sizeable. Our companies' principals and project managers have considerable technical expertise and unique problem solving skills. Their many years of field experience and dedication to a job well done are second to none in our industry. In addition, they all hold a Grade IV Wastewater Collection System Operations certification.

Our philosophy is and always will be to build long-term relationships within our industry by providing to the client, accurate, professional and cost efficient services.

As a sub consultant to professional engineering firms and municipalities throughout the Northeast United States, we understand our role is to deliver accurate, timely data in a format most useful to the client. Our customized field data acquisition and management software allows us to provide our clients with accurate information even though each system we enter is diverse and has its own unique problems. Besides our software capabilities, our up to date field and office equipment provides our staff with the latest and most modern equipment available. All our survey vehicles are furnished with OSHA approved equipment. This not only assures the safety and efficiency of our field crews, but it also illustrates to the client and owner that Flow Assessment Services is serious about safety. In addition to the safety equipment, we own:

- Fully furnished field survey vehicles.
- A large inventory of electronic depth and velocity flow meters. (Both American Sigma and Isco).
- Several smoke testing units utilizing both the liquid smoke system or the smoke candles system.
- Dye testing units used for the efficient testing of roof drain, area drains or catch basins.
- Numerous pneumatic plugs used for dyed water flooding and flow isolation.
- Numerous hand held weirs used during flow isolation.
- Hand held velocity meters to confirm the proper operation of the depth and velocity flow meters.

**KEY
PERSONNEL
RESUMES**

GEORGE HARRINGTON

Managing Partner
Flow Assessment Services, LLC

PROFESSIONAL AFFILIATIONS

Member of the New England Water Environment Association
Member of the New York, Pennsylvania, and New Jersey Water Pollution Control Associations

Certifications

Grade IV wastewater collection system operator

Summary

Mr. Harrington has over 25 years of project management experience in wastewater flow monitoring of both combined and separate collection systems. In 1987 after leaving a national firm, joined Utility Pipeline Services as a key project manager and client officer. His specialty included all aspects of sewer system operation & management with a specialty in large diameter pipe flow monitoring and CSO quantification. In 2000, after the acquisition of Utility Pipeline Services by a National Firm, Mr. Harrington was named VP of Operations for its entire Northeast region. During that period, he was responsible for directing company efforts to focus more on long term flow monitoring and CSO flow management. In addition, he was responsible for the overall business development and administration of numerous key projects for the company. A large portion of his responsibilities dealt with establishing a quality control program used by field project managers on large multiple site flow monitoring projects. Mr. Harrington is a managing partner and co-founder of Flow Assessment Services LLC.

RELATED PROJECT EXPERIENCE

LACKAWANNA COUNTY, (SCRANTON AREA) PENNSYLVANIA CSO CHARACTERIZATION STUDY

Mr. Harrington served as Project Administrator for this major study. The study area encompassed 6 wastewater treatment facilities and 23 different municipalities. Challenges of this project were of both geographic as well as terrain. Most of the CSO regulators were in cross-country areas, unmapped and inaccessible by street vehicles. Inspection teams often had to resort to non-conventional methods of locating overflows in areas overgrown with brush and trees by forcing smoke into upstream accessible sewers to trace easement manhole locations. Maps and plans of the collection systems were either poor or non-existent, especially in areas of multiple jurisdictional boundaries.

After meter site selection was accomplished, a network of over 70 meters was used to quantify interceptor and CSO flows. Rain data from gauges also installed for the project provided excellent correlation between CSO activity and rainfall events in each geographic area established boundary.

NEWARK, NEW JERSEY COMBINED SEWER OVERFLOW STUDY

Flow monitoring in large, old, combined sewer collection systems requires both caution above and below ground. This project involved monitoring at 62 locations of both combined sewer overflows as well as smaller separated tributary lines throughout the city. Obstacles of working in areas often deemed unsafe by local public safety authorities created an entirely different problem for field crews, further complicated by the fact that much of the work had to be accomplished in the nighttime hours to accommodate heavy traffic or flow issues. Work in trouble areas often required scheduling multiple personal & vehicles as well as coordination with local police precincts. Newark engineering department officials extended the monitoring portion of the project for several years to further characterize the system and verify flows for billing purposes.

HARTFORD, CONNECTICUT MDC COMBINED SEWER OVERFLOW MONITORING

This project involved working directly with the Hartford Metropolitan District Commission operations/engineering staff. During a previous contract, a network of over 50 flow monitors were installed and needed both calibration & servicing. Over a period of two weeks, several field crews moved meter locations and brought the system up to 100% operation. Crews under the direction of Mr. Harrington continued operating the system for an additional two years and monthly CSO reports were prepared and presented to state regulatory officials. This overflow monitoring served as the impetus for the elimination of 35 combined sewer overflows during that period. An additional contract extension was executed which also included the training of a select team at the MDC to maintain and operate the system in house. Software was also developed and provided that allowed the MDC to also take over data management.

FALL RIVER, MA CSO & SEPARATED SYSTEM FLOW MONITORING

With a strong enforcement action threatening the city, a program to monitor CSO activity was started with an emphasis on eliminating dry weather overflows. All regulator structures were inspected and a plan to modify those contributing to dry weather overflow activity was developed and implemented. A network of 40 meters were installed to document overflow activity as well as flow quantification in key interceptor locations. Due to the topography of the city, often times pipe flow velocities would exceed ten feet per second creating both a hazard for field crews, as well as difficulty in monitoring those areas. Mr. Harrington developed methods for each location that allowed field crews to focus their efforts in areas of questionable site characteristics resulting in more accurate data and an overall flow balance program that further confirmed proper operation of the meters.

