BUREAU OF TECHNICAL UTILITY SERVICES DATA REQUESTS

TO PENNSYLVANIA-AMERICAN WATER COMPANY

Docket No. A-2017-2606103
Data Request 1

Data Requests A-16 and A-17 refer to PAWC-WD Statement No. 3 in the Application's Appendix A-14.

A-17. Please provide a copy of both the NMCP and LTCP.

Response: The Nine Minimum Control Plan prepared by PAWC is provided in Attachment 1. The Long Term Control Plans for Duquesne, Dravosburg, (both awaiting approval by PaDEP) and McKeesport are provided as Attachments 2 through 4. There is not an LTCP available for Port Vue at this time.

Responsible Witness: David Kaufman
Title: Vice President, Engineering

Date: July 14, 2017

PAWC RESPONSE TO TUS-17 [Attachment 1]

Nine Minimum Control Plan Update

McKeesport Wastewater System

PENNSYLVANIA-AMERICAN WATER COMPANY

DRAFT, June 7, 2017

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<u>Appendix</u>

Exhibits

ACRONYM LIST

Acronym	Term
ACHD	Allegheny County Health Department
BMP	Best Management Practice
BOD5	Biochemical Oxygen Demand (5-Day)
CBOD	Carbonaceous Biochemical Oxygen Demand
CSO	Combined Sewer Overflow
CSS	Combined Sewer System
CWA	Clean Water Act
DWO	Dry Weather Overflow
EPA	United States Environmental Protection Agency
FOG	Fats, Oils, and Grease
I/I	Infiltration/Inflow
LTCP	Long-Term Control Plan
NMC	Nine Minimum Controls
NPDES	National Pollutant Discharge Elimination System
O&M	Operation & Maintenance
PaDEP	Pennsylvania Department of Environmental Protection
SBR	Sequencing Batch Reactor
SCADA	Supervisory Control and Data Acquisition
SIU	Significant Industrial User
TSS	Total Suspended Solids
WQS	Water Quality Standards

Background

This updated Nine Minimum Controls (NMC) Plan is intended to become effective upon Closing of the proposed acquisition by Pennsylvania- American Water Company (PAW) of the wastewater system assets of the Municipal Authority of the City of McKeesport (MACM). MACM currently owns and operates three wastewater treatment plants and their associated collection systems: McKeesport, Duquesne, and Dravosburg. MACM also owns and operates the collection system for Port Vue Borough. The collection systems in the City of Duquesne and the Borough of Dravosburg only treat sewage from their respective communities and are not interconnected to other systems.

Additional communities surrounding the City of McKeesport own and operate collection systems that connect to the MACM interceptor system directly or via an adjoining municipality's sewer system. These are considered separate sanitary systems. These communities are:

- East McKeesport Borough
- Elizabeth Township
- Liberty Borough
- Glassport Borough
- Lincoln Borough
- North Versailles Township
- Versailles Borough
- White Oak Borough

The collection systems within the McKeesport, Duquesne, Dravosburg, and Port Vue service areas have been classified by the Pennsylvania Department of Environmental Protection (PaDEP) as combined sewer overflow (CSO) systems. The collection systems within these four areas include both separate sanitary sewers designed to carry sanitary wastewater only and combined sewers which were intended to carry both sanitary sewage and stormwater runoff to the interceptor. The storm water diversion chambers (CSO regulators) divert dry weather sewage flow from the combined sewers into the interceptor sewers. Sewage flow is diverted to the interceptor until the flow rate reaches a set value based on an allowable flow rate to the wastewater treatment plant. As this flow rate is exceeded (under high wet-weather flow conditions that exceed the capacities of downstream facilities), the combined sewage begins to discharge through the CSO outfalls to the river.

This NMC Plan will focus on the four service areas which are owned by the MACM and which are CSO systems: McKeesport, Duquesne, Dravosburg, and PortVue. Following are brief descriptions of these four service areas:

<u>McKeesport Service Area</u>

The McKeesport wastewater system consists of over 117 miles of collection sewers and large interceptors, 27 CSOs (excluding the WWTP outfall), nine pumping stations, and a wastewater treatment plant (WWTP).

The McKeesport wastewater treatment plant (McKeesport WWTP) discharges treated effluent to the Monongahela River under National Pollutant Discharge Elimination System (NPDES) Permit No. PA0026913. The McKeesport WWTP has an annual average design hydraulic capacity of 13.0 million gallons per day (mgd) and an annual average design organic loading capacity of 19,950 lbs. of Biochemical Oxygen Demand (BOD5) per day. The McKeesport WWTP includes the following processes:

- Screening and grit removal
- Flow Control Splitter Box
- Process Train 1:
    - Activated Sludge Process
    - Final Settling
    - Chlorine Disinfection
- Process Train 2:
    - Sequencing Batch Reactors (SBR)
    - UV Disinfection

The NPDES Permit No. PA0026913 lists permitted discharge points including: Treatment Plant Outfall – 001; and CSOs – 003 through 010, 012 through 015, 018 (017 combined with 018), and 020 through 033. NDPES Permit No. PA0026913 was issued to MACM on March 1, 2016 and expires on February 28, 2021.

Port Vue Service Area

The Port Vue wastewater system consists of approximately 21 miles of collection sewers, four CSOs, and one pumping station.

The NPDES Permit No. PA0254690 lists four permitted discharge points: CSOs 001, 002, 004, and 005. NDPES Permit No. PA0254690 was issued to the Borough of Port Vue on November 1, 2013 and expires on October 31, 2018.

Duquesne Service Area

The Duquesne wastewater system consists of approximately 35 miles of collection sewers and large interceptors, four CSOs (excluding the WWTP outfall), and a WWTP. The Duquesne system does not have any pumping stations.

The Duquesne WWTP discharges treated effluent to Thompson Run under NPDES Permit No. PA0026981. The Duquesne WWTP has a maximum monthly average hydraulic capacity of 2.0 mgd and an annual average design organic loading capacity of 2,780 lbs. of BOD5 per day. The Duquesne WWTP includes the following processes:

- Bar screening and grit removal
- Aeration basins (stabilization basins and contact tanks)

- Final Settling
- Chlorine Disinfection

The NPDES Permit No. PA0026981 lists permitted discharge points including: Treatment Plant Outfall – 001; CSOs – 002 through 005; and storm water outfall SW-1. NDPES Permit No. PA0026981 was issued to the Sanitary Authority of Duquesne on September 5, 2003 and expired on September 5, 2008. MACM is still operating under the provisions of this permit.

Dravosburg Service Area

The Dravosburg wastewater system consists of approximately 10 miles of collection sewers and large interceptors, one CSO (excluding the WWTP outfall), two pumping stations, and a WWTP.

The Dravosburg WWTP discharges treated effluent to the Monongahela River under NPDES Permit No. PA0028401. The Dravosburg WWTP has a maximum monthly average hydraulic capacity of 0.48 mgd and an annual average design organic loading capacity of 2,780 lbs. of BOD5 per day. The Dravosburg WWTP includes the following processes:

- Comminutor with bar screening
- Grit removal
- Aeration basins
- Final Settling
- Chlorine Disinfection

The NPDES Permit No. PA0028401 lists two permitted discharge points: Treatment Plant Outfall – 001 and CSO – 002. NDPES Permit No. PA0028401 was issued to the Borough of Dravosburg on December 28, 1999 and expired on December 28, 2004. MACM is still operating under the provisions of this permit.

To ensure proper operation and maintenance of the CSOs and to comply with the requirements set forth in the NPDES Permits, PAW has developed and implemented the procedures and guidelines in this NMC Plan. The overall goal of this NMC Plan is to eliminate dry weather overflows; bring all wet weather CSO discharge points into compliance with the technology based and water quality based requirements of the Clean Water Act (CWA); and if CSOs occur as a result of a wet weather event, to minimize their impact on water quality, aquatic biota, and human health. The NMC Plan identifies actions or measures designed to reduce CSOs and their effects on receiving water quality during wet weather as well as to eliminate dry weather overflows.

The NMC Plan will be reviewed annually by various departments within PAW including, but not limited to, Water Quality & Environmental Compliance, Field Operations, Legal, Engineering, and External Affairs. The NMC Plan will be revised as changes occur within the system, i.e. new construction, major repairs, equipment upgrades, inflow & infiltration (I&I) reduction, etc.

Additional documentation related to and supporting this NMC Plan are the Act 537 Plans and Long Term Control Plans (LTCP), as described below.

Act 537 Plans

The Act 537 Plan for MACM and its surrounding municipalities was prepared in 2006 and recommended upgrades of MACM interceptors, pump stations, and McKeesport WWTP. In 2008, Elizabeth Township updated its Act 537 plan to abandon the Buena Vista WWTP and send the Buena Vista flow to the MACM McKeesport WWTP. An update was prepared by MACM in 2009 to incorporate the 2008 planning completed and adopted by Elizabeth Township. In 2014, MACM prepared another Act 537 Plan Update to address the City of Duquesne's and the Borough of Dravosburg's wastewater systems, both of which had been purchased by MACM in 2011. The Act 537 Plan for MACM and its surrounding municipalities is currently being updated under a Special Study to evaluate PAW's proposed purchase of MACM, and to reflect MACM's purchase of the Port Vue Borough wastewater system in 2016.

Long Term Control Plans

The MACM LTCP was prepared in December 2007 and subsequently approved by PaDEP. The 2007 MACM LTCP addressed the areas served by the McKeesport WWTP at that time. In August 2014, MACM prepared additional and separate LTCPs for the City of Duquesne and the Borough of Dravosburg service areas. These two LTCPs are currently under review by PaDEP. There is currently not an LTCP for the Borough of Port Vue service area.

1.0 <u>Proper Operation and Regular Maintenance Program – NMC No. 1</u>

1.1 Overview

The first minimum control, proper operation and regular maintenance of the combined sewer system (CSS) and CSO outfalls in the McKeesport and surrounding CSS service areas, consists of a program that establishes operation, maintenance and inspection procedures. These procedures ensure that a CSS and treatment facility will function during wet weather in a way to reduce CSOs and their effects on receiving water quality, maximize treatment of combined sewage, and still comply with NPDES Permit limitations. Implementation of this control is intended to ensure that the collection and treatment systems perform effectively in order to reduce the magnitude, frequency and duration of CSOs. The essential elements of a proper operation and maintenance (O&M) program include maintenance of suitable records and identification of O&M as a high management priority.

The steps involved in implementing this minimum control are:

1. Assess how well the O&M program is implemented.

2. Determine if the O&M program needs to be improved to satisfy the intent of the CSO control policy.

3. Develop and implement the improvements to address CSOs.

4. Document any actions and report them to the PaDEP.

Frequent inspection, regular maintenance, and the timely repair of facilities, including tide gates and regulators, are cost-effective ways to improve the control of CSOs. The elimination of obstructions increases the effective storage capacity of the CSS system and the quantity of wet weather flows that can be delivered to the treatment plant. Effective O&M practices will tend to mitigate the extent to which CSOs occur.

PAW management is committed to allocate the proper resources to properly maintain the CSS, perform inspection and maintenance activities on equipment at the appropriate frequency, and make timely repairs to ensure that the CSS is operated effectively. The records management practices currently in place and used by MACM will continue to be utilized until PAW can migrate them into SAP. The MACM system will be immediately incorporated into PAW's ERSI GIS system.

1.2 Organizational Structure

The combined sewer system, to be owned and operated by PAW, serves the City of McKeesport, the City of Duquesne, the Borough of Port Vue, the Borough of Dravosburg, and also serves eight other adjoining municipalities and their sewer authorities via inter-municipal agreements. NPDES permits PA0026913, PA0026981, PA0028401, and PA0254690 have been issued by PaDEP for the discharge of treated effluent and CSOs into the Monongahela River, Youghiogheny River, and their tributaries.

Effective upon Closing of the acquisition Transaction, PAW will become the permittee for the combined sewer system and is responsible for routine O&M. Figure 1 shows the organization structure of PAW. The listing below is the contact information for key operations personnel for the MACM-area wastewater system.

Sr. Director of Operations, Western PA
Beatty (Wynn) Morgan
Phone: 724-743-6650

Sr. Manager of Operations, Southwest PA
Marek Jacobs
Phone: 724-743-3137

Superintendent Operations, Southwest PA
Tim Berdar
Phone: 724-880-8806

Superintendent Wastewater Operations & Maintenance
Chuck Schultz
Phone: 412-673-9701 ext. 23

Water Quality and Compliance Manager
Ron Bargiel
Phone: 412-884-5112

Director of Water Quality and Compliance
Chris Abruzzo
Phone: 717-531-3308

Production Asset Manager
Jasun Stanton
Phone: 412-884-5109

Engineering Manager, Western PA
Jay Lucas
Phone: 724-873-3653

Emergency Contact Number: 314-267-6483

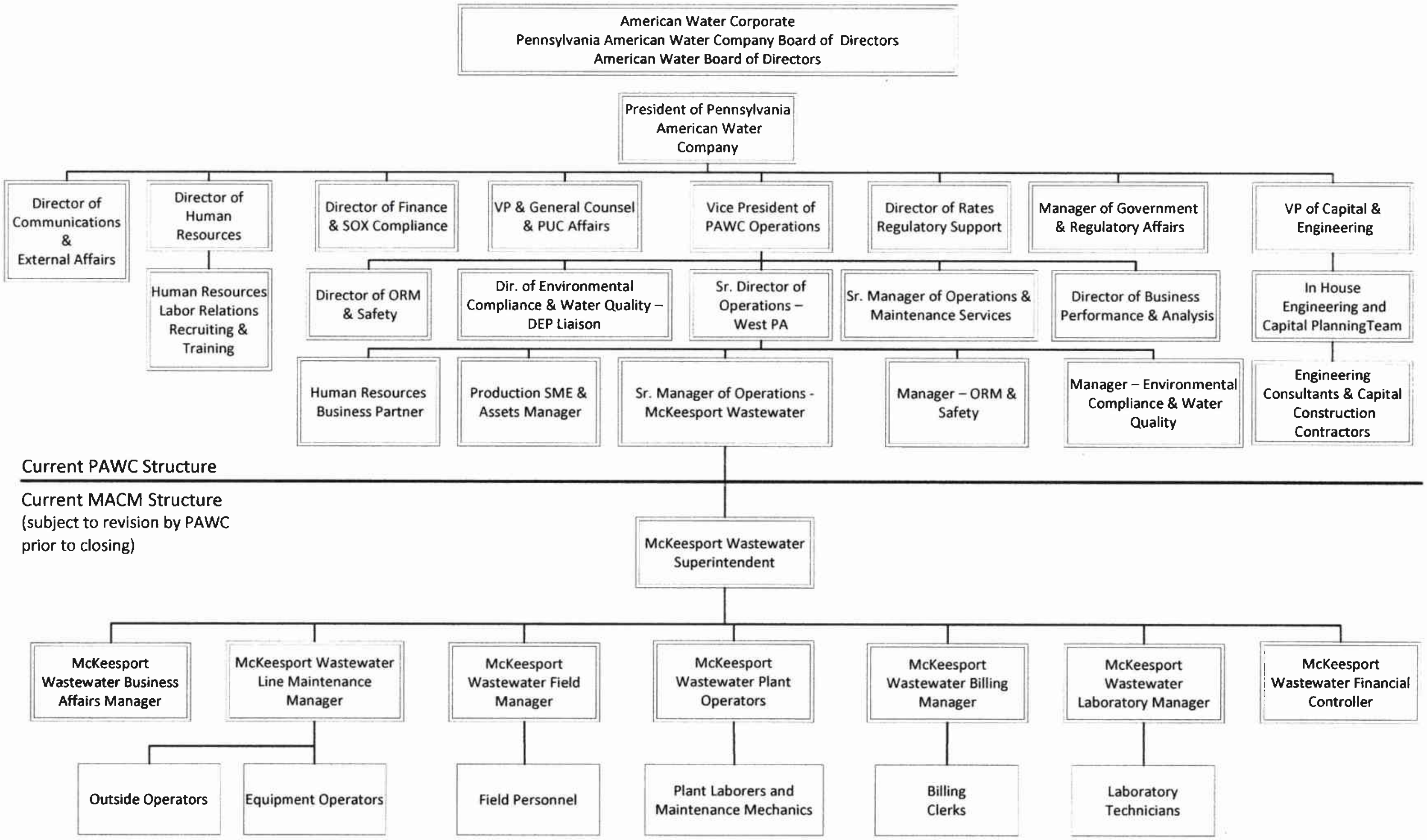
American Water Corporate
Pennsylvania American Water Company Board of Directors
American Water Board of Directors
President of Pennsylvania American Water Company
Director of Communications & External Affairs
Director of Human Resources
Human Resources Labor Relations Recruiting & Training
Director of Finance & SOX Compliance
VP & General Counsel & PUC Affairs
Vice President of PAWC Operations
Director of Rates Regulatory Support
Manager of Government & Regulatory Affairs
VP of Capital & Engineering
Director of ORM & Safety
Dir. of Environmental Compliance & Water Quality – DEP Liaison
Sr. Director of Operations – West PA
Sr. Manager of Operations & Maintenance Services
Director of Business Performance & Analysis
In House Engineering and Capital PlanningTeam
Human Resources Business Partner
Production SME & Assets Manager
Sr. Manager of Operations - McKeesport Wastewater
Manager – ORM & Safety
Manager – Environmental Compliance & Water Quality
Engineering Consultants & Capital Construction Contractors
Current PAWC Structure
Current MACM Structure (subject to revision by PAWC prior to closing)
McKeesport Wastewater Superintendent
McKeesport Wastewater Business Affairs Manager
McKeesport Wastewater Line Maintenance Manager
McKeesport Wastewater Field Manager
McKeesport Wastewater Plant Operators
McKeesport Wastewater Billing Manager
McKeesport Wastewater Laboratory Manager
McKeesport Wastewater Financial Controller
Outside Operators
Equipment Operators
Field Personnel
Plant Laborers and Maintenance Mechanics
Billing Clerks
Laboratory Technicians

Figure 1

1.3 Critical Facilities

The critical elements of the MACM combined sewer system are listed in general order of priority below. These facilities and their roles in the operation of the combined sewer system were previously characterized in Act 537 Plans and/or LTCPs for the McKeesport, Duquesne, Dravosburg, and Port Vue systems.

PRIORITY	CRITICAL ELEMENTS OF THE COMBINED SEWER SYSTEMS
1	Wastewater Treatment Plant
2	NPDES Outfalls
3	Pump Stations
4	Diversion Chambers and CSO Outfalls
5	Combined Sewer Piping

The operation, maintenance, inspection, and reporting requirement for the above identified facilities (except the WWTPs) are outlined in the CSS Operation and Maintenance Program. This manual will be updated in 2017 and undergo an annual review thereafter to determine if further revisions are needed. A list of the CSO regulators and their locations is included in the CSS Operation and Maintenance Program.

Operation of the McKeesport WWTP during wet weather events and power outages is outlined in the High Flow Management Plan, which was prepared and submitted to PaDEP in February 2017.

1.4 Budget

PAW is responsible for funding both O&M expenditures as well as capital improvement projects. Capital and O&M Budgets are approved on a calendar year basis. The annual budgeting process typically begins in April of the preceding year in coordination with the state executive leadership, operations management, and administrative budget owners. In Q3, the budget is reviewed and approved by Executive Leadership Team and presented to the PAW Board of Directors and approved by the American Water Board in Q4.

Capital Expenditures

Capital expenditures are developed annually by the PAW engineering group, working with the local district managers and operations leadership. This planning encompasses large projects and more costly items such as pumps, instrumentation, and large maintenance items. Each year, the wastewater staff provides input in the budget process to assess the needs of the wastewater plant and collection system including all projects identified in the LTCPs. The collection system portion of the budget includes proposed funds for the CSOs. The needs are then prioritized and, if approved, incorporated into PAW's annual budgetary plan. PAW engineering is responsible for short term and long term planning and project delivery and will retain consulting engineers, as needed, to assist in that effort.

Operation and Maintenance Expenditures

Operating expenses, which include O&M, are developed annually at the local district level by the district budget owners based on the needs of the districts and are reviewed and approved by PAW leadership. Environmental compliance issues are given top priority in the budget process as are any requirements identified in the approved LTCPs. The size and financial structure of PAW provides ample capacity to fund environmental compliance projects. The size of the organization also allows for flexibility in the allocation of resources such as manpower and needed equipment.

1.5 Procedures for Routine Maintenance

Operating personnel work under the Superintendent of Wastewater Operations and Maintenance, a certified wastewater treatment plant operator, to provide continuous full-time system operation and maintenance. Fiscal records and other administrative duties are performed by or under the direction of the Sr. Manager of Operations. The Superintendent of Operations for Southwest PA and the Superintendent of Wastewater Operations and Maintenance are responsible for the three WWTPs' process and maintenance.

Daily attendance of the system consists of a regular eight (8) hour day, five (5) days per week, plus two (2) hours on Saturday and two (2) hours on Sunday. The McKeesport WWTP contains a security system, which is electronically monitored 24 hours every day. Vital technical elements such as high wet well level, pump failures, pressure loss, or power failures are a part of the monitoring system. The Superintendent of Wastewater Operations and Maintenance, or his designated representative, is on 24-hour call and can be reached in case of emergency.

A routine monitoring and maintenance program has been established and is carried out by the maintenance crew under the direction of the Superintendent of Wastewater Operations and Maintenance. Sewers and manholes are checked weekly. If structural damage or blockages are found, corrective measures and repairs are undertaken immediately, if necessary. Jet/vactor trucks and CCTV equipment, currently owned by MACM, are utilized on a regular basis to maintain and investigate the condition of the collection system. This process began in November 2010 immediately after MACM acquired the McKeesport collection system from the City of McKeesport. MACM also purchased and installed flow monitors at the CSO structures. Cleaning is conducted on an as needed basis and repairs are made as necessary. Emergency maintenance operations include repair of broken sewers and alleviating blocked sewer lines or manholes.

Major equipment maintenance operations at the WWTPs are grouped into three general service categories: preventative maintenance, corrective maintenance, and major repairs. Preventative maintenance consists of functions that are generally performed while the plant is operating. Corrective maintenance measures are minor repairs made while the plant is still in operation with minimum equipment downtime. Major repairs result in a process unit being out of service. Major, corrective and preventative maintenance are performed periodically at the WWTPs. Records are kept to indicate all work performed.

Repairs and/or rehabilitation are carried out by the maintenance personnel. Emergency maintenance or repairs are conducted on an as-needed basis. A 24-hour emergency number is on file at the local police headquarters and a work crew can be assembled whenever required. Assistance for major repairs or rehabilitation is readily available from one of the several contractors within the area. Complaints are immediately investigated and problems are corrected as quickly as possible.

Inspection of laterals from any new customer building or a new sewer extension is performed by the field supervisor and is installed in accordance with the Sewer Users Ordinance. All sewer tap-ins for new customers will be made by PAW Employees using 6" plastic pipe from the main to the user's property line. Customers are responsible from property line onward, with installation in accordance with the above mentioned user ordinance.

The four applicable NPDES permits, as listed in the Background Section of this document, include compliance requirements for the management and control of CSOs. MACM has been making every effort possible to control combined sewer overflows within the system. The maintenance performed in 2015 was considered typical and preventative, consisting of repairing gates in the regulators and cleaning debris out of the gates and lines.

The procedures for routine O&M are included in the CSS Operation and Maintenance Program. Typical O&M procedures that are part of the manual include inspection with a CCTV camera, flow measurement, cleaning and removal of foreign materials, chemical treatment of roots, repair/rehabilitation of defects, and maintaining adequate records of inspections and findings.

Normal O&M of the WWTPs occurs with records of operation maintained daily. Historical records are stored in the MACM office at the McKeesport WWTP.

PAW will continue to use MACM's current work order procedures, which includes paper documentation to identify and track all maintenance activities, until these systems are integrated into PAW's SAP systems. Documentation for work completed currently includes a description of the work performed, date, location, and total repair cost for the work.

1.6 Non-Routine Maintenance and Emergency Situations

A call out list of private prequalified contractors is maintained for the WWTPs and the collection systems to insure that repairs can be arranged outside of normal working hours to the extent outside assistance is necessary.

Management of emergencies in the collection system is critical. Pipe failures can result in dry weather overflows. Upon notification by outside parties or upon discovery, PAW takes immediate and appropriate steps to respond to the collection system problem, repair the problem and maintain or restore service to the customers. Our target response time for complaints and emergencies relating to collection system releases is as soon as possible. Typical response times are within an hour or two, depending upon the circumstances. Procedures are in place for bypass pumping between manholes, if needed, to perform the work. We maintain a variety of pumps on hand, in addition to a call out list of private contractors, and are well equipped to respond to pump station problems, as necessary.

The following is a list of PAW and external personnel who are available to respond to an emergency:

<u>PAW</u>

See personnel list in Section 1.2	Phone Number
Emergency Contact Number	314-267-6483
<u>PaDEP</u>	
Southwest Regional Office	
Christopher Kriley – Program Manager – Clean Water	412-442-4032
<u>Allegheny County Emergency Management Agency</u>	
Steven J. Wilharm – Division Manager	412-473-2550
<u>Contractors</u>	
Casper Colosimo and Son, Inc.	412-787-1266
Golden Triangle Construction, Inc.	724-828-2800
Alex E. Paris Contracting Co., Inc.	724-947-2235
Midway Excavating	412-244-9433
Hufnagel Excavating	724-348-4294
Kukurin Contracting, Inc.	724-325-2136
Lee's Plumbing and Excavating, Inc.	724-245-2950
Port Vue Plumbing	412-673-3988

1.7 Inspections

Manual on-site inspections of all CSO discharge points and regulators will occur at least twice a month; however, most outfalls are inspected several times each month in response to significant rain events. The practice of reviewing rainfall data and correlating it to activations at certain regulators will continue. The result is that most outfalls are visited frequently each month whether due to (1) routinely scheduled inspections, (2) inspection following rain events, (3) in connection with outfall flow meter inspections, or (4) in connection with other visits/inspections.

Inspections include the following: (1) recording date and time of arrival and departure, (2) noting the inspection type (twice monthly or rain event), (3) noting the condition of the outfall, (4) noting infiltration from the river, (5) noting if the gate was moving freely, (6) noting the weather conditions, (7) noting whether discharge is present, and if so, (8) estimating rainfall, (9) noting the receiving waters, (10) estimating flow, (11) determining the cause of the discharge, (12) noting whether the discharge is wet weather or dry weather related, (13) estimating the duration of the discharge, (14) noting any erosion, (15) dispatching necessary equipment, (16) noting if solids and floatables being discharged, (17) noting whether a plume is present, and (18) noting any other maintenance needs for the regulator. If debris is present in the structure, the crew will utilize a jet truck or a vactor truck to wash down the structure and remove the debris. Inspection forms will be completed for each CSO inspection. An example inspection log is shown in the Appendix (NMC-1, Exhibit A).

These frequent physical inspections are supported by permanent flow monitoring devices at all regulators within the system, which are Telog Meters (Ru-33-1xV, RTU submersible) and FloWav Velocity Sensors (PSA-AV). Each of the 36 CSOs (27 in McKeesport, four in Duquesne, four in Port Vue, and one in Dravosburg) has both the meter and sensor installed, and the information is digitally transmitted via both email and phone.

Pump stations are inspected daily and repaired as needed, with records of O&M activity maintained on log sheets. All pumps are cycled at least once per day. Maintenance (pump lubrication) is performed on all pumps every two weeks. Bar screens are cleaned on a daily basis or more frequently if needed. Emergency generators are tested on a monthly basis, and portable generators are also available if needed.

SCADA equipment will continue to be utilized at the pump stations to provide for real-time monitoring of the facilities in an effort to reduce the probability of an overflow event and improve response times if such an event occurs.

Sewer lines, manhole structures, and catch basins are inspected weekly as part of routine maintenance and cleaned as needed. Targeted inspections for particular areas are conducted when required. New manholes are installed as needed. As appropriate, inspections are recorded and log sheets and recordings of the work are maintained at the McKeesport WWTP office. Management staff are kept up to date on maintenance activities.

MACM currently maintains a network of six rain gauges, which will be acquired and maintained by PAW. These are inspected at least monthly, with many being inspected twice a month. One of the gauges is located at the McKeesport WWTP, and the other five are located at the following pump stations: Cliff Street, Long Run, 28th Street, Ripple Road, and West Shore.

1.8 Training

1.8.1 Operations Risk Management

PAW has an established Safety and Health Procedures Manual for all facilities throughout Pennsylvania. This manual contains various safety programs, including but not limited to Confined Spaces, Electrical Safety, Hazard Communication, Hand and Power Tool Safety, Process Safety Management, and Employee Training.

PAW provides and promotes training of operators and maintenance personnel. We require every new employee to attend an initial orientation that incorporates an overview of the overall Safety and Health program. Employees will also undergo additional training at this time for specific areas related to their particular job duties. In addition, PAW also provides safety and health related training at various times during the year to continually educate our employees and install a high sense of safety awareness. Local supervisors also conduct safety talks on a weekly basis with all their employees to supplement and reinforce the importance of safety.

The Operational Risk Management (ORM) department and the Collection and Treatment departments are responsible for developing the overall training program and for applying for certification of continuing education hours with the PaDEP. Topics are chosen based on the requirements set forth in federal, state, and local regulations, and as hazards are identified within the company. The information contained in each training session includes those items required by pertinent external regulations or internal requirements.

Training is conducted in a variety of ways and settings including but not limited to formal classroom, hands-on, peer to peer, computer based, video, and informal one to one. All training is performed in such a manner as to encourage employee involvement and interaction. Instructors are chosen based on qualification and experience related to the topics. PAW utilizes both internal and external individuals and organizations to perform its training. A written record of the training is maintained by the ORM department.

1.8.2 Certification Programs

PAW encourages all wastewater employees to attain the maximum level of certification appropriate for their duties. Currently the MACM wastewater system employs 44 full-time employees (12 Class A Wastewater operators and 12 Subclassification A1E4 operators for the collection system) to maintain and operate the wastewater treatment plant and the collection system. Training is provided to meet the requirements of State operator certification as well as those for PENNVEST loan compliance. PAW's program includes an optional Wastewater Collection System Certification.

1.9 Periodic Review of O&M Plans

Operations manuals and other operational instructions are reviewed annually, during the 4th quarter of each calendar year. Key field O&M personnel are involved in this process. O&M manuals are in a central electronic database. During the annual review of O&M manuals, a summary report is developed which will identify any modifications to the previous O&M plans and document the benefits realized from the specific revisions. Best efforts will be made to obtain electronic versions of O&M manuals and incorporate them into the database.

O&M and collection system activities are currently logged by MACM on paper work orders to record and report the extensive collection system O&M that is performed annually. These procedures will eventually migrate over to PAW's SAP system.

2.0 <u>Maximum Use of the Collection System for Storage – NMC No. 2</u>

2.1 Overview

The second of the nine minimum controls is to maximize the use of the collection system for storage of wet weather flows. The goal of this control is to enable the sewer system to store wet weather flows, as much as possible, until downstream sewers and treatment facilities can handle them. Control measures to attain the goal include inspection and removal of obstructions; tide and control gate maintenance and repair; regulator adjustment (including float mechanisms); reduction or retardation of inflows and infiltration; upgrade and adjustment of pumps; raising existing weirs and installation of new weirs. Any attempt to implement the typical measures to maximize the use of the collection system for storage must be tempered with the prevention of upstream basement and street flooding.

MACM currently has existing agreements with each of the eight surrounding municipalities, as listed in the Background section of this NMC Plan, which own and operate their own collection systems which ultimately discharge sewage to the McKeesport WWTP for treatment. Each agreement stipulates that MACM agrees to accept all sewage and wastes which are discharged into MACM's intercepting sewer, subject to the condition that the municipalities and/or and municipal authorities shall not discharge certain types of wastes, including but not limited to storm water and flow from streams. These agreements will be assigned to PAW upon closing. Therefore, discussion in this Section 2.0 will be limited to the four CSS's owned and operated directly by the MACM.

Following is a discussion of relevant projects within the McKeesport, Duquesne, Dravosburg, and Port Vue CSS's:

<u>McKeesport Service Area</u>

In March 2008, MACM prepared a Feasibility and Preliminary Design Report for its Act 537 Projects, which recommended (but was not limited to) the projects listed below. These projects were recently completed, resulting in increased capacity within the collection system:

- Capacity improvements to the Long Run Interceptor were made by constructing a submersible pump station within the McKeesport limits and a force main to address needs along the upper portion of the interceptor, along with the installation of a parallel relief interceptor and replacement of the bottom portion of the line.
- The Long Run Force main was increased from 12" ductile iron pipe to 20" PVC pipe and aligned in properties occupied by the Youghiogheny River Trail to a point where it crosses the Youghiogheny River by horizontal directional drilling methods and discharges to the new West Shore Pump Station.

All of the projects outlined in MACM's 2007 LTCP have been successfully completed. MACM, and ultimately PAW, will implement the Post Construction Monitoring Plan once it is approved by PaDEP, as described in Section 9.1.

Duquesne Service Area

An LTCP for Duquesne was prepared in August 2014. The LTCP included comprehensive hydraulic modeling and an evaluation of alternatives to address the Duquesne WWTP and CSS upgrades necessary to meet State and Federal regulations. The US Environmental Protection Agency's (EPA) CSO control policy "presumption" approach was used, i.e., the elimination or capture of no less than 85 percent by volume of combined sewage collected in the CSS during precipitation events on a system-wide annual average basis. The recommended alternative includes the construction of a pump station, the addition of CSO bypass treatment (for peak flows above 2.5 MGD), efficiency upgrades to the final clarifiers, the addition of two gravity relief sewers totaling 1,025 lineal feet, and other minor improvements. The anticipated tentative schedule for the upgrades is for construction to begin in early 2021; however this schedule is subject to change based on the time frame for PaDEP's approval of the LTCP (pending at time of writing) and receipt of the PaDEP Water Quality Management (WQM) Part II Permit.

Dravosburg Service Area

An LTCP for Dravosburg was prepared in August 2014. Similar to the Duquesne LTCP, the Dravosburg LTCP included comprehensive hydraulic modeling and an evaluation of alternatives to address the Dravosburg WWTP and CSS upgrades necessary to meet State and Federal regulations. EPA's CSO control policy "presumption" approach was used, i.e., the elimination or capture of no less than 85 percent by volume of combined sewage collected in the CSS during precipitation events on a system-wide annual average basis. The recommended alternative includes the addition of a new raw sewage pump station to pump all flows (up to 1.0 MGD) to the McKeesport WWTP, force main piping to the McKeesport WWTP, the utilization of the existing aeration basins for flow storage, and other minor upgrades. The anticipated tentative schedule for the upgrades is for construction to begin in early 2021; however this schedule is subject to change based on the time frame for PaDEP's approval of the LTCP (pending at time of writing) and receipt of the PaDEP Water Quality Management (WQM) Part II Permit.

Port Vue Service Area

At the time of writing, there is not an LTCP for Port Vue. If an LTCP has not been prepared at the time of Closing of PAW's acquisition of the MACM facilities, PAW will prepare and implement an LTCP for the Port Vue service area following the Closing.

In 2012, a comprehensive CCTV inspection was conducted of Port Vue's CSS. The program identified numerous Significant Deficiencies throughout the system. Port Vue's consulting engineer recommended repairs in specific locations, and outlined the associated costs as of February 2013. It is anticipated that Port Vue's LTCP will include recommendations and a prioritized schedule for repairing these deficiencies.

2.2 Inspection and Maintenance

Routine maintenance and inspections are also discussed in Sections 1.4 and 1.6, respectively.

2.2.1 CSO Regulator Structures

Comprehensive CSO regulator and tide gate inspections will be performed each year. Detailed assessments of all regulators and appropriate remedial measures are recorded and summarized in the annual reports.

2.2.2 Lift Pump Stations

Pumping stations are inspected by trained operators on a daily basis. Wet wells at all pump stations will be cleaned once per year or more frequently if identified to be necessary. MACM currently has a pump station SCADA system in place, which PAW will continue to utilize, at key locations which assists in evaluating dry and wet weather flows to each station. In-line flow meters will document flow, real-time recording rain gauges will document rainfall information (which can be used to correlate pump station flow), wet well levels will be continuously recorded (providing for monitoring of overflows), and storm pump operation will be documented.

2.2.3 Collection System

MACM owns two Vactor jet rodding trucks, to be acquired by PAW, which are used by operators typically at least weekly (when temperatures are above freezing) for inspection and maintenance. MACM also owns CCTV camera equipment, to be acquired by PAW, which is used to support maintenance activities.

Going forward, the length of lines to be televised will be a combination of those televised in support of normal maintenance activities and those of exploratory nature. Where it is documented that sediment or other obstructions in non-major sewer lines are present, the sewer lines will be flushed and/or scheduled for repair. The removal of obstructions increases the storage capacity of the system and can reduce the volume of overflows. Where televising documents excessive clear water flow during dry weather, investigations will be performed to discover/identify the source of the inflow and/or infiltration, since the removal of extraneous flow increases the capacity of the system. Depending on the magnitude and severity, repair/rehabilitation will be scheduled as a part of major capital or extraordinary repair. In the case of storm sewer separation, projects will be coordinated with the appropriate party (City or Borough).

2.2.4 Catch Basins

Routine maintenance activities including inlet and catch basin cleaning and sewer flushing are performed. The purpose of such routine catch basin cleaning is to minimize grit and debris that can enter into the collection system and be discharged from CSO outfalls, and to reduce the frequency of having the interceptors cleaned. Cleaning will occur when problems are reported. As defects are observed, they will be reported for corrective action. Copies of daily work reports and management reports are maintained.

2.2.5 CSO Outfalls

Approximately ten years ago, as part of the anticipated Phase I of the US Army Corps of Engineers project, MACM installed Tideflex type gates at the majority of outfalls. Remaining outfalls, where the possibility of inflows to the combined system could occur, will continue to be monitored. If any material inflow is confirmed to be occurring, the need for and appropriateness of installing a similar gate or duckbill to prevent river water intrusion will be evaluated.

2.2.6 Tide Gates

The function of tide gates is to deter the receiving stream from flowing back into the sewer system during high river water levels. Proper maintenance is required to ensure that leaks and cracks are not present and that the gate is operating as designed. Leaks and cracks permit water to pass into the overflow and reduce the available downstream storage capacity of the system. PAW personnel will generally inspect flap tide gates monthly from topside and specific gates will be inspected as required from the interior. Certain gates may also inspected as needed from the riverside to clean debris. Inspection of the downstream side of the tide gates will be completed monthly. The CSS Operation and Maintenance Program contains more specifics on regulator/gate inspection protocol.

2.3 **Regulator Adjustments**

Regulator settings will be adjusted and overflow weirs will be raised as practicable. Regulators are an important component of the CSO system as they regulate the amount of flow permitted into the downstream sewer and provide an outlet for excessive flows. Adjusting the regulator settings and increasing the overflow weirs may permit an additional amount of flow into the downstream sewer and will control the amount of flow discharged into the overflow line.

Some of the regulators that accept flow from a relatively large area with very little dry average flow are set to capture and convey flow in excess of 350 percent of average dry weather flow. This pertains in particular to regulators along the Lower Youghiogheny Interceptor: 5th Street, 6th Street, 7th Street, and 11th Street. The current settings of the regulators allow that much more than 350 percent of average dry weather flow is captured (and, if the conveyance system allows, conveyed to the McKeesport WWTP).

The five regulator gates in the Duquesne and Dravosburg service areas are currently set to achieve maximum storage. Regulator settings in Port Vue will be reviewed as adjusted if possible as described above.

The settings of the regulators will be reviewed regularly and adjusted if needed / possible to allow for utilizing the maximum capacity of the collection system upstream of the regulator.

2.4 Upgrade/Adjustment of Pump Operations at Intercepting Lift Stations

Pump operations at lift stations will be evaluated based on the monitoring being performed. Upgrades/adjustments will be made consistent with the hydraulic evaluation of the system.

3.0 Review and Modify Industrial Pretreatment Programs (IPPs) – NMC No. 3

3.1 PAW Industrial Pretreatment Program

Minimum Control No. 3 requires the examination of industrial pretreatment programs and the development of program modifications as appropriate to reduce the environmental impact of CSOs. Through the implementation of Control No. 3, limits are established to control "non-domestic discharges" to the combined sewer system from industrial and commercial locations (restaurants, gas stations, etc.). The overall objective of this control is to effectively implement and optimize pretreatment programs as appropriate for minimizing CSO impacts from industrial facilities.

Wastewater from homes, commercial buildings, and industrial facilities is transported via the collection system to the WWTPs to treat typical biodegradable wastes, such as household waste, commercial waste, and industrial waste. PAW's pretreatment program reduces the potential negative impact to the water quality of rivers and streams by treating wastewater before it is discharged to the wastewater treatment works.

Although upon acquisition of the system, the WWTPs cease to be publicly-owned treatment works subject to the EPA industrial pretreatment regulations and program (see 40 C.F.R. Part 403), PAW has adopted and intends to implement an industrial pretreatment program pursuant to PAW's PUC-approved tariff and conditions in the NPDES Permits governing the system. Such provisions are intended to comply with the requirements of 40 C.F.R. §122.44(m) (governing indirect discharges to privately owned treatment works), and 25 Pa. Code §§92a.46, 92a.47(d), and specifically are designed to regulate indirect discharges such as to provide adequate protection of surface waters and avoid discharges that could cause interference or passthrough.

The PAW pretreatment program regulates industrial discharges that may be detrimental to the wastewater treatment works. Regulations are established with specific load limitations for discharges to the system in order to:

- prevent any damage to sewer system and wastewater treatment plants,
- minimize health and the safety risks for workers,
- minimize the impact of discharges into the CSS from non-domestic sources during wet-weather events, and
- prevent the discharge of any harmful substances to the rivers, streams, and other water resources.

To accomplish this, PAW issues two types of permits which regulate discharges to the sewer system. The permits which are part of PAW's pretreatment program are as follows:

- Industrial Waste Discharge Permit - This permit specifies monitoring and reporting requirements for Significant Industrial Users (SIU) to demonstrate compliance with applicable local, state, and federal regulations.

- Hauled Wastewater Discharge Permit – This permit must be obtained by any discharger seeking to collect and transport septage waste to the WWTPs for disposal.

The pretreatment program is primarily executed through the Industrial Waste Discharge Permit which specifies the monitoring, sampling, and reporting requirements for SIUs. The implementation of the SIU permit program enables PAW to monitor and enforce the requirements for discharging wastewater to the sewer system. The SIUs contributing to the system meet EPA's definition of non-domestic users. As part of PAW's program, the size and nature of their process discharges are evaluated to determine which users have the greatest non-domestic impact on the WWTPs and potential water quality impacts from CSOs.

The MACM wastewater system currently has an Industrial Pretreatment Program (IPP) in place. At this time, MACM system has no permitted SIUs.

During inspections of sewers, if oil and grease is observed, an attempt is made to determine its origin and contact the source for resolution. All inspections and follow-up investigations are documented. The MACM wastewater system does not have any chronic Fats, Oil, and Grease (FOG) areas that have not been addressed.

3.2 **Significant Industrial Users**

SIUs are wastewater system users that:

- Are subject to any National Categorical Pretreatment Standard;
- Discharge an average of 25,000 gallons per day or more of process wastewater to the system or contribute a process waste stream that makes up to 5 percent or more of the average dry weather hydraulic or organic capacity of the treatment plant; or
- Are found by PAW, PaDEP, or EPA to have a reasonable potential, either alone or in conjunction with other discharges, to adversely affect the system.

SIUs are classified as either Categorical or Non-Categorical. Categorical SIUs are those who perform a categorically regulated process as stipulated in the federal regulations and have numerical limits as well as other reporting requirements. Non-Categorical SIUs are subject to the same federal reporting requirements, but are not subject to categorical pretreatment standards.

PAW will monitor and enforce the pretreatment requirements for SIUs through site-specific permits in the combined sewer systems.

Currently, the MACM wastewater system does not have any permitted SIUs.

Future SIUs that discharge process wastewater will be required to periodically monitor their industrial process wastewater or process flow and develop spill prevention plans. All permitted SIUs will be subject to required facility inspections by the IPP program staff at least once a year. The SIUs must provide a quarterly report of their facility that includes process flow and wastewater sample results, or certification of zero discharge. They must also notify PAW of any noncompliance. Depending on the type of noncompliance, PAW can undertake a number of enforcement actions, including the issuance of a Notice of Violation, compliance or cessation directives, referral to PaDEP, or termination of discharge. Detailed records are kept by PAW to document instances of SIUs non-compliance.

3.3 Pretreatment Program Sampling, Tests, and Reporting

PAW requires the SIU to self-perform periodic quarterly sampling and testing of its wastewater. The SIU is required to submit a quarterly self monitoring Industrial Wastewater Discharge Monitoring Report form to PAW. An example of the quarterly report submitted can be found in the Appendix (NMC-3, Exhibit B). PAW conducts a complete inspection of the SIU facility and sampling of the permitted SIU once a year. PAW utilizes an SIU Inspection Checklist during the yearly inspection. An example of the SIU Inspection Checklist can be found in the Appendix (NMC-3, Exhibit C). The inspection schedules are updated as needed based on facility compliance, however the frequency shall never be reduced below that required by the NPDES permit requirements.

The facility inspection and documentation of the inspection is as follows:

1. Record the name of the facility, date, time, PAW Inspector, and facility representative.
2. Examine the maintenance and cleaning documentation of any grease traps, oil water separators, silver recovery units, or other pretreatment devices.
3. Conduct physical inspections of the pretreatment devices to verify proper operation and maintenance.
4. Collect regulatory samples of the pretreatment discharge for environmental compliance.
5. Process samples may be collected to measure the effectiveness of the maintenance and cleaning, and to recommend any changes to the maintenance schedules that may be needed.
6. Assess the impacts of each non-residential customer discharge on the total system flow and contamination of CSO discharges.
7. Review Emergency Response Plan with updated flow chart and chemical MSDS sheets.

The inspection form also includes sections on:

- water usage,
- storage of raw materials and chemicals,
- universal/non-hazardous/hazardous waste generation and disposal,
- spill/slug control,
- solvent/toxic organic management plan,
- production processes, and
- pretreatment systems.

PAW will maintain an inventory of non-domestic users at the McKeesport WWTP and in an electronic database. The inventory will be updated annually for accuracy. Hard copies at the facility will be maintained for a period of seven (7) years.

Following every calendar year, PAW develops an annual report of its pretreatment program activities pertaining to all permitted SIUs for the previous reporting year. This report lists permitted SIUs, sampling and inspection activities, noncompliance and enforcement actions taken during the previous year. Details of specific violations and enforcement actions are also provided. Facility pretreatment inspection reports are filed in hard copy at the WWTP for a period of 5 years and also in electronic format.

3.4 General Permit Evaluation

Industrial Waste Discharge Permits are site-specific permits which require additional administrative needs in comparison to general permits. There would be no additional benefit to issue general permits for industrial discharges. Any future site-specific permits will regulate all wastewater discharged from the permitted facility, which includes contaminated stormwater (i.e. rainfall contaminated by products, by-products, waste products, or other materials). Additionally, all SIUs will be required to monitor their flow to the sewer system.

3.5 IPP Enforcement Response Plan

Appropriate enforcement action will be taken to bring industrial users into compliance and the Enforcement Response Guide shall be fully implemented. The Guide identifies the staff that is utilized to administer the program, the SIU compliance monitoring performed, and the enforcement procedures utilized for SIU discharge violations. PAW will prepare an annual report in accordance with NPDES permitting requirements. If a new SIU is proposed to be connected to the sewer collection system, the SIU will need to provide PAW with an Application for Industrial User Wastewater Survey and Permit Application. An example of the Application for Industrial User Wastewater Survey and Permit Application can be found in the Appendix (NMC-3, Exhibit D).

3.6 Fee Program

The fee program was developed by PAW to recover costs of treating wastewater that exceeds the characteristics of normal household wastewater. PAW will administer the fee program to future applicable industrial users through routine wastewater sampling. The fee program establishes industrial loading fees, excess loading fees, and special discharge fees based in part on discharge concentrations of BOD5, ammonia nitrogen, and total suspended solids (TSS). The fee program will ensure regular contact with facilities discharging high strength wastewater that may not require permitting as SIUs.

3.7 Evaluate modifications to approved pretreatment program

PAW has prepared a substantially-similar IPP for MACM-area customers that PAW will submit to PaDEP for review as part of the NDPES permit process. The proposed IPP in substance tracks the existing rules and standards that the MACM has in place for future industrial users, and includes similar general prohibited discharge standards already in place for the system. The IPP program has been updated to reflect the change in ownership of the MACM treatment works system from a publicly owned treatment works (POTW) system operated by MACM to a privately owned treatment works system operated by PAW.

4.0 <u>Maximize Flow to the WWTP for Treatment – NMC No. 4</u>

4.1 Overview

The fourth minimum control is to maximize the volume of combined wastewater that is processed at the WWTP. The overall objective of this minimum control is to reduce the frequency, duration, and volume of combined sewer overflows by maximizing flows to the WWTP through simple modifications to the combined sewer system and treatment plant. These modifications will enable as much wet weather flow as possible to reach the treatment plant and receive treatment.

4.2 Flow Optimization

<u>McKeesport Service Area</u>

In March 2008, MACM prepared a Feasibility and Preliminary Design Report for its Act 537 Projects, which recommended (but was not limited to) the projects listed below. These projects were recently completed, resulting in increased flow capacity to the McKeesport WWTP for treatment, as well as increased treatment capacity at the McKeesport WWTP:

- The Cliff Street and 28th Avenue Pump Stations were upgraded by replacing the pumps in kind, renovating the pump controls and electrical gear, and remodeling the structure to meet regulatory codes for classified areas.
- The Long Run Pump Station was completely overhauled. The scope of work to achieve the capacity increase included the installation of screening facilities, submersible pumps, additions constructed for increased wet well capacity, and electrical gear.
- The new West Shore Pump Station and accompanying force main were constructed with below grade screening facilities, wet well and vertical shaft dry pit pumps sized to discharge directly to the McKeesport WWTP headworks building through a 24" PVC force main aligned mostly in River Road.
- The McKeesport WWTP was upgraded to accommodate a peak capacity of 56 MGD. This is achieved through a split treatment process. The influent is primarily treated through screens and grit removal before being split into the existing activated sludge and disinfection processes and new SBR and UV disinfection processes before being combined to one common outfall in an open flume that discharges into the Monongahela River. Considerations for biological nutrient removal were incorporated into the project as well as addressing several items in need of repair from the capital plan developed prior to the 2008 Feasibility and Preliminary Design Report.

In addition to the projects listed above from the 2008 Feasibility and Preliminary Design Report, an additional new pump station at Ripple Road was constructed and placed into operation in 2016.

Table 1 indicates the pump stations that were constructed or refurbished and modified during the recent improvements project. The table also identifies the capacity of each station and the peak day pumping rate since the SCADA system was able to record data in August 2015.

Table 1 – Recent Pump Station Upgrades

Pump Station	Condition	Capacity	Peak Day Experienced
McKeesport WWTP Pump Station	Recently refurbished with new pumps	23.5 MGD	16.1 MGD
West Shore Pump Station	Newly Constructed	31.5 MGD	20.42 MGD
28th Street Pump Station	Recently refurbished with new pumps	7.94 MGD	5.33 MGD
Cliff Street Pump Station	Recently refurbished with new pumps	7.42 MGD	6.79 MGD
Long Run Pump Station	Recently refurbished with new pumps	9.7 MGD	2.79 MGD
Ripple Road Pump Station	Newly Constructed	5.0 MGD	1.58 MGD

As noted in Table 1, the pump stations have sufficient capacity, and flow monitoring will be performed to evaluate the ability of the collection system to adequately handle projected flows.

With respect to the Perry Street, RIDC 1, and RIDC 2 pump stations, there is limited digital data recorded. However, no changes to the service area have occurred for these pump stations, and the capacity is considered adequate.

As required by NDPES Permit PA0026913, a High Flow Management Plan for the McKeesport WWTP has been developed and submitted to the PaDEP which describes the operation of the WWTP under high flow conditions. The McKeesport WWTP consists of parallel treatment trains of activated sludge treatment and SBR treatment. The flow to the two trains is controlled by a flow splitting chamber at the plant headworks, which permits all influent flows to be split in various proportions commensurate with the influent hydraulic load to maintain the biological process and solids inventory in both trains during low flow to ensure the proper biota is available when peak treatment is required and minimize potential downstream disinfection impacts. The flow splitting process is automated by a Programmable Logic Controller based on the influent flow rate and consists of an influent chamber that will cause forward flow to spill over a weir into a chamber that is proportionally divided by seven automatically operated weir gates. The placement of the gates in the effluent troughs is strategically placed to divide the flow proportionately for various flow rates which are used as set points.

In summary, all flow is pumped to the McKeesport WWTP headworks and all facilities and channels therein were designed and constructed to hydraulically convey and process flow rates totaling 56 MGD on a continuous basis without an overflow or bypass in the facility. The flow splitting chamber then limits the flow to the respective downstream processes which were hydraulically designed and constructed to accept and treat the proportional peak flows on a continuous basis without an overflow or bypass in the facility.

Duquesne Service Area

As discussed in Section 2.1, an LTCP for Duquesne was prepared in August 2014 which recommended the construction of a pump station, the addition of CSO bypass treatment, efficiency upgrades to the final clarifiers, the addition of two gravity relief sewers, and other minor improvements. The implementation of these measures, currently scheduled to begin in early 2021, will result in the elimination or capture of no less than 85 percent by volume of combined sewage collected in the CSS during precipitation events on a system-wide annual average basis.

Dravosburg Service Area

As discussed in Section 2.1, an LTCP for Dravosburg was prepared in August 2014 which recommended the addition of a new raw sewage pump station to pump all flows to the McKeesport WWTP, force main piping to the McKeesport WWTP, the utilization of the existing aeration basins for flow storage, and other minor upgrades. The implementation of these measures, currently scheduled to begin in early 2021, will result in the elimination or capture of no less than 85 percent by volume of combined sewage collected in the CSS during precipitation events on a system-wide annual average basis.

Port Vue Service Area

As discussed in Section 2.1, an LTCP will be developed for Port Vue, which is anticipated to address previously identified Significant Deficiencies in the Port Vue CSS.

4.3 Cleaning and Inspection

Refer to Sections 1.6 and 2.2.2 of this Plan for discussions of cleaning and inspections.

4.4 Facility Modification

As described previously in this section, a capacity expansion at the McKeesport WWTP and upgrades at numerous pump stations were recently completed. Pumping rates from each of the pump stations will continue to be digitally recorded and compared with pumping capacity.

4.5 Documentation and Reporting

Documentation will be submitted which demonstrates a diligent effort to evaluate alternatives for increasing flow to the McKeesport WWTP and a description of any measures which are implemented. Examples are as follows:

- A description of any planned physical changes that are part of this control.
- A cost estimate and implementation schedule for each of the changes listed above.

5.0 <u>Elimination of CSO Discharges during Dry Weather – NMC No. 5</u>

5.1 Overview

The fifth minimum control is intended to eliminate CSOs during dry weather periods when the sewer system is not conveying significant quantities of storm water. It includes control measures used to ensure that the CSS does not overflow during dry weather flow conditions, such as inspection of the system to identify dry weather overflows (DWOs), correction of the DWOs, notification to the NPDES permitting authority when a DWO has occurred, and a description of the corrective actions taken. The collection, conveyance, and treatment facilities must have sufficient capacity to be able to handle peak dry weather flow. In addition, the facilities must be properly operated and maintained to minimize the potential for overflows during dry weather (i.e. blockages, pump malfunctions, etc.).

One of the goals of the CSO control program is to prevent dry weather discharges. Dry weather discharges at CSO outfalls can occur in any CSS on either a chronic (i.e., regular or even frequent) basis or on a random basis (i.e., as a result of unusual conditions, or equipment malfunction). They are often the result of numerous site-specific conditions, including clogging by natural and manmade debris, construction activity, structural failure of the regulator, or hydraulic overloading by an unusual discharge of flow to the CSS. Control measures used to minimize DWOs include regular inspection of CSS infrastructure that impacts the CSOs, sewer cleaning, prompt response to backups, CSO outfall and regulator inspection and maintenance, and regular pump station maintenance. Chronic dry weather discharges can and should be prevented from occurring at all CSO outfalls. Responding to any reports and determining the cause of dry weather discharges occurring within the sewer system is a priority. Often, random dry weather discharges cannot be prevented, and instead are promptly identified and abated. We have not observed any outfalls which have chronic discharges.

FOG from improperly maintained discharges can accumulate on the interior of sewer collection system pipes, thereby reducing system storage and conveyance. Thus, FOG discharged to the combined sewer system can contribute to CSO events. FOG originates primarily from commercial food preparation establishments that do not have adequate grease control measures in place. Grease control equipment, such as grease interceptors and grease traps, separate and retain FOG prior to the wastewater exiting the food service establishment and entering the sewer system.

A key component of the FOG program is public education of both commercial and residential dischargers. Not only is washing grease down the drain a problem for the sewer system, but disposal of grease in a homeowner's or business's drain allows for possible blockage in the lateral and a sewer backup into the building.

In addition to public education, FOG related dry weather CSO events can be minimized by proactively cleaning and jetting sewer areas known to have issues with FOG build up.

5.2 CSO Outfall and Regulator Inspections and Maintenance

Regulators are a principal focus of inspection activity as they are most commonly the originating point for DWOs. A minimum of twice monthly inspections are conducted at the CSO outfalls and regulators. These inspections ensure that sediment accumulations and/or blockages are identified and corrected immediately to avoid dry weather overflows. The maintenance staff maintains combined sewer regulator chambers with regulator devices that control the diversion of wastewater flow to the interceptor system and storm relief diversion chambers that allow excess flow during storm events to be diverted to storm relief sewers. These regulator chambers discharge through NPDES Permitted point sources which make up the CSO outfalls. The maintenance of the chambers are critical to the performance of the system in that they control the frequency, duration and quantity of CSO discharges. The inspection program emphasizes frequent site visits aimed at clearing minor blockages before they develop into dry weather discharges. All combined sewer regulator chambers in the system are visually inspected at least two times per month and after wet weather events. Permanent flow monitors are also installed at all CSO structures, as described previously in Section 1.6. All overflow inspections conducted and maintenance performed will be documented and all overflows will be reported on the CSO Discharge Monitoring Reports which are submitted to PaDEP. Dry weather overflows shall be reported to PaDEP and the Allegheny County Health Department (ACHD) as soon as possible after discovery.

5.3 Pump Station Cleaning, Inspection and Maintenance

Refer to Sections 1.6 and 2.2.2 of this Plan for discussions of pump station cleaning, inspection, and maintenance.

5.4 Collections System Cleaning, Inspection, and Maintenance

The conveyance system is monitored through direct observation and corrective action is taken in a prompt manner if a problem occurs. Sediments, tree roots, and other items can restrict flow and result in DWOs at upstream locations in interceptors. Restrictions can be removed through sewer flushing, power rodding, balling, jetting, power bucket machines, or other common maintenance methods. Ground water can enter the sewer system by infiltration and, when combined with peak sanitary sewage flow, can exceed the capacity of the regulator. Where specific DWO problem locations can be linked to defects in localized sewer segments, repair may be appropriate as a minimum control measure.

See Sections 1.4 and 1.6 of this Plan for additional discussion of collection system cleaning, inspection, and maintenance.

5.5 Documentation and Reporting

The following documentation should demonstrate to the NPDES permitting authority the efforts to correct DWOs:

- A summary of alternatives considered and actions taken to identify and the correct DWOs
- A description of the procedures for notifying NPDES permitting authorities of DWOs and a summary of reports submitted
- A summary of periodic reports on progress toward eliminating DWOs

5.6 **Signage at CSO Outfalls**

CSO signs will be maintained and replaced promptly in the event a sign is missing or damaged. The permanent signage located at each CSO is described in Section 8.2 and examples of signage are found in the Appendix (NMC-8, Exhibit E).

6.0 Control of the Discharge of Solids and Floatables in CSOs – NMC No. 6

6.1 Overview

The goal of Minimum Control No. 6 is, where feasible, to reduce if not eliminate, by relatively simple means, the discharge of visible floatables and coarse solids from CSO discharges to the receiving water.

There are various technologies that can be used to control solids and floatables entering the receiving waters from CSOs. These technologies range from simple devices that remove the material from the CSO flow stream to devices that remove the floatables from the receiving water after they are discharged. Control practices also include efforts to prevent the extraneous solids and floatables from entering the CSS. The methods utilized to address floatables and solids are described in this section.

Floatables and solids control measures consist of non-structural and structural technologies. Non-structural technologies include combined sewer system maintenance procedures such as sewer flushing, street sweeping, and inlet cleaning. Public education, land use planning and zoning, municipal solid waste collection programs including public trash receptacles within the CSO area, and ordinances are also considered non-structural technologies implemented to reduce solids and floatables entering the combined sewer system. These technologies are included as part of the Pollution Prevention Program Section (Minimum Control No. 7).

Structural controls such as baffles, screens or racks can be included in the combined system to remove solids and floatables before reaching the receiving water. Floatables can be removed from larger receiving water with the use of booms and skimmer vessels. Baffles in CSOs and/or pipe hoods in system catch basins will be evaluated and implemented as needed.

6.2 Inlet (Catch Basin) Cleaning and Inspection

The effectiveness of a catch basin in controlling floatables is dependent on regular maintenance and cleaning. Inlets and catch basins in the system are inspected weekly and cleaned as needed and when problems are reported. Maintenance staff will document cleaning activities.

6.3 Installation Solids Capture Measures in CSOs

Screens and trash racks are a series of vertical and horizontal bars or wires designed to remove coarse and floating debris from CSOs. The efficiency of this control is based on the design size and typically ranges from 25-90 percent of the total solids. Fine screens are more effective at removing smaller particles but they are also more susceptible to clogging and require additional maintenance. The effectiveness of screening units is reduced significantly by the presence of FOG. In order for trash racks or screens to be utilized, the outfall pipe must be an adequate length or land space must be available for a small structure and outfall must be high enough above the receiving water to permit regular maintenance. Trash racks and screens require regular inspection and maintenance.

Baffles are floatable control devices that can be installed in a discharge chamber in front of the overflow weir. Baffles are simpler than many of the other control methods and they have lower operating and maintenance costs. The design of the diversion chamber flow regulator and overflow weir determines the effectiveness of the baffles. The discharge chamber and overflow weir must be designed to provide reasonably uniform flow at a low velocity to ensure that floatables are not entrained.

Baffles, bar screens, and/or other types of screening and floating controls were installed by MACM at all regulators as part of (or in advance of) the US Army Corps of Engineers Phase I and II projects approximately ten years ago. The controls will continue to be monitored during and after storm events.

6.4 **Catch Basin Modification**

The catch basin design will continue to be evaluated to assess potential improvements that may be feasibly and cost effectively implemented during the process of periodic replacement or possible retrofits to facilitate adequate storm water control, while attempting to reduce the amount of storm water and debris entering the combined system and prevent or reduce floatables from entering the combined system. Inlet grates can be installed at the top of the catch basins to reduce the street debris that can enter. Trash buckets can be installed in the basin below the grate to retain floatables while letting the stormwater pass to the combined system. Hoods are vertical cast iron baffles that are installed in basins. Hoods are effective for retaining debris within catch basins. A basin can be modified with a vortex valve, which is a throttling device to reduce the frequency and volume of a CSO event and control floatables.

Regulator and diversion chambers will be inspected twice monthly and cleaned as required. The inspection and cleaning will be documented.

End-of-Pipe Controls are not currently in place in the system. We have not found these controls to be effective for the system.

6.5 **Street Sweeping**

Street sweeping can be an effective method to control the amount of street debris entering the combined system. See Section 7.2 for a discussion of the street sweeping program.

6.6 **Waterways Restorations**

Receiving water removal methods are not currently utilized in the receiving water.

6.7 **Outreach**

PAW's website will include public information about combined sewer systems as well as key messages regarding the importance of keeping storm sewers free of debris and litter.

The company will partner with stakeholders in the MACM service area communities, including local municipalities, watershed groups, and conversation groups, and will utilize social media to reinforce/communicate key messages.

PAW also will continue the outreach campaign targeted to local students in the service area as described in Section 8.2.

7.0 <u>Pollution Prevention Programs – NMC No. 7</u>

7.1 **Overview**

The seventh minimum control is the implementation of pollution prevention programs to reduce contaminants in CSOs. The objective of this control is to reduce to the greatest extent possible, the amount of contaminants that enter the combined sewer system, and thus receiving waters via CSOs.

7.2 **Existing Programs**

Pollution prevention programs help to reduce the amount of contaminants and floatables that enter the combined sewer system. The following pollution prevention programs have been undertaken either by PAW, the City of McKeesport, the City of Duquesne, the Borough of Dravosburg, and/or the Borough of Port Vue.

1. Street Cleaning
2. Solid Waste Collection and Recycling
3. Bulk Refuse Disposal
4. Yard Waste
5. Water Conservation Program
6. Catch Basin Cleaning
7. Litter Control
8. Hazardous Waste Collection
9. Public Education

Street cleaning practices can remove a considerable solids load from the watershed surface, preventing litter, debris, and sand deposited on streets from entering catch basins and the combined sewer system and thus entering the receiving streams. The City of McKeesport performs street sweeping at least once per month, and more frequently if needed. Additional street sweeping also occurs following each storm event. MACM and the City of McKeesport have an existing street sweeping agreement, which will be updated to reflect PAW as the owner of the system. PAW will also work with the City of Duquesne, the Borough of Dravosburg, and the Borough of Port Vue to attempt to obtain street sweeping agreements with these municipalities.

The two Cities and two Boroughs have solid waste collection and recycling programs that support pollution prevention as a CSO control. These activities are performed by third party solid waste collection companies for the Cities of McKeesport and Duquesne, and the Boroughs of Dravosburg and Port Vue. All household refuse is collected once per week from the curb or alley in the four municipalities. Recycling is provided on a bi-weekly basis in the four municipalities.

In the Cities of McKeesport and Duquesne and in the Borough of Port Vue, yard wastes can be picked up by the municipality upon the request of the homeowner. The Borough of Dravosburg picks up yard wastes on a quarterly basis.

All four municipalities hold an electronic waste collection event once per year. Additionally, the City of Duquesne, as part of the contract with its third party solid waste collection company, offers a home collection program for certain household generated materials. Items that can be collected include, but are not limited to, household chemicals, batteries, light bulbs, televisions, computer equipment, and small electronics. Residents of Duquesne schedule a collection appointment for pickup at their home, and are provided with a collection kit including instructions for packing the materials.

The Pennsylvania Resources Council (PRC) holds Hard-to-Recycle collection events several times per year throughout western Pennsylvania. Items collected at the Hard-to-Recycle events include but are not limited to electronic goods such as computers, small electronics, and televisions; batteries; light bulbs; and tires. Some items are collected at no cost and others require a fee. The PRC also holds Household Chemical Collection events several times per year in western Pennsylvania, where leftover hazardous household chemicals are collected for a small fee. These events provide residents with a means of disposing household chemicals, and an additional means of disposing electronics beyond the once-yearly municipal collection events. The Borough of Dravosburg's website provides links to PRC's current calendars for Hard-to-Recycle and Household Chemical collection events.

The websites for the Boroughs of Port Vue and Dravosburg both provide information to residents regarding the importance of preventing household chemical pollution from entering the local drainage systems, and ultimately into local streams and rivers.

To assist in litter control, the City of McKeesport previously purchased and installed twenty-five 55-gallon drums to use as trash receptacles at the locations where the public may congregate.

Cleaning of inlets and catch basins in the collection system is a routine maintenance activity conducted by MACM, which will be continued by PAW, utilizing Vactor trucks.

Each year, a review will be conducted to evaluate the effectiveness of the overall pollution prevention program and the need for further educational efforts within the McKeesport, Duquesne, Dravosburg, and Port Vue service areas. Any improvements, modifications or evaluations of the program conducted during the reporting period, will be documented and reported.

7.3 Existing Public Information and Education Programs

Promoting public awareness of CSOs and their harmful impacts on receiving waters can significantly reduce the amount of pollutants and floatables able to enter waterways. Well-informed consumers are usually empowered to make small behavioral changes to assist in pollution prevention efforts and in reducing the amount of litter, contaminants on the streets, and the amount of floatables and pollutants in the receiving waters.

The company has numerous community partners, whom will be utilized to promote best practices regarding stormwater infiltration. PAW will focus on communicating the CSO LTCPs through educational materials and public outreach events with our partners to raise awareness on effective stormwater management and the importance of minimizing discharges into the collection system.

MACM has conducted public outreach efforts in the past by contacting formal and non-formal groups throughout the communities, such as the McKeesport Collaborative, to provide an informational brochure which explains the nature of a combined sewer system and combined sewer outflow, and identifies various preventative measures that could be taken by all members of the community including local litter campaigns. Catch basins are also marked to inform residents that sewers are inappropriate waste disposal sites. Public outreach efforts will continue to be used to educate residents on the importance of not littering in order to keep the municipalities clean.

PAW will provide information regarding pollution prevention on its website. PAW's website will be used to provide educational information regarding recycling, proper disposal of waste, and proper fertilizer and lawn care products application. In addition, pollution prevention information will be included in water/sewer bills. The PAW brochure highlights the details of the PAW pollution prevention program and how the public can get involved in pollution prevention. PAW personnel will also distribute this educational material during staff participation in public meetings, demonstrations, talks or conferences whenever such opportunities present themselves in order to further educate the public on its role in the program.

PAW sponsors a "Protecting Our Watersheds" art contest each year for fourth-, fifth-, and sixth-grade students in the company's service area. The contest encourages teachers and students to learn more about the importance of our local watersheds and their role in protecting them. The annual contest opens in January, with judging and prize notifications taking place around Earth Day (April 22).

Additionally, PAW partners with local environmental groups to sponsor its annual Wonders of Water Camp for students 7-11 years old. The three-day camp educates students about the water cycle, importance of water and our watersheds.

PAW has working relationships with a number of local environmental organizations working to benefit our watersheds, including:

- 3 Rivers Wet Weather Organization
- Allegheny County Sanitary Authority (ALCOSAN)
- Pennsylvania Environmental Council

8.0 <u>Public Notifications – NMC No. 8</u>

8.1 Introduction

The eighth minimum control is public notification to inform the public of the location of CSO outfalls, the actual occurrences of CSOs, and the potential health and environmental effects of CSOs. The principal benefit of a notification program is to reduce the potential public health risks in affected areas, and to increase public awareness of CSOs. The methods used are intended to provide reasonable assurance that the affected public will be informed in a timely, cost effective manner.

8.2 Public Notification Measures

As required by the ACHD, at the time of a potential wet weather event, MACM currently displays a CSO flag at its McKeesport WWTP, which is located adjacent to the McKee's Point Marina and Boat Club along the Monongahela River. MACM has also installed signs and information on the outfall structures to alert the public of a potential health impact of CSO discharges. These practices will be continued by PAW.

MACM has developed a children's education program to inform school students and children about the environmental impact of CSOs, the nature of wastewater treatment, and explain the importance of the implementation of these controls. MACM performs this education program at the surrounding schools in McKeesport, Duquesne, and South Allegheny on or around Earth Day (April 22) each year. MACM also holds an informational booth at the City of McKeesport's International Village event held every year in August. PAW will continue participating in these programs upon acquisition of the MACM system.

The permanent signage located at each CSO will be revised with the following or similar language: "WARNING- Combined Sewer Overflow Point – Pollution May be Present When Outfall is Discharging – CSO Outfall No. ___ NDPES Permit No. ___ For More Information, Call Pennsylvania American Water District xxx-xxx-xxxx;" or "CAUTION – During and After Rain Events – The water in this stream may be contaminated by a temporary overflow or sewer. Physical contact with the water may pose a health risk. For additional information, call xxx-xxx-xxxx." Examples of signage are found in the Appendix (NMC-8, Exhibit E).

PAW provides educational materials in bill mailings and online through the company's website and social media channels. PAW will continue to provide educational materials to residents and local stakeholders. PAW also provides information on water conservation and household water use via bill inserts, website and social media. Conservation information is also shared at community events, such as senior fairs, environmental events, and presentations to civic and school groups throughout the year. Household conservation devices are available to customers enrolled in PAW's low-income assistance program, H2O – Help to Others.

PAW's website will provide information to residents about the sewer system and proper operation of the system. Also, the site includes appropriate precautions, risks, potential health hazards, locations and occurrences of CSO discharges and incidents of DWOs. The website is also an important method of informing the public of system upgrades and projects.

Social media has become a very useful tool to pollution prevention, helping to spread information about these programs. PAW utilizes multiple social media pages, such as Facebook (www.facebook.com/pennsylvaniaamwater), Twitter (@paamwater), Instagram (@paamwater), and YouTube (@paamwater). Social media sites are used to educate and inform customers about a variety of topics and issues, as well as emergency notification.

Public awareness programs and events will be centerpiece of our stormwater awareness efforts. This approach will also be used to notify stakeholders about projects, so that the public can adapt this information to help implement stormwater management and green infrastructure on their properties and in their communities.

PAW will participate in community activities and events to discuss planned projects with various neighborhood and civic organizations. These events enable the company to gain community input on work that the public would like to see. Community meetings will also give the company a chance to answer questions and disseminate information about key issues, such as stormwater management, CSO, green infrastructure, and other pollution prevention initiatives.

PAW supports numerous watershed groups and stream restoration efforts through the company's Environmental Grant Program and other types of partnerships. PAW has strong working relationships with state and local environmental groups, including the Pennsylvania Environmental Council, which can help the company develop and implement a Public Education and Outreach Program. The company regularly conducts educational programs at schools and in the community and supports volunteer opportunities for public involvement.

9.0 Monitoring to Characterize CSO Impacts and the Efficacy of CSO Controls-NMC No. 9

9.1 General

Monitoring and characterization of CSO impacts from a combined wastewater collection and treatment system are necessary to document existing conditions and to identify any water quality benefits achievable via CSO mitigation measures.

The purpose of the ninth minimum control is to perform visual reviews and apply other simple methods to characterize the CSO occurrences and impacts. Limited sampling and water quality analysis may also be performed to improve knowledge concerning CSO characteristics and potential water quality impacts.

PAW has instituted many programs, reports, and activities that demonstrate and document the efforts taken to monitor and evaluate CSOs. These initiatives are constantly being updated and evaluated for improvements. This plan has supplied many methods for assessing the relative effectiveness of implementing of a number of the Nine Minimum Controls.

- For instance, MACM's current Operation & Maintenance tracking system described in Section 1 and the flow monitoring systems referenced in Section 5 provide the basis to track, document and quantify the performance of Operation & Maintenance activities (Minimum Control No. 5). MACM visually inspects CSO discharges and documents apparent impacts. Observations of debris discharged from the CSOs is recorded on inspection forms. MACM characterizes the frequency, duration and volume of CSO discharges on a monthly basis in the Discharge Monitoring Reports (DMR). Inspections document the dates the regulators were checked and presence/absence of previous overflows. This information is provided with the monthly DMRs. These practices will be continued by PAW and the Operation and Maintenance activities will be incorporated into PAW's SAP system.
- Additionally, hydraulic and hydrologic models of the CSS can be used if needed to characterize and quantify the relative effectiveness of implementation of Minimum Control No. 2, Minimum Control No. 4, and Minimum Control No. 5. MACM employs flow meters to monitor CSO activations and volumes. PAW will continue to monitor flow with the existing permanent flow metering equipment at CSO regulators and pumping stations. Continuous flow monitoring at these select sites will provide information and documented data on frequency, duration and volumes of wet weather overflows. Rain gauges have been installed throughout the sewer system. Dry weather overflows will be recorded when observed or when determined from public calls. PAW will document and track public complaints after receiving them.
- Analyses are performed for assessing the potential for modifications to PAWs pretreatment program to reduce industry-related impacts on CSO discharges.

The following CSO Post Construction Monitoring Plan, as required by the MACM LTCP, has been submitted for PaDEP's review and approval:

1. Identify locations for stream water quality monitoring.
2. Complete dry weather sampling at each monitoring location.
    - Three (3) sampling events at each monitoring location between May 1 and October 31.
    - Three (3) sampling events at each monitoring location between November 1 and April 30.
    - Sampling to include Carbonaceous Biochemical Oxygen Demand (CBOD), TSS, alkalinity, ammonia-N, fecal coliform, pH, temperature, and dissolved oxygen upstream and downstream of the CSO outfall pipe discharge.
    - Upstream and downstream sample locations shall be taken approximately 100 feet from the CSO outfall location, and 10 feet from the river bank.
    - Sampling to be completed during a time with no rainfall for the preceeding time period of at least 72 hours.
3. Complete wet weather sampling.
    - Three (3) sampling events at each monitoring location between May 1 and October 31.
    - Three (3) sampling events at each monitoring location between November 1 and April 30.
    - Sampling to include CBOD, TSS, alkalinity, ammonia-N, fecal coliform, pH, temperature, and dissolved oxygen upstream and downstream of the CSO outfall pipe discharge.
    - Upstream and downstream sample locations shall be taken approximately 100 feet from the CSO outfall location, and 10 feet from the river bank.
    - Sampling to be completed during a period of significant rainfall when CSOs are expected to be active.
    - Photographs of the diversion chamber overflow, outfall discharge, receiving stream upstream and downstream of the outfall discharge shall be taken for each CSO event.
4. Prepare report.
    - Compare stream constituents upstream and downstream of CSOs outfall pipe.
    - Report rainfall depth and duration corresponding to each wet weather sampling event.
    - Report CSO volume, based on CSO Meter Data, corresponding to each event.
    - Report to be completed and submitted to DEP within six months of completion of water quality monitoring.

The proposed sampling will proceed after approval from PaDEP.

9.2 Reports

9.2.1 Monthly DMR Supplemental Reports for CSOs

Once per month, MACM submits, and PAW will continue to submit, a Monthly CSO Inspection Report and Detailed Outfall Report to PaDEP documenting the CSO discharges that occurred during the previous month. The Inspection Report lists all CSOs and indicates which ones had a discharge at any time during the calendar month. If there were any discharges, the Detailed Outfall Report indicates the discharge volume, method used to determine volume, duration of the discharge, cause of the overflow, and precipitation amount for the day. The report is due 28 days after the end of each month.

9.2.2 CSO Control Program Annual Reports

Every year, PAW will provide an overview of all the activities and programs pertaining to components of the CSO Control Program.

PAW will prepare and submit to PaDEP an Annual Municipal Wasteload Management report in accordance to PA Code § 94.12 ("Chapter 94 report"), which is intended to provide a review of sewerage facilities for the preceding calendar year to ensure that progress is being made to address existing operational or maintenance problems, or to plan and construct needed additions. The purpose of this regulation is to prevent unpermitted and insufficiently treated wastewater from entering waters of the Commonwealth by requiring the owners and operators of sewerage facilities to project, plan, and manage future hydraulic, organic and industrial waste loadings to their sewerage facilities.

PAW will also submit to PaDEP an Annual CSO Status Report which documents an overview of all its activities and programs pertaining to the CSO portion of the NPDES permits. This report is conducted in accordance with the NPDES permits that are reported to PaDEP and is submitted with the annual Chapter 94 report.

The Annual CSO Status Report will contain information on rainfall, inspections and maintenance, dry weather overflows, and wet weather overflows. The Annual CSO Status Report will include the following elements:

- Summary of the frequency, duration, and volume of CSO discharges during previous year;
- Operational status of overflow points;
- Identification of known in-stream water quality impacts, their causes, and their effects on downstream water users;
- Summarize all actions taken to implement the NMCs and the LTCP and their effectiveness; and
- Evaluate and provide a progress report on implementing and necessary revisions to the NMC Plan and LTCP.

EXHIBIT A

PENNSYLVANIA AMERICAN WATER COMPANY CSO INSPECTION LOG

CSO No: ______________________________ CSO LOCATION :__________________________________

DATE: _____/_____/_____ TIME :__________ AM/PM

WEATHER: CLEAR DRY OVERCAST RAIN SNOW TYPE OF INSPECTION: RAIN EVENT_____BI-WEEKLY INSPECTION

INSPECTOR:_________________________

VISUAL Inspection

IS THERE A DISCHARGE? YES NO

CAUSE OF DISCHARGE : LINE BLOCKAGE EXCESSIVE FLOW OTHER (Explain in Comment section)

RAINFALL ESTIMATE: _______ INCHES TIME OF RAINFALL: START_______ STOP________

Is there evidence of erosion? YES NO

IF DISCHARGING TO STREAM

Are there any solids or floatables being discharged to river	Yes	No
Is there a visible plume in stream	Yes	No
Were samples taken up stream of discharge	Yes	No
Were samples taken of discharge	Yes	No
Is outfall structure in need of repairs	Yes	No

COMMENTS:

____

____

____

PENNSYLVANIA
AMERICAN WATER

EXHIBIT B

INDUSTRY: ____

SAMPLE DATES: ____________ - ____________

Report Complete ☐yes ☐no

TTO Stmt: ☐yes ☐ no ☐ n/a Cert Stmt: ☐ yes ☐ no ☐ n/a

COC: ☐ yes ☐ no ☐ n/a Sampling Results: ☐ yes ☐ no ☐ n/a

Resampling Results: ☐ yes ☐ no ☐ n/a Flows: ☐ yes ☐ no ☐ n/a

Manifest: ☐ yes ☐ no ☐ n/a

ENTERED INTO LINKO: ☐ yes ☐ no

VIOLATIONS PRESENT: ☐ yes ☐ no ☐ n/a SNC ☐ NC ☐

If yes, describe____

Resampling Results Attached: ☐ yes ☐ no

Surcharges Applicable: ☐ yes ☐ no
Invoice #:________________
Entered in QuickBooks: ☐ yes ☐ no

Surcharge $: _______

- Elevated: Ammonia ☐ yes BOD ☐ yes

Ammonia:	Day 1:________	Day 2:________	Day 3:________	Avg:________(23.0mg/l)
BOD:	Day 1:________	Day 2:________	Day 3:________	Avg:________(330.0mg/l)
pH:	Day 1:________	Day 2:________	Day 3:________	Avg:________(6.0-9.0)

Flow Avg (Gals):)____________________ Flow Total (Gals):________________

RECV'D ON TIME: ☐ YES ☐ NO
- At least Ten Days Late: ☐ yes ☐ no

SCANNED: ☐ yes ☐ no

ENTERED INTO MIPP QUARTER REPORT: ☐ yes ☐ no Date:__________

SURCHARGE SENT: ☐ yes ☐ no ☐ n/a

NOTICE OF VIOLATION(S) SENT: ☐ yes ☐ no ☐ n/a Date:__________

PENNSYLVANIA
AMERICAN WATER

EXHIBIT B

November 4, 2015

Company
Address
Address

Re: Quarterly Outfall FAC monitoring results
Permit No.______________________

Ms/Mr:

Enclosed please find the monitoring results for (company), permit #________ for the 4th quarter 2016.

Please do not hesitate to contact me should you have any questions on the enclosed material.

Sincerely,

Name
Title

cc: file

EXHIBIT B

PENNSYLVANIA
AMERICAN WATER

January 14, 2016

Company
Address
Address

Re: Waste Permit No.______________ Quarterly Flow Report

Ms/Mr:

Below please find the monthly flow for the 4th quarter 2015. Unfortunately, we only have flow for the month of October and half of November, due to the flow meter not functioning. This was discovered on Monday, January 11th and the meter was fixed on Thursday the 14th. As soon as it was realized that the meter was not functioning correctly, it was fixed. We also spoke on 1/14/15 to keep you updated on the situation.

October 2015
1384 gallons

November 2015 (through November 16th)
816 gallons

December 2015
0 gallons recorded

Please do not hesitate to contact me should you have any questions on the enclosed material.

Respectfully Submitted,

Name
Title

cc: file

PENNSYLVANIA
AMERICAN WATER

EXHIBIT B

CERTIFICATION STATEMENT

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those directly responsible for gathering the information, the information submitted is to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

____________________	______________________________
Date	Signature of Official
____________________	______________________________
Phone	Title

PENNSYLVANIA
AMERICAN WATER

EXHIBIT B

TOTAL TOXIC ORGANICS STATEMENT

Based on my inquiry of the person or persons responsible for managing compliance with permit limitation or pretreatment standards for Total Toxic Organics (TTO), I certify that to the best of my knowledge and belief, no dumping of toxic organics into the waste water has occurred since the filing of the last discharge monitoring report. I further certify that the facility is implementing the toxic organic management plan submitted to the Control Authority.

______________________	______________________________
Date	Signature of Official
______________________	______________________________
Phone	Title

October 26, 2015

Attn: Name
Address

PENNSYLVANIA
AMERICAN WATER

EXHIBIT B

Address

Re: 2015 – 4th Quarter Pretreatment Sampling

Date Sampled: Day 1 – 10/06/15
Day 2 – 10/07/15
Day 3 – 10/08/15

Sampled By: "Company"
Sample Type: Wastewaster; 1-hour Composite (pH, CN, O&G, TPH, Toluene – Grab)
Sample Location: Sanitary Pump Station (FAC)
Sample Description: Discharge to Sewer
Laboratory IDs: Day 1 – 1510-07-07
Day 2 – 1510-08-07
Day 3 – 1510-09-07

Parameter	Method	Date(s) Analyzed (Day 1 to Day 3)	By	Day1 Results (mg/l)	Day 2 Results (mg/l)	Day 3 Results (mg/l)	Daily Mac (mg/l)
Arsenic	SM3113B	10/20/15	TDK	<0.005	<0.005	<0.005	0.20
Cadmium	SM3111B	10/15	TDK	0.002	0.002	<0.001	0.026
Chromium +6	SM3500CrD	10/07/15,10/08/15,10/09/15	TDK	<0.010	<0.010	<0.010	0.42
Chromium	SM3111B	10/20/15	TDK	0.009	0.003	0.001	6.00
Total Copper	SM3111B	10/20/15	TDK	0.037	0.022	0.023	2.00
Lead	SM3111B	10/20/15	TDK	0.009	<0.005	<0.005	0.69
Mercury	SW8467470A	10/15/15	(1)STL	<0.0002	<0.0002	<0.0002	0.02
Nickel	SM3111B	10/20/15	TDK	0.012	0.008	0.00	3.00
Silver	SM3111B	10/20/15	TDK	0.002	0.001	0.001	0.43
Zinc	SM3111B	10/20//15	TDK	0.164	0.117	0.1309	2.50
pH (std.units)	SM4500HB	10/06/15,10/07/15,10/08/15	TDK	7.22@18.0°C	7.86@18.4°C	6.82@18.2°C	6.0-9.0
Ammonia Nitrogen	SM4500NH3BD	10/26/15	TDK	56.8	71.0	62.8	350
BOD-5 Day	Sm5210B	10/07/15,10/09/15,10/09/15	TDK	231.	166.	183.	5,300
Cyanide	SM4500CNCE	10/19/15	TDK	<0.005	<0.005	<0.005	0.80
Oil & Grease	SM5520B (N Hexane)	10/15/15	TDK	Not Tested	Not Tested	Not Tested	1,500
TPH	EPA1664A (N Hexane)	10/15/15	TDK	Not Tested	Not Tested	Not Tested	100
Toluene	EPA624	10/14/15	(1)STL	0.231	Not Tested	Not Tested	2.1

[1] Analysis completed by Suburban Testing Labs PADEP 06-0008

Results that exceed any limits are indicated by **Bold Red** font

Note: All analyses performed in accordance with US EPA approved analytical methods (Reference 40 CFR 136), including EPA acid digestion procedures (3010A/3020A). This report includes the attached Chain-of-Custody Form and has been reviewed and approved by the person signed below. The report is accurate to the best of our knowledge.

Quarterly Pretreatment FAC Sampling

Analysis conducted using the following Reporting Detection Limits (RDL)

PENNSYLVANIA AMERICAN WATER

EXHIBIT B

Parameter	RDL (mg.l)
pH @ 16.2°C	NA
Ammonia as N	0.100
BODS	2.0
Cyanide	0.005
Oil & Grease	5.0
TPH	5.0
Arsenic	0.005
Cadmium	0.001
Chromium, Hexavalent	0.010
Chromium, total	0.001
Copper	0.001
Lead	0.005
Mercury	0.0002
Nickel	0.002
Silver	0.001
Zinc	0.001
Toluene	0.005

Parameter	Laboratory ID	Date Analyzed	Time Analyzed
Chromium +6	1510-0707	10/07/15	10/07/15 09:40
Chromium +6	1510-07-08	10/08/15	10/08/15 10:05
Chromium +6	1510-07-09	10/09/15	10/09/15 10:05
pH (std. units)	1510-07-07	10/06/15	10/06/15 07:40
pH (std. units)	1510-07-08	10/07/15	10/07/15 07:30
pH (std. units)	1510-07-09	10/08/15	10/08/15 07:30
BOD – 5 Day	1510-07=07	10/07/15	10/07/15 12:30
BOD – 5 Day	1510-07-08	10/09/15	10/09/15 13:00
BOD – 5 Day	1510-07-09	10/09/15	10/09/15 13:00

Sincerely,

PENNSYLVANIA
AMERICAN WATER

INDUSTRIAL PRETREATMENT INPECTION REPORT

Permit No:__________ Inspection Date: __________ Time: __________

1. GENERAL INFORMATION:
   a. Facility Name:______________________________
   b. Parent Company or Affiliation:______________________________
   c. Facility Street Address:______________________________
   d. Facility Mailing Address:______________________________
   e. Date Present Operation Began at this Facility:______________________________
   f. (1) Facility Contact Person:______________________________
      Position/Title:______________________________
      Phone #______________________ Cell #______________________
      Fax #______________________________
      (2) Facility Contact Person:______________________________
      Position/Title:______________________________
      Phone #______________________ Cell #______________________
      Fax #______________________________

      Facility Personnel Present at Inspection:______________________________
      ____

2. PRODUCT OR SERVICE INFORMATION:
   a. Narrative description of the primary manufacturing or service activity at the facility:

      ____
      ____
      ____
      ____
      ____
      ____

b. Kind of Operations: Continuous_____ Seasonal_____ Batch_____

Hours & Days of Operation - Explain:______________________________________

____

____

____

c. Major Raw Materials Used:

____

____

____

d. Major Products or Services of the Operation:

____

____

____

e. List all other activities, specific products, and services from this facility e.g., laboratory, research, etc.