PAUL R. CASEY

Managing Partner
Flow Assessment Services, LLC

PROFESSIONAL AFFILIATIONS

Member of the New England Water Environment Association
Member of the New Hampshire, Massachusetts, and Connecticut Water Pollution Control Associations

Certifications

Grade IV wastewater collection system operator

Summary

Mr. Casey has over 25 years experience in the wastewater collection systems industry. During this period, he co-founded Utility Pipeline Services, Inc. that, in 1998 was sold to a National Firm, specializing in water and wastewater treatment. Acting as president and operations manager grew the company into the regions largest collection system management company securing many long-term, multiple year projects. Duties included overall day-to-day management of a twenty-four person staff.

Mr. Casey is a managing partner and co-founder of Flow Assessment Services LLC.

RELATED PROJECT EXPERIENCE

BOSTON, MASSACHUSETTS CSO MONITORING PROGRAM

Mr. Casey served as the Principal in charge of long-term CSO monitoring program in Boston, MA. The project required a total of 106 stormwater outfalls to be visited and inspected throughout the Boston Metropolitan Area. Discharges were sampled and evaluated on site by means of a portable test kit. Phase II of this project required six sites to be tested which included the installation of automated flow monitors, flow proportional flow samplers, and continuous recording rain gauges. The sampling and monitoring program continued for a period of 4 months. All the data gathered was summarized and presented in report format.

HARTFORD, CONNECTICUT LONG TERM CSO MONITORING PROGRAM

Mr. Casey served as the Principal in charge for this temporary CSO monitoring project. This project required the installation of calibrated continuous flow meters at over 50 sites to monitor the time of occurrence, duration, and quantity of combined sewer overflow discharge. For a period of two years, the meters were maintained and periodically relocated to different combined sewer overflow locations within the Hartford, CT system. Flow data reports were presented to the client on a monthly basis. These reports have served as the impetus for the elimination of 35 combined sewer overflows to date.

LYNN, MASSACHUSETTS LONG TERM CSO MONITORING PROGRAM

Mr. Casey served as the Principal for this I/I analysis. One hundred and thirty flow monitoring weeks of data was collected and analyzed. 131,669 linear feet of sewer was flow isolated. The limited inspection (no manhole entry) of 633 manholes was performed during high groundwater conditions as was the TV inspection of 32,542 LF of sewer. All data collected and analyzed was submitted in a final report. The report served as a means for the consultant and the City of Lynn to implement a comprehensive rehabilitation program for the system.

ADDITIONAL EXPERIENCE

Selected in 1984 by the State of Massachusetts Department of Environmental Quality Engineering, Division of Water Pollution control to represent the wastewater contracting industry. The 15 member board developed and integrated management plans for the removal of infiltration/inflow from the MDC Collection system and its 43 member communities. The board was formed as a result of the *Quincy, MA vs. MDC-MA* suit and the resulting order to clean up Boston Harbor. Selected in 1985 by the State of Massachusetts D.E.Q.E., W.P.C. to participate on a technical advisory group. The group's purpose was to recommend to the State the minimum requirements of communities in maintaining and operating wastewater collection systems. In addition, the group worked to implement an education program for operators of systems, the mandatory licensing of operators and contractors, and guidelines for procedures in sewer rehabilitation. Selected in 1991 by the Massachusetts Department of Environmental Protection to participate in a technical advisory group for the purpose of revising and streamlining the guidelines for performing Infiltration/Inflow Studies. The revisions were published in 1993.

BRIAN F. HARRINGTON

Senior Project Manager
Flow Assessment Services, LLC

PROFESSIONAL AFFILIATIONS

Member of the New England Water Environment Association, and a member of the New Hampshire and Massachusetts Water Pollution Control Associations

Certifications

NEWEA certified Grade IV wastewater collection system operator and is certified in confined space entry

Summary

Mr. Harrington currently serves as senior project manager for Flow Assessment Services. He also serves in the capacity as manager in charge of “special projects”.

With his 30 years of hands-on field and management experience in wastewater collection systems, he is especially qualified to manage projects that require his special skills and problem solving abilities. His experience with sewer evaluation surveys, infiltration/inflow studies, combined sewer overflow studies and flow meter installations, both temporary and permanent is unprecedented.

RELATED PROJECT EXPERIENCE

AUGUSTA, MAINE CSO DISCHARGE REDUCTION AND MONITORING PROJECT

Mr. Harrington acted as on-site project manager in the field and managed the installation and the calibration of continuous meters at eleven sites to monitor the time of occurrence, duration, and quantity of combined sewer overflow discharge. The meters were in operation over a five month period recording combined sewer overflow events during both spring runoff and low groundwater summer conditions. Reports presenting the results of the metering and summarizing the combined sewer overflow discharge events were prepared and submitted to the client. This initial five month monitoring period established the ground work for the August Sanitary District to continue a flow monitoring program on their own.

ALLSTON-BRIGHTON SECTION OF BOSTON, MASSACHUSETTS SSES PROGRAM

Mr. Harrington acted as on-site project manager for this project and participated in the flow monitoring, inspection and smoke testing portion of the study. The project consisted of the installation of 13 continuous flow meters for a 10 week period. Smoke testing was conducted on approximately 90,900 linear feet of sanitary sewer line. As part of a downspout disconnection program, exterior inspections were conducted on 3,854 buildings. In addition, dye water testing was conducted on approximately 1,280 downspouts to confirm the point of discharge. Reports presenting the results were prepared and submitted to the client.

FALL RIVER, MASSACHUSETTS CSO REDUCTION AND MONITORING STUDY

Mr. Harrington acted as project manager for this project. The study area consisted of seventeen combined sewer overflow structures that were rehabilitated to significantly reduce dry weather sewer overflow discharge. At ten of these sites, sharp crested weirs were constructed and continuous depth meters were installed and calibrated to monitor the time of occurrence, duration and quantity of combined sewer overflow discharge. The meters were in operation for approximately two years. Reports presenting the results of the metering and summarizing the combined sewer overflow discharge events were prepared and submitted to the client.

PORTSMOUTH, NH TEMPORARY AND PERMANENT FLOW MONITORING STUDY

As field manager for this study, Mr. Harrington directed the installation, calibration, maintenance and data collection of 12 temporary flow meters and 3 permanent flow meters. Mr. Harrington was also involved in providing telemetry to the permanent flow meters.

BURLINGTON, MASSACHUSETTS FLOW MONITORING OF LARGE DIAMETER SEWERS

Mr. Harrington was the project manager for the flow monitoring phase of this project, which involved the installation, calibration, maintenance and data collection of 18 temporary flow meters.

WORCESTER, MASSACHUSETTS FLOW MONITORING OF LARGE DIAMETER SEWER LINES AND COMBINED SEWER OVERFLOWS

Mr. Harrington was the project manager for the flow monitoring phase of this project, which involved the installation, calibration, maintenance and data collection of 20 temporary flow meters. Most of the flow monitoring sites were in large diameter pipes and/or diversion chambers requiring multiple sensors to accurately determine flows and overflows.

NASHUA, NEW HAMPSHIRE COMBINED OVERFLOW PERMANENT MONITORING

Mr. Harrington was the project manager for this flow monitoring project, which involved the installation, calibration, maintenance and data collection of 9 permanent flow meters. The flow monitoring sites were in large diameter pipes and/or diversion chambers requiring multiple sensors to accurately determine flows and overflows.

STONY BROOK SECTION OF BOSTON, MASSACHUSETTS INFLOW SOURCE IDENTIFICATION PROGRAM

Mr. Harrington participated in the flow monitoring, inspection and smoke testing on this project. The project consisted of the installation of 21 continuous flow meters for an 8 week period. Smoke testing was conducted on approximately 206,000 linear feet of sanitary sewer line. As part of a downspout disconnection program, exterior inspections were conducted on 8,300 buildings. In addition, dye water testing was conducted on approximately 2,700 downspouts to confirm the point of discharge. Reports presenting the results were prepared and submitted to the client.

TERRY BARTLE

Senior Project Manager
Flow Assessment Services, LLC

Certifications

NEWEA certified Grade IV Wastewater Collection System Operator
Certified in confined space entry

Summary

A working field manager, Mr. Bartle has over 25 years of hands-on field and management experience in the field of wastewater collection system flow monitoring, combined sewer overflow studies, sewer system evaluation surveys, and flow meter site/meter assessment. He has extensive experience in both short and long term monitoring programs with proficiency in the installation of telemetry wire and wireless systems.

At the request of American Sigma, a significant manufacturer of flow monitoring equipment in the industry today, Mr. Bartle field tested and evaluated their 900 Series flow meter prior to its' public release. Based upon his field assessment and subsequent recommendation, the 900 Series meter comprises a large portion of Flow Assessments own in-house inventory of flow monitoring equipment. In addition, he has installed and maintained numerous flow meters such as the Accusonic transit time meter; the Marsh McBirney depth and velocity meter, the Isco depth and velocity meter and the ADS 1500 and 3500 flow meters with numerous flume and ultrasonic depth combinations.

RELATED PROJECT EXPERIENCE

LACKAWANNA COUNTY, PENNSYLVANIA CSO CHARACTERIZATION STUDY

Mr. Bartle served as Project Manager for this temporary CSO monitoring project. The study area encompassed six wastewater treatment facilities and 23 different municipalities. Working closely with Montgomery Watson engineers, a total of 70 flow meters were calibrated and installed throughout the study area. Data was collected on a weekly basis and submitted to Montgomery Watson in monthly reports.

HARTFORD, CONNECTICUT CSO MONITORING PROJECT

Mr. Bartle served as Project Manager for this temporary CSO monitoring project. This project required the installation of calibrated continuous flow meters at over 50 sites to monitor the time of occurrence, duration, and quantity of combined sewer overflow discharge. For a period of two years, the meters were maintained and periodically relocated to different combined sewer overflow locations within the Hartford, CT system. Flow data reports were presented to the client on a monthly basis. These reports have served as the impetus for the elimination of over 70 combined sewer overflows to date.

HOBOKEN, NEW JERSEY CSO MONITORING PROJECT

Mr. Bartle served as Project Manager for this temporary CSO monitoring project. This project required the installation, calibration and maintenance of 28 continuous flow meters. The meters were maintained for a three-month period. All data was analyzed, summarized and presented in monthly interim reports.

BRIDGEWATER, NJ SOMERSET VALLEY SEWERAGE AUTHORITY PERMANENT FLOW MONITORING PROJECT

Mr. Bartle served as Project Manager for a large permanent flow monitoring project in Bridgewater, NJ. This project required the installation of an ultrasonic transit-time flow monitoring/data acquisition system (Accusonics) at one of the Authority's existing flow measurement chambers. The recorded data was uploaded via telephone modem to a central computer installed at the wastewater treatment plant. Phase two of the project, which involved the installation of similar permanent flow metering systems at seventeen additional sites, was also successfully completed. Mr. Bartle has also served as project manager on annual maintenance and calibration contracts for these eighteen meter sites.

NEWARK, NEW JERSEY LONG TERM TEMPORARY FLOW MONITORING PROJECT

Mr. Bartle served as Project Manager for the temporary flow monitoring project in Newark, NJ. This project required the investigation of 52 sites that were selected for flow meter installations or CSO sampling. 62 flow meters were installed and calibrated within the Newark system. The meters were maintained for a period of 12 months. In addition, flow data was downloaded on a weekly basis and delivered to the client for analysis. At the completion of this project, a scaled down, long term phase consisting of maintaining 8 flow meters was initiated, with data downloaded and delivered to the client on a weekly basis.