____

____

____

3. WATER SOURCES AND USE:

a. Raw Water Sources:

Public Water Supply: Yes_____ No_____ Specify_______________

Private Wells(s): Yes_____ No_____ Specify_______________

Surface Water: Yes_____ No_____ Specify_______________

b. Is the raw water source metered: Yes_____ No_____ Explain means of measuring the water flow: ____

c. Average Daily Water Usage:

____

d. Describe any water treatment, water conditioning, or purification process utilized:

____

____

____

e. The company provided an updated process water flow schematic diagram: Yes___ No___

____

4. WASTEWATER INFORMATION:

a. Discharge Method:

1._____public sewer
2._____surface water
3._____storm drain
4._____ground discharge
5._____waste hauler

b. Source of Public Wastewater:

1.______________________
2.______________________
3.______________________
4.______________________
5.______________________

b. Discharge flow is measured: Yes_____ No_____. If yes, describe the means of flow measurement:____

____

c. Typical flow of discharge: ______________________ per day,

______________________ per year.

d. Kind of discharge: Continuous _____, Batch _____, Continuous-seasonal _____
If batch or continuous seasonal, explain flow, frequency, and quantity per batch:

____

____

____

e. List names of the 4 major chemical constituents in discharging waste:_____________

____

____

f. Discharge contains Categorical Standards: Yes _____ No _____

If yes, list applicable subpart:____

____

5. WASTEWATER PRETREATMENT:

EXHIBIT C

a. Does the facility have an active pretreatment program? Yes _____ No_____
If yes, what type of flow? Continuous __________ Batch __________

b. Is the process wastewater pretreated prior to discharge to the public sewer?
Yes _____ No _____ Describe:____

____

____

c. Is this facility operation under a compliance schedule to install pretreatment?
Yes _____ No_____ Explain:____

____

____

____

d. Is process wastewater completely separated from the sanitary waste?:
Yes _____ No _____ Includes schematic flow charts of both process waste and sanitary waste. The charts should show the points of generations (different units making the waste), discharge points to the main collection line, all the floor drains, flow directions, points of treatments, and points of discharge to sewer for both waste flows.
Copy attached: __________ On file?:__________ Copy requested by PAWC?________

e. In pretreatment of process waste, what parameters require major attention and relatively extensive effort to comply with the permit requirements?

____

____

____

f. Describe any method/procedure that has been adopted and also any future plan that is under consideration by the facility management to reduce the volume and/or strength of the process waste at the point of generation.

____

____

____

g. Kind of treatment process: Physical _____ Chemical _____ Biological ____
Combination of some _____. If a combination , explain the process:

____

____

____

____

h. Describe the mechanism or means involved in the pretreatment process:

____

____

____

____

i. Include a schematic flow chart of the pretreatment facility and show all the units and different steps of the process.
Copy attached? _____ On file? _____ Copy requested by PAWC? _____

____

____

j. Explain the chemical(s) that are added during pretreatment process and their specific purpose?____

____

____

____

k. If the discharge flow is continuous, explain what parameters (in addition to the requirements) are measured, and on what frequencies (daily, weekly, quarterly):

____

____

l. What means/methods of quality control are used for in-house monitoring of these parameters? ____

____

____

m. List the name, address and phone number of the engineering consultant firm or the individual engineer who assisted with the design of the pretreatment facility:

____

____

n. Name of the analytical laboratory who analyses the self-monitoring samples:

____

____

o. Does the analytical laboratory personnel also perform the sampling? Yes____No____

____

If no, name the person(s) who sample and deliver to the laboratory:

____

p. Name the person who operates the pretreatment facility:____________________

What are said person's credentials:______________________________
Is said person a certified operator for industrial waste treatment? Yes____ No_____
If no, explain what technical training they have:__________________________

____

q. Does the pretreatment facility generate any sludge or other residuals as a result of its operation? Yes _____ No ____ Explain: ______________________________

____

____

____

____

What chemical or chemicals are used in the dewatering process?_______________

____

____

What are the percent solids in the dewatered sludge and the monthly average solids generated? %TS: __________ Monthly Average (lb/mo): __________
How are the solid wastes stored? ______________________________

____

____

r. What is the disposal method of dewatered sludge? Recycling______ Landfill_____

Others_____ Explain:______________________________________

____

____

s. Do you use or operate any in-house recycling/recovery method? Yes_____ No _____ N/A _____ If yes, explain: ____

____

____

t. Recommendation of the inspector for pretreatment facility condition, operation and self-monitoring procedure:____

____

____

____

____

____

____

____

____

6. WASTE:

a. Does this facility generate any waste process materials such as spent solvents, spent acids, base, etc.? Yes_____ No _____ If yes, explain:______________________________

____

List quantities generated per month:______________________________

____

How are the waste process materials disposed?______________________________

____

How are the process materials stored?______________________________

____

b. Does this facility generate any solid waste as a result of its operation? Yes_____ No_____ If yes, explain:______________________________

____

List quantities generated per month:______________________________

____

How are the waste process material disposed?:______________________________

____

How are the waste process materials stored?:______________________________

____

c. Does this facility have a designated or centralized area for the storage of hazardous waste?
Yes _____ No _____ Explain/Comment:____

____

____

____

7. AIR POLLUTION:
   a. Are there any process tanks greater than 100 gallons? Yes _____ No _____
   Specify:____

   ____

   ____

   ____

   b. Are there any heated surface cleaners (e.g., vapor degreasers, etc.)?
   Yes _____ No _____

   c. Does the facility have any exhaust systems in conjunction with the process operation (e.g., plating tanks, painting rooms, vapor degreaser, etc.)?
   Yes _____ No _____ if yes, is the system registered? Yes _____ No _____
   Describe:____

   ____

   d. Are there any air pollution control devices: Yes _____ No _____
   Explain: ____

   ____

8. CHEMICALS USED AND IN POSSESSION:
   List, in this section, all the chemical names, describe in what forms (liquid, slurry, powder, and granule) they are used, mark approximate quantities used (lb/yr), and describe the purpose they are used for (industrial process, laboratory use, pest control, etc.). If chemical group is not found in a group name in the following, list them under "others."
   Example: Hydrochloric Acid (500 lb/yr, liquid, process)

   a. Acids: ____

   ____

   ____

   ____

   b. Ammonium Compounds (ammonia, ammonium hydroxide, ammonium chloride, ammonium nitrate, ammonium persulfate, etc.):

   ____

   ____

   ____

c. Hydroxides/Caustic materials (sodium hydroxide/caustic soda, potassium hydroxide, etc.):____

d. Inorganic Salts (chloride):____

e. Trace Metals (Arsenic, Cadmium, Chromium, Copper, Lead, Mercury, Nickel, Silver, Zinc, etc.):____

f. Regulated Volatile Organic Compounds (VOCs) and Solvents (acetone, benzene, ethylene glycol, formaldehyde, methylene, toluene, xylene):____________________

g. Regulated Synthetic Organic Compounds (SOCs) (various herbicides, pesticides, fungicides, and insecticides:____________________________________

h. Biological Cell Products (bacteria, viruses, etc.):______________________________

i. Nuclear Materials (Uranium, Radium, Cobalt Isotope, Nickel Isotope, etc):

j. Liquid Chlorine (Hypochlorite) and Chlorine Gas: ______________________

____

____

____

k. Surfactants (detergents, fabric softeners, emulsions, paints, adhesives, biocides, etc.):

____

____

____

l. Explosive Materials: ______________________________

____

____

____

m. Enzyme Products: ______________________________

____

____

____

n. Motor Oil, Industrial Oil, Hydraulic Fluid, etc.: ______________________

____

____

o. Cooking Grease: ______________________________

____

p. Sugar Syrup, Maple Syrup, Liquid Starch, Glucose and Fructose:

____

____

____

q. Protein-based Products (proteins, amino acids, etc.): ______________________

____

____

r. Others: ______________________________

____

____

9. CHEMICAL STORAGE ROOM:
Describe, in this section, the factors/parameters related to the chemical storage room(s). The factors include: location and size of chemical storage room or stock room, arrangement of different chemicals and distance from the closest floor drain:

a. Are there raw organic solvents stored in an area appropriately safeguarded against spills reaching the sewers? Yes_____ No_____ Explain:______________________________

____

b. Are there spent organics stored in an area appropriately safeguarded against spills reaching the sewers? Yes_____ No_____ Explain:______________________________

____

c. Do you have a slug control plan? Yes_____ No_____ If yes, provide PAWC with a copy of the plan:____

d. Have adequate hauling procedures been developed to prevent the organics used during the process operations from reaching the sewer in amounts exceeding Federal and Local Standard? Yes_____ No_____ Explain:______________________________

____

e. How are the organic solvent used onsite disposed? Explain:______________________

____

f. Do you use a licensed hauler to haul your hazardous chemicals?

Name:______________________________________ Phone:_______________________

Hauling Manifest No.:____

g. Do you have a designated chemical storage room? Yes_____ No_____
If yes describe:____

____

h. Do you have a designated chemical storage area? Yes_____ No_____
If yes describe:____

____

i. Are the reactive chemicals stored separately? Yes_____ No_____
If yes, describe:____

Ventilation of chemical storage room or area: Yes_____ No_____ Describe:________

____

Adequate ventilation __________ Inadequate ventilation________ Describe:________

____

Storage room security (door, lock, etc.): Yes____ No____ Describe:____________

____

Fire protection means: Adequate_____ Inadequate_____ Describe:______________

____

Distance of storage room, or area, to the points of use:

____

____

j. Chemical Transportation: Describe means of transport of chemicals from storage room or area to points of use (fork lift, hand truck, by hand, etc.):__________________________

____

10. CHEMICAL SPILL CONTAINMENT::

a. Chemical Spill Containment: Yes_____ No_____ No. of Containments:____________
b. Describe type, shape, and size of each containment:

____

____

____

____

c. Structure of the containments (concrete, blocks, metal, double-wall container, spill skids etc.)::

____

____

____

____

d. Are the containment's volumes adequate to hold the maximum spill? Yes_____ No_____
e. Are any floor drains in the containment area or in the vicinity of the storage room or area? Yes_____ No_____ If yes, explain the possibility of spill into the drain:

____

____

11. EMERGENCY SPILL PLAN:

a. Do you have a written emergency plan? Yes_____ No_____ Under preparation______
Copy attached?_____ On file?_____ Copy requested by SSA?_____

b. Do you have a designated group or persons for an emergency: Yes_____ No_____

If yes, provide PAWC with the names and phone numbers:________________________

Is any type of emergency drill practiced? Yes_____ No_____
How often?____

c. Is any general all-staff emergency training given? Yes_____ No_____
What is the date of the latest training?__________________________________

d. Do you conduct general staff safety meetings? Yes_____ No_____
How often?____

e. Do you have a designated outside spill clean up team/company: Yes_____ No_____
If yes, provide PAWC with the names and phone numbers:________________________

f. Describe preparations for a spot spill clean up (sponge, blanket, absorbent, clean up kit, etc.):____

g. Has there been any chemical spills in the last twelve months?: Yes_____ No_____
If yes, describe the kind and size of spill as well as the type of control/clean up work performed.

12. COMMENTS AND OBSERVATIONS NOTED DURING INSPECTION:

EXHIBIT C

13. INSPECTION PARTICIPANTS

Print Name: ______________________

Signature: ______________________

Title: ______________________

Date: ______________________

Print Name: ______________________

Signature: ______________________

Title: ______________________

Date: ______________________

Print Name: ______________________

Signature: ______________________

Title: ______________________

Date: ______________________

Print Name: ______________________

Signature: ______________________

Title: ______________________

Date: ______________________

Print Name: ______________________

Signature: ______________________

Title: ______________________

Date: ______________________

EXHIBIT D

Pennsylvania American Water Company
800 W. Hersheypark Drive
Hershey, PA 17033
717-531-3000

Industrial User Wastewater Survey & Permit Application

Company Name			
Name of authorized personnel		Name of alternative personnel	
Title		Title	
Phone	Fax	Phone	Fax
Physical street address of business		Official mailing address, if different.	
City	State, Zip	City	State, Zip

The information provided by you on this questionnaire serves two functions:

1. The information is used to determine if your facility needs an Industrial User Pretreatment Permit (IUP) for the discharge of wastewater to the local sewer.

2. If an Industrial User Pretreatment Permit (IUP) is required, this survey serves as the application for an Industrial User Pretreatment Permit (IUP).

Requests for confidential treatment of information provided on this form shall be governed by procedures specified in 40 CFR Part 2. In accordance with Title 40 of the Code of Federal Regulations Part 403, Section 403.14 and the Local Sewer Use Ordinance (SUO), information and data provided in this questionnaire that identifies the content, volume and frequency of discharge shall be available to the public without restriction.

This is to be signed by an authorized official of your business establishment.

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based upon my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true accurate and complete. I am aware that there are significant penalties for submitting false information including the possibility of fine and/or imprisonment for knowing violations.

Signature of Authorized Representative ____________________ Date ____________________

Industrial User Wastewater Survey & Permit Application

Part 1. General Information:

1. **Provide a brief narrative description of the type of business, manufacturing processes, or service activities your firm conducts at this site.**

2. **List the primary products produced at this facility:**

3. **List raw materials and process additives used:**

4. **Are biocides added to any water discharged to the POTW, if yes describe:**

Yes	
No	

5. **Describe weekly production schedule, including shifts worked per day, employees per shift, and primary operation during shift.**

6. **Production process is:**

Check, if all continuous	
Check, if all batch	

If both please enter, % continuous = ____ % % Batch = ____ %

Industrial User Wastewater Survey & Permit Application

Part 1. General Information: (continued)

7. Does production vary significantly (+ 20%) by season. Describe.

Yes	
No	

8. Are any significant (+ 20%) changes in production that will affect wastewater discharge expected in the next 5 years. If yes, please describe.

Yes	
No	

9. List all current waste haulers. Give name, address, phone numbers, volume, and materials hauled off.

10. Attach a copy of laboratory analysis performed in the last year on the wastewater discharge(s) from your facilities. Summarize data on the attached Data Summary Form.

11. Attach sketch or schematic showing sampling points and all connections to the sewer.

12. Complete the Wastewater Pollutants Checklist attached to this Survey.

Industrial User Wastewater Survey & Permit Application

Part 1. General Information: (continued)

13. Do you have, or have you ever applied for, been issued, or been denied an NPDES permit to discharge to the surface waters or storm sewers of Pennsylvania? If yes, list all other NPDES permits, permit numbers, dates, and names used to apply for them, or reason denied.

If yes: Permit, #, date, applicant name		Yes	
If yes: Permit, #, date, applicant name		No	

14. Do you have, or have your ever applied for or been issued an Industrial User Pretreatment Permit (IUP) to discharge wastewater to the sewer collection system. If yes, list all other IUP permits, permit numbers, dates, and names used to apply for them.

If yes: Permit, #, date, applicant name		Yes	
If yes: Permit, #, date, applicant name		No	

15. Do you have, or have you ever applied for or been issued any other Environmental Permits (for example; air, RCRA, groundwater, stormwater, general, Non-Discharge, septic tank, etc.). If yes, list all other permits, permit numbers, dates, and names used to apply for them.

If yes: Permit, #, date, applicant name		Yes	
If yes: Permit, #, date, applicant name		No	

16. Is a Spill Prevention Control and Countermeasure (SPCC) Plan prepared for this facility?

Yes	
No	

17. Is a Spill/Slug Control Plan required by the POTW, prepared for this facility?

Yes	
No	

Industrial User Wastewater Survey & Permit Application

Part 1. General Information: (continued)

18. Do you have any underground storage tanks at your facility? If yes, list contents and volume of each tank.

Yes [ ]
No [ ]

19. Do you have any above ground storage tanks at your facility? If yes, for each tank, list the contents, volume, whether the tank has any spill prevention or containment devices, such as dikes, and procedures for draining any containment devices.

Yes [ ]
No [ ]

# of Tanks [ ]

Industrial User Wastewater Survey & Permit Application

Part 2. Water Supply, Use, & Disposal Worksheet:

Water Used for:	Water Source (s) see Source List below	Avg. gal/day	Max gal/day	Measured	Estimated	Disposal Method (s) see Disposal List below	Avg. gal/day	Max gal/day	Measured	Estimated
1. Process Water										
2. Washdown water										
3. Water into product										
4. Air Quality Permitted units										
5. Domestic - toilets, drinking, café										
6. Cooling water, Process NON-Contact										
7. Boiler / Cooling tower blowdown										
8. Cooling water, HVAC										
9. Other										
	Totals =>					Totals =>				

Typical Water Sources:

1. City/Public supply
2. Private wells, drinking
3. Groundwater remediation wells
4. Private ponds
5. Surface waters of NC, please identify
6. Include others if applicable

Possible Water Disposal Methods

1. Sanitary sewer, with pretreatment
2. Sanitary sewer, without pretreatment
3. Storm sewer
4. Surface waters of NC
5. Evaporation
6. Land applied
7. To groundwater
8. Septic tank
9. Waste Haulers Identify
10. Water into Product
11. Include others, if applicable

Industrial User Wastewater Survey & Permit Application

Part 3. Pretreatment Facilites

Are there any pretreatment devices or processes used for treating wastewater before being discharged to the sewer? Check all that are present, and describe.

No pretreatment facilities => [ ]

1. Flow equalization

Aerated equalization =>	
Non-Aerated equalization =>	
Total volume of equalization (million gal.) =>	

	Yes	No	Describe any, if present
2. Activated Carbon			
3. Activated Sludge			
4. Air Stripping			
5. Centrifugation			
6. Chemical Precipitation			
7. Chlorination			
8. Cyanide Destruction			
9. Cyclone			
10. Dissolved Air Floatation			
11. Filtration			
12. Floculation			
13. Grease Trap			
14. Grit Removal			
15. Ion Exchange			
16. Neutralize, pH adjust			
17. Other Biological Treatment			
18. Ozonation			
19. Reverse Osmosis			
20. Screening			
21. Sedimentation			
22. Septic Tank			
23. Silver Recovery			
24. Solvent Separation			
25. Spill Protection			

List any others.

Industrial User Wastewater Survey & Permit Application

Part 4. Categorical Information:

1. When were operations started at this facility? **Facility start up date** | |

2. List all Standard Industrial Classification (SIC) codes for your facility. These may be found on State Unemployment forms, tax forms, accounting records, or from the Chamber of Commerce.

3. Has this facility ever been considered a Categorical Industrial User (CIU) as described by the Code of Federal Regulations (40 CFR)?

If yes, give complete 40 CFR number => | |
No | |

4. Are any other facilities owned and/or operated by your company permitted as Categorical Industrial Users (CIUs) as described by the Code of Federal Regulations (40 CFR)?

If yes please give name(s), location, and 40 CFR number.

Yes | |
No | |

Industrial User Wastewater Survey & Permit Application

Part 4. Categorical Information: (continued)

5. Check any activities listed below that are performed at your facility:

Check Below	40 CFR #	Industrial Activity	Check Below	40 CFR #	Industrial Activity
	467	Aluminum Forming		432	Meat products
	427	Asbestos Manufacturing		433	Metal finishing
	461	Battery Manufacturing		464	Metal molding and casting
	431	Builders paper & board mills		436	Mineral mining and processing
	407	Canned & preserved fruits & veg.		471	Nonferrous Metal, Form & Powder
	408	Canned & preserved seafood		421	Nonferrous Metals Manufacturing
	458	Carbon black Manufacturing		414	OCPSF, Organic Chemicals, Plastics, & Synthetic Fiber Manufacturing
	411	Cement Manufacturing			
	434	Coal Mining		435	Oil & gas extraction
	465	Coil Coating		440	Ore mining and dressing
	468	Copper Forming		446	Paint formulating
	405	Dairy products processing		443	Paving & roofing materials mfg.
	469	Electrical, electronic components		455	Pesticide Manufacturing
	413	Electroplating		419	Petroleum Refining
	457	Explosives Manufacturing		439	Pharmaceutical Manufacturing
	412	Feedlots		422	Phosphate Manufacturing
	424	Ferro alloy Manufacturing		459	Photographic supplies
	418	Fertilizer Manufacturing		463	Plastics molding and forming
	464	Foundries, Metal Mold & Casting		466	Porcelain enameling
	426	Glass Manufacturing		430	Pulp, paper, and paperboard
	406	Grain Mills		428	Rubber Manufacturing
	454	Gum & Wood Chemicals Mfg.		417	Soap & Detergent Manufacturing
	460	Hospitals		423	Steam Electric power Generation
	447	Ink formulating		409	Sugar processing
	415	Inorganic chemical Manufact.		410	Textile mills
	420	Iron & Steel Manufacturing		429	Timber products processing
	425	Leather Tanning & Finishing		Others	

Wastewater Pollutant Checklist

Chemical Name	EPA Storet Code	Check if present at facility	Check if absent at facility	Check if present in discharge	Check if absent in discharge	Conentration in discharge, if known (mg/l)

Acid Extractable Organics

2-Chlorophenol	34586					
2,4-Dichlorophenol	34601					
2,4-Dimethylphenol	34606					
2,4-Dinitrophenol	34616					
2-Methyl-4,6-dinitrophenol	34657					
4-Chloro-3-methylphenol	34452					
2-Nitrophenol	34591					
4-Nitrophenol	34646					
Pentachlorophenol	39032					
Phenol	34694					
2,4,6-Trichlorophenol	34621					

Base Neutral Organics

1,2,4-Trichlorobenzene	34551					
1,2-Dichlorobenzene	34536					
1,2-Diphenylhydrazine	34346					
1,3-Dichlorobenzene	34566					
1,4-Dichlorobenzene	34571					
2,4-Dinitrotoluene	34611					
2,6-Dinitrotoluene	34626					
2-Chloronaphthalene	34581					
3,3-Dichlorobenzidine	34631					
4-Bromophenyl phenyl ether	34636					
4-Chlorophenyl phenyl ether	34641					
Acenaphthene	03405					
Acenaphthylene	34200					
Anthracene	34220					
Benzidine	39120					
Benzo (a) anthracene	34526					
Benzo (a) pyrene	34247					
Benzo (b) fluoranthene	34230					
Benzo (ghi) perylene	34521					
Benzo (k) fluoranthene	34242					
Bis(2-chloroethoxy) methane	34278					
Bis(2-chloroethyl) ether	34273					
Bis(2-chloroisopropyl) ether	34283					
Bis(2-ethylhexyl) phthalate	39100					
Butyl benzyl phthalate	34292					
Chrysene	34320					
Di-n-butyl phthalate	39110					

Wastewater Pollutant Checklist

Chemical Name	EPA Storet Code	Check if present at facility	Check if absent at facility	Check if present in discharge	Check if absent in discharge	Conentration in discharge, if known (mg/l)

Base Neutral Organics (continued)

Di-n-octyl phthalate	34596					
Dibenzo (a,h) anthracene	34556					
Diethyl phthalate	34336					
Dimethyl phthalate	34341					
Fluoranthene	34376					
Fluorene	34381					
Hexachlorobenzene	39700					
Hexachlorobutadiene	34391					
Hexachlorocyclopentadiene	34386					
Hexachloroethane	34396					
Indeno(1,2,3-cd) pyrene	34403					
Isophorone	34408					
N-nitroso-di-n-propylamine	34428					
N-nitrosodimethylamine	34438					
N-nitrosodiphenylamine	34433					
Naphthalene	34696					
Nitrobenzene	34447					
Phenanthrene	34461					
Pyrene	34469					

Metals

Aluminum	01104					
Antimony	01097					
Arsenic	01002					
Beryllium	01012					
Cadmium	01027					
Chromium	01034					
Copper	01042					
Lead	01051					
Mercury	71900					
Molybdenum	01062					
Nickel	01067					
Selenium	01147					
Silver	01077					
Thalium	00982					
Zinc	01092					

Wastewater Pollutant Checklist

Chemical Name	EPA Storet Code	Check if present at facility	Check if absent at facility	Check if present in discharge	Check if absent in discharge	Conentration in discharge, if known (mg/l)

Other Inorganics

Barium	01007					
Chloride	00940					
Cyanide	00720					
Fluoride	00951					

Purgeable Volatile Organics

1,1,1-Trichloroethane	34506					
1,1,2,2-Tetrachloroethane	34516					
1,1,2-Trichloroethane	34511					
1,1-Dichloroethane	34496					
1,1-Dichloroethylene	34501					
1,2-Dichloroethane	34531					
1,2-Dichloropropane	34541					
2-Chloroethyl vinyl ether	34576					
Acrolein	34210					
Acrylonitrile	34215					
Benzene	34030					
Bromodichloromethane	32101					
Bromoform	32104					
Bromomethane	34413					
Carbon tetrachloride	32102					
Chlorobenzene	34301					
Chloroethane	34311					
Chloroform	32106					
Chloromethane	34418					
cis 1,3-Dichloropropene	34704					
Dibromochloromethane	32105					
Ethylbenzene	34371					
Methylene chloride	34423					
Tetrachloroethylene	34475					
Toluene	34010					
trans 1,3-Dichloropropene	34699					
trans-1,2-Dichloroethylene	34546					
Trichloroethylene	39180					
Trichlorofluoromethane	34488					
Vinyl chloride	39175					

Others

Xylene						

Data Summary Form

	<= Receiving POTW
	<= Receiving NPDES #
	<= Specific Sample Location ! **i.e., Give IU Name, IUP#, and/or pipe#**

Lab => Laboratory performing analysis =>

MDL => Laboratory Method Detection Limits =>

Notes => Notes =>

Sample ID, or Count	Date Sample Collected	Notes about Sample	**Q = Flow** M = Metered E = Estimated	MGD	gal/day	**BOD** <?	**BOD** Conc. Results from Lab mg/l	**TSS** <?	**TSS** Conc. Results from Lab mg/l	**Ammonia** <?	**Ammonia** Conc. Results from Lab mg/l
1											
2											
3											
4											
5											
6											
7											
8											
9											
10											
11											
12											
etc.											

		Flow (gal/day)	BOD	TSS	Ammonia
TNS =>	Total number of samples =>				
Max. value =>	Maximum data value (mg/l) =>				
Avg. (use 1/2 BDL) =>	Average data value, Include BDL values as 1/2 detect limit =>				

Data Summary Form

	<= Receiving POTW
	<= Receiving NPDES #
	<= Specific Sample Location ! i.e., Give IU Name, IUP#, and/or pipe#

		Arsenic		Cadmium		Chromium		COD		Copper	
	Lab =>										
	MDL =>										
	Notes =>										
Sample ID, or Count	Date Sample Collected	<?	Conc. Results from Lab mg/l	<?	Conc. Results from Lab mg/l	<?	Conc. Results from Lab mg/l	<?	Conc. Results from Lab mg/l	<?	Conc. Results from Lab mg/l
1											
2											
3											
4											
5											
6											
7											
8											
9											
10											
11											
12											
etc.											

	Arsenic	Cadmium	Chromium	COD	Copper
TNS =>					
Max. value =>					
Avg. (use 1/2 BDL) =>					

Data Summary Form

	<= **Receiving POTW**
	<= **Receiving NPDES #**
	<= **Specific Sample Location !** **i.e., Give IU Name, IUP#, and/or pipe#**

		Cyanide		**Lead**		**Mercury**		**Nickel**		**Silver**		**Zinc**	
	Lab =>												
	MDL =>												
	Notes =>												
Sample ID, or Count	Date Sample Collected	<?	Conc. Results from Lab mg/l	<?	Conc. Results from Lab mg/l	<?	Conc. Results from Lab mg/l	<?	Conc. Results from Lab mg/l	<?	Conc. Results from Lab mg/l	<?	Conc. Results from Lab mg/l
1													
2													
3													
4													
5													
6													
7													
8													
9													
10													
11													
12													
etc.													

	Cyanide	Lead	Mercury	Nickel	Silver	Zinc
TNS =>						
Max. value =>						
Avg. (use 1/2 BDL) =>						

Data Summary Form

	<= Receiving POTW
	<= Receiving NPDES #
	<= Specific Sample Location ! i.e., Give IU Name, IUP#, and/or pipe#

		Other =		Other =		Other =		Other =		Other =		Other =	
	Lab =>												
	MDL =>												
	Notes =>												
Sample ID, or Count	Date Sample Collected	<?	Conc. Results from Lab mg/l	<?	Conc. Results from Lab mg/l	<?	Conc. Results from Lab mg/l	<?	Conc. Results from Lab mg/l	<?	Conc. Results from Lab mg/l	<?	Conc. Results from Lab mg/l
1													
2													
3													
4													
5													
6													
7													
8													
9													
10													
11													
12													
etc.													
	TNS =>												
	Max. value =>												
	Avg. (use 1/2 BDL) =>												

Industrial User Wastewater Survey & Permit Application

Part 4. Waste Reduction Information:

State Pretreatment Rule 15A NCAC 2H0916 (C)(1)(M) requires Significant Industrial Users to include a description of waste reduction (pollution prevention) activities being utilized. The codes listed are standard EPA codes found on Toxic Release Inventory and other environmental forms. Please check all applicable codes for your facility related to wastewater discharge

Utilized	Code	Description
	W13	Improved maintenance scheduling recordkeeping, or procedures
	W14	Changed production schedule to minimize equipment and feedstock changeovers
	W19	Other changes in operating practices (explain briefly in comments)
	W21	Instituted procedures to ensure that materials do not stay in inventory beyond shelf life
	W22	Began to test outdated material - continue to use if still effective
	W23	Eliminated shelf-life requirements for stable materials
	W24	Instituted better labeling procedures
	W25	Instituted clearinghouse to exchange materials that would otherwise be discarded
	W29	Other changes in Inventory control (explain briefly in comments)
	W31	Improved storage or stacking procedures
	W32	Improved procedures for loading, unloading, and transfer operations
	W33	Installed overflow alarms or automatic shutoff valves
	W34	Installed secondary containment
	W35	Installed vapor recovery systems
	W36	Implemented inspection or monitoring program of potential spill or leak sources
	W39	Other spill and leak prevention (explain briefly in comments)
	W41	Increased purity of raw materials
	W42	Substituted raw materials
	W49	Other raw material modifications (explain briefly in comments)
	W51	Instituted recirculation within a process
	W52	Modified equipment, layout, or piping
	W53	Use of a different process catalyst
	W54	Instituted better controls on operating bulk containers to minimize discarding of empty containers
	W55	Changed from small volume containers to bulk containers to minimize discarding of empty containers
	W58	Other process modifications (explain briefly in comments)

Industrial User Wastewater Survey & Permit Application

Part 4. Waste Reduction Information:

Utilized	Code	Description
	W59	Modified stripping/cleaning equipment
	W60	Changed to mechanical stripping/cleaning devices (from solvents or other materials)
	W61	Changes to aqueous cleaners (from solvents or other materials)
	W62	Reduced the number of solvents used to make waste more amenable to recycling
	W63	Modified containment procedures for cleaning units
	W64	Improved draining procedures
	W65	Redesigned parts racks to reduce dragout
	W66	Modified or installed rinse systems
	W67	Improved rinse equipment design
	W68	Improved rinse equipment operation
	W71	Other cleaning and degreasing operation (explain briefly in comments)
	W72	Modified spray systems or equipment
	W73	Substituted coating materials used
	W74	Improved application techniques
	W75	Changed from spray to other system
	W78	Other surface preparation and finishing (explain briefly in comments)
	W81	Changed product specifications
	W82	Modified designed or composition of product
	W83	Modified packaging
	W89	Other product modifications (explain briefly in comments)
	W99	Other (specify in comments)

Comments (Please list corresponding code)

EXHIBIT E

CSO Outfall Warning Signs

CAUTION

DURING AND AFTER RAIN EVENTS

The water in this stream may be contaminated by a temporary overflow of sanitary sewer.

Physical contact with the water may pose a health risk.

For additional information, call XXX-XXX-XXXX.

WARNING

COMBINED SEWER OVERFLOW POINT

POLLUTION MAY BE PRESENT
WHEN OUTFALL IS DISCHARGING

CSO OUTFALL NO. 001

NPDES PERMIT NO.: PA0099999

FOR MORE INFORMATION, CALL
PENNSYLVANIA AMERICAN WATER-DISTRICT
XXX-XXX-XXXX

PAWC RESPONSE TO TUS-17 [Attachment 2]

Municipal Authority of the City of McKeesport
City of Duquesne

Combined Sewer System
Long Term Control Plan
August 2014

KLH
ENGINEERS, INC
5173 Campbells Run Road
Pittsburgh, PA 15205-9733

MUNICIPAL AUTHORITY OF THE CITY OF MCKEESPORT

CITY OF DUQUESNE

COMBINED SEWER SYSTEM LONG TERM CONTROL PLAN

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ABBREVIATIONS

AAF	Annual Average Flow
BNR	Biological Nutrient Removal
BOD	Biological Oxygen Demand
CSO	Combined Sewer Overflow
CSS	Combined Sewer System
DEP	Pennsylvania Department of Environmental Protection
EDU	Equivalent Dwelling Unit
EPA	United States Environmental Protection Agency
FEMA	Federal Emergency Management Agency
GPD	Gallons Per Day
GPM	Gallons Per Minute
LF	Linear Feet
LTCP	Long-Term Control Plan
lb/day	Pounds Per Day
mg/L	Milligrams Per Liter
MGD	Million Gallons Per Day
/100ml	Colony Forming Units Per 100 Milliliter
MMF	Maximum Monthly Average Flow
NH_3-N	Ammonia Nitrogen
NO_2	Nitrite
NO_3	Nitrate
NPDES	National Polluant Discharge Elimination System
PDF	Peak Daily Flow
PIF	Peak Instantaneous Flow
PHF	Peak Hourly Flow
PLC	Programmable Logic Controller
POTW	Publicly Owned Treatment Works
SBR	Sequencing Batch Reactor
SCS	United States Natural Resources Conservation Service
SOR	Surface Overflow Rate
SWMM	Storm Water Management Model
TF	Trickling Filter
TKN	Total Kjeldahl Nitrogen
TMDL	Total Maximum Daily Load
TN	Total Nitrogen
TP	Total Phosphorus
TSS	Total Suspended Solids
UV	Ultraviolet
VFD	Variable Frequency Drive
WWTP	Wastewater Treatment Plant

1.0 EXECUTIVE SUMMARY

The Long-Term Control Plan (LTCP) was completed in order to address wastewater treatment plant (WWTP) and combined sewer system (CSS) upgrades necessary to meet Federal and State regulatory requirements. The goal of the LTCP is to decrease volume of combined sewage overflows on an annual basis and subsequently, increase the volume that receives treatment at the WWTP.

The focus of this LTCP update was to:

1. Develop WWTP design loadings required in order to address combined sewer overflow (CSO) regulatory requirements.
2. Evaluate the capacity of the existing City of Duquesne WWTP processes relative to design loadings.
3. Complete evaluation of feasible alternatives developed to address WWTP process deficiencies relative to design loadings.
4. Summarize all CSS upgrades required in order to address CSO regulatory requirements.
5. Complete Financial Capability Assessment in order to evaluate economic feasibility of recommended alternative.

Detailed evaluation was completed for three (3) alternatives.

- Alternative 1 – Existing WWTP + new pump station + CSO bypass treatment.
- Alternative 2 – New pump station to MACM WWTP + flow storage.
- Alternative 3 – Existing WWTP + new pump station + flow storage.

All alternatives include two (2) gravity relief sewers totaling 1,025 lineal feet. It was determined that these CSS upgrades are required to convey the 10-year, 24-hour design storm flow (without manhole overflows) while maintaining greater than 85% capture of all combined flow during a typical year.

Detailed evaluation of the proposed alternatives led to the recommendation of Alternative 1 for City's LTCP upgrades. The total estimated project cost is $7,424,000. This alternative is recommended for the following reasons:

- Alternative 2 project cost is $8,087,000 more than the recommended Alternative 1, and Alternative 3 project cost is $5,483,000 more.

- The existing WWTP is in good operating condition with adequate capacity for dry weather flows, and Alternative 1 allows the WWTP to continue operation under these conditions.

The following LTCP schedule is proposed.

Milestone	Date
Submit draft LTCP	September 1, 2014
Submit final LTCP with MACM ACT 537	November 1, 2015
DEP approval of LTCP and ACT 537	January 1, 2016
Obtain funding for design related services	January 1, 2017
Begin design of upgrades	January 1, 2017
Apply for MACM WWTP re-rate	July 1, 2017
Apply for Part II Permit for pump station	July 1, 2018
Receive Part II Permit for pump station	January 1, 2019
Obtain funding for construction	January 1, 2021
Begin construction for CSS upgrades	March 1, 2021
Complete construction	March 1, 2023
Submit post construction compliance monitoring plan	September 1, 2023

*DEP LTCP approval and Part II Permit dates are beyond the control of the City and KLH, therefore schedule dates will be adjusted based on actual DEP milestone completion dates.

2.0 INTRODUCTION

2.1 BACKGROUND

The City of Duquesne is located in Allegheny County, Pennsylvania; it is situated along the Monongahela River. The population was 5,565 at the 2010 Census. For all intents and purposes, 100% of the City is provided sewer service and the service area does not go beyond the corporate limits. The City's combined sewer system (CSS) presently serves 1,909 customers. Utilizing the U.S. Census data for 2010, which indicates an average of 2.22 persons per household, it is estimated that the WWTP serves approximately 4,238 persons. The WWTP is located in the center of the City adjacent to Route 837 and discharges into Thompson Run, tributary to the Monongahela River. The plant is owned by the Municipal Authority of the City of McKeesport and operated under NPDES Permit No. PA0026981.

The City has selected to utilize the EPA CSO Control Policy "presumption" approach criteria ii through their Long Term Control Plan (LTCP) process. The criteria are as follows.

> *"The elimination or capture for treatment of no less than 85% by volume of combined sewage collected in the CSS during precipitation events on a system-wide annual average basis."*

In order to assess the overflow volumes relative to total CSS conveyance on an annual average basis, the City completed a system characterization survey, a comprehensive flow monitoring study (from January 1, 2013 through June 1, 2013), and a computer modeling, utilizing SWMM, of CSS hydraulic and hydrologic characteristics. The results of the flow monitoring and modeling study are described through this report.

This report will summarize sewer system upgrades/modifications required in order to allow for the "presumption" approach criteria to be met.

The monitoring and modeling established peak flow instantaneous flow as 14.57 MGD, based on 1-year, 24-hour rain event with no manhole overflows. This peak flow value is far in excess of the existing WWTP's peak capacity, and minor CSS upgrades are required to convey all flow to the WWTP. Therefore, conveyance/storage and treatment of the design flows discussed in this report will be necessary to meet the EPA CSO Control Policy.

The focus of this Long-Term Control Plan is to:

1. Develop WWTP design loadings required in order to address CSO regulatory requirements.

2. Evaluate the capacity of the existing City of Duquesne WWTP processes relative to design loadings.

3. Complete evaluation of feasible alternatives developed to address WWTP process deficiencies relative to design loadings.

4. Summarize all CSS upgrades required in order to address CSO regulatory requirements.

5. Complete Financial Capability Assessment in order to evaluate economic feasibility of recommended alternative.

2.2 DOCUMENT INTENTION

This document is intended for planning purposes only. Evaluation of specific processes is limited to confirming feasibility and estimating planning level project costs. Once this LTCP update report is approved, the basis of design study can commence. This study will focus on the process modeling, detailed equipment evaluation, and development of process control logic for the recommended alternative. The Basis of Design Report will serve as the basis for all design phase work.

3.0 SYSTEM CHARACTERIZATION

3.1 SERVICE AREA

The City of Duquesne presently serves 1,909 customers. The City's sewage conveyance system is divided into five drainage areas. All of these areas have combined sewage flow and are controlled by a regulator.

AREA 1: Crawford Avenue area	(flows into area 2)
AREA 2: Wylie Avenue area	(Regulator 002)
AREA 3: Hamilton Avenue area	(Regulator 003)
AREA 4: Overland Avenue area	(Regulator 004)
AREA 5: Clark Street area	(Regulator 005)

3.2 DIVERSION CHAMBERS

The CSS includes four (4) CSO outfalls, in addition to the WWTP outfall. The CSO identification numbers and locations are listed in Table 3.1 below. The locations of these CSO's are shown on the drawing set included in Appendix A.

Duquesne CSO's
Table 3.1

CSO ID No.	Location
001	WWTP Outfall
002	Wylie Avenue
003	Hamilton Avenue
004	Overland Avenue
005	Clark Street

3.3 PUMP STATIONS

The City of Duquesne service area does not have any sewage pumping stations.

3.3.1 Interceptor Sewer

The following chart represents the approximate quantities of sewer line and related appurtenances, as published in the City of Duquesne's Chapter 94 Report.

Area	Flush Tanks		Manholes		EggShape Pipe		Total Pipe	
1	10	EA	79	EA	0	LF	15,760	LF
2	25	EA	188	EA	5,500	LF	27,500	LF
3	23	EA	146	EA	2,850	LF	30,820	LF
4	6	EA	58	EA	0	LF	63,150	LF
5	0	EA	86	EA	0	LF	20,650	LF
Total:	**64**	**EA**	**557**	**EA**	**8350**	**LF**	**157880**	**LF**

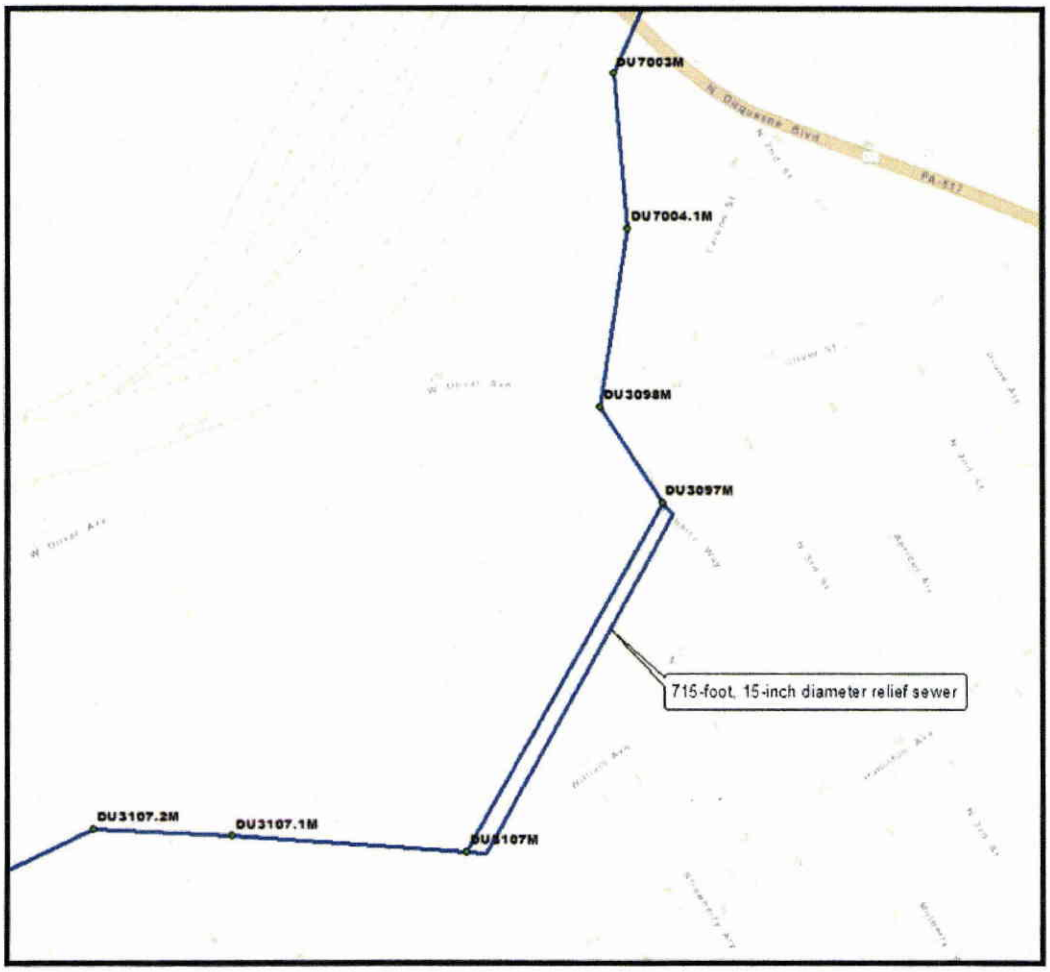
A copy of the City of Duquesne field survey data is included in Appendix B.

3.4 CSS UPGRADES REQUIRED

Flow monitoring and SWMM modeling was completed for the City's CSS. It was determined that two (2) sewer improvements are required within the system to allow for conveyance of the peak flow resulting from the 10-year, 24-hour rain event, given a free discharge at the WWTP.

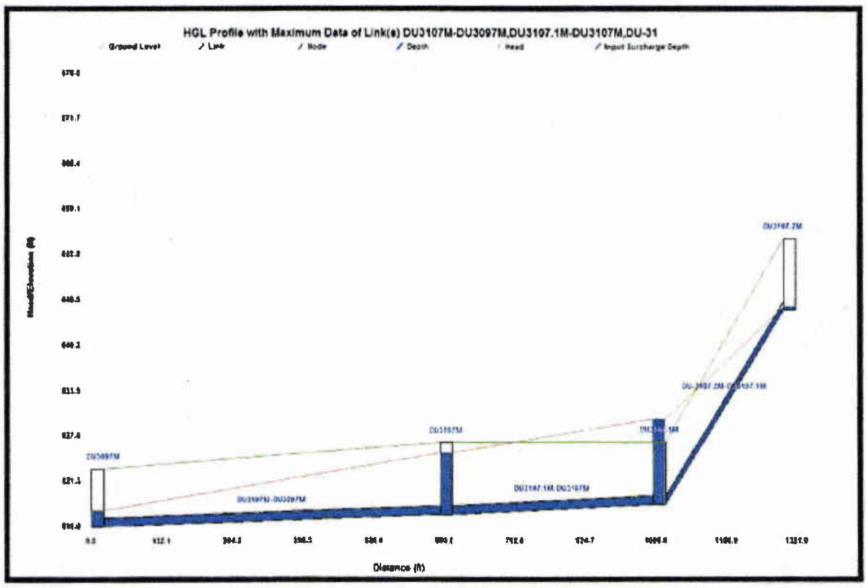
The first required conveyance system upgrade is a parallel relief sewer downstream of CSO 005 between William Avenue and Mulberry Way, from Manhole DU3107M to DU3097M. Figure 3.1 depicts the location of the relief sewer.

Parallel Relief Sewer 1
Figure 3.1

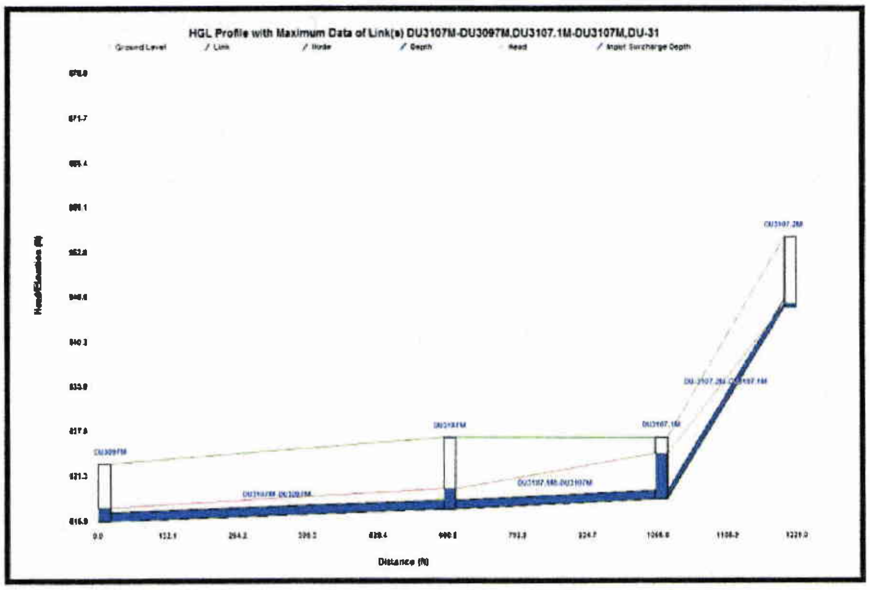


The relief sewer is estimated to be 715-feet length, and 15-inch diameter, to ensure no manhole overflows during the 10-year, 24-hour design rain event. Figure 3.2 shows the hydraulic profile in the sewer under existing conditions, while Figure 3.3 shows the profile after the relief sewer is constructed.

Hydraulic Profile for Existing Conditions
10-Year, 24-hour Design Rain Event
Figure 3.2

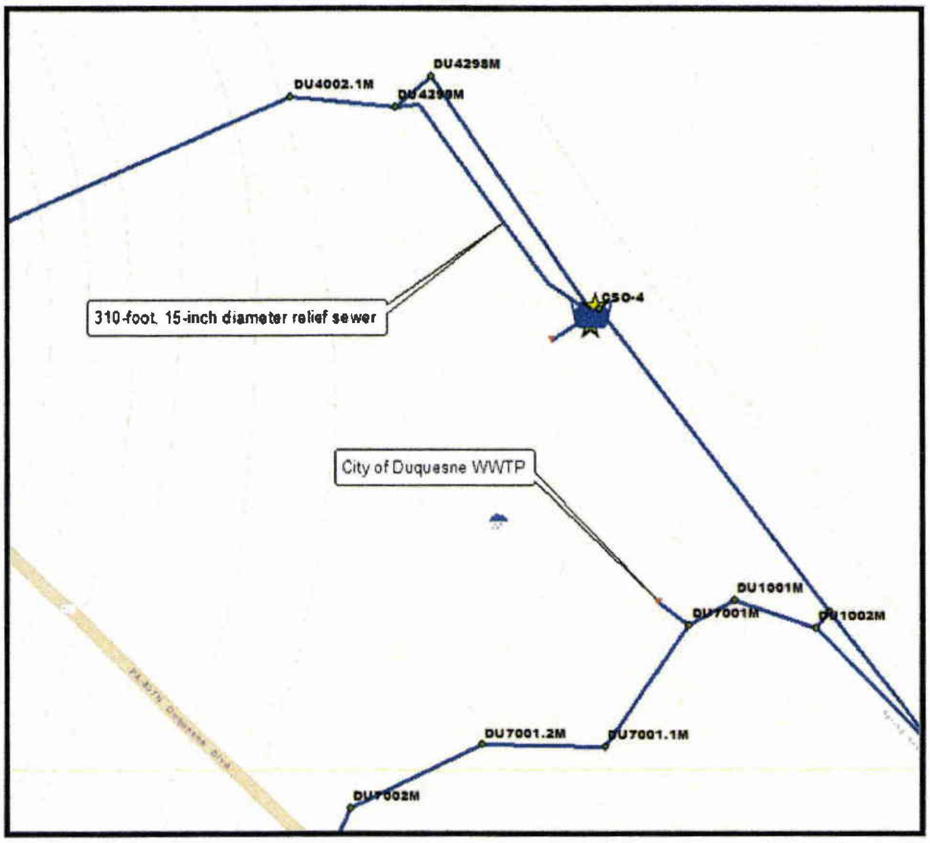


Hydraulic Profile for Proposed Relief Sewer 1
10-Year, 24-hour Design Rain Event
Figure 3.3



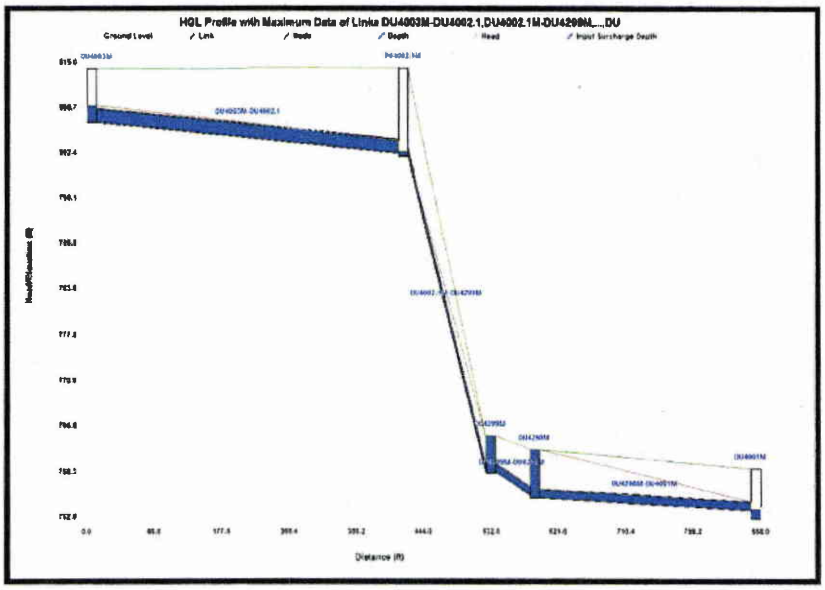
The second required conveyance system upgrade is a parallel relief sewer upstream of CSO 004 along the railroad, from Manhole DU4299M to CSO 004. In addition to the relief sewer, the lids on Manholes DU4299M and DU4298M will need bolted down to prevent flooding. Figure 3.4 depicts the location of the relief sewer.

Parallel Relief Sewer 2
Figure 3.4

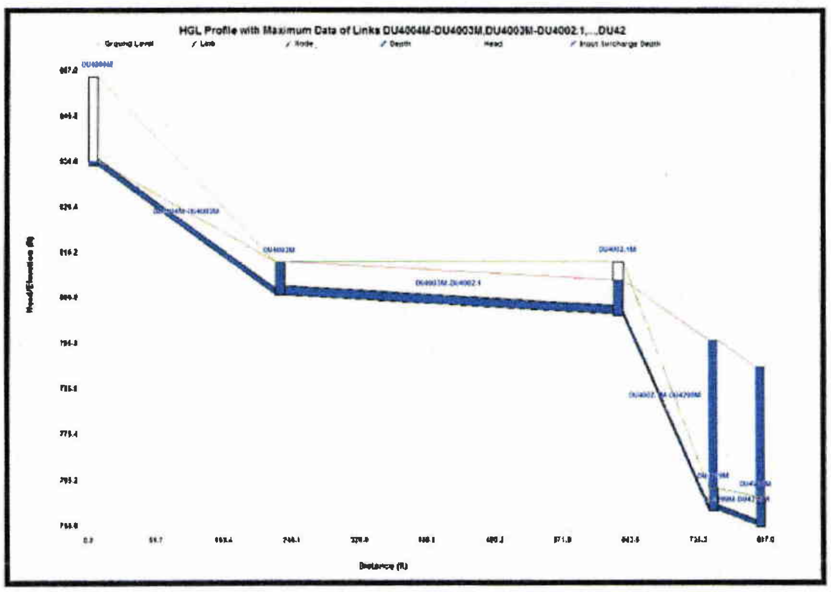


The relief sewer is estimated to be 310-feet length, and 24-inch diameter, to ensure no manhole overflows during the 10-year, 24-hour design rain event. Figure 3.5 shows the hydraulic profile in the sewer under existing conditions. As seen in Figure 3.6, bolted manhole lids without the relief sewer caused additional flooding upstream. Figure 3.7 shows the profile after the relief sewer is constructed.

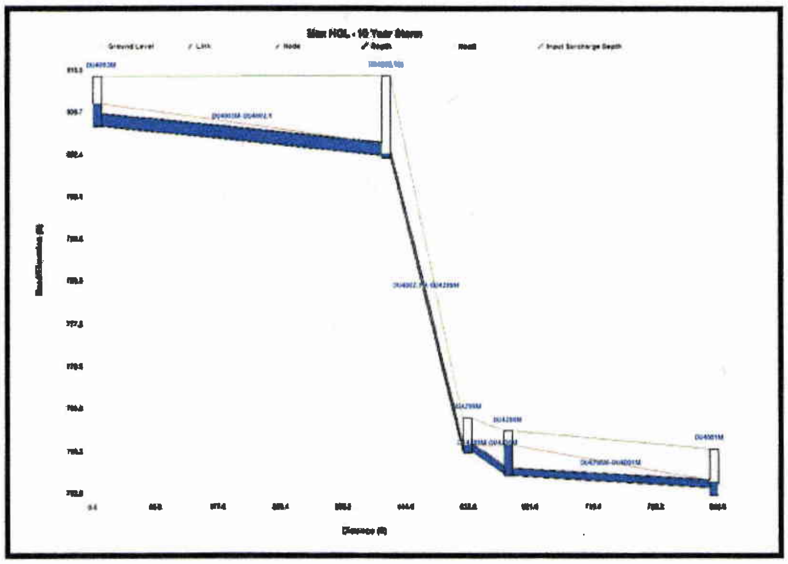
Hydraulic Profile
Existing Conditions
10-Year, 24-hour Design Rain Event
Figure 3.5



Hydraulic Profile
No Relief Sewer, Bolted Manholes
10-Year, 24-hour Design Rain Event
Figure 3.6



Hydraulic Profile
Proposed Relief Sewer 2
10-Year, 24-hour Design Rain Event
Figure 3.7



4.0 FLOW MONITORING STUDY

4.1 SITE SELECTION

Flow monitoring site locations were selected based on their importance in the collection system. Meters were installed and maintained by Drnach Environmental, Inc. (DE). Monitoring sites were selected to ensure all areas of the system were accounted for. In total, eight (8) meters were required to account for all flow. These areas are as follows:

- Tributary to Wylie Avenue CSO 002 (Meter M-1)
- West tributary of Hamilton Avenue CSO 003 (Meter M-3)
- North tributary of Hamilton Avenue CSO 003 (Meter M-5A8)
- East tributary of Hamilton Avenue CSO 003 (Meter M-5A18)
- Tributary to Overland Avenue CSO 004 (Meter M-6)
- Tributary to Overland Avenue CSO 004 (Meter M-6A)
- South tributary to Clark Avenue CSO 005 (Meter M-8)
- East downstream of Clark Avenue CS0 005 (Meter M-10)
- West downstream of Clark Avenue CSO 005 (Meter M-11)

DE Site Inspection Forms are included in Appendix C. Table 4.1 shows the flow monitoring sites and monitoring period.

Duquesne Flow Monitoring Sites
Table 4.1

Sites	Location	Monitoring Period
M-1	520 S Duquesne Ave	January 1 – June 1, 2013
M-3	130 Duquesne Blvd	January 1 – June 1, 2013
M-5A8	10 N Linden St	January 1 – June 1, 2013
M-5A18	10 N Linden St	January 1 – June 1, 2013
M-6	Overland CSO 004	January 1, 2013 – June 1, 2014
M-6A	Railroad (near CSO 004)	December 1, 2013 – June 1, 2014
M-8	Clark St & Parallel Way	January 1 – June 1, 2013
M-10	Clark St & Edith Ave	January 1 – June 1, 2013
M-11	125 Clark St	January 1 – June 1, 2013

A map illustrating the metered areas of Duquesne is included in Appendix A.

Additional flow monitoring for Sites M-6 and M-6A from December 1, 2013 through April 30, 2014 was completed to evaluate manhole overflows upstream of CSO 004.

4.2 EQUIPMENT DESCRIPTION

The meters installed, by DE, for the flow monitoring study were area-velocity (A-V) meters. The A-V meters are capable of measuring head and flow velocity over the full range of sewer flow, from free-flow to surcharged as well as reverse flow.

Rain gauges utilized were tipping-bucket type.

4.3 FIELD QUALITY CONTROL

The A-V meters were installed, maintained, and downloaded by DE. Each site was visited on a weekly basis in order to ensure that the equipment was functioning properly. This approach allowed for issues to be corrected without significant loss of data and time.

4.4 OFFICE QUALITY ASSURANCE

Flow data provided to Duquesne was reviewed by KLH Engineers, Inc. (KLH) in order to ensure that the data was reliable. Reliability of flow data was evaluated in terms of precision and accuracy.

Precision, repeatability of measurements, is best evaluated through use of scattergraphs. KLH reviewed scattergraphs provided by DE in order to confirm that the data being provided had a reasonable level of precision. Drnach scattergraphs for the meter sites are included in Appendix D.

Accuracy, how well meter values compare to actual values, was also evaluated. This evaluation is more difficult given that the actual flow or velocities at any given time are difficult to know for certain. However, accuracy was evaluated from a magnitude standpoint. Comparisons of total daily flows from the meter sites to the WWTP were made as well as individual site evaluations with respect to hydraulic evaluation tools such as Manning's Equation.

The data from all sites was determined by KLH to have reasonable levels of precision and accuracy, and therefore, the data was considered to be reliable for the purposes of this study.

4.5 RAIN EVENT SUMMARY

The major rainfall monitoring began on January 1, 2013 and ended on June 1, 2013. During this time period three (3) significant rain events occurred. These events are listed in Table 4.2 below. A significant rain event was defined as an event where rainfall depth was greater than or equal to one inch.

Significant Rain Events
Table 4.2

Event No.	Start Date	End Date	Duration [hrs]	Depth [in]
1	1/30/2013	1/31/2013	22.25	1.08
2	2/26/2013	2/27/2013	24.75	1.01
3	4/16/2013	4/17/2013	8.75	1.13

During this time period, the total rainfall depth was 13.08 inches. Annual average rainfall for the National Oceanic and Atmospheric Administration (NOAA) McKeesport, PA site (nearest rain gage site to Duquesne) is 37.05 inches. The rainfall recorded during the monitoring period is a slightly less than the annual average rain event.

$$(13.08 \text{ inches}) \times (12 \text{ months/year}) \div (5 \text{ months}) = 31.39 \text{ inches/year}$$

5.0 COMBINED SEWER SYSTEM MODELING

5.1 METHODOLOGY

The Duquesne CSS was modeled utilizing Innovyze InfoSWMM (SWMM). SWMM is a dynamic rainfall-runoff simulation model used for single event or long-term (continuous) simulation of runoff quantity and quality from primarily urban areas. The runoff component of SWMM operates on a collection of sub-catchment areas that receive precipitation and generate runoff and pollutant loads. The routing portion of SWMM transports this runoff through a system of pipes, channels, storage/treatment devices, pumps, and regulators.

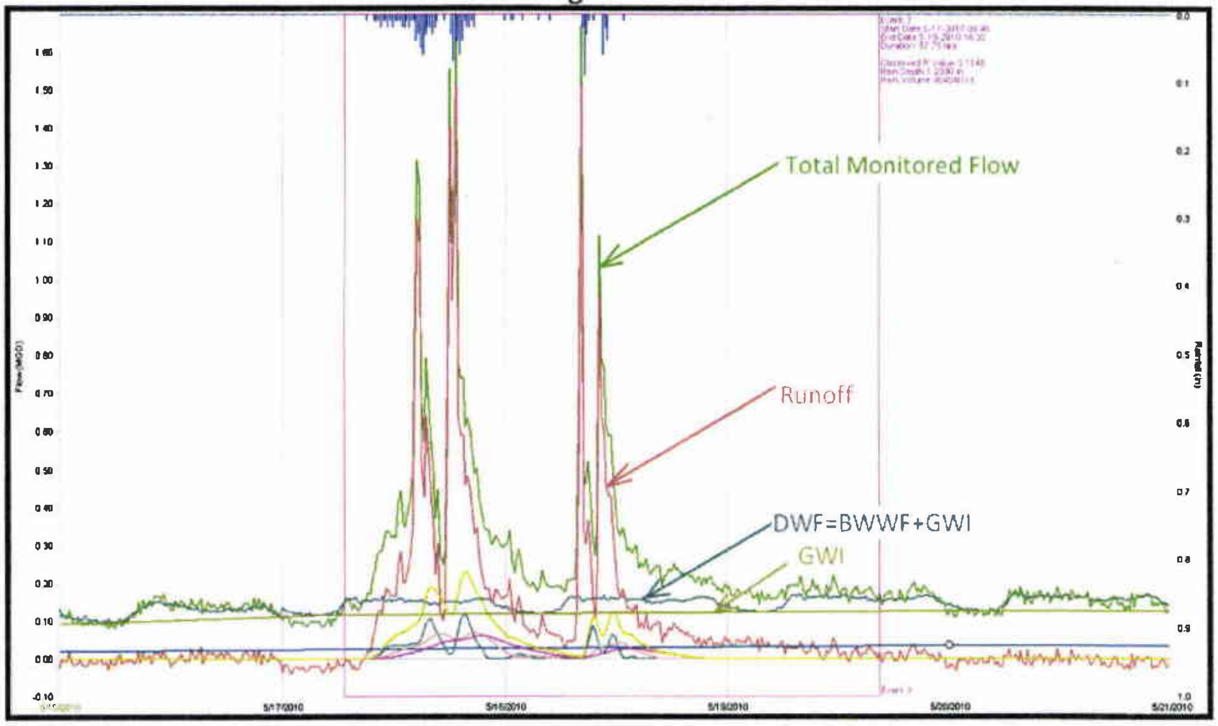
5.1.1 Model Hydrology

There are three (3) major components of the total sewer flow in combined sewer system. Dry weather flow (DWF) includes two components (groundwater infiltration and base wastewater flow). The third component is runoff. Groundwater infiltration (GWI) represents groundwater that enters the collection system through defective pipes, pipe joints, and leaking manhole walls during dry weather. Base wastewater flow (BWWF) is the residential, industrial and commercial flow discharged to the sewer system for collection and treatment. GWI and BWWF together comprise the base flow, or dry weather portion of sewer flow. Runoff represents the wet-weather contribution that enters a combined sewer system during and after a rainfall event.

Accurate dry weather flow plays an important role in hydrologic and hydraulic (H&H) modeling. Dry weather flow loadings were determined through analysis of flow monitoring data during dry weather days from each flow monitoring location as well as the total system flow monitored at the WWTP. Hydrograph decomposition is the process of analyzing a total monitored sewer flow hydrograph and estimating the three components of wastewater flow (Runoff, BWWF and GWI). Hydrograph decomposition was performed using EPA Sanitary Sewer Overflow Analysis and Planning (SSOAP) Toolbox. Although SSOAP Toolbox is mainly used in sanitary sewer overflow analysis, its capability of hydrograph decomposition can also be utilized in combined sewer overflow analysis. Figure 5.1 illustrates the hydrograph decomposition of monitored wastewater flow. The average base flow (BWWF and GWI) time series is projected through the monitored wet weather hydrograph. The area between the wet-weather hydrograph and the average base flow time series represents the Runoff volume.

Hydrograph Decomposition of Total Monitored Flow

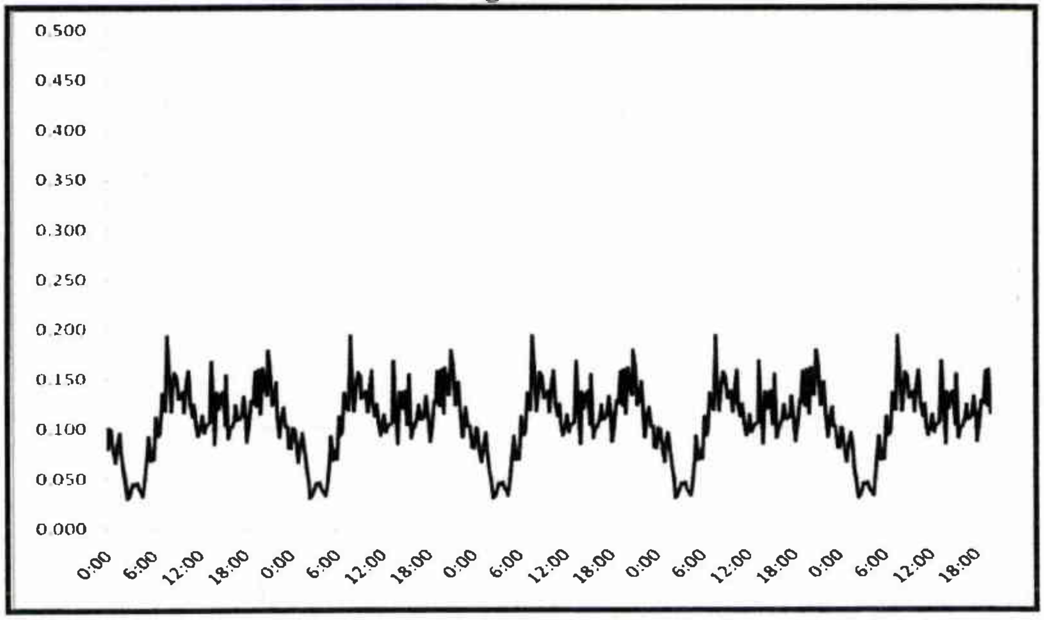
Figure 5.1



Generally, the dry weather flow varies with time in a day, with two peaks at about 7:00AM and 7:00PM, two bottoms at about 3:00AM and 3:00PM. The dry weather flows were loaded in corresponding upstream manholes. Figure 5.2 shows the typical dry weather flow pattern.

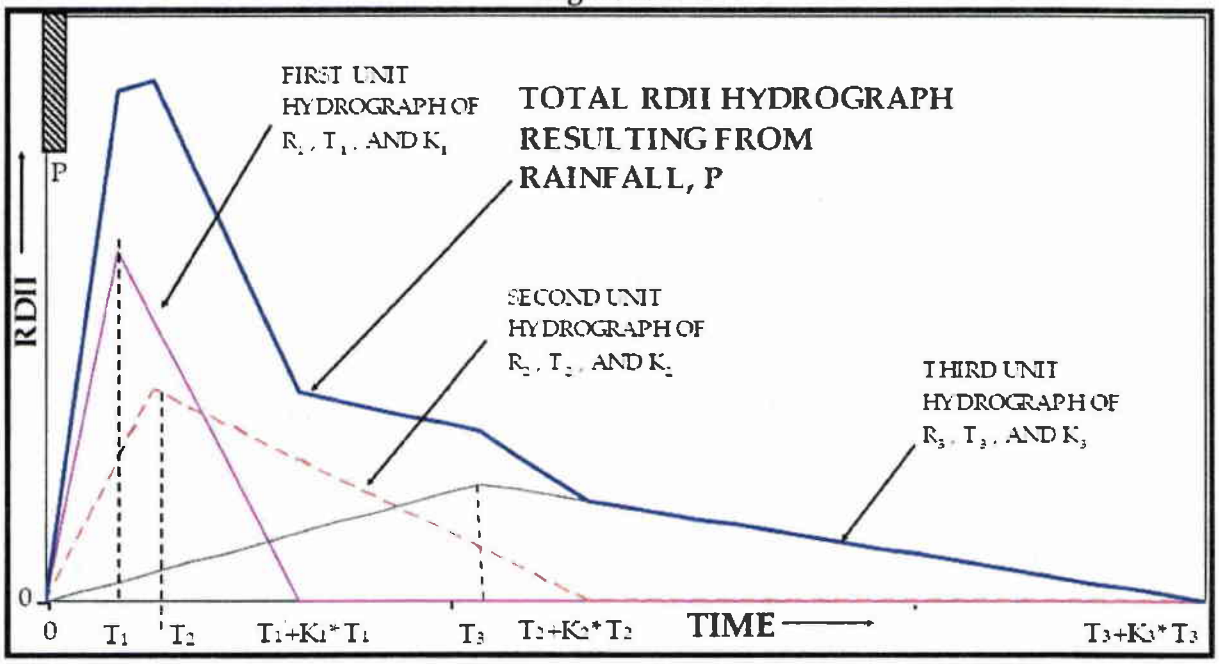
Typical Dry Weather Flow Pattern

Figure 5.2



Wet weather flows were simulated using InfoSWMM by utilizing the RTK unit hydrograph method. Figure 5.3 illustrates how SWMM generates three unit hydrographs based on the RTK parameters for a given unit rainfall input. It also demonstrates that the total RDII unit hydrograph is the summation of three individual unit hydrographs. The three unit hydrographs can be related with fast (first unit hydrograph), medium (second unit hydrograph), and slow (third unit hydrograph) RDII responses typically observed in the sanitary sewer system. In some cases, only one or two unit hydrographs are required to adequately define observed RDII hydrographs.

Summation of Three Unit Hydrographs
Figure 5.3



The following general guidelines should be followed in selecting the RTK parameters to ensure that the calculated RDII hydrograph meets the goal of visual curve fittings:

- Total R value = $R_1 + R_2 + R_3$, if all three unit hydrographs used.
- The T and K parameters should be similar for rainfall events for a given sewershed tributary to the flow monitor since they depend on the geometry and sewer system layout.
- In all cases, $T_1 < T_2 < T_3$.
- In most cases, $K_1 < K_2 < K_3$.
- The necessity to change T and K significantly for a particular event to match the observed flows is often a sign that the rainfall data being used is not representative of the rainfall that fell over the basin for the event or the system experienced operational challenges resulting in an altered shape of the hydrograph.

- The event specific R-values will vary, generally being higher for wet antecedent moisture conditions and lower for dryer antecedent conditions. Similarly, R-values will typically be higher in a wet season.
- T and K for the three triangular unit hydrograph should generally be within the ranges shown in Table 5.1.

Ranges of Values for Unit Hydrograph Parameters
Table 5.1

Curve	T (Hours)	K
1	0.5 – 2	1 – 2
2	3 – 5	2 – 3
3	5 – 10	3 – 7

5.1.2 Model Hydraulics

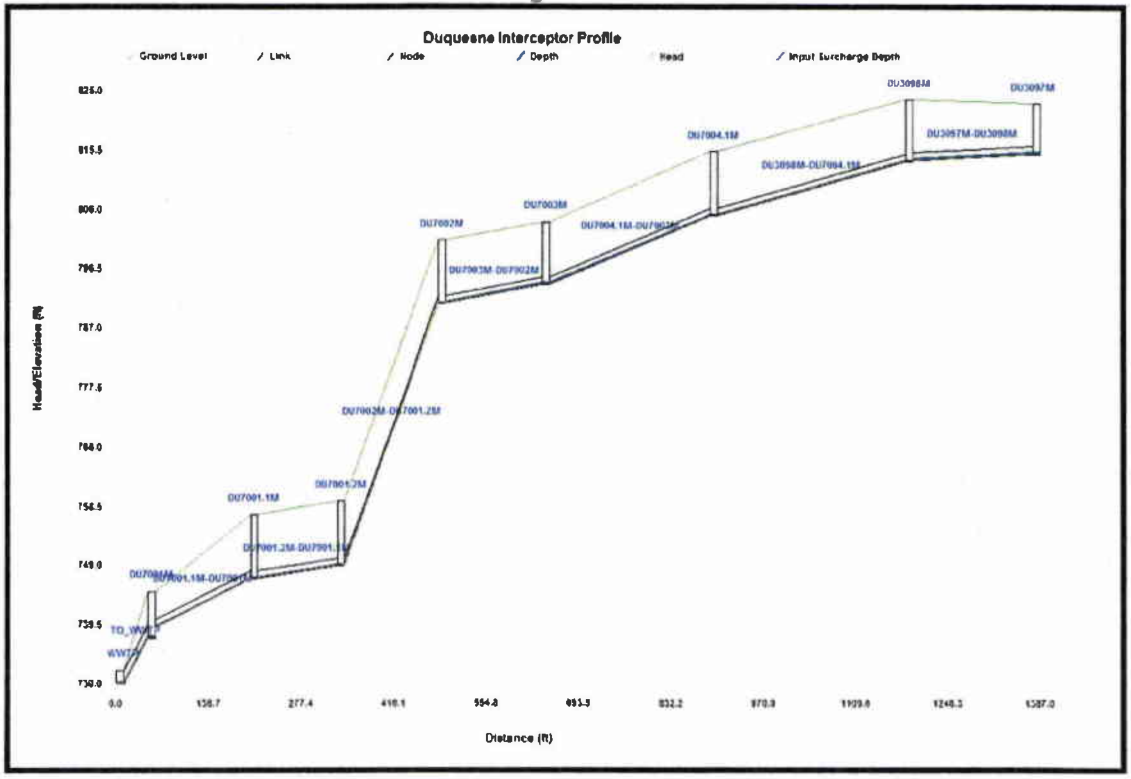
Flows in the collection system, which include dry-weather flows and the wet-weather flows, are routed through the hydraulic configuration of the model. The hydraulic configuration of a model is the representation of the various hydraulic elements of the system, which can broadly be classified as nodes and links. Nodes in the model are the manholes, diversion chambers, wet well, and outfalls, while the links are the conduits, orifices, diversion weirs, and pumps connecting the nodes.

The purpose of a diversion chamber is to intercept and convey all of the dry-weather flow, and a regulated fraction of wet-weather flow, to the wastewater treatment plant. The diverted dry- and wet-weather flow is conveyed by a connector pipe to the interceptor, while wet-weather flows in excess of the design capacity of the regulator are diverted through a diversion weir or overflow pipe to a receiving stream. Wet wells are drainage system nodes that provide storage volume. Physically they could represent storage facilities as small as a catch-basin or as large as a lake. The volumetric properties of a storage unit are described by a function or table of surface area versus height. Outfalls are terminal nodes of the drainage system used to define final downstream boundaries under Dynamic Wave flow routing or discharge overflow to the receiving stream.

An orifice diversion structure is a modification of the dam structure consisting of a fixed plate or gate. At the entrance to the connector pipe, the gate or plate is designed to place additional hydraulic restrictions beyond that of the connector pipe on flow diverted to the interceptor. Usually the incoming municipal pipe and the overflow pipe are the same size while the connector pipe to the interceptor is smaller. As higher flows increase the hydraulic grade line (HGL) or water level in the structure, wet-weather overflow in excess of the engineered conveyance capacity of the regulator device and connector pipe is diverted through an outfall pipe to a receiving stream. Pumps are links used to lift water to higher elevations. A pump curve describes the relation between a pump's flow rate and conditions at its inlet and outlet nodes.

An example profile of the interceptor is shown in Figure 5.4.

Interceptor Profile between Manhole DU3097M and Outfall WWTP-OF
Figure 5.4



Hydraulic routing of dry and wet weather flows was accomplished utilizing dynamic wave. Dynamic wave is the full solution of the Saint-Venant Equations, which describe one-dimensional unsteady flow through conservation of mass and momentum. The dynamic wave method is capable of estimating hydraulic parameters for free-flow, open channel with backwater effects, surcharged, full pipe, and reverse flow conditions. Although analysis utilizing this method is complex and time consuming, it is well suited to CSS which are subject to a variety of hydraulic conditions.

5.2 MODEL DEVELOPMENT

The major characteristics of interceptors in the model, which include conduit length, size, manhole invert, manhole depth, were developed using KLH survey data. Unlike sub-catchment hydrological parameters, the major characteristics of interceptors were deemed fixed and were not adjusted during model validation process, unless reliable investigation showed that there was an update for the manhole or conduit.

Additionally, field data collected by DE were used. Data collected by DE are manhole inspection with site photographs, precipitation data, and flow monitoring data.

Totally, the model contains eight (8) sub-catchments, 61 manhole structures, 66 conduits, five (5) outfall structures, and three (3) orifices. Appendix E shows the schematics of the Duquesne model. Appendix F shows the model components details in text format.

5.3 VALIDATION

Model validation is the process of adjusting both hydrologic (flow development) and hydraulic (flow routing) variables to best match actual measured flow data. The result is a hydrologic and hydraulic model of an existing collection system that best represents dry weather conditions and the flow responses to wet weather conditions and hydraulic grade lines (HGL) within the sewer system. A properly validated hydrologic and hydraulic model provides a valuable tool for many types of analyses including simple capacity analyses and CSO alternatives evaluation.

The Duquesne model will be used as a predictive tool to characterize the sewage collection system under existing and future conditions. Therefore, it is imperative that the model accurately represents wastewater flows in the collection systems. To calibrate the Duquesne model, extensive basin-wide flow monitoring was conducted to collect the required data. This data, once subjected to quality assurance procedures, was compared to the modeled response at the monitored locations. The model input parameters were then subject to validation to facilitate a closer correlation between the observed data and the simulated response.

5.3.1 Validation Criteria

The accuracy of the developed model during wet-weather events is essential when recommending appropriate wet-weather control facilities. To make sure that the model accurately represents the best available information, rigorous wet-weather validation criteria were applied to the Duquesne model using a large quantity of quality-assured monitoring data.

Hydrologic validation was conducted for all of the monitored sites to properly simulate the wet-weather response from the monitored sewershed. Hydrologic validation of a monitored sewershed was based on the maximum number of successfully monitored wet-weather events. The number of events used for validation depends on the monitoring period and flow monitoring quality.

Using time series plots, graphical comparisons were made of peak flow and volume for each wet-weather event occurring during the validation period. Statistical comparison plots were developed to illustrate the goodness-of-fit between the modeled response and the monitored data. For a large number of storm events monitored locations, the simulated storm volumes and peak flows vs. the corresponding monitored volumes and peak flows were plotted. Regression plots were also generated to make statistical comparisons of the simulated flows and the monitored flows. The statistics include a regression trendline of model results compared to the metering results, a calculation of the slope and intercept of the trendline. An R-square value calculation is performed to provide a measure of the model's accuracy to predict flow monitoring results. Storm events with missing, incomplete and/or errant flow monitoring data, unreasonable responses in either the simulated flows or monitored flows or inaccurate or unreasonable precipitation data were identified and deemed "outliers." These outlier storm events were deleted for the regression analysis, so they did not affect the results of the regression analysis. The iterative process of optimizing the runoff and RDII parameters was continued until the validation objectives were achieved.

While using any monitored flow data to validate a hydraulic model, the variability of the monitored data needs to be considered. This is to say that even under optimal conditions within a monitoring manhole, the accuracy of monitored data is typically +/-10 percent, and the variability can be higher in a hydraulically challenged site such as high velocities, surface turbulence and varying backwater interferences. Depending on the hydraulic conditions present at a monitoring site, there can be ample variation in the performance of a monitoring site in terms of flow monitoring data collected during dry- and wet-weather flow from that site. This variability was accounted for when using the observed flow monitoring data during the hydrologic validation of the sites.

The purpose of the validation process for monitored combined sewersheds is to determine the runoff parameters to achieve the following primary goals of model validation:

- On the statistical regression plots, a regression line with slope close to one (1) indicates that the modeled storm event volumes and peak flow rates are consistent with the monitored volumes and peak flow rates.

- On the statistical regression plots, an intercept of the regression line close to zero (0) indicates that the modeled event volumes and peak flow rates were not biased (i.e., consistently over-simulating or under-simulating) with respect to the monitored volumes and peak flow rates.

- On the statistical regression plots, an R-square value of the regression line close to one (1) indicates that the degree of scatter in the data points in the regression plot is low.

- On the time series plots, matching as closely as possible the ratio of the time to peak, shape and magnitude for the monitored and simulated events.

For small number of storm events monitored locations, the statistical method may not generate stable regression plots. In these cases, model validation was evaluated for individual storms and overall storms. The validation criteria are the percentage of model peak higher than meter peak (P_{per}) and the percentage of model volume higher than meter volume (V_{per}). These criteria where used in conjunction when determining whether or not a particular portion of the system was adequately validated. The iterative process of optimizing the runoff parameters was continued until the validation objectives were achieved. The definition of P_{per} and V_{per} were shown in Equation 2 and Equation 3.

$$P_{per} = \frac{P_o - P_m}{P_o} \times 100\%$$ Equation 2

$$V_{per} = \frac{V_o - V_m}{V_o} \times 100\%$$ Equation 3

where:

P_o = Observed (meter) hydrograph peak;
P_m = Modeled hydrograph peak;
V_o = Observed (meter) hydrograph total volume;
V_m = Modeled hydrograph total volume;

The purpose of the validation process for monitored combined and separate sub-catchments is to determine the runoff parameters to achieve the primary goals of model validation. Generally speaking, peaks and volumes within 15 percent are considered to be well validated.

It is important to emphasize that with the large number of storms used to validate the model, data scatter is expected and acceptable in the regression plots, especially for simulated vs. monitored storm peak flow rates. Because of the large number of storm events considered in the analyses, a higher degree of scatter in the data points (with a corresponding lower R-square value) needs to be allowed, as long as there is no overall bias demonstrated in these plots. With the long-term continuous simulation modeling approach, simulation of individual storms is not significant when compared with the accuracy of the overall model simulation over the course of the total model duration. The criterion is to make sure that there is no overall bias in the simulations, and that over-simulation and under-simulation of individual storms balance out over the course of the long-term simulation.

5.3.2 Model Validation QA/QC Procedures

QA/QC procedures were utilized during both the hydrologic and hydraulic validation processes to verify that the model yields meaningful, accurate, and reliable results consistent with the modeling goals and objectives. The following general QA/QC procedures were performed during the model validation processes:

- Checked for warnings and error messages in the model output file and resolved all major warnings and errors.
- Checked the model's run report for inconsistencies and/or unexpected results.
- Checked the model's overall continuity error and resolved items resulting in an overall continuity error greater than 2%.

- Checked individual continuity errors and resolved items resulting in individual continuity errors greater than 5%.

- Checked model stability using the following methods:

  - Visually checked the dynamic performance of the hydraulic grade line along profile views of sewers.
  - Visually checked the output hydrographs at key hydraulic locations across the simulated area.
  - Checked for dry pipes under both dry weather and wet weather flow conditions and resolved any improperly loaded conditions.
  - Checked the performance of system appurtenances such as pumps, weirs, orifices, and storage elements and verified that they are performing as expected.
  - Checked manholes where flows are lost from the system and verified that these losses are as expected.

5.3.3 Model Validation

For the validation process, all of the wet weather events where data were available were initially utilized at each monitoring location. During the QA/QC process, certain events were noted to have various data problems, including uncharacteristic responses, and these events were generally defined as outliers. Table 5.2 shows the kept events number, outlier events number and the total events number for each site.

Number of Kept, Outlier, and Total Events by Site
Table 5.2

	Kept	Outlier	Total
M-1	7	0	7
M-3	7	0	7
M-5A8	7	0	7
M-5A18	7	0	7
M-6A	7	0	7
M-8	7	0	7
M-10	7	0	7
M-11	7	0	7

Figure 5.5 and Figure 5.6 present the overall validation results for all the monitoring sites in the Duquesne system for event volume and event peak flow, respectively. The plots show all of the validation events and a trend line for the validation events. The data used to generate these figures is derived from the individual modeling and monitoring site.

Figure 5.5 shows the regression plot between the simulated event volume and monitored event volume for all the monitored sites in the Duquesne system. As the plot shows, the slope of the regression line is 0.9469, which suggests that there is good correlation between the simulated and monitored event volumes. The small value of 0.0189 for the intercept suggests that there is no relative bias in the simulation of the event volumes. The R-squared value of the regression plots is 0.9098 suggesting that there is a very small scatter in the data points around the regression. The source of the scatter is attributed to non-uniform hydrologic responses in the collection system and inaccuracies in flow monitoring and rainfall data collection.

Event Volume Regression Plot for All Sites in the Duquesne System
Figure 5.5

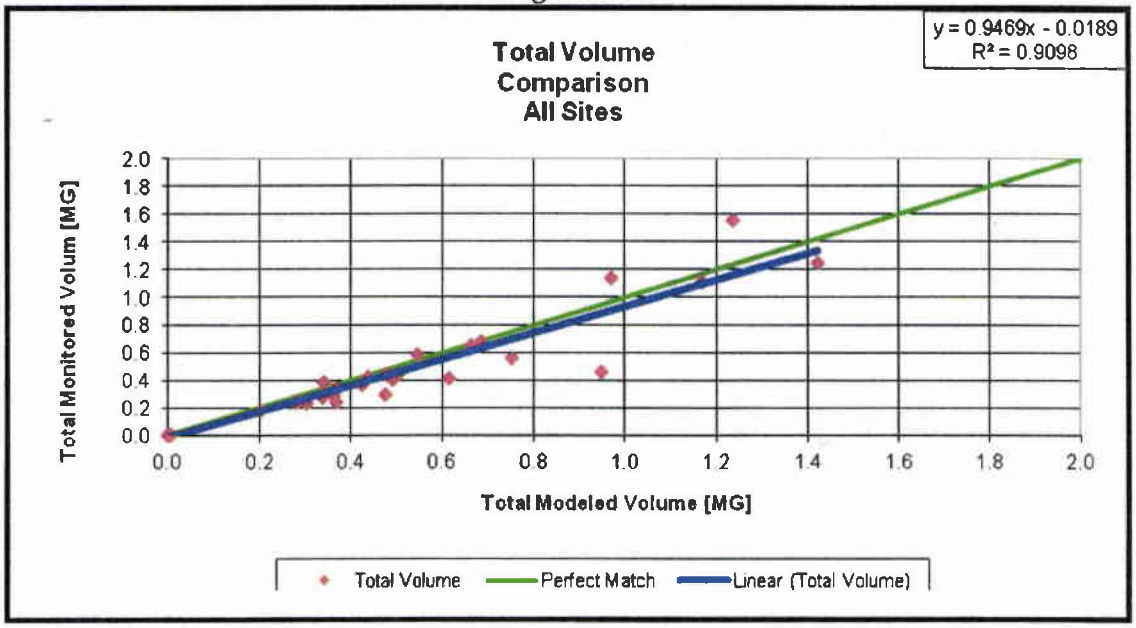
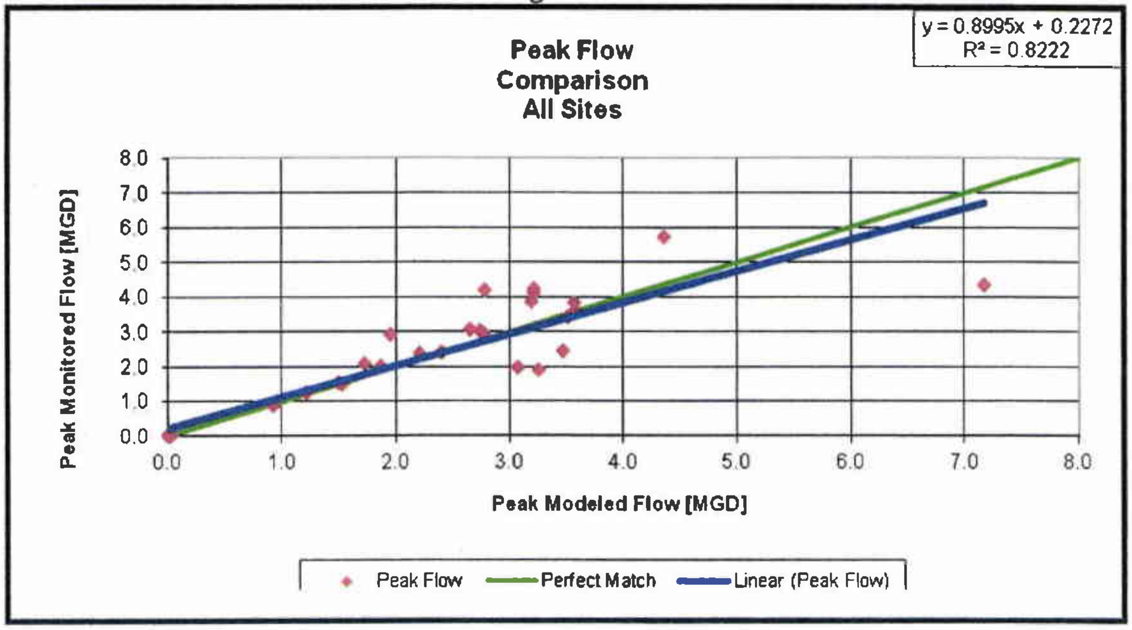


Figure 5.6 shows the regression plot between the simulated event peak flow and monitored peak flow for all the monitored locations in the Duquesne system. As the plot shows, the slope of the regression lines is 0.8995, which suggests that there is good correlation between the simulated and monitored event peak flows. The small value of 0.2272 for the intercept suggests that there is no relative bias in the simulation of the event peak flows. The R-squared value of the peak flow regression plot is 0.8222 suggesting that there is a small scatter in the data points. The source of the scatter is attributed to non-uniform hydrologic responses in the collection system and inaccuracies in flow monitoring and rainfall data collection.

Event Peak Regression Plot for All Sites in the Duquesne System

Figure 5.6



To illustrate modeling details, Appendix G shows the modeled and monitored volumes and peaks for each site and each event, as well as the monitored and modeled hydrographs. Appendix H shows the regression plots for each site. Because some sites have a small number of monitoring events, the statistical method may not generate stable regression plots. This does not mean the validation is poor, as long as the total volume and peak differences are in reasonable range.

Overall, the model is considered to be well validated and suitable for evaluating the system performance in various rain events.

5.4 HISTORICAL RAINFALL ANALYSIS

As previously stated, the "presumption" approach evaluates overflows on an annual average basis.

> *"The elimination or capture for treatment of no less than 85% by volume of combined sewage collected in the CSS during precipitation events on a system-wide annual average basis."*

The ALCOSAN typical year 15-minute interval rainfall data was used for this analysis. This data was used because it is readily available to KLH and it is representative of the annual average conditions for the City of Duquesne. This data is included in Appendix I.

5.5 LONG-TERM CONTINUOUS SIMULATION RESULTS

In order to determine whether or not the Duquesne CSS can capture for treatment 85 percent of flow volume resulting from rain events, on an annual average basis, a year-long continuous model simulation was completed using the increased ALCOSAN Pixel Eight typical year rainfall.

Equation 4 was utilized for percent capture evaluation.

$$\% \text{ Capture} = [V_{WWTP} / (V_{WWTP} + V_{CSO})] \times 100\% \qquad \text{Equation 4}$$

Where

V_{WWTP} - Total volume of CSS flow conveyed to the WWTP during wet weather,
V_{CSO} = Total volume of overflow from the CSO's,

These volumes were determined based on the one year simulation.

V_{WWTP} = 233.76 MG
V_{CSO} = 28.97 MG
%Capture = [233.76 / (233.76 + 28.97)] x 100% = 88.97%

Based on the continuous simulation modeling, the Duquesne CSS, on a system-wide annual average basis, does not meet the "presumption" approach criteria ii, after completion of the WWTP improvements described in the following sections. Maintaining a free discharge boundary condition at the proposed WWTP influent pump station, in addition to the proposed relief sewers, will allow for the "presumption" approach to be met. The SWMM model report is included in Appendix J.

6.0 EXISTING FACILITY

6.1 EXISTING NPDES PERMIT REQUIREMENTS

The existing WWTP provides screening, grit removal, contact stabilization, secondary treatment and disinfection prior to discharging treated effluent to Monongahela River. The operation and discharge is regulated under the terms of the current NPDES Permit Number PA0026981. The permit limits are listed in Table 6.1. The WWTP design flow is 2.0 MGD.

Existing Effluent Limits
Table 6.1

PARAMETER	LOADING (lbs)			CONCENTRATION (mg/L)			
	Average Monthly	Average Weekly	Units	Average Monthly	Average Weekly	Instant. Maximum	Units
Flow	-	-	-	Monitor and Report			-
CBOD-5 Day	417	626	lb/day	25	37.5	50	mg/L
Suspended Solids	500	751	lb/day	30	45	60	mg/L
Total Residual Chlorine				1.0		3.3	mg/L
Fecal Coliform							
May 1 to Sept 30				200			/ 100ml
Oct. 1 to April 30				2,000			/ 100ml
pH	Within Limits of 6.0 to 9.0 Standard Units At All Times.						

6.2 EXISTING HYDRAULIC LOADINGS

6.2.1 Average Flows

The facility has an average daily design capacity of 2.0 MGD. Analysis of flow data from the past five (5) years shows that monthly average flow has not exceeded 2.0 MGD for three (3) consecutive months, and therefore, the WWTP is technically not hydraulically overloaded. The monthly average flows have not exceeded 2.0 MGD over the past five (5) years. The maximum monthly average flow observed over the past five (5) years is 1.412 MGD.

Analysis of flow data from the past five (5) years shows that the annual average flow for the WWTP is 0.863 MGD. Table 6.2 summarizes average flows for the five (5) years.

Existing Hydraulic Loadings
Table 6.2

Year	Max. Mo. Ave. Flow (MGD)	Annual Ave. Flow (MGD)
2009	0.981	0.66
2010	1.080	0.90
2011	1.199	0.84
2012	1.280	0.94
2013	1.412	0.97

6.2.2 Peak Flows

The capacity of the CSS limits the flows that are received at the WWTP. Peak hourly flow should be limited to 2.77 MGD based on final clarifier surface overflow rate. Given the available footprint at the WWTP site, there is no space available for additional clarifiers.

6.3 EXISTING MASS LOADINGS

6.3.1 Historical Loadings

WWTP raw sewage organic loading data was evaluated for the past five (5) years. Organic loadings are summarized in Table 6.3 below.

Existing Influent Organic Loadings
Table 6.3

Year	Max. Month (lb. BOD/day)	Annual Ave. (lb. BOD/day)
2009	701	538
2010	1,241	620
2011	933	487
2012	806	592
2013	493	351

The WWTP's current rated organic capacity is 2,780 lb/day. Given the 5-year annual average BOD loading of 518 lb/day and the 5-year annual average flow of 0.863 MGD, the average BOD concentration is 72 mg/L. The City's wastewater would be classified as low strength which is not uncommon for old CSS's.

6.4 EXISTING PROCESS

A process flow diagram for the existing WWTP is included in Appendix K of this report. A site plan for the existing WWTP is included in Appendix L. Calculations associated with the existing processes are included in Appendix M.

6.4.1 Preliminary Treatment

Flow enters the WWTP through a parshall flume, which continuously records flow using an ultrasonic flow meter and seven-day chart recorder. Flow is then conveyed through a mechanically cleaned bar screen, or during times of maintenance, a manually cleaned bar screen.

Influent Channel

Photograph 6.1

6.4.2 Grit Removal

Wastewater flows via open channel from the parshall flume through an aerated grit chamber utilizing a mechanical grit removal system. The grit basin's peak capacity is 5.48 MGD based on a 3 minute minimum detention time. It is noted that the square configuration of this basin is not conducive to plug flow. Plug flow is desirable in an aerated grit basin in order to reduce potential for basin short-circuiting.

Grit Removal System
Photograph 6.2

6.4.3 Secondary Treatment

The Duquesne WWTP has four (4) aeration basins. Two (2) serve as contact tanks and two (2) are utilized as stabilization basins. Each basin is approximately 21-feet wide by 24-feet long, with an average flow water surface depth of 13.50-feet.

Aeration Basins
Photograph 6.3

Aeration basin effluent flows by gravity to two (2) square final settling tanks, each 34-feet x 34-feet. The settling tanks have a maximum monthly average flow capacity of 1.85 MGD based on surface overflow rate, and a peak hour flow capacity of 2.77 MGD, also based on surface overflow rate.

Final Clarifiers
Photograph 6.4

6.4.4 Disinfection

Final settling tank effluent flows by gravity into one (1) chlorine contact tank. The tank is 56-feet long by 31-feet wide with an average flow water depth of 9-feet. It is constructed with dividing walls, providing a serpentine pattern, totaling 190-linear feet of channels and 1,380 square feet of surface area. The maximum monthly average flow capacity is 3.02 MGD and the peak hour flow capacity is 6.88 MGD, both limited by total detention time.

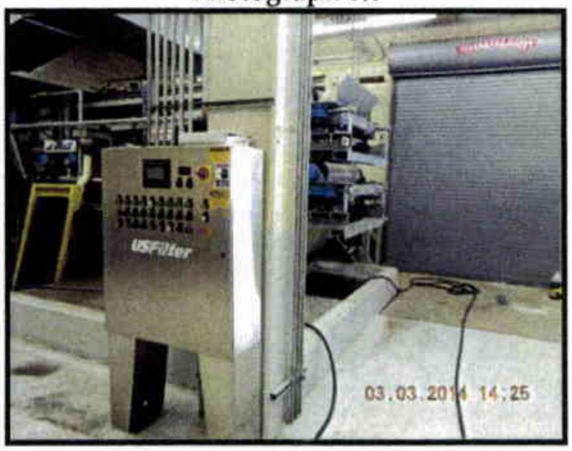
Chlorine Contact Tank
Photograph 6.5

6.4.5 Solids Handling

At the Duquesne WWTP, return activated sludge is removed from the bottom of the final clarifiers and is transferred to the stabilization tanks by an air lift line. Waste activated sludge is then removed from the stabilization tanks and pumped to the aerobic digesters.

Adjacent to the contact stabilization tanks, the WWTP contains four (4) aerobic digesters in series and two (2) sludge thickening tanks. Each aerobic digester is approximately 21-feet wide by 26-feet long, with a total four (4) tank capacity of 282,422 gallons. Each sludge thickening tank is 20-feet in diameter, providing a total two (2) tank capacity of 45,823 gallons. Thickened sludge is then conveyed to a 1.0-m belt filter press.

Belt Filter Press
Photograph 6.6



7.0 TREATMENT PLANT UPGRADES

7.1 DESIGN HYDRAULIC LOADINGS

In order to meet the EPA CSO Control Policy, "presumption" approach as well as DEP design standards, three criteria were evaluated:

1. Percent capture – at least 85% of CSS volume (resulting from rain events), on an annual average basis, must be captured and conveyed to the WWTP for full biological treatment.
2. Design rain event – application of a design rain event is critical to ensure that upgrades completed to address percent capture will not result in manhole overflows.

Including the conveyance system upgrades previously outlined in this report, H&H modeling resulted in the 88.97% capture, which was described in the Flow Monitoring and System Modeling section of this report. Application of the typical year rainfall to the sewer system results in a modeled peak flow at the WWTP of 14.57 MGD. Design flows are summarized in Table 7.1 below.

Design Hydraulic Loadings
Table 7.1

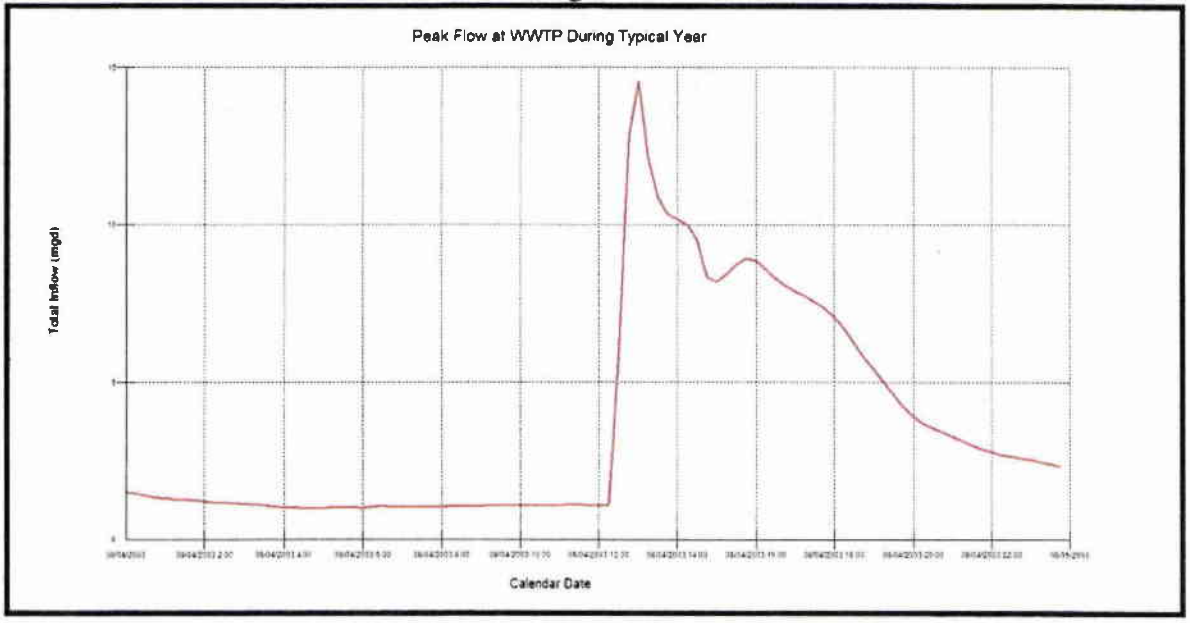
Design Flow	WWTP (MGD)
Peak Instantaneous	14.57
Peak Hourly	12.60
Peak Daily	6.97
Max Monthly Ave	2.00
Annual Average	1.00

All design flows were based on 30-year population projection. No significant growth is anticipated within the City over the next 30 years. Consistent with past Chapter 94 reports, 2 EDUs/year over the next 30 years was included. Development of each design flow is further described below.

7.1.1 Peak Instantaneous Flow (PIF)

As discussed above, PIF is governed by the design rain event. The design hydrograph resulting from the SWMM modeling is shown in Figure 7.1 below.

Design Hydrograph
Typical Year Peak Flow
Figure 7.1



7.1.2 Peak Hourly Flow (PHF)

PHF was also estimated based on SWMM modeling.

7.1.3 Peak Daily Flow (PDF)

Application of design rain event to the SWMM model resulted in a PDF of 6.97 MGD.

7.1.4 Maximum Monthly Average Flow (MMAF)

MMAF is a critical design parameter for evaluating WWTP treatment capacity. As discussed under Section 6.2.1, monthly average flows have not exceeded 2.0 MGD over the past five (5) years. The maximum monthly average flow (MMAF) observed over the past five (5) years is 1.412 MGD. This is consistent with the H&H model, which provided a MMAF of 1.72 MGD.

Therefore, the maximum month average flow design capacity of 2.0 MGD will be maintained. This value still provides a 1.4 factor of safety over the MMAF from the last five (5) years, and 1.2 factor of safety over the MMAF from the model simulation.

Projected growth was also included in the design MMAF, but no significant growth is projected for the City for the next 30 years.

No hydraulic re-rate will be required for the alternatives set forth in this report.

7.1.5 Annual Average Flow (AAF)

AAF of 1.0 MGD was estimated based on the typical year rainfall distribution applied to the SWMM model and is consistent with the AAF reported in the Chapter 94 Report.

7.2 DESIGN MASS LOADINGS

Design mass loadings were developed based on review of existing WWTP loading data with respect to industry standard typical values. It must be noted that by significantly increasing percent capture, there may be an increase in mass loadings. However, given the fact that the City's current loads are far below the WWTP's design capacity, it is reasonable to conclude that no organic re-rate will be necessary. Industry standard loadings for low to medium strength sewage and combined sewage were evaluated with respect to WWTP influent data available from the recent NPDES Permit Renewal.

Design Mass Loadings
Table 7.2

Parameter	Design Concentration (mg/L)	Design Loading (lb/day)
BOD	167	2,780
TSS	210	3,503

7.3 DESIGN EFFLUENT LIMITS

No new design effluent limits are required for the alternatives in this report.

7.4 ALTERNATIVES EVALUATION

7.4.1 Development of Alternatives

Alternatives were developed for evaluation with the primary focus of providing treatment to 85 percent of CSS flow captured during rain events on an annual average basis. In order to meet the 85 percent criteria, a hydraulic re-rate will not be required. During the development of each alternative, it was high priority to maintain as much of the existing processes as possible. Three (3) alternatives were developed for detailed evaluation.

1. Alternative 1 – Continue operation of existing processes and construct new CSO bypass treatment facilities. This alternative utilizes the existing WWTP up to peak flows of 2.5 MGD. Peak flows above 2.5 MGD will receive CSO bypass treatment. This alternative includes construction of new headworks facilities, influent pump station, and CSO bypass treatment facilities, as well as the installation of new clarifier equipment to maximize efficiency. Additionally, this alternative includes CSS

upgrades required to convey the 10-year, 24-hour design storm to the WWTP. The following items are included in Alternative 1.

- CSS upgrades.
- New automatic bar screen and by-pass channel with static screen.
- New headworks building.
- New raw sewage pump station and controls.
- New raw sewage pump station piping and valve vault.
- New pump flow meter.
- Site gravity and force main piping.
- New CSO bypass treatment.
- Upgrade final clarifier equipment to maximize efficiency.

2. Alternative 2 – Pump to McKeesport WWTP and build new peak flow storage facilities. This alternative includes construction of a new raw sewage pump station, with new headworks facilities, to convey all flow up to 2.5 MGD to the MACM WWTP. All flow above 2.5 MGD will be pumped by separate storm pumps and stored in a newly constructed storage facility. It should be noted that the MACM WWTP does not currently have the capacity to accept an additional 2.5 MGD flow, and upgrade costs for the WWTP are not included. Additionally, this alternative includes CSS upgrades required to convey the 10-year, 24-hour design storm to the pump station. The following items are included in Alternative 2.

- CSS upgrades.
- New automatic bar screen and by-pass channel with static screen.
- New headworks building.
- New raw sewage pump station and controls.
- Average flow pumps and storm pumps.
- New raw sewage pump station piping and valve vault.
- New pump flow meter.
- Site gravity and force main piping.
- Force main piping to the MACM WWTP.
- Force main piping to storage facility.
- New storage facility and land acquisition.

3. Alternative 3 – Continue operation of existing processes and construct new peak flow storage facilities. This alternative utilizes the existing WWTP up to peak flows of 2.5 MGD. Peak flows above 2.5 MGD will be pumped by separate storm pumps and stored in a newly constructed storage facility. This alternative also includes construction of new headworks facilities, as well as the installation of new clarifier equipment to maximize efficiency. Additionally, this alternative includes CSS upgrades required to convey the 10-year, 24-hour design storm to the WWTP. The following items are included in Alternative 3.

- CSS upgrades.
- New automatic bar screen and by-pass channel with static screen.
- New headworks building.
- New raw sewage pump station and controls.
- Average flow pumps and storm pumps.
- New raw sewage pump station piping and valve vault.
- New pump flow meter.
- Site gravity and force main piping.
- Force main piping to storage facility.
- New storage facility and land acquisition.
- Upgrade final clarifier equipment to maximize efficiency

Existing final clarifier plans and proposed upgrade equipment for alternatives 1 and 3 can be found in Appendix N.

7.4.2 Evaluation of Alternatives

The following sections summarize design considerations associated with each alternative. Both Alternatives 1 and 3 will meet the current permit requirements and will not require a design capacity re-rate. Alternative 2 may require new facilities and/or a design capacity re-rate at the MACM WWTP, but those issues will only be investigated if Alternative 2 proves to be the preferred alternative for the City of Duquesne. Table 7.3 lists the advantages and disadvantages associated with each alternative.

Alternatives Comparison
Table 7.3

Alternative No.	Alternative	Advantages	Disadvantages
1	CSO Bypass Treatment	1. Maintain existing WWTP processes with minor upgrades 2. Bypass protects WWTP biology during peak flow events 3. Provides screening, primary treatment and disinfection in small footprint 4. Able to handle peak flows much higher than the WWTP design capacity 5. Low power requirement and no moving parts	1. No biological treatment for bypass 2. Additional O&M costs for influent pump station
2	Pump Station To MACM WWTP	1. Operation and maintenance of WWTP eliminated. 2. Lower manpower requirement.	1. Flow storage facilities still required 2. MACM WWTP capacity restrictions may require upgrades and a re-rate 3. Large pump station will require various sized pumps
3	Flow Storage Facilities	1. Maintain existing WWTP processes with minor upgrades 2. Protects WWTP biology during peak flow events 3. Biological treatment of all flow	1. Site restrictions require additional land acquisition 2. Pump station and force main required to convey flow to storage tank 3. Large pump station will require various sized pumps 4. Additional O&M costs for pump station

7.4.2.1 <u>Alternative 1 – CSO Bypass Treatmeant</u>

Alternative 1 includes three main components:

1. Construction of a new headworks facility with mechanical screening and a raw sewage pump station.
2. Construction of CSO bypass treatment facilities to provide screening, primary treatment, and disinfection to peak wet weather flows above the current WWTP capacity of 2.5 MGD.
3. Installation of new final clarifier equipment to maximize efficiency.

A process flow diagram associated with Alternative 1 is included in Appendix O. A site plan associated with Alternative 1 is included in Appendix P. Calculations associated with Alternative 1 are included in Appendix Q.

A mechanical bar screen, sized for 14.57 MGD, is recommended prior to the new raw sewage pump station. This screen will protect the new pump station pumps, eliminate static screen cleaning requirement, and remove more fibrous materials from the flow stream than the existing static screens are capable of. Automatic bar screen clear openings of 1/4 inch are recommended. A by-pass channel with a static bar screen is recommended so that the automatic bar screen can be taken out of service for maintenance. This screen will be sized for at least 14.57 MGD. A static screen is proposed in order to reduce cost and required footprint. However, it is important to note that the larger clear openings in the static screen, required to reduce blinding potential, will increase flow storage basin cleaning requirements.

The existing WWTP influent comes in at grade, and as such, pumping is not currently required. However, in order to achieve 85% capture, a free discharge boundary condition must be maintained at the WWTP. Additionally, the CSO bypass treatment facilities can be constructed above grade at a lower cost. Therefore, an influent pump station is proposed. The station will handle both average and peak flow, pumping to either the WWTP or CSO bypass treatment facilities based on rate of flow. This will be accomplished by installing two (2) sets of pumps, average flow and storm pumps. All flow up to 2.5 MGD will be pumped to the head of the WWTP to then be conveyed through the existing treatment processes. As wet weather flows increase and the wet well level rises due to lack of capacity in the average flow pumps, the storm pumps will activate and pump to the CSO bypass treatment facilities.

This station will be located adjacent to the existing building and will require new gravity sewers to reroute influent flow. In addition to the structure and pumps, new pump controls and associated electrical equipment will be included. Also, new pump discharge flow meters are recommended, located in an adjacent underground valve vault. This flow meter is used for DEP reporting; therefore, accuracy is critical.

Flows over 2.5 MGD will be conveyed by the storm pumps to CSO bypass treatment facilities which will provide screening, grit removal, primary treatment, and disinfection. CSO treatment technologies, such as Hydro International's Storm King, achieve up to 50% total suspended solids reduction and 30% BOD reduction, while also providing under 200 cfu/100 ml fecal concentrations, screening to 4mm solids, grit removal, and high rate disinfection using sodium hypochlorite.

The technology uses tangential flow patterns within the unit to allow solids to settle out by gravity. Flow is introduced tangentially into the side of the Storm King causing the contents to rotate slowly about the vertical axis.

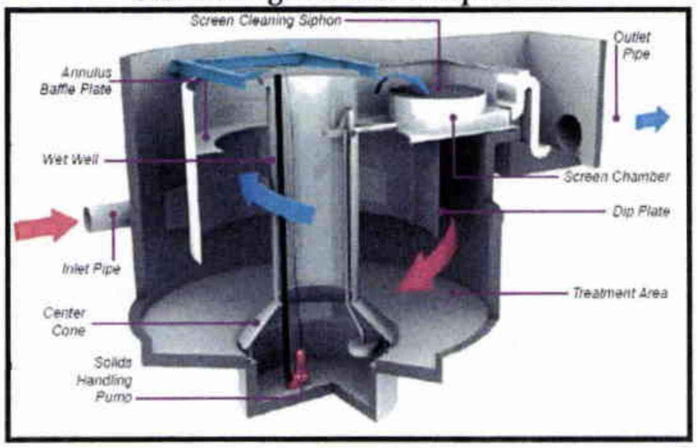
The flow spirals down the perimeter allowing the solids to settle out. This process is aided by rotary forces, shear forces and drag forces at the boundary layer on the wall and base of the vessel.

The internal components direct the main flow away from the perimeter and back up the middle of the vessel as a broad spiraling column, rotating at a slower velocity than the outer downward flow. By the time the flow reaches the top of the vessel, it is virtually free of settleable solids and is discharged to the outlet channel. Prior to discharge, the overflow passes through the swirl cleanse screen.

The swirl cleanse screen captures all floatables and neutrally buoyant material greater than 4mm. The air regulated siphon provides an effective backwash mechanism to prevent the screen from blinding.

The collected solids and floatables are then discharged by gravity or pumped out from the base of the unit to the sanitary sewer.

Figure 7.2
Storm King Internal Components



It is important to note that mass balance calculations were performed to verify that effluent limits would be met when biologically treated flow and CSO treated flows were combined prior to the WWTP outfall. These calculations can be found in Appendix O.

Photograph 7.1
Example Storm King

Flow from the CSO bypass treatment facilities will then be combined with the flow from the existing plant effluent, downstream of the existing chlorine contact tanks.

All sludge handling processes will remain as they currently exist.

7.4.2.2 <u>Alternative 2 – Pump Station to MACM WWTP</u>

Alternative 2 includes the following main components:

1. Construction of a new raw sewage pump station, including normal flow and peak flow pump capacity.
2. Construction of a new force main to the MACM WWTP.
3. Construction of a new wet weather storage facility.
4. Construction of a new force main to the storage facility.

A process flow diagram associated with Alternative 2 is included in Appendix R. Site plans associated with Alternative 2 are included in Appendix S.

Alternative 2 includes the same headworks and pump station as Alternative 1. In this alternative, the existing WWTP will be decommissioned and the average flow pumps will convey flow through an estimated 12-inch diameter force main spanning 16,400 linear feet. The force main will require a 90-ft road bore, 100-ft road bore, and 1100-ft road, railroad, and river bore. The proposed force main alignment is included in Appendix T.

The wet weather storm pumps will have the same operation as in Alternative 1, but will pump through an estimated 24-inch diameter force main spanning 2,000 linear feet. The proposed location of the flow storage facilities is on a portion of a property currently owned by U.S. Steel on Parcel 304-K-400. The site is located south west of the Duquesne WWTP. Land acquisition negotiations would need explored prior to determining final storage facility location.

Figure 7.3
US Steel Parcel 304-K-400

The H&H modeling for the 1-year, 24-hour design storm yielded a storage capacity requirement of 1.87 MG. Therefore, a 104-foot diameter by 33-foot high above ground storage tank is recommended, having a storage capacity of 2 MG. The tank will include a cover, aeration system, stairs and access platforms, and automatic cleaning nozzle system.

Following wet weather events, the storage facilities would drain back into the existing sewers in the area that flow by gravity back to the pump station.

7.4.2.3 Alternative 3 – Existing WWTP and Flow Storage Facilities

Alternative 3 includes the following main components:

1. Construction of a new raw sewage pump station, including normal flow and peak flow pump capacity.
2. Construction of a new wet weather storage facility.
3. Construction of a new force main to the storage facility.
4. Installation of new final clarifier equipment to maximize efficiency.

A process flow diagram associated with Alternative 3 is included in Appendix U. A site plan associated with Alternative 3 is included in Appendix V.

Alternative 3 is a combination of Alternatives 1 and 2. Similar to Alternative 1, this alternative maintains the existing WWTP and processes, with the exception of clarifier efficiency improvements. It also plans for new headworks and raw sewage pump station, but the pump station would be similar to that in Alternative 2. Average flow pumps would pump to the existing WWTP, while storm pumps would convey peak flows to the same proposed storage facilities as in Alternative 2.

7.4.2.4 Cost Evaluation

Study level total project cost estimates were completed for the evaluated alternatives. The costs are as summarized in Table 7.4 below. Detailed cost estimates are included in Appendix W.

WWTP Upgrade Costs
Table 7.4

Alternative	Year 2014 Construction Cost	Year 2014 Total Project Cost
Alt 1 – CSO Bypass Treatment	$5,939,000	$7,424,000
Alt 2 – Pump to MACM WWTP	$12,408,000	$15,511,000
Alt 3 – Flow Storage Tank	$10,325,000	$12,907,000

7.4.2.5 Financial Capability Assessment

Given the magnitude of upgrades required relative to the low number of rate payers, it was necessary to complete a financial capability assessment in accordance with EPA guidance document, "Combined Sewer Overflows-Guidance for Financial Capability Assessment and Schedule Development." This assessment provides a means of determining whether or not the proposed Alternatives are affordable. All three (3) were determined to be "High Burden", but Alternative 1 has a significantly lower impact on the City. The projected additional cost per household and overall residential indicator associated with each Alternative are as follows.

Project Affordability
Table 7.5

Alternative	Additional Cost per Household per Year	Residential Indicator
Alt 1 – CSO Bypass Treatment	$292	3.79
Alt 2 – Pump to MACM WWTP	$501	4.91
Alt 3 – Flow Storage Tank	$443	4.63

As seen in Table 7.5, construction of CSO bypass treatment facilities will cost each customer $151 less per year, or $12.58 per month, over the second lowest cost option in Alternative 3.

Financial Capability Assessment Worksheets are included for Alternatives 1, 2, and 3 in Appendices X, Y, and Z respectively.

7.4.2.6 Recommended Alternative

A detailed evaluation of the proposed alternatives led to the recommendation of Alternative 1 for City's LTCP upgrades. The total estimated project cost is $7,424,000. This alternative is recommended for the following reasons:

- Alternative 2 project cost is $8,087,000 more than the recommended Alternative 1, while Alternative 3 project cost is $5,483,000 more.
- The existing WWTP is in good operating condition for average flows, and Alternative 1 allows the WWTP to continue operation under these conditions.

Alternative 1 is recommended. However, given the "High Burden" classification associated with this work, completion of the proposed upgrades on a typical project timeline is not feasible. Project financing will drive the schedule for implementing Alternative 1 upgrades.

8.0 PROJECT PLANNING

The following LTCP schedule is proposed.

LTCP Schedule
Table 8.1

Milestone	Date
Submit draft LTCP	September 1, 2014
Submit final LTCP with MACM ACT 537	November 1, 2015
DEP approval of LTCP and ACT 537	January 1, 2016
Obtain funding for design related services	January 1, 2017
Begin design of upgrades	January 1, 2017
Apply for Part II Permit for upgrades	July 1, 2018
Receive Part II Permit for upgrades	January 1, 2019
Obtain funding for construction	January 1, 2021
Begin construction for CSS upgrades	March 1, 2021
Complete construction	March 1, 2023
Submit post construction compliance monitoring plan	September 1, 2023

*DEP LTCP approval and Part II Permit dates are beyond the control of the City and KLH, therefore schedule dates will be adjusted based on actual DEP milestone completion dates.

9.0 SUMMARY AND CONCLUSIONS

In order to address the "presumption" approach percent capture criteria the following upgrades are recommended:

- Construct Alternative 1 – New headworks, raw sewage pump station, and CSO bypass treatment facilities, and upgrade existing final clarifier equipment to maximize efficiency.

Flow monitoring and SWMM modeling was completed for the City's CSS. It was determined that two (2) sewer improvements are required within the system to allow for conveyance of the peak core flow, 85% capture, and no manhole overflows given 10-year, 24-hour rain event, and a free discharge at the WWTP.

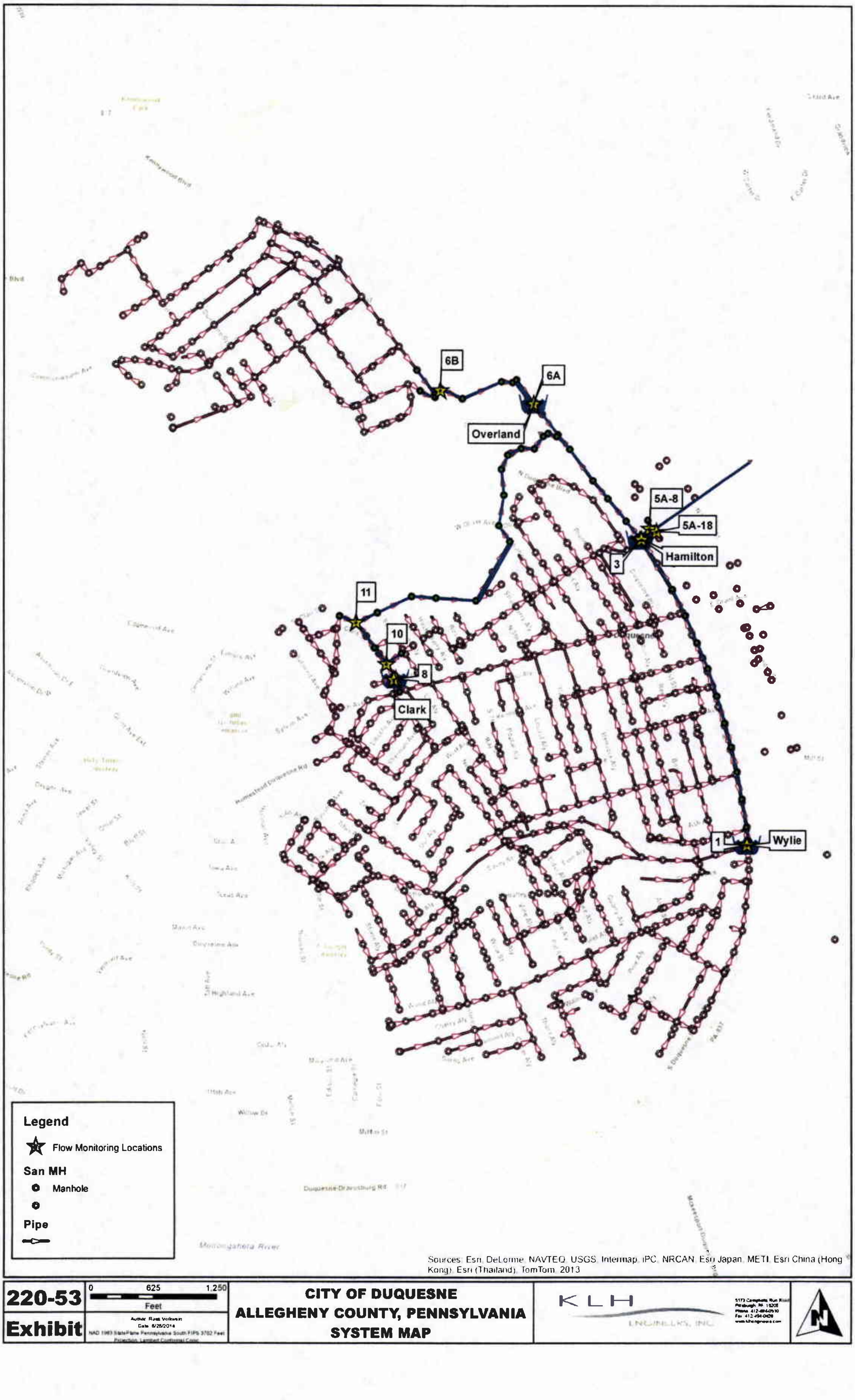
The first required conveyance system upgrade is a parallel relief sewer downstream of CSO 005 between William Avenue and Mulberry Way, from Manhole DU3107M to DU3097M. The relief sewer is estimated to be 715-feet length, and 15-inch diameter, to ensure no flooding during the 10-year, 24-hour design rain event.

The second required conveyance system upgrade is a parallel relief sewer upstream of CSO 004 along the railroad, from Manhole DU4299M to CSO 004. In addition to the relief sewer, the lids on Manholes DU4299M and DU4298M will need bolted down to prevent flooding. The relief sewer is estimated to be 310-feet length, and 15-inch diameter, to ensure no flooding during the 10-year, 24-hour design rain event.

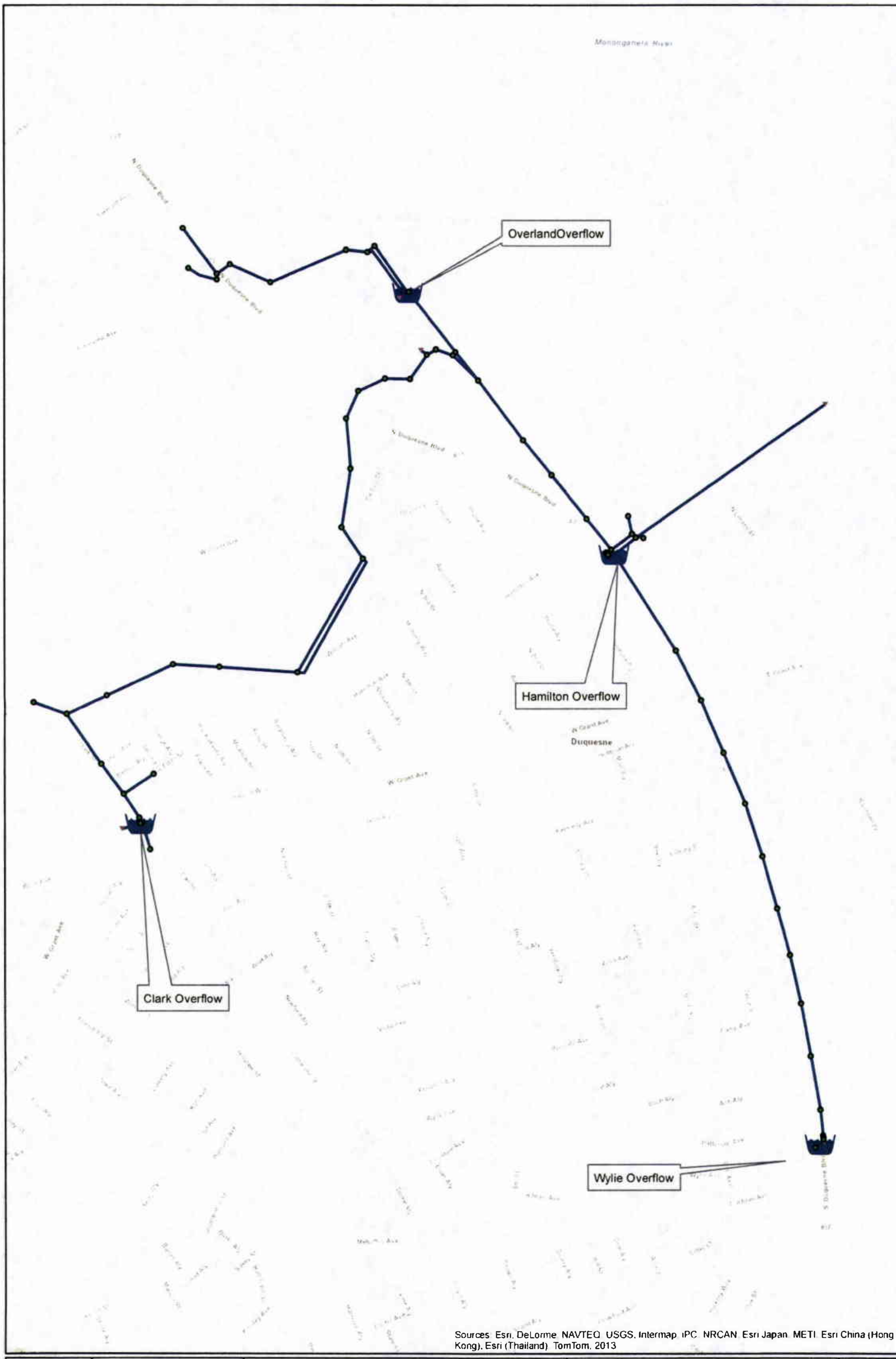
The work associated with Alternative 1 has an estimated total project cost of $7,424,000.

APPENDIX A

System Map
CSO Location Map
Tributary Area Map



220-53 Exhibit	0 625 1,250 Feet	**CITY OF DUQUESNE ALLEGHENY COUNTY, PENNSYLVANIA SYSTEM MAP**	KLH ENGINEERS, INC.



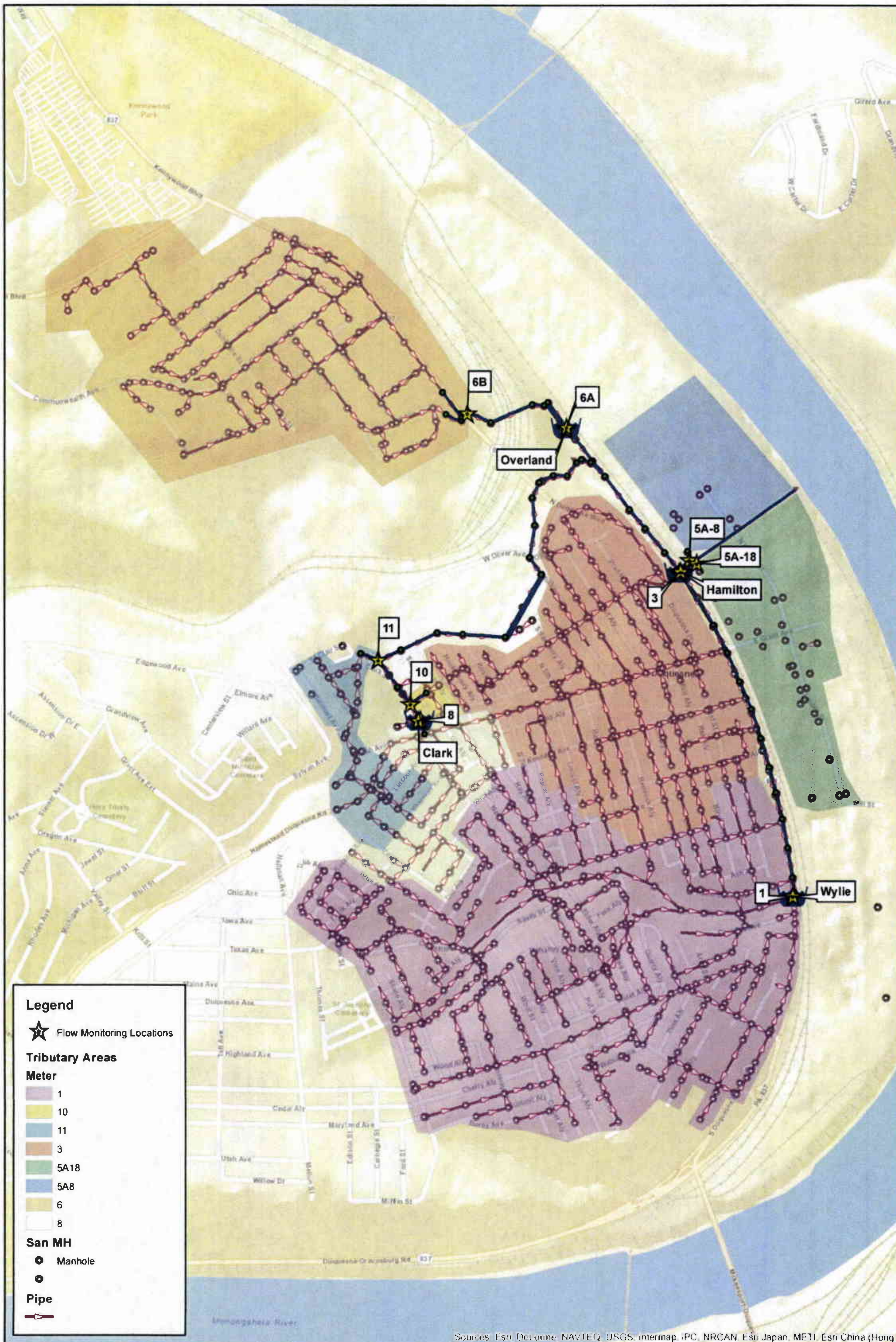
220-53 Exhibit

0 350 700
Feet

NAD 1983 StatePlane Pennsylvania South FIPS 3702 Feet

CITY OF DUQUESNE
ALLEGHENY COUNTY, PENNSYLVANIA
CSO LOCATIONS

KLH ENGINEERS, INC.

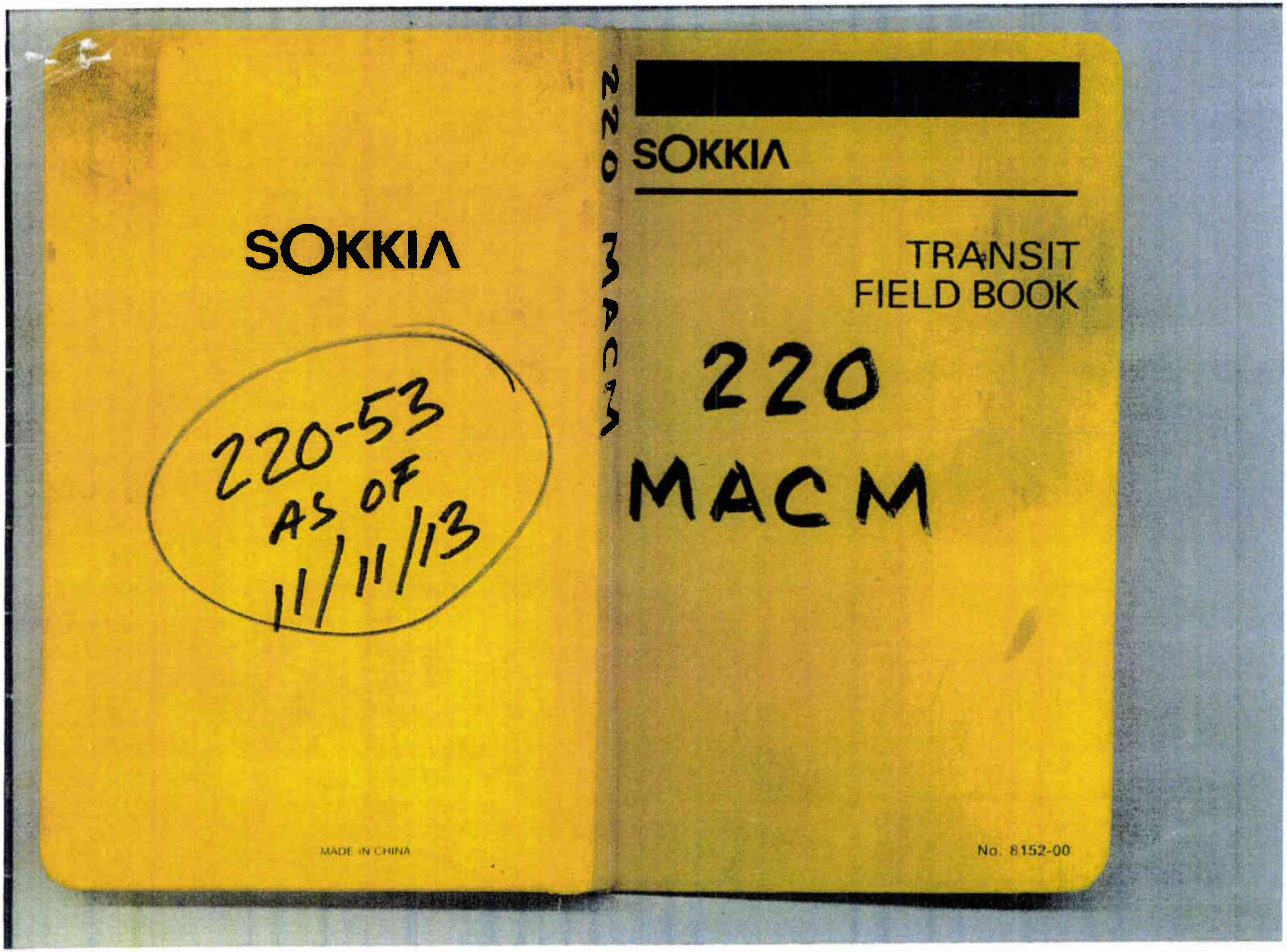


220-53 Exhibit	0 625 1,250 Feet	CITY OF DUQUESNE ALLEGHENY COUNTY, PENNSYLVANIA TRIBUTARY AREAS MAP

KLH ENGINEERS, INC

Appendix B

Duquesne Survey Field Book


SOKKIA
220-53
AS OF
11/11/13
MADE IN CHINA
220 MACM
SOKKIA
TRANSIT
FIELD BOOK
220
MACM
No. 8152-00

220-53
DRAVOSBURG / DUQUESNE
ADT 537 & LTC PLANS

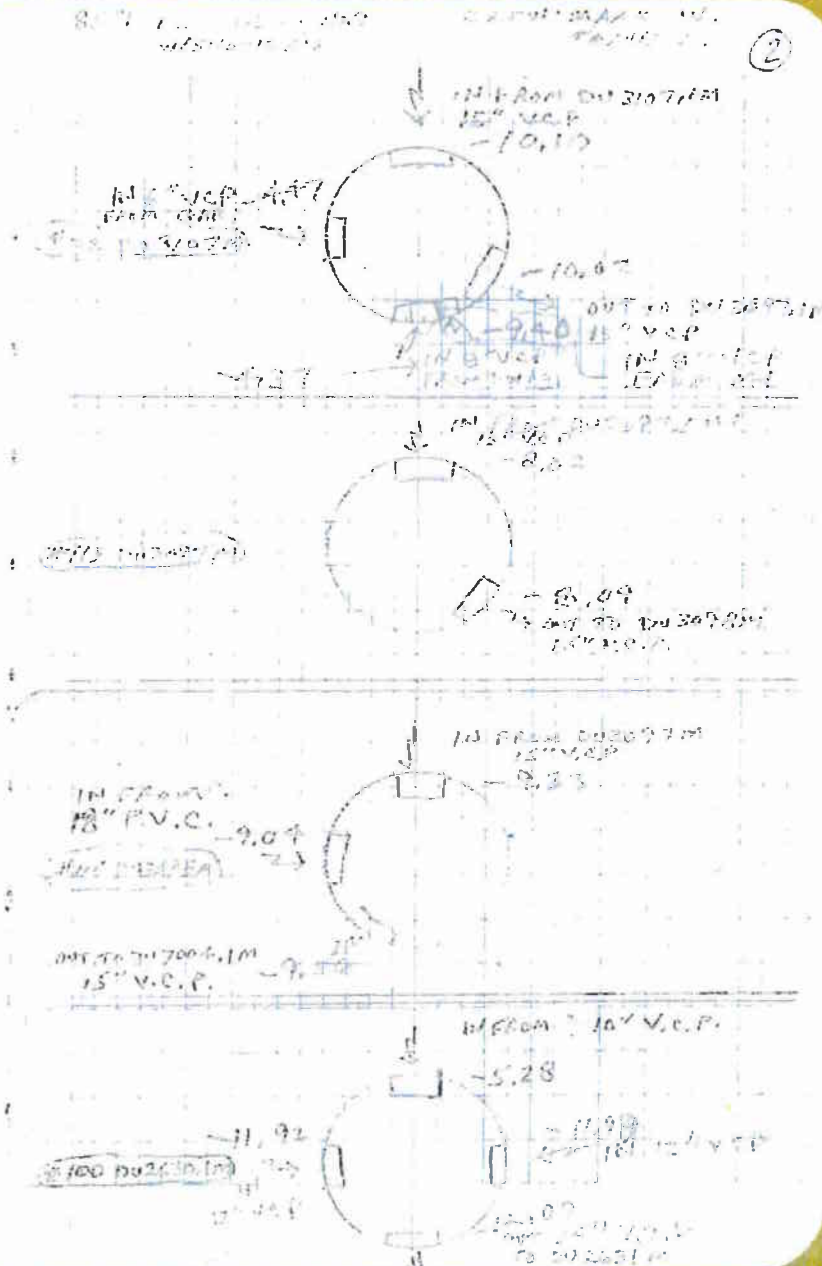
BOB ROBB [illegible]

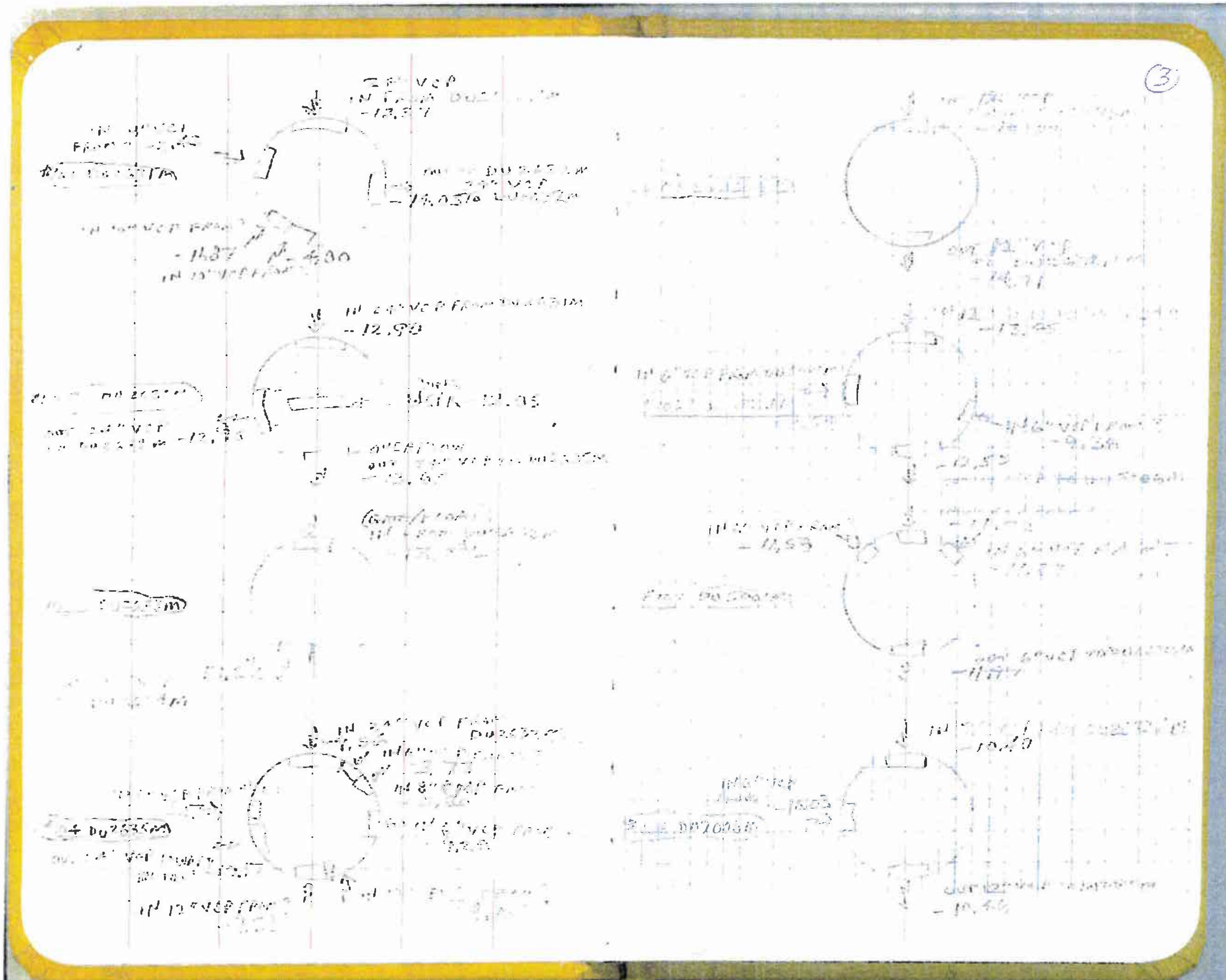
[illegible]

220 - 5? [illegible]

VE3 LOCATIONS (5" [illegible], [illegible])

[illegible]	[illegible]	DU2[illegible]	
101	"	DU2631m	
[illegible]	"	DU2632M	
[illegible]	"	DU2633M	
[illegible]	"	DU2635M	
[illegible]	"	[illegible]	
[illegible]	"	DU2632A m	
107		DU5001 m	
108	"	DU7006M	
109	"	DU7004M	
110	"	DU2597M	
111	"	DU501[illegible]M	
112	"	DU3107M	
[illegible]	"	DU3497M	
[illegible]	"	[illegible]	





(3)
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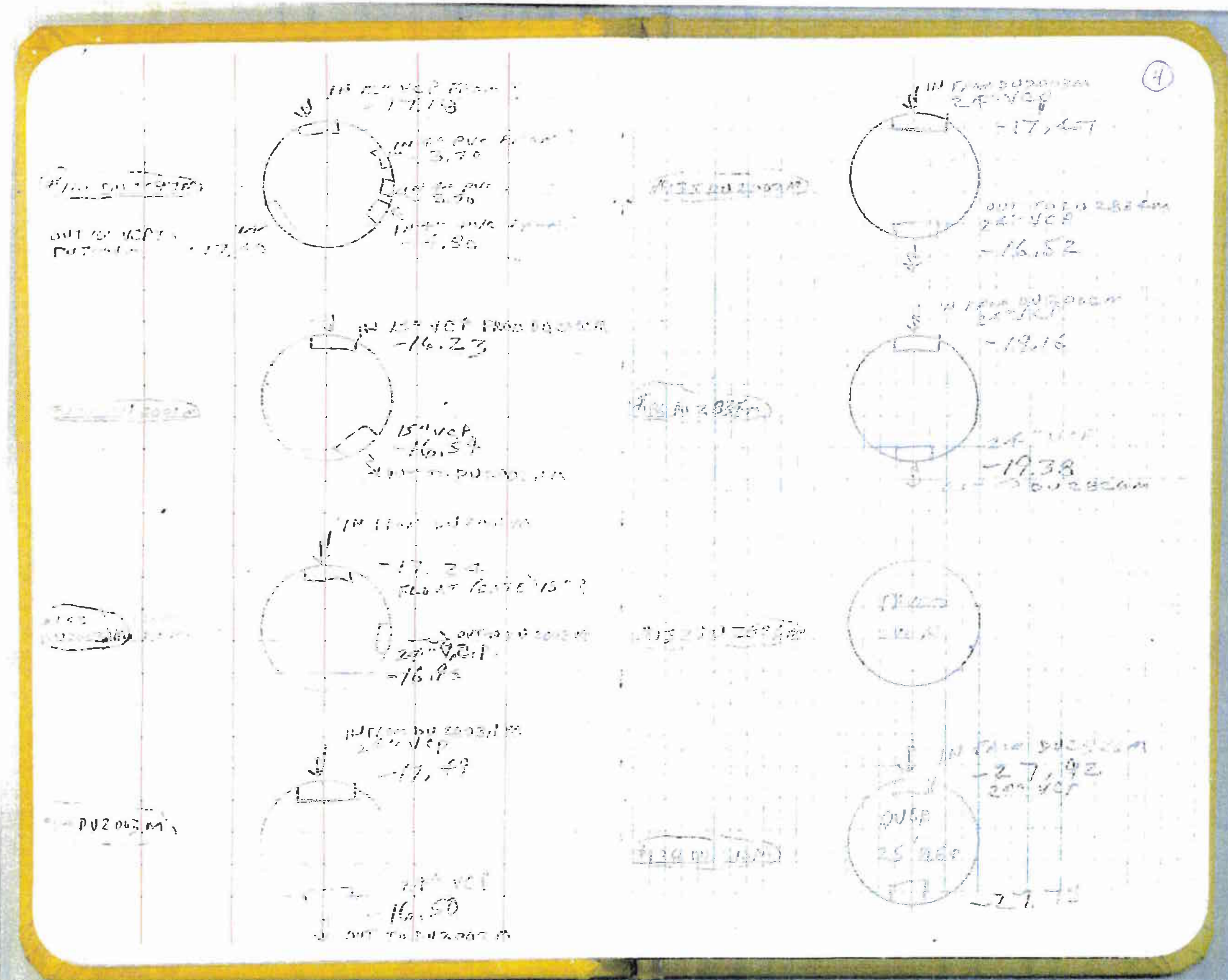
-14.71
-13.95
-9.28
-11.53
-10.46



-17.78
-16.23
15" VCP
-16.54
-17.24
-16.83
-17.49
16.50
-17.47
-16.52
-19.16
-19.38
-27.42

[illegible] 64°F CLOUDY & [illegible] W/SHOWERS [illegible]

[illegible] 220-53 - 050413

[illegible] ([illegible] TAPE [illegible], [illegible])

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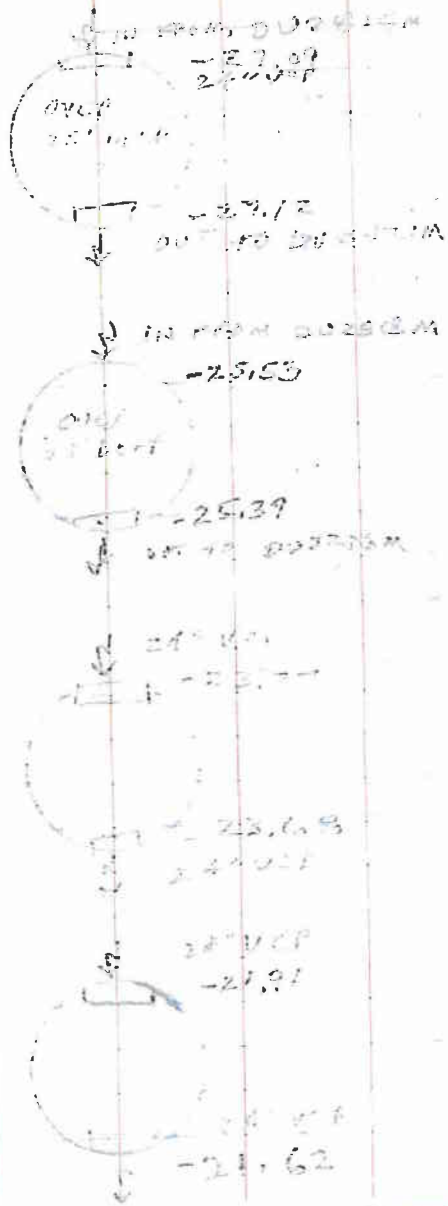
	"	DU Z901 [illegible]	
	"	[illegible]	
		[illegible]	
		[illegible] M	
1.25	"	DU 700 [illegible]	
	"	DU 101 [illegible]	
	"	[illegible] M	
		[illegible]	
	"	[illegible]	* ([illegible])
	"	UNKNOWN MARKET	*
1.26	"	DU [illegible]	
		[illegible]	
	"	[illegible] M	
		DU 60 [illegible]	
		DU [illegible]	

[illegible] 65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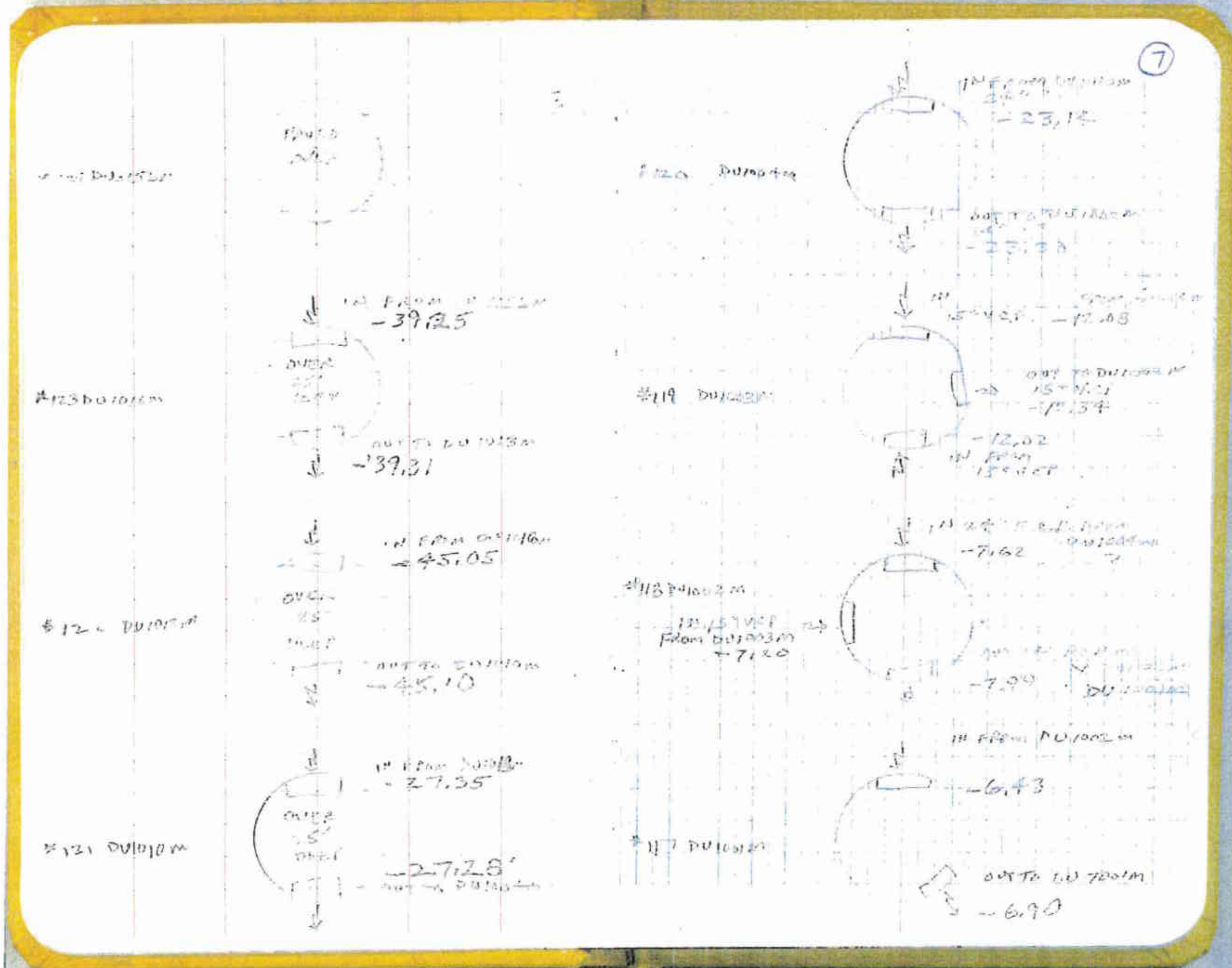
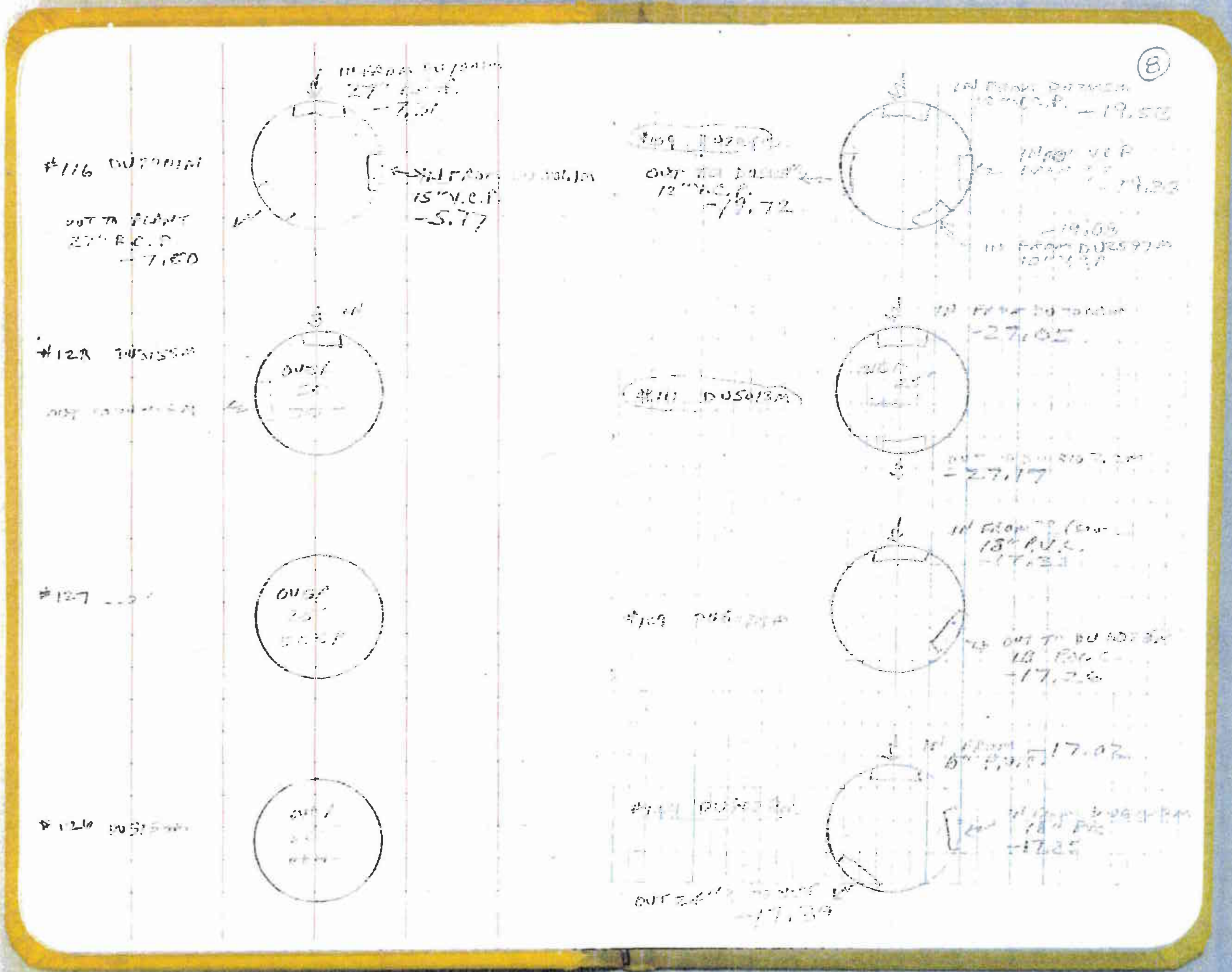
-25.39
-23.68
-21.62


-18.34
-18.25



7
-39.25
#123 DU1012M
-39.31
-45.05
-45.10
-27.35
#121 DU1010M
-27.28'
#120 DU1004M
-23.14
#119 DU1003M
-12.08
-12.02
-7.62
#118 DU1002M
From DU1003M
+7.20
-7.99
IN FROM DU1002M
-6.43
#117 DU1001M
OUT TO DU 7001M
-6.90



8
#116
27"
-7.51
15"V.C.P.
-5.77
-7.80
#127
-19.58
-19.23
-19.08
-27.05
-27.17
18" P.V.C.
-17.31
-17.26
-17.07
-17.25
-17.34

(7-03-15) [illegible]

70°F [illegible]

CREW MARK [illegible]

(9)

(Time) 220-513 [illegible] 082715

[illegible]	[illegible]	DU2007PM
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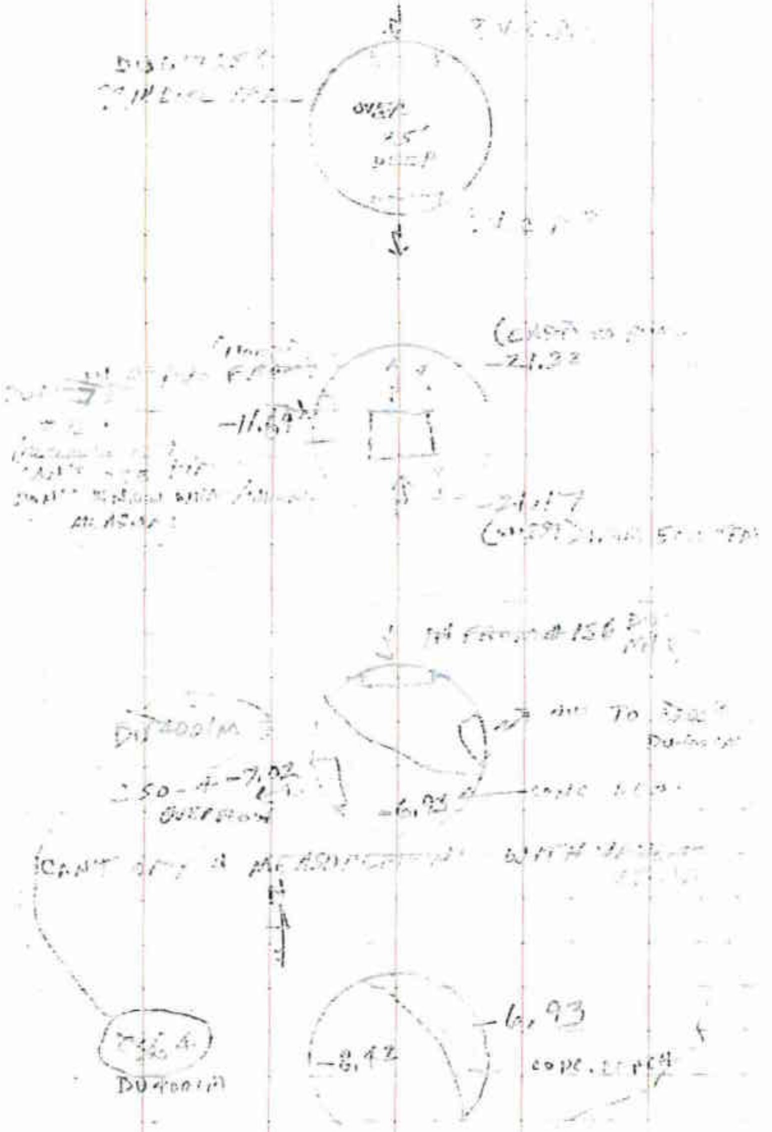
134		[illegible]2003[illegible]
135		[illegible]20[illegible]
136		[illegible]2_B34
137		[illegible]-B3[illegible]
		PHASE [illegible]
[illegible]		[illegible]2815[illegible]
		[illegible]
139		DU2818[illegible]
140		DU[illegible]
141		DU[illegible]
[illegible]		DU[illegible]
		[illegible]
[illegible]		[illegible]
[illegible]		DU3[illegible]
[illegible]		[illegible]
[illegible]		DU3[illegible]


-21.32
-11.69
-24.17
-7.02
OVERFLOW
-6.93
-6.93
-8.42

(11)

[illegible]		[illegible]
[illegible]	[illegible]	[illegible], [illegible]
[illegible]		[illegible] DUGO[illegible]

(11-05-13)

(cont.) [illegible]

(SKETCHES P.7 [illegible])

[illegible]	SAN MH	DU [illegible]
150	"	DU [illegible]
151	"	DU 4004 M
152	"	DU 4006.1 M
153	"	DU 4006 M
154	"	DU 4033 M
155	"	DU 4037 M
156	"	DU ?
157	"	DU 4299 M

([illegible])

158	SAN MH	DU 3169 M PAVED OVER - CAN'T OPEN

([illegible])

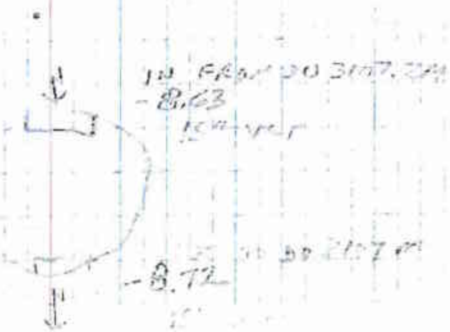
159	SAN MH	DU 3107.1 M

50' [illegible]

CREWS MARK W.
TRA[illegible] S.

(12)

#159 DU 3107.1M



APPENDIX C

DRNACH METER SITE INSPECTION FORMS

DRNACH ENVIRONMENTAL, INC.

MANHOLE INSPECTION FORM

Project Name: Duquesne Flow

Manhole Identification: M-1

Surveyor's Name: Alexander Matscherz

Site Description: Underneath Route 837 / S Duquesne Avenue

Street: 520 S Duquesne Avenue

Date: August 29, 2013

Site Photo

Frame And Cover

Cover:	Solid	Pick holes:	Yes
At Grade:	X	Below:	Above:

Diameter (in.): (Unable to measure)

DS Rim to Invert (in): 163

Interior

Brick:	Precast: X	Other:

Ladder Present: No | Safe:

Infiltration Observed

Describe:

Inlets

Size:		Pipe Material:	Notes:
60	inch	Concrete	Egg shape
30	inch	VCP	
24	inch	VCP	
	inch		
	inch		

Interior Photo

Outlets

Size:		Pipe Material:	Notes:
18	inch	Concrete	Metering point
72	inch	Weir	Wylie CSO

GPS Information

Accuracy:	20 feet	Elevation:	764 feet	Latitude:	40.367374	Longitude:	79.84229

Notes

Additional pictures of chamber inlets, and overflow point included.

Unable to take outside picture of manhole due to road construction. Outside picture used is from Google Earth.

DRNACH ENVIRONMENTAL, INC.

MANHOLE INSPECTION FORM

Project Name	Duquesne Flow
Manhole Identification	M-3
Surveyor's Name	Alexander Matscherz
Site Description	Underneath Route 837 / Duquesne Boulevard.
Street	130 Duquesne Boulevard
Date	August 29, 2013

Site Photo

Frame And Cover

Cover:	Solid	Pick holes:	Yes		
At Grade:	X	Below:		Above:	

Diameter (in.):	(Unable to measure)
DS Rim to Invert (in):	324 (approx)

Interior

Brick:	X	Precast:		Other:	

Ladder Present:	No	Safe:	

Infiltration Observed

Describe:

Inlets

Size:		Pipe Material:	Notes:
54	inch	Brick	Egg shape
30	inch	Concrete	Storm
48	inch	Brick	Egg shape
	inch		
	inch		

Interior Photo

Outlets

Size:		Pipe Material:	Notes:
18	inch	Concrete	Metering point
67	inch	Brick	Egg shape overflow pipe

GPS Information

Accuracy: 20 feet	Elevation: 773 feet	Latitude: 40.375663	Longitude: 79.846372

Notes

Additional pictures of chamber, storm line, and overflow pipe included.

DRNACH ENVIRONMENTAL, INC.

MANHOLE INSPECTION FORM

Project Name	Duquesne Flow
Manhole Identification	M-5A 18" Upstream
Surveyor's Name	Alexander Matscherz
Site Description	In grass behind American Textile Co. gravel parking lot.
Street	10 N Linden Street
Date	August 29, 2013

Site Photo

Frame And Cover

Cover:	Solid	Pick holes:	No
At Grade: X	Below:	Above:	

Diameter (in.):	28.75
DS Rim to Invert (in):	214

Interior

Brick:	Precast: X	Other:

Ladder Present:	Yes	Safe:	Yes

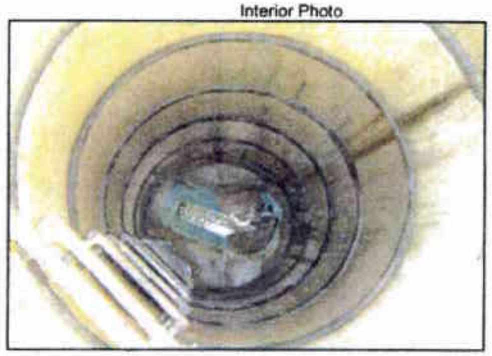
Infiltration Observed

Describe:

Inlets

Size:	Pipe Material:	Notes:
18 inch	VCP	
inch		
inch		
inch		
inch		

Interior Photo



Outlets

Size:	Pipe Material:	Notes:
18 inch	PVC	Metering point
inch		

GPS Information

Accuracy:	Elevation:	Latitude:	Longitude:
20 feet	759 feet	40.37587	79.845852

Notes One manhole upstream from the original M-5A 18" location.

DRNACH ENVIRONMENTAL, INC.

MANHOLE INSPECTION FORM

Project Name	Duquesne Flow
Manhole Identification	M-5A 8" / M-5A 18"
Surveyor's Name	Alexander Matscherz
Site Description	In grass behind American Textile Co. gravel parking lot.
Street	10 N Linden Street
Date	August 29, 2013

Site Photo

Frame And Cover

Cover:	Solid	Pick holes:	No
Diameter (in.):	28.5		

At Grade:	X	Below:		Above:	
DS Rim to Invert (in):	212				

Interior

Brick:		Precast:	X	Other:	
Ladder Present:	Yes	Safe:	Yes		

Infiltration Observed

Describe:

Inlets

Interior Photo

Size:		Pipe Material:	Notes:
18	inch	PVC	Metering point
8	inch	PVC	Metering point
	inch		
	inch		
	inch		

Outlets

Size:		Pipe Material:	Notes:
21	inch	Concrete	
	inch		

GPS Information

Accuracy:	Elevation:	Latitude:	Longitude:
20 feet	760 feet	40.375982	79.84609

Notes

DRNACH ENVIRONMENTAL, INC. **MANHOLE INSPECTION FORM**

Project Name	Duquesne Flow	**Manhole Identification**	M-6

Surveyor's Name: Alexander Matscherz

Site Description: Inlet to Overland CSO chamber.

Street: Next to Railroad tracks.

Date: August 29, 2013

Site Photo

Frame And Cover

Cover:	Solid	Pick holes:	No
At Grade:	Below:	Above:	X

Diameter (in.):	31.5
DS Rim to Bench (in):	84

Interior

Brick:	Precast: X	Other:

Ladder Present:	Yes	Safe:	Yes

Infiltration Observed

Describe:

Interior Photo

Inlets

Size:		Pipe Material:	Notes:
15	inch	Concrete	Metering point
	inch		
	inch		
	inch		
	inch		

Outlets

Size:		Pipe Material:	Notes:
15	inch	Concrete	CSO
9x9	inch	Concrete	Rectangular

GPS Information

Accuracy:	20 feet	Elevation:	760 feet	Latitude:	40.379271	Longitude:	79.85026

Notes

DRNACH ENVIRONMENTAL, INC.

MANHOLE INSPECTION FORM

Project Name	Duquesne Flow
Manhole Identification	M-8
Surveyor's Name	Alexander Matscherz
Site Description	Middle of road at intersection of Clark Street and Parallel Way.
Street	Clark Street and Parallel Way
Date	August 29, 2013

Site Photo

Frame And Cover

Cover:	Solid	Pick holes:	Yes
At Grade:	X	Below:	Above:

Diameter (in.):	23
DS Rim to Bench (in):	161

Interior

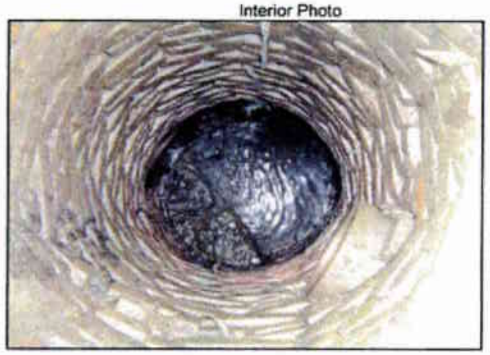
Brick:	X	Precast:	Other:

Ladder Present:	No	Safe:	

Infiltration Observed

Describe:

Interior Photo



Inlets

Size:		Pipe Material:	Notes:
24	inch	VCP	Metering point
	inch		
	inch		
	inch		
	inch		

Outlets

Size:		Pipe Material:	Notes:
24	inch	VCP	
	inch		

GPS Information

Accuracy:	Elevation:	Latitude:	Longitude:
20 feet	914 feet	40.371694	79.855026

Notes

DRNACH ENVIRONMENTAL, INC.

MANHOLE INSPECTION FORM

Project Name	Duquesne Flow
Manhole Identification	M-10
Surveyor's Name	Alexander Matscherz
Site Description	Near the edge of the road at the intersection of Clark Street and Edith Avenue.
Street	Clark Street and Edith Avenue
Date	August 29, 2013

Site Photo

Frame And Cover

Cover:	Solid	Pick holes:	Yes
At Grade: X	Below:	Above:	

Diameter (in.):	26.5		
DS Rim to Invert (in):	163	To metering point:	114

Interior

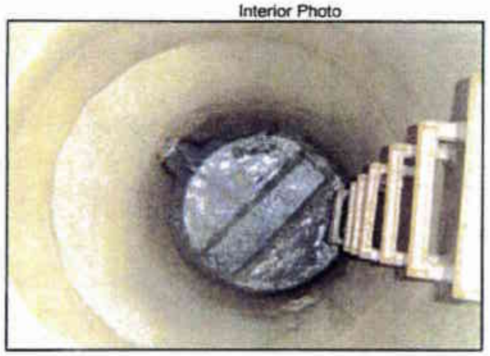
Brick:	Precast: X	Other:

Ladder Present:	Yes	Safe:	Yes

Infiltration Observed

Describe:

Interior Photo



Inlets

Size:		Pipe Material:	Notes:
8	inch	VCP	Metering point
12	inch	VCP	
8	inch	VCP	Storm
	inch		
	inch		

Outlets

Size:		Pipe Material:	Notes:
12	inch	VCP	
	inch		

GPS Information

Accuracy:	Elevation:	Latitude:	Longitude:
20 feet	912 feet	40.372105	79.855397

Notes

DRNACH ENVIRONMENTAL, INC.