WASHINGTON, DC POTOMAC INTERCEPTOR CONDITIONS SURVEY, MODELING AND METE STUDY

Mr. Bartle served as project manager for this project in the metropolitan Washington DC area. The work included field inspections of 54 jurisdictional billing meter sites to inventory and evaluate all instrumentation and primary flow measurement devices. The obtained information was entered into a database and used to develop an overall meter management plan. The work also included the installation, operation and maintenance of 8 flow monitors at client designated locations, which operated over the duration of the project to provide verification data for the jurisdictional meter flows.

PHILADELPHIA, PA CSO AND MODELING FLOW MONITORING AND MUNICIPAL PERSONNEL TRAINING

Mr. Bartle served as project manager for this project working with the Philadelphia Water Department. Over a one year period, potential flow monitoring sites were evaluated and flow meters were installed at suitable locations. Some flow meters were removed after sufficient data had been obtained and re-installed in new locations. A total of 22 meter installations were performed with a total of 14 flow meters in operation simultaneously. The flow meters were visited every two weeks to verify proper operations, upload data and obtain calibration data. Continuous on the job training was provided to Philadelphia Water Department personnel on all the above listed tasks over the entire duration of this project. Several two (2) day classroom training sessions were also conducted. The on the job and classroom training enabled the Philadelphia Water Department personnel to take over the flow monitoring tasks and continue to obtain flow monitoring data for use in CSO and modeling studies.

THOMAS A. MITCHELL

Senior Project Manager
Flow Assessment Services, LLC

Certifications

NEWEA certified Grade IV wastewater collection system operator
Certified in confined space entry
Member of NEWEA

Summary

As the senior member of our staff, Mr. Mitchell plays a key role in our team. His responsibilities include training in both safety and field procedures working within collection systems. As the training officer, Tom works with all new recruits for the first three months “make it or break it” period. Tom coordinates all confined space entry training and the proper use of safety equipment. His adherence to strict guidelines in data gathering procedures are a hallmark of Tom’s reputation. Not only versatile in the field for “hands on” project management, Tom also possesses the skills to review, and presentation of field data using our techniques and in house software for final reporting. Tom has over 20 years experience in both flow monitoring and I/I studies.

RELATED PROJECT EXPERIENCE

LYNN, MASSACHUSETTS LONG TERM CSO MONITORING AND SAMPLING PROGRAM

Mr. Mitchell served as field manager for this I/I analysis. One hundred and thirty flow-monitoring weeks of data was collected and analyzed. 132,000 linear feet of sewer was flow isolated. The limited inspection (no manhole entry) of 630 manholes was performed during high groundwater conditions, as was the TV inspection of 32,500 LF of sewer. All data collected and analyzed was submitted in a final report. The report served as a means for the consultant and the City of Lynn to implement a comprehensive rehabilitation program for the system.

PEABODY, MASSACHUSETTS STORM DRAINAGE AND SANITARY SEWER SYSTEM INVENTORY AND MAPPING PROGRAM

Mr. Mitchell served as field manager on the inventory and mapping of the entire Peabody, MA drainage system. Mr. Mitchell was responsible for performing conductivity tests at sites meeting specified parameters and pinpointing areas where sanitary sewage was contaminating storm lines. A total of 4,470 sanitary sewer manholes were inventoried. A physical inspection of the manholes in the Peabody, MA sanitary sewage system was conducted to verify the location of all manholes and the configuration of all entering and exiting sewer lines to prepare an accurate map of the sanitary system. In addition, the structural integrity of the manholes was assessed and sources of infiltration and inflow within the manholes were identified. The results of the physical inventory were an up-to-date, accurate inventory database and map of the Peabody, MA wastewater collection system.

AMESBURY, MASSACHUSETTS FLOW MONITORING AND SSES PROGRAM

Mr. Mitchell served as field manager for this project. A total of 56 flow-monitoring weeks of data was collected. A total of 27,000 linear feet of sewer was flow isolated. In addition, a total of 1,270 sewer manholes were inspected. All data collected and analyzed was submitted in a final report to the Town of Amesbury to implement a comprehensive rehabilitation and maintenance program for the sewer system.

ALLSTON-BRIGHTON SECTION OF BOSTON, MASSACHUSETTS SSES PROGRAM

Mr. Mitchell participated in the flow monitoring, inspection and smoke testing on this project. The project consisted of the installation of 13 continuous flow meters for a 10-week period. Smoke testing was conducted on approximately 90,900 linear feet of sanitary sewer line. As part of a downspout disconnection program, exterior inspections were conducted on a total of 3,850 buildings. In addition, dye water testing was conducted on approximately 1,280 downspouts to confirm the point of discharge. Reports presenting the results were prepared and submitted to the client.

SALEM, MASSACHUSETTS SMOKE TESTING PROGRAM

Mr. Mitchell served as project manager on this project. He was responsible for the successful completion of 350,000 linear feet of smoke testing of sanitary sewer. A report presenting the results was prepared and submitted to the client.

ONONDAGA COUNTY, NEW YORK FLOW MONITORING PROGRAM

Mr. Mitchell served as field manager participating in flow monitoring site analysis, flow monitor installation, calibration, maintenance and data retrieval at 34 selected sites. The project requirements included submitting uploaded flow monitoring and field calibration data to the client on weekly basis.

LYNN, MASSACHUSETTS CSO ABATEMENT PROGRAM

Mr. Mitchell participated as field manager for this project. In this capacity, Mr. Mitchell installed flow monitors and performed weekly maintenance, calibration and data retrieval at 17 flow-monitoring sites. Mr. Mitchell performed surface inspections of approximately 800 combined and sanitary manholes. Mr. Mitchell also performed dyed water testing inspections in selected areas.

ADDITIONAL EXPERIENCE

Mr. Mitchell served as project manager on numerous* small projects interspersed throughout the New England area. He also troubleshoots problem areas and recommends corrective courses of action. Mr. Mitchell monitors, evaluates and repairs all sections gas detectors as required, and evaluates and tests flow monitoring equipment and field gear.