MANHOLE INSPECTION FORM

Project Name	Duquesne Flow
Manhole Identification	M-11
Surveyor's Name	Alexander Matscherz
Site Description	Inside Mckee Asphalt Paving equipment storage lot.
Street	125 Clark Street
Date	August 29, 2013

Site Photo

Frame And Cover

Cover:	Solid	Pick holes:	Yes
At Grade: X	Below:	Above:	

Diameter (in.):	26.5
DS Rim to Invert (in):	235

Interior

Brick:	Precast: X	Other:

Ladder Present:	Yes	Safe:	No

Infiltration Observed

Describe:

Inlets

Size:		Pipe Material:	Notes:
12	inch	VCP	Metering point
12	inch	VCP	
	inch		
	inch		
	inch		

Interior Photo

Outlets

Size:		Pipe Material:	Notes:
15	inch	VCP	
	inch		

GPS Information

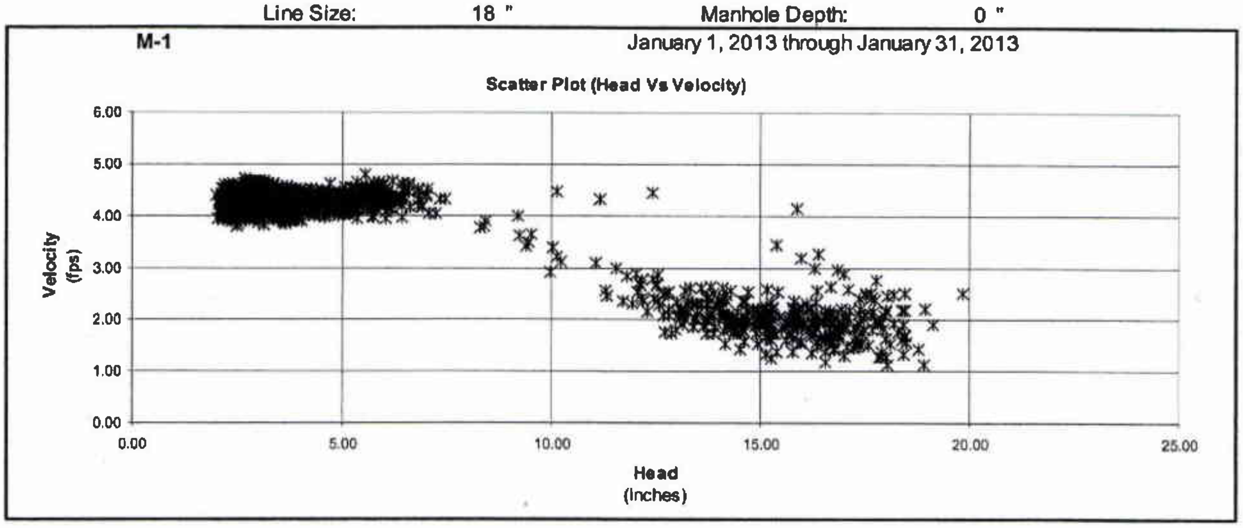
Accuracy:	Elevation:	Latitude:	Longitude:
20 feet	919 feet	40.373216	79.856479

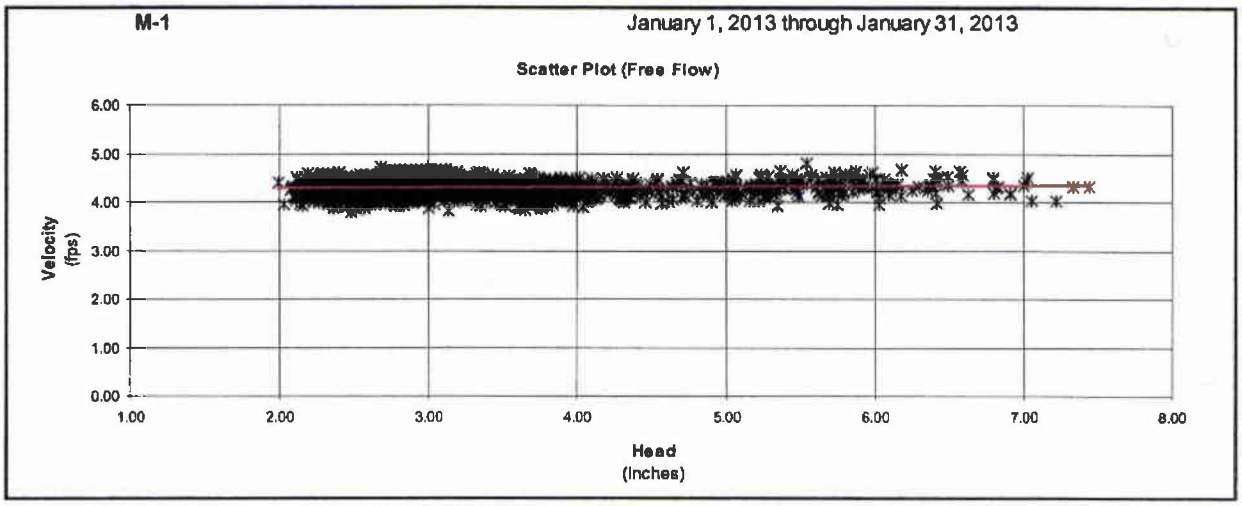
Notes

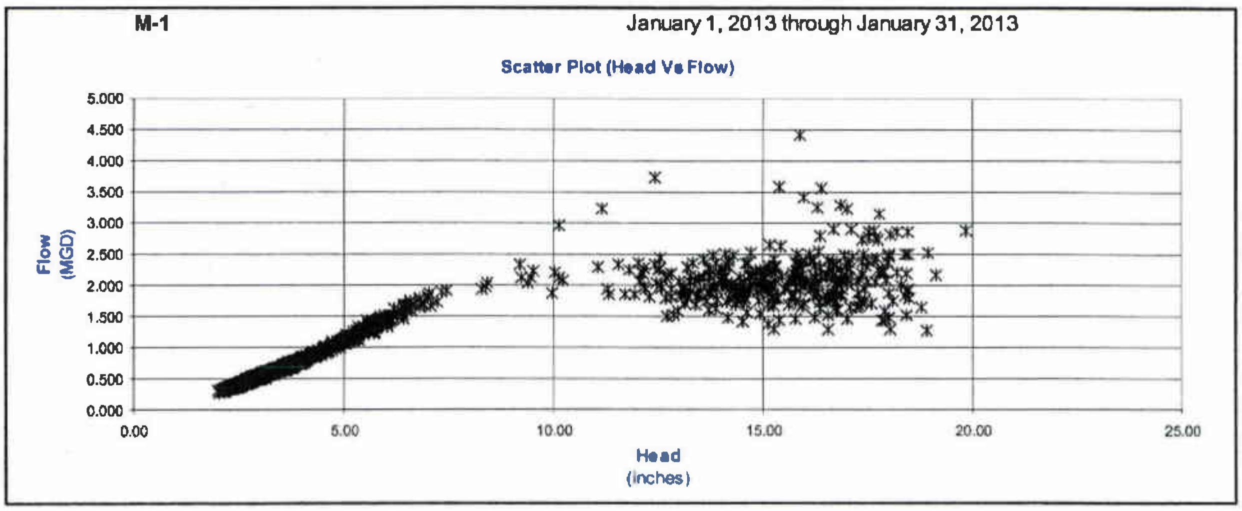
APPENDIX D

DRNACH SCATTERGRAPHS

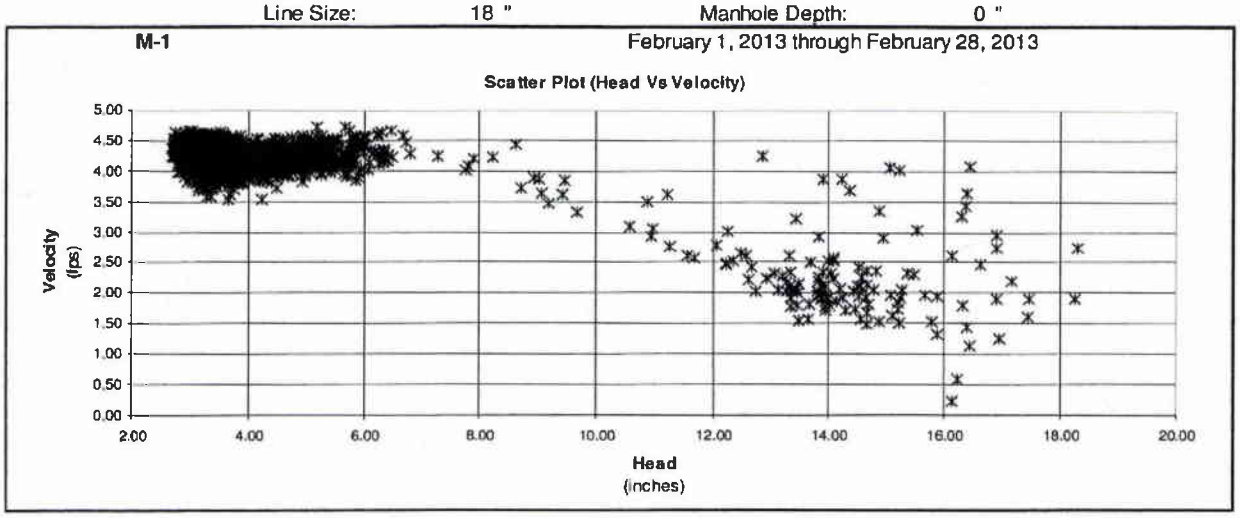
Line Size: 18 " Manhole Depth: 0 "

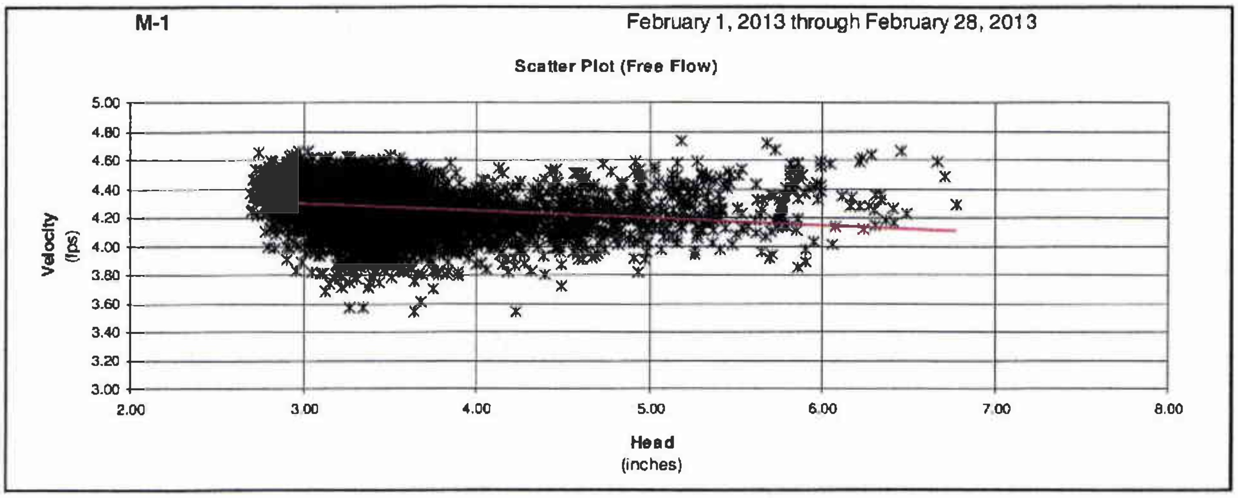


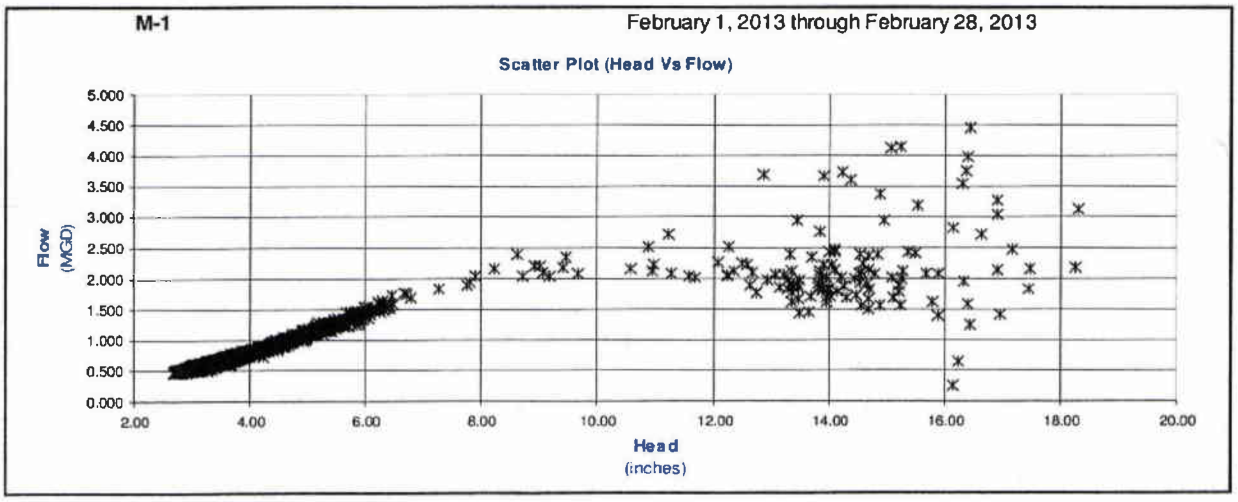




Line Size: 18 " Manhole Depth: 0 "

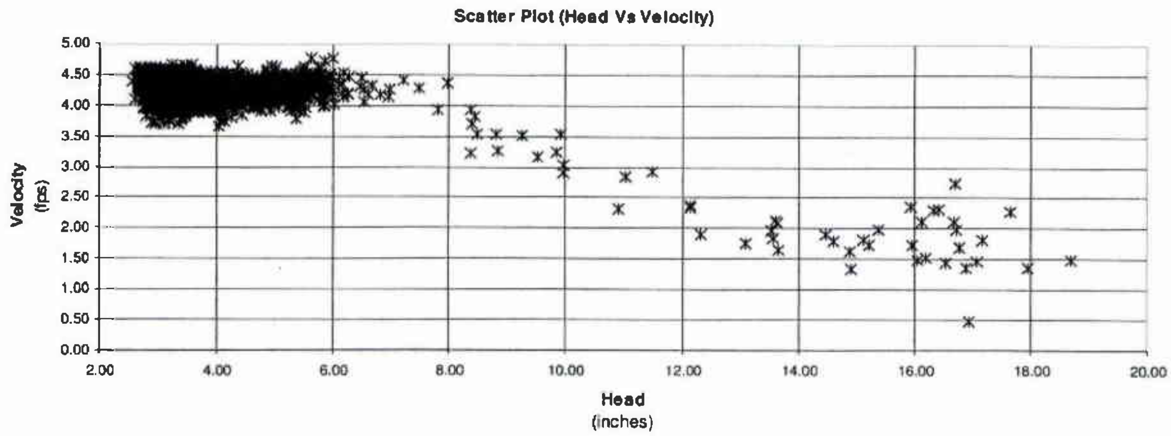




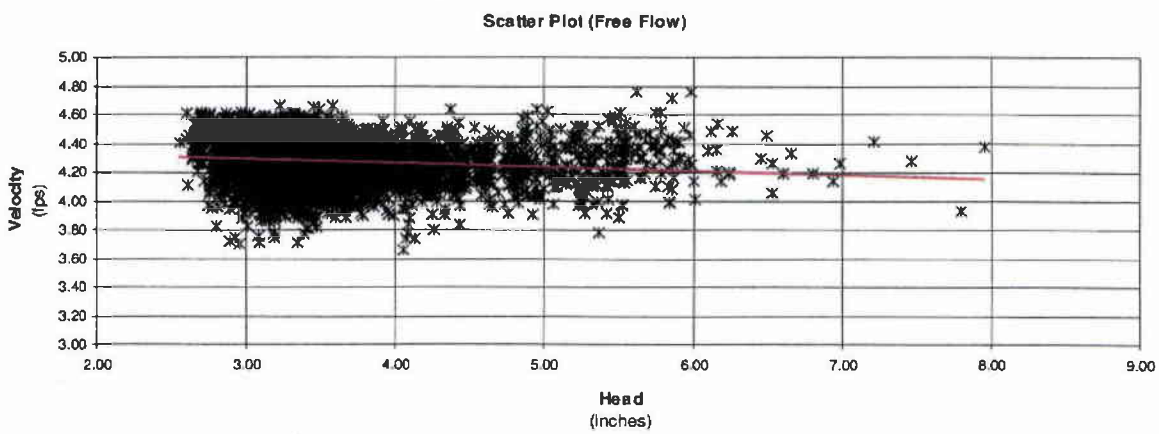


Line Size: 18 " Manhole Depth: 0 "

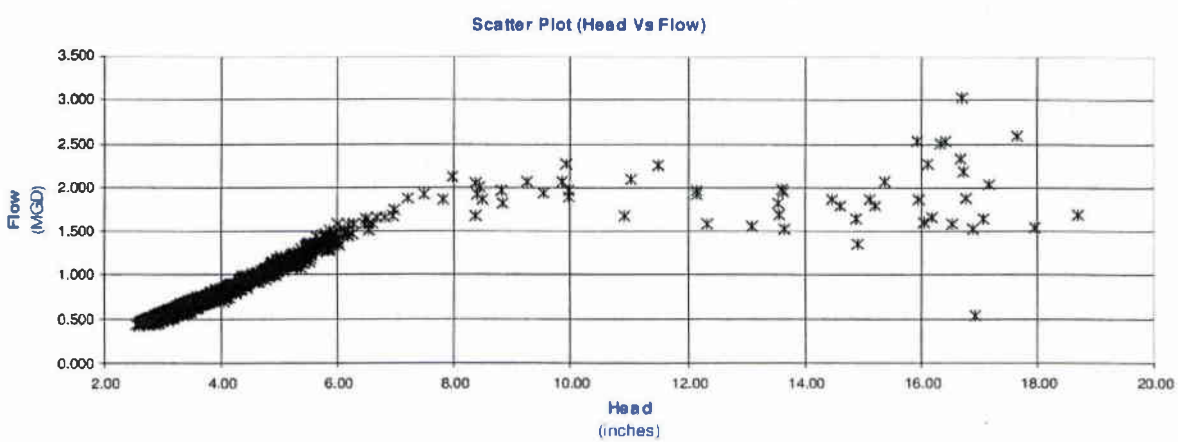
M-1 March 1, 2013 through March 31, 2013



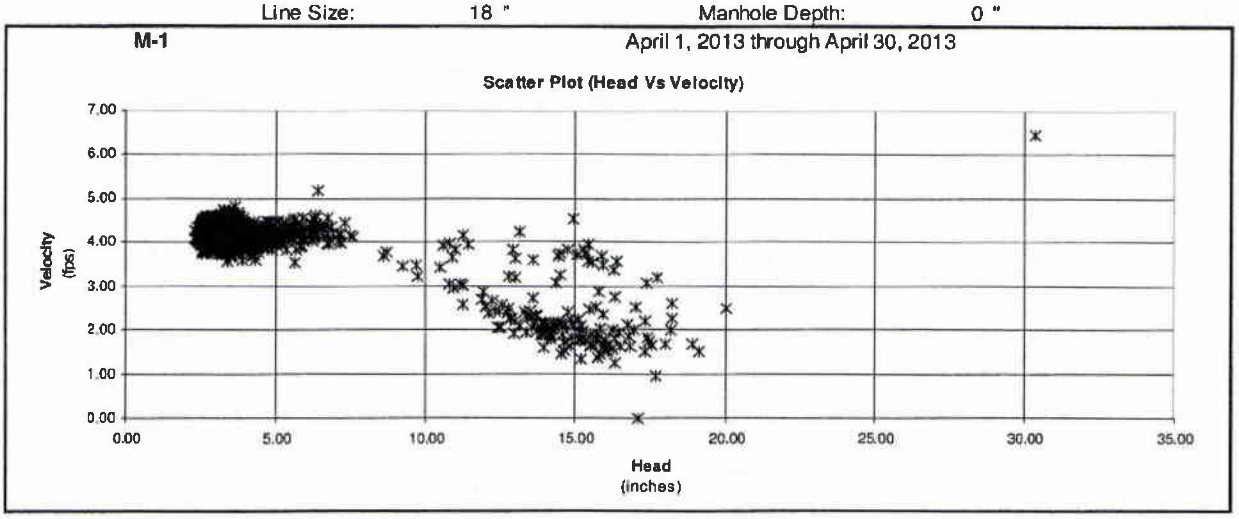
M-1 March 1, 2013 through March 31, 2013

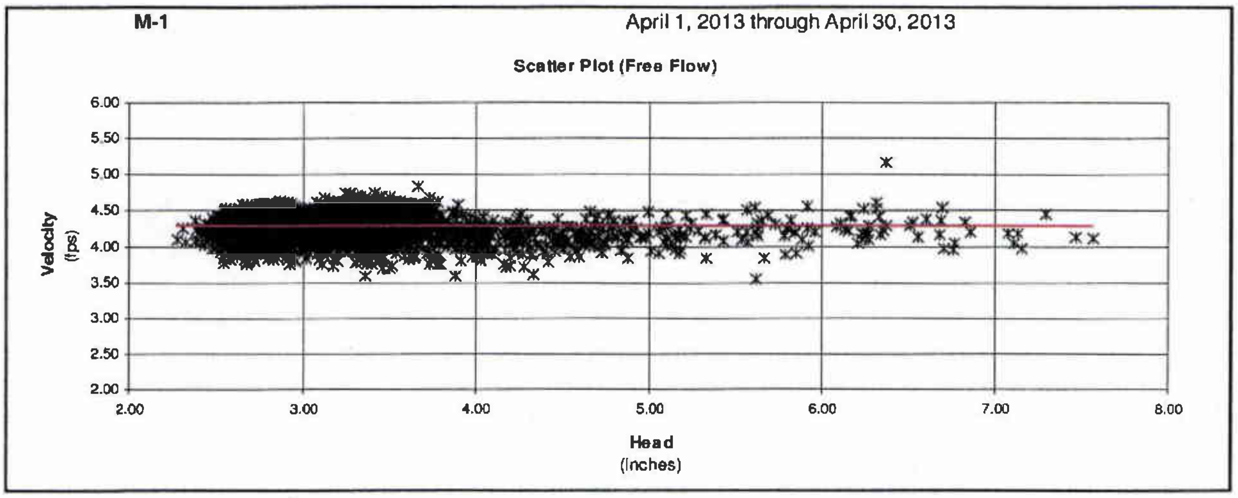


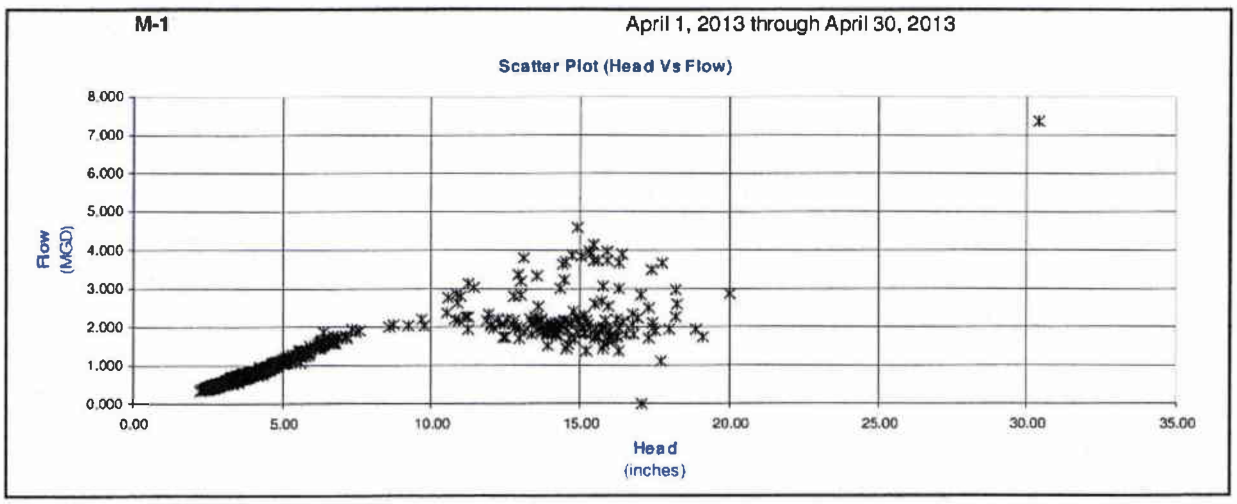
M-1 March 1, 2013 through March 31, 2013



Line Size: 18 " Manhole Depth: 0 "

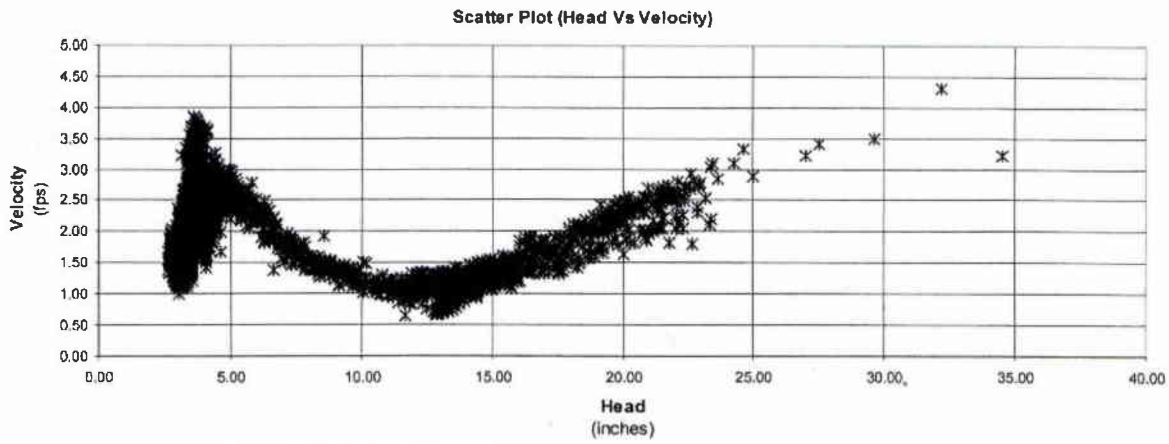




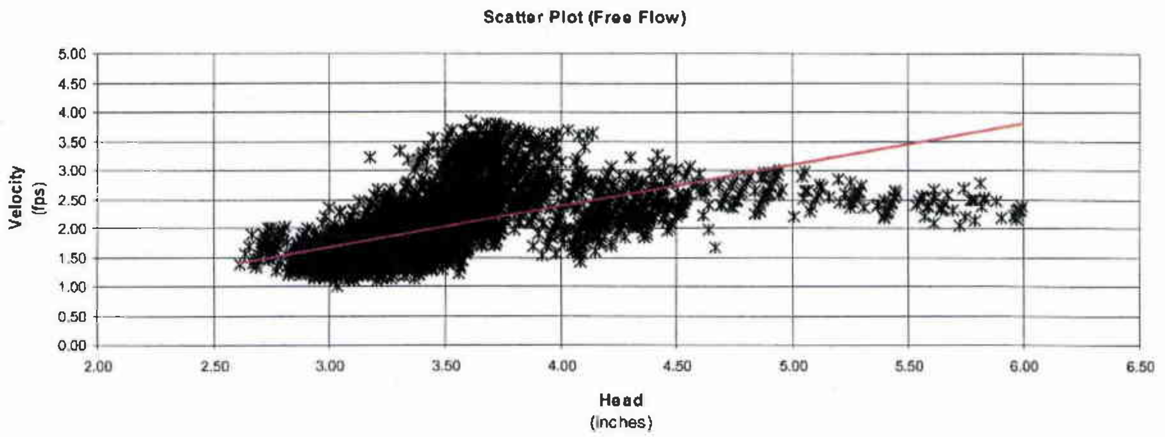


Line Size: 18 " Manhole Depth: 0 "

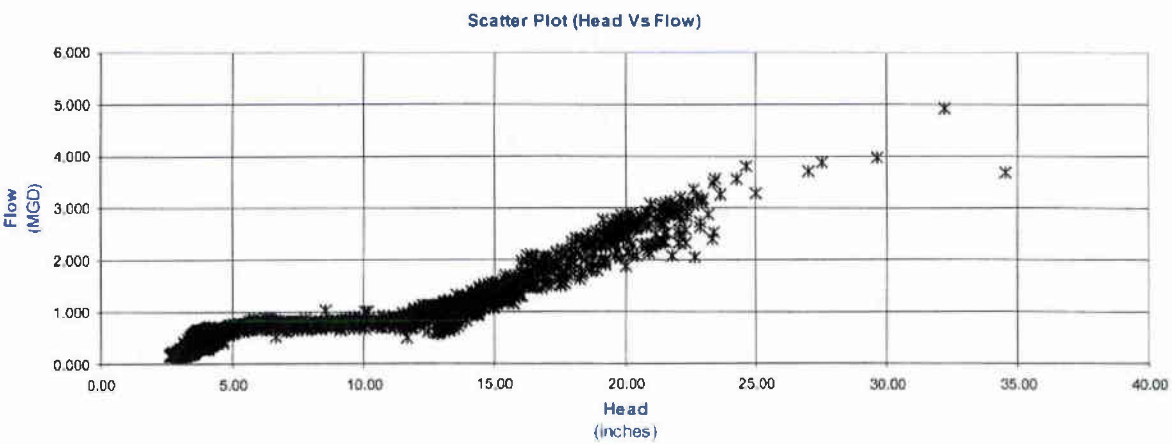
M-3 January 1, 2013 through January 31, 2013



M-3 January 1, 2013 through January 31, 2013



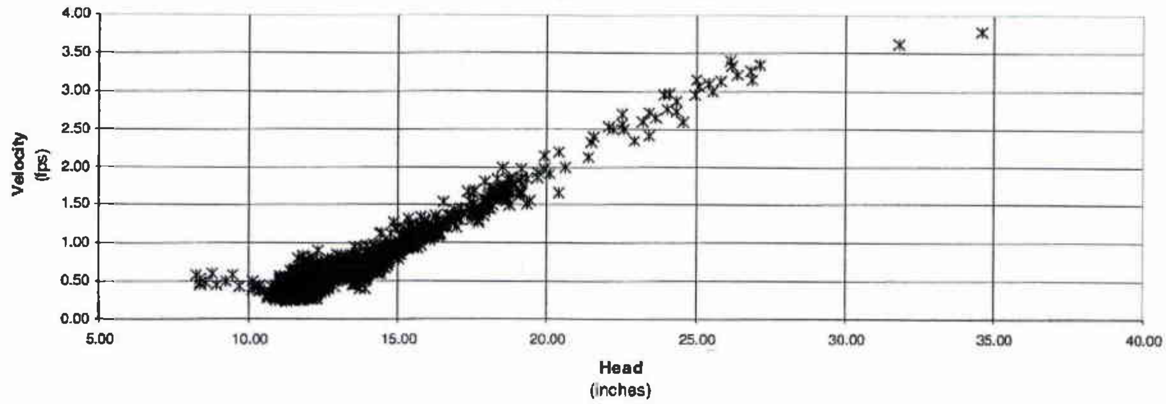
M-3 January 1, 2013 through January 31, 2013



Line Size: 18 " Manhole Depth: 0 "

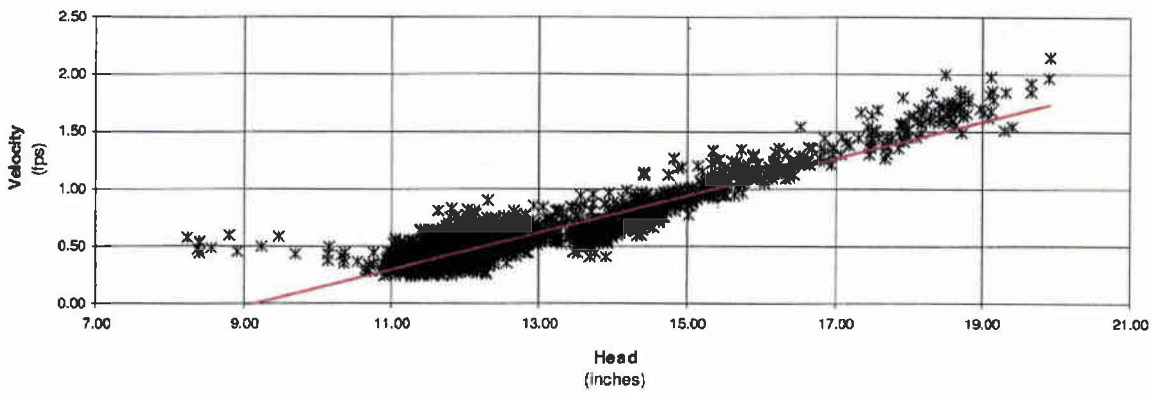
M-3 February 1, 2013 through February 28, 2013

Scatter Plot (Head Vs Velocity)



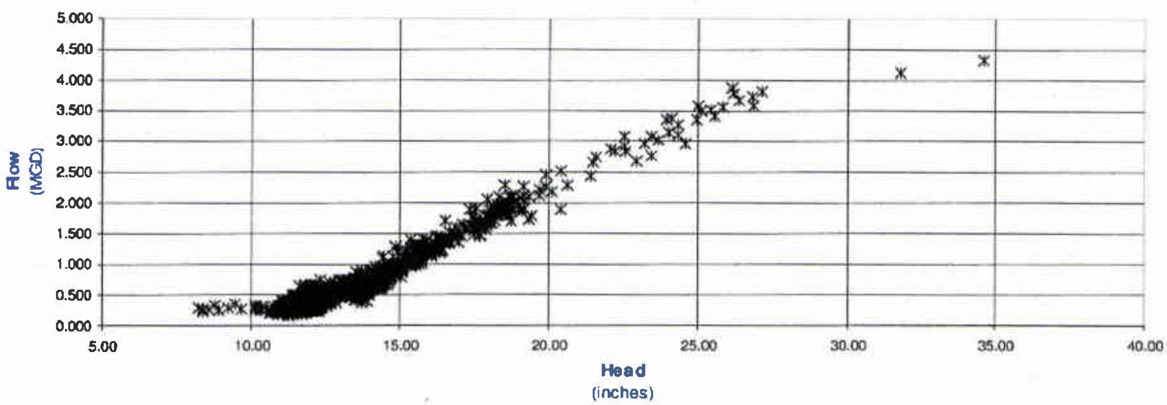
M-3 February 1, 2013 through February 28, 2013

Scatter Plot (Free Flow)

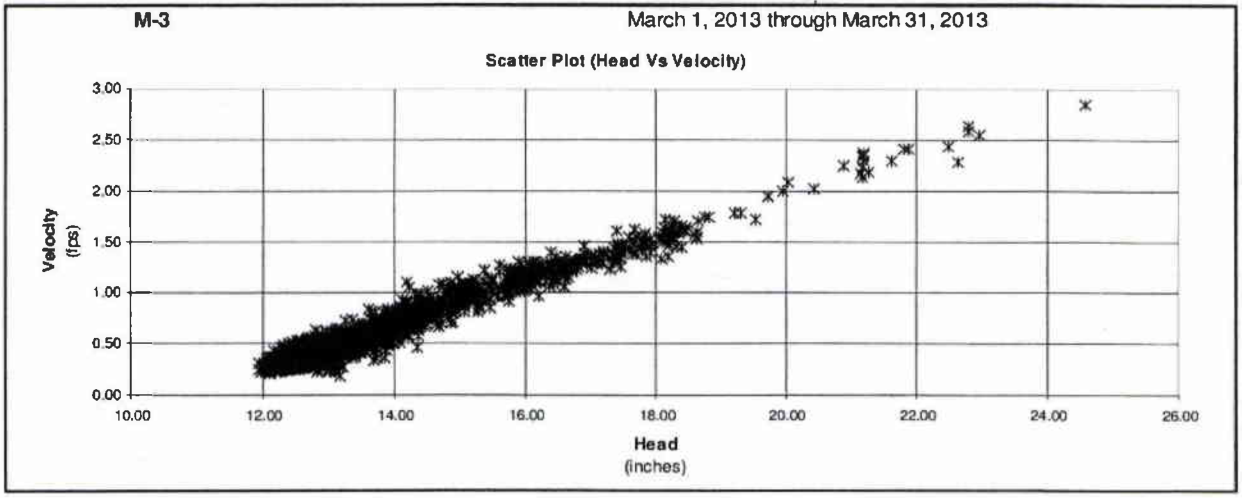


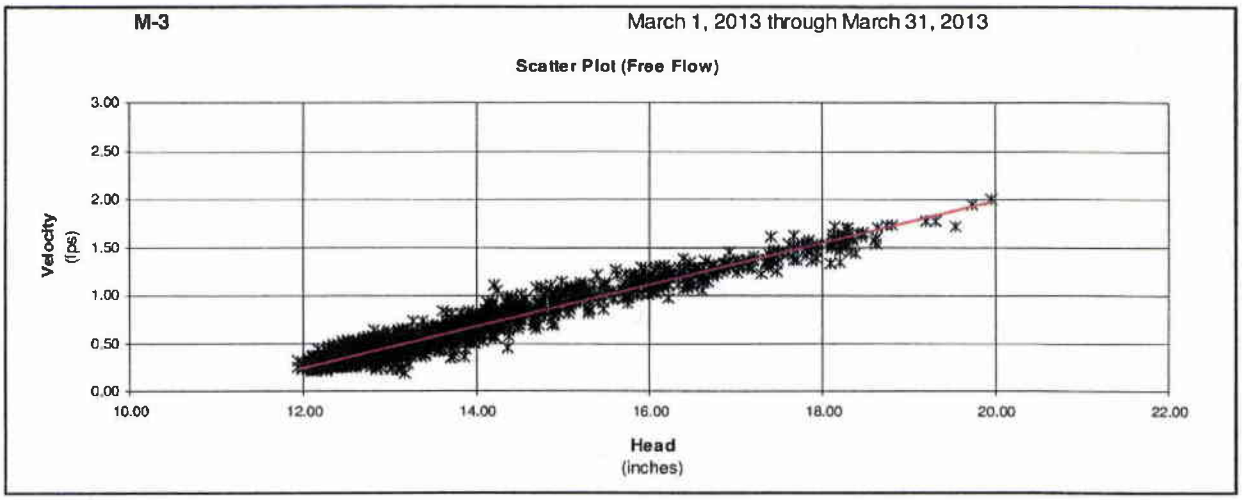
M-3 February 1, 2013 through February 28, 2013

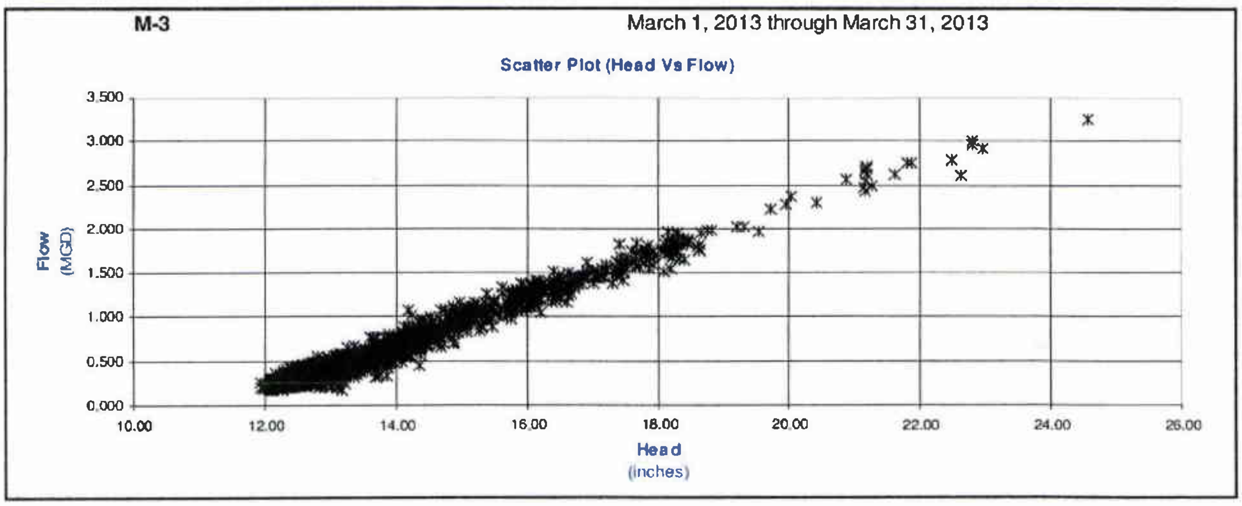
Scatter Plot (Head Vs Flow)



Line Size: 18 " Manhole Depth: 0 "







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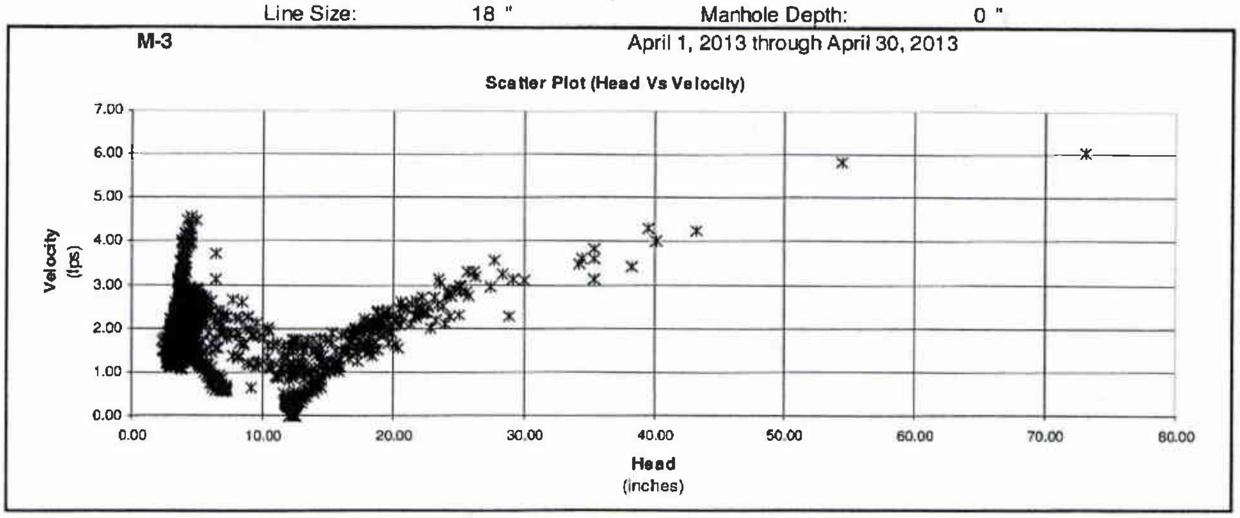
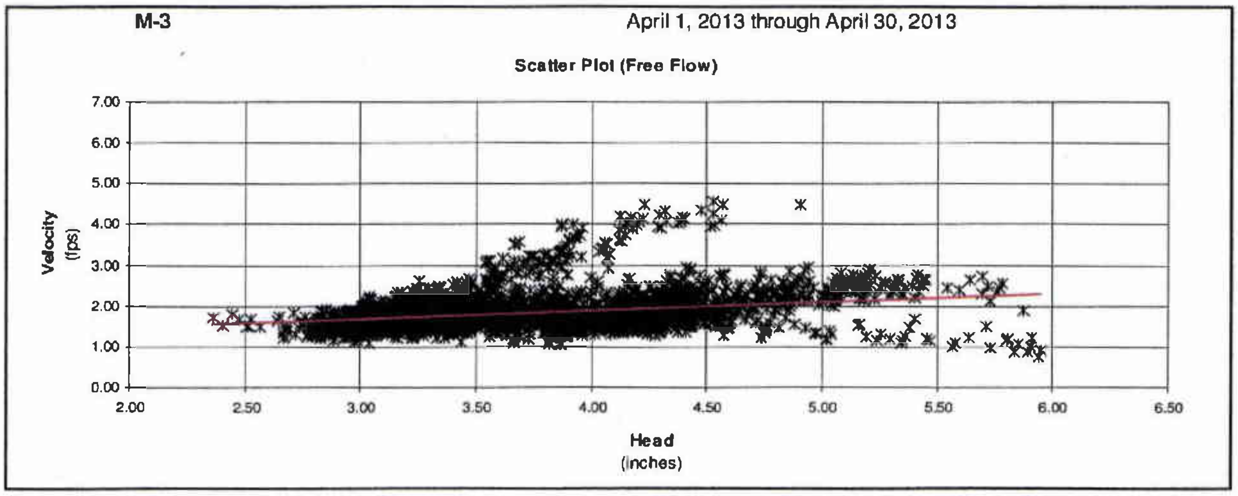
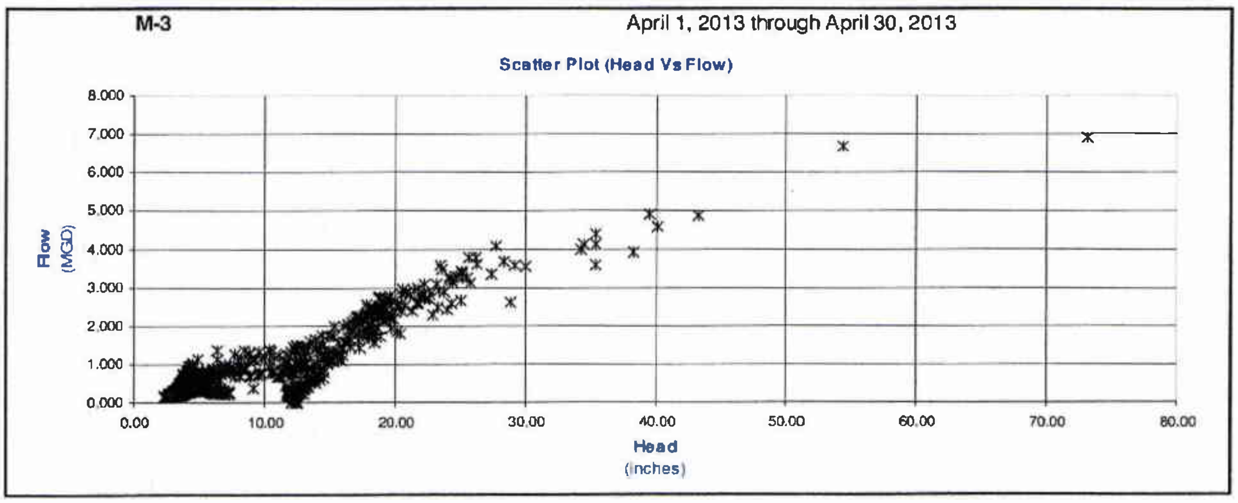
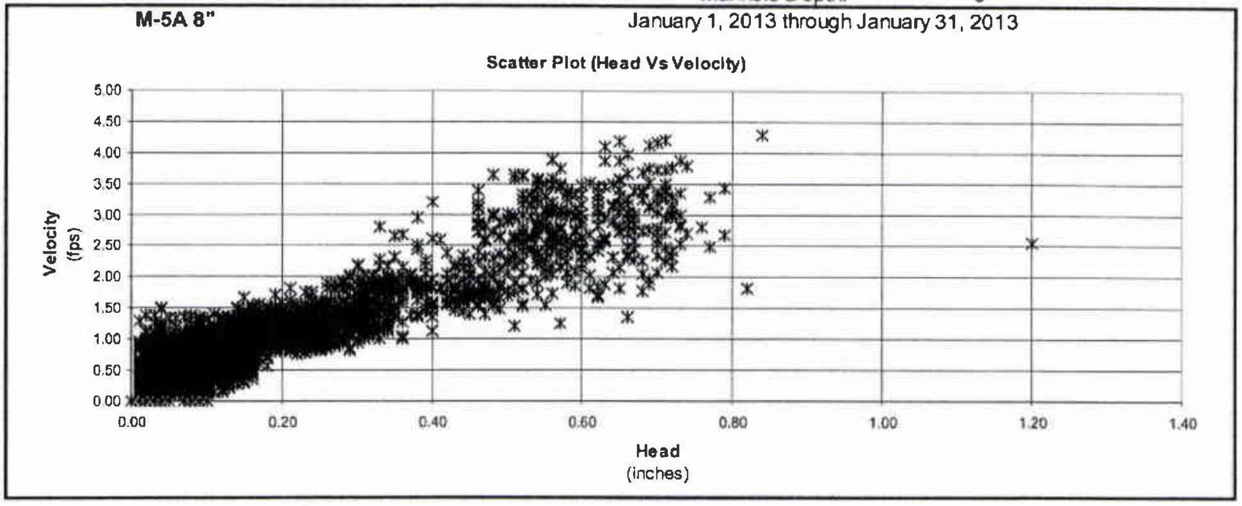
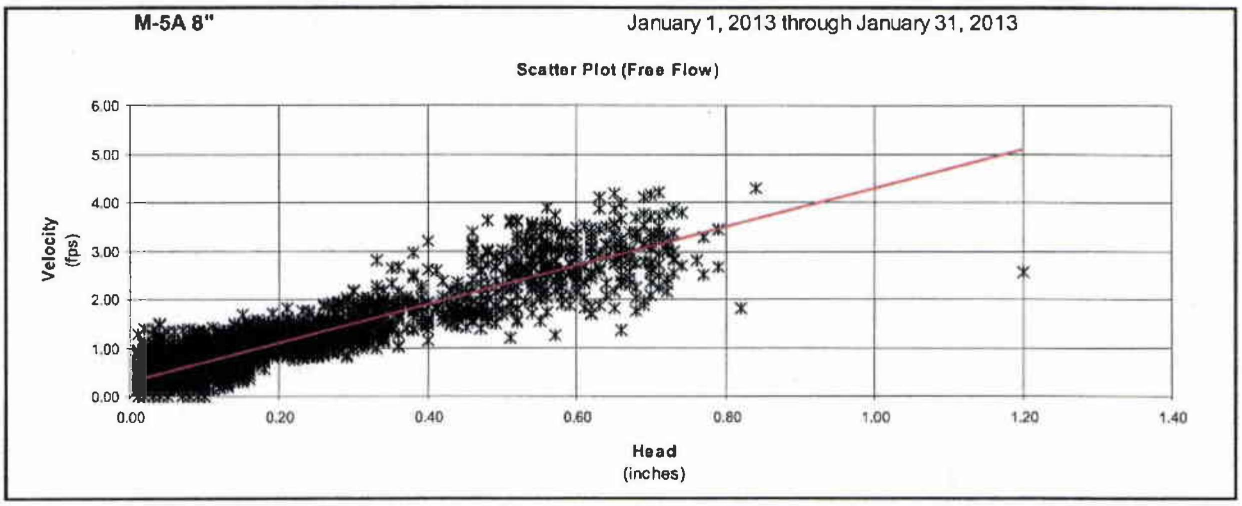


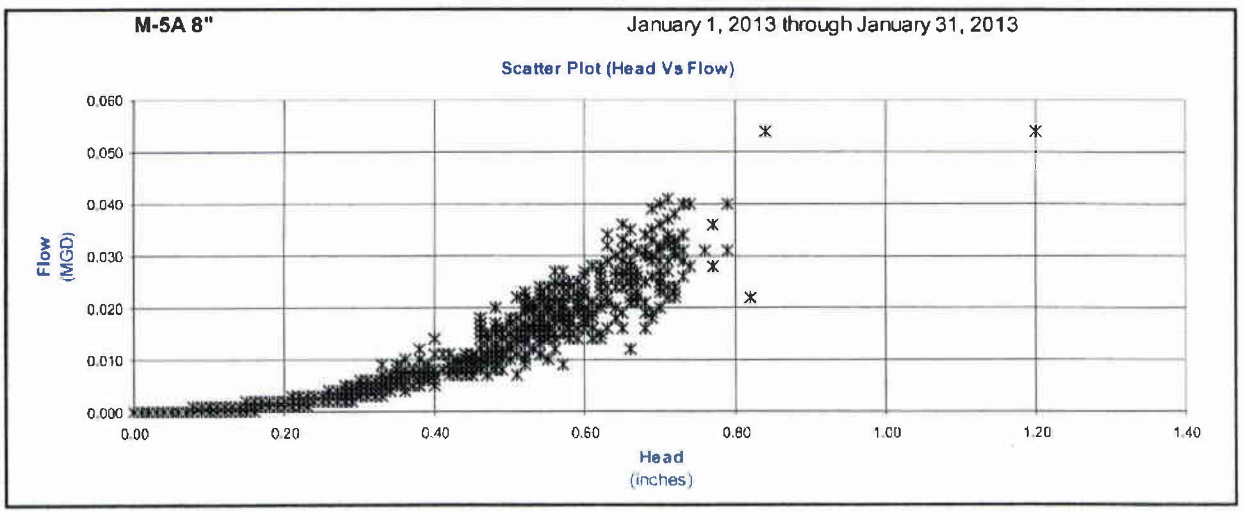




Line Size: 8 " Manhole Depth: 0 "







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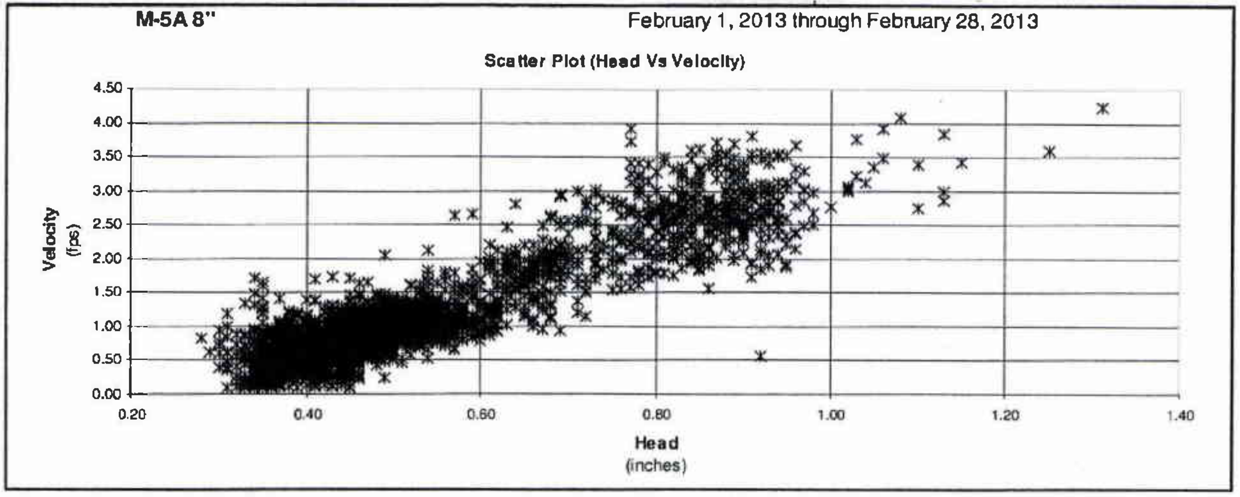

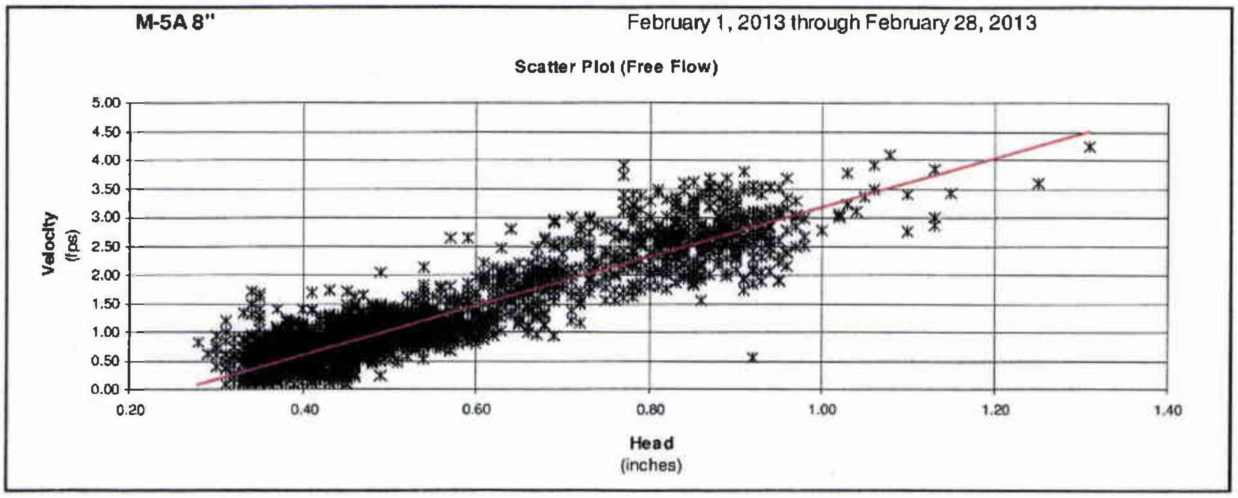

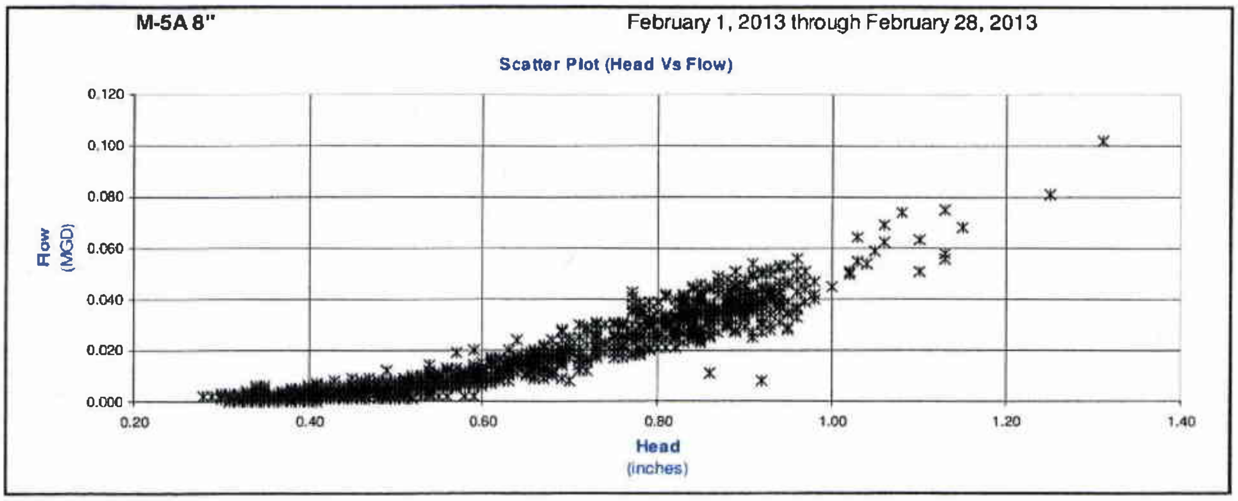

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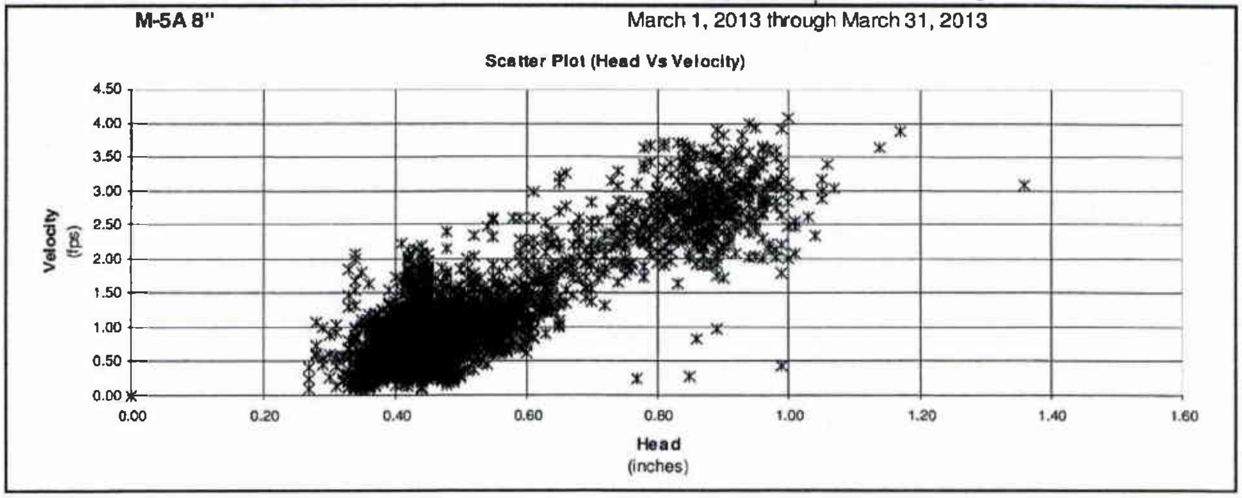

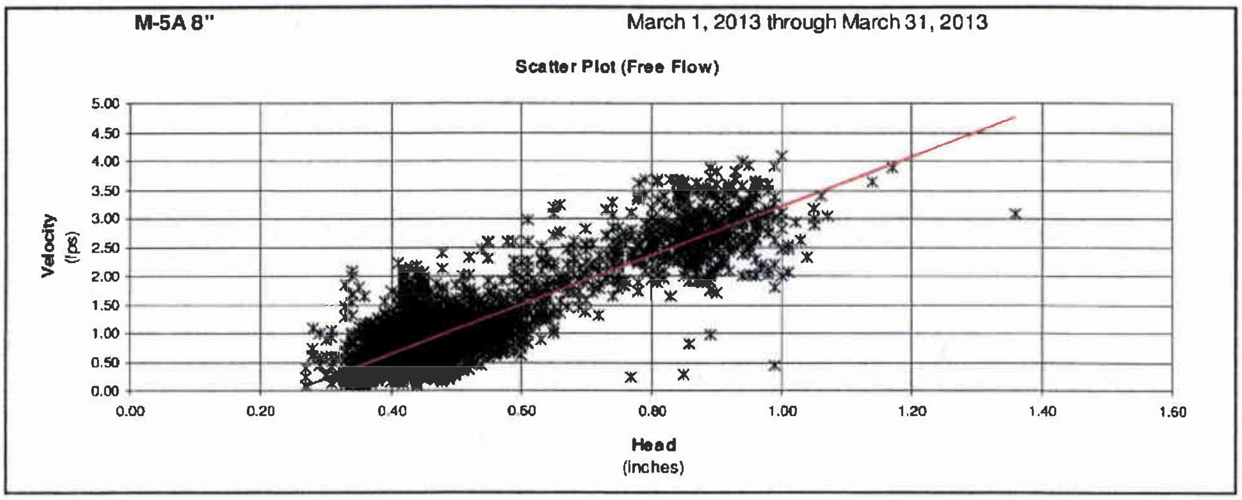

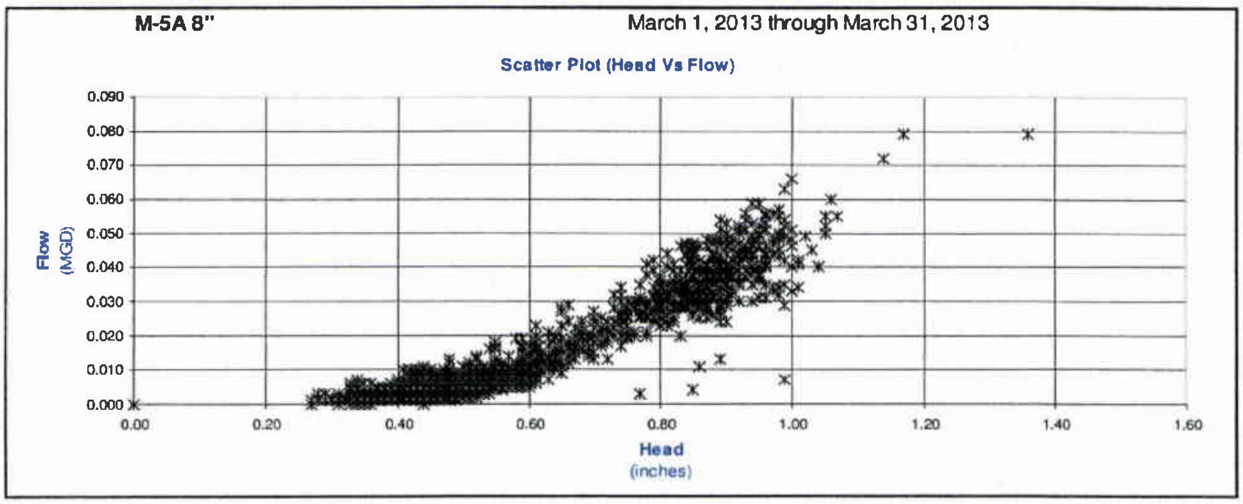

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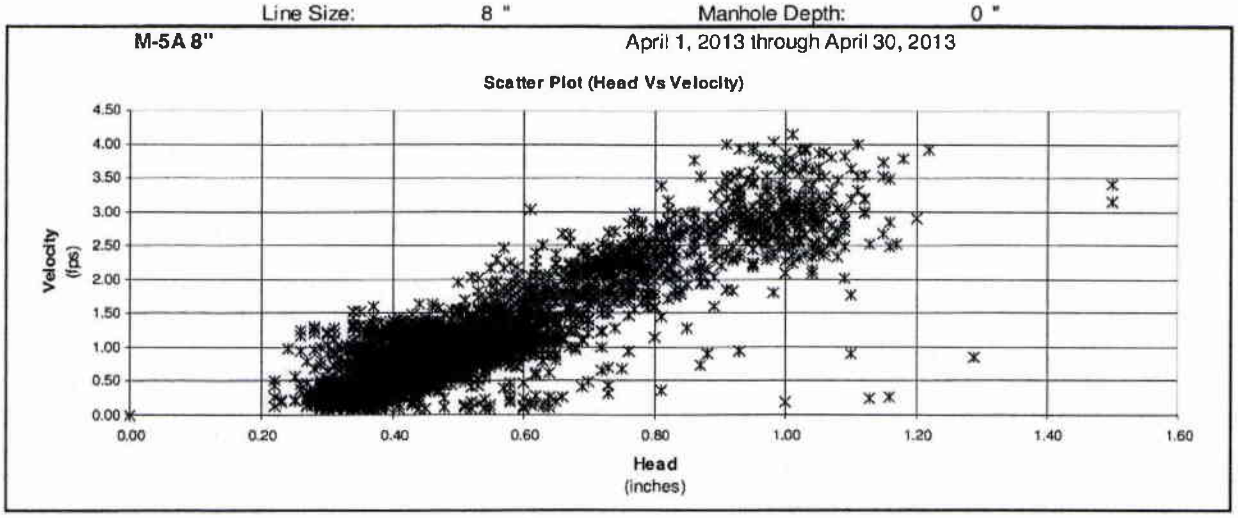

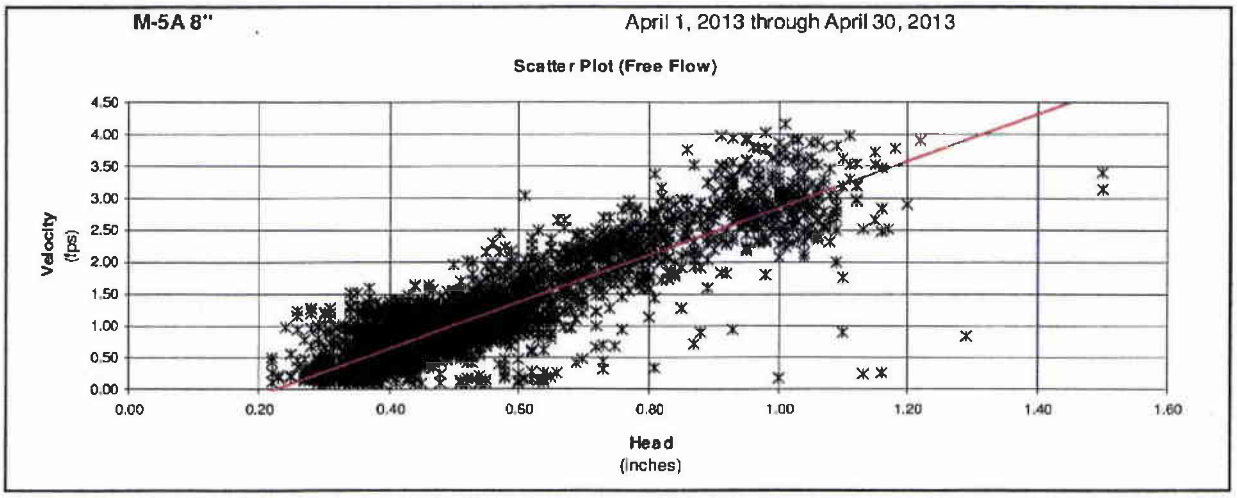

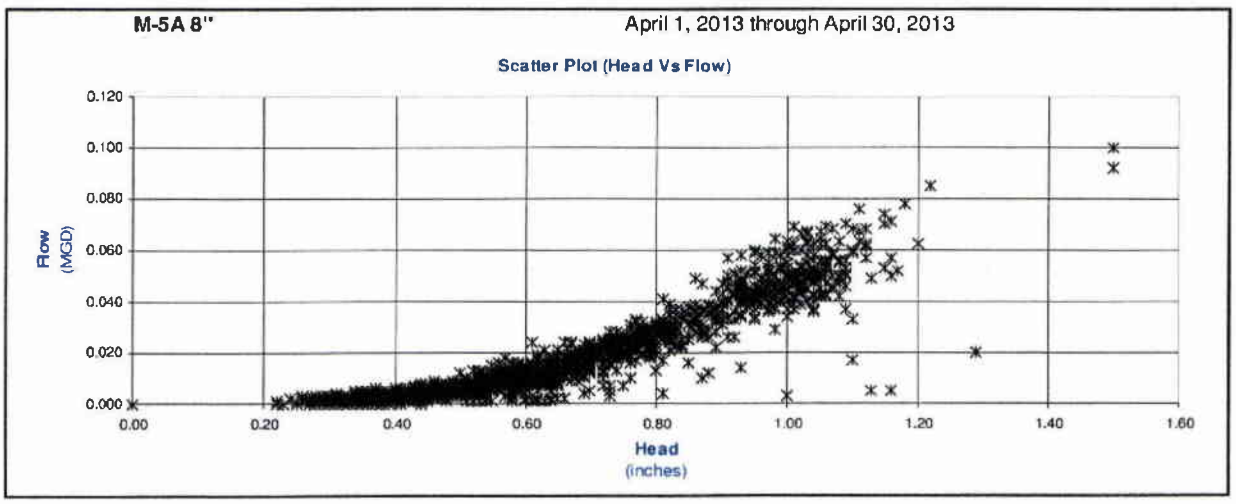

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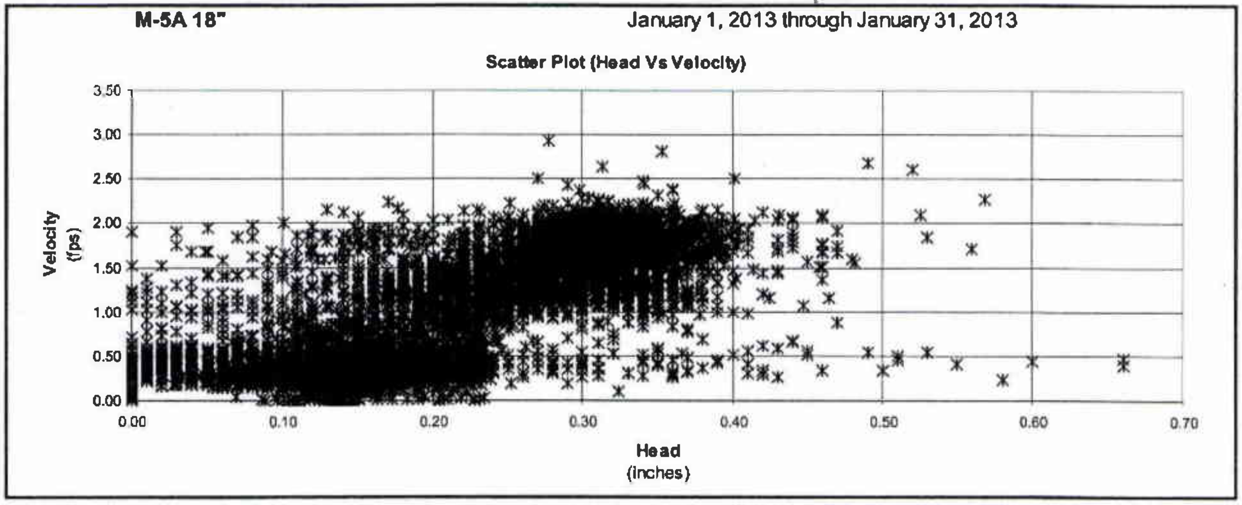

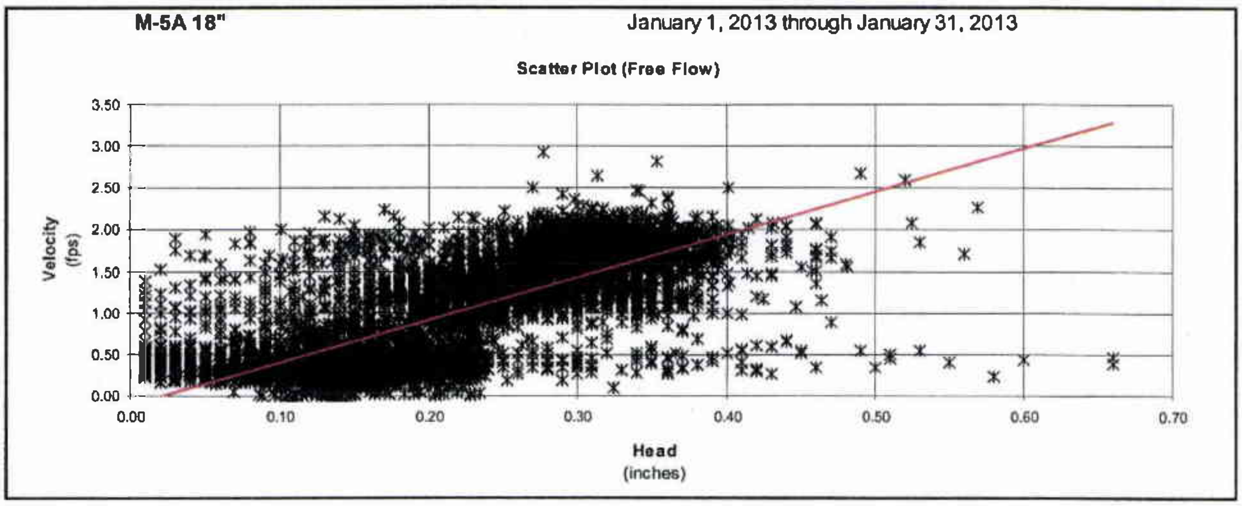

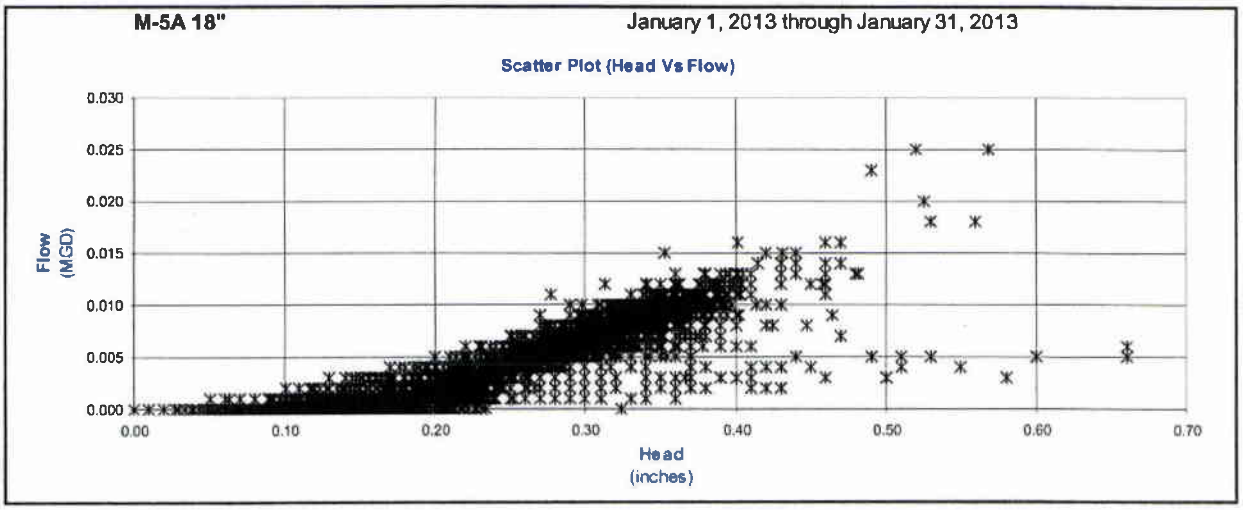

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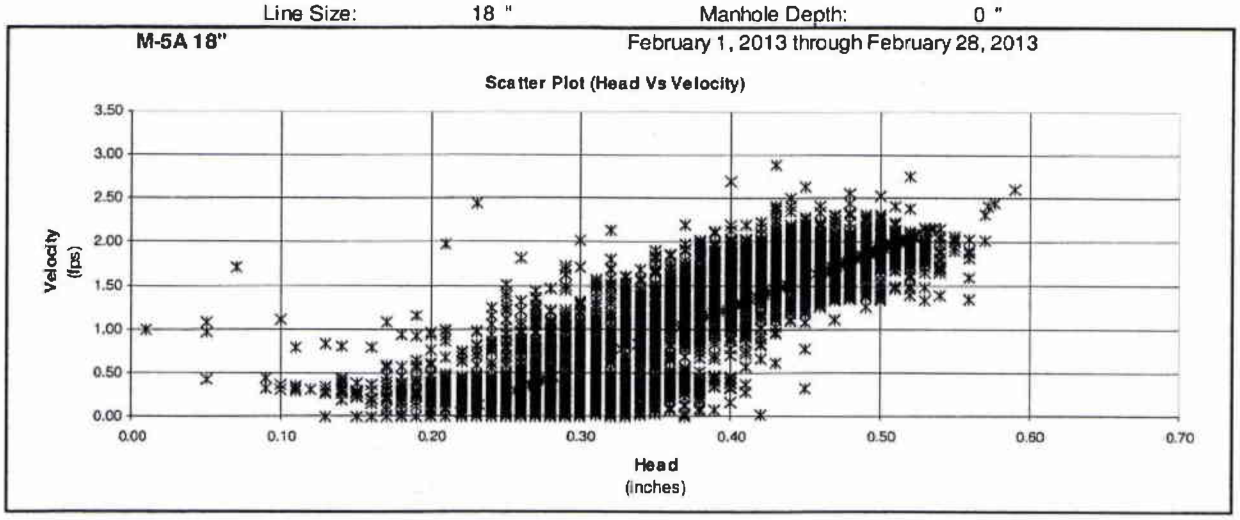

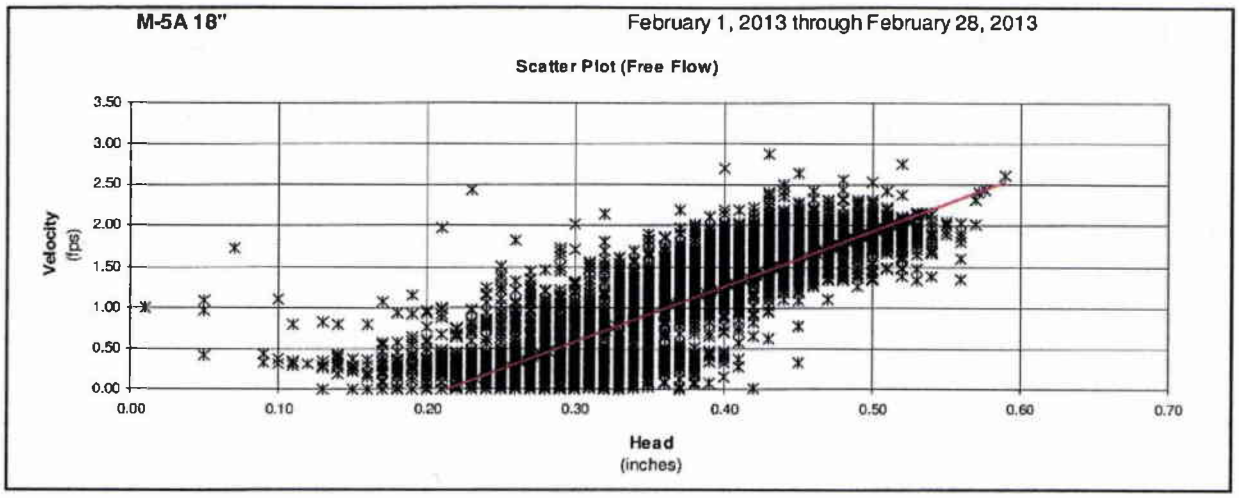

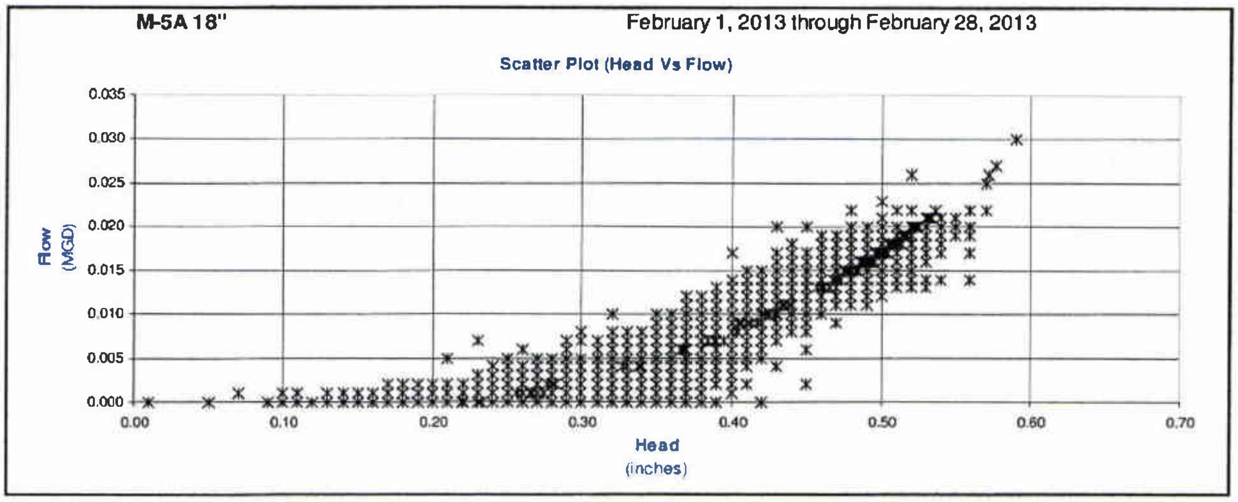

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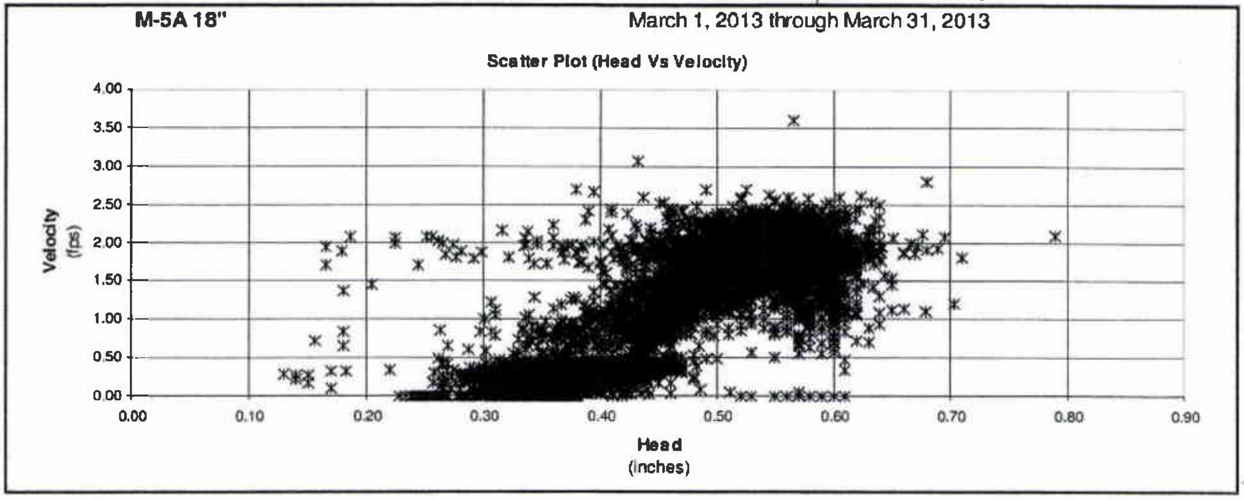

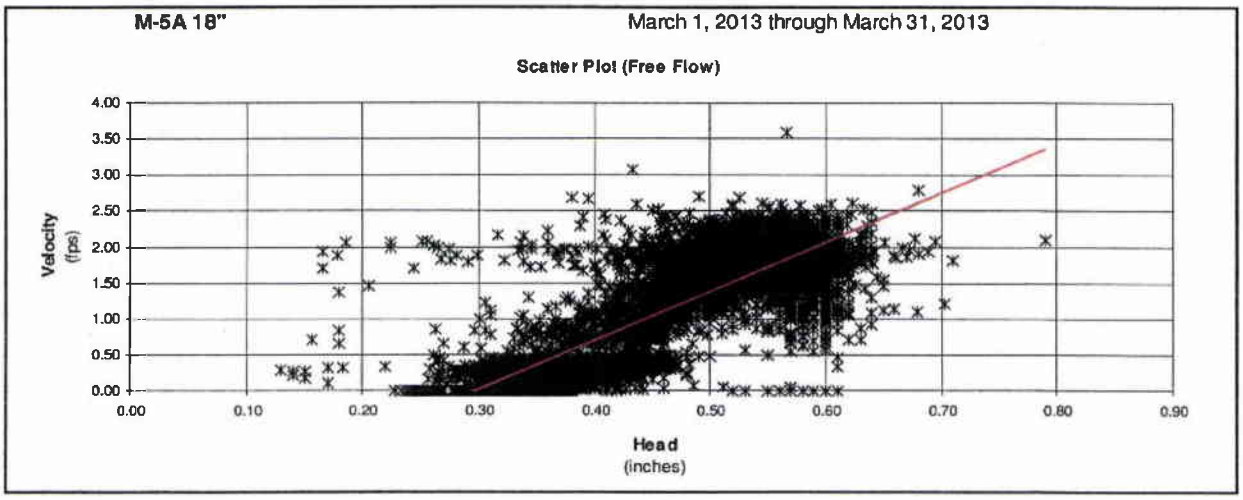

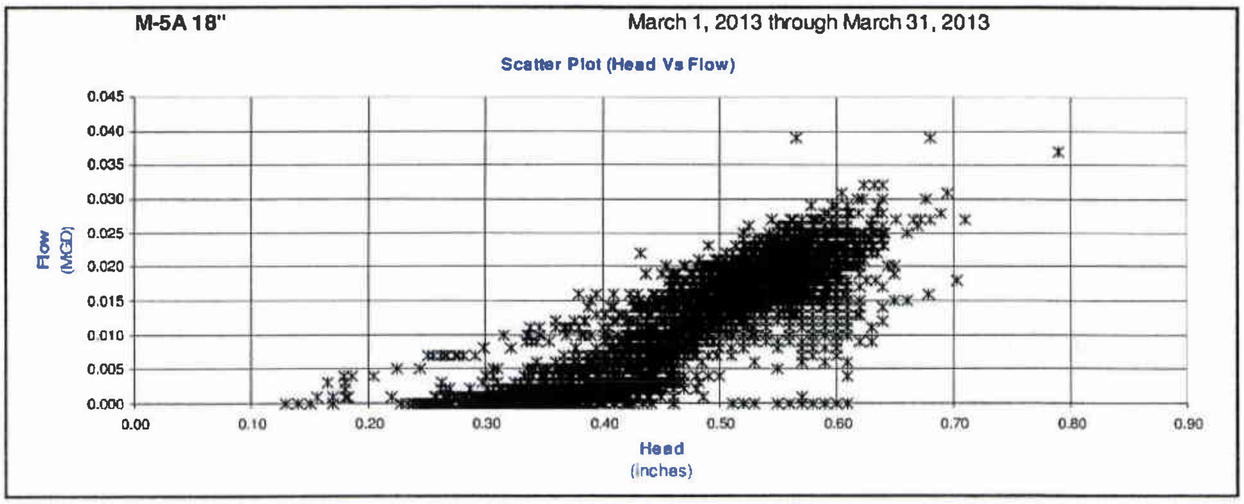

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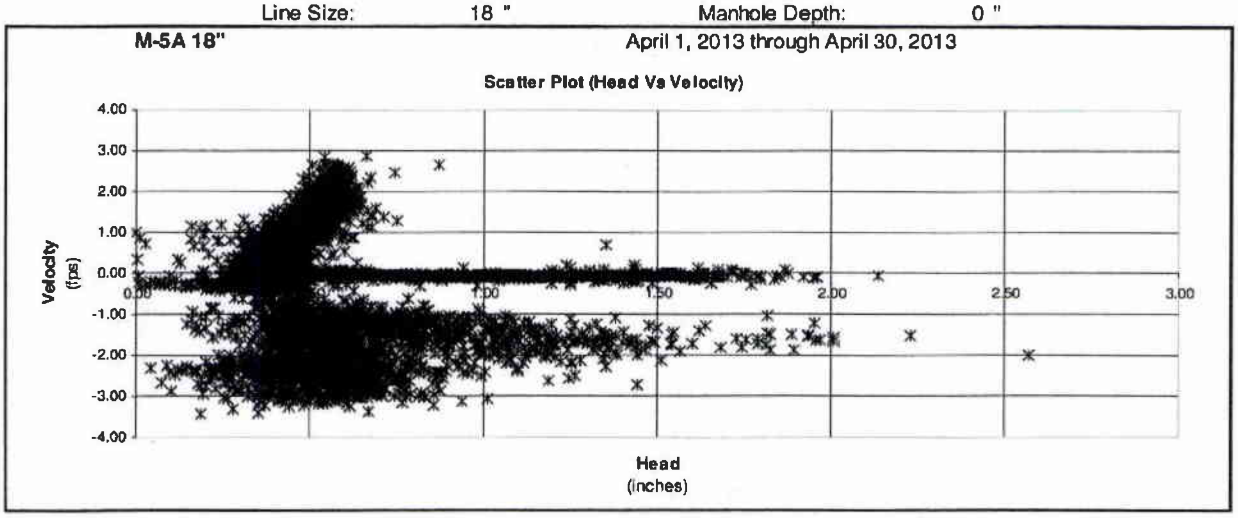
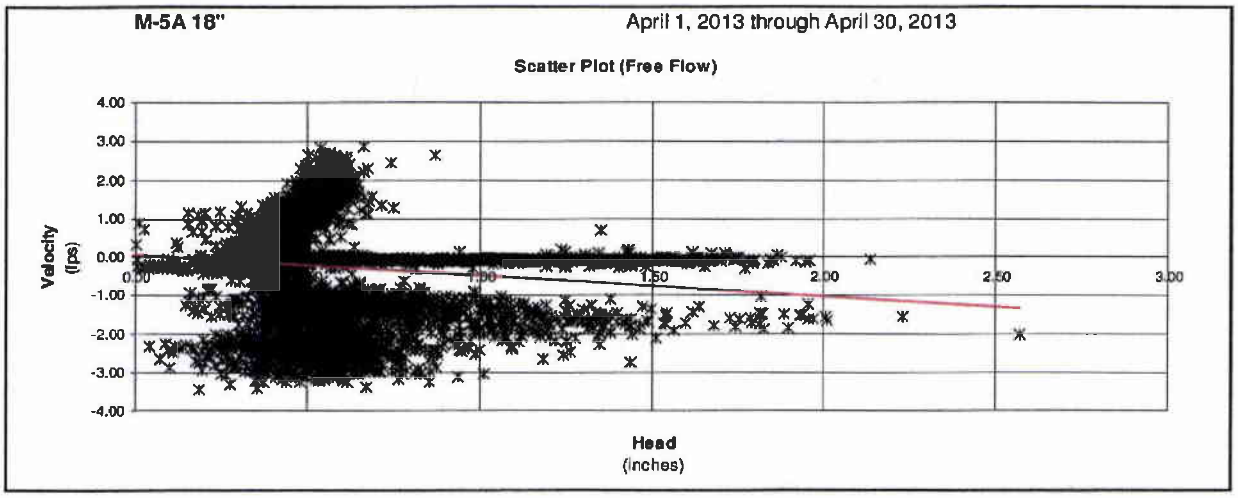
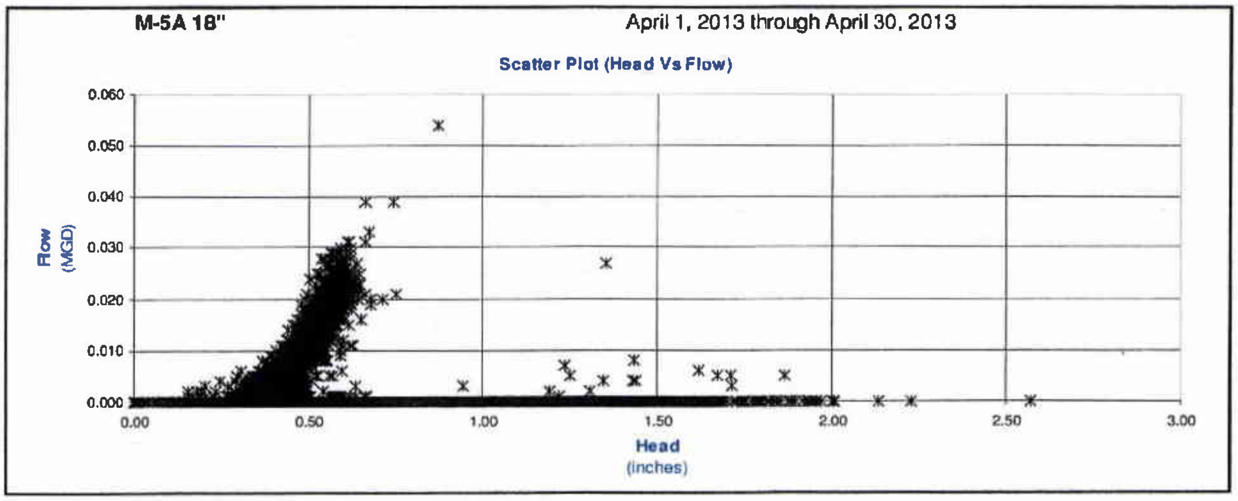
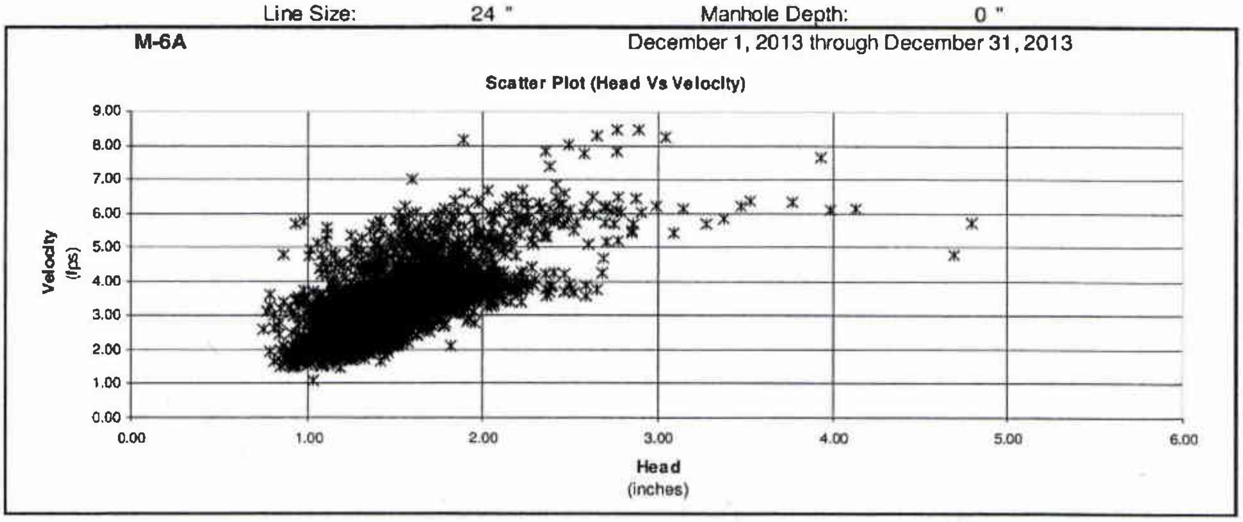
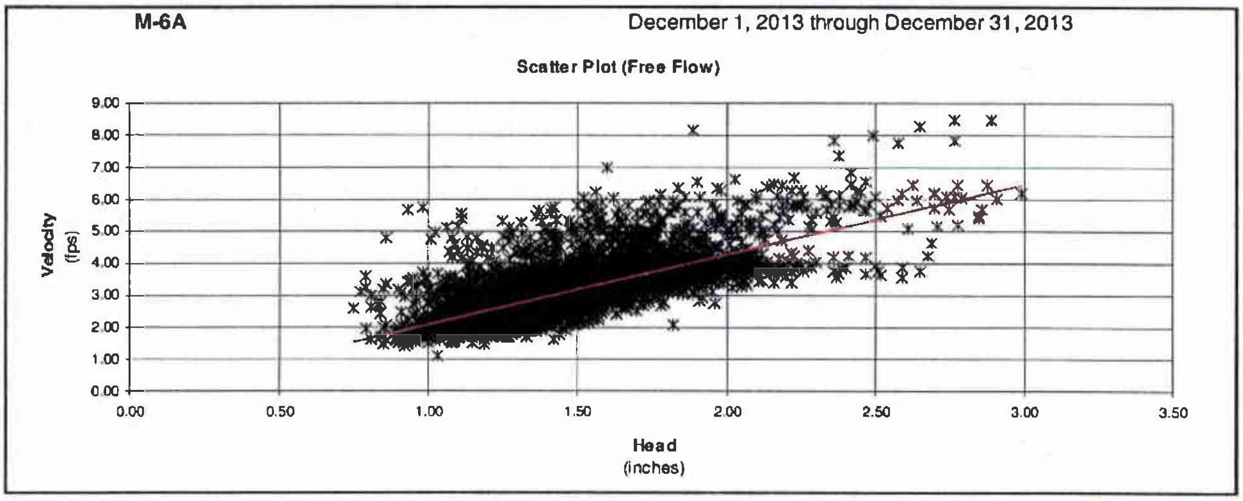


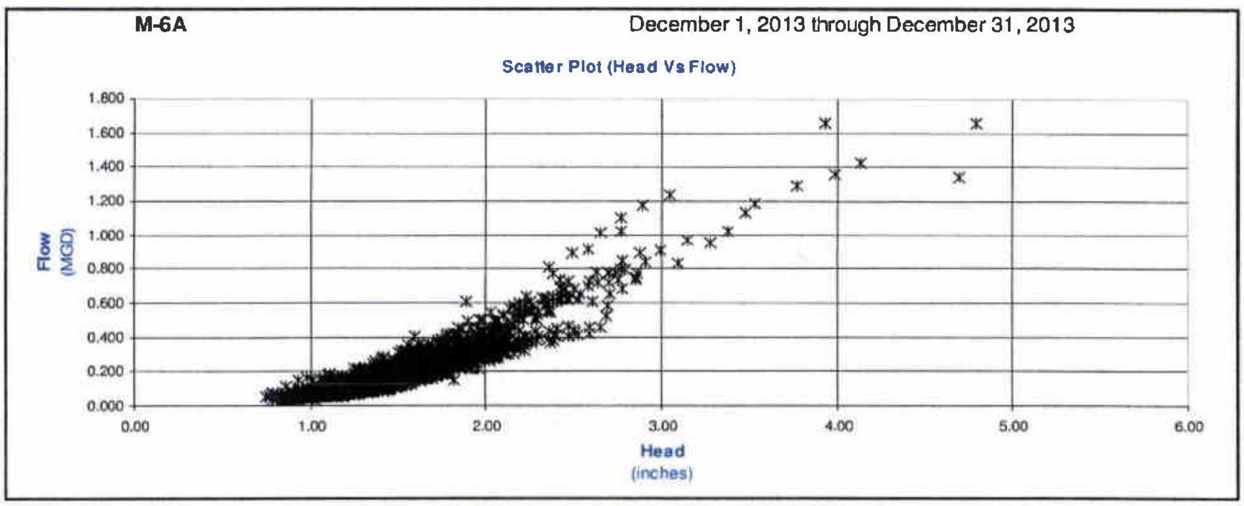




Line Size: 24 " Manhole Depth: 0 "







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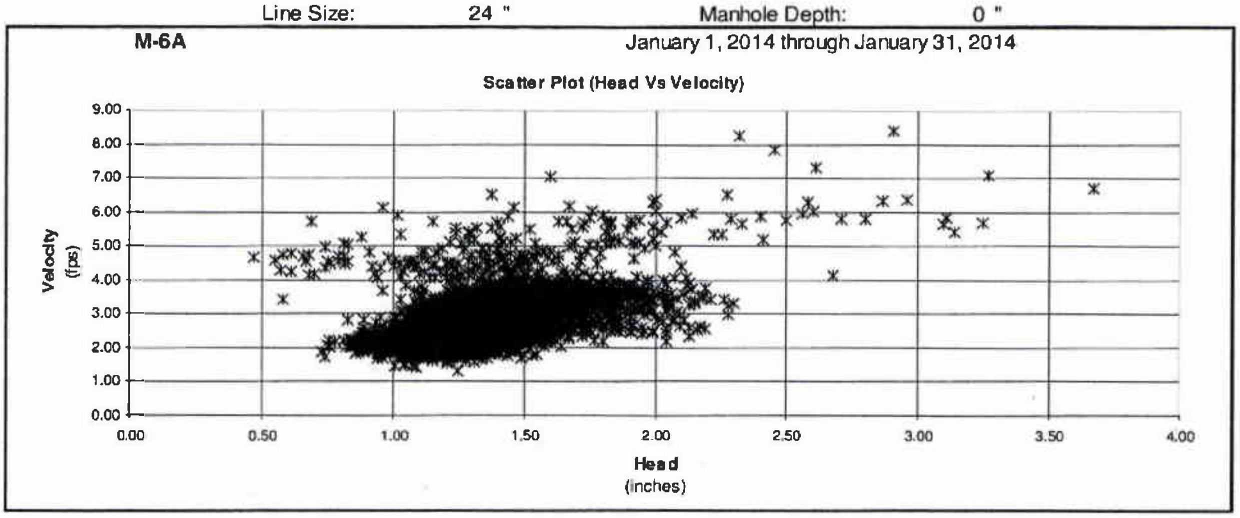

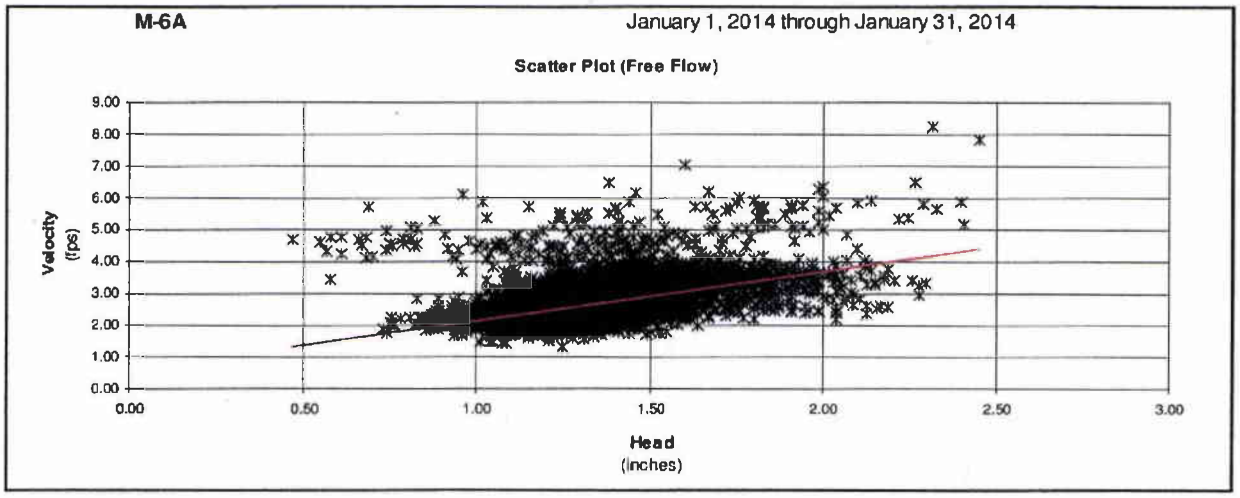

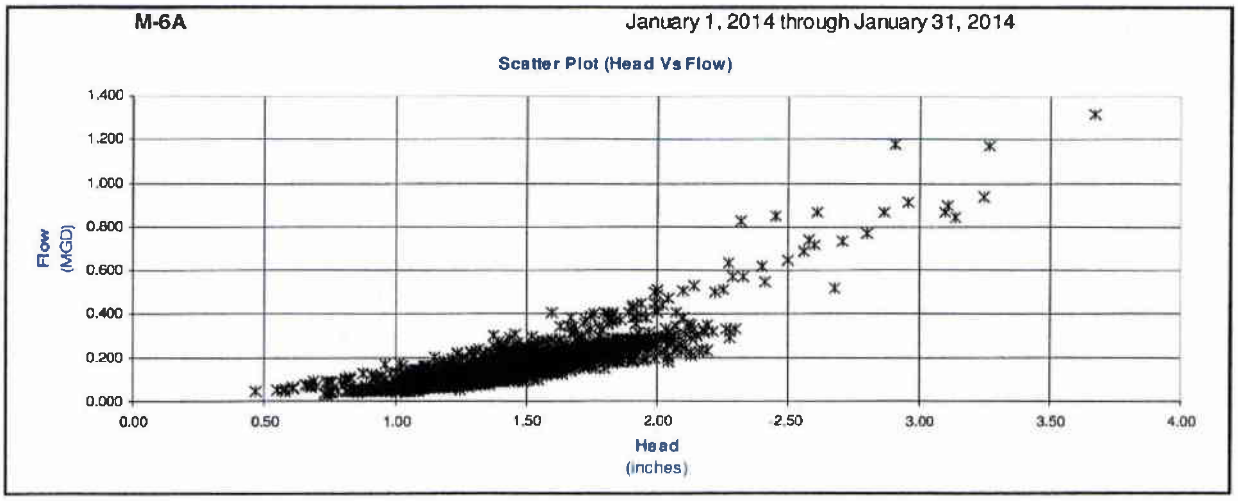

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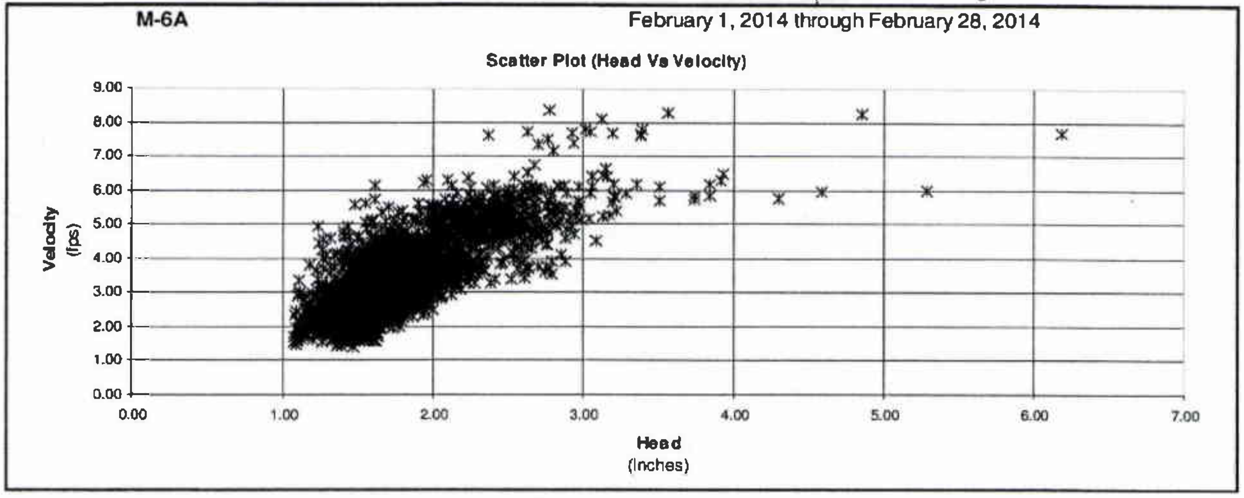

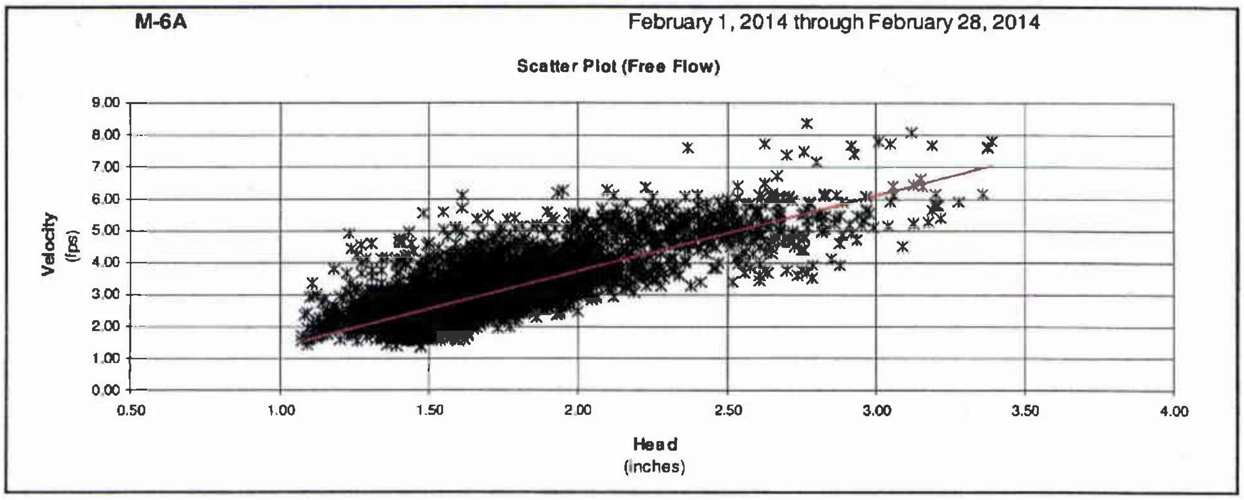

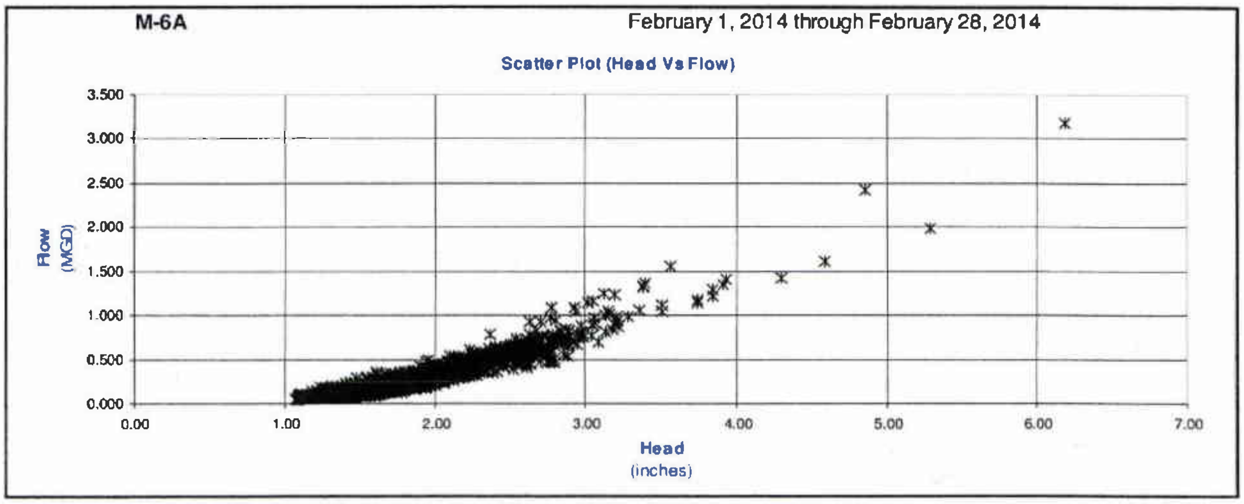

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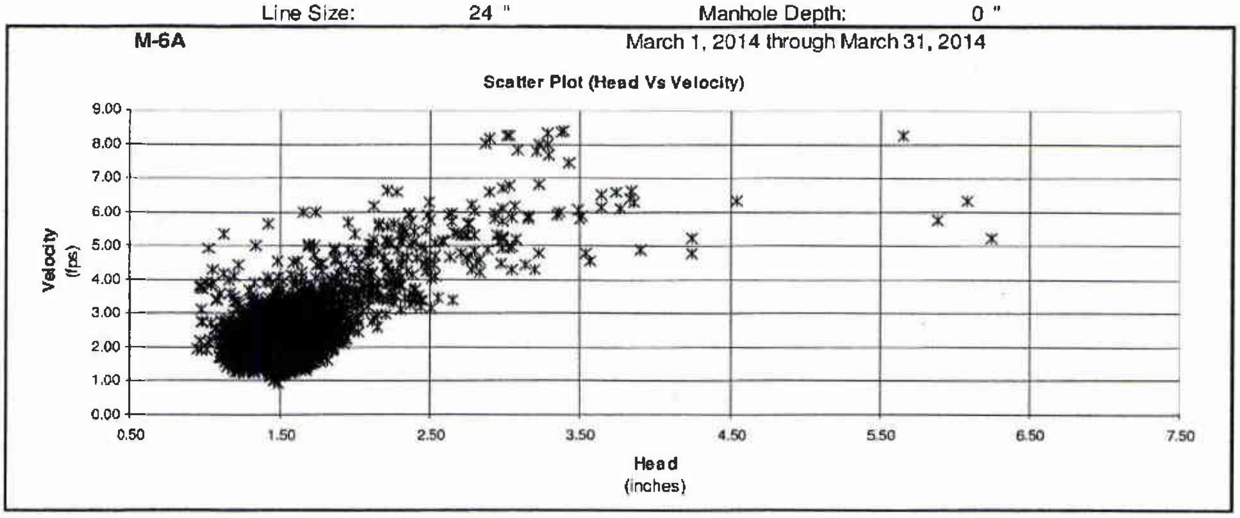

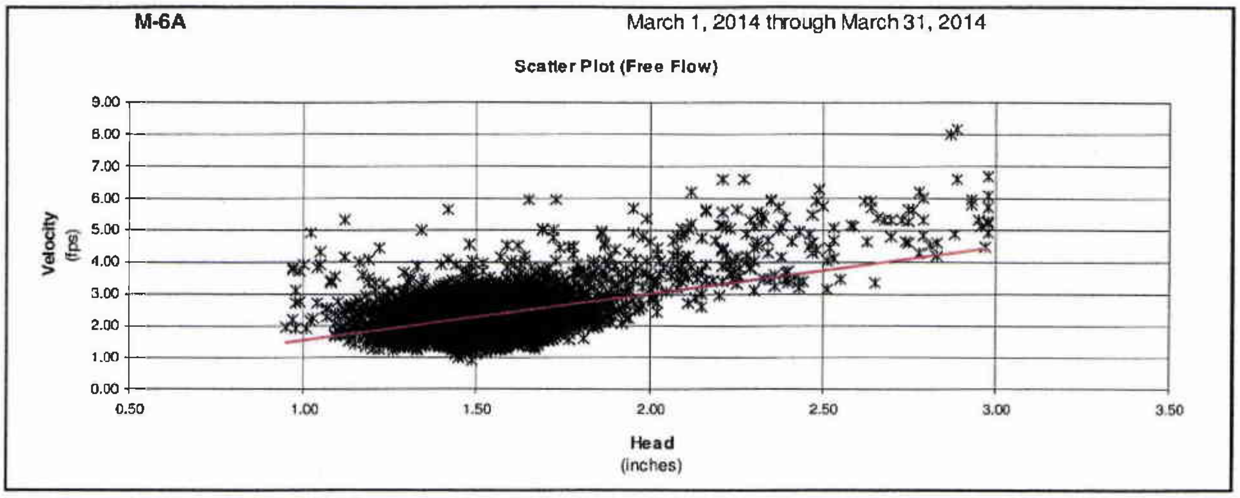

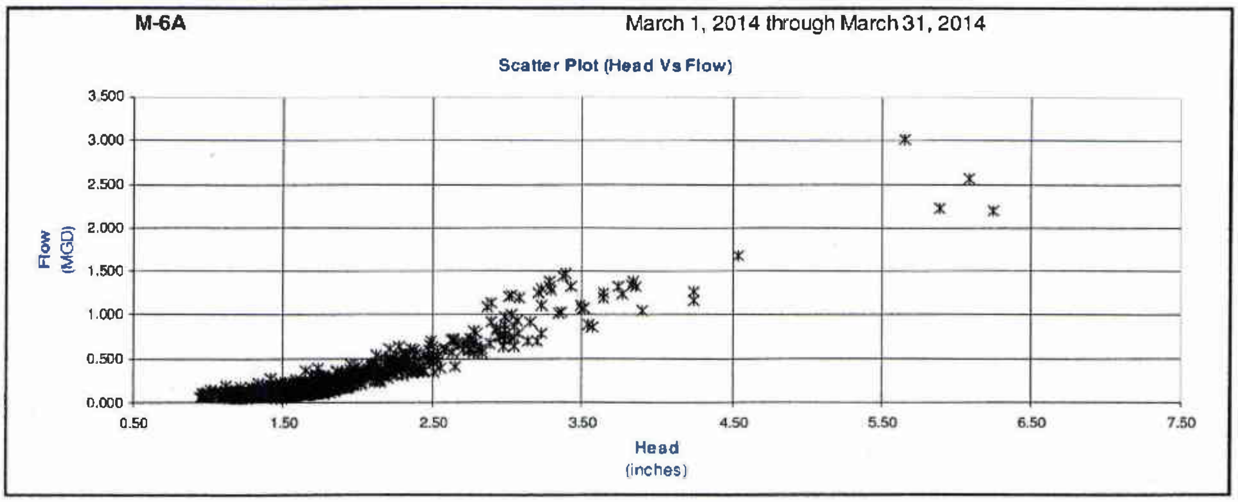

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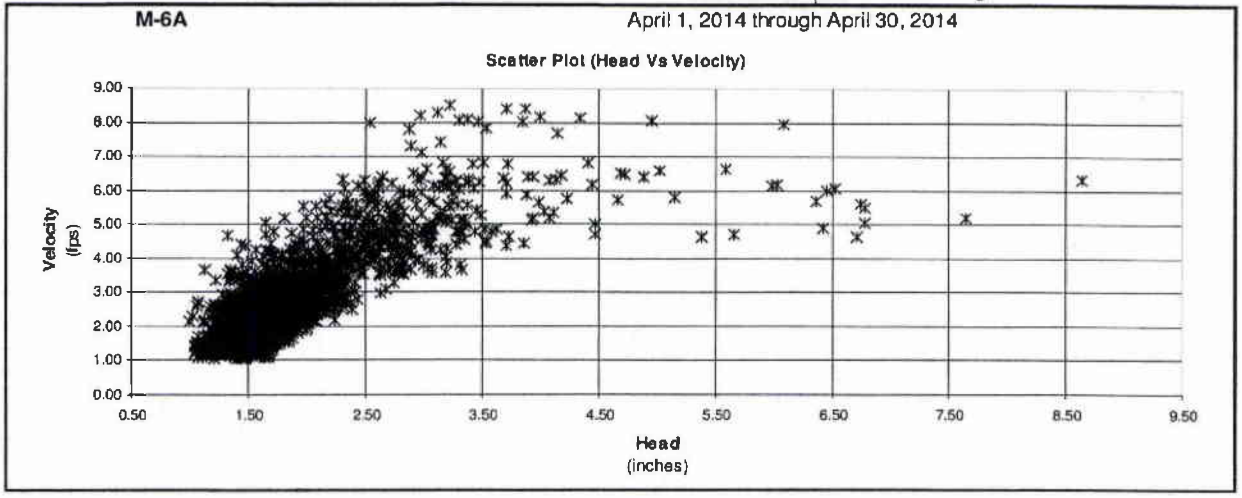
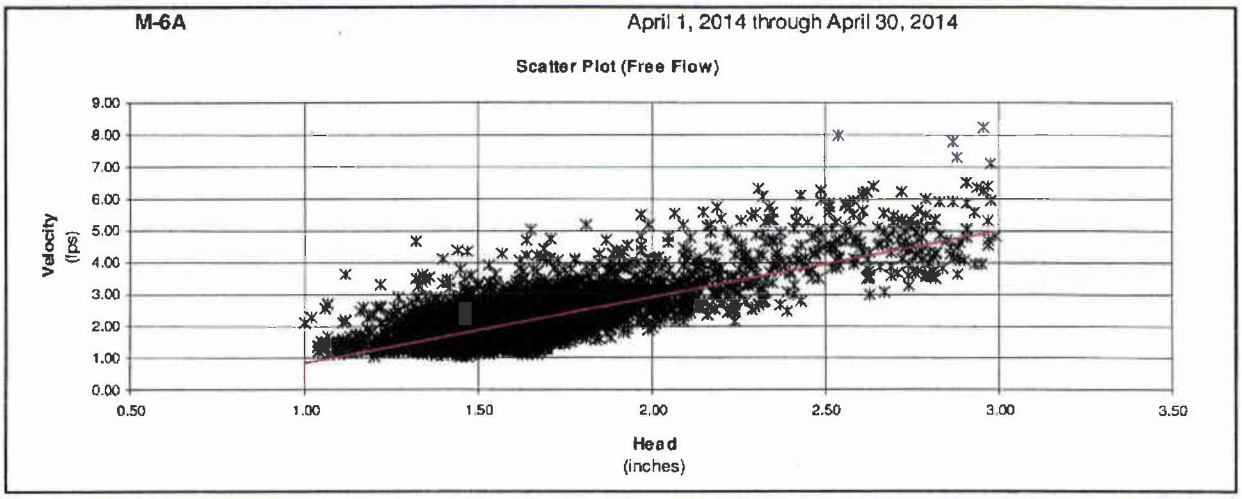
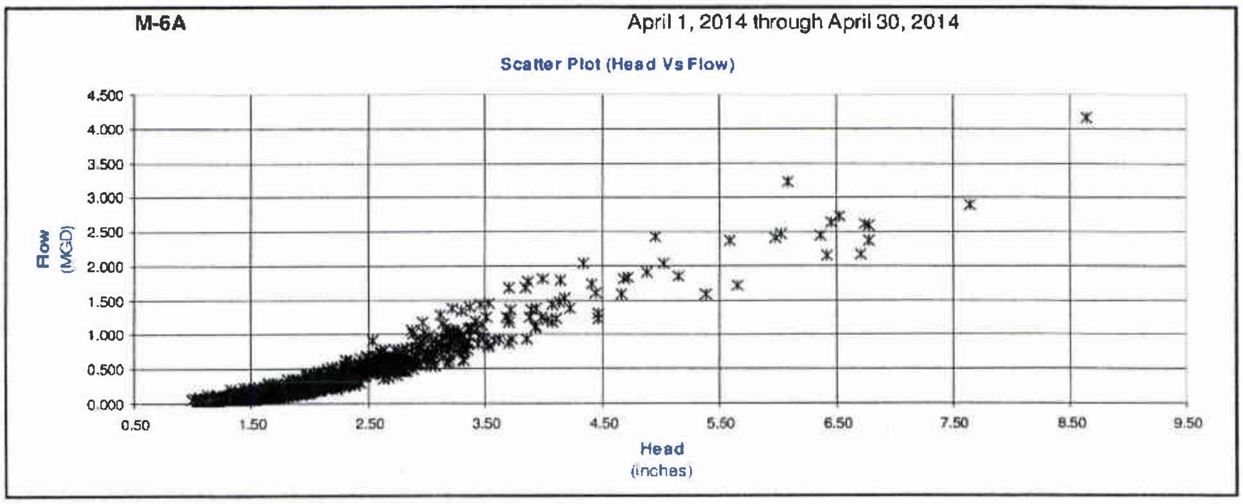
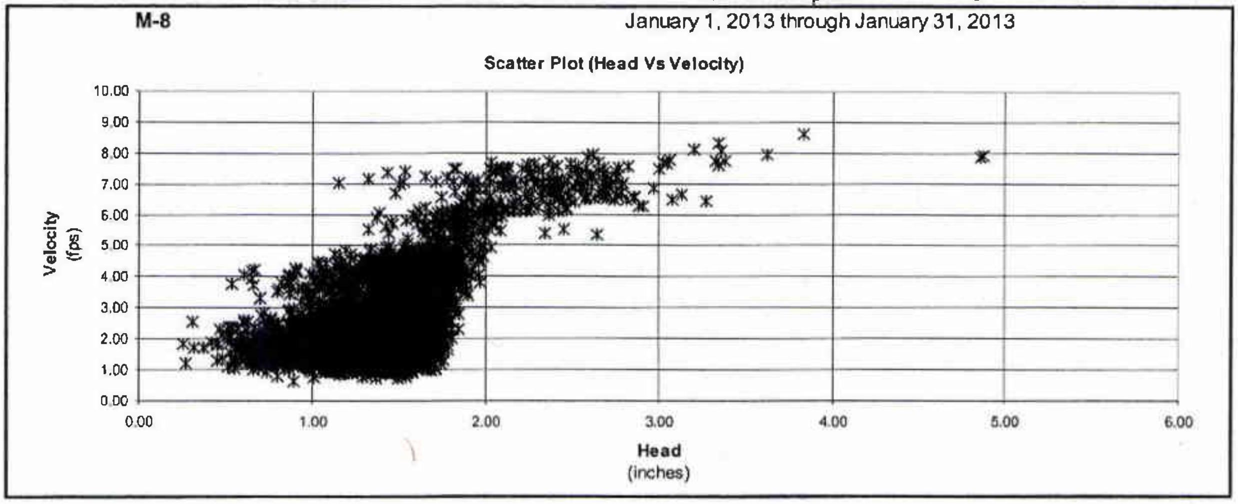
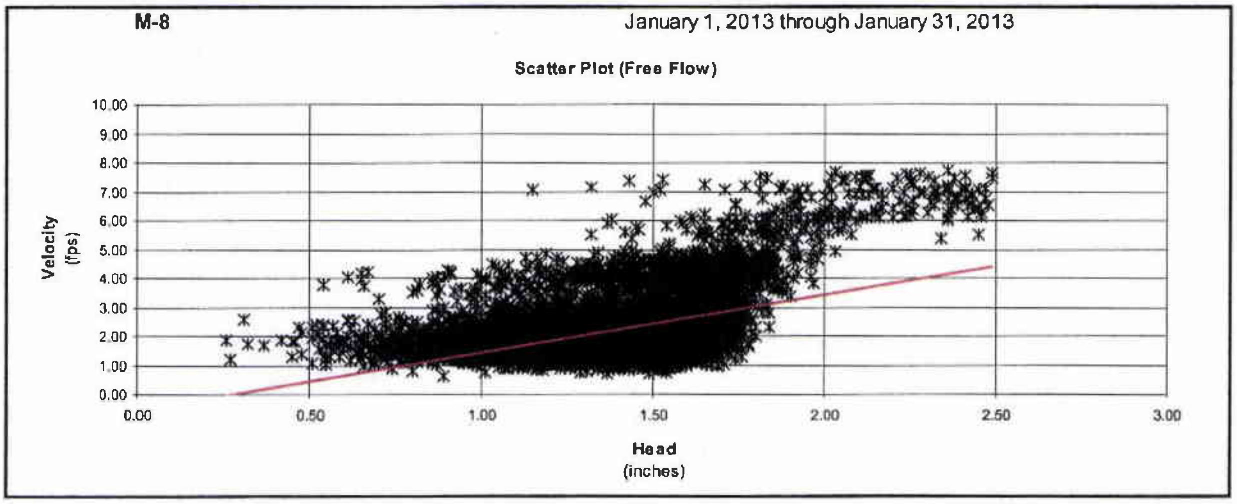


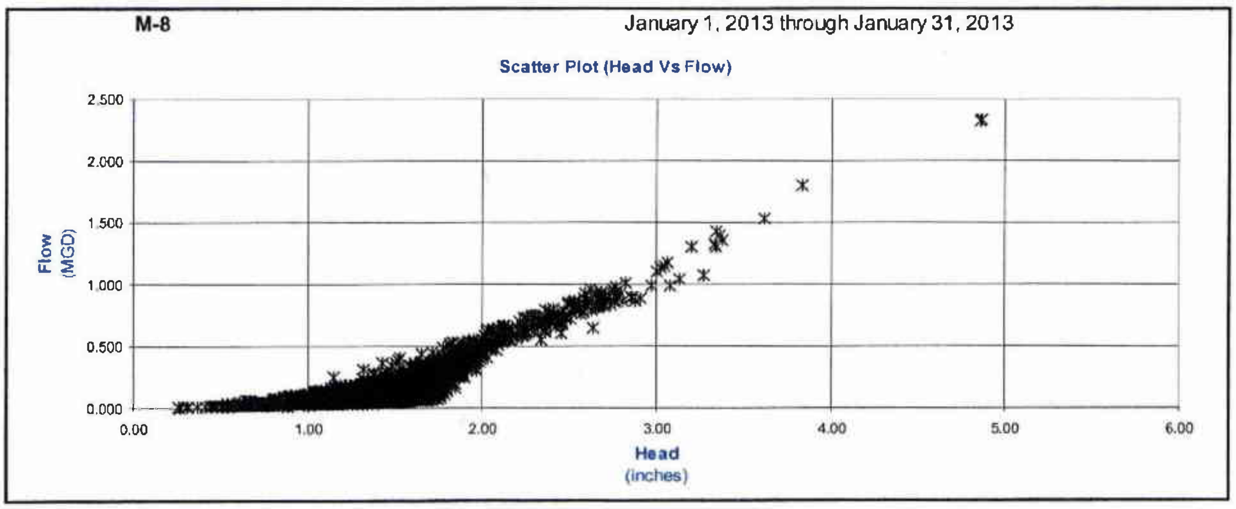




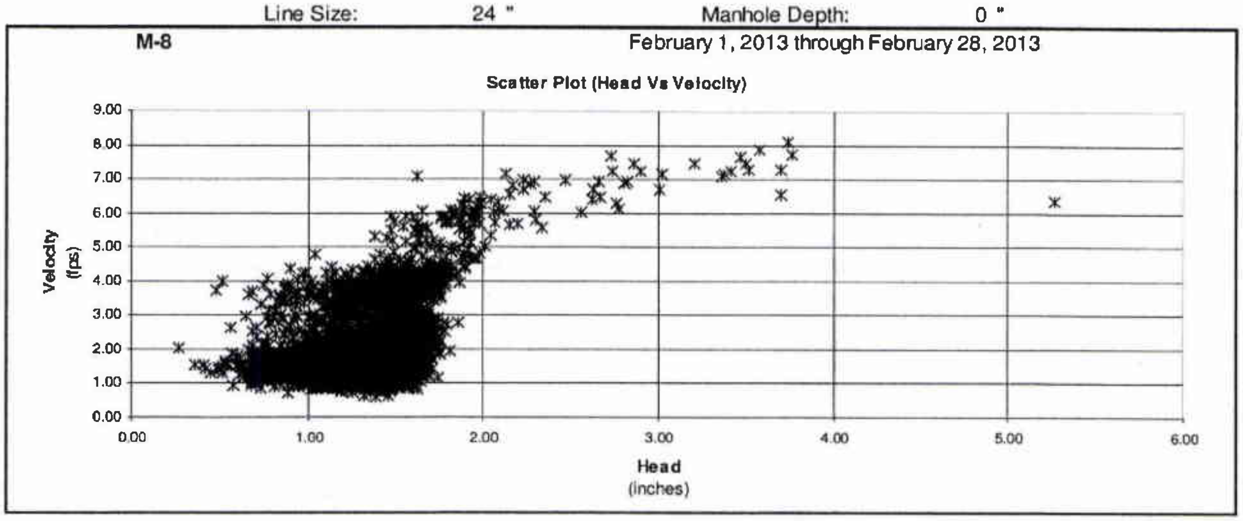
Line Size: 24 " Manhole Depth: 0 "

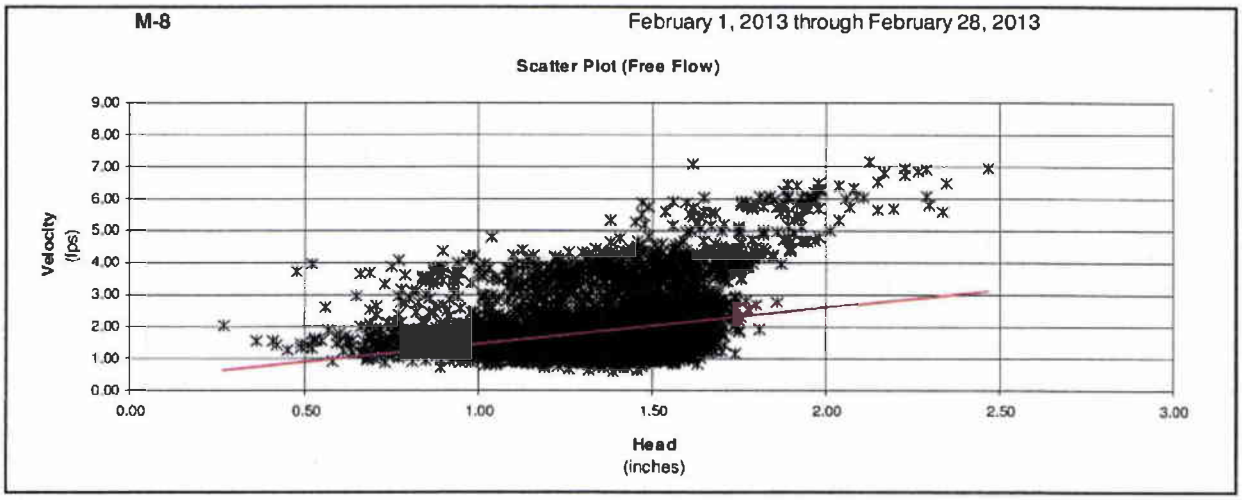


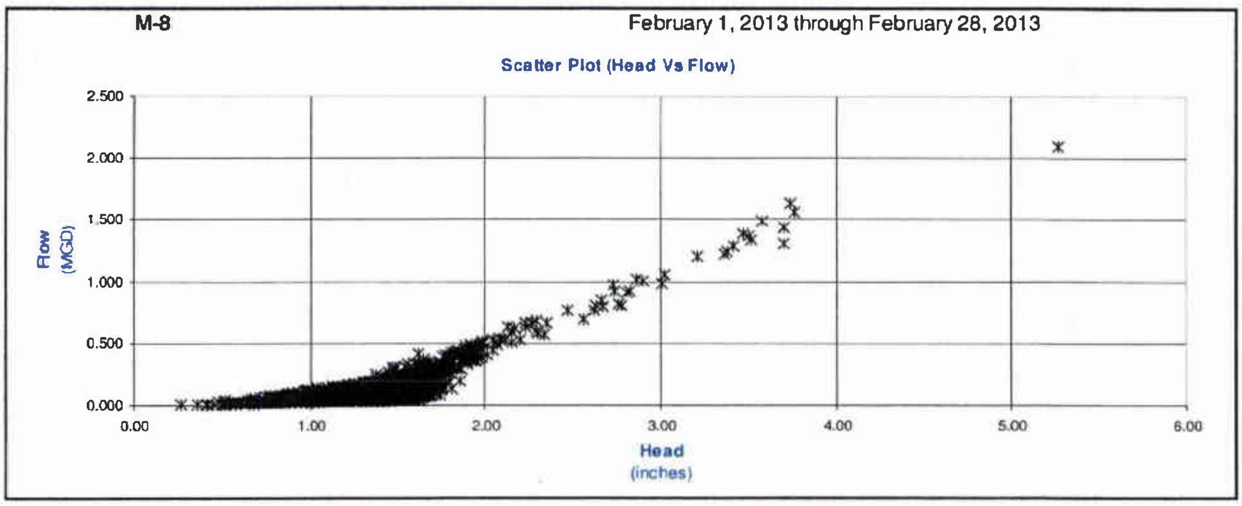




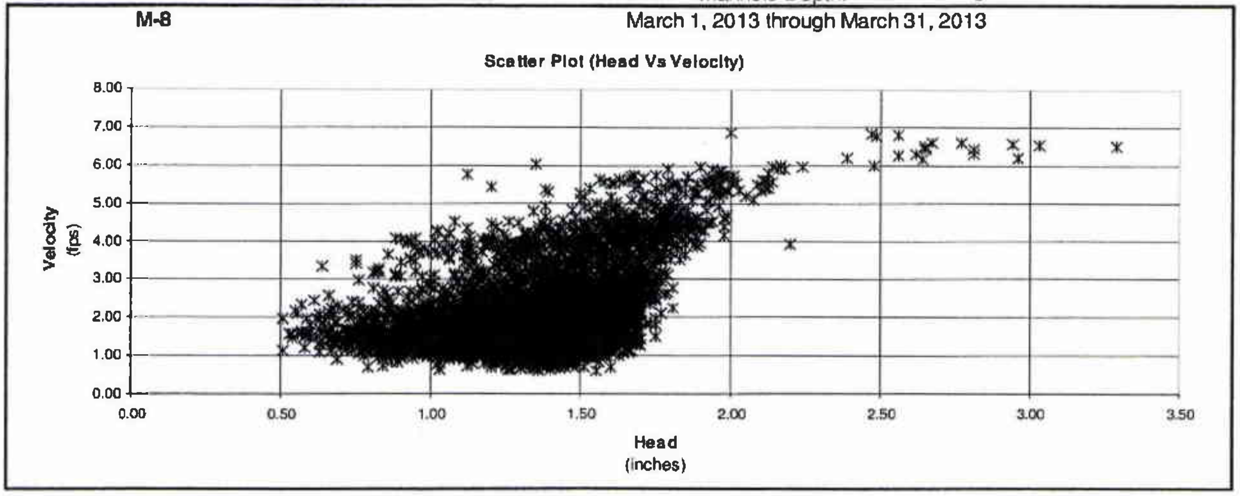
Line Size: 24 " Manhole Depth: 0 "

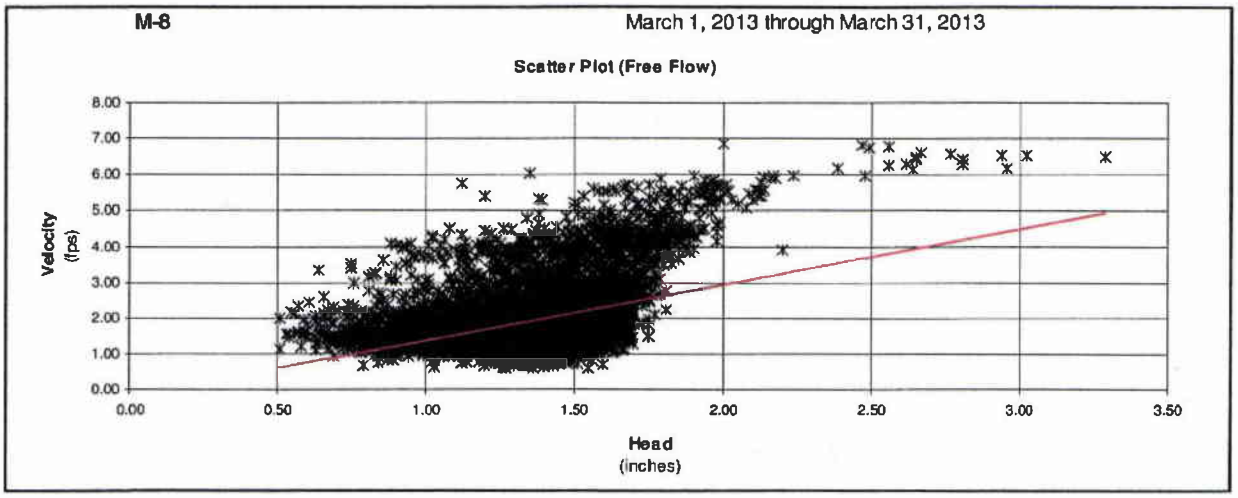


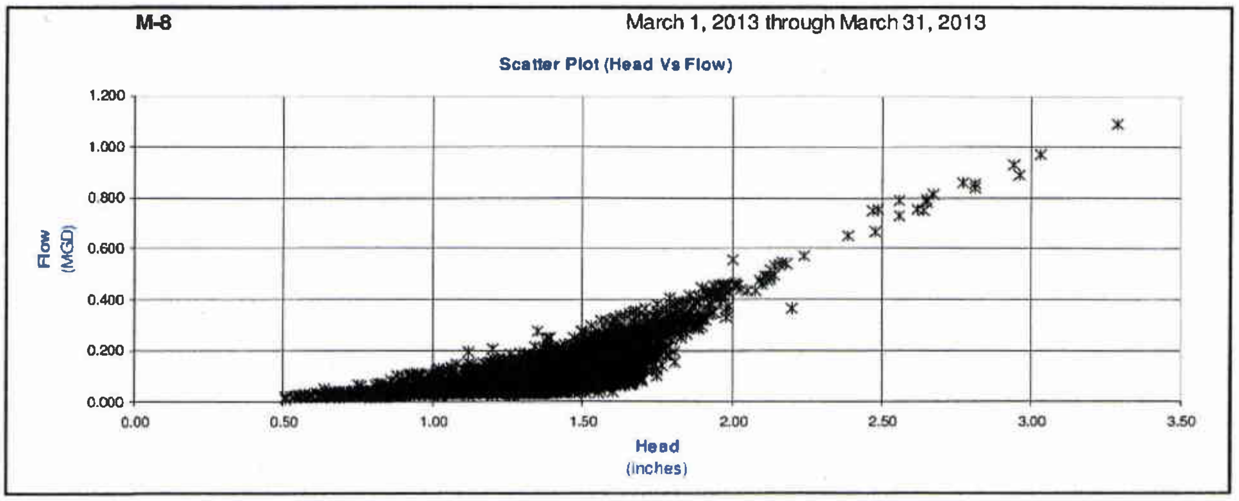




Line Size: 24 " Manhole Depth: 0 "

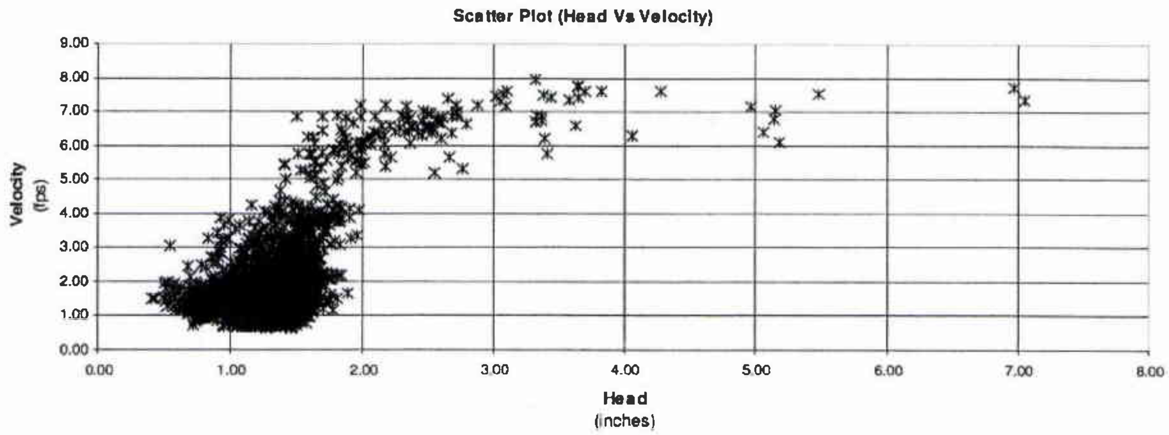




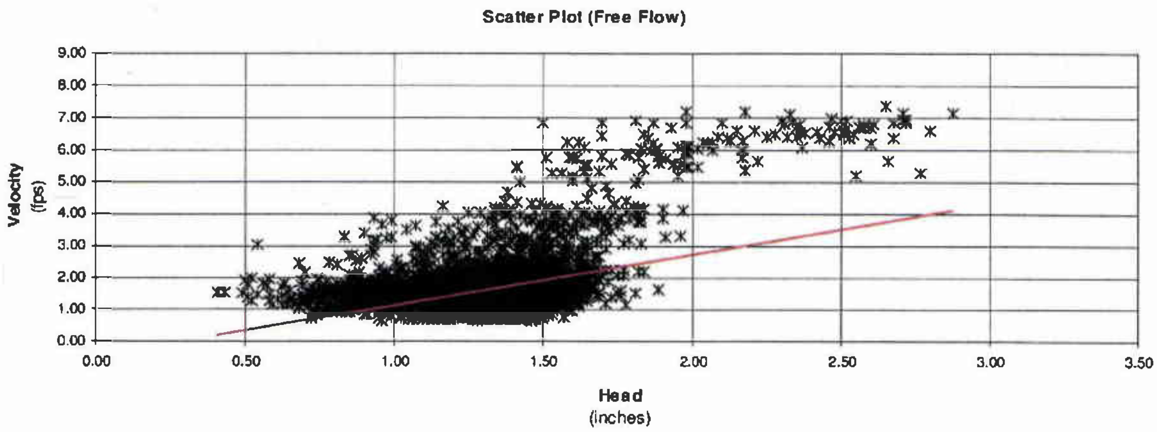


Line Size: 24 " Manhole Depth: 0 "

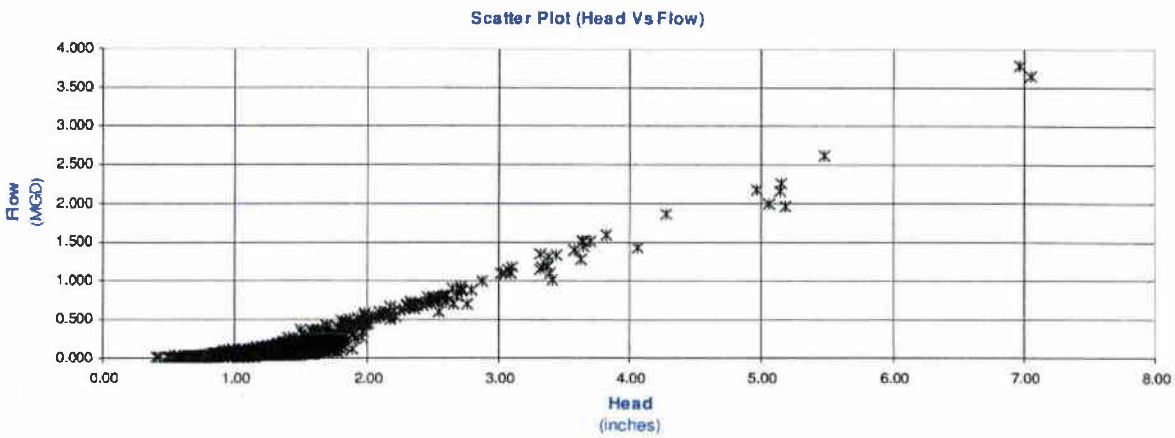
M-8 April 1, 2013 through April 30, 2013



M-8 April 1, 2013 through April 30, 2013

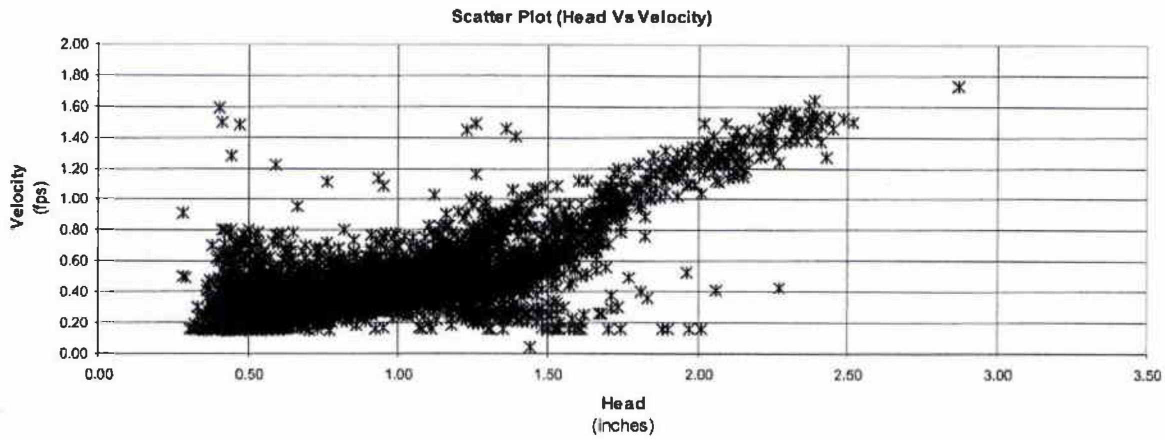


M-8 April 1, 2013 through April 30, 2013

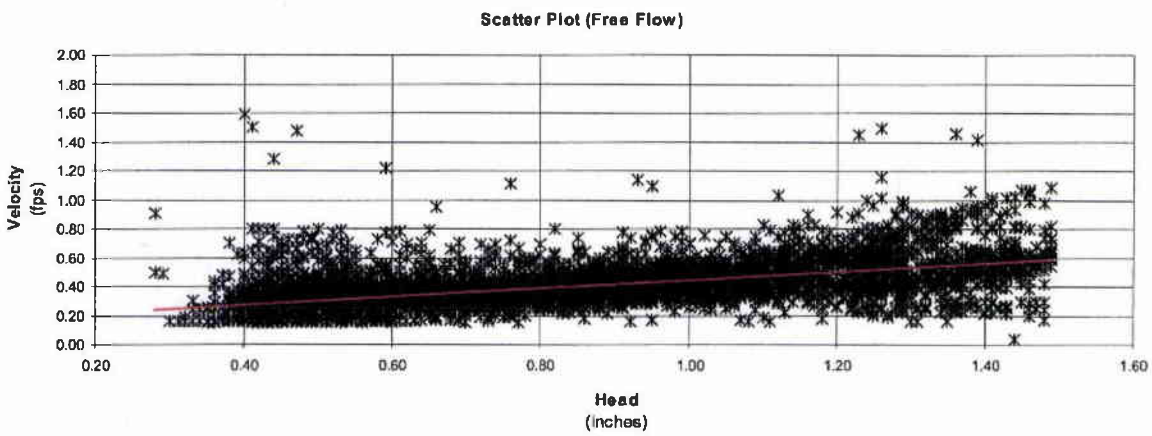


Line Size: 8 " Manhole Depth: 0 "

M-10 January 1, 2013 through January 31, 2013



M-10 January 1, 2013 through January 31, 2013



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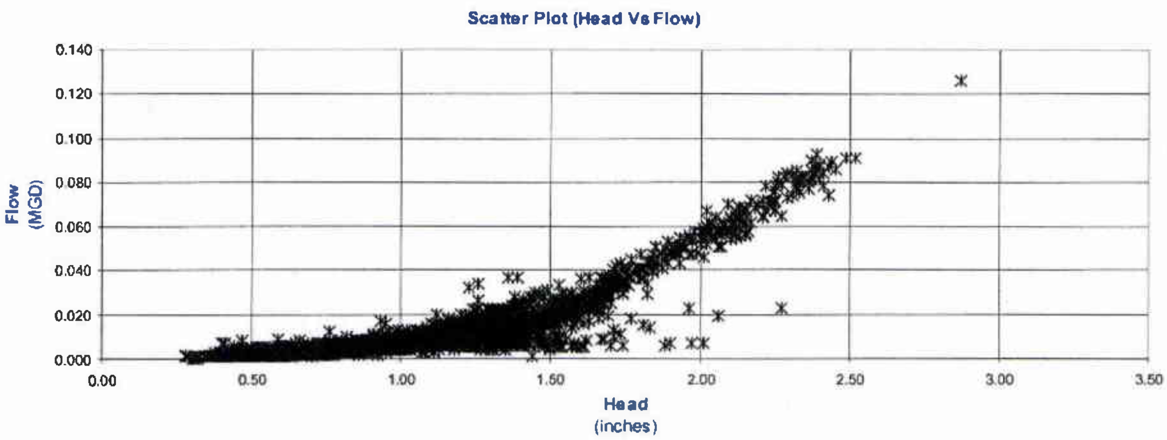
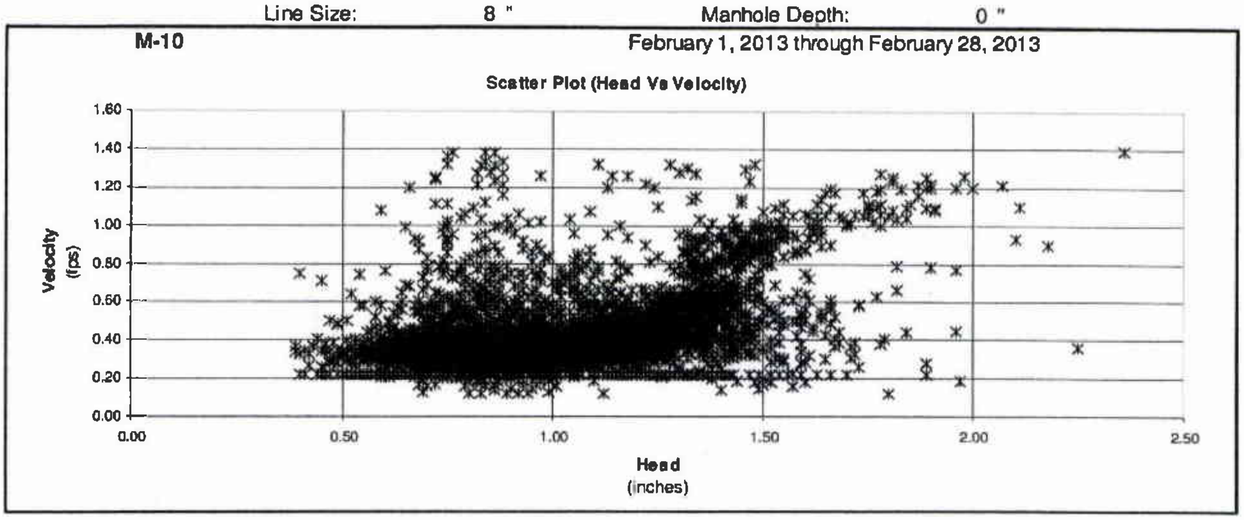
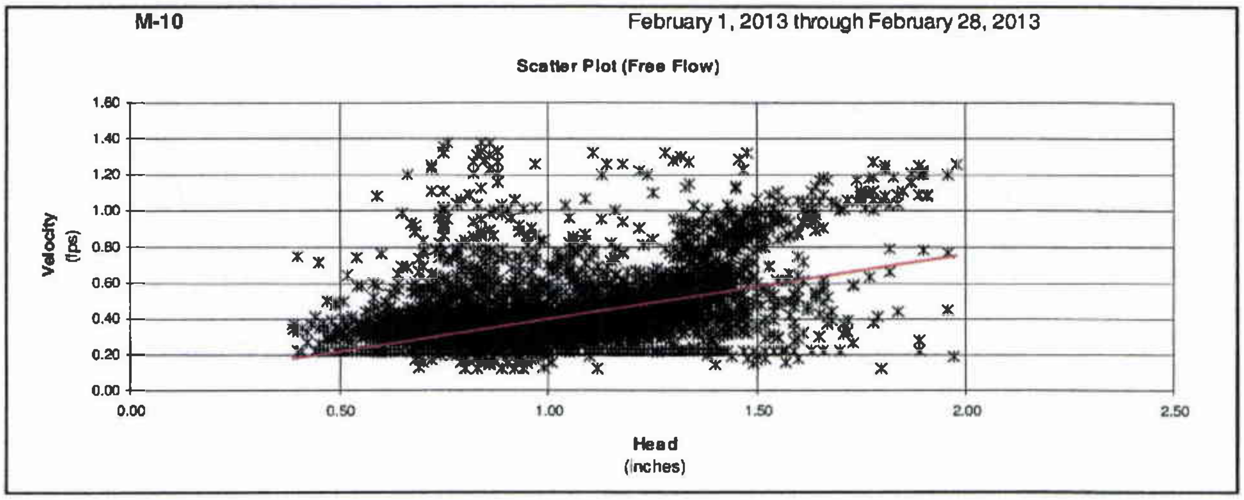
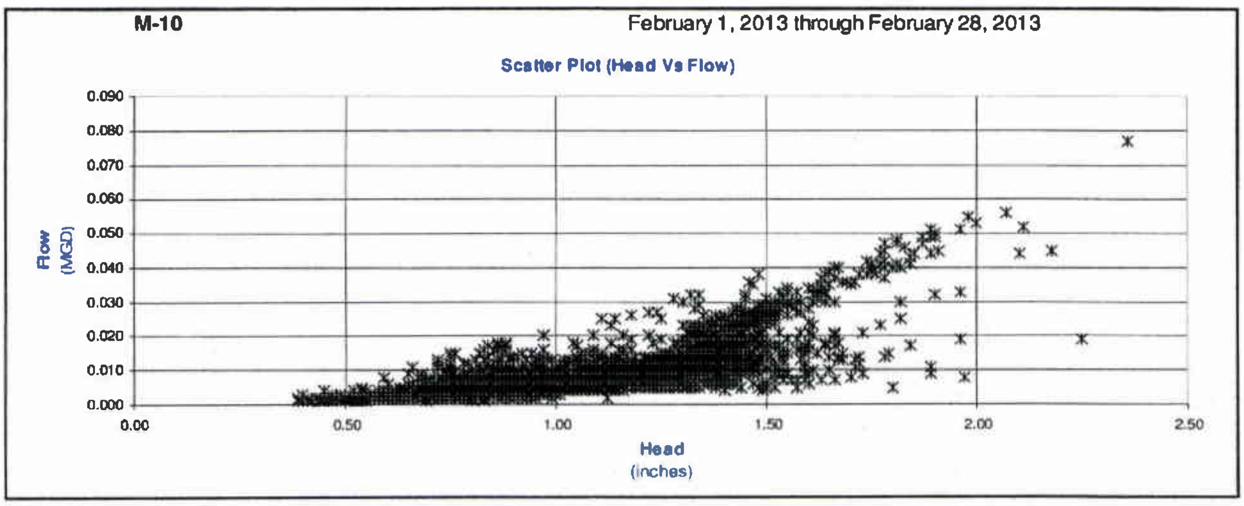


Line Size: 8 " Manhole Depth: 0 "



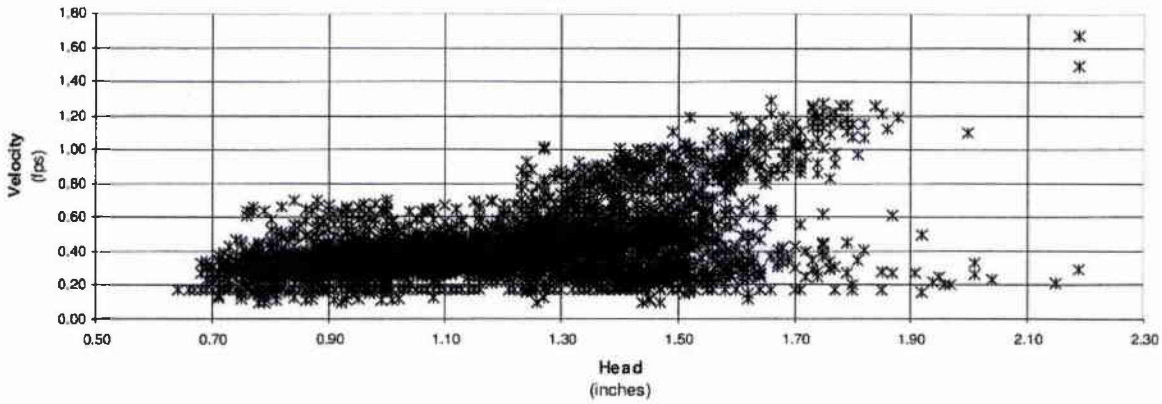




Line Size: 8 " Manhole Depth: 0 "

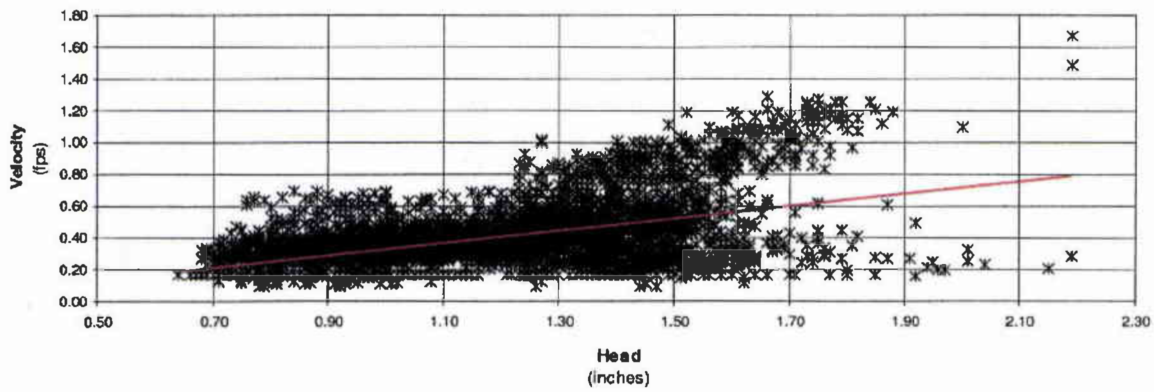
M-10 March 1, 2013 through March 31, 2013

Scatter Plot (Head Vs Velocity)



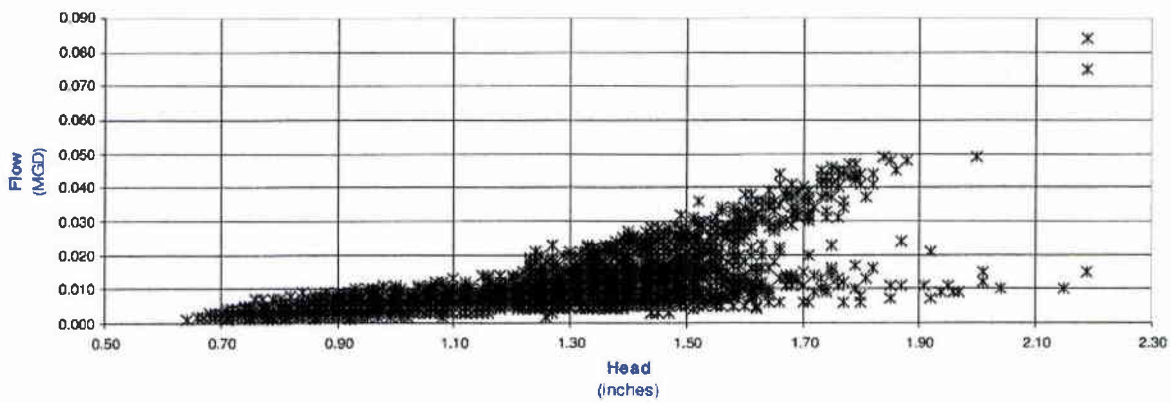
M-10 March 1, 2013 through March 31, 2013

Scatter Plot (Free Flow)

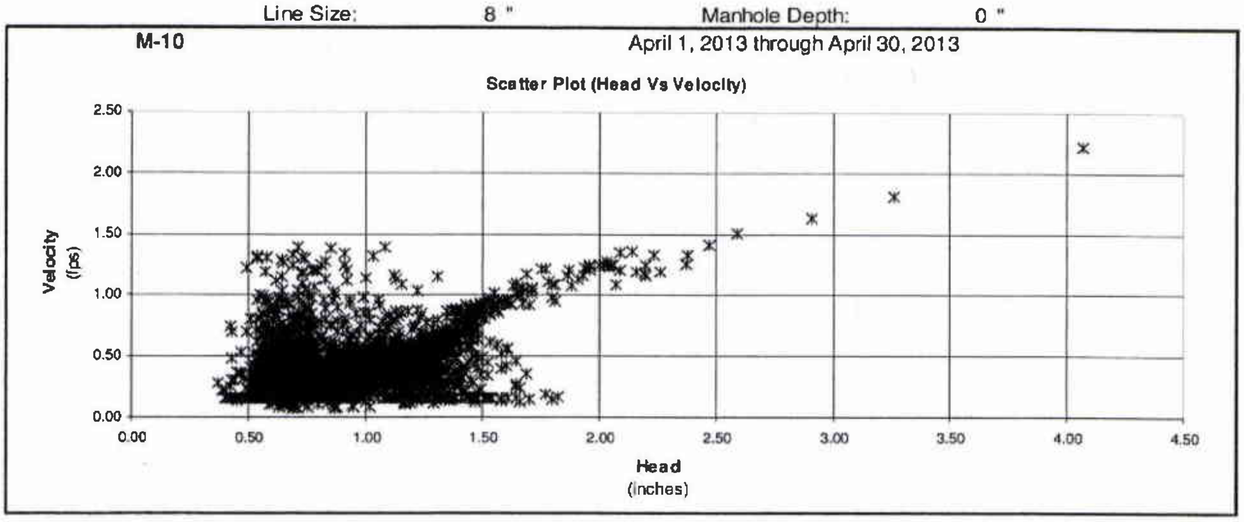


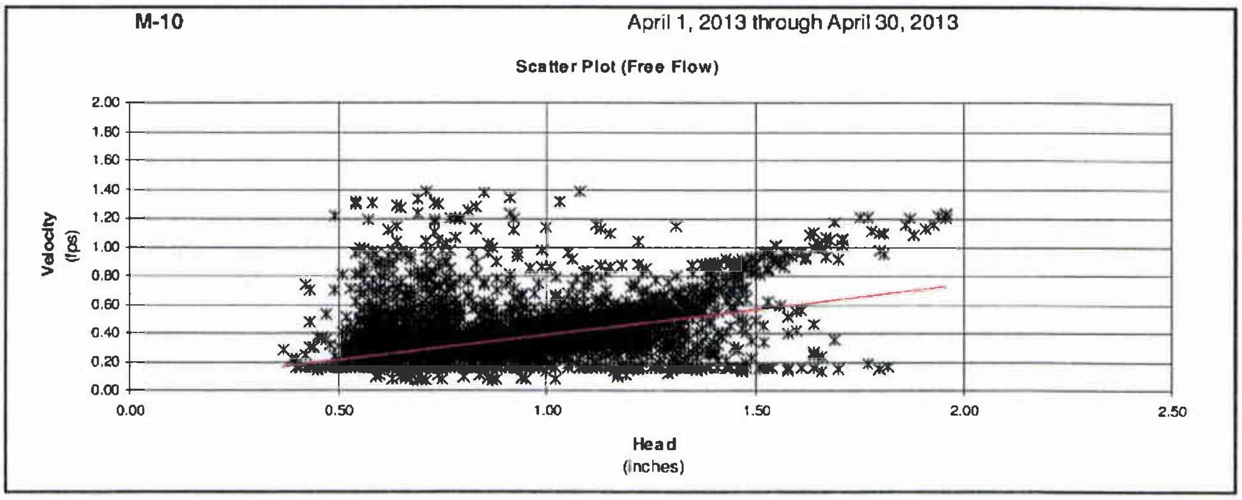
M-10 March 1, 2013 through March 31, 2013

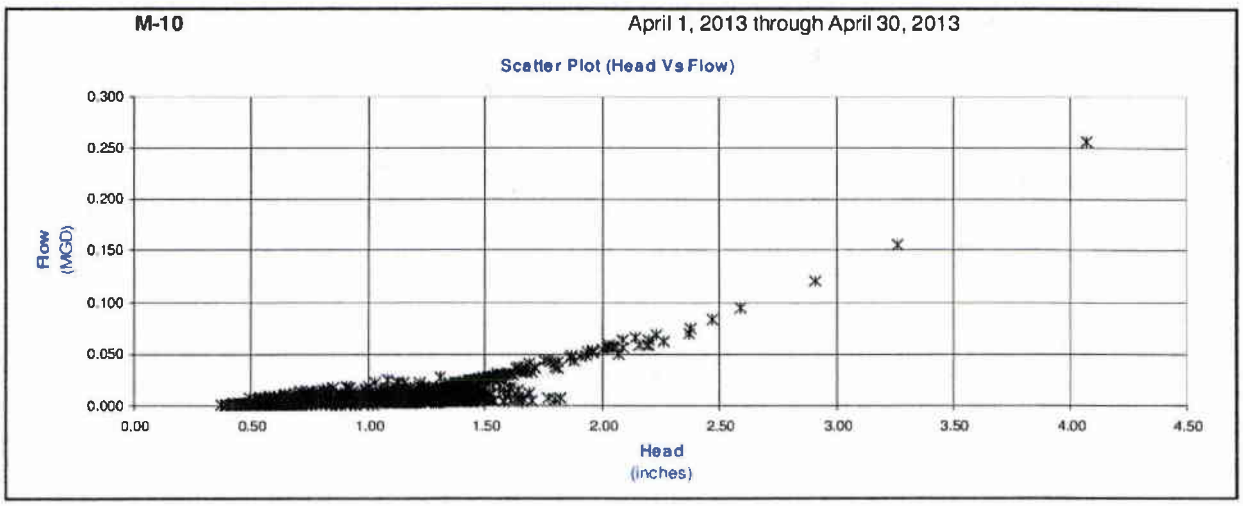
Scatter Plot (Head Vs Flow)



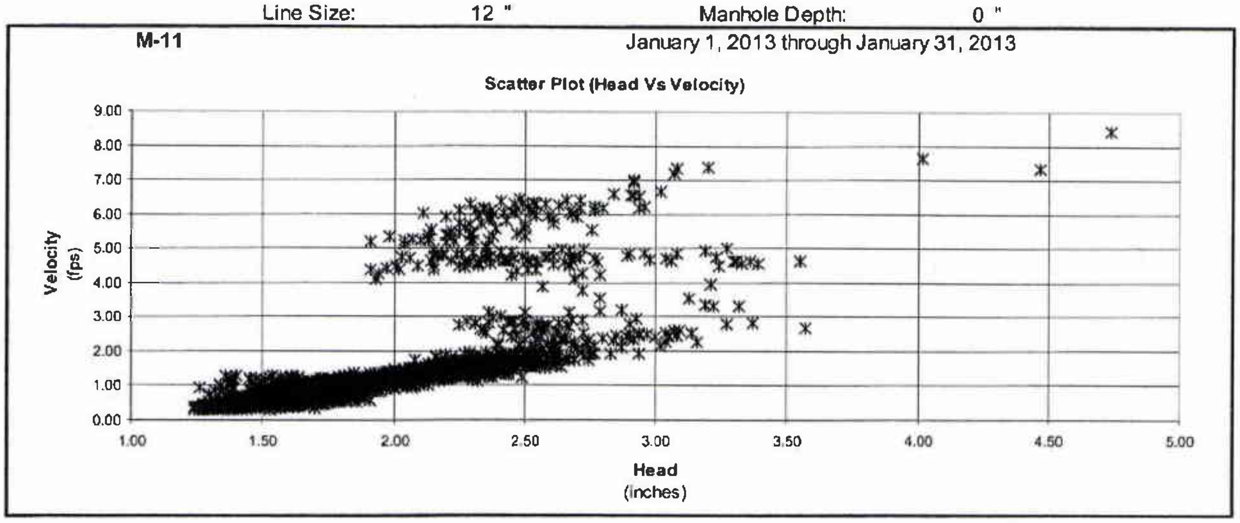
Line Size: 8 " Manhole Depth: 0 "

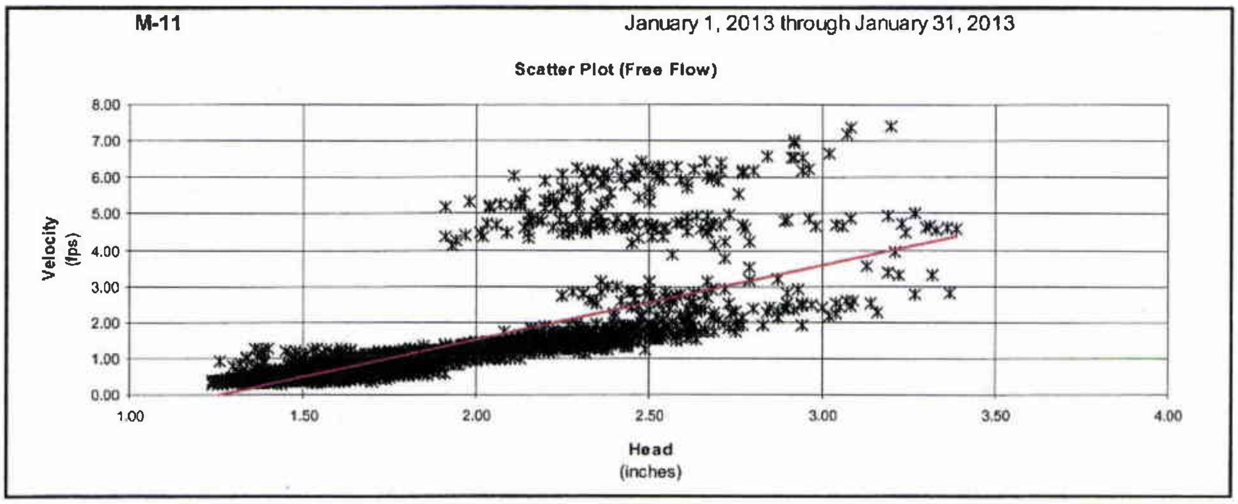


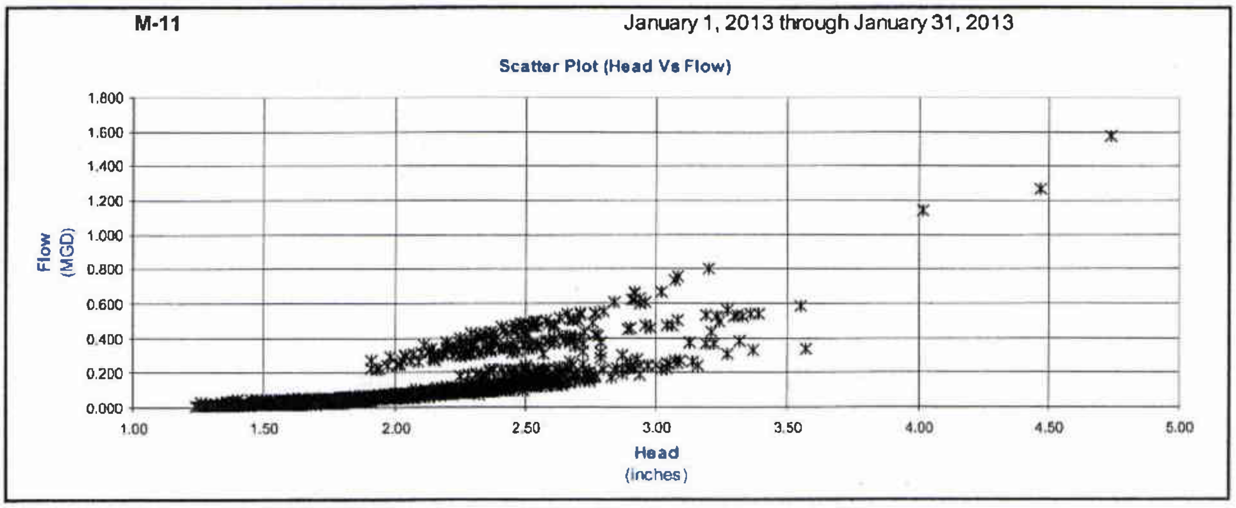




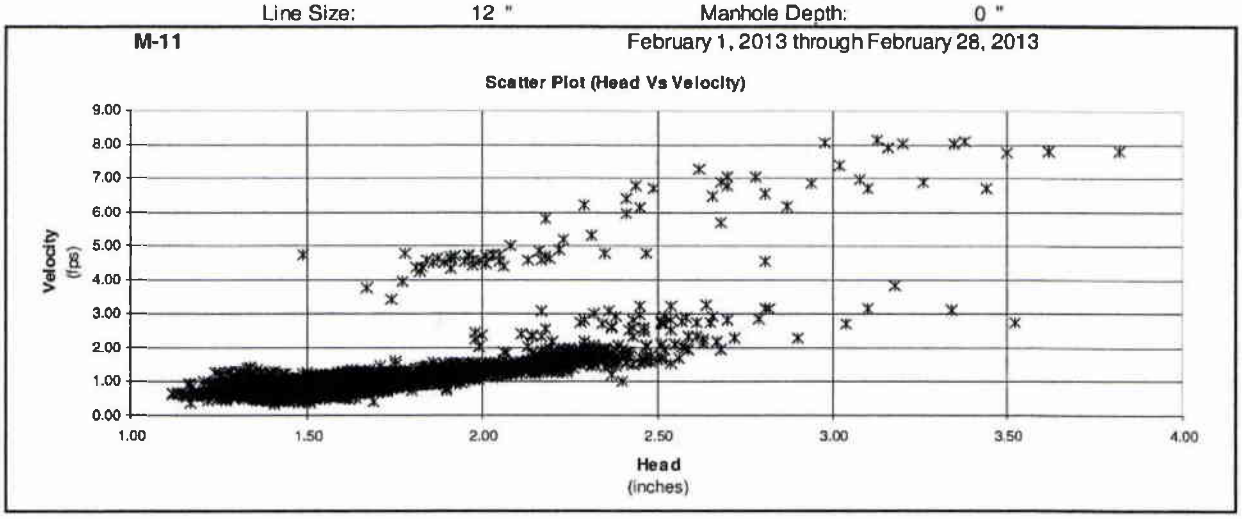
Line Size: 12 " Manhole Depth: 0 "

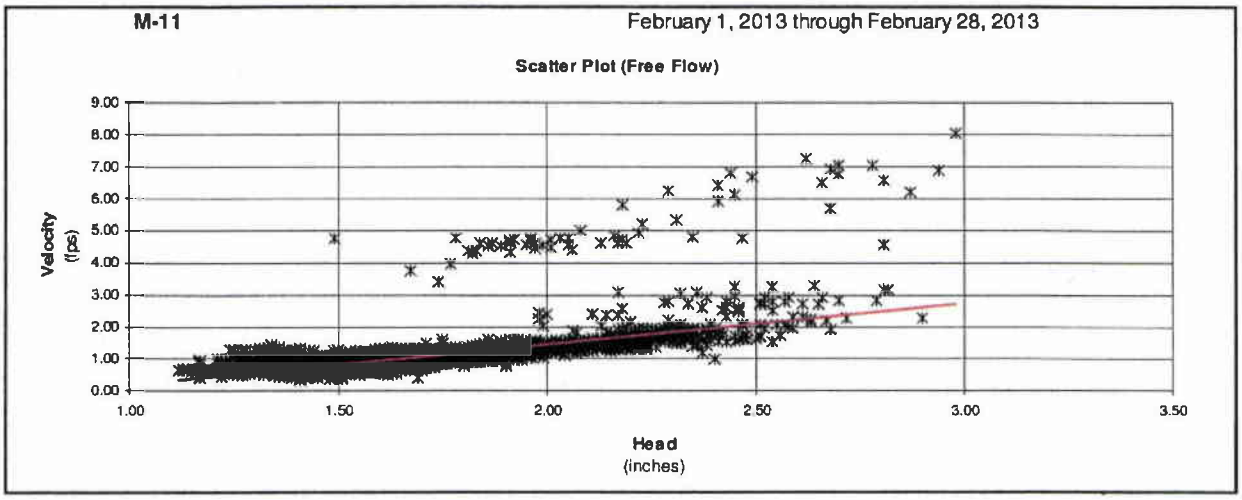


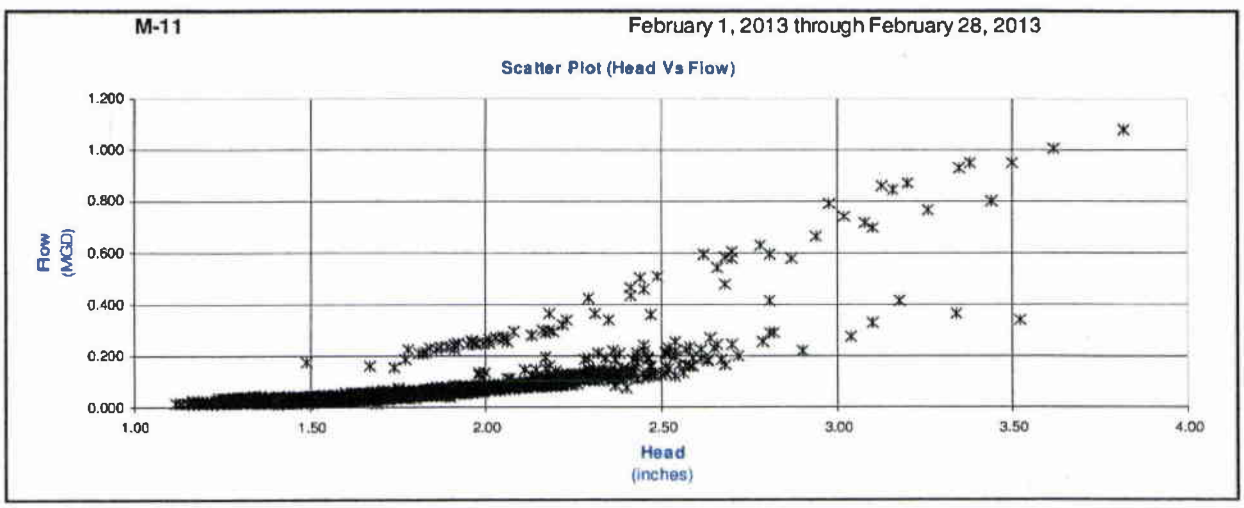




Line Size: 12 " Manhole Depth: 0 "