* Taunton, MA, Everett, MA, Holyoke, MA, Medfield, MA, Newburyport, MA, Jaffrey, NH, Quincy, MA, Shrewsbury, MA, Natick, MA, Somerset, MA, Waltham, MA, Sunderland, MA, and Framingham, MA

JOHN P. SOKOL

Senior Data Analyst

Flow Assessment Services, LLC

Certifications

Member of NEWEA

Confined Space Training

NH subsurface system licensed designer

Received Flow meter factory training for: American Sigma/Hach

Isco/Teledyne

Marsh McBirney

Telog Instruments

Received software factory training for: Telog Enterprise Software

Summary

Mr. Sokol has over five years experience in sewer system design and over 14 years of experience in flow meter data reduction and review. It is estimated that he has reviewed and calculated over 30,000 weeks of flow metering data.

As a senior data analyst, Mr. Sokol plays a key role in our team. He is responsible for all flow data management, review and presentation. Mr. Sokol insures that the data is merged into our database from the variety of ways the data is collected, from wireless web connections to phone lines and manual uploads. He also reviews and performs the necessary QA/QC to the data calculations. He likewise posts data for our clients to our near real time web data site.

Due to his involvement with the latest technologies, Mr. Sokol also evaluates flow monitoring equipment. Products are often tailored to our needs through our feedback to manufacturers and we are frequently aware of new cost saving items, months before their release.

RELATED PROJECT EXPERIENCE

LACKAWANNA COUNTY, PENNSYLVANIA CSO CHARACTERIZATION STUDY

Seventy (70) flow meters were calibrated and installed throughout this study area. Mr. Sokol reviewed and produced monthly reports for approximately 700 flow meter weeks of flow data.

HARTFORD, CONNECTICUT CSO MONITORING PROJECT

Fifty (50) flow meters were calibrated and installed to measure combined sewer overflow discharge. The project occurred over a two year period and resulted in the elimination of over seventy (70) combined sewer overflows. Mr. Sokol reviewed, managed and produced monthly reports for approximately 4,000 flow meter weeks of flow data.

HOBOKEN, NEW JERSEY CSO MONITORING PROJECT

This project required the calibration and installation of twenty eight (28) continuous flow meters. Mr. Sokol reviewed, managed and produced interim reports for approximately 400 flow meter weeks of flow data.

ROCKY HILL AND WINDSOR, CONNECTICUT INFILTRATION/INFLOW STUDY

Forty four (44) flow meters were calibrated and installed throughout this study area. Mr. Sokol reviewed, managed and produced interim reports for 350 flow meter weeks of flow data.

WEST HARTFORD AND NEWINGTON, CONNECTICUT INFILTRATION/INFLOW STUDY

This project required the calibration and installation of sixty (60) continuous flow meters. Mr. Sokol was responsible for the review and management of 480 flow meter weeks of flow data. All data was provided to the client in a final report.

GARY C. WELCH

Senior Project Manager
Flow Assessment Services, LLC

Certification

NEWEA certified Grade IV Wastewater Collection System Operator
Certified in confined space entry

Summary

Mr. Welch brings to his position a strong background in the field of wastewater collections systems. With over 19 years of hands on field experience, he is a valued member of the Flow Assessment project management team. While proficient in all phases of a sewer system evaluation study including flow monitoring, smoke testing, manhole inspection and dyed water testing services, he is particularly adept in the area of short and long term CSO flow monitoring with a strong emphasis on telemetry systems. His strong leadership skills and commitment to ensuring the on-time, in-budget completion of each project have earned him the respect of our clients as well as his fellow team members.

RELATED PROJECT EXPERIENCE

NARRAGANSETT BAY COMMISSION - MAINTENANCE SERVICES ON FLOW MONITORING EQUIPMENT

Mr. Welch served as project manager on this project and was responsible for the evaluation and subsequent recommendation of improvements to 14 permanent flow monitoring sites. In addition, Mr. Welch completed the installation and telemetering of flow monitoring equipment at 6 additional permanent flow monitoring sites. Twenty (20) temporary flow monitoring and CSO sites along with maintenance and data collection tasks.

FALL RIVER, MASSACHUSETTS CSO REDUCTION AND MONITORING STUDY

Mr. Welch participated in this study. The study area consisted of seventeen combined sewer overflow structures within the city to significantly reduce dry weather combined sewer overflow discharge. At ten of these sites, sharp crested weirs were constructed and continuous depth meters were installed and calibrated to monitor the time of occurrence, duration and quantity of combined sewer overflow discharge. The meters were in operation for approximately two years. Reports presenting the results of the metering and summarizing the combined sewer overflow discharge events were prepared and submitted to the client.

HOBOKEN, NEW JERSEY CSO MONITORING PROJECT

Mr. Welch participated in this temporary CSO monitoring project. This project required the installation, calibration and maintenance of 28 continuous flow meters. The meters were maintained for a three month period. All data was analyzed, summarized and presented in monthly interim reports.

ALLSTON-BRIGHTON SECTION OF BOSTON, MASSACHUSETTS SSES PROGRAM

Mr. Welch was involved in the flow monitoring, inspection and smoke testing on this project. The project consisted of the installation of 13 continuous flow meters for a 10 week period. Smoke testing was conducted on approximately 90,900 linear feet of sanitary sewer line. As part of a downspout disconnection program, exterior inspections were conducted on a total of 3,854 buildings. In addition, dye water testing was conducted on approximately 1,280 downspouts to confirm the point of discharge. Reports presenting results were prepared and submitted to the client.

BOSTON WATER SEWER COMMISSION INTERCEPTOR FLOW STUDY

Mr. Welch served as project manager for this project. He was responsible for meter equipment installation, telemetry installation, calibration, maintenance, and data collection of 25 flow monitors and 6 rain gauges during the project's 3 year duration.