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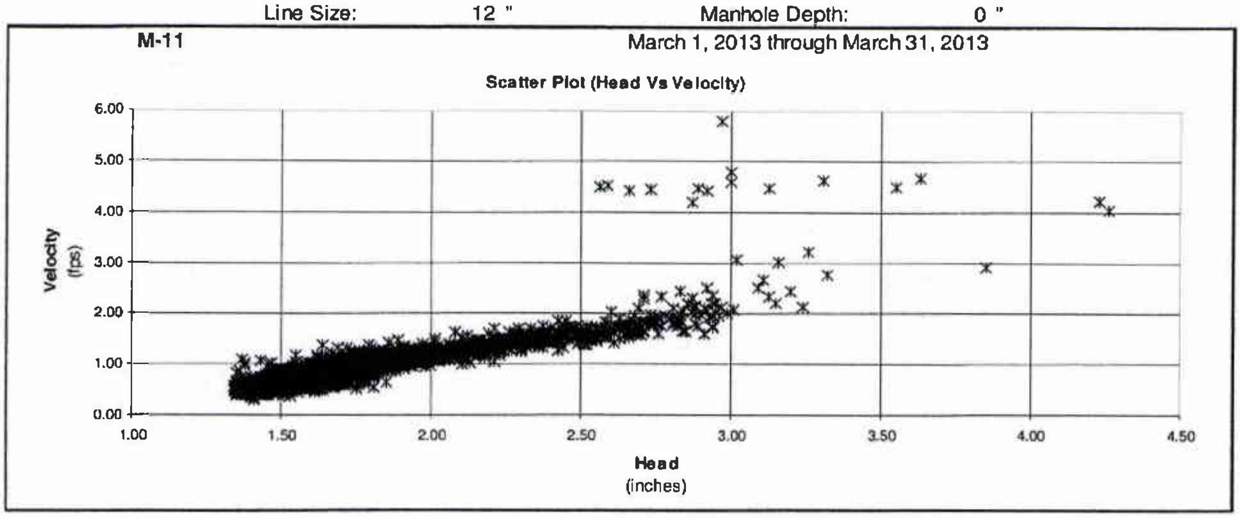
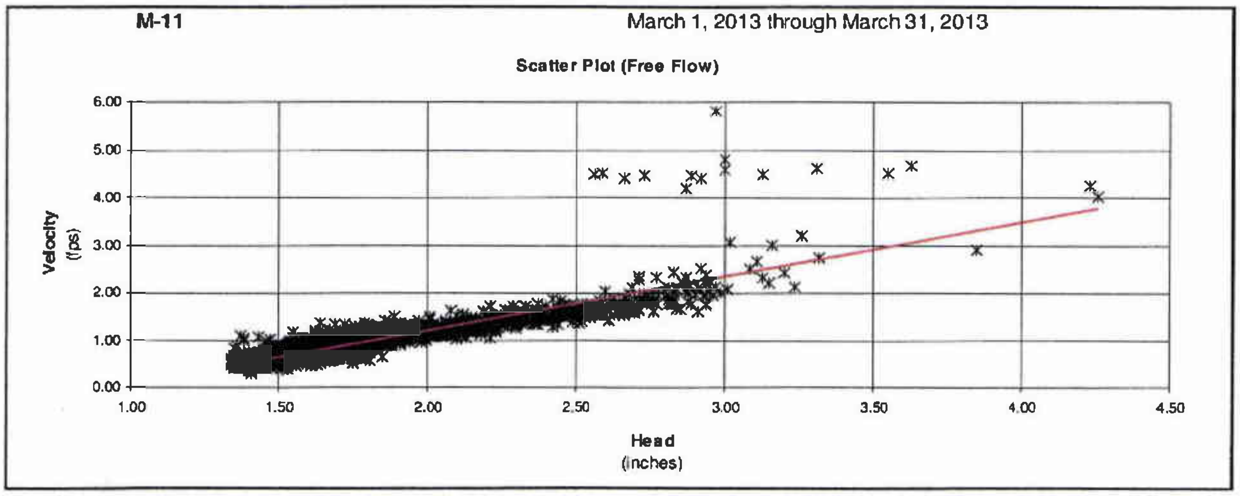
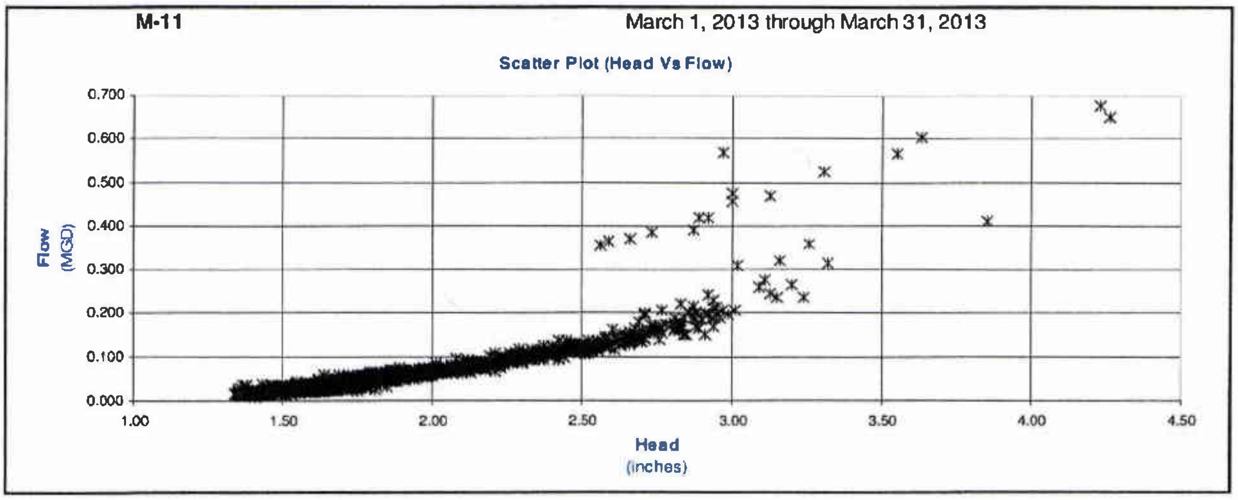
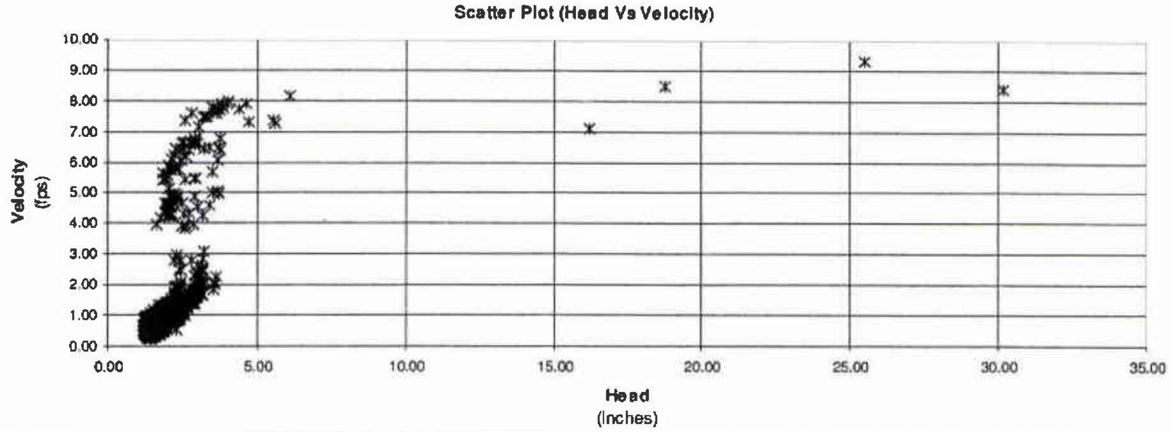




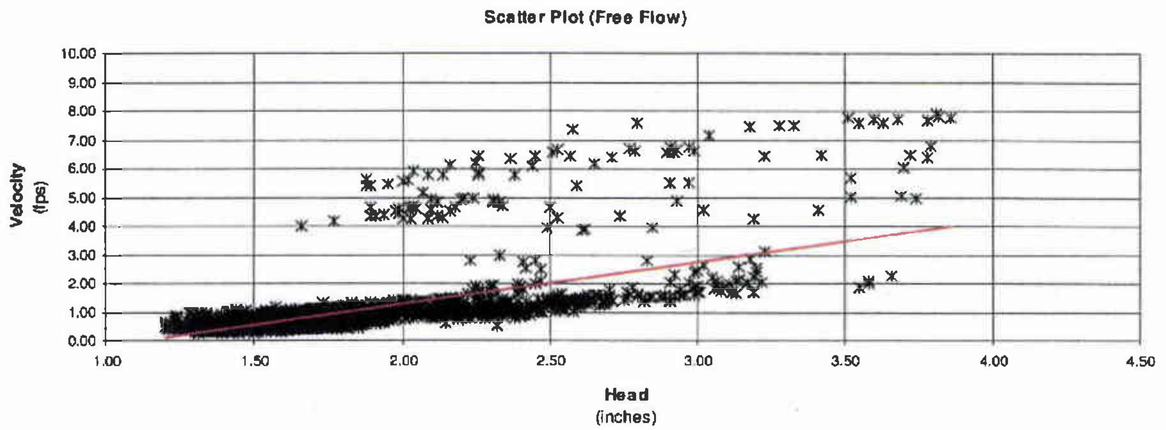


Line Size: 12 " Manhole Depth: 0 "

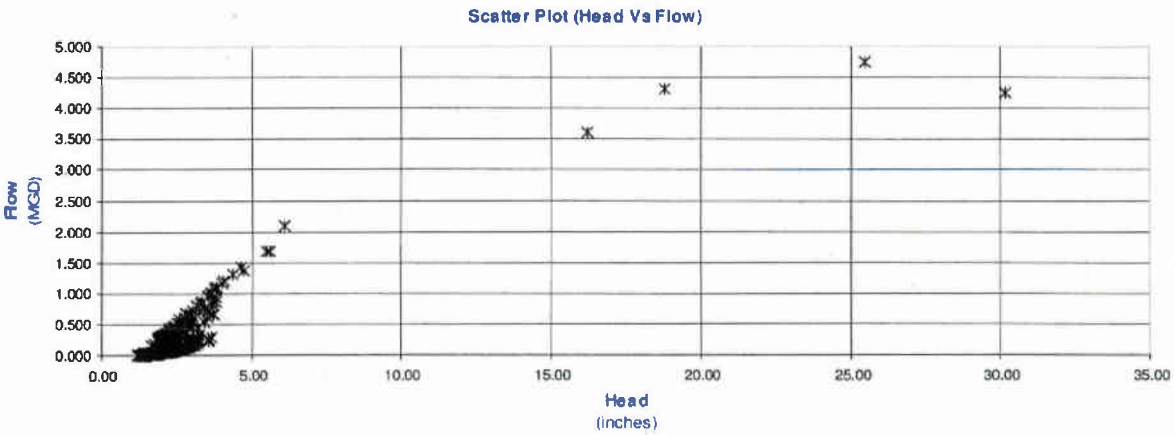
M-11 April 1, 2013 through April 30, 2013



M-11 April 1, 2013 through April 30, 2013

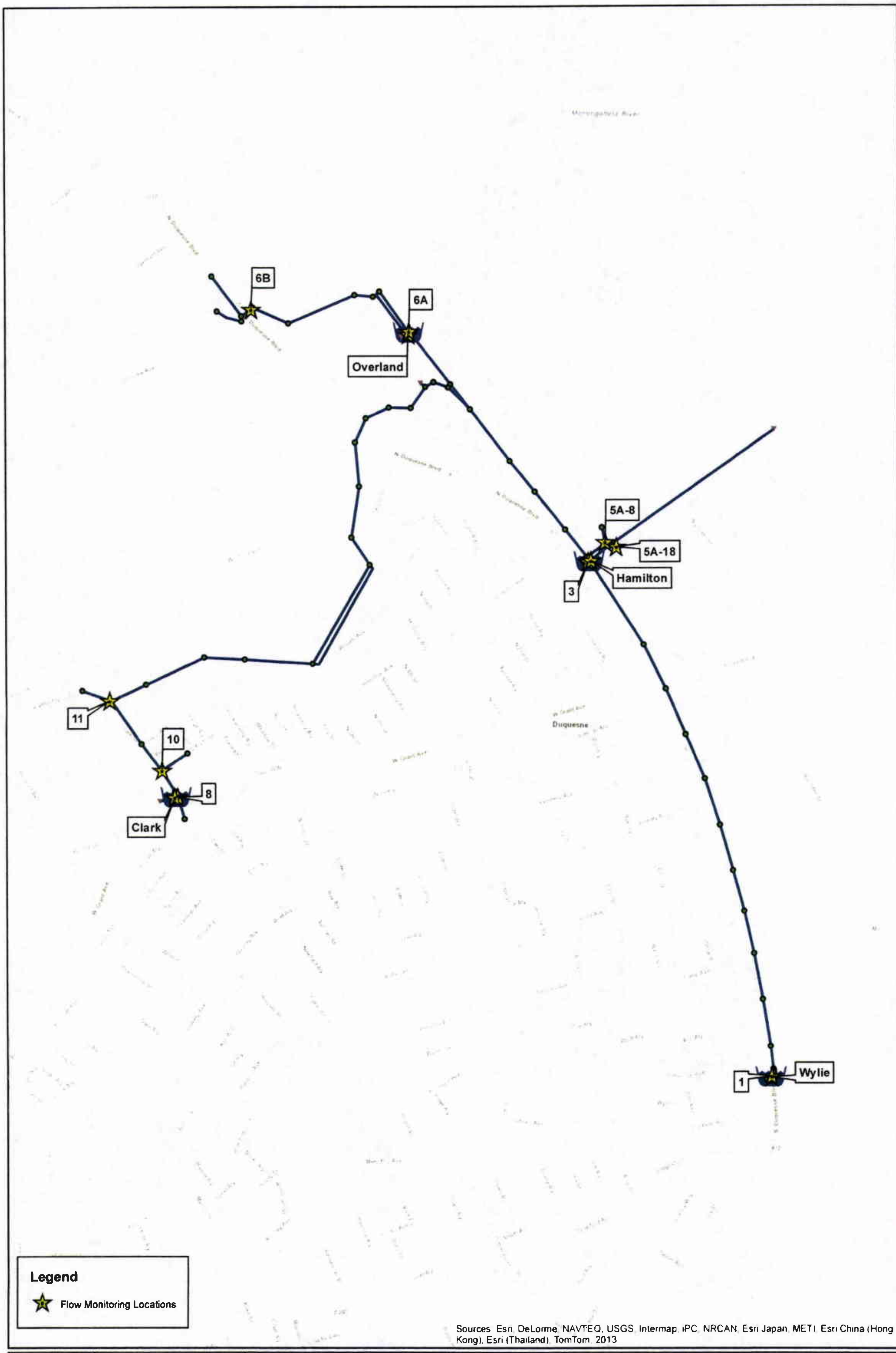


M-11 April 1, 2013 through April 30, 2013



APPENDIX E

DUQUESNE MODEL SYSTEM MAP



220-53	0 400 800 Feet	CITY OF DUQUESNE	KLH ENGINEERS, INC
Exhibit	Date 6/25/2014	ALLEGHENY COUNTY, PENNSYLVANIA MODEL SYSTEM MAP	

Appendix F

Duquesne Model Physical Characteristics (List)

Sewer Pipe

Conduit ID	Length [FT]	Manning N	Upstream Offset [FT]	Downstream Offset [FT]	Avg. Loss Coefficient	Flap Gate	Shape Type	Diameter [FT]	Diameter [in]
DU3107.1M-DU3107M	404.446	0.013	0	0	0.05	No	0: Circular	1.25	15
DU3107M-DU3097M	677.064	0.013	0	0	0.05	No	0: Circular	1.25	15
DU3097M-DU3098M	193.602	0.013	0	0.23	0.05	No	0: Circular	1.25	15
DU3098M-DU7004.1M	304.536	0.013	0	0	0.05	No	0: Circular	1.25	15
DU2630.1M-DU2631M	142.469	0.013	0	0.68	0.05	No	0: Circular	2	24
DU2631M-DU2632M	10.926	0.013	0	0.05	0.05	No	0: Circular	2	24
DU2633M-DU2634M	22.749	0.013	0	0	0.05	No	0: Circular	1	12
DU2632M-DU2635M	98.262	0.013	1	0.61	0.05	No	0: Circular	2	24
DU2634M-DU2632.1M	146.504	0.013	0	0	0.05	No	0: Circular	1	12
DU2632.1M-DU7006M	194.134	0.013	0	0.06	0.05	No	0: Circular	1	12
DU5001M-DU2632.1M	184.802	0.013	0	4.01	0.05	No	0: Circular	0.667	8
DU2597M-DU7004M	180.481	0.013	0	0.64	0.05	No	0: Circular	0.833	10
DU2005M-DU2001M	33.277	0.013	0	0.31	0.05	No	0: Circular	1.5	18
DU2001M-DU2003.1M	8.034	0.013	0	0	0.05	No	0: Circular	1.5	18
DU2003M-DU2002M	8.562	0.013	0.99	0	0.05	No	0: Circular	2	24
DU2002M-DU2834M	134.57	0.013	0.95	0.22	0.05	No	0: Circular	2	24
DU2834M-DU2826M	280.964	0.013	0	0	0.05	No	0: Circular	2	24
DU2826M-DU2815M	276.073	0.013	0	0	0.05	No	0: Circular	2	24
DU2815M-DU2818M	253.784	0.013	0	0	0.05	No	0: Circular	2	24
DU2818M-DU2821M	247.916	0.013	0	0	0.05	No	0: Circular	2	24
DU2821M-DU3206M	281.67	0.013	0	0	0.05	No	0: Circular	2	24
DU3206M-DU3191M	287.806	0.013	0.09	0	0.05	No	0: Circular	2	24
DU3191M-DU3184M	285.165	0.013	0.29	0.11	0.05	No	0: Circular	2	24
DU3184M-DU3177M	292.981	0.013	0	0	0.05	No	0: Circular	2	24
DU3177M-DU3168M	289.641	0.013	0.09	0	0.05	No	0: Circular	2	24
DU1010M-DU1004M	385.645	0.013	0	0.16	0.05	No	0: Circular	2	24
DU1004M-DU1002M	184.942	0.013	0	0.37	0.05	No	0: Circular	2	24
DU1003M-DU1002M	22.244	0.013	0	0	0.05	No	0: Circular	1.25	15
DU1004M-DU1003M	188.332	0.013	0	0.26	0.05	No	0: Circular	1.25	15
DU1002M-DU1001M	90.628	0.013	0	0	0.05	No	0: Circular	2	24
DU1001M-DU7001M	54.73	0.013	0	0.19	0.05	No	0: Circular	2.25	27
DU7001.1M-DU7001M	153.015	0.013	0	1.73	0.05	No	0: Circular	1.25	15
DU3155M-DU3156M	29.396	0.013	0	0	0.05	No	0: Circular	2	24
DU7006M-DU7004M	312.329	0.013	0	0.19	0.05	No	0: Circular	1	12
DU7004M-DU5013M	229.189	0.013	0	0	0.05	No	0: Circular	1	12
DU5013M-DU3107.2M	379.103	0.013	0	0	0.05	No	0: Circular	1	12
DU6029M-DU6028M	60.75	0.013	0.09	0.14	0.05	No	0: Circular	1.5	18
DU6025M-DU6028M	93.83	0.013	0	0.37	0.05	No	0: Circular	0.5	6
DU3168M-DU3156M	618.144	0.013	0.02	0	0.05	No	0: Circular	2	24
DU3157M-DU3158M	28.557	0.013	0	0.21	0.05	No	0: Circular	2	24
DU6028M-DU3156M	134.748	0.013	0	0	0.05	No	0: Circular	2	24
CSO4-DU1003M	393.575	0.013	0	0	0.05	No	0: Circular	1.25	15
DU-3107.2M-DU3107.1M	239.012	0.013	0	0	0.05	No	0: Circular	1.25	15
DU7004.1M-DU7003M	259.859	0.013	0	0	0.05	No	0: Circular	1.25	15
DU7003M-DU7002M	155.957	0.013	0	0	0.05	No	0: Circular	1.25	15
DU7002M-DU7001.2M	151.969	0.013	0	0	0.05	No	0: Circular	1.25	15
DU7001.2M-DU7001.1M	128.784	0.013	0	0	0.05	No	0: Circular	1.25	15
DU1013M-DU1010M	232.082	0.013	0	0	0.05	No	0: Circular	2	24
DU1016M-DU1013M	290.065	0.013	0	0	0.05	No	0: Circular	2	24
DU3158M-CSO3	8.298	0.013	0	1.25	0.05	No	0: Circular	2	24
CSO3-DU3155M	18.312	0.013	0	0.21	0.05	No	0: Circular	2	24
DU3156M-DU1016M	202.8	0.013	0	0	0.05	No	0: Circular	2	24
DU6177S-DU3157M	144.734	0.013	0.85	0	0.05	No	0: Circular	5.583	67
CSO_OVERFLOW	16.068	0.013	0.9	0	0.05	No	0: Circular	1.25	15
DU4006.1M-DU4006M	159.788	0.013	0	0.2	0.05	No	0: Circular	0.667	8
DU4006M-DU4033M	28.597	0.013	0	0.5	0.05	No	0: Circular	1	12
DU4037MDU4033M	295.539	0.013	2.29	4.64	0.05	No	0: Circular	0.833	10
DU4033M-DU4004M	83.84	0.013	0	0	0.05	No	0: Circular	1.5	18
DU4004M-DU4003M	229.718	0.013	0.05	0.08	0.05	No	0: Circular	1.5	18
DU4003M-DU4002.1	426.975	0.013	0	0.38	0.05	No	0: Circular	2	24
DU4002.1M-DU4299M	110.782	0.013	0	0	0.05	No	0: Circular	1.25	15
DU4299M-DU4298M	49.195	0.013	0.15	0.4	0.05	No	0: Circular	1.25	15
DU4298M-DU4001M	301.049	0.013	0	1.1	0.05	No	0: Circular	1.25	15
TO_WWTP	38.873	0.013	0	0	0.05	No	0: Circular	2.25	27
DU2006M-DU2005M	27.376	0.013			0.05	No	0: Circular	1.5	18
DU6177S-CSO3OUTFALL	1,199.59	0.013			0.05	No	0: Circular	2	24
CDT-67	6.427	0.013	0	0	0.05	No	0: Circular	1	12
BYPASS1	714.632	0.013			0.05	No	0: Circular	1.25	15
BYPASS2	308.65	0.013		1.1	0.05	No	0: Circular	1.25	15

Manholes

Junction ID	Invert Elevation [FT]	Rim Elevation [FT]	Surcharge Depth [FT]
DU6028M	741.772	759.162	0
DU3168M	744.744	763.324	0
DU3177M	744.802	763.142	0
DU3191M	745.526	767.436	0
CSO-4	751.7	760.443	0
DU3184M	745.193	765.493	0
DU3206M	745.91	769.68	0
DU2821M	746.452	771.842	0
DU2818M	746.604	773.724	0
DU2815M	747.091	774.841	0
DU2826M	747.385	771.829	0
DU2834M	747.685	767.065	0
DU2002M	747.174	764.644	0
DU2003M	747.117	764.607	0
DU2003.1M	747.331	764.571	0
DU2001M	747.911	764.451	0
DU6177S	738.262	759.582	0
DU6029M	744.121	761.471	0
DU3155M	741.098	771.048	0
CSO-3	741.058	770.958	0
DU3158M	742.02	770.892	0
DU3156M	741.095	771	0
DU1016M	739.793	779.103	50
DU1013M	739.45	784.55	0
DU1010M	739.003	766.283	0
DU1004M	738.21	758.237	0
DU1003M	738.01	755.771	0
DU1002M	737.86	745.85	0
DU1001M	737.77	744.67	0
DU7001M	737.43	744.93	0
DU7003M	794	804.07	0
DU3098M	813.618	823.62	0
DU3097M	814.902	822.992	0
DU3107M	816.551	826.651	50
DU5013M	887.802	914.972	0
DU2597M	900.876	918.356	50
DU7004M	896.082	915.802	0
DU7006M	898.125	909.385	0
DU5001M	904.191	916.161	0
DU2632.1M	898.237	911.887	0
DU2634M	898.291	913.501	0
DU2633M	898.307	911.807	0
DU2631M	899.006	913.056	0
DU2630.1M	903.042	915.042	0
DU7002M	791	801.18	0
DU3107.2M	844.977	854.977	0
DU3107.1M	817.972	826.691	50
DU7004.1M	805	815.33	0
DU7001.1M	747	757.26	0
DU7001.2M	749	759.49	0
DU6025M	742.56	758.56	50
DU4299M	758.114	763.234	50
DU4298M	754.563	761.313	50
DU4037M	846.398	862.238	0
DU4033M	838.446	856.886	0
DU4006M	840.084	856.944	0
DU4006.1M	859.088	867.348	0
DU4004M	835.573	855.553	0
DU4003M	806.596	814.076	0
DU4002.1M	801.901	814.181	0
DU2006M	752.289	762.8	0
JCT-38	898.35	911.8	0

Outfalls

Outfall ID	Type	Invert Elevation [FT]
CSO2	0: Free	723.91
WWTP	0: Free	730
JCT-20	0: Free	735
CSO3-OUTFALL	0: Free	727.16
DU2635M		889.607

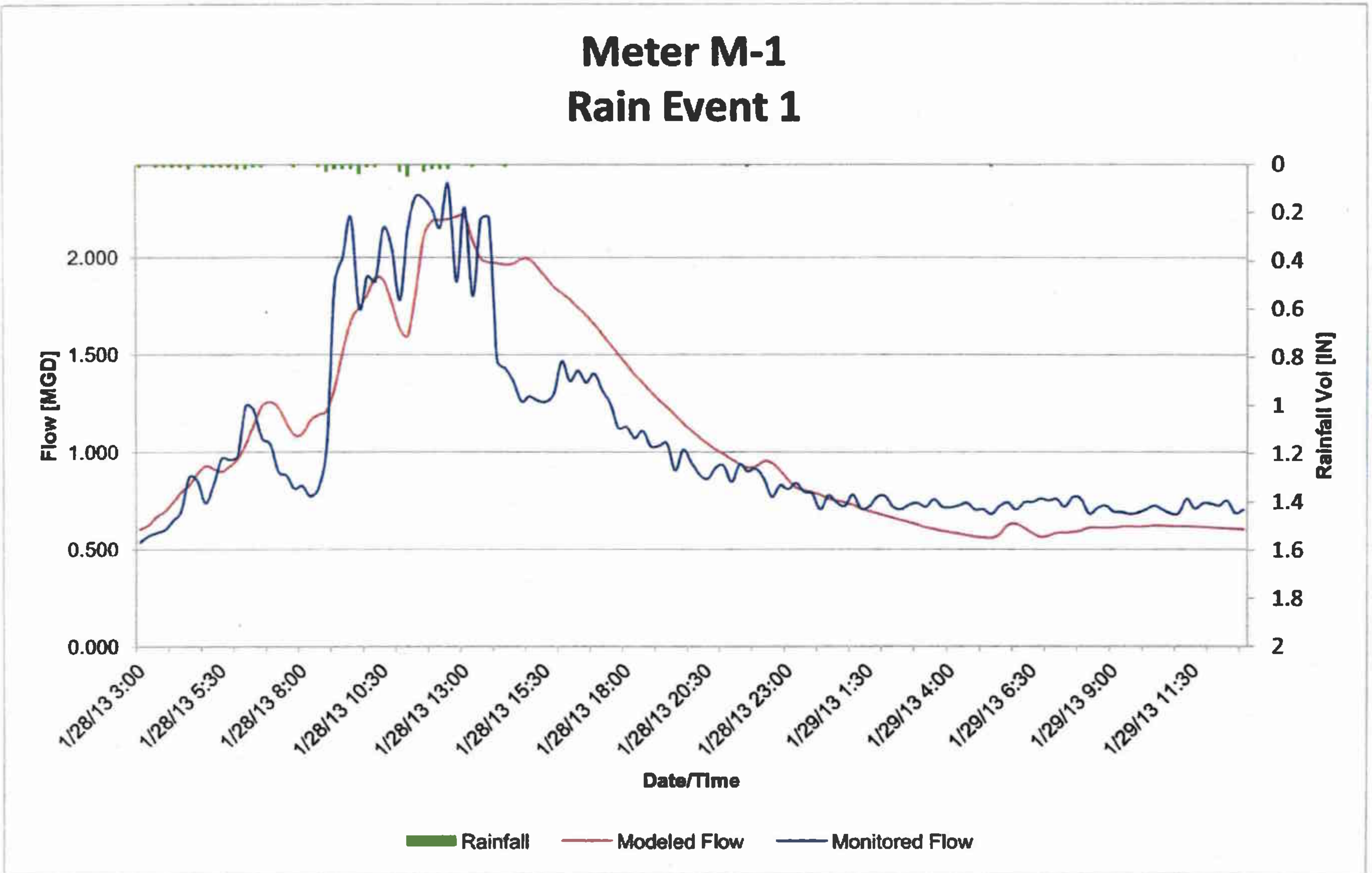
CSOs

Storage ID	Invert Elevation [FT]	Maximum Depth [FT]	Shape Type	Shape Curve ID
DU3157M	742.298	28.79	1: Tabular	HAMILTON_CHAMBER
DU2005M	750.314	15	1: Tabular	WYLIE_CHAMBER
DU4001M	751.716	6.93	0: Functional	OVERLAND_CHAMBER
DU2632M	898.8	6	1: Tabular	CLARK_CHAMBER

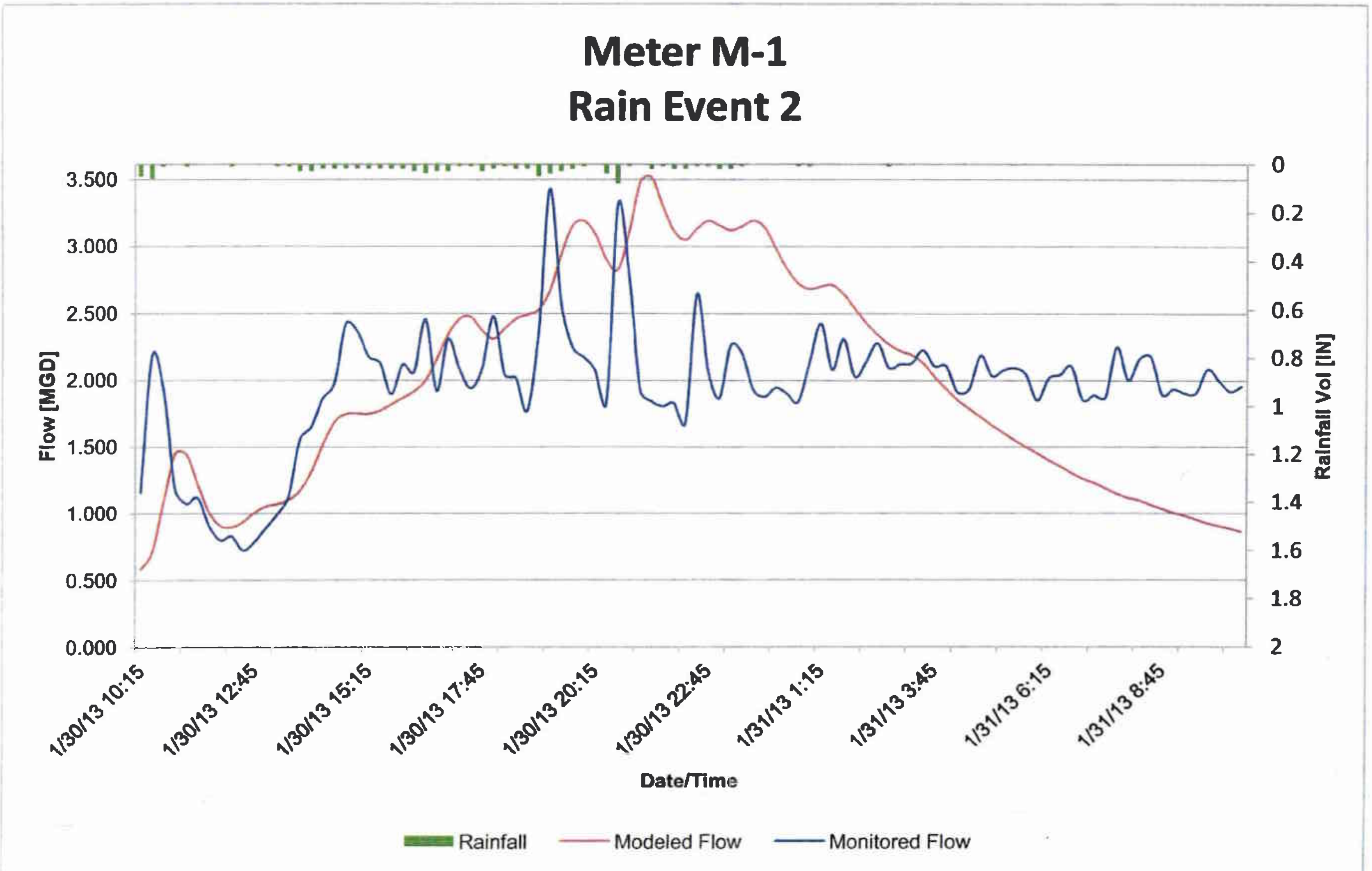
APPENDIX G

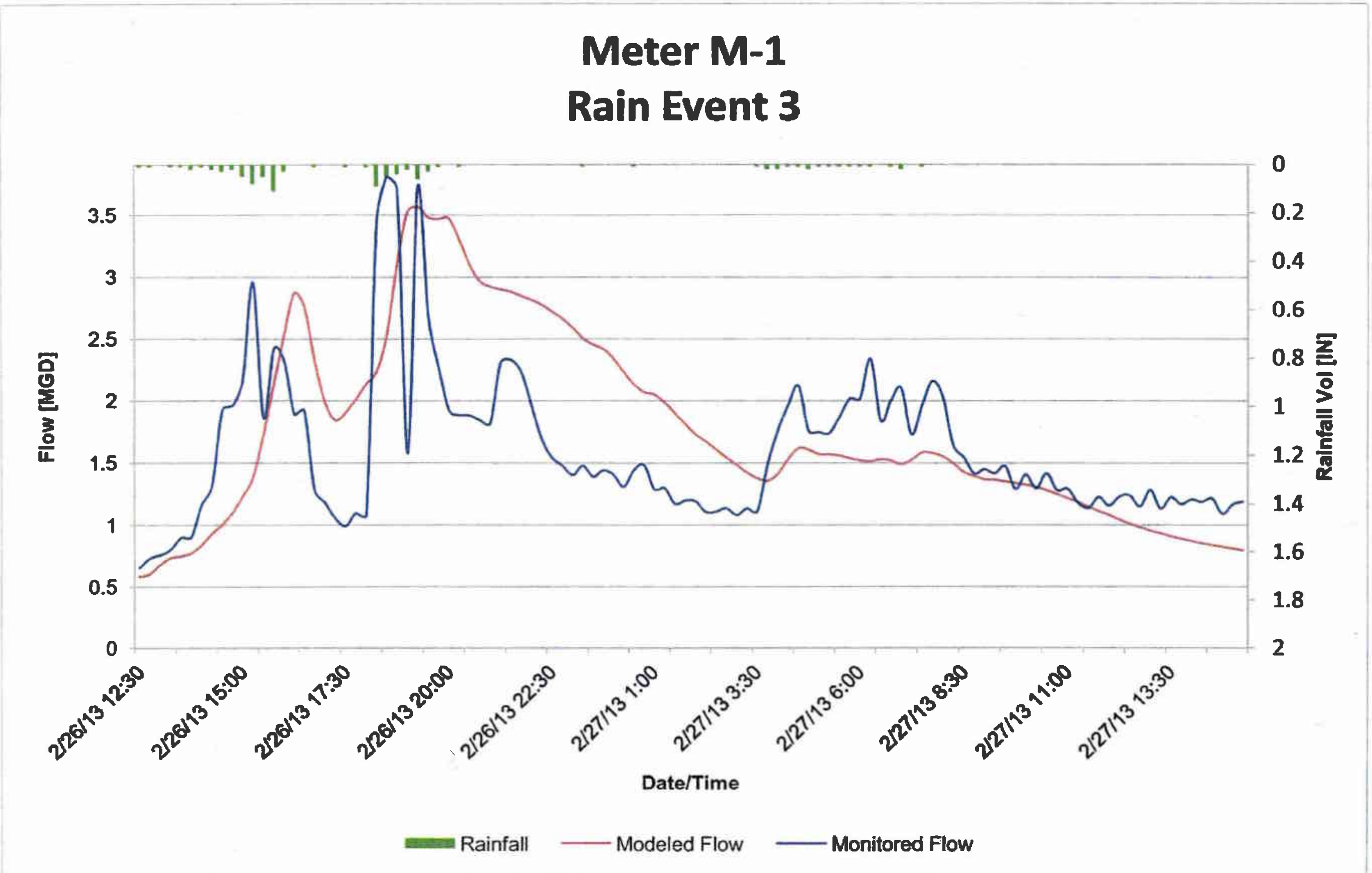
MONITORED VS. MODELED HYDROGRAPHS

M-1 SUMMER MODEL RAIN EVENTS													
No.	Start Date	End Date	Total Rain	Max Int	Peak MOD Flow	Peak MON Flow	% Difference		Modeled Volume	Monitored Volume	% Difference	
1	1/28/13 3:00	1/28/13 20:00	0.53	0.20	2.21	2.38	6.96%	Mod LOW	0.687	0.678	1.27%	Mod HIGH
2	1/30/13 10:15	1/31/13 8:30	1.08	0.32	3.52	3.43	2.37%	Mod HIGH	1.424	1.238	13.06%	Mod HIGH
3	2/26/13 12:30	2/27/13 13:15	1.01	0.44	3.57	3.81	6.38%	Mod LOW	1.169	1.108	5.23%	Mod HIGH
4	3/25/13 15:15	3/26/13 6:30	0.77	0.44	3.08	1.98	35.53%	Mod HIGH	0.950	0.457	51.86%	Mod HIGH
5	4/10/13 15:45	4/11/13 5:30	0.58	0.88	3.47	2.44	29.59%	Mod HIGH	0.368	0.240	34.81%	Mod HIGH
6	4/16/13 20:00	4/17/13 4:45	1.13	2.40	7.17	4.32	39.76%	Mod HIGH	0.615	0.416	32.41%	Mod HIGH
7	5/22/13 23:15	5/23/13 14:30	0.52	0.72	3.576	3.589	0.35%	Mod LOW	0.475	0.295	37.89%	Mod HIGH

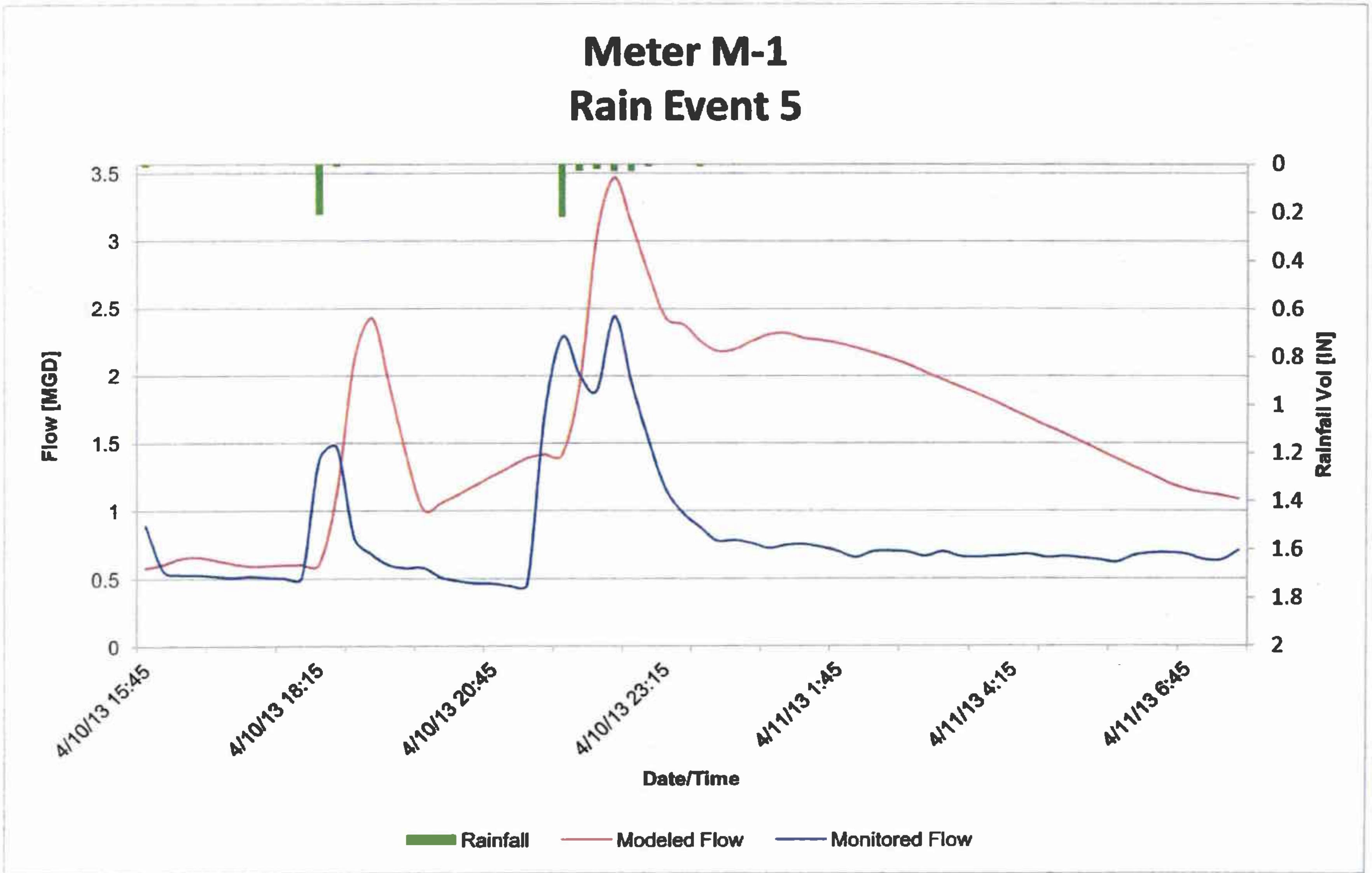


Meter M-1
Rain Event 1
Flow [MGD]
2.000
1.500
1.000
0.500
0.000
Rainfall Vol [IN]
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
1/28/13 3:00
1/28/13 5:30
1/28/13 8:00
1/28/13 10:30
1/28/13 13:00
1/28/13 15:30
1/28/13 18:00
1/28/13 20:30
1/28/13 23:00
1/29/13 1:30
1/29/13 4:00
1/29/13 6:30
1/29/13 9:00
1/29/13 11:30
Date/Time
Rainfall
Modeled Flow
Monitored Flow

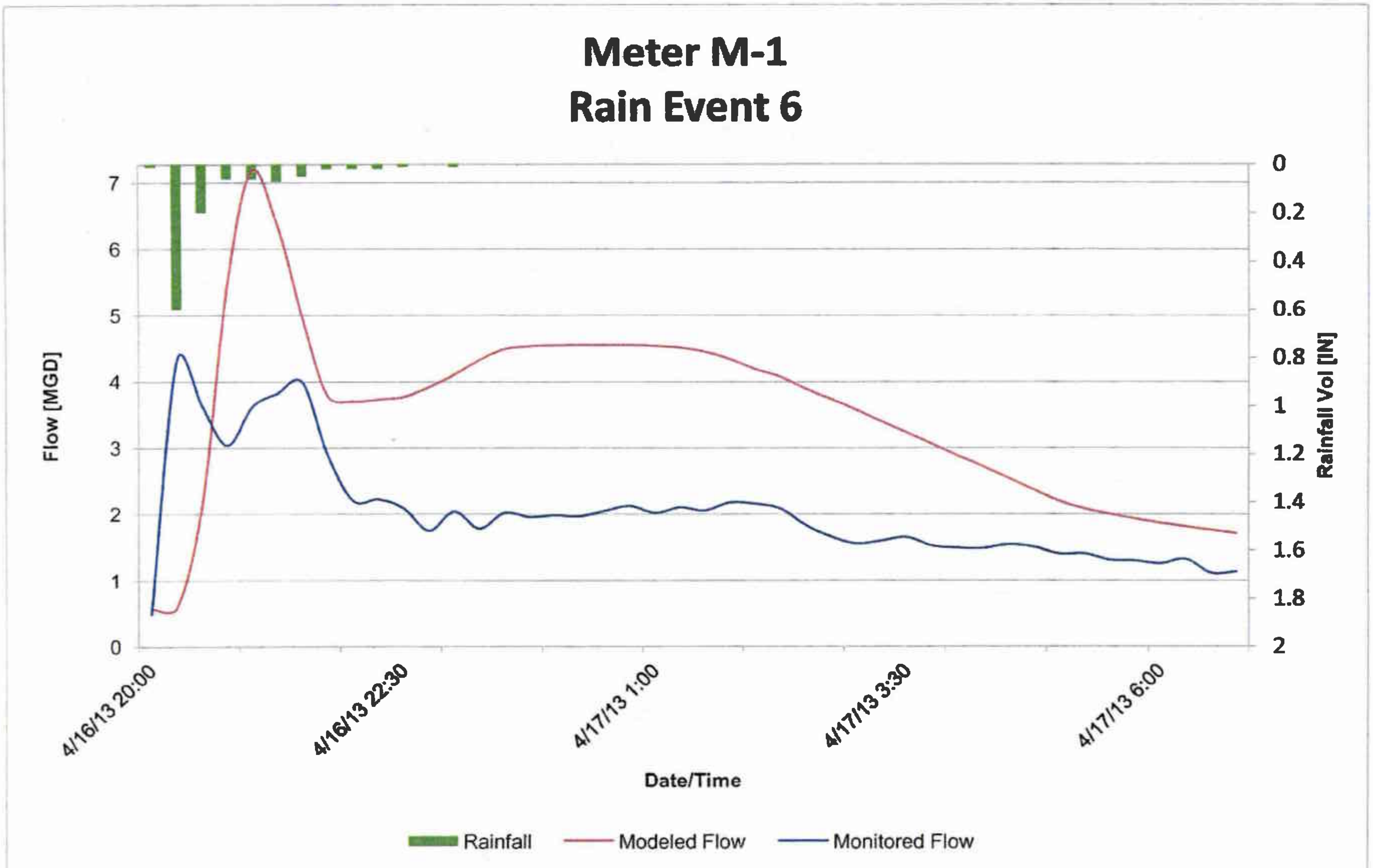

Meter M-1
Rain Event 2
Flow [MGD]
3.500
3.000
2.500
2.000
1.500
1.000
0.500
0.000
Rainfall Vol [IN]
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
1/30/13 10:15
1/30/13 12:45
1/30/13 15:15
1/30/13 17:45
1/30/13 20:15
1/30/13 22:45
1/31/13 1:15
1/31/13 3:45
1/31/13 6:15
1/31/13 8:45
Date/Time
Rainfall
Modeled Flow
Monitored Flow

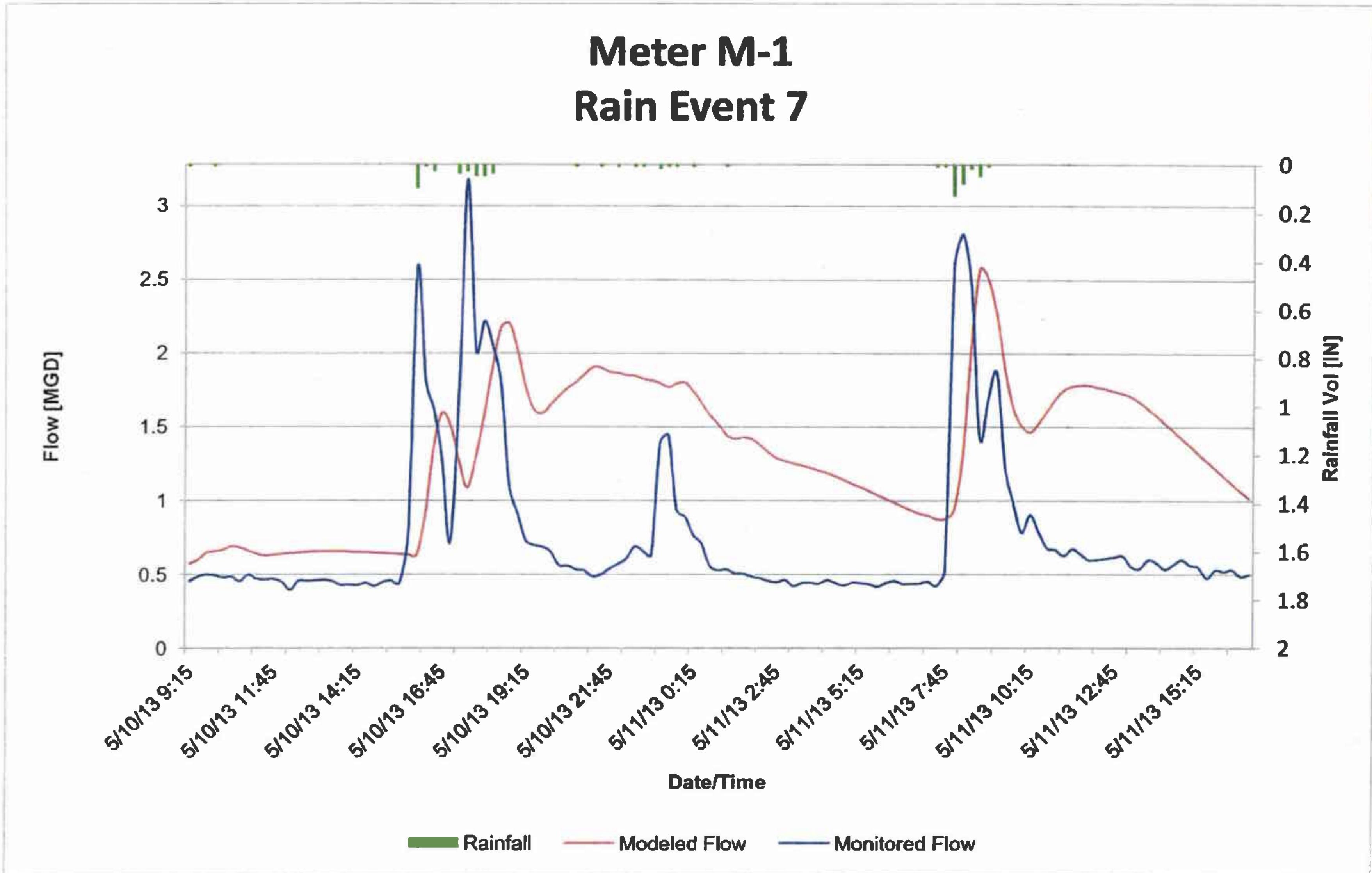


Meter M-1
Rain Event 3
Flow [MGD]
0
0.5
1
1.5
2
2.5
3
3.5
Rainfall Vol [IN]
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
2/26/13 12:30
2/26/13 15:00
2/26/13 17:30
2/26/13 20:00
2/26/13 22:30
2/27/13 1:00
2/27/13 3:30
2/27/13 6:00
2/27/13 8:30
2/27/13 11:00
2/27/13 13:30
Date/Time
Rainfall
Modeled Flow
Monitored Flow

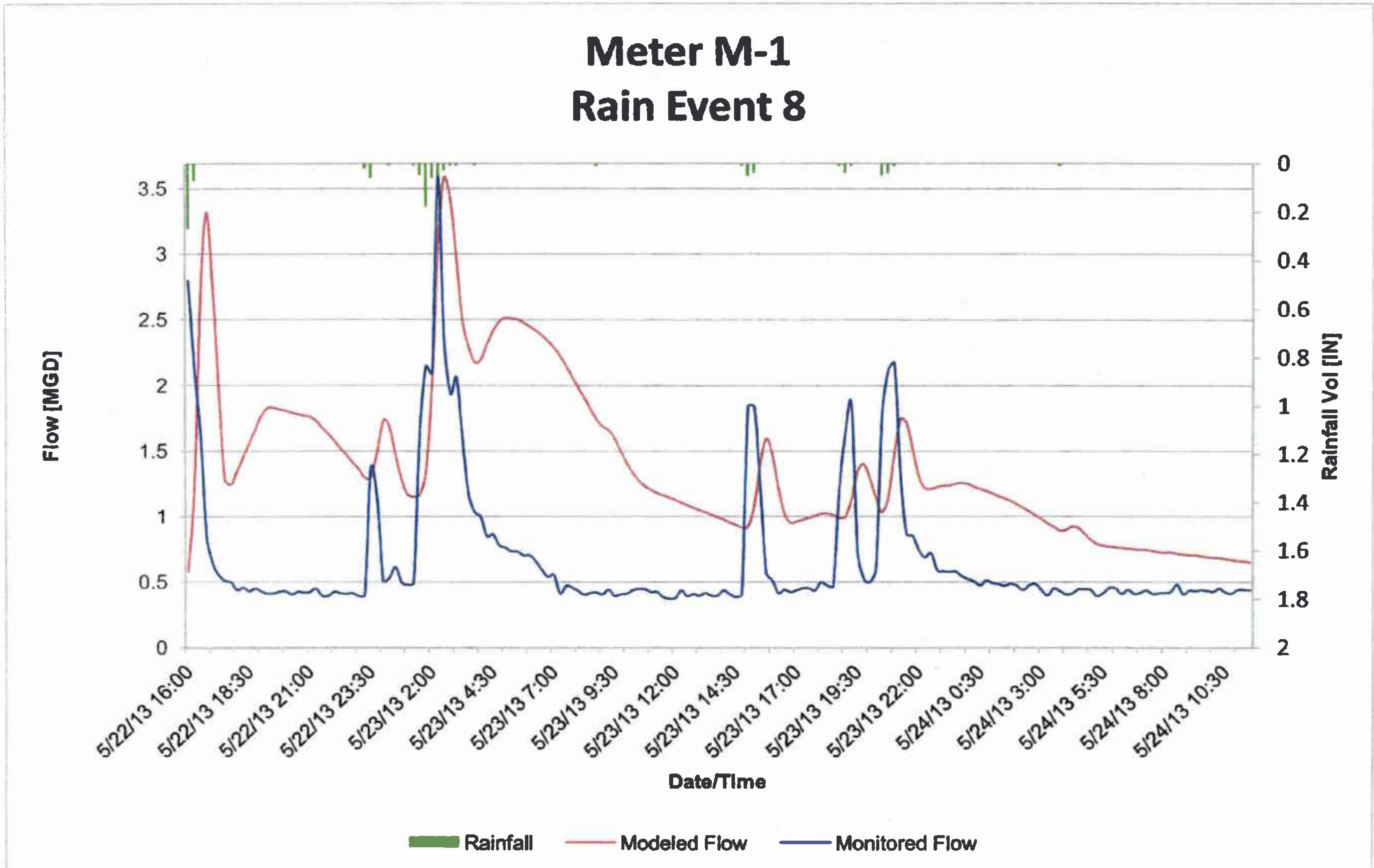


Meter M-1
Rain Event 5
3.5
3
2.5
2
1.5
1
0.5
0
Flow [MGD]
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
Rainfall Vol [IN]
4/10/13 15:45
4/10/13 18:15
4/10/13 20:45
4/10/13 23:15
4/11/13 1:45
4/11/13 4:15
4/11/13 6:45
Date/Time
Rainfall
Modeled Flow
Monitored Flow


Meter M-1
Rain Event 6
Flow [MGD]
0
1
2
3
4
5
6
7
Rainfall Vol [IN]
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
4/16/13 20:00
4/16/13 22:30
4/17/13 1:00
4/17/13 3:30
4/17/13 6:00
Date/Time
Rainfall
Modeled Flow
Monitored Flow

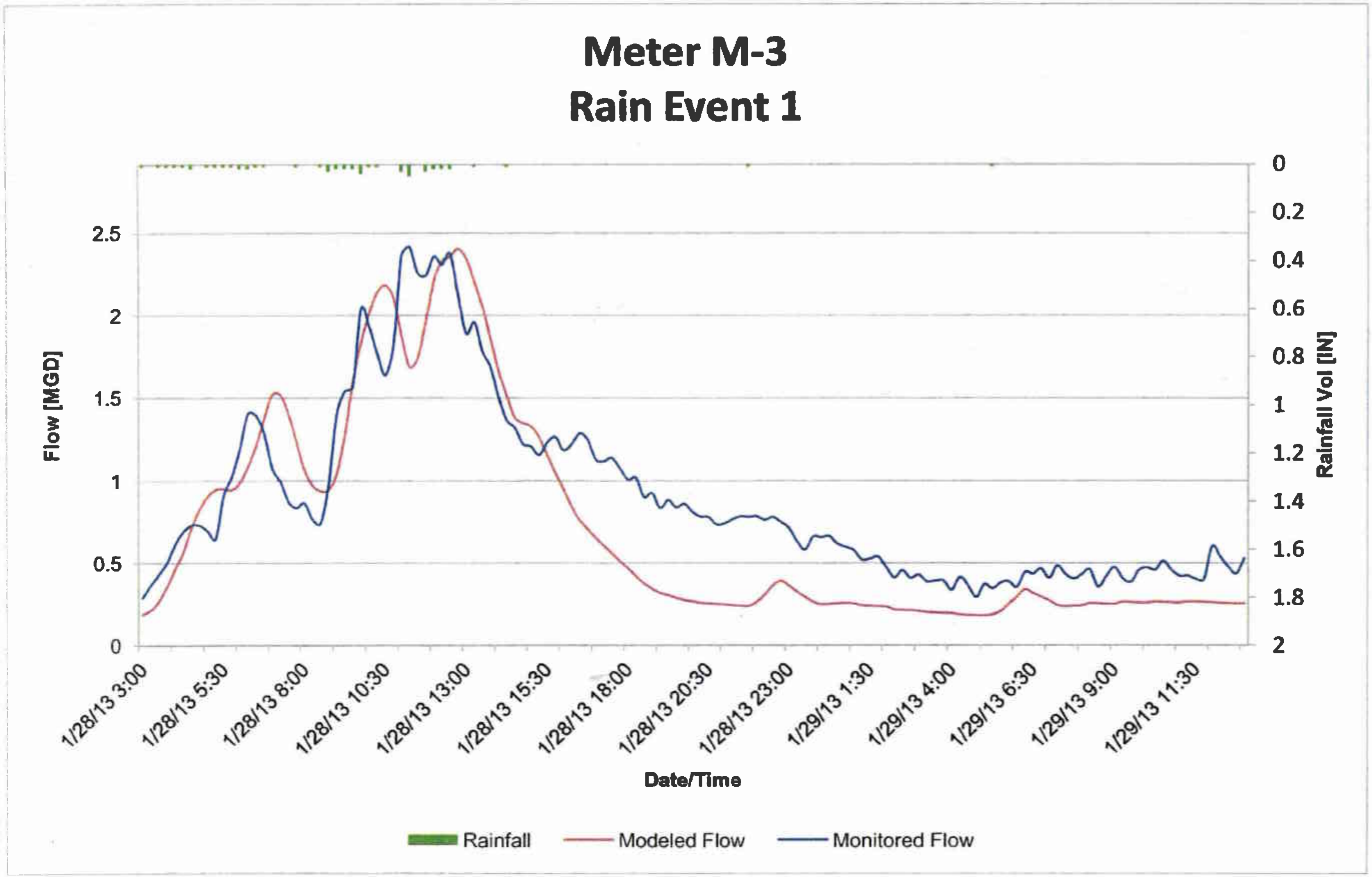


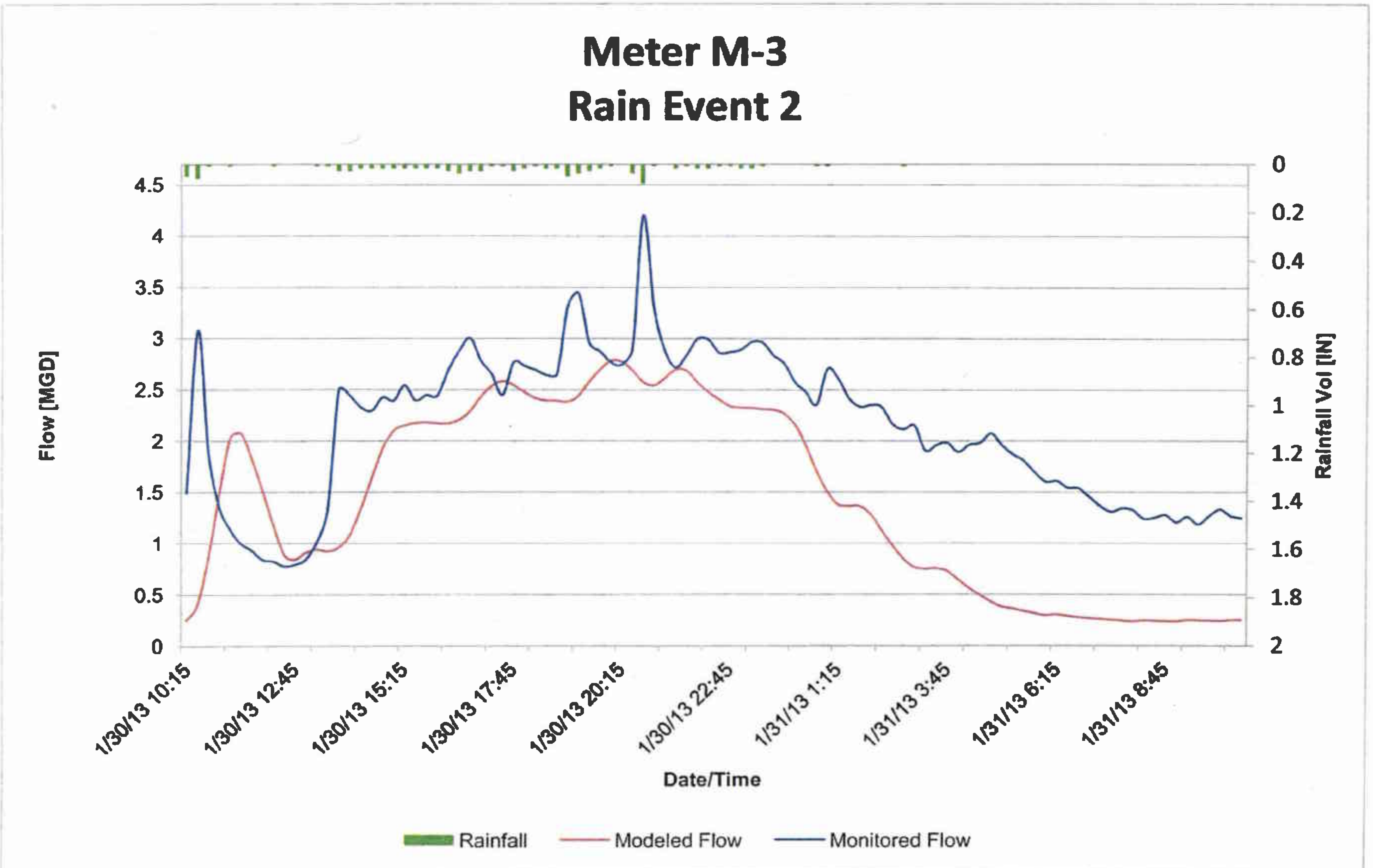
Meter M-1
Rain Event 7
Flow [MGD]
Rainfall Vol [IN]
0
0.5
1
1.5
2
2.5
3
0.2
0.4
0.6
0.8
1.2
1.4
1.6
1.8
5/10/13 9:15
5/10/13 11:45
5/10/13 14:15
5/10/13 16:45
5/10/13 19:15
5/10/13 21:45
5/11/13 0:15
5/11/13 2:45
5/11/13 5:15
5/11/13 7:45
5/11/13 10:15
5/11/13 12:45
5/11/13 15:15
Date/Time
Rainfall
Modeled Flow
Monitored Flow

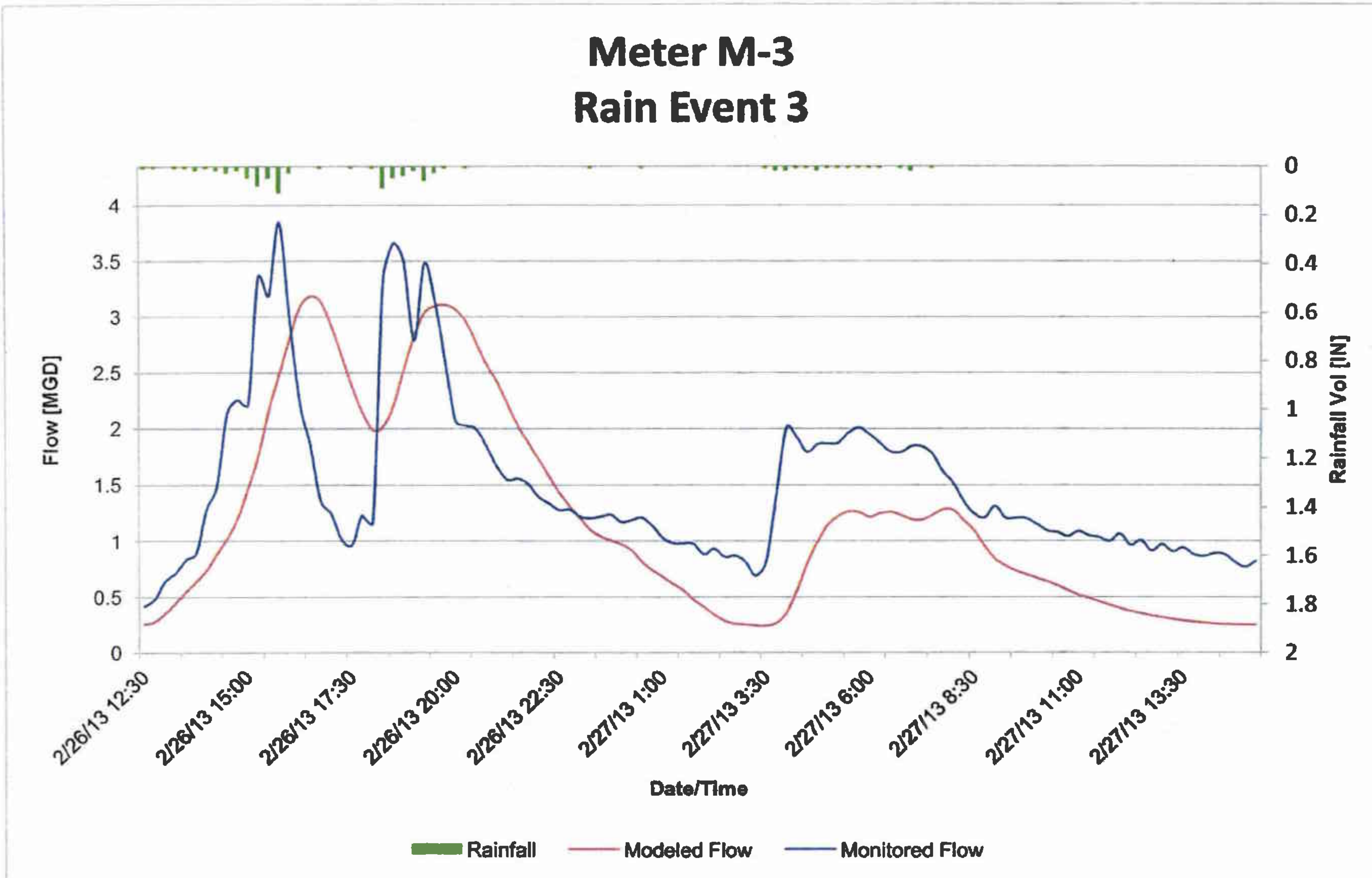

Meter M-1
Rain Event 8
Flow [MGD]
Rainfall Vol [IN]
Date/Time
0
0.5
1
1.5
2
2.5
3
3.5
0.2
0.4
0.6
0.8
1.2
1.4
1.6
1.8
5/22/13 16:00
5/22/13 18:30
5/22/13 21:00
5/22/13 23:30
5/23/13 2:00
5/23/13 4:30
5/23/13 7:00
5/23/13 9:30
5/23/13 12:00
5/23/13 14:30
5/23/13 17:00
5/23/13 19:30
5/23/13 22:00
5/24/13 0:30
5/24/13 3:00
5/24/13 5:30
5/24/13 8:00
5/24/13 10:30
Rainfall
Modeled Flow
Monitored Flow

M-3
SUMMER MODEL
RAIN EVENTS

No.	Start Date	End Date	Total Rain	Max Int	Peak MOD Flow	Peak MON Flow	% Difference		Modeled Volume	Monitored Volume	% Difference	
1	1/28/13 3:00	1/28/13 20:00	0.53	0.20	2.41	2.42	0.54%	Mod LOW	0.664	0.651	1.86%	Mod HIGH
2	1/30/13 10:15	1/31/13 8:30	1.08	0.32	2.78	4.20	33.77%	Mod LOW	1.238	1.554	20.29%	Mod LOW
3	2/26/13 12:30	2/27/13 13:15	1.01	0.44	3.19	3.85	17.18%	Mod LOW	0.972	1.133	14.15%	Mod LOW
4	3/25/13 15:15	3/26/13 6:30	0.77	0.44	3.25	1.90	41.72%	Mod HIGH	0.753	0.558	25.98%	Mod HIGH
5	4/10/13 15:45	4/11/13 5:30	0.58	0.88	3.22	4.24	24.10%	Mod LOW	0.339	0.274	19.20%	Mod HIGH
6	4/16/13 20:00	4/17/13 4:45	1.13	2.40	4.35	5.71	23.78%	Mod LOW	0.507	0.446	11.99%	Mod HIGH
7	5/22/13 23:15	5/23/13 14:30	0.52	0.72	3.21	4.127	22.22%	Mod LOW	0.371	0.339	8.72%	Mod HIGH

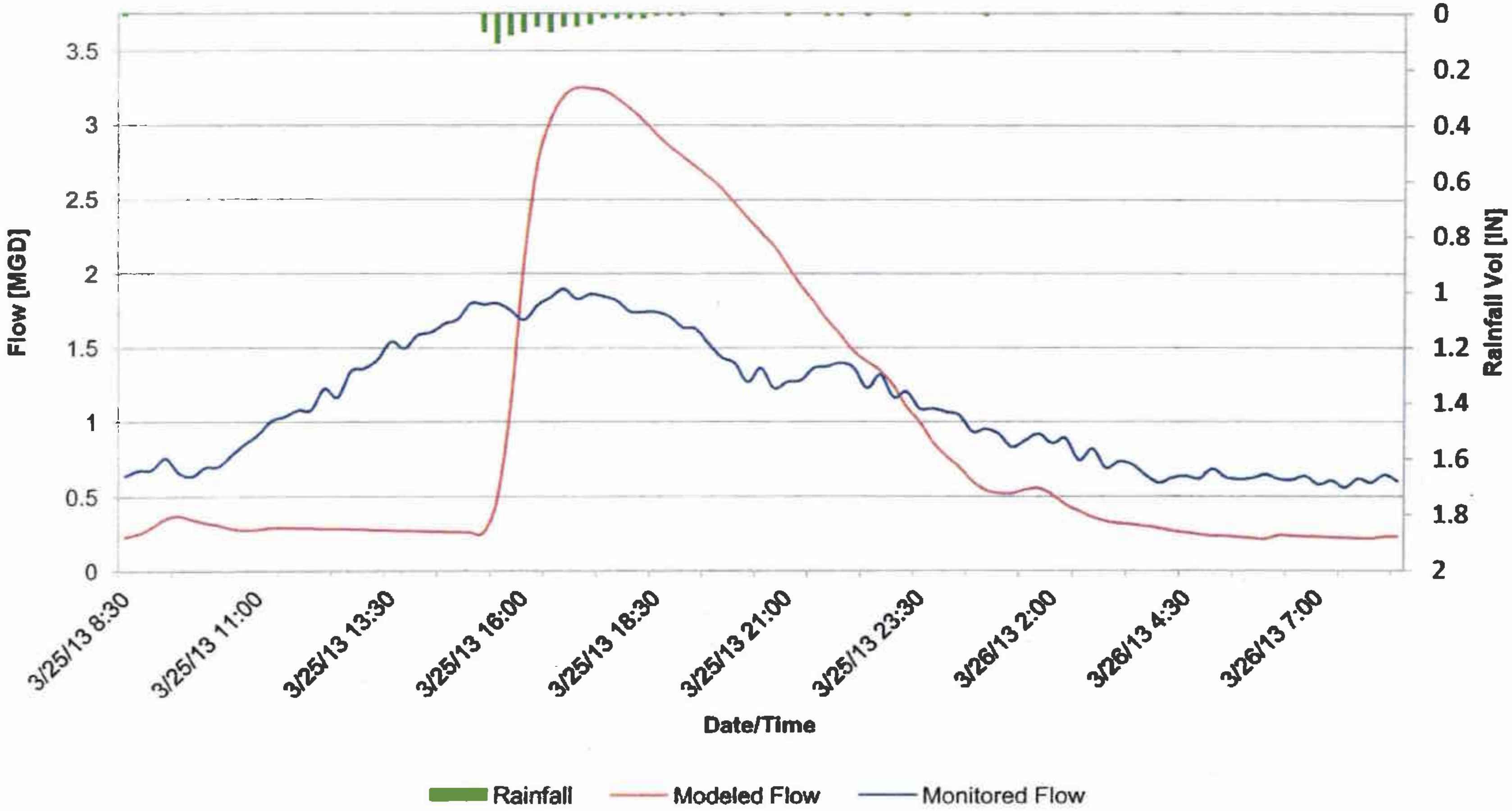

Meter M-3
Rain Event 1
Flow [MGD]
Rainfall Vol [IN]
Date/Time
1/28/13 3:00
1/28/13 5:30
1/28/13 8:00
1/28/13 10:30
1/28/13 13:00
1/28/13 15:30
1/28/13 18:00
1/28/13 20:30
1/28/13 23:00
1/29/13 1:30
1/29/13 4:00
1/29/13 6:30
1/29/13 9:00
1/29/13 11:30
Rainfall
Modeled Flow
Monitored Flow

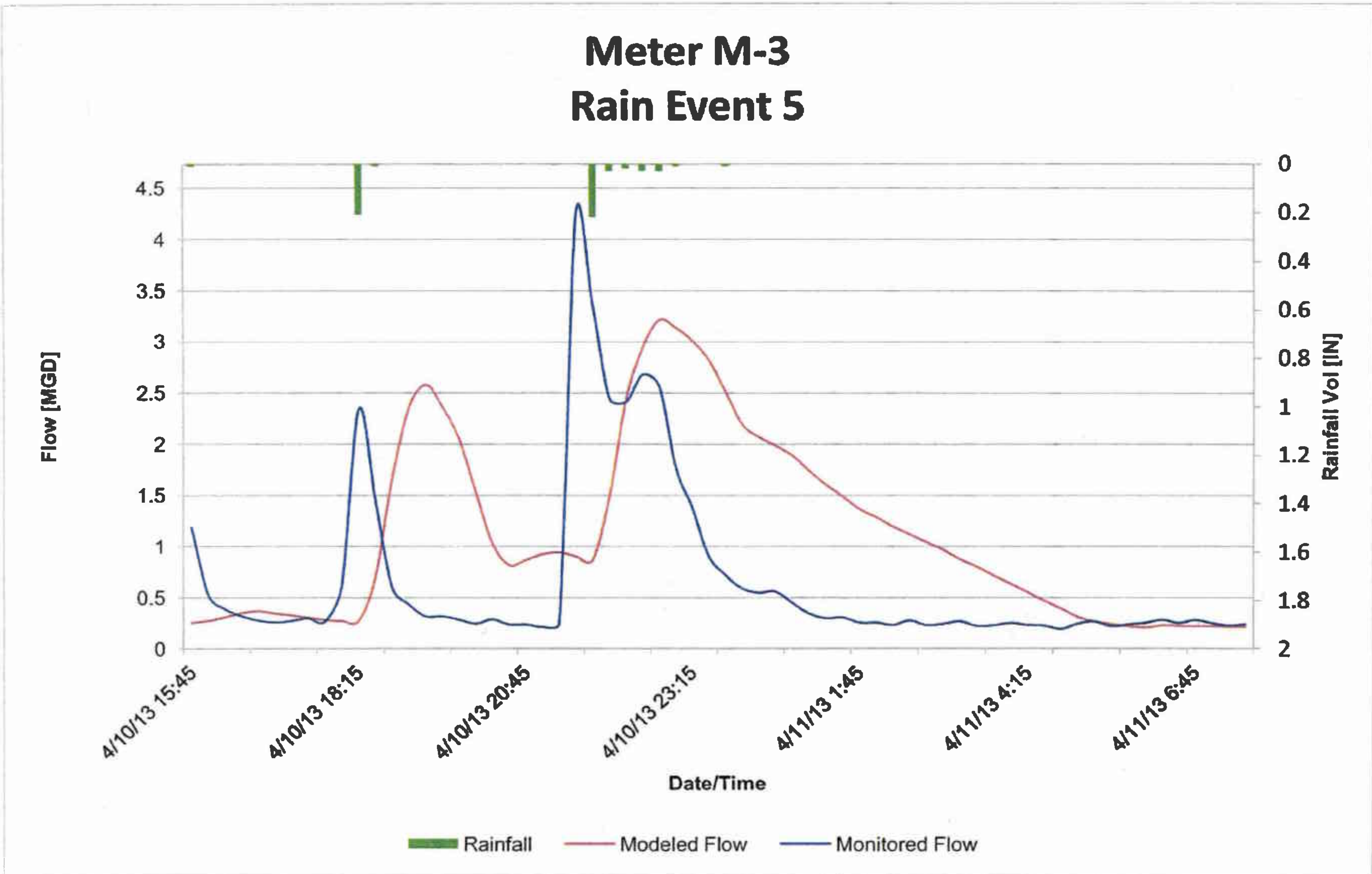

Meter M-3
Rain Event 2
Flow [MGD]
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
Rainfall Vol [IN]
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
1/30/13 10:15
1/30/13 12:45
1/30/13 15:15
1/30/13 17:45
1/30/13 20:15
1/30/13 22:45
1/31/13 1:15
1/31/13 3:45
1/31/13 6:15
1/31/13 8:45
Date/Time
Rainfall
Modeled Flow
Monitored Flow



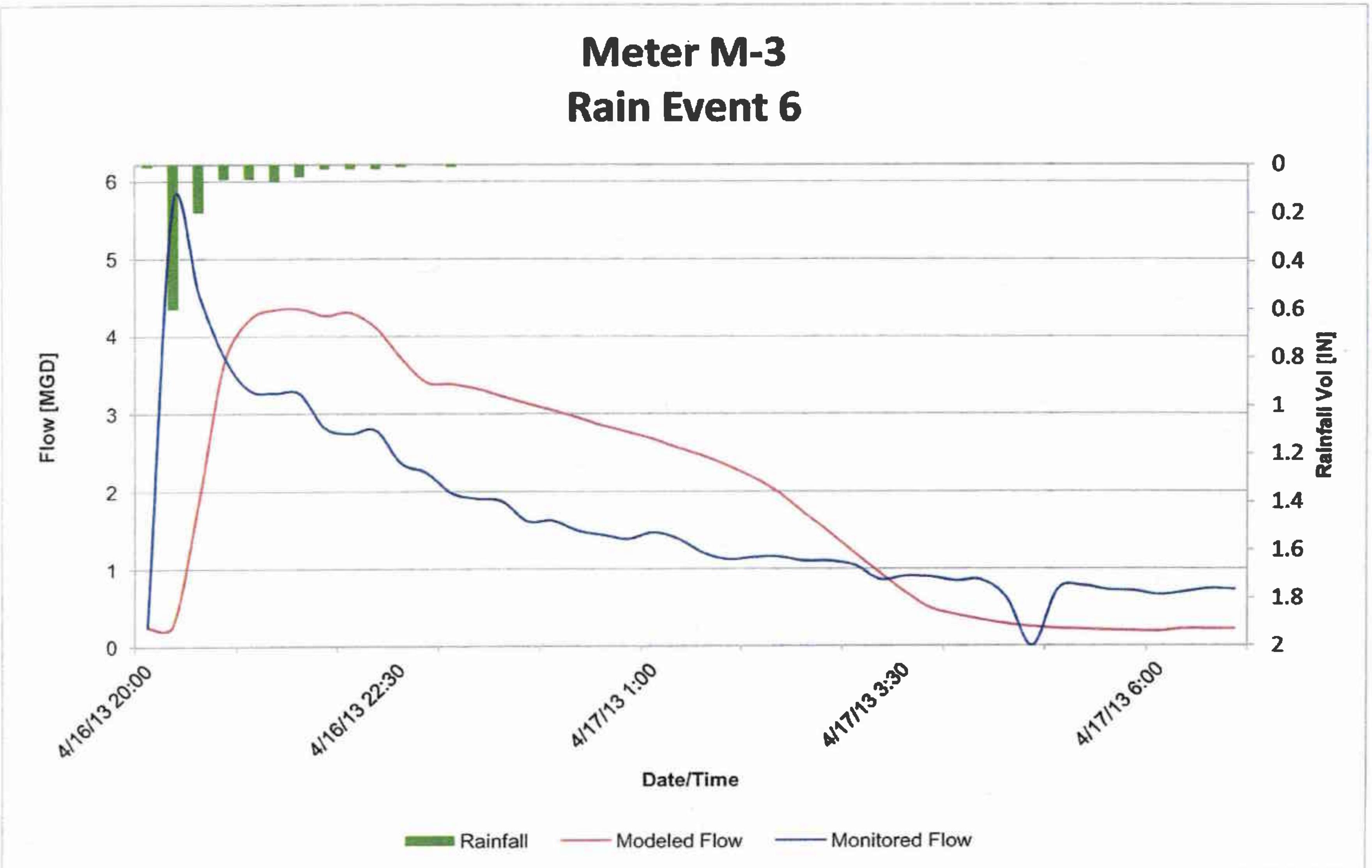
Meter M-3
Rain Event 3
Flow [MGD]
Rainfall Vol [IN]
0
0.5
1
1.5
2
2.5
3
3.5
4
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
2/26/13 12:30
2/26/13 15:00
2/26/13 17:30
2/26/13 20:00
2/26/13 22:30
2/27/13 1:00
2/27/13 3:30
2/27/13 6:00
2/27/13 8:30
2/27/13 11:00
2/27/13 13:30
Date/Time
Rainfall
Modeled Flow
Monitored Flow

Meter M-3
Rain Event 4

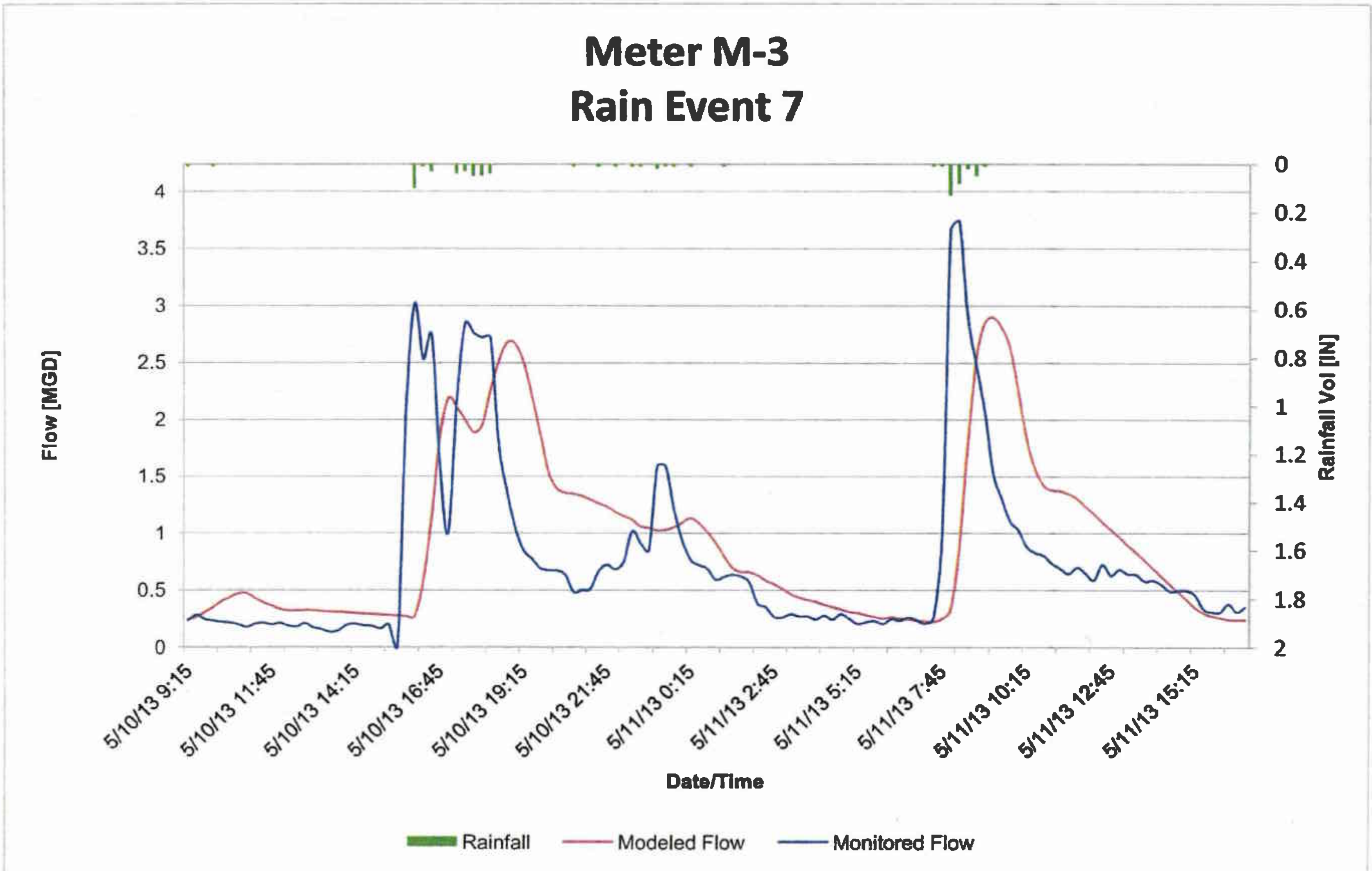




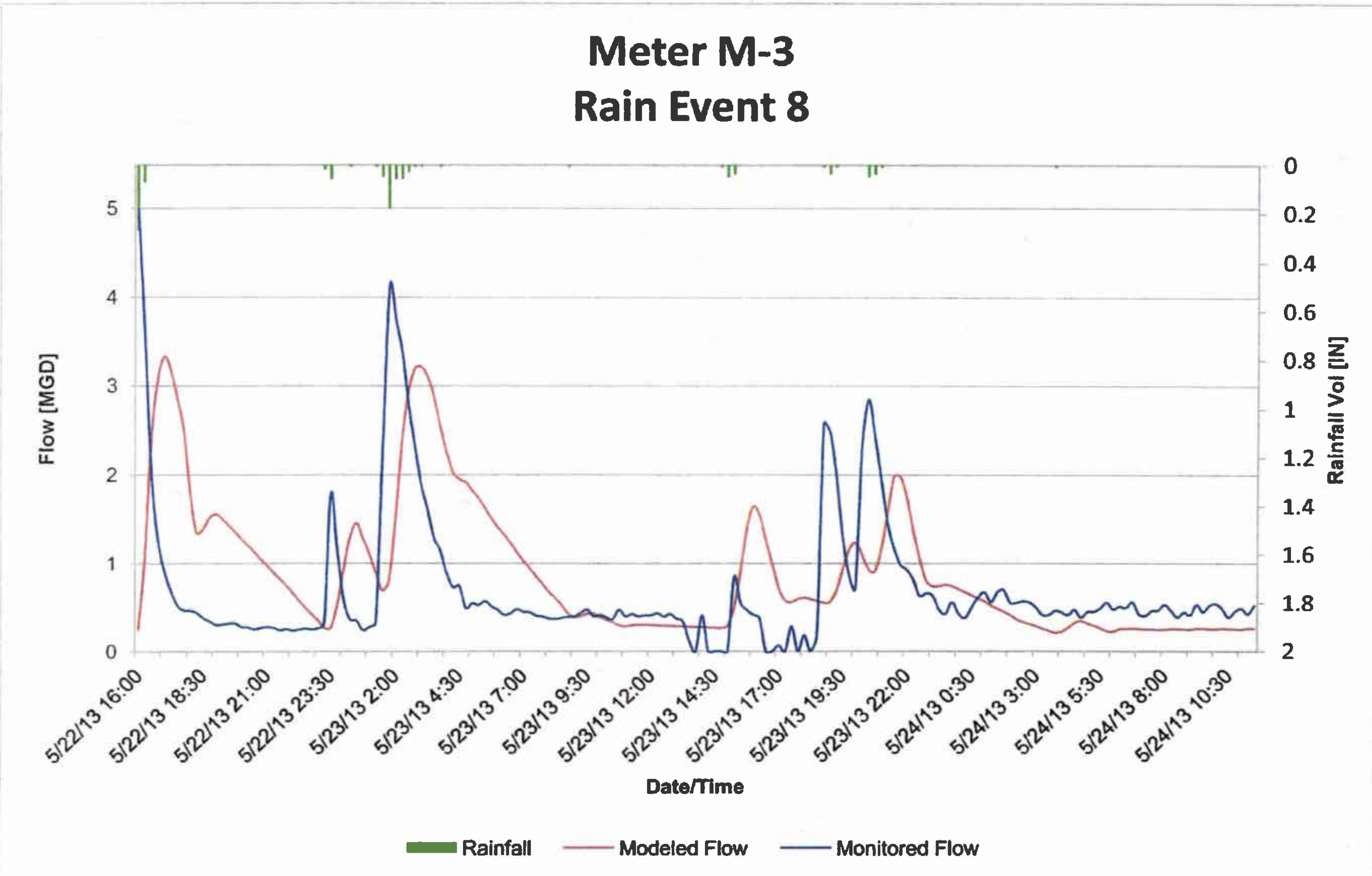
Meter M-3
Rain Event 5
Flow [MGD]
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
Rainfall Vol [IN]
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
4/10/13 15:45
4/10/13 18:15
4/10/13 20:45
4/10/13 23:15
4/11/13 1:45
4/11/13 4:15
4/11/13 6:45
Date/Time
Rainfall
Modeled Flow
Monitored Flow



Meter M-3
Rain Event 6
Flow [MGD]
0
1
2
3
4
5
6
Rainfall Vol [IN]
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
4/16/13 20:00
4/16/13 22:30
4/17/13 1:00
4/17/13 3:30
4/17/13 6:00
Date/Time
Rainfall
Modeled Flow
Monitored Flow