BROOKLINE, MASSACHUSETTS ILLICIT CONNECTION IDENTIFICATION STUDY

Mr. Welch served as project manager on two separate studies investigating illicit sewer connections into the Longwood and Tannery Brook drainage systems. Flow monitoring, flow sampling, smoke testing, dye testing, and closed circuit television inspection were all used to pinpoint and identify sewage sources contributing to the contamination metro Boston's Muddy River.

HARTFORD, CONNECTICUT CSO REDUCTION AND MONITORING

Mr. Welch was involved in this CSO monitoring project. This project required the installation of calibrated continuous flow meters at over 50 sites to monitor the time of occurrence, duration, and quantity of combined sewer overflow discharge. For a period of two years, the meters were maintained and periodically relocated to different combined sewer overflow locations within the Hartford, CT system. Flow data reports were presented to the client on a monthly basis. These reports have served as the impetus for the elimination of over 70 combined sewer overflows to date.

SPRINGFIELD, MASSACHUSETTS SSES

Mr. Welch participated in the installation, maintenance, calibration and data collection of approximately 160 temporary flow monitors. In addition, Mr. Welch served as field project manager and was responsible for the successful completion of approximately 400,000 linear feet of smoke testing.

LYNN, MASSACHUSETTS, CSO ABATEMENT PROGRAM

Mr. Welch served as field project manager on this study. The work included installation, maintenance and subsequent recommendation of improvements to 14 permanent flow monitoring sites. In addition, Mr. Welch completed the installation and telemetering of flow monitoring equipment at 6 additional permanent flow monitoring sites. Twenty (20) temporary flow monitoring and CSO sites along with maintenance and data collection tasks.

ADDITIONAL EXPERIENCE

Mr. Welch has extensive field experience in CSO monitoring and sampling programs as well as long term monitoring programs using telemetry.

SYDNEY D. RAINES

Data Analyst

Flow Assessment Services, LLC

Certifications

Confined Space Training

Summary

Ms. Raines has over 7 years experience in SSES data review and over 3 years experience in flow meter data reduction and review.

As a data analyst, Ms. Raines plays a key role in our team. She is responsible for all SSES data management, review and presentation. Ms. Raines insures that the data collected from the field is complete and correct. She also is involved with reviewing and performing the necessary QA/QC to various flow monitoring data.

RELATED PROJECT EXPERIENCE

HARTFORD, CT MDC BUILDING INSPECTION PROGRAM

Ms. Raines served as project manager on this project and was responsible overseeing multiple crews during the completion of over 12,000 building inspections throughout 5 towns.

Throughout this project, Ms. Raines worked hand in hand with the client while a new building inspection database was created.

PROJECT DESCRIPTIONS

TAUNTON, MA

ILLICIT CONNECTION STUDY

PROJECT VALUE - \$20,000

During August 2004, personnel from Flow Assessment Services, conducted internal dye testing to determine illicit connections to the storm sewer in the Weir Street area. Water samples gathered at selected locations from storm lines within the study area were transported to the Taunton Wastewater Treatment Plant for fecal coliform analysis.

Notices informing the public of the study were delivered to each building within the affected area prior to the sampling program. After gaining access to the building interior, which often required visits at different times, green or red water dyes were introduced into the toilet fixture and then flushed 3 to 4 times. Personnel downstream of the building monitored both storm and sanitary manholes for the presence of dye. Once the dyed water was observed, the results of the test were recorded.

Of the eighty one (81) structures visited, twenty five (25) tested positive to the storm line, 10 buildings could not be tested as access could not be gained to the interior, one (1) building could not be tested as it no longer existed.

GLOUCESTER, MA

INFILTRATION/INFLOW ANALYSIS

PROJECT VALUE - \$90,000

During the spring of 2004, Flow Assessment Services installed, calibrated and maintained seventeen continuous flow meters within the Gloucester system. The flow meters remained in place for a ten-week period. In addition to the continuous flow meters, twenty-three groundwater gauges and a recording rain gauge were installed and maintained throughout the monitoring period. A tidal meter was also installed to help identify the effects of a high tide on the collection system.

Gloucester is unique due to the numerous pumping stations within its system. Much care was taken during the meter installation phase of the program. Field crews were careful not to install flow meters immediately downstream of the stations. This helps eliminate a “spiking effect” which in many cases masks the infiltration/inflow component of the metered flow.

All flow data was analyzed, summarized and presented in report form. Both digital and hard copy formats were presented to the client.

UXBRIDGE, MA

INFILTRATION/INFLOW ANALYSIS

PROJECT VALUE - \$45,500

This project was divided into two phases. Phase one was initiated during the spring of 2004, and phase two was completed during the summer of 2004.

Flow Assessment field crews installed, calibrated and maintained eight continuous flow meters for eight weeks during the spring phase of this study. In addition to the flow meters, eight groundwater gauges and one recording rain gauge were installed and maintained throughout the monitoring period. The groundwater gauges were checked weekly to assure that groundwater levels were elevated during this phase of the program. The rain gauge data was used to correlate rainfall amounts and intensity with the recorded flow data.

The summer phase of this project consisted of the installation, calibration and maintenance of eight continuous flow meters for a period of two weeks. The client had requested this summer metering program to provide a comparison of infiltration rates during the springtime (high groundwater levels) and the summertime (low groundwater levels). The flow metering provided the client with a baseline flow for the springtime infiltration and a significantly decreased infiltration rate during the summertime monitoring period.

All flow data was analyzed, balanced and presented in report form. Both digital and hard copy formats were presented to the client.

WHITMAN, MA

INFILTRATION/INFLOW STUDY

PROJECT VALUE - \$50,000

Flow Assessment Services recently installed, calibrated and maintained nine continuous flow meters for a ten-week period. A recording rain gauge was also installed and maintained in order to correlate rainfall intensity with the recorded flow data.

All flow data was summarized, balanced and submitted to the client for review. Both digital and hard copy formats were made available to the client. The results of the flow monitoring program will serve as a foundation for additional study work within the Whitman system.

SHREWSBURY, MA

INFILTRATION/INFLOW STUDY

PROJECT VALUE - \$45,000

Flow Assessment Services recently installed, calibrated and maintained ten continuous flow meters within the Shrewsbury system. The project took place during the spring of 2004. A recording rain gauge was also installed and maintained throughout the eight-week duration of the project.

The Shrewsbury project was unique in the following manner. At the request of the client, flow data was reduced, summarized and turned over to the client in a short time span. This allowed the consultant to direct the removal and reinstallation of a portion of the meters to other strategic areas within the system. Coordination between the consultant, field crews and our office staff provided for a successful completion of the project. Both digital and hard copy formats were made available to the client.

Newtown Bucks County Joint Municipal Sewer Authority

Newtown, PA

Installation, Maintenance and Monthly Reporting for Permanent Metering Sites

Project Value - \$40,000

Flow Assessment Services was hired in the summer of 2005 to upgrade nine (9) existing permanent metering sites within the Newtown Authorities system. The flow monitoring chambers had commercial power and telephone modem service at all sites. The primary flow monitoring device at each location is a continuous electronic depth recorder measuring a flume depth, most sites have redundant depth and velocity recorders. On occasion, lightning strikes would disable modems creating maintenance and data recovery issues. The upgrade included the installation of solar panels to eliminate this problem.

The project included the cost to purchase and install all equipment required to upgrade the program to a wireless web based system. After the system was in place, designated users were given password access to view and utilize real time flow data. Flow Assessment is currently providing bi-monthly service visits to all metering sites as well as preparing monthly reports of all data.

Schenectady, New York

Infiltration/Inflow Analysis

Project Value - \$65,000

During the spring of 2006, Flow Assessment Services crews installed, calibrated and maintained eighteen (18) continuous flow meters within the Schenectady sanitary sewer system. In addition to the flow meters, a recording rain gauge was also installed to correlate rainfall events to the recorded flow meter data. The equipment remained in place for an eight (8) week period. Flow data was summarized, balanced and submitted to the client for their review. All data was available in a digital format and accessible on Flow Assessments' Web-based metering data site.

The results of the flow metering program will provide the basis for additional study work within the Schenectady collection system.

New York City

Long Term Control Plan for Combined Sewer Overflows

Project Value - \$360,000

This project was initiated during the summer of 2005. Flow Assessment Services field crews performed many different tasks in selected drainage basins within four of the New York City Boroughs.

A typical drainage basin would first be investigated to determine if the chosen meter sites were acceptable as good monitoring sites. Once the site qualified as acceptable, the meters were installed, calibrated and maintained throughout the course of the study period. This was typically a seven (7) to ten (10) week period. Sketches of the monitoring site structure documented incoming and outgoing pipe sizes and configurations. Any overflow lines and/or weir structures and configurations along with meter sensor locations were also documented. Digital photographs were also taken and submitted to the client for further documentation of the metering site.

Continuous recording rain gauges were installed to correlate rainfall events with the recorded flow meter data.

Weekly flow data reports were submitted to the client and were accessible on our flow data Web site.

In addition to the flow monitoring portion of the study, Flow Assessment Services field crews inspected and provided accurate documentation of various regulator/diversion chambers and sewer connections. Digital photographs were also taken to further document these structures.

All data provided to the client assisted in the calibration of their flow model and with the development of the long term control plan for the City of New York.

WEST HARTFORD & NEWINGTON, CT

INFILTRATION/INFLOW STUDY

PROJECT VALUE - \$160,000

During the Spring of 2005, Flow Assessment field crews installed, calibrated and maintained sixty (60) flow meters for a period of eight (8) weeks. A total of 480 flow monitoring weeks of data was collected, analyzed and presented to the client for their use and review.

In addition to the 60 flow meters, crews installed two recording rain gauges and numerous groundwater gauges throughout the study area to monitoring groundwater levels for the project duration.

The flow data provided the basis for a cost effective analysis which was used to prioritize and further study sub-systems that exhibited excessive infiltration and inflow.

ENFIELD, CT

INFILTRATION/INFLOW STUDY

PROJECT VALUE - \$45,000

Flow Assessment Services installed, calibrated and maintained fourteen (14) flow meters for a period of six (6) weeks in the Spring of 2005. In addition to the flow meters a recording rain gauge was installed within the Enfield study area. Data was collected, analyzed and presented to the consultant for their review. The flow data provides the basis for additional study work with the Enfield system.

ROCKY HILL & WINDSOR, CT

INFILTRATION/INFLOW STUDY

PROJECT VALUE - \$120,000

During the Spring of 2005, Flow Assessment crews installed, calibrated and maintained forty five (45) continuous flow meters within the Rocky Hill and Windsor systems. The flow meters were in place for an eight week period. Flow data was summarized, balanced and submitted to the client for review. All data was available in digital format and accessible on Flow Assessments' Web-based metering data site.

The results of the flow monitoring program provided the basis for additional study work within these collection systems.

MIDDLETOWN, CT

INFILTRATION/INFLOW ANALYSIS 7 SSES

PROJECT VALUE - \$145,000

This project was initiated in the spring of 2004 with the installation of 28 continuous flow meters which remained in operation for a six-week period. In addition to the flow meters, seventeen ground water gauges were installed in preselected manholes to monitor ground water levels throughout the study. A recording rain gauge was also installed and maintained in order to correlate rainfall intensity with the recorded flow data.

All flow data was summarized, balanced and submitted to the client for review. The data provided the basis for a cost effective analysis which allowed the client to prioritize and further study sub systems that exhibited excessive infiltration & inflow.

Flow Assessment field crews also performed nighttime flow isolation @ 450 different locations throughout the Middletown system. These measurements provide the justification for the television inspection portion of the project.

All data was presented in both a digital and hard copy format.