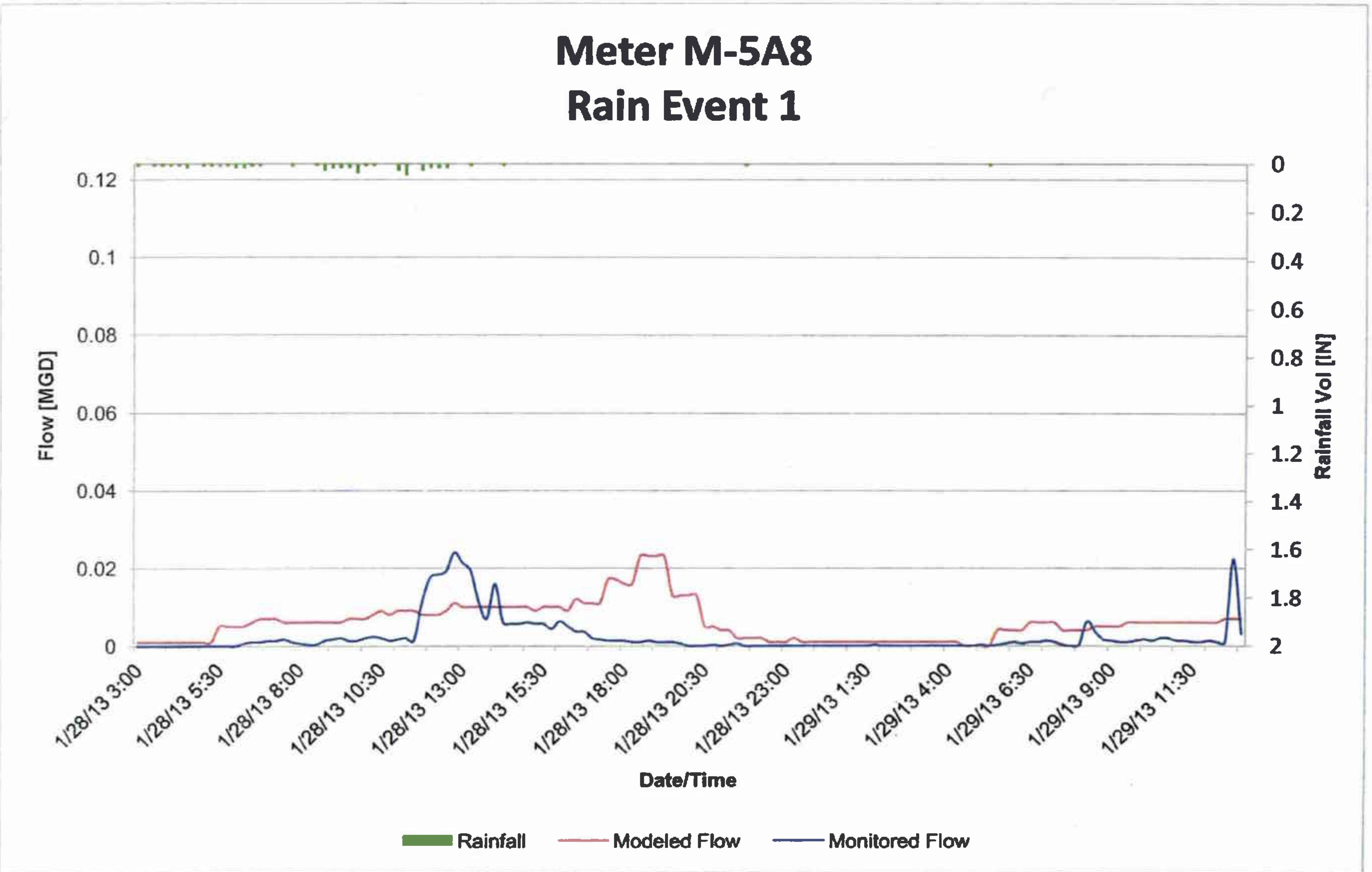
Meter M-3
Rain Event 7
Flow [MGD]
Rainfall Vol [IN]
Date/Time
0
0.5
1
1.5
2
2.5
3
3.5
4
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
5/10/13 9:15
5/10/13 11:45
5/10/13 14:15
5/10/13 16:45
5/10/13 19:15
5/10/13 21:45
5/11/13 0:15
5/11/13 2:45
5/11/13 5:15
5/11/13 7:45
5/11/13 10:15
5/11/13 12:45
5/11/13 15:15
Rainfall
Modeled Flow
Monitored Flow



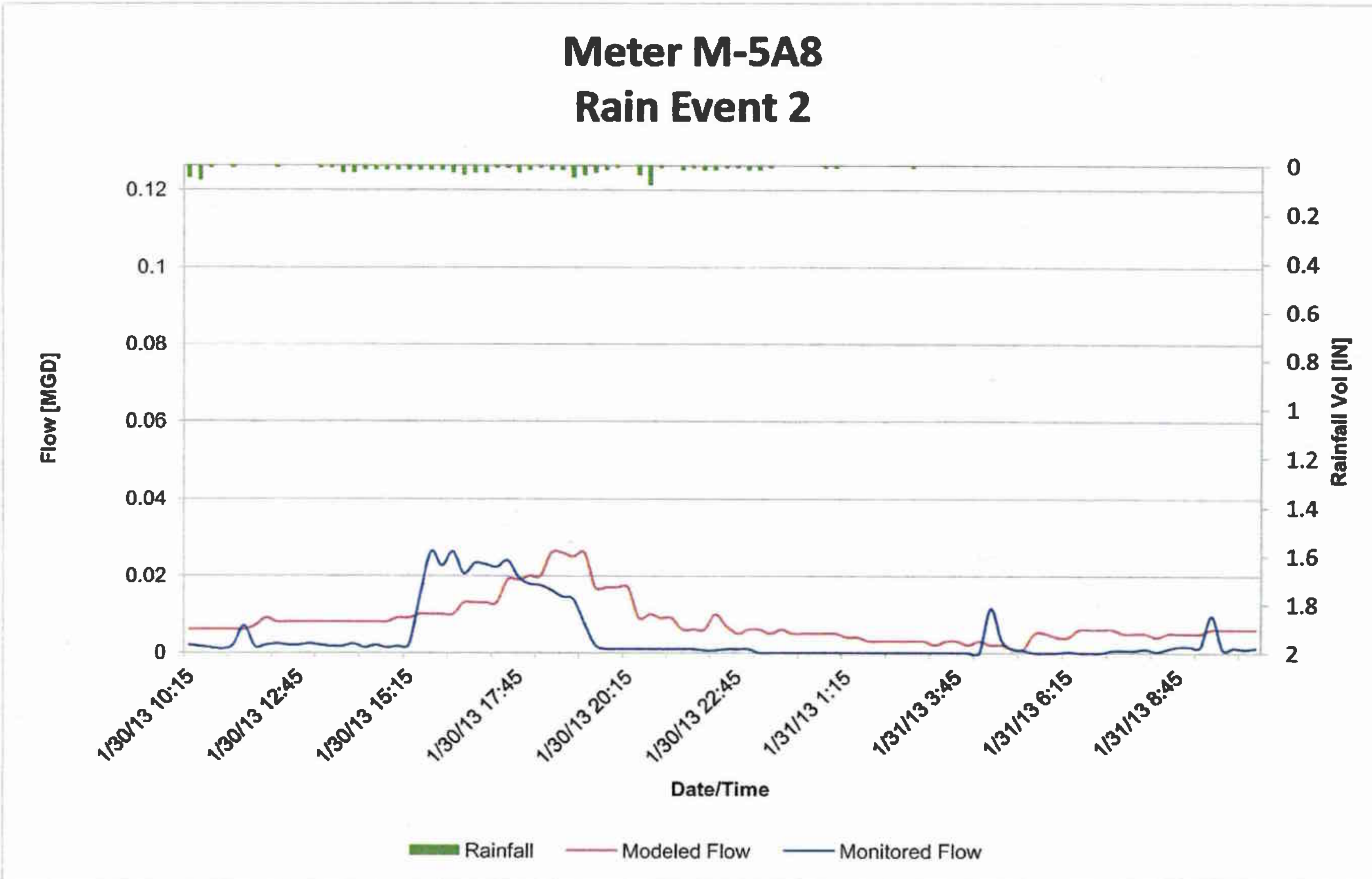
Meter M-3
Rain Event 8
Flow [MGD]
Rainfall Vol [IN]
0
1
2
3
4
5
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
5/22/13 16:00
5/22/13 18:30
5/22/13 21:00
5/22/13 23:30
5/23/13 2:00
5/23/13 4:30
5/23/13 7:00
5/23/13 9:30
5/23/13 12:00
5/23/13 14:30
5/23/13 17:00
5/23/13 19:30
5/23/13 22:00
5/24/13 0:30
5/24/13 3:00
5/24/13 5:30
5/24/13 8:00
5/24/13 10:30
Date/Time
Rainfall
Modeled Flow
Monitored Flow

M-5A8
SUMMER MODEL
RAIN EVENTS

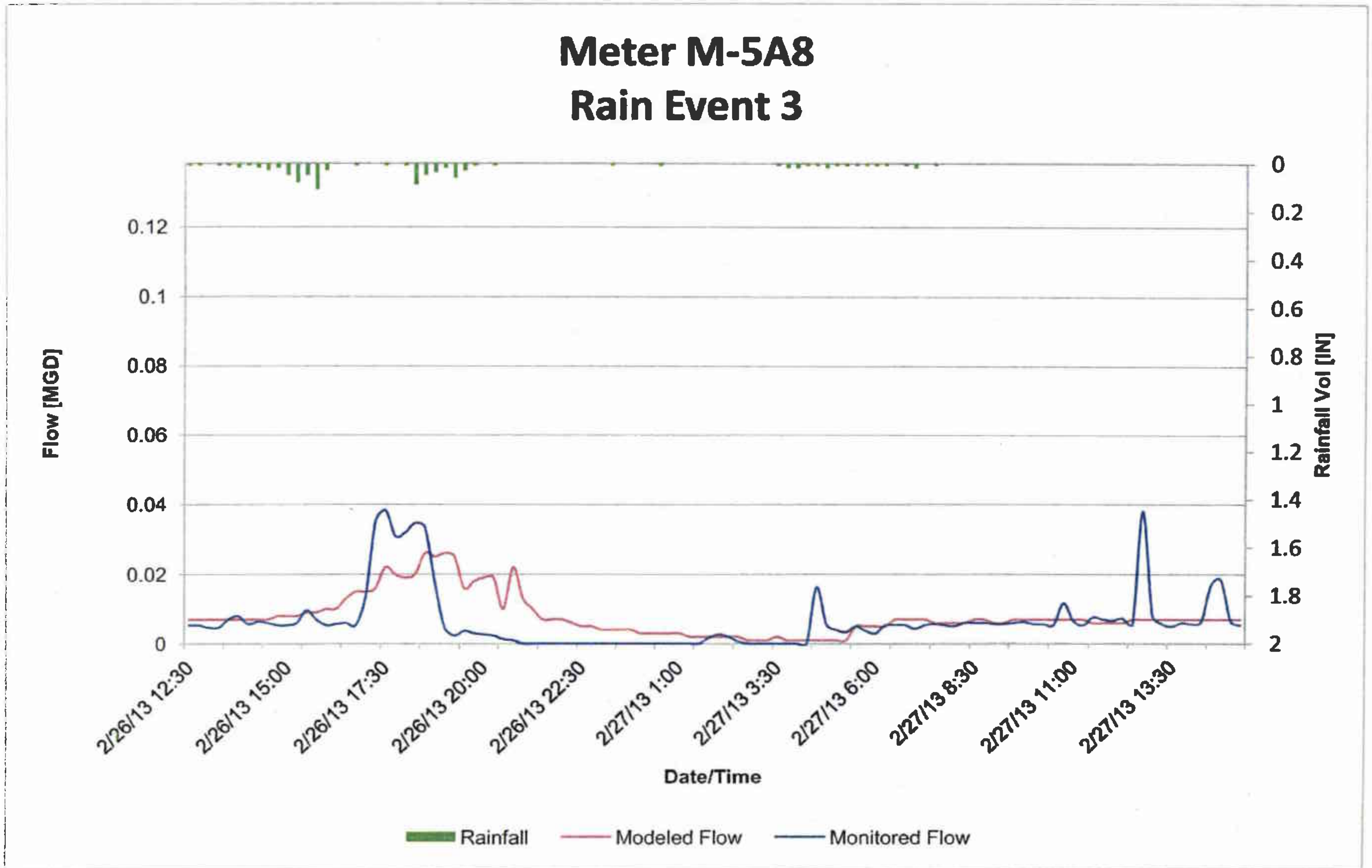
No.	Start Date	End Date	Total Rain	Max Int	Peak MOD Flow	Peak MON Flow	% Difference		Modeled Volume	Monitored Volume	% Difference	
1	1/28/13 3:00	1/28/13 20:00	0.53	0.20	0.02	0.02	4.17%	Mod LOW	0.003	0.002	31.82%	Mod HIGH
2	1/30/13 10:15	1/31/13 8:30	1.08	0.32	0.03	0.03	1.27%	Mod LOW	0.006	0.004	40.35%	Mod HIGH
3	2/26/13 12:30	2/27/13 13:15	1.01	0.44	0.03	0.04	32.17%	Mod LOW	0.006	0.005	20.93%	Mod HIGH
4	3/25/13 15:15	3/26/13 6:30	0.77	0.44	0.03	0.05	42.38%	Mod LOW	0.005	0.005	6.54%	Mod LOW
5	4/10/13 15:45	4/11/13 5:30	0.58	0.88	0.02	0.06	60.48%	Mod LOW	0.002	0.001	47.73%	Mod HIGH
6	4/16/13 20:00	4/17/13 4:45	1.13	2.40	0.03	0.02	1.33%	Mod HIGH	0.002	0.001	58.53%	Mod HIGH
7	5/22/13 23:15	5/23/13 14:30	0.52	0.72	0.009	0.040	77.50%	Mod LOW	0.001	0.000	55.56%	Mod HIGH

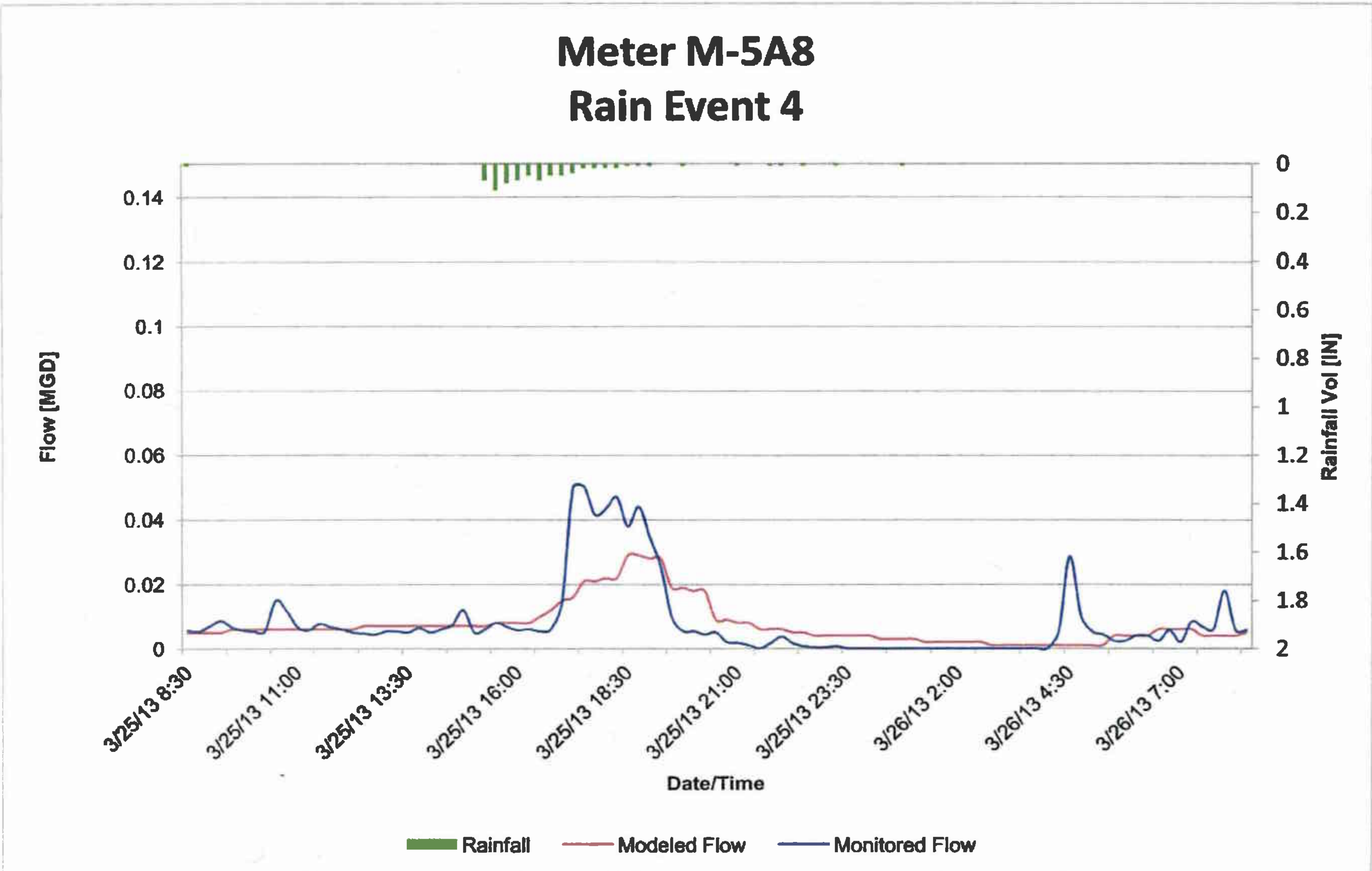


Meter M-5A8
Rain Event 1
Flow [MGD]
0.12
0.1
0.08
0.06
0.04
0.02
0
Rainfall Vol [IN]
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
1/28/13 3:00
1/28/13 5:30
1/28/13 8:00
1/28/13 10:30
1/28/13 13:00
1/28/13 15:30
1/28/13 18:00
1/28/13 20:30
1/28/13 23:00
1/29/13 1:30
1/29/13 4:00
1/29/13 6:30
1/29/13 9:00
1/29/13 11:30
Date/Time
Rainfall
Modeled Flow
Monitored Flow

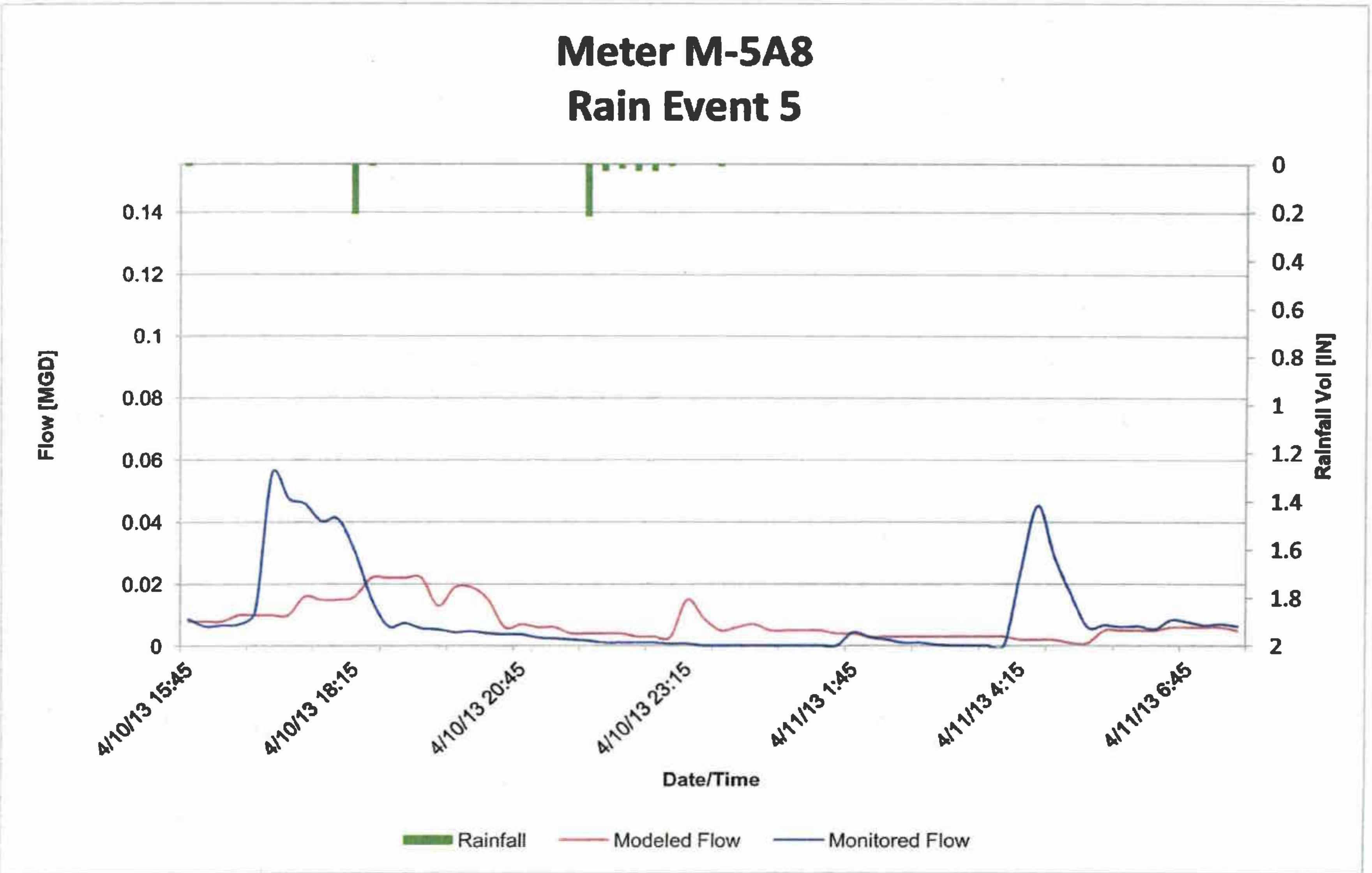


Meter M-5A8
Rain Event 2
Flow [MGD]
0.12
0.1
0.08
0.06
0.04
0.02
0
Rainfall Vol [IN]
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
1/30/13 10:15
1/30/13 12:45
1/30/13 15:15
1/30/13 17:45
1/30/13 20:15
1/30/13 22:45
1/31/13 1:15
1/31/13 3:45
1/31/13 6:15
1/31/13 8:45
Date/Time
Rainfall
Modeled Flow
Monitored Flow

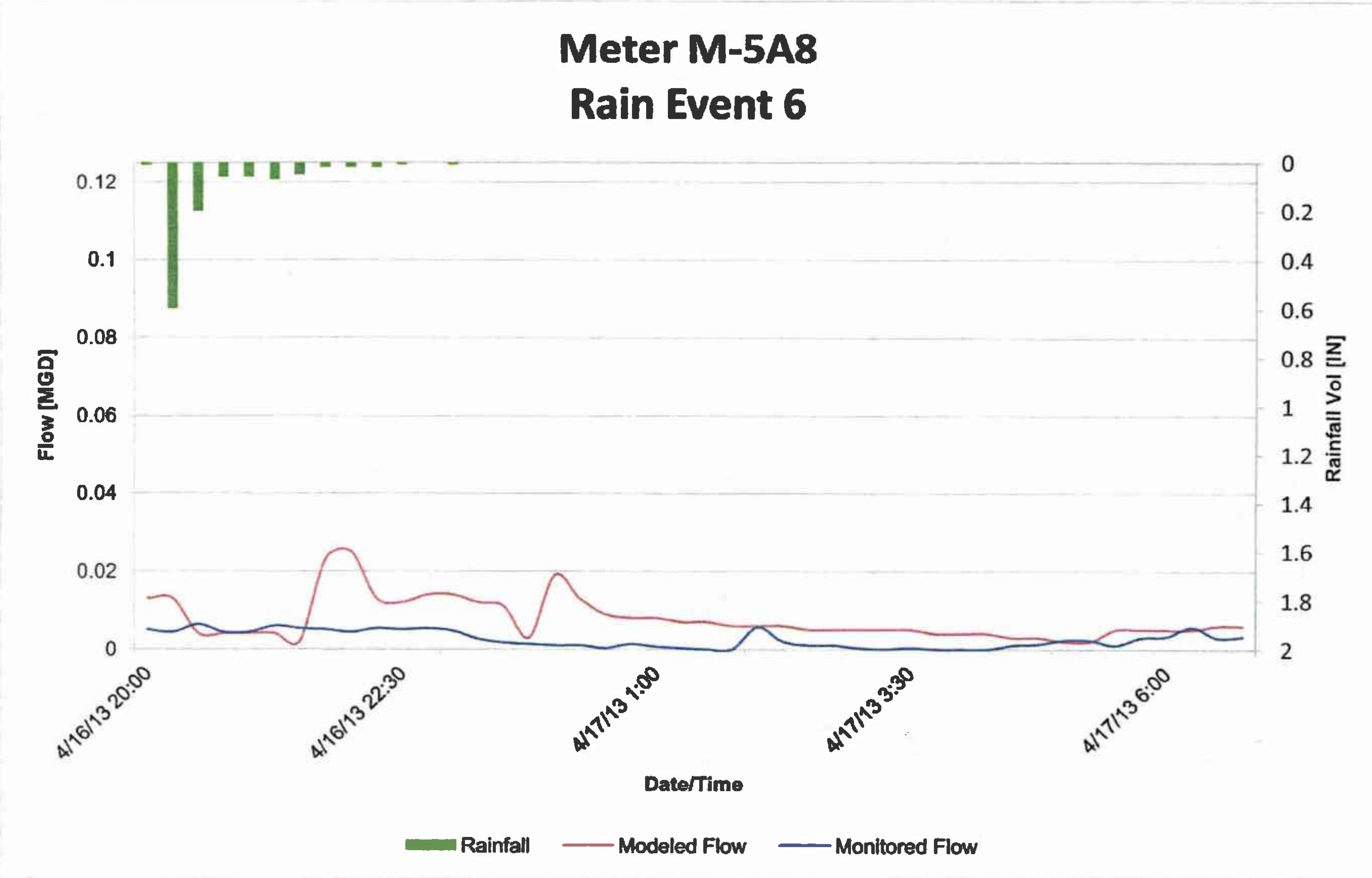

Meter M-5A8
Rain Event 3
Flow [MGD]
0.12
0.1
0.08
0.06
0.04
0.02
0
Rainfall Vol [IN]
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
2/26/13 12:30
2/26/13 15:00
2/26/13 17:30
2/26/13 20:00
2/26/13 22:30
2/27/13 1:00
2/27/13 3:30
2/27/13 6:00
2/27/13 8:30
2/27/13 11:00
2/27/13 13:30
Date/Time
Rainfall
Modeled Flow
Monitored Flow

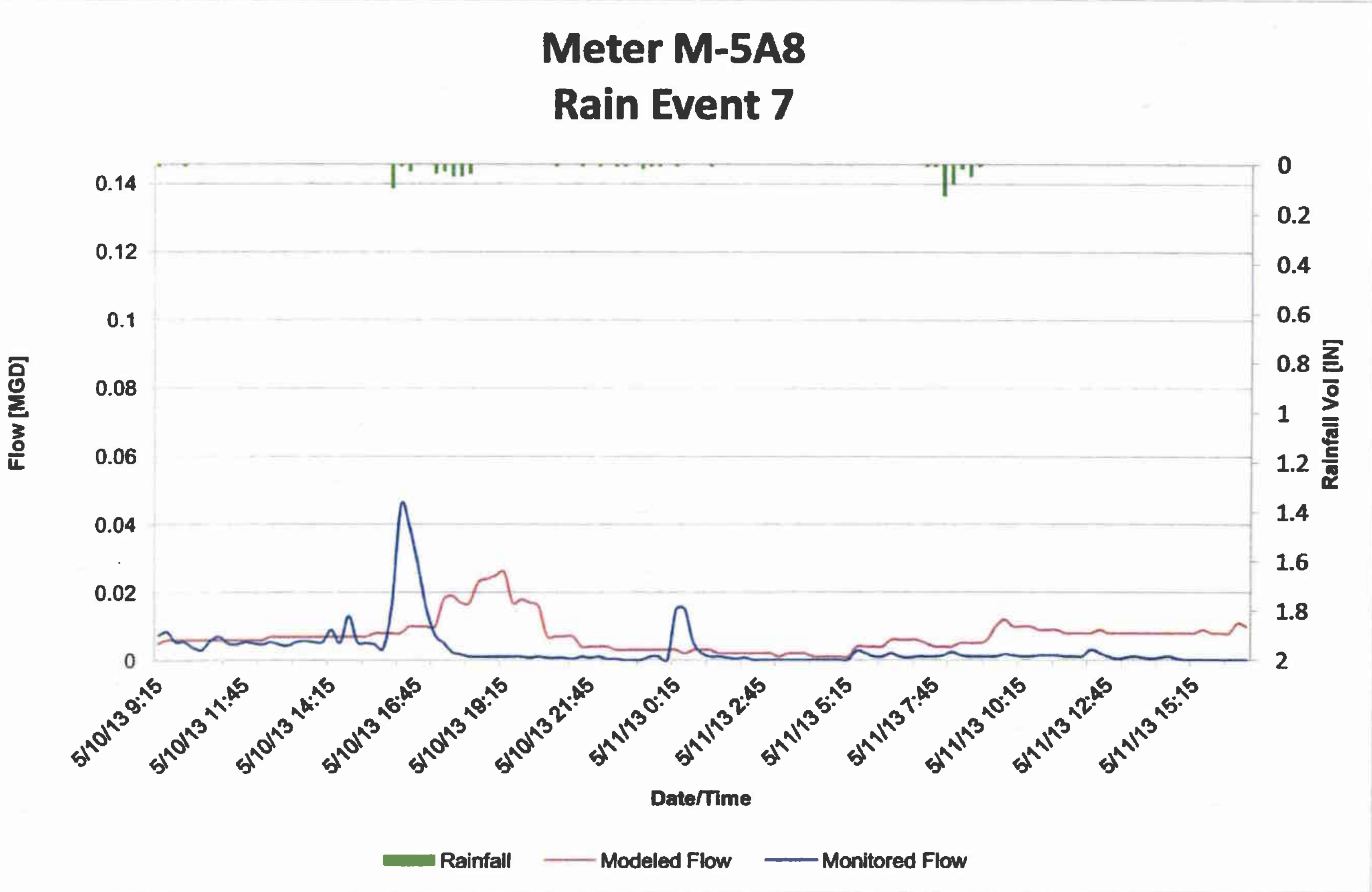


Meter M-5A8
Rain Event 4
Flow [MGD]
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
Rainfall Vol [IN]
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
3/25/13 8:30
3/25/13 11:00
3/25/13 13:30
3/25/13 16:00
3/25/13 18:30
3/25/13 21:00
3/25/13 23:30
3/26/13 2:00
3/26/13 4:30
3/26/13 7:00
Date/Time
Rainfall
Modeled Flow
Monitored Flow

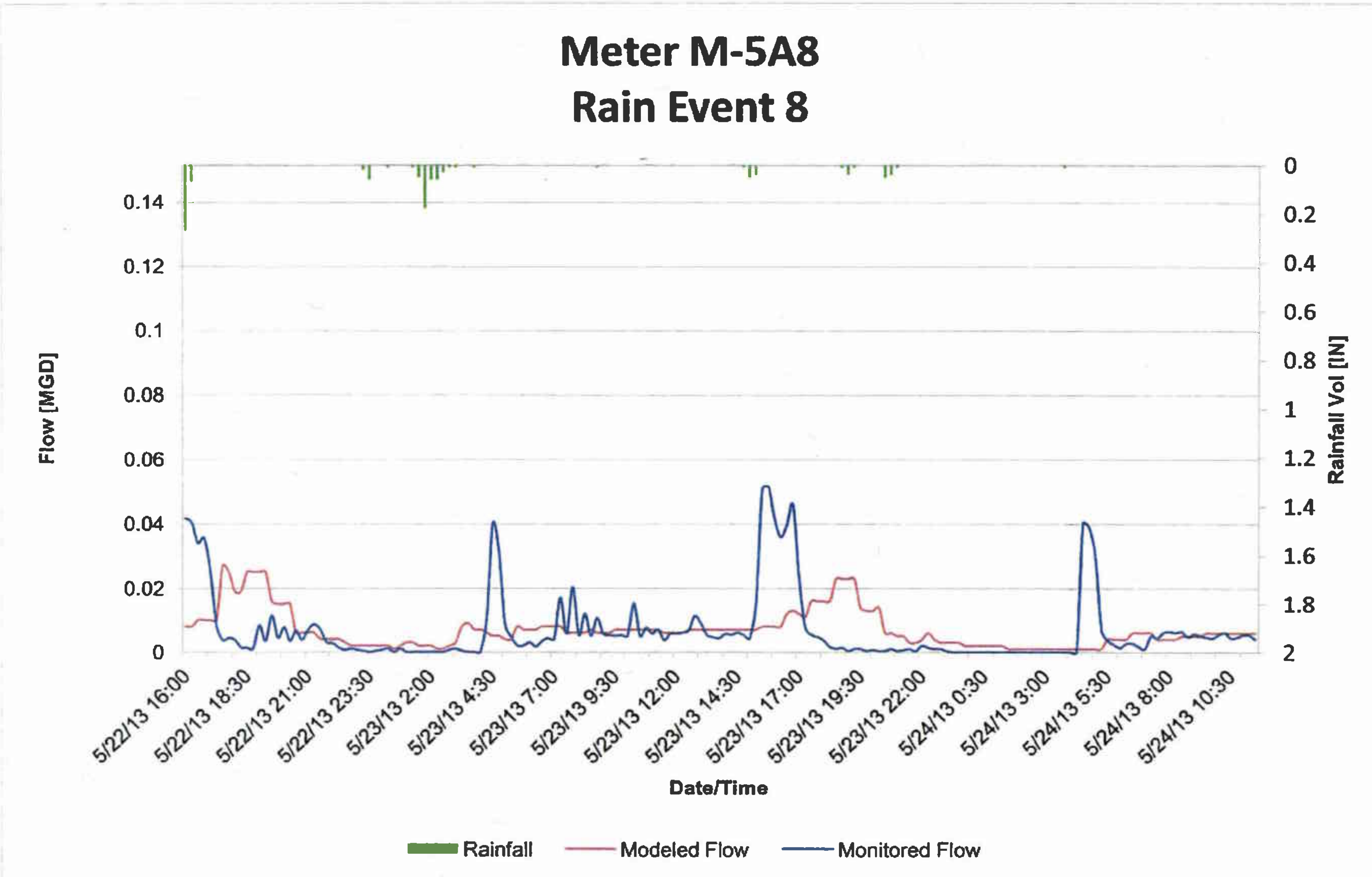


Meter M-5A8
Rain Event 5
Flow [MGD]
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
Rainfall Vol [IN]
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
4/10/13 15:45
4/10/13 18:15
4/10/13 20:45
4/10/13 23:15
4/11/13 1:45
4/11/13 4:15
4/11/13 6:45
Date/Time
Rainfall
Modeled Flow
Monitored Flow


Meter M-5A8
Rain Event 6
Flow [MGD]
0.12
0.1
0.08
0.06
0.04
0.02
0
Rainfall Vol [IN]
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
4/16/13 20:00
4/16/13 22:30
4/17/13 1:00
4/17/13 3:30
4/17/13 6:00
Date/Time
Rainfall
Modeled Flow
Monitored Flow

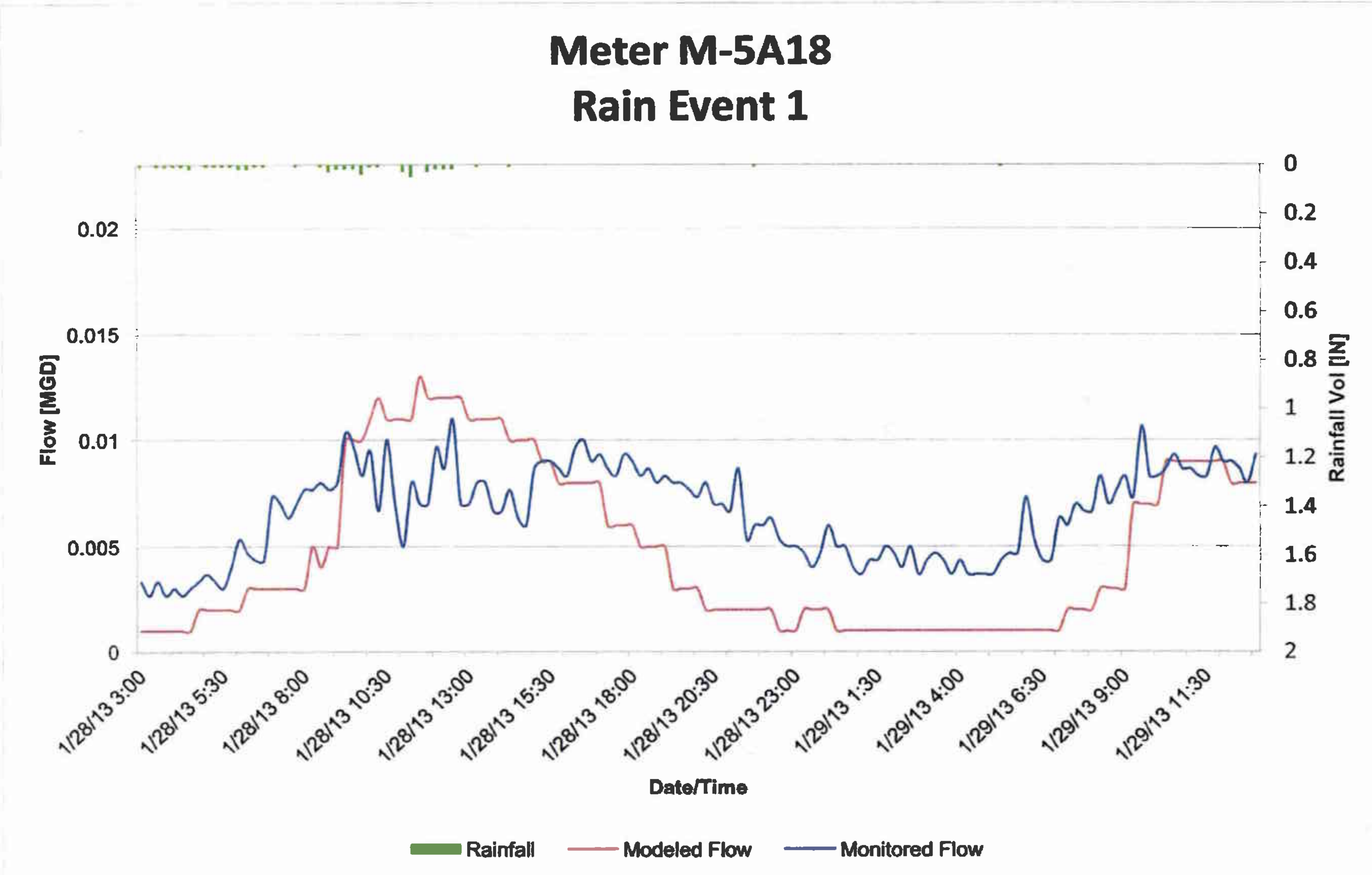


Meter M-5A8
Rain Event 7
Flow [MGD]
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
Rainfall Vol [IN]
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
5/10/13 9:15
5/10/13 11:45
5/10/13 14:15
5/10/13 16:45
5/10/13 19:15
5/10/13 21:45
5/11/13 0:15
5/11/13 2:45
5/11/13 5:15
5/11/13 7:45
5/11/13 10:15
5/11/13 12:45
5/11/13 15:15
Date/Time
Rainfall
Modeled Flow
Monitored Flow

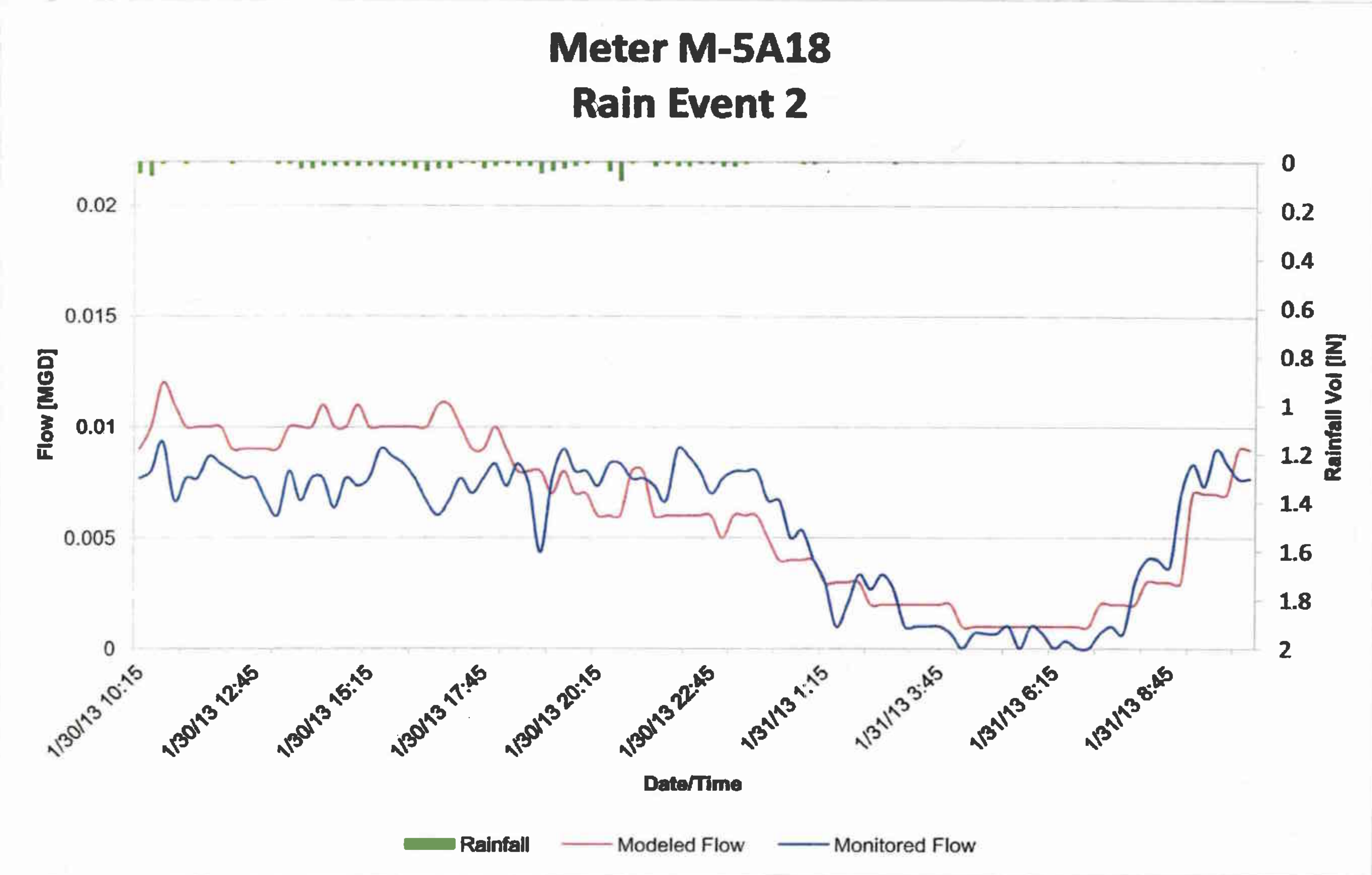

Meter M-5A8
Rain Event 8
Flow [MGD]
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
Rainfall Vol [IN]
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
5/22/13 16:00
5/22/13 18:30
5/22/13 21:00
5/22/13 23:30
5/23/13 2:00
5/23/13 4:30
5/23/13 7:00
5/23/13 9:30
5/23/13 12:00
5/23/13 14:30
5/23/13 17:00
5/23/13 19:30
5/23/13 22:00
5/24/13 0:30
5/24/13 3:00
5/24/13 5:30
5/24/13 8:00
5/24/13 10:30
Date/Time
Rainfall
Modeled Flow
Monitored Flow

M5A-18
SUMMER MODEL
RAIN EVENTS

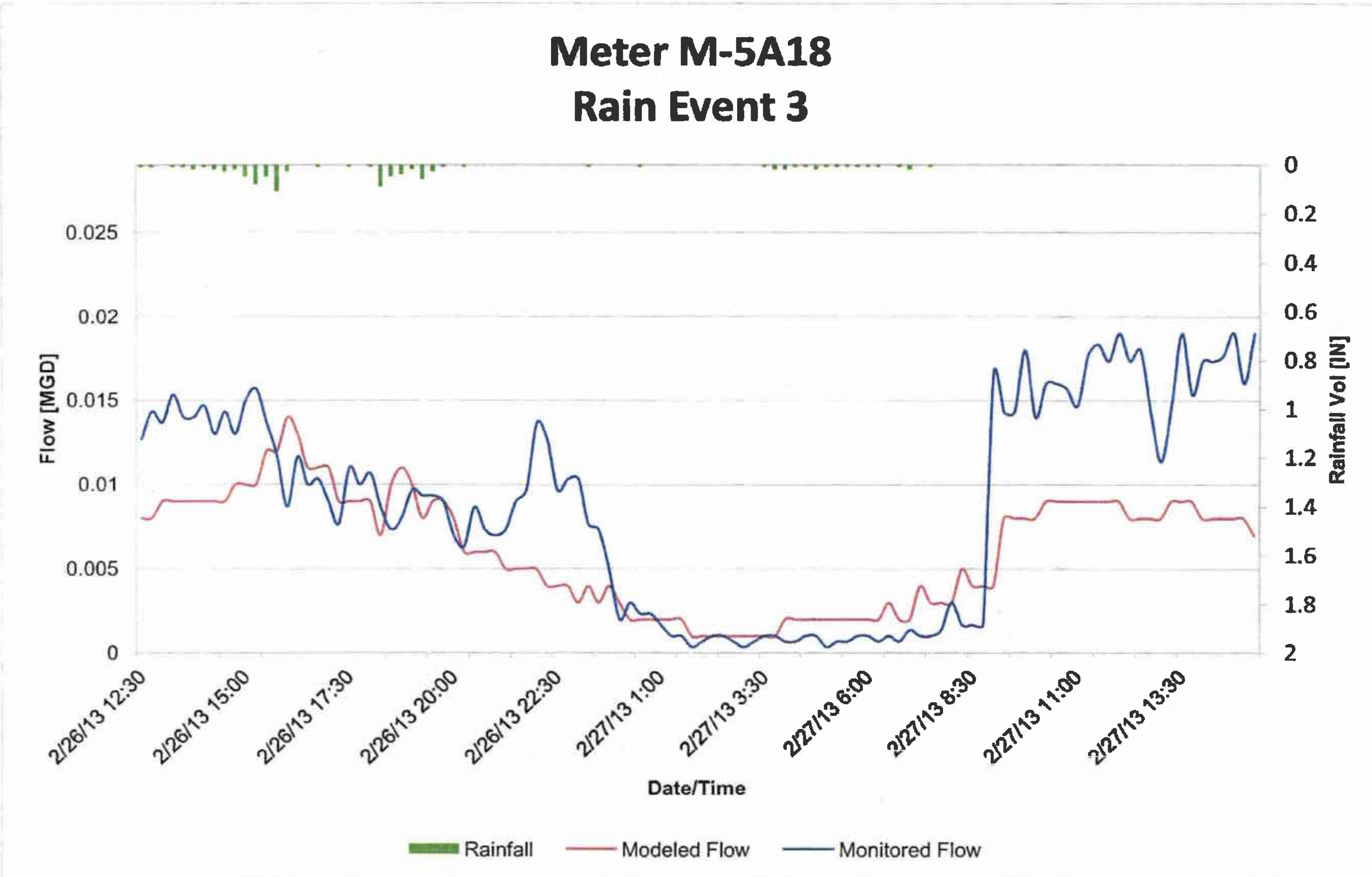
No.	Start Date	End Date	Total Rain	Max Int	Peak MOD Flow	Peak MON Flow	% Difference		Modeled Volume	Monitored Volume	% Difference	
1	1/28/13 3:00	1/28/13 20:00	0.53	0.20	0.01	0.01	15.38%	Mod HIGH	0.003	0.003	3.80%	Mod HIGH
2	1/30/13 10:15	1/31/13 8:30	1.08	0.32	0.01	0.01	22.22%	Mod HIGH	0.005	0.004	10.42%	Mod HIGH
3	2/26/13 12:30	2/27/13 13:15	1.01	0.44	0.01	0.02	26.32%	Mod LOW	0.004	0.004	10.00%	Mod LOW
4	3/25/13 15:15	3/26/13 6:30	0.77	0.44	0.01	0.03	53.85%	Mod LOW	0.003	0.007	60.56%	Mod LOW
5	4/10/13 15:45	4/11/13 5:30	0.58	0.88	0.01	0.03	63.41%	Mod LOW	0.001	0.003	62.62%	Mod LOW
6	4/16/13 20:00	4/17/13 4:45	1.13	2.40	0.02	0.01	65.28%	Mod HIGH	0.002	0.000	88.64%	Mod HIGH
7	5/22/13 23:15	5/23/13 14:30	0.52	0.72	0.009	0.005	44.44%	Mod HIGH	0.001	0.000	81.14%	Mod HIGH



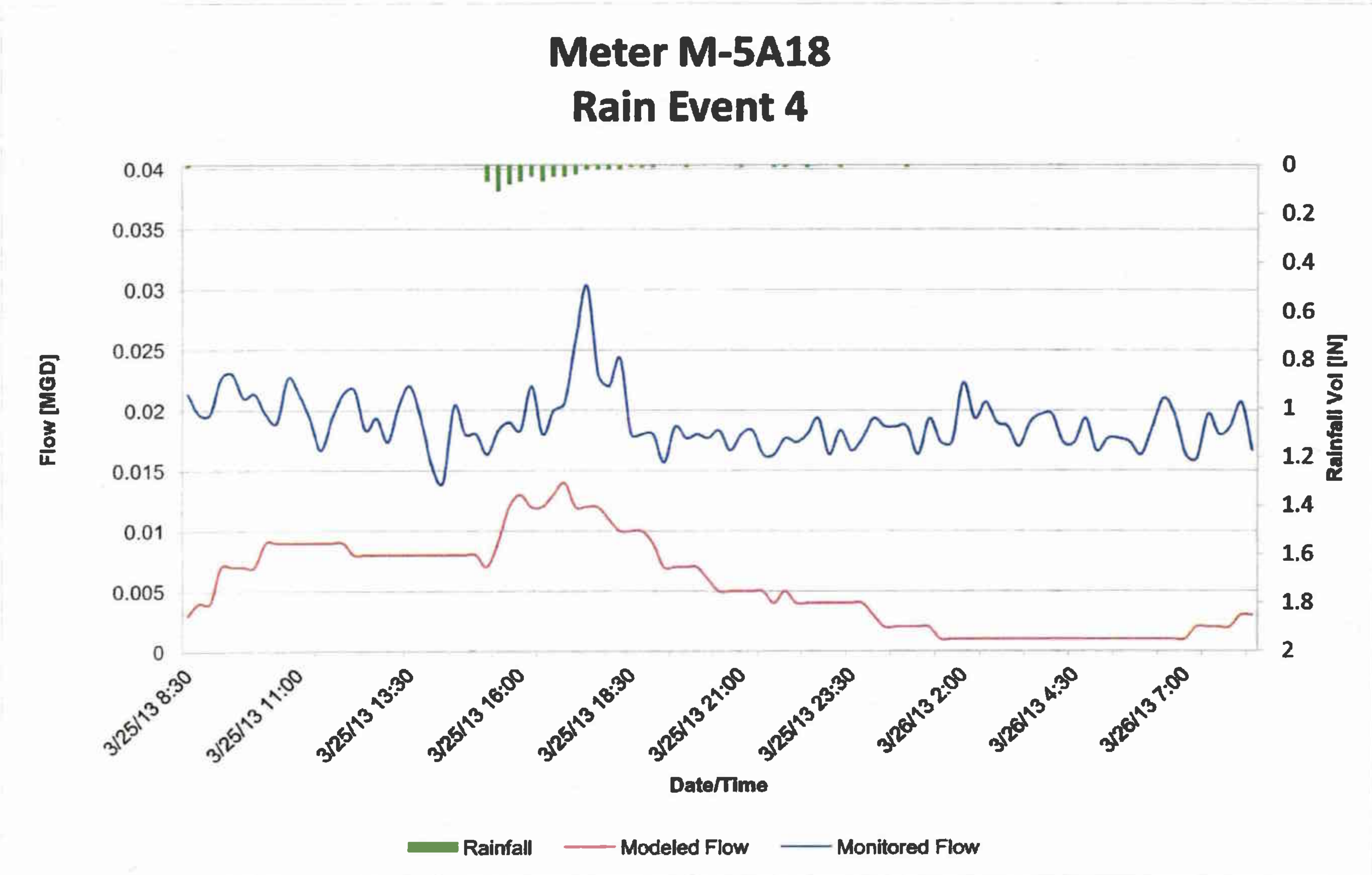
Meter M-5A18
Rain Event 1
Flow [MGD]
0.02
0.015
0.01
0.005
0
Rainfall Vol [IN]
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
1/28/13 3:00
1/28/13 5:30
1/28/13 8:00
1/28/13 10:30
1/28/13 13:00
1/28/13 15:30
1/28/13 18:00
1/28/13 20:30
1/28/13 23:00
1/29/13 1:30
1/29/13 4:00
1/29/13 6:30
1/29/13 9:00
1/29/13 11:30
Date/Time
Rainfall
Modeled Flow
Monitored Flow

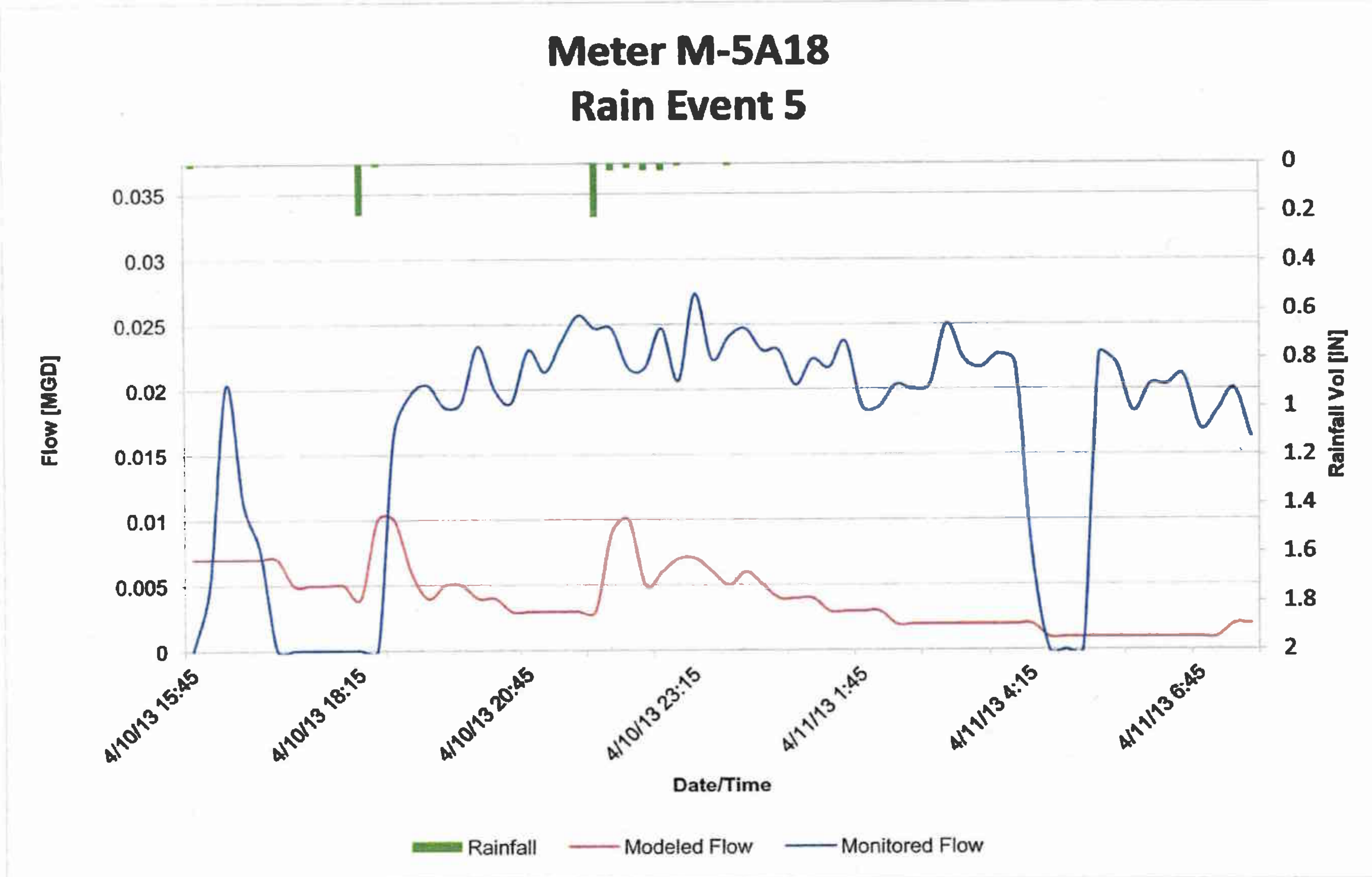


Meter M-5A18
Rain Event 2
Flow [MGD]
0.02
0.015
0.01
0.005
0
Rainfall Vol [IN]
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
1/30/13 10:15
1/30/13 12:45
1/30/13 15:15
1/30/13 17:45
1/30/13 20:15
1/30/13 22:45
1/31/13 1:15
1/31/13 3:45
1/31/13 6:15
1/31/13 8:45
Date/Time
Rainfall
Modeled Flow
Monitored Flow

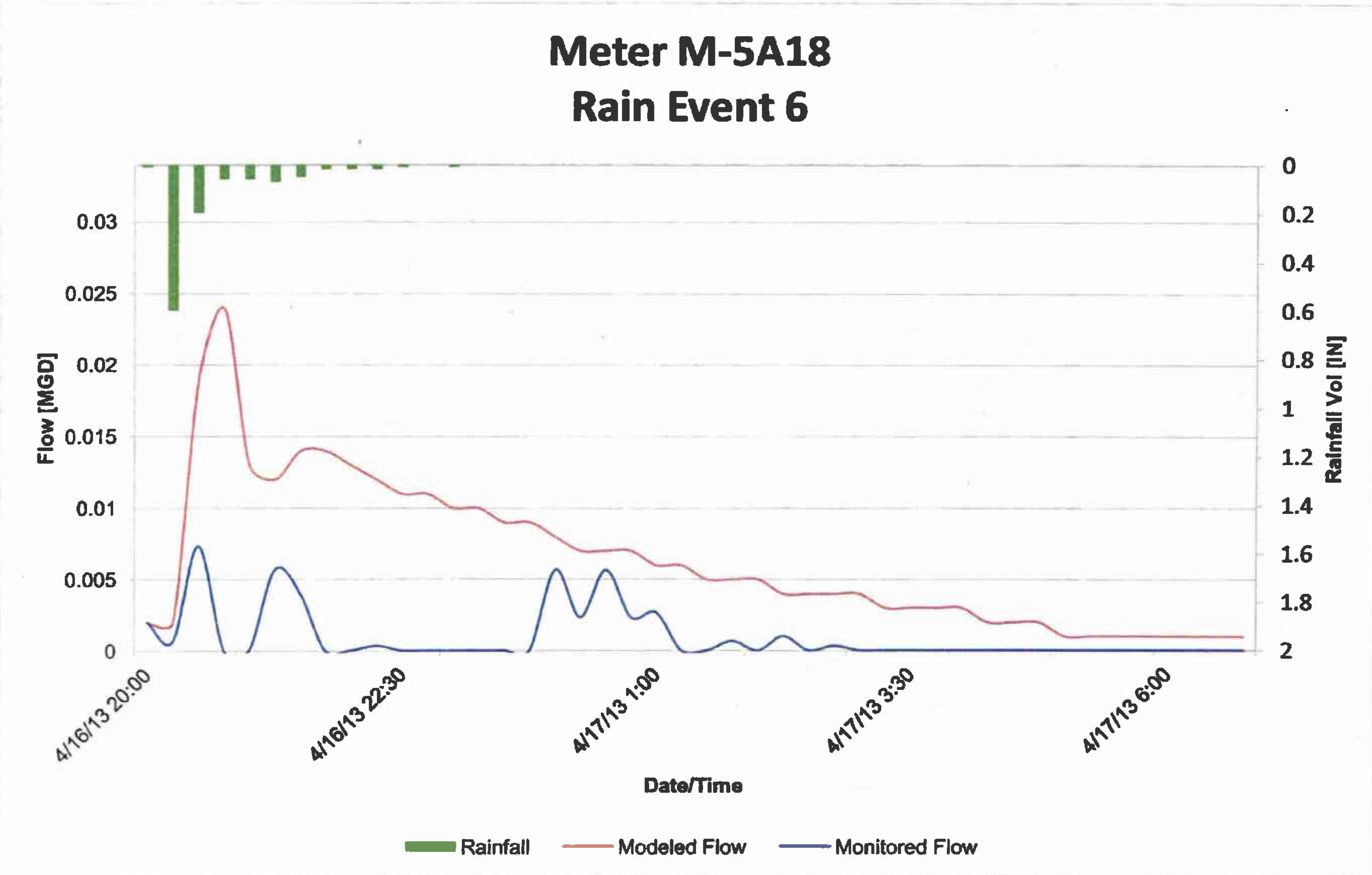


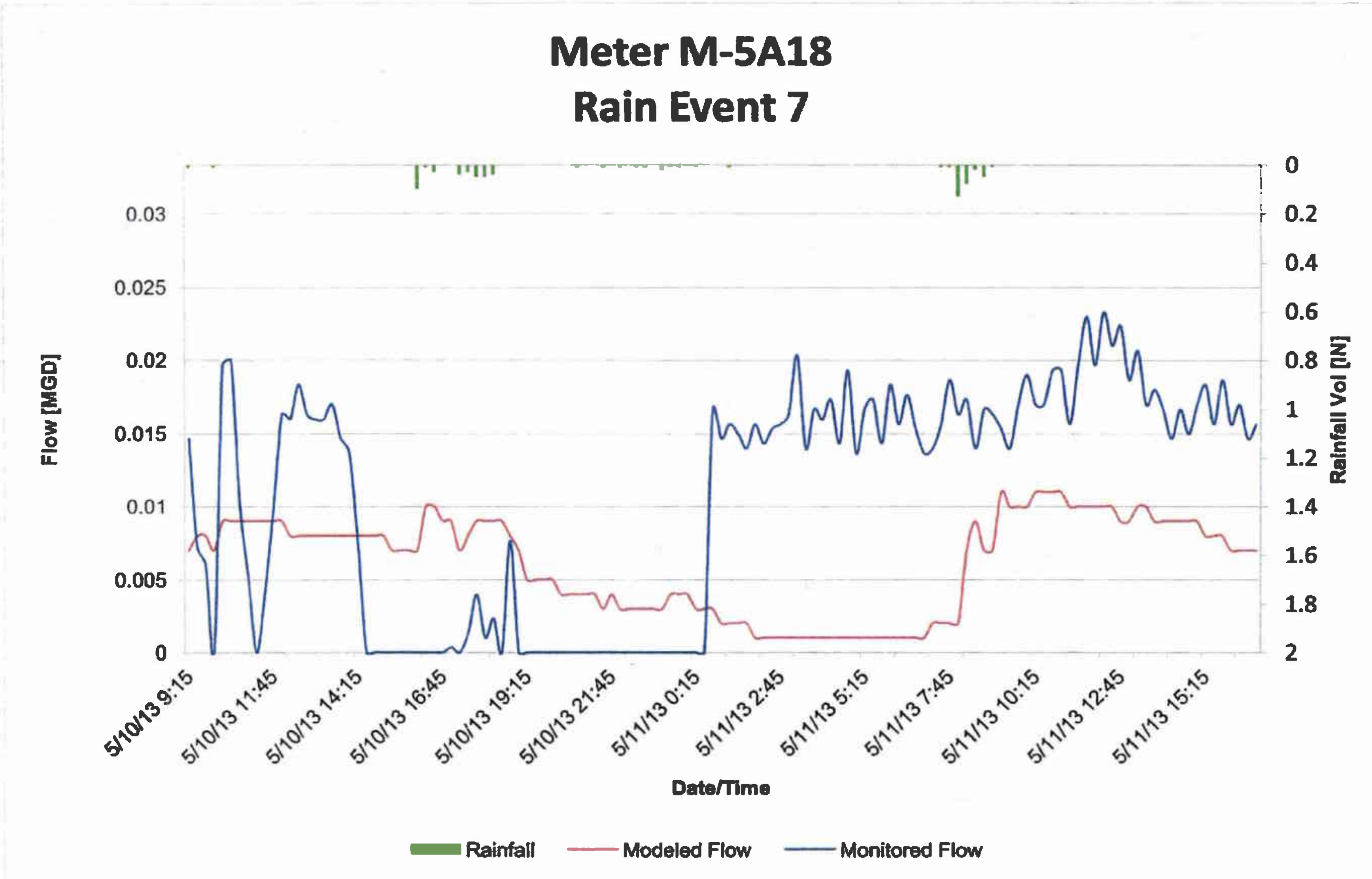
Meter M-5A18
Rain Event 3
Flow [MGD]
0.025
0.02
0.015
0.01
0.005
0
Rainfall Vol [IN]
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
2/26/13 12:30
2/26/13 15:00
2/26/13 17:30
2/26/13 20:00
2/26/13 22:30
2/27/13 1:00
2/27/13 3:30
2/27/13 6:00
2/27/13 8:30
2/27/13 11:00
2/27/13 13:30
Date/Time
Rainfall
Modeled Flow
Monitored Flow


Meter M-5A18
Rain Event 4
Flow [MGD]
0.04
0.035
0.03
0.025
0.02
0.015
0.01
0.005
0
Rainfall Vol [IN]
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
3/25/13 8:30
3/25/13 11:00
3/25/13 13:30
3/25/13 16:00
3/25/13 18:30
3/25/13 21:00
3/25/13 23:30
3/26/13 2:00
3/26/13 4:30
3/26/13 7:00
Date/Time
Rainfall
Modeled Flow
Monitored Flow

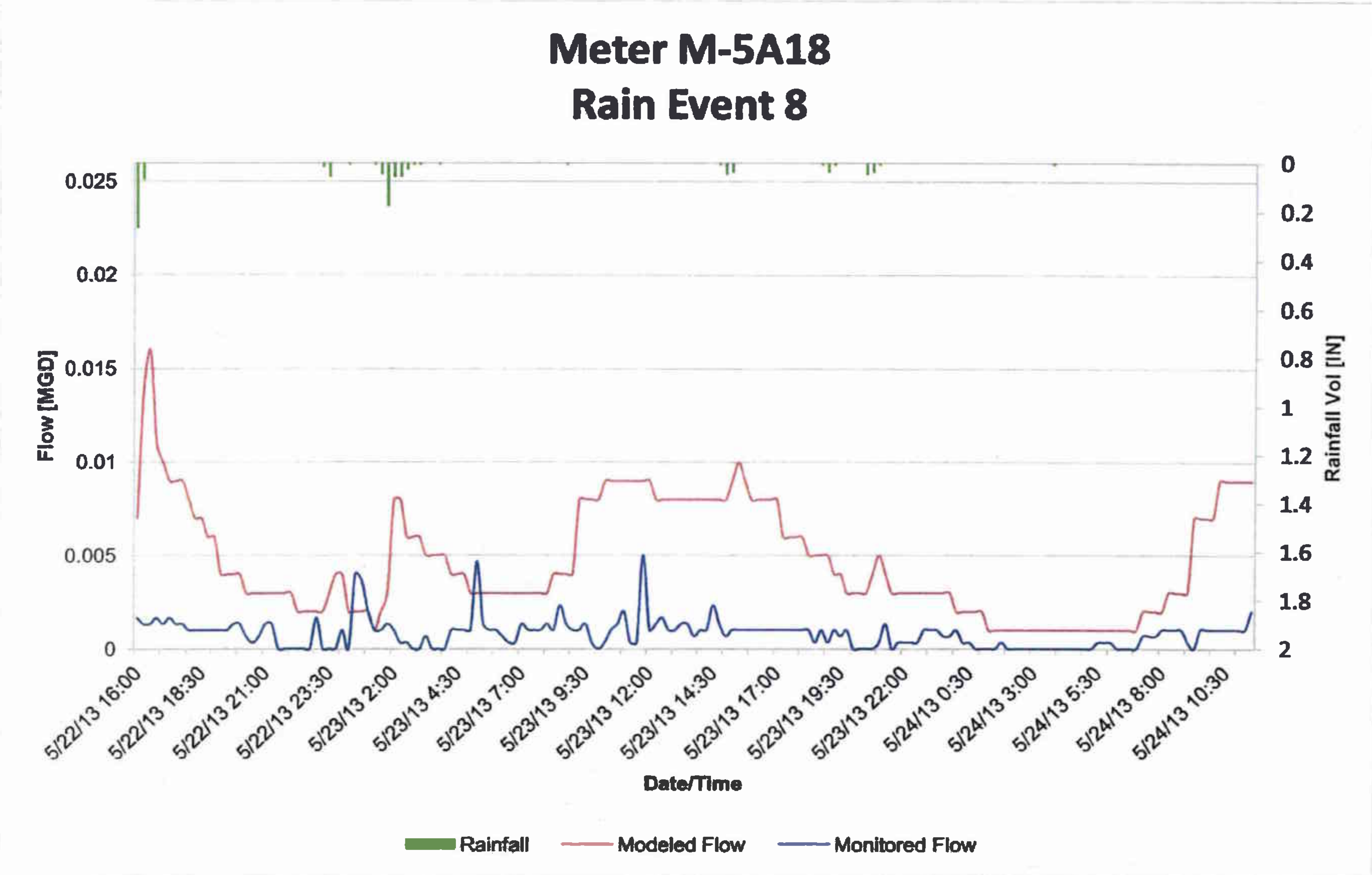


Meter M-5A18
Rain Event 5
Flow [MGD]
0.035
0.03
0.025
0.02
0.015
0.01
0.005
0
Rainfall Vol [IN]
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
4/10/13 15:45
4/10/13 18:15
4/10/13 20:45
4/10/13 23:15
4/11/13 1:45
4/11/13 4:15
4/11/13 6:45
Date/Time
Rainfall
Modeled Flow
Monitored Flow


Meter M-5A18
Rain Event 6
Flow [MGD]
0.03
0.025
0.02
0.015
0.01
0.005
0
Rainfall Vol [IN]
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
4/16/13 20:00
4/16/13 22:30
4/17/13 1:00
4/17/13 3:30
4/17/13 6:00
Date/Time
Rainfall
Modeled Flow
Monitored Flow



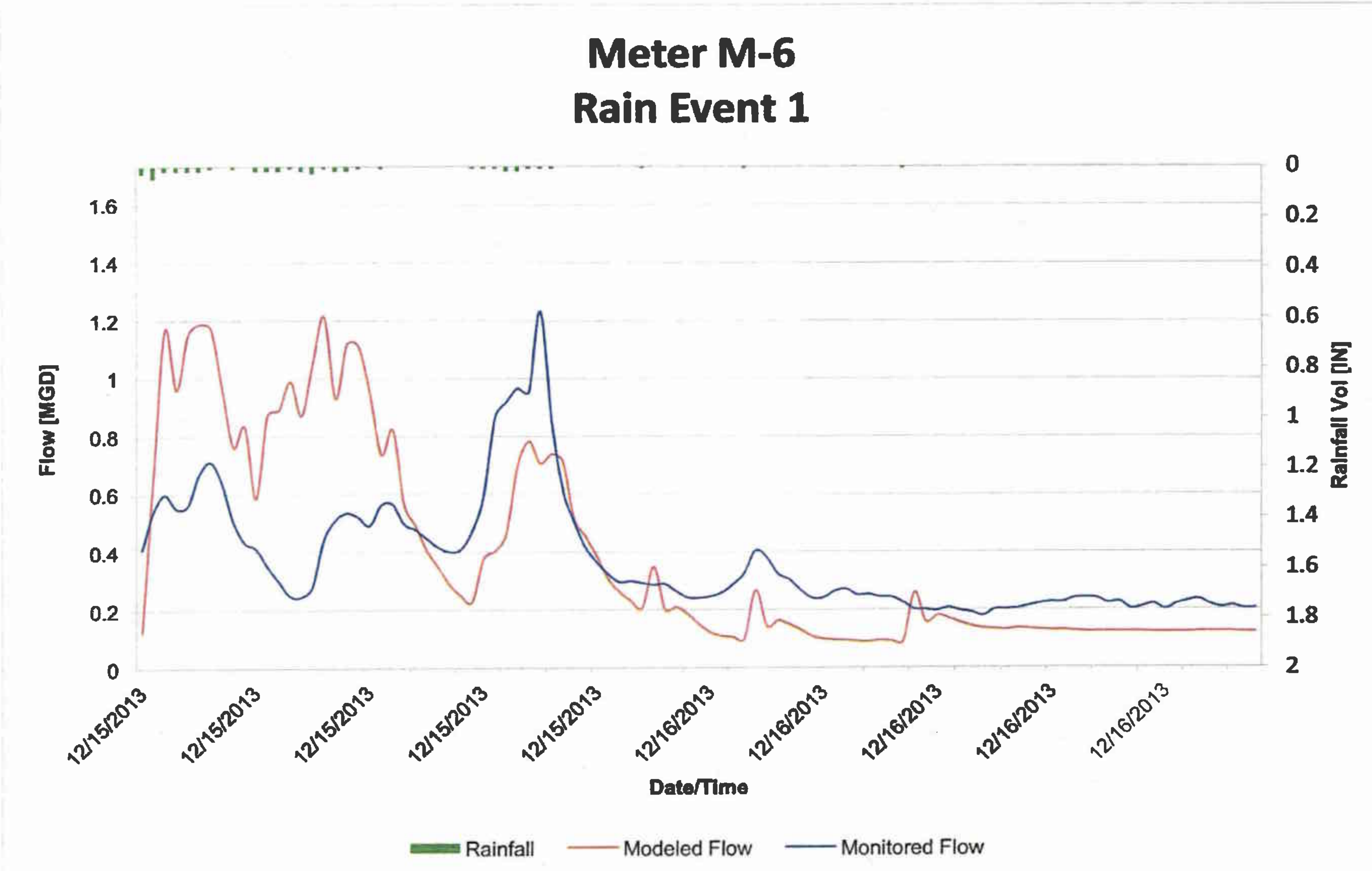
Meter M-5A18
Rain Event 7
Flow [MGD]
0.03
0.025
0.02
0.015
0.01
0.005
0
Rainfall Vol [IN]
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
5/10/13 9:15
5/10/13 11:45
5/10/13 14:15
5/10/13 16:45
5/10/13 19:15
5/10/13 21:45
5/11/13 0:15
5/11/13 2:45
5/11/13 5:15
5/11/13 7:45
5/11/13 10:15
5/11/13 12:45
5/11/13 15:15
Date/Time
Rainfall
Modeled Flow
Monitored Flow

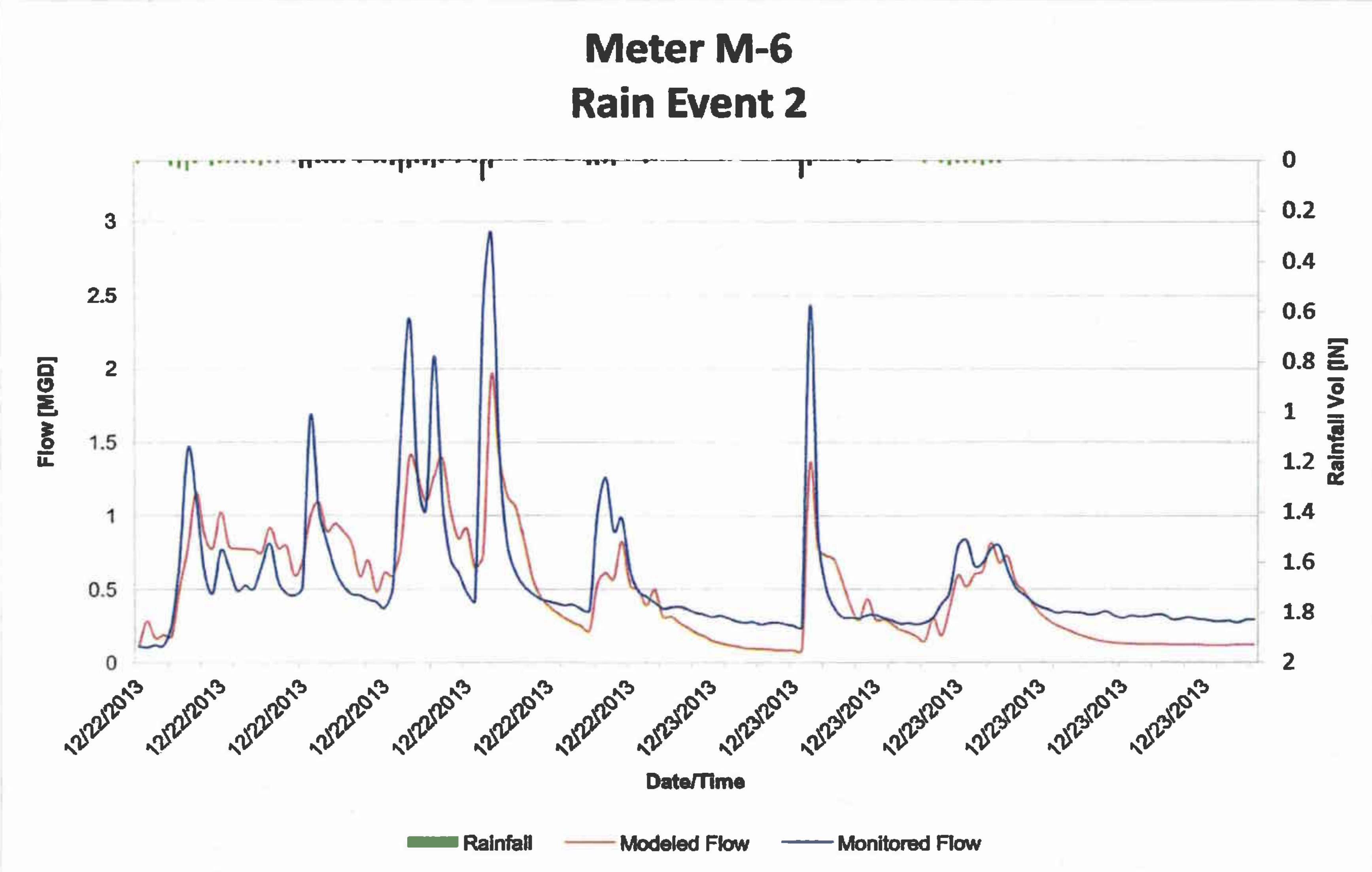


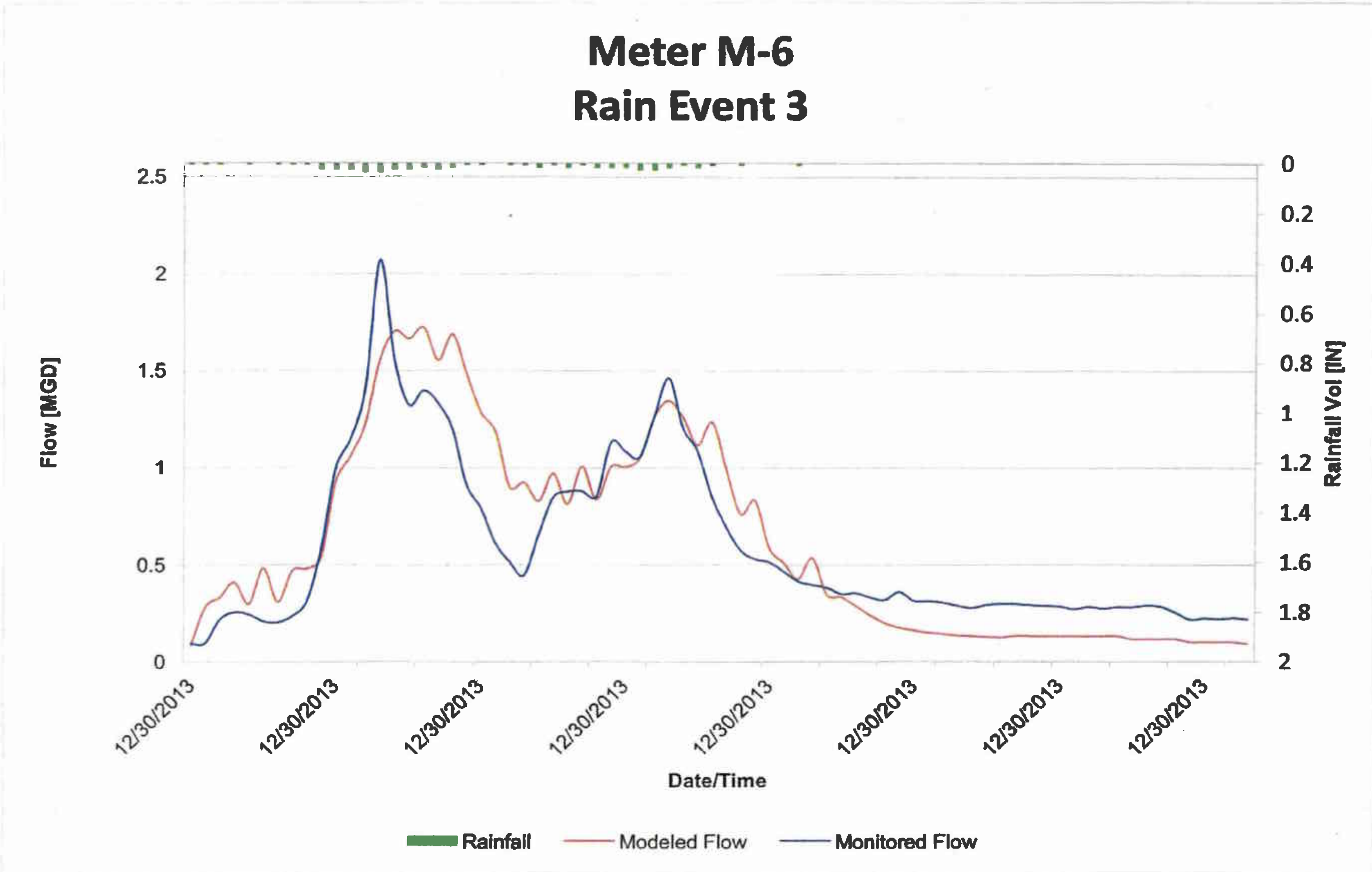
Meter M-5A18
Rain Event 8
Flow [MGD]
0.025
0.02
0.015
0.01
0.005
0
Rainfall Vol [IN]
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
5/22/13 16:00
5/22/13 18:30
5/22/13 21:00
5/22/13 23:30
5/23/13 2:00
5/23/13 4:30
5/23/13 7:00
5/23/13 9:30
5/23/13 12:00
5/23/13 14:30
5/23/13 17:00
5/23/13 19:30
5/23/13 22:00
5/24/13 0:30
5/24/13 3:00
5/24/13 5:30
5/24/13 8:00
5/24/13 10:30
Date/Time
Rainfall
Modeled Flow
Monitored Flow

M-6
SUMMER MODEL
RAIN EVENTS

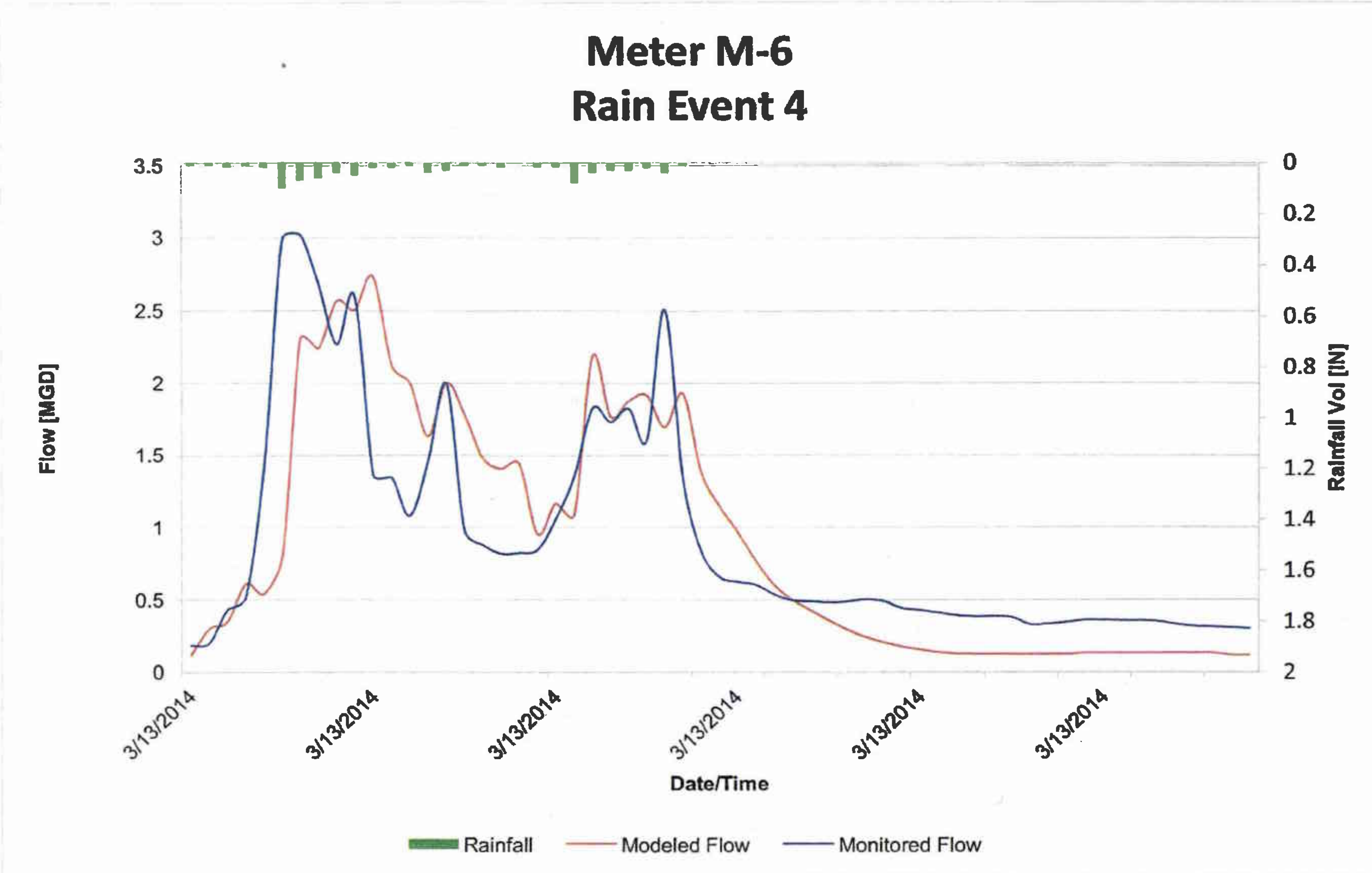
No.	Start Date	End Date	Total Rain	Max Int	Peak MOD Flow	Peak MON Flow	% Difference		Modeled Volume	Monitored Volume	% Difference	
1	12/15/13 13:00	12/16/13 11:30	0.50	0.20	1.22	1.23	1.46%	Mod LOW	0.303	0.231	23.82%	Mod HIGH
2	12/22/13 6:45	12/23/13 14:45	0.95	0.32	1.95	2.91	32.98%	Mod LOW	0.546	0.588	7.06%	Mod LOW
3	12/30/13 6:00	12/30/13 22:15	0.67	0.16	1.72	2.07	16.82%	Mod LOW	0.425	0.364	14.37%	Mod HIGH
4	3/13/14 8:00	3/13/14 20:30	0.84	0.40	2.73	3.02	9.45%	Mod LOW	0.479	0.444	7.37%	Mod HIGH
5	3/30/14 12:00	3/31/14 11:00	0.78	0.16	1.87	1.98	6.03%	Mod LOW	0.491	0.401	18.22%	Mod HIGH
6	4/3/14 5:30	4/3/14 15:00	0.50	0.28	2.77	2.96	6.21%	Mod LOW	0.283	0.237	16.12%	Mod HIGH
7	4/5/14 7:45	4/6/14 0:15	0.65	0.44	2.65	3.069	13.66%	Mod LOW	0.342	0.387	11.66%	Mod LOW


Meter M-6
Rain Event 1
Flow [MGD]
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
Rainfall Vol [IN]
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
12/15/2013
12/15/2013
12/15/2013
12/15/2013
12/15/2013
12/16/2013
12/16/2013
12/16/2013
12/16/2013
12/16/2013
Date/Time
Rainfall
Modeled Flow
Monitored Flow

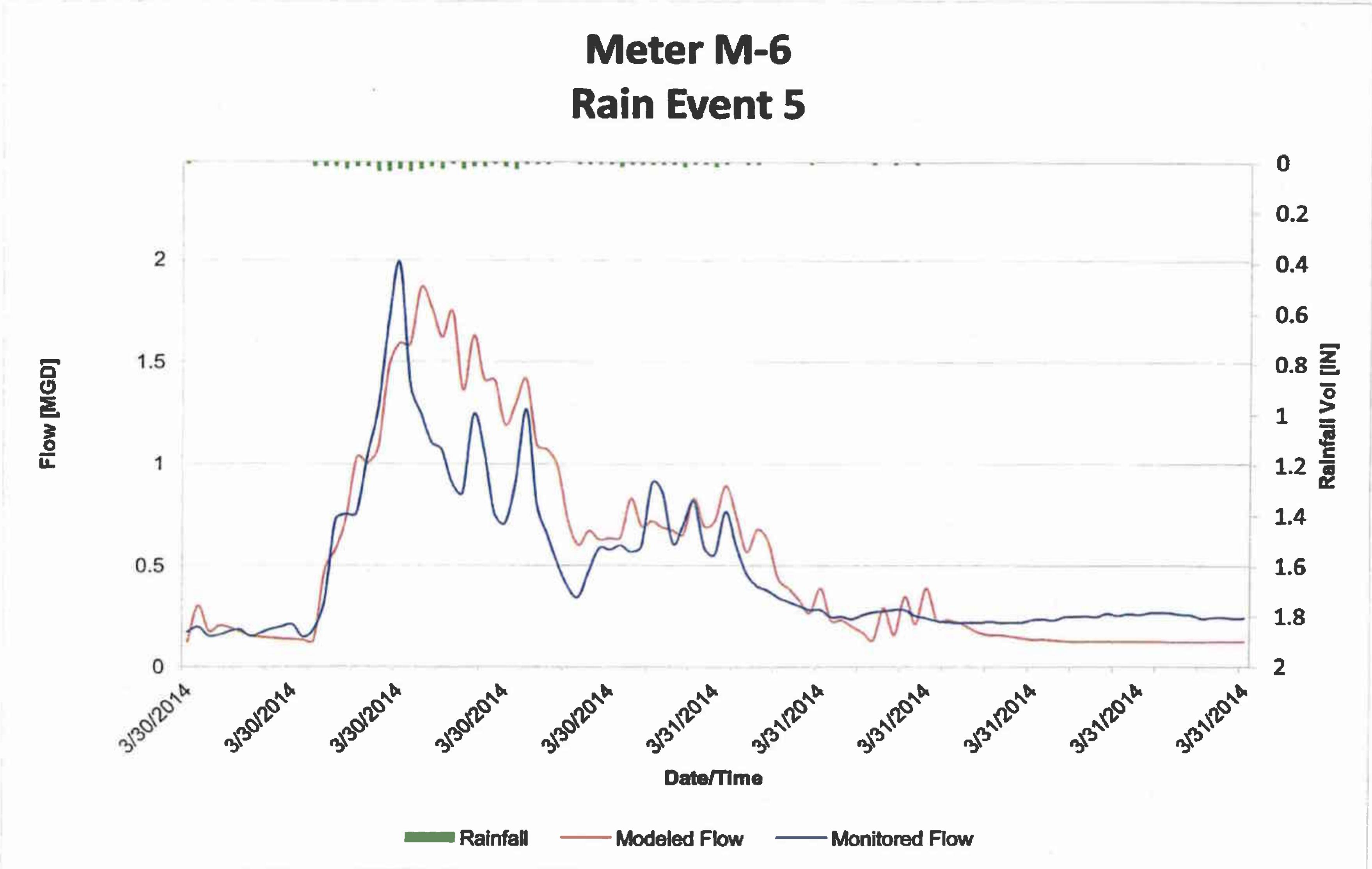

Meter M-6
Rain Event 2
Flow [MGD]
0
0.5
1
1.5
2
2.5
3
Rainfall Vol [IN]
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
12/22/2013
12/22/2013
12/22/2013
12/22/2013
12/22/2013
12/22/2013
12/22/2013
12/23/2013
12/23/2013
12/23/2013
12/23/2013
12/23/2013
12/23/2013
12/23/2013
Date/Time
Rainfall
Modeled Flow
Monitored Flow



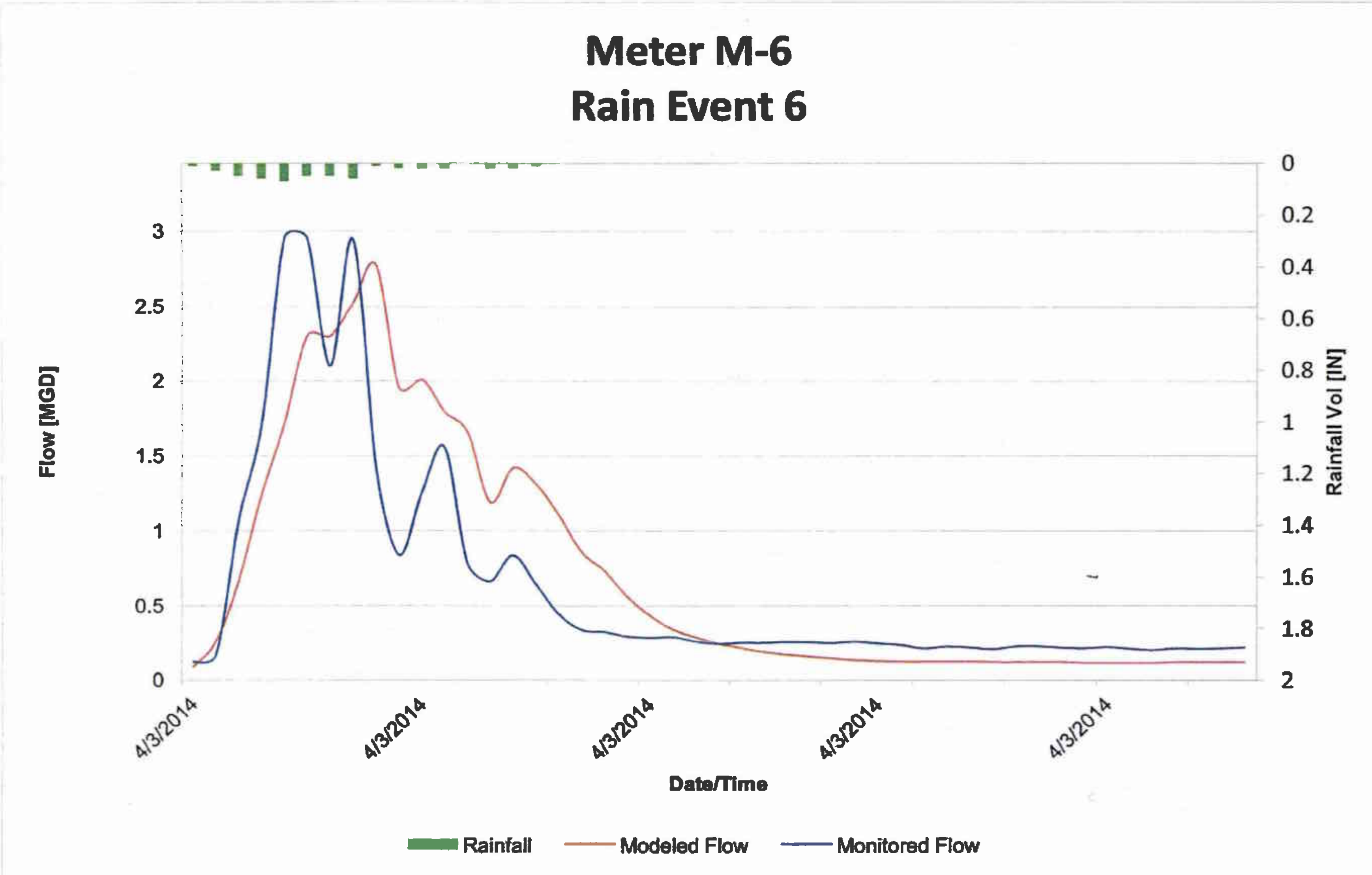
Meter M-6
Rain Event 3
Flow [MGD]
2.5
2
1.5
1
0.5
0
Rainfall Vol [IN]
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
12/30/2013
12/30/2013
12/30/2013
12/30/2013
12/30/2013
12/30/2013
12/30/2013
12/30/2013
Date/Time
Rainfall
Modeled Flow
Monitored Flow



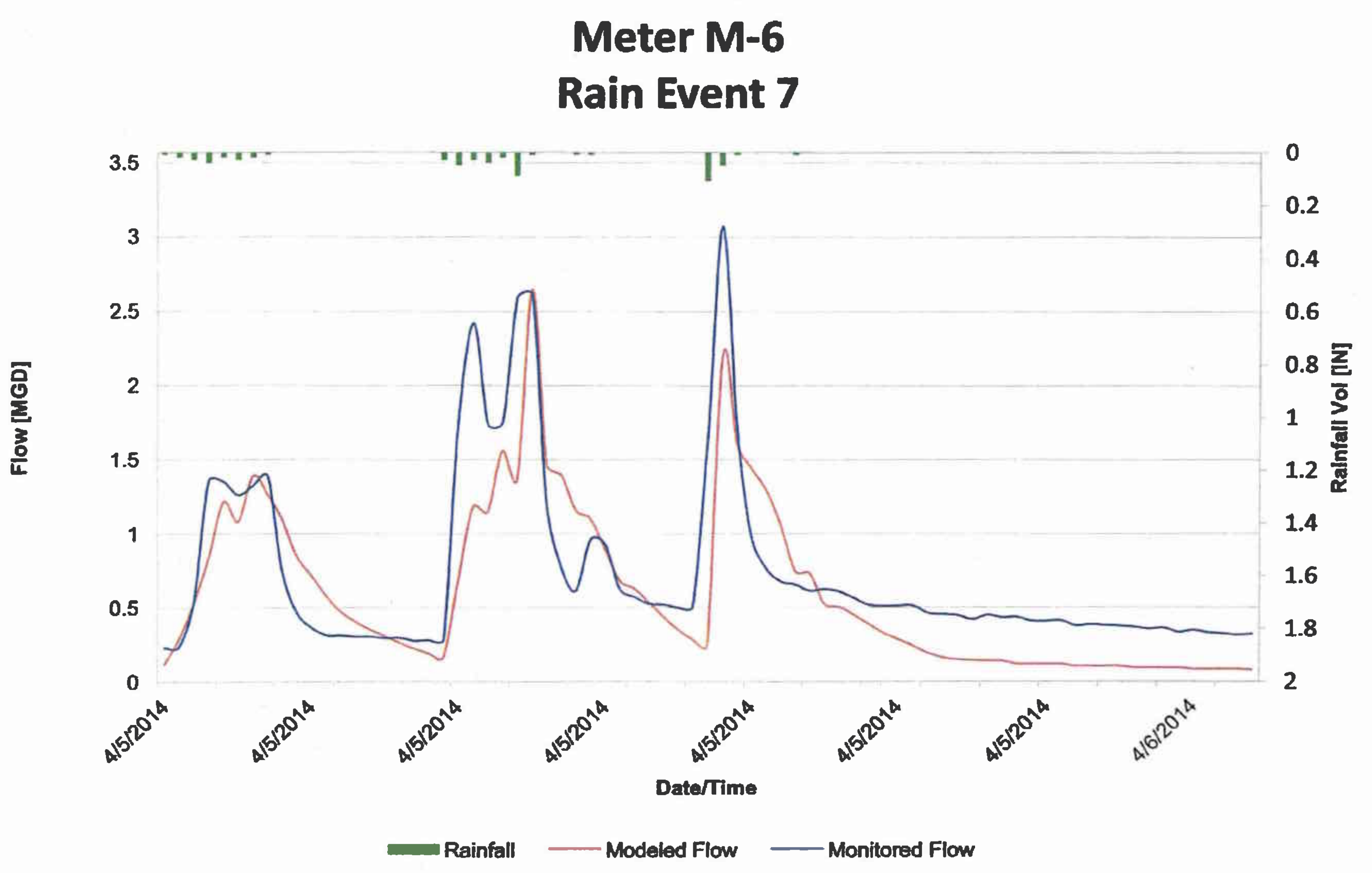
Meter M-6
Rain Event 4
Flow [MGD]
3.5
3
2.5
2
1.5
1
0.5
0
Rainfall Vol [IN]
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
3/13/2014
3/13/2014
3/13/2014
3/13/2014
3/13/2014
3/13/2014
Date/Time
Rainfall
Modeled Flow
Monitored Flow



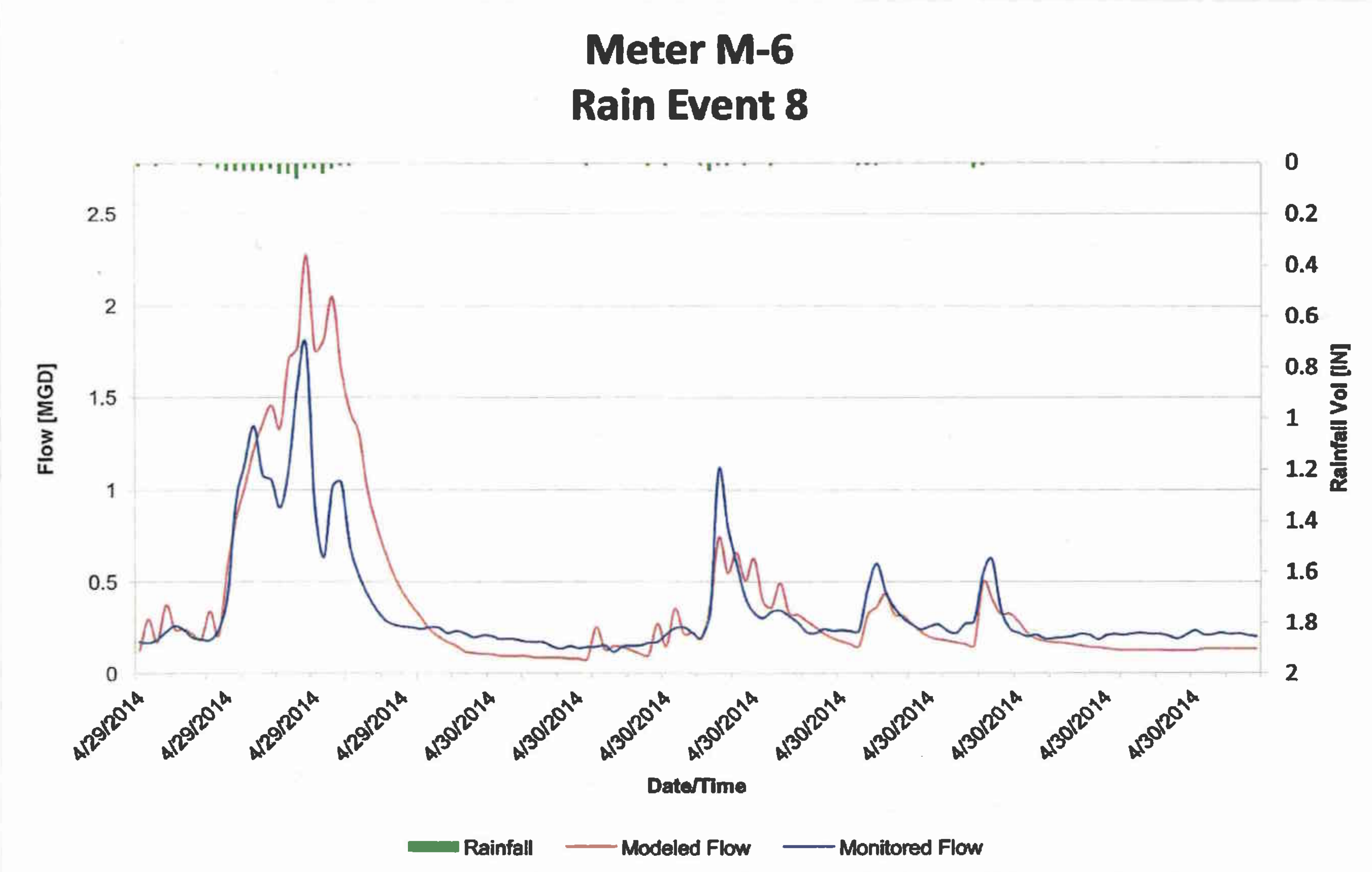
Meter M-6
Rain Event 5
Flow [MGD]
2
1.5
1
0.5
0
Rainfall Vol [IN]
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
3/30/2014
3/30/2014
3/30/2014
3/30/2014
3/30/2014
3/31/2014
3/31/2014
3/31/2014
3/31/2014
3/31/2014
3/31/2014
Date/Time
Rainfall
Modeled Flow
Monitored Flow



Meter M-6
Rain Event 6
Flow [MGD]
3
2.5
2
1.5
1
0.5
0
Rainfall Vol [IN]
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
4/3/2014
4/3/2014
4/3/2014
4/3/2014
4/3/2014
Date/Time
Rainfall
Modeled Flow
Monitored Flow



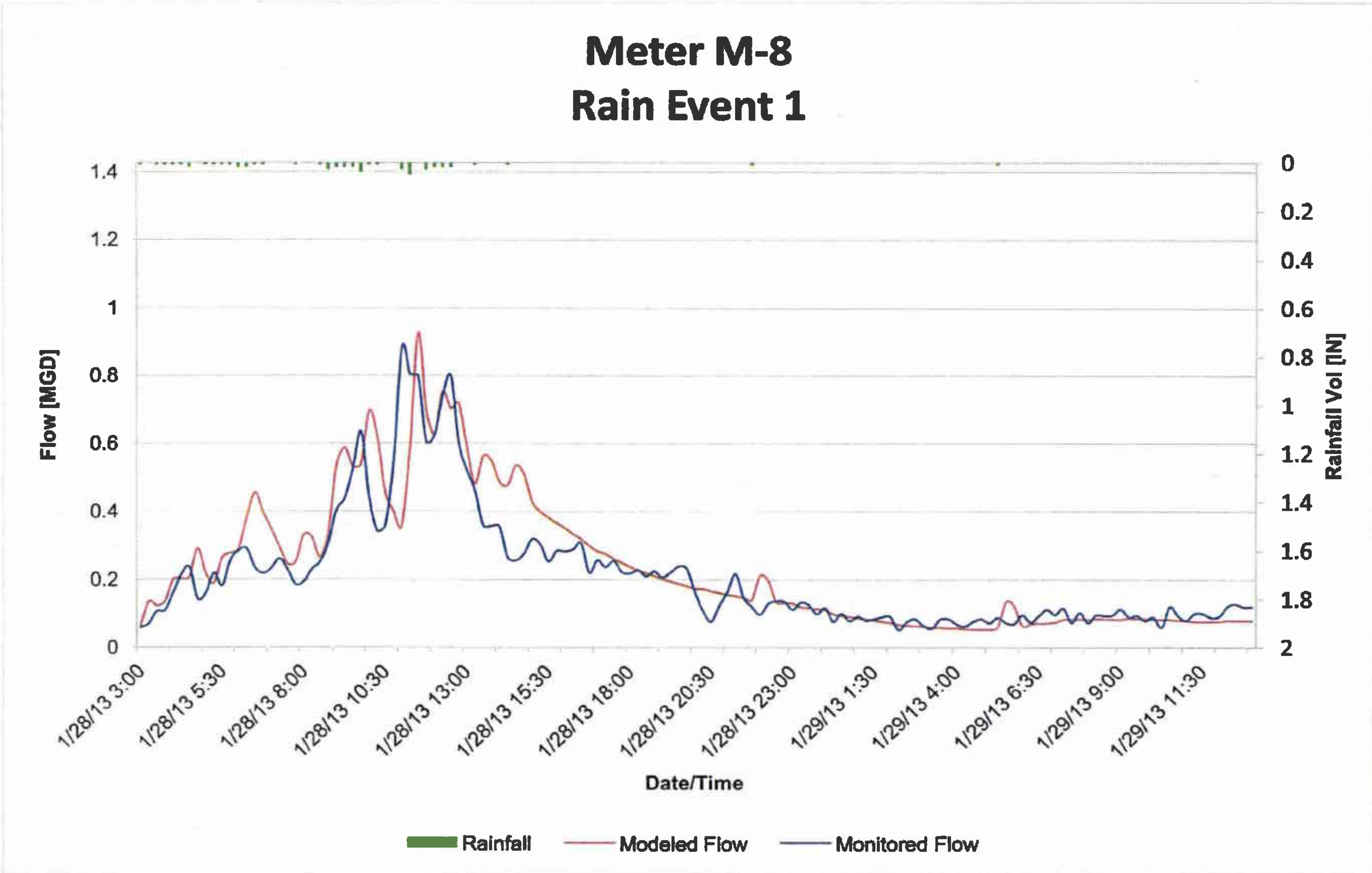
Meter M-6
Rain Event 7
Flow [MGD]
3.5
3
2.5
2
1.5
1
0.5
0
Rainfall Vol [IN]
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
4/5/2014
4/5/2014
4/5/2014
4/5/2014
4/5/2014
4/5/2014
4/5/2014
4/6/2014
Date/Time
Rainfall
Modeled Flow
Monitored Flow



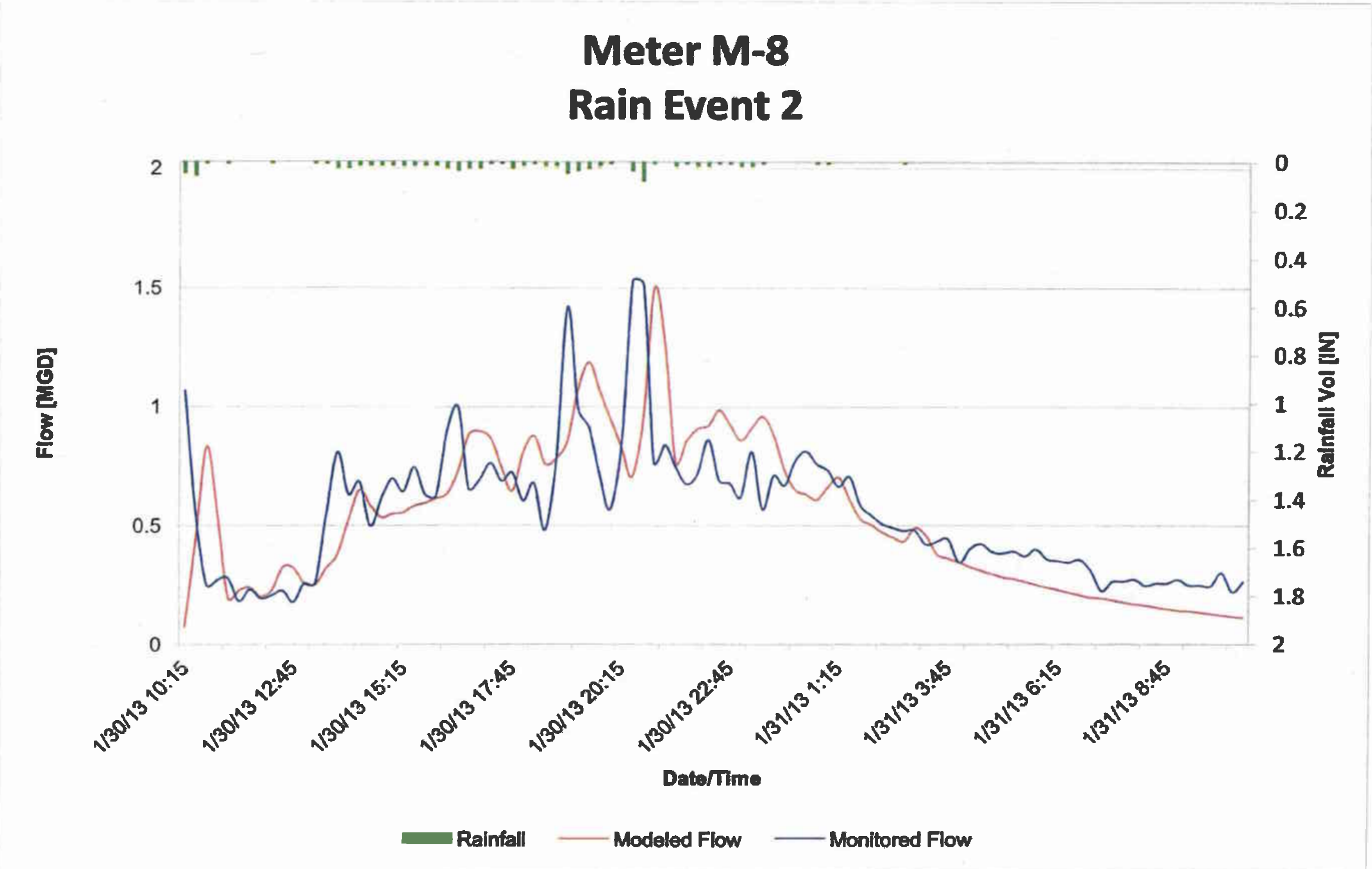
Meter M-6
Rain Event 8
Flow [MGD]
2.5
2
1.5
1
0.5
0
Rainfall Vol [IN]
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
4/29/2014
4/29/2014
4/29/2014
4/29/2014
4/30/2014
4/30/2014
4/30/2014
4/30/2014
4/30/2014
4/30/2014
4/30/2014
4/30/2014
4/30/2014
Date/Time
Rainfall
Modeled Flow
Monitored Flow

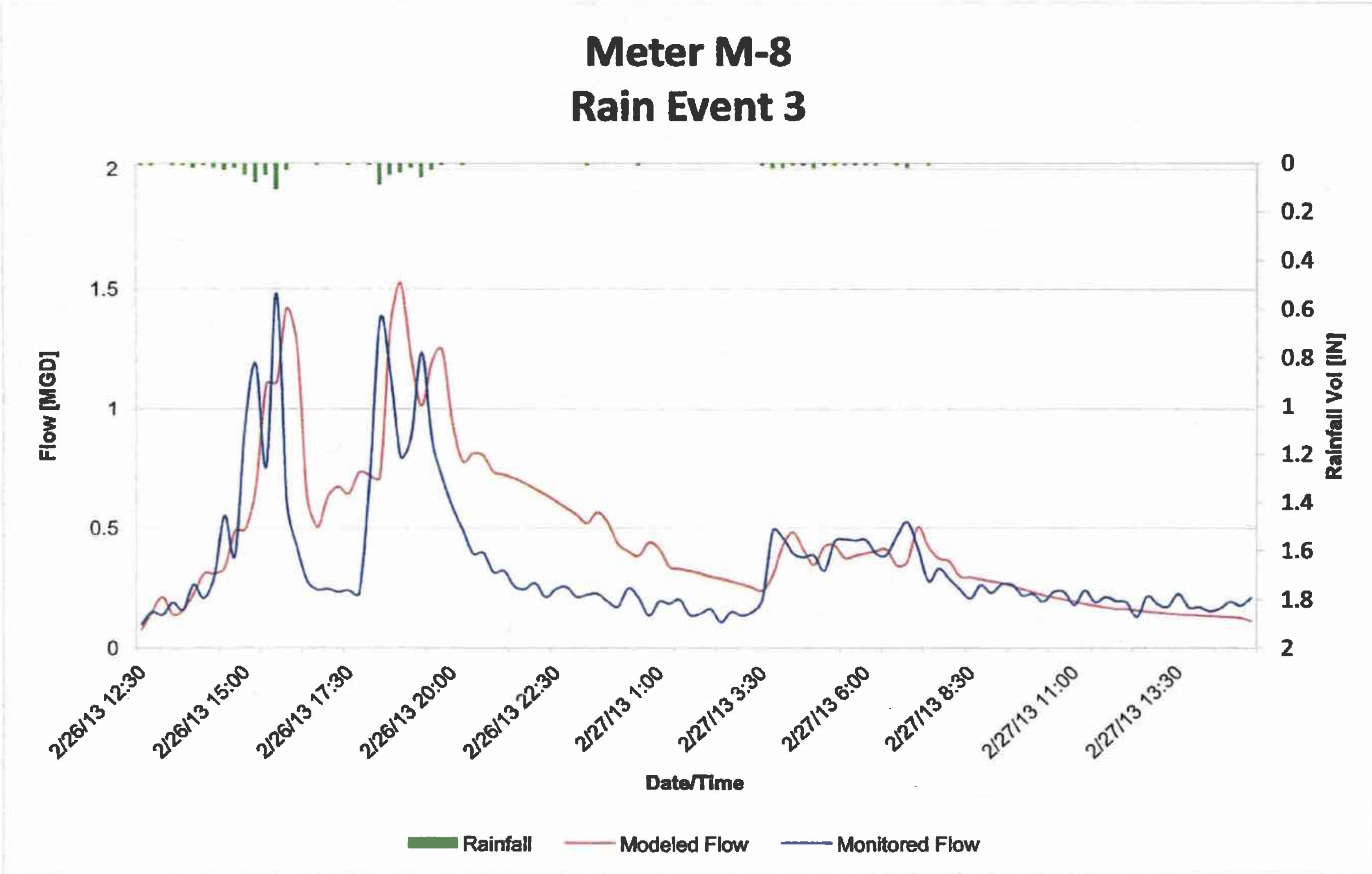
M-8
SUMMER MODEL
RAIN EVENTS

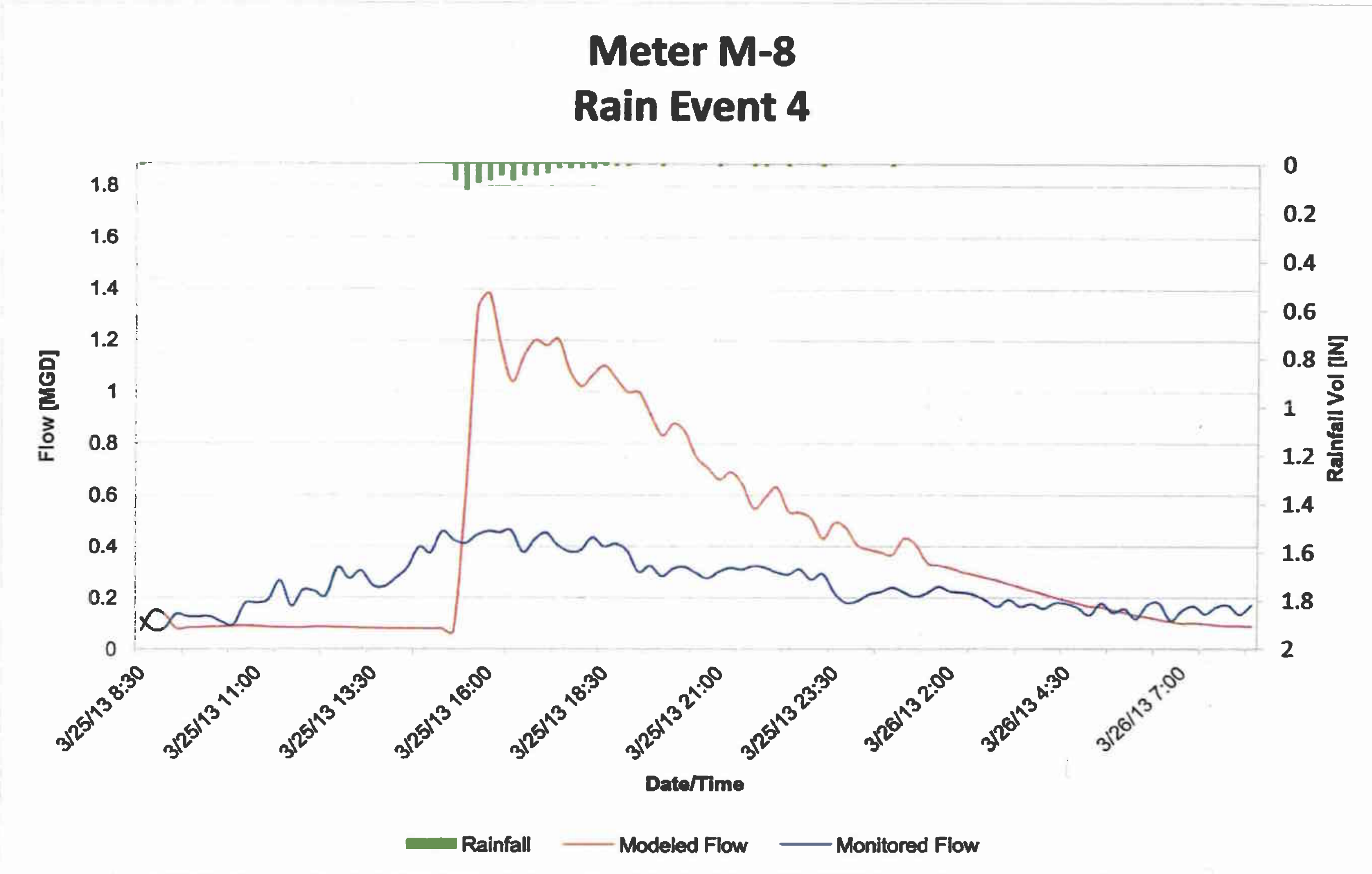
No.	Start Date	End Date	Total Rain	Max Int	Peak MOD Flow	Peak MON Flow	% Difference		Modeled Volume	Monitored Volume	% Difference	
1	1/28/13 3:00	1/28/13 20:00	0.53	0.20	0.93	0.89	4.53%	Mod HIGH	0.202	0.174	14.24%	Mod HIGH
2	1/30/13 10:15	1/31/13 8:30	1.08	0.32	1.50	1.53	1.79%	Mod LOW	0.440	0.425	3.20%	Mod HIGH
3	2/26/13 12:30	2/27/13 13:15	1.01	0.44	1.53	1.48	2.84%	Mod HIGH	0.362	0.287	20.70%	Mod HIGH
4	3/25/13 15:15	3/26/13 6:30	0.77	0.44	1.39	0.46	66.81%	Mod HIGH	0.302	0.128	57.61%	Mod HIGH
5	4/10/13 15:45	4/11/13 5:30	0.58	0.88	1.93	2.16	10.62%	Mod LOW	0.142	0.052	63.26%	Mod HIGH
6	4/16/13 20:00	4/17/13 4:45	1.13	2.40	5.36	2.44	54.38%	Mod HIGH	0.293	0.148	49.30%	Mod HIGH
7	5/22/13 23:15	5/23/13 14:30	0.52	0.72	1.914	2.267	15.57%	Mod LOW	0.160	0.101	36.84%	Mod HIGH



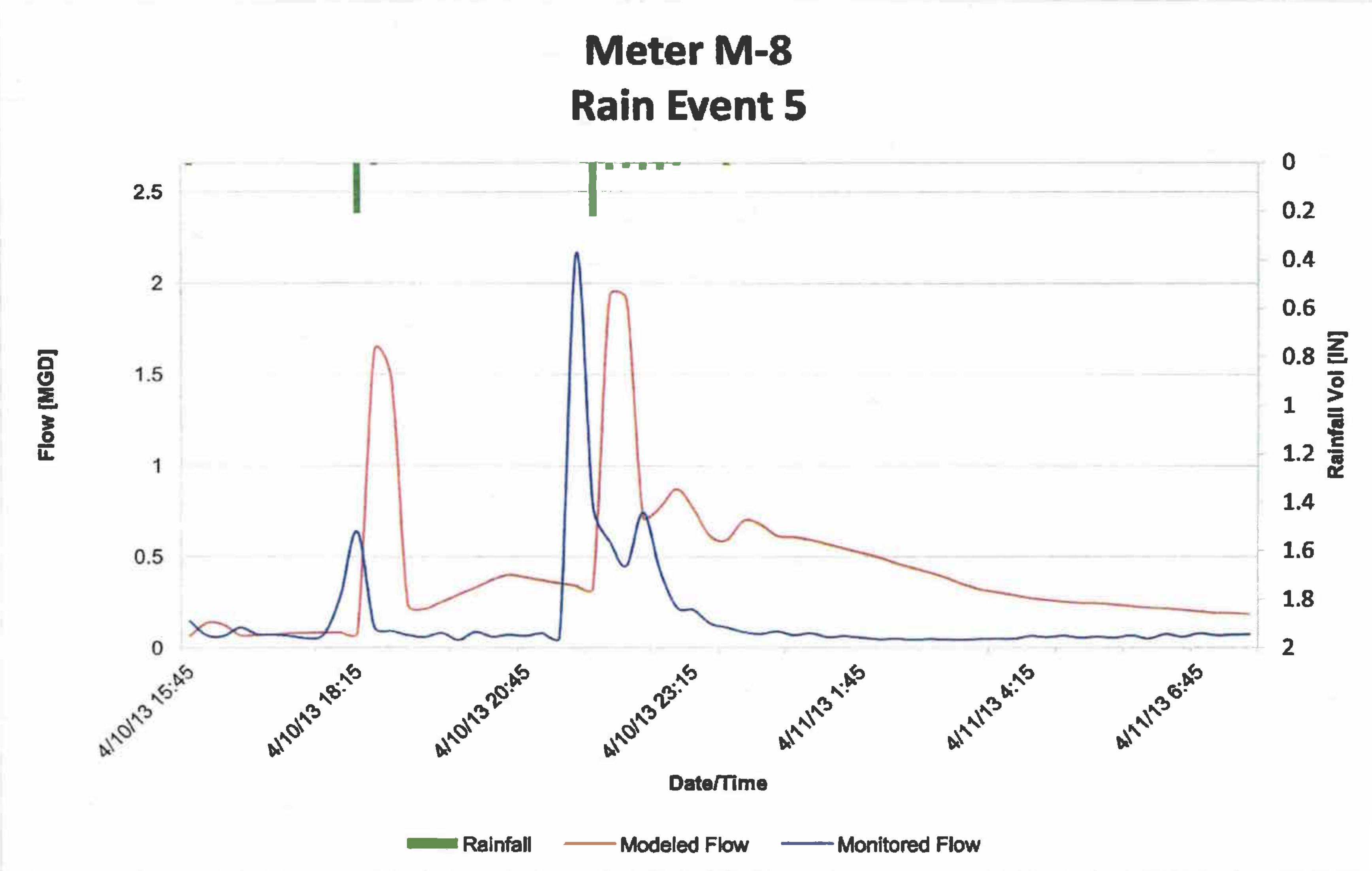
Meter M-8
Rain Event 1
Flow [MGD]
Rainfall Vol [IN]
1.4
1.2
1
0.8
0.6
0.4
0.2
0
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
1/28/13 3:00
1/28/13 5:30
1/28/13 8:00
1/28/13 10:30
1/28/13 13:00
1/28/13 15:30
1/28/13 18:00
1/28/13 20:30
1/28/13 23:00
1/29/13 1:30
1/29/13 4:00
1/29/13 6:30
1/29/13 9:00
1/29/13 11:30
Date/Time
Rainfall
Modeled Flow
Monitored Flow


Meter M-8
Rain Event 2
Flow [MGD]
Rainfall Vol [IN]
Date/Time
0
0.5
1
1.5
2
0.2
0.4
0.6
0.8
1.2
1.4
1.6
1.8
1/30/13 10:15
1/30/13 12:45
1/30/13 15:15
1/30/13 17:45
1/30/13 20:15
1/30/13 22:45
1/31/13 1:15
1/31/13 3:45
1/31/13 6:15
1/31/13 8:45
Rainfall
Modeled Flow
Monitored Flow

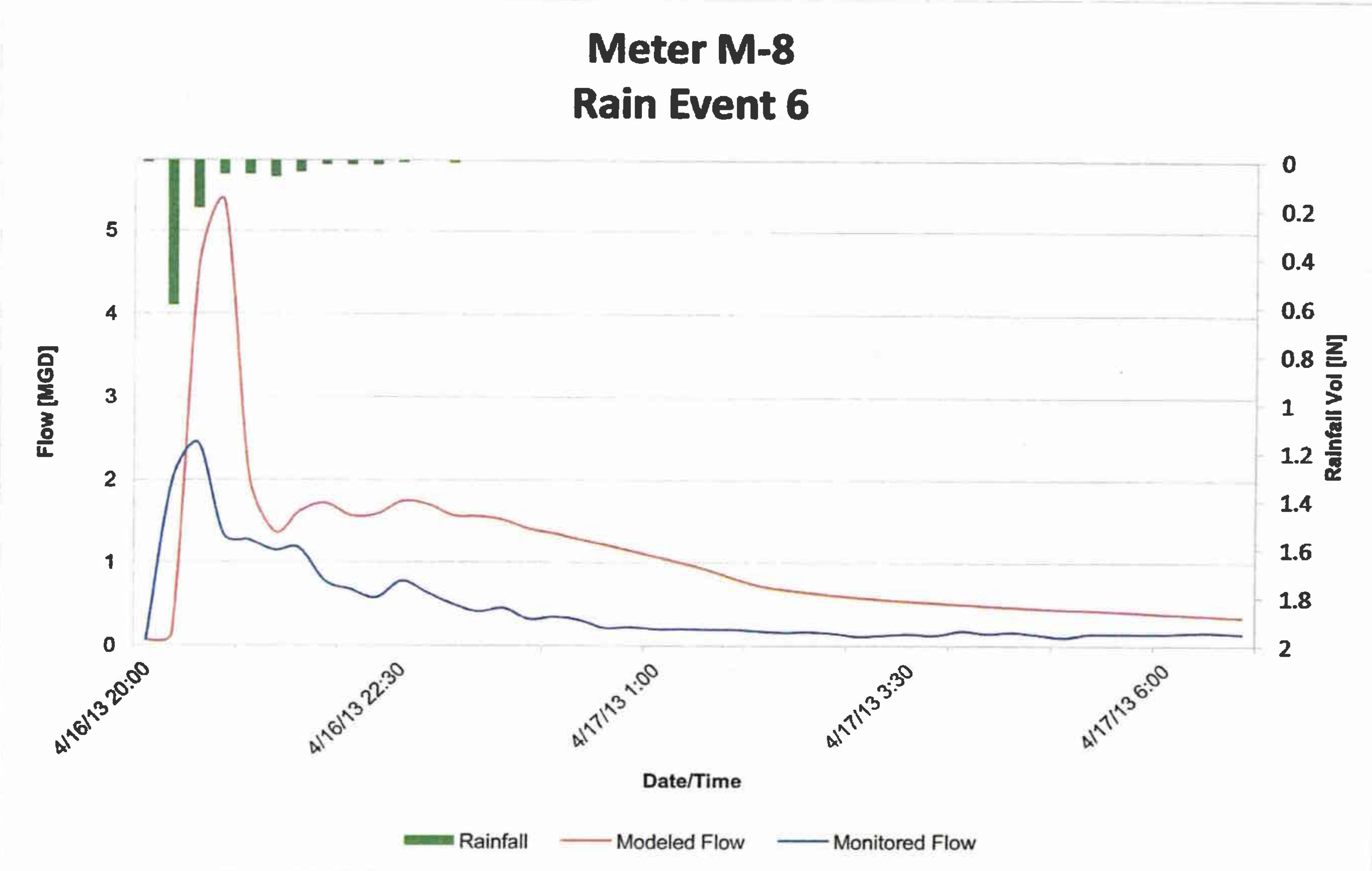

Meter M-8
Rain Event 3
Flow [MGD]
2
1.5
1
0.5
0
Rainfall Vol [IN]
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
2/26/13 12:30
2/26/13 15:00
2/26/13 17:30
2/26/13 20:00
2/26/13 22:30
2/27/13 1:00
2/27/13 3:30
2/27/13 6:00
2/27/13 8:30
2/27/13 11:00
2/27/13 13:30
Date/Time
Rainfall
Modeled Flow
Monitored Flow

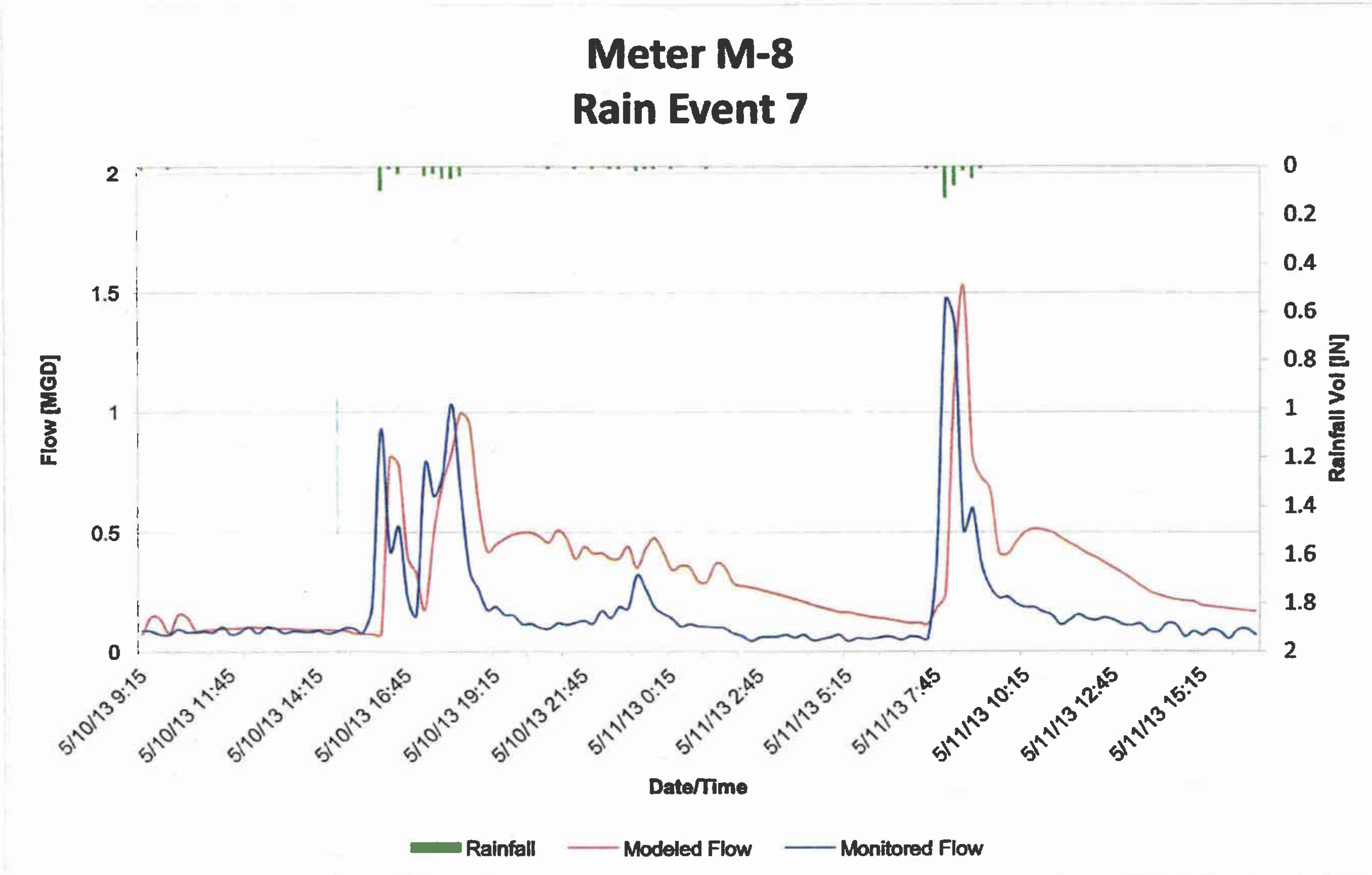


Meter M-8
Rain Event 4
Flow [MGD]
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
Rainfall Vol [IN]
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
3/25/13 8:30
3/25/13 11:00
3/25/13 13:30
3/25/13 16:00
3/25/13 18:30
3/25/13 21:00
3/25/13 23:30
3/26/13 2:00
3/26/13 4:30
3/26/13 7:00
Date/Time
Rainfall
Modeled Flow
Monitored Flow

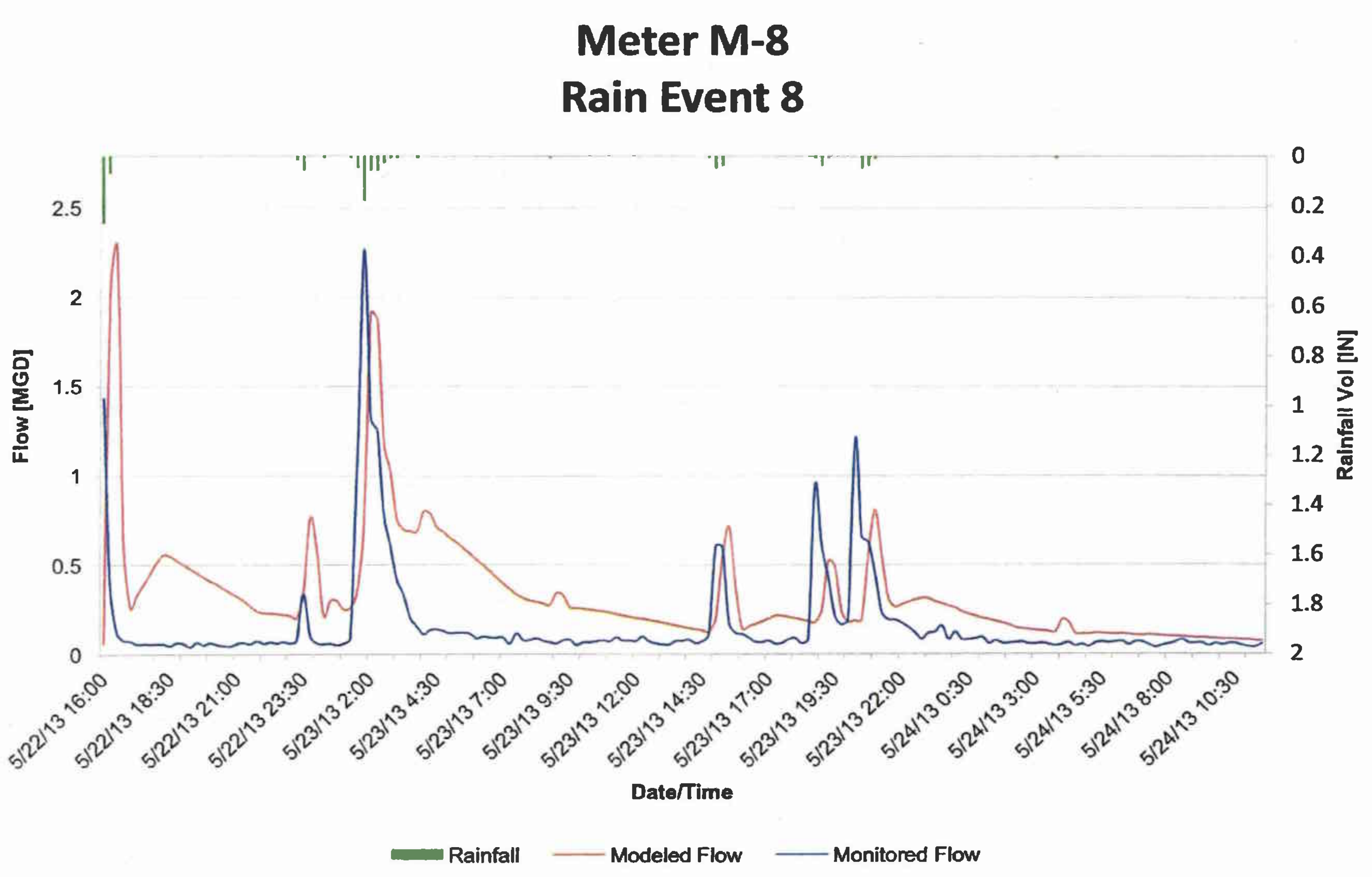


Meter M-8
Rain Event 5
Flow [MGD]
2.5
2
1.5
1
0.5
0
Rainfall Vol [IN]
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
4/10/13 15:45
4/10/13 18:15
4/10/13 20:45
4/10/13 23:15
4/11/13 1:45
4/11/13 4:15
4/11/13 6:45
Date/Time
Rainfall
Modeled Flow
Monitored Flow


Meter M-8
Rain Event 6
Flow [MGD]
0
1
2
3
4
5
Rainfall Vol [IN]
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
4/16/13 20:00
4/16/13 22:30
4/17/13 1:00
4/17/13 3:30
4/17/13 6:00
Date/Time
Rainfall
Modeled Flow
Monitored Flow



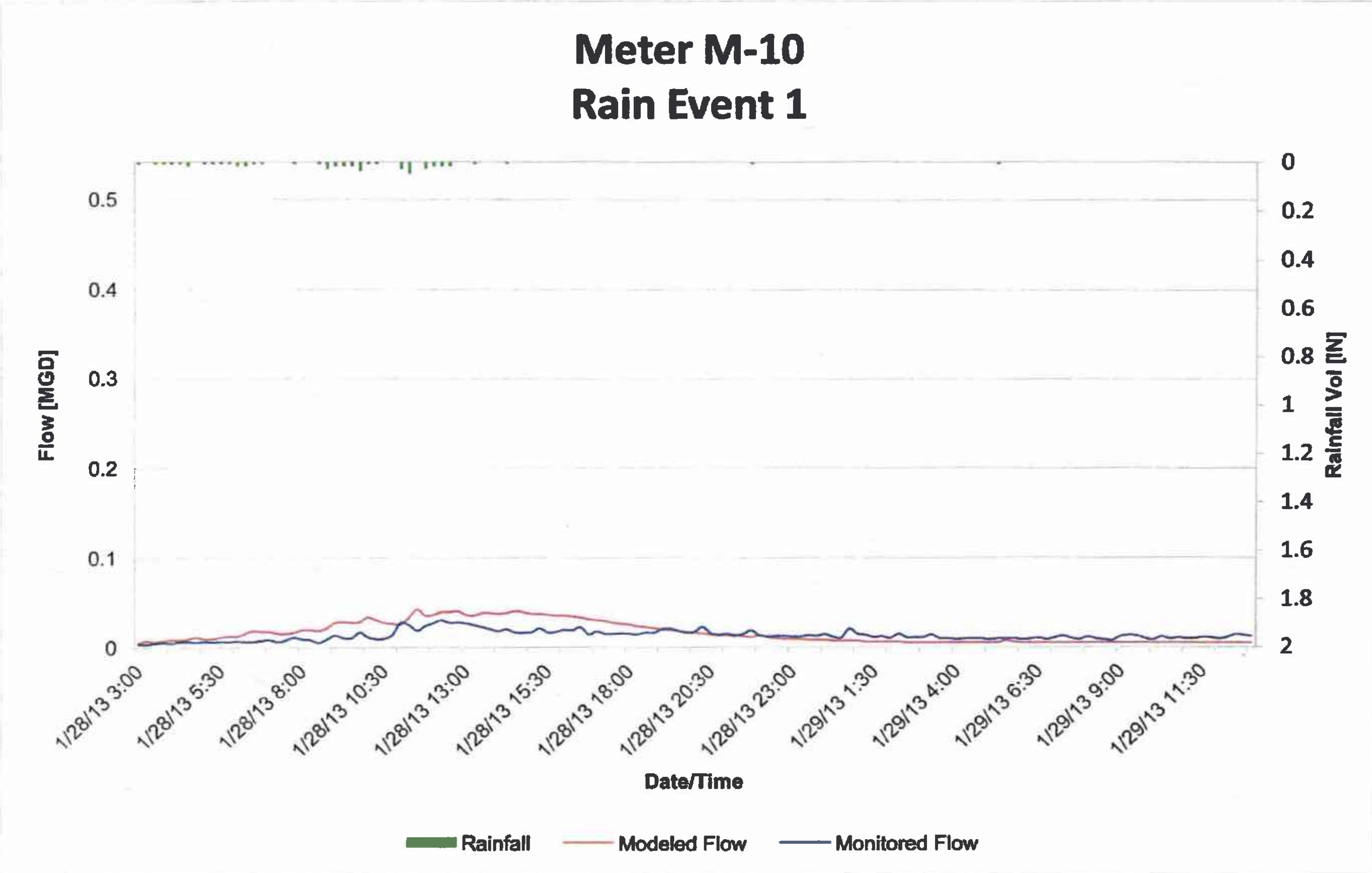
Meter M-8
Rain Event 7
Flow [MGD]
2
1.5
1
0.5
0
Rainfall Vol [IN]
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
5/10/13 9:15
5/10/13 11:45
5/10/13 14:15
5/10/13 16:45
5/10/13 19:15
5/10/13 21:45
5/11/13 0:15
5/11/13 2:45
5/11/13 5:15
5/11/13 7:45
5/11/13 10:15
5/11/13 12:45
5/11/13 15:15
Date/Time
Rainfall
Modeled Flow
Monitored Flow

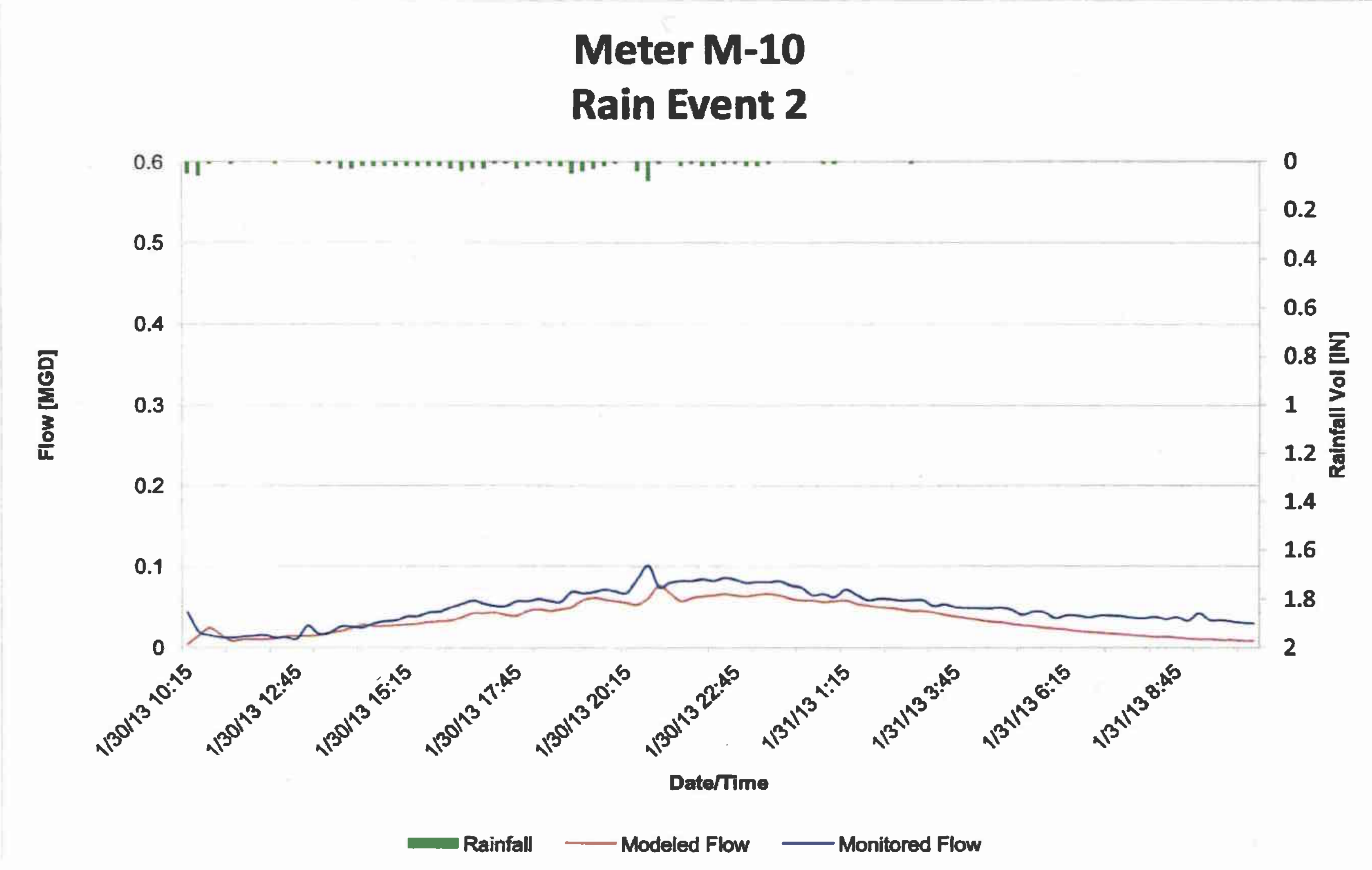


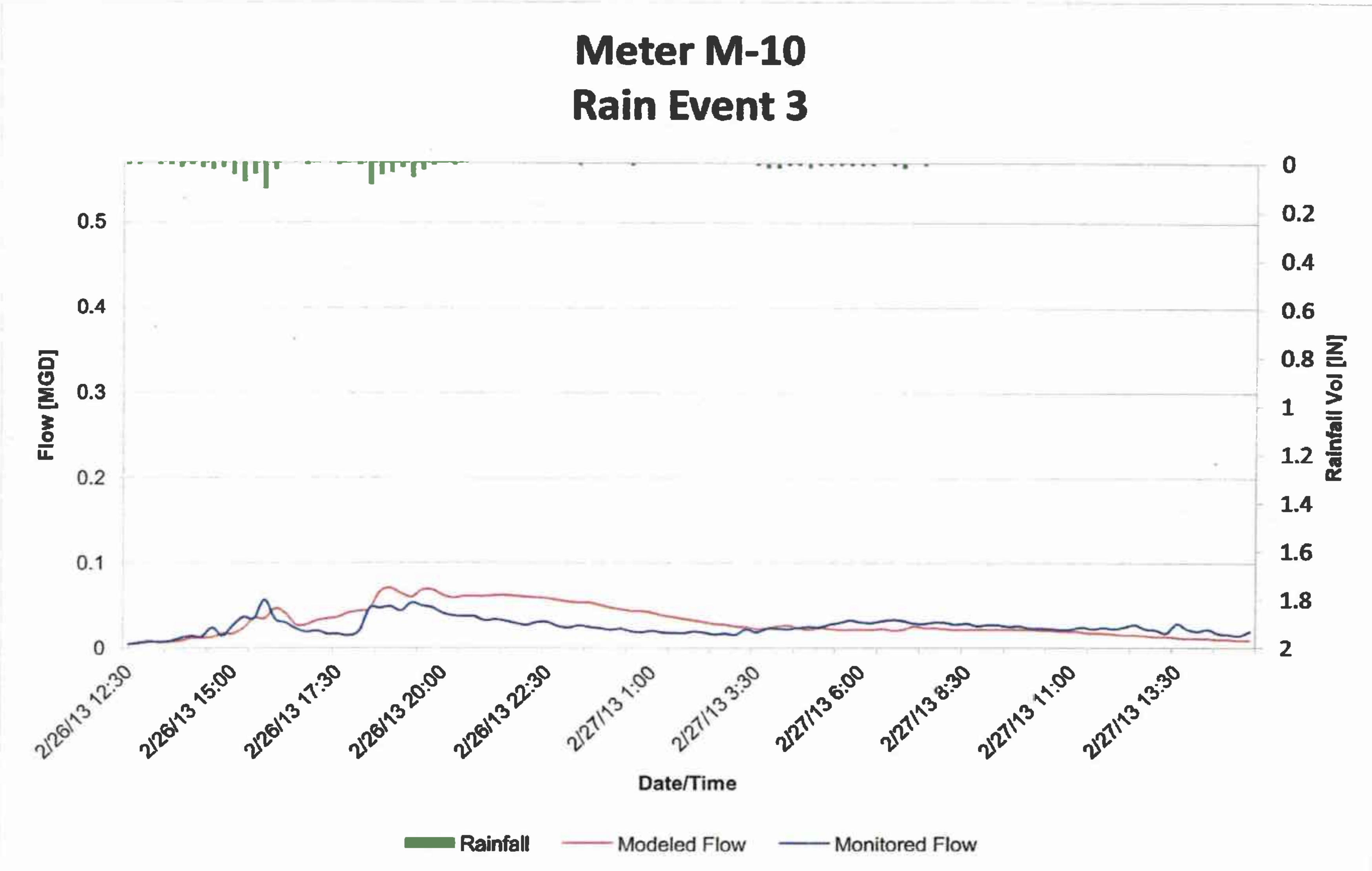
Meter M-8
Rain Event 8
Flow [MGD]
2.5
2
1.5
1
0.5
0
Rainfall Vol [IN]
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
5/22/13 16:00
5/22/13 18:30
5/22/13 21:00
5/22/13 23:30
5/23/13 2:00
5/23/13 4:30
5/23/13 7:00
5/23/13 9:30
5/23/13 12:00
5/23/13 14:30
5/23/13 17:00
5/23/13 19:30
5/23/13 22:00
5/24/13 0:30
5/24/13 3:00
5/24/13 5:30
5/24/13 8:00
5/24/13 10:30
Date/Time
Rainfall
Modeled Flow
Monitored Flow

M-10
SUMMER MODEL
RAIN EVENTS

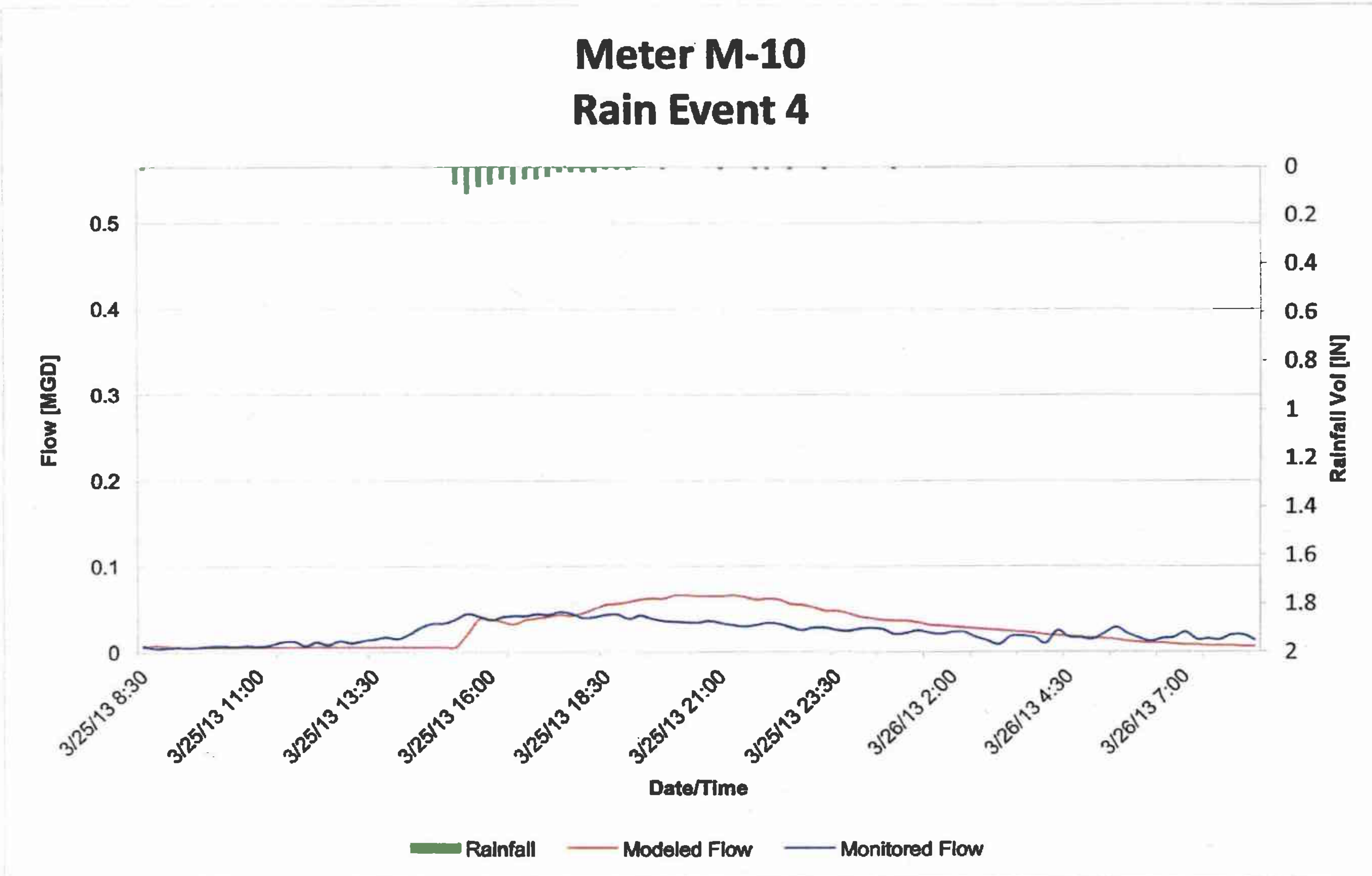
No.	Start Date	End Date	Total Rain	Max Int	Peak MOD Flow	Peak MON Flow	% Difference		Modeled Volume	Monitored Volume	% Difference	
1	1/28/13 3:00	1/28/13 20:00	0.53	0.20	0.04	0.03	27.78%	Mod HIGH	0.011	0.006	44.98%	Mod HIGH
2	1/30/13 10:15	1/31/13 8:30	1.08	0.32	0.08	0.10	24.50%	Mod LOW	0.026	0.034	21.69%	Mod LOW
3	2/26/13 12:30	2/27/13 13:15	1.01	0.44	0.07	0.06	20.00%	Mod HIGH	0.020	0.016	17.41%	Mod HIGH
4	3/25/13 15:15	3/26/13 6:30	0.77	0.44	0.07	0.05	29.29%	Mod HIGH	0.018	0.013	26.34%	Mod HIGH
5	4/10/13 15:45	4/11/13 5:30	0.58	0.88	0.07	0.06	14.16%	Mod HIGH	0.006	0.002	70.36%	Mod HIGH
6	4/16/13 20:00	4/17/13 4:45	1.13	2.40	0.14	0.17	18.34%	Mod LOW	0.011	0.009	21.22%	Mod HIGH
7	5/22/13 23:15	5/23/13 14:30	0.52	0.72	0.066	0.069	4.35%	Mod LOW	0.008	0.005	39.42%	Mod HIGH


Meter M-10
Rain Event 1
0.5
0.4
0.3
0.2
0.1
0
Flow [MGD]
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
Rainfall Vol [IN]
1/28/13 3:00
1/28/13 5:30
1/28/13 8:00
1/28/13 10:30
1/28/13 13:00
1/28/13 15:30
1/28/13 18:00
1/28/13 20:30
1/28/13 23:00
1/29/13 1:30
1/29/13 4:00
1/29/13 6:30
1/29/13 9:00
1/29/13 11:30
Date/Time
Rainfall
Modeled Flow
Monitored Flow


Meter M-10
Rain Event 2
0.6
0.5
0.4
0.3
0.2
0.1
0
Flow [MGD]
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
Rainfall Vol [IN]
1/30/13 10:15
1/30/13 12:45
1/30/13 15:15
1/30/13 17:45
1/30/13 20:15
1/30/13 22:45
1/31/13 1:15
1/31/13 3:45
1/31/13 6:15
1/31/13 8:45
Date/Time
Rainfall
Modeled Flow
Monitored Flow

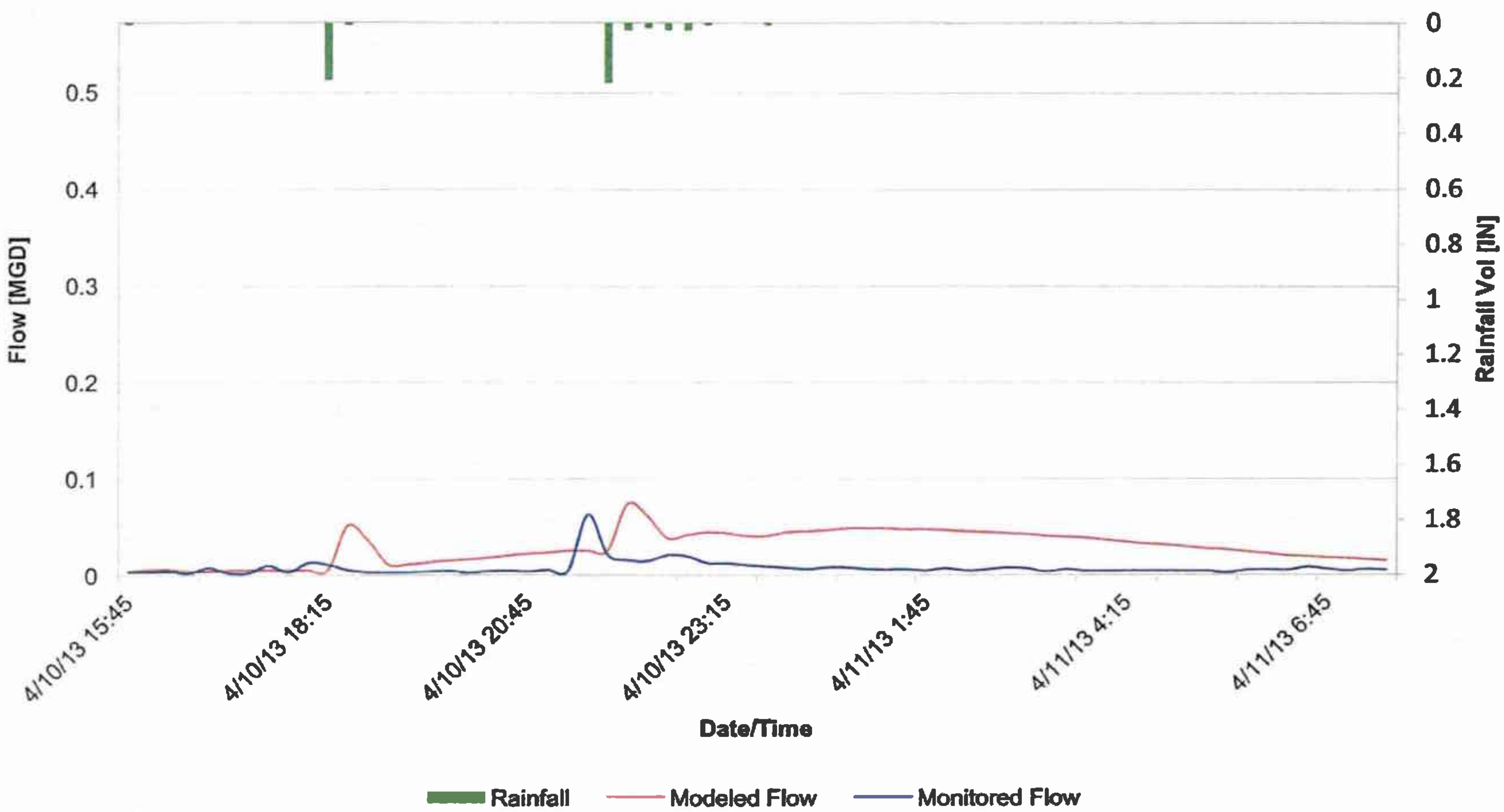


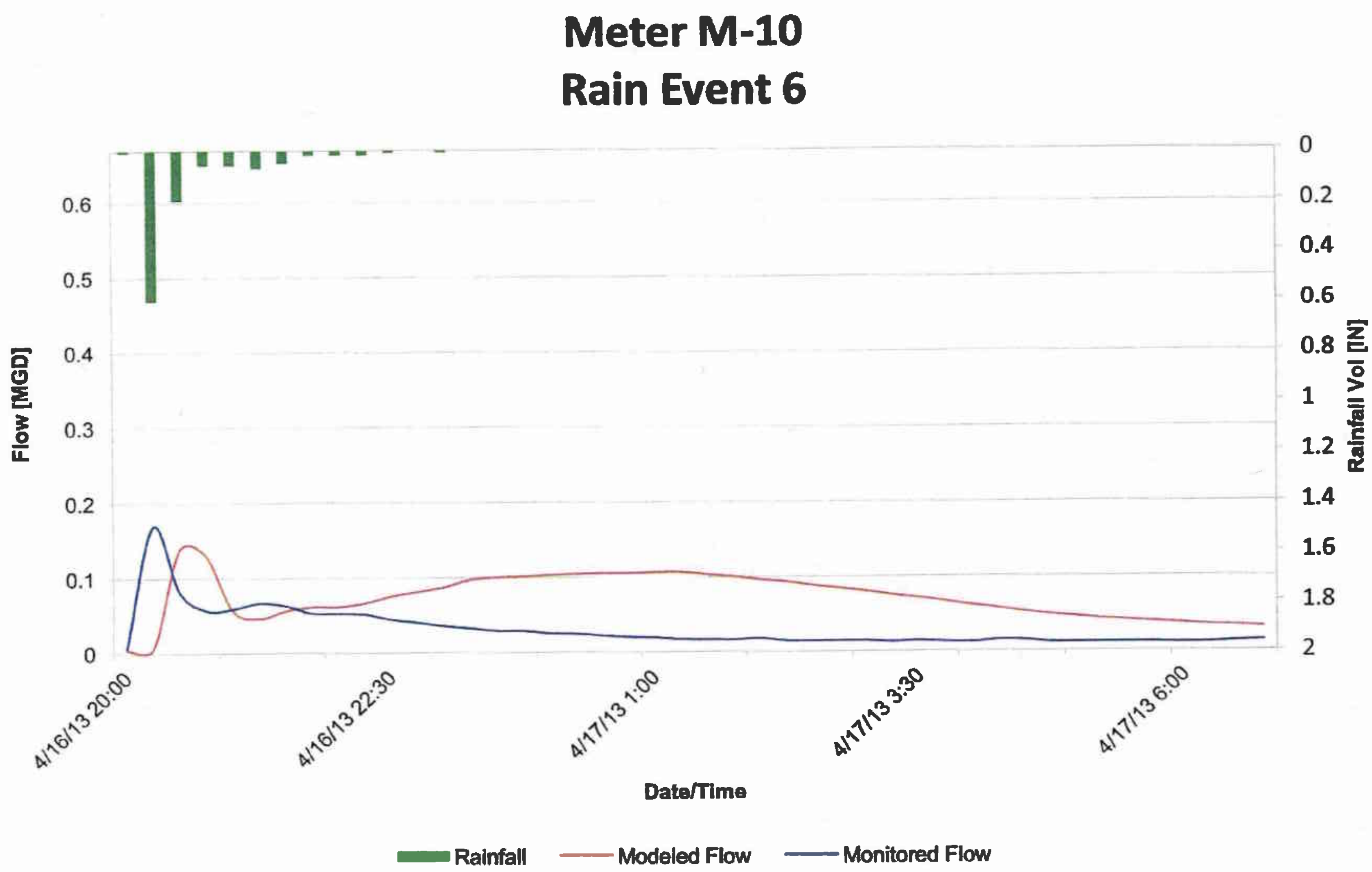
Meter M-10
Rain Event 3
Flow [MGD]
0.5
0.4
0.3
0.2
0.1
0
Rainfall Vol [IN]
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
2/26/13 12:30
2/26/13 15:00
2/26/13 17:30
2/26/13 20:00
2/26/13 22:30
2/27/13 1:00
2/27/13 3:30
2/27/13 6:00
2/27/13 8:30
2/27/13 11:00
2/27/13 13:30
Date/Time
Rainfall
Modeled Flow
Monitored Flow



Meter M-10
Rain Event 4
Flow [MGD]
0.5
0.4
0.3
0.2
0.1
0
Rainfall Vol [IN]
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
3/25/13 8:30
3/25/13 11:00
3/25/13 13:30
3/25/13 16:00
3/25/13 18:30
3/25/13 21:00
3/25/13 23:30
3/26/13 2:00
3/26/13 4:30
3/26/13 7:00
Date/Time
Rainfall
Modeled Flow
Monitored Flow

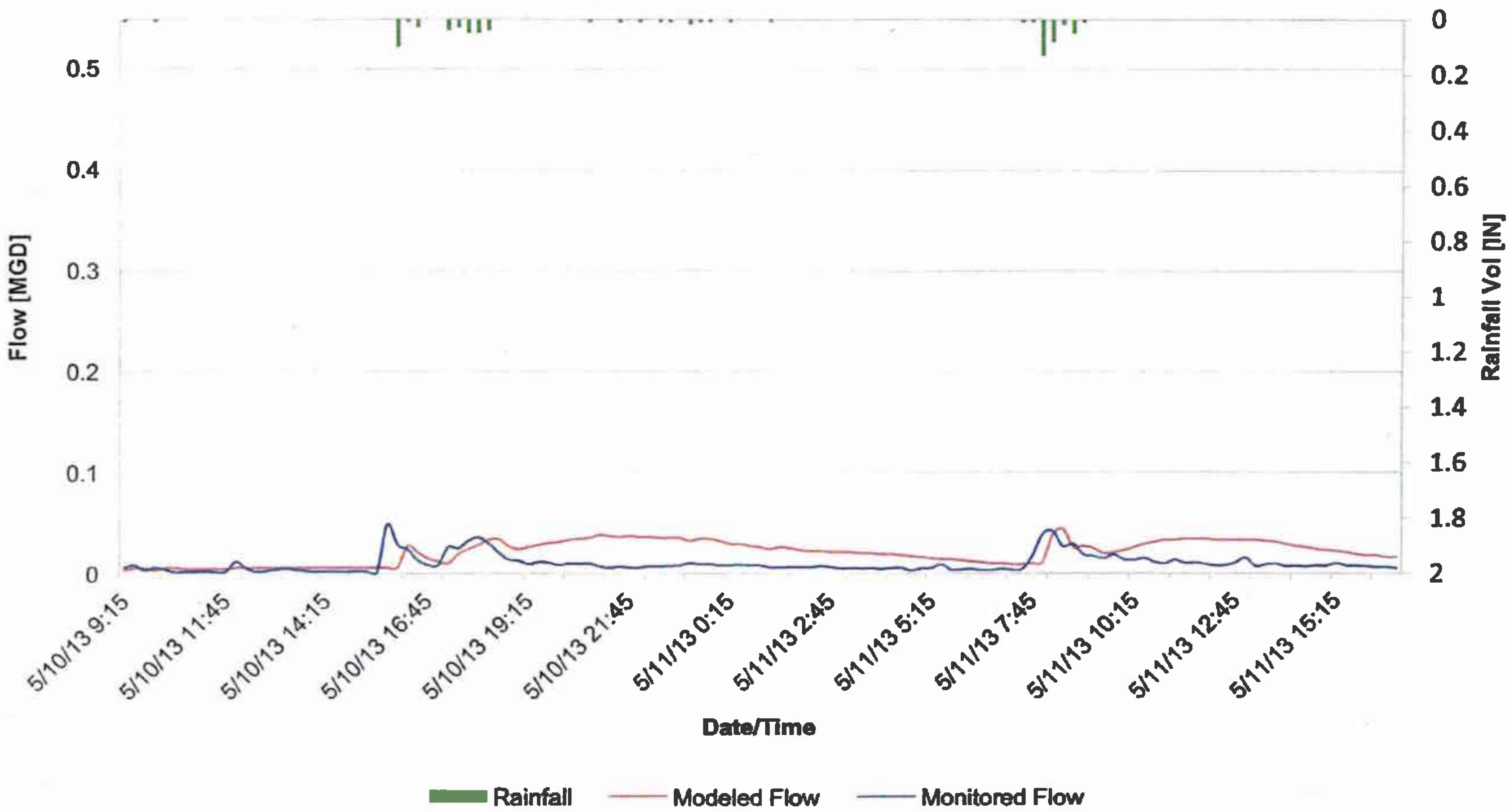
Meter M-10
Rain Event 5

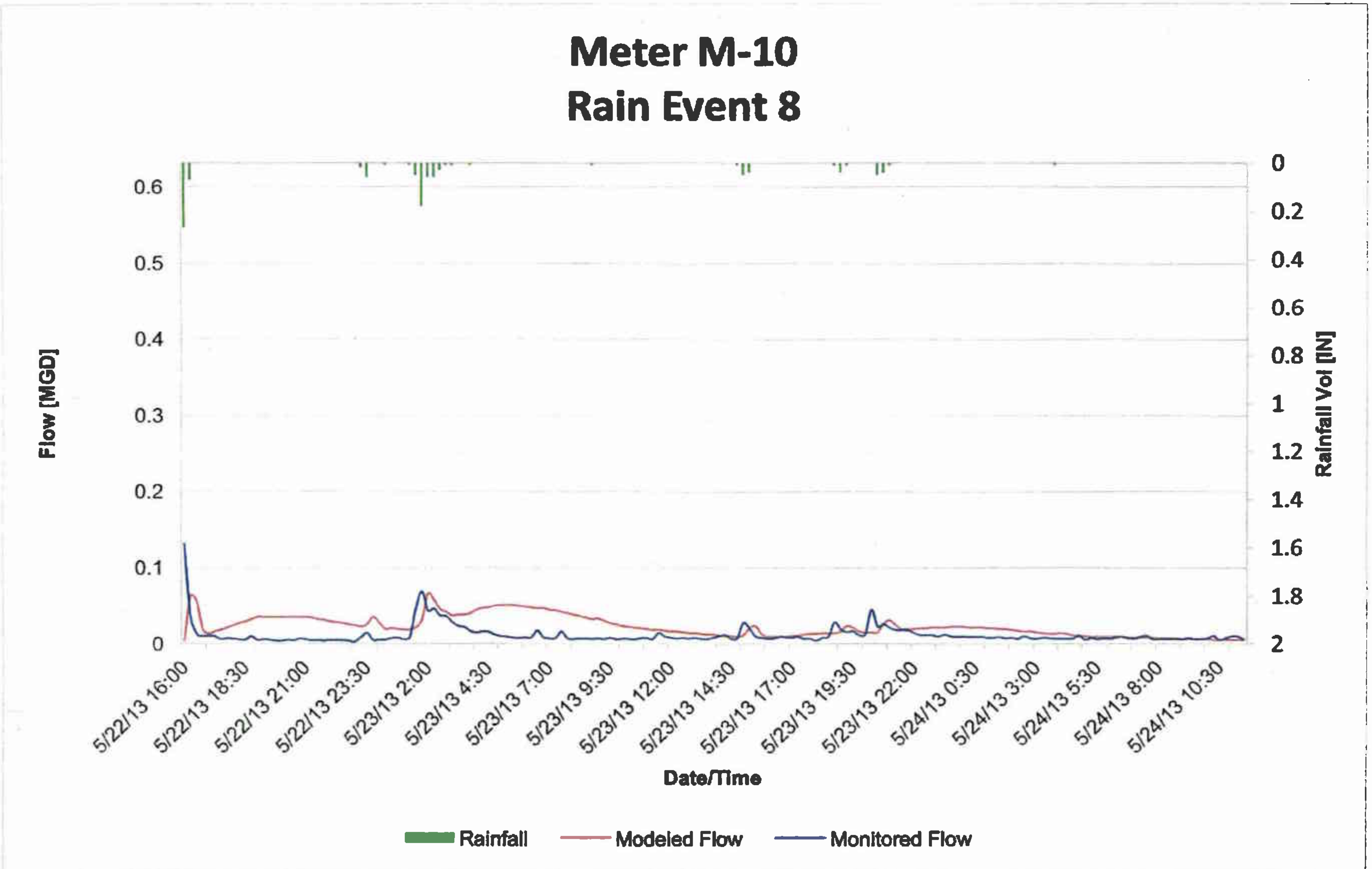




Meter M-10
Rain Event 6
Flow [MGD]
0.6
0.5
0.4
0.3
0.2
0.1
0
Rainfall Vol [IN]
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
4/16/13 20:00
4/16/13 22:30
4/17/13 1:00
4/17/13 3:30
4/17/13 6:00
Date/Time
Rainfall
Modeled Flow
Monitored Flow

Meter M-10
Rain Event 7

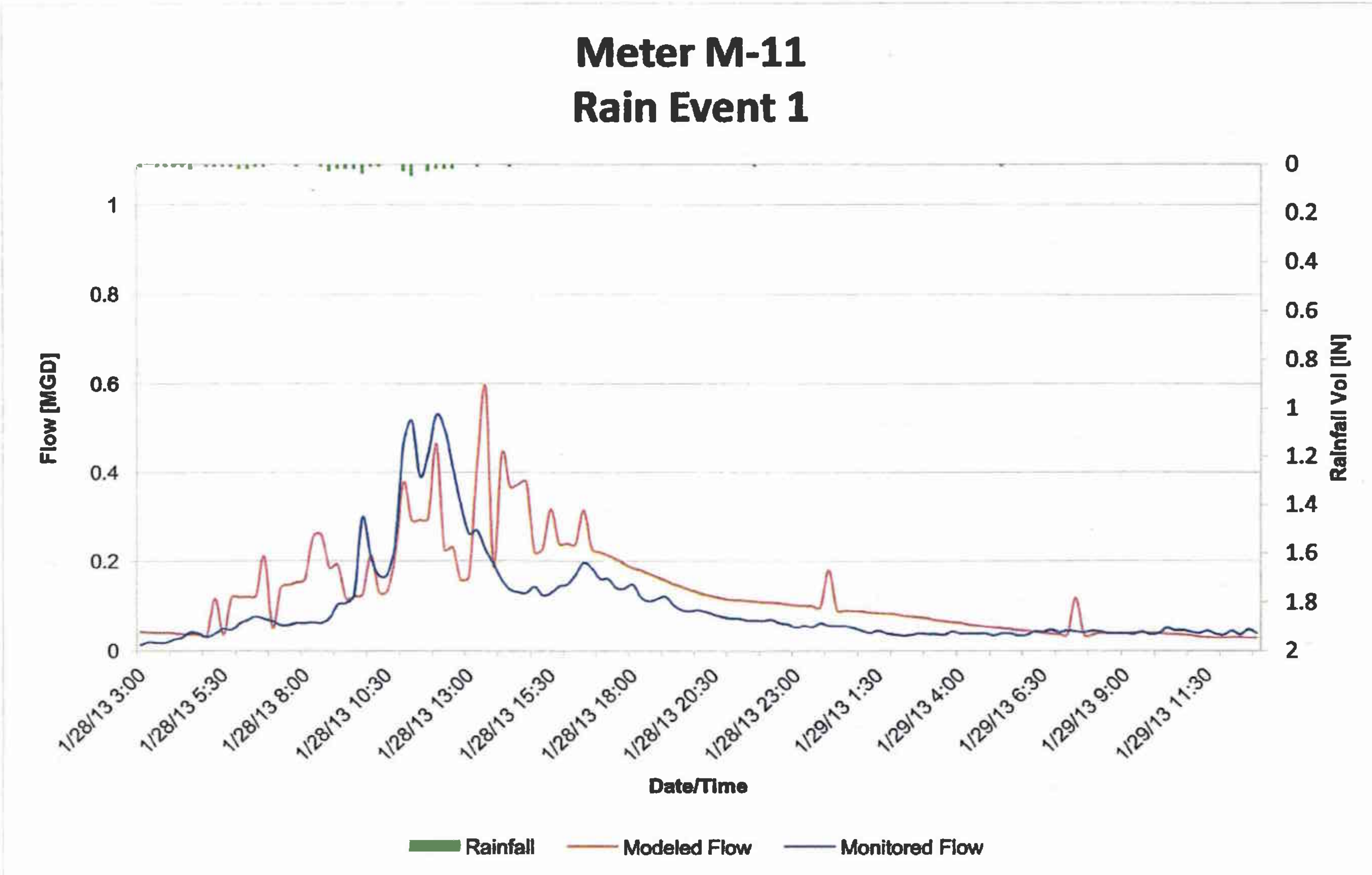