WEST HARTFORD, NEWINGTON, WINDSOR, ROCKY HILL AND WETHERSFIELD, CT

BUILDING INSPECTION

PROJECT VALUE - \$500,000

During the Summer of 2007, Flow Assessment Services, LLC performed building inspections on over 12,000 residential and commercial structures within 5 towns in CT. Notices informing the public of the study were delivered to each building within the affected area prior to the program. After gaining access to the building interior, which often required visits at different times, the field crews entered the basement and inspected its drainage system and sewer locations. After the internal inspection was completed, the field crews would perform an inspection of the exterior of the building searching for locations where storm water could be entering the sanitary.

The data collected was then entered into a database provided by the client.

BELMONT, MA

SMOKE TESTING PROGRAM

PROJECT VALUE - \$70,000

This is an ongoing project, projected at 200,000LF of smoke testing, that was initiated in the fall of 2007. A smoke blower was placed in strategic manholes and smoke produced by a non-toxic and non-staining mineral oil was introduced into the sewer lines. Smoke testing was conducted during the periods of low groundwater and with sufficient time having elapsed from a previous rain event. No testing was conducted unless groundwater was below the pipe and the ground was not frozen. Prior to initiating smoke testing, police and fire officials were notified. Homeowner notifications were distributed prior to initiating smoke testing by means of door-to-door leaflets.

“Suspect” inflow sources, which may be expected to be connected to the sanitary sewer, were recorded along with confirmed sources which actually smoked. These suspect sources included driveway, stairwell, window well, patio and area drains, and/or downspouts piped underground or to the foundation.

A report of the results of the smoke testing including digital photographs and field sketches was provided to the client.

BOSTON, MA – LONGWOOD MEDICAL AREA

SSES PROGRAM

PROJECT VALUE - \$193,125

This is an ongoing project that was initiated in the fall of 2007 with the installation of 10 continuous flow meters which remained in operation for a four and a half week period. A recording rain gauge was also installed and maintained in order to correlate rainfall intensity with the recorded flow data. Field crews calibrated and maintained these meters throughout the metering period.

A river level gauge was also installed, calibrated and maintained by our field crews for a five week period.

All flow data was summarized, balanced and submitted to the client for review. The flow data provides the basis for additional study work with the Longwood Medical Area system.

Approximately 384 manholes throughout the Longwood Medical Area were inspected. Combined Sewer Overflows were identified throughout the program. The field crews performed internal inspections of about 12 manholes to closer inspect defects in the incoming and outgoing line sections. Photographs of every manhole taken from the road surface were included within the report.

Field crews performed building inspections on over 240 residential and commercial structures. Our office staff coordinated with the universities and hospitals within the Longwood Medical Area to allow access to our crews. Notices informing the public of the study were delivered to each building within the affected area prior to the program. After gaining access to the building interior, the field crews entered the basement and inspected its drainage system and sewer locations. After the internal inspection was completed, the field crews would perform an inspection of the exterior of the building searching for locations where storm water could be entering the sanitary.

The crews reinstalled, calibrated and maintained the flow meters, rain gauge and river level gauge again in the spring of 2008 for a total of seven and a half weeks.

This project also involves the dyed water testing of approximately 75 catch basins and 150 sources that were found to discharge to an unknown location during the building inspection. This is in an effort to locate where the storm water discharges to.

Flow isolation of approximately 10,000 LF will be completed within the spring of 2008.

REFERENCES

1. Town of Hooksett
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2. TRUE Wastewater Consulting, LLC
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5. Clough Harbour & Associates
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6. Newtown Bucks County Joint Municipal Authority
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ACCURACY OF THE FLOW METERS/FLOW MONITORING

It is important to recognize when discussing accuracy of a flow meter it usually means the accuracy of flow monitoring. To consider just the issues of the meter alone does not give you the answers needed to make an informed decision. Our over 25 years of experience in wastewater flow monitoring has identified more problems associated with the user rather than the meter, so we will discuss both issues here.

First, we will present the instrumentation manufacturers side of the equation. In general, the portable open channel flow monitoring market is dominated by two manufacturers, American Sigma (Hach Company) and Isco (Teledyne Corporation). In laboratory situations, both claim accuracies within the acceptable verifiable standards of 2-3%. Although American Sigma has tested their equipment in flow labs in both the United States and abroad, we consider both companies to be equal when considering accuracy. Technical data from the manufacturer can be found at their websites at www.americansigma.com or www.isco.com.



Even with that information, we take it one step further, that is, each meter is tested prior to deployment in our “Pipe Flow Simulator” at our facility in Bedford, NH. Both components of open channel monitoring are tested, depths can be simulated to 8 feet in stand pipes and velocities can be varied using slope from as low as 0.1 feet per second to as much as 6.8 feet per second. We have found this “in house” testing to be invaluable as it identifies problems that might not show up until well into the monitoring program.

The second component to consider when evaluating meter accuracy is the deployment and operation. The meter site selected and installation of the equipment easily plays a far greater role in accuracy of flow data than the meter equipment. We call this “operator induced error”. To minimize this it is always best to scrutinize each meter site in the field under real world conditions. Issues such as debris, surcharging, pump stations, capacity and poor flow pattern can be overcome, eliminated or managed by proper site selection. Next comes the installation, here even the best equipment will only give you marginal results if not properly installed. Getting the sensors tightly attached to the wall pipe is mandatory to discourage fowling of the probe and data loss.

Finally, we analyze the data with the regions most comprehensive proprietary software package. This allows us to present flow data on a password-protected web site for our clients. Once inside the site, data review and report printing is easy, fast and efficient. No black magic formulas for deriving flow components, just good engineering equations that allow our clients to engineer proper solutions.

Our approach to accuracy is simple:

- Use the best available equipment
- Provide our crews with the finest installation tools
- Provide our clients with the best trained and most experienced operators
- Test and confirm proper operation

Analyze, Scrutinize and Summarize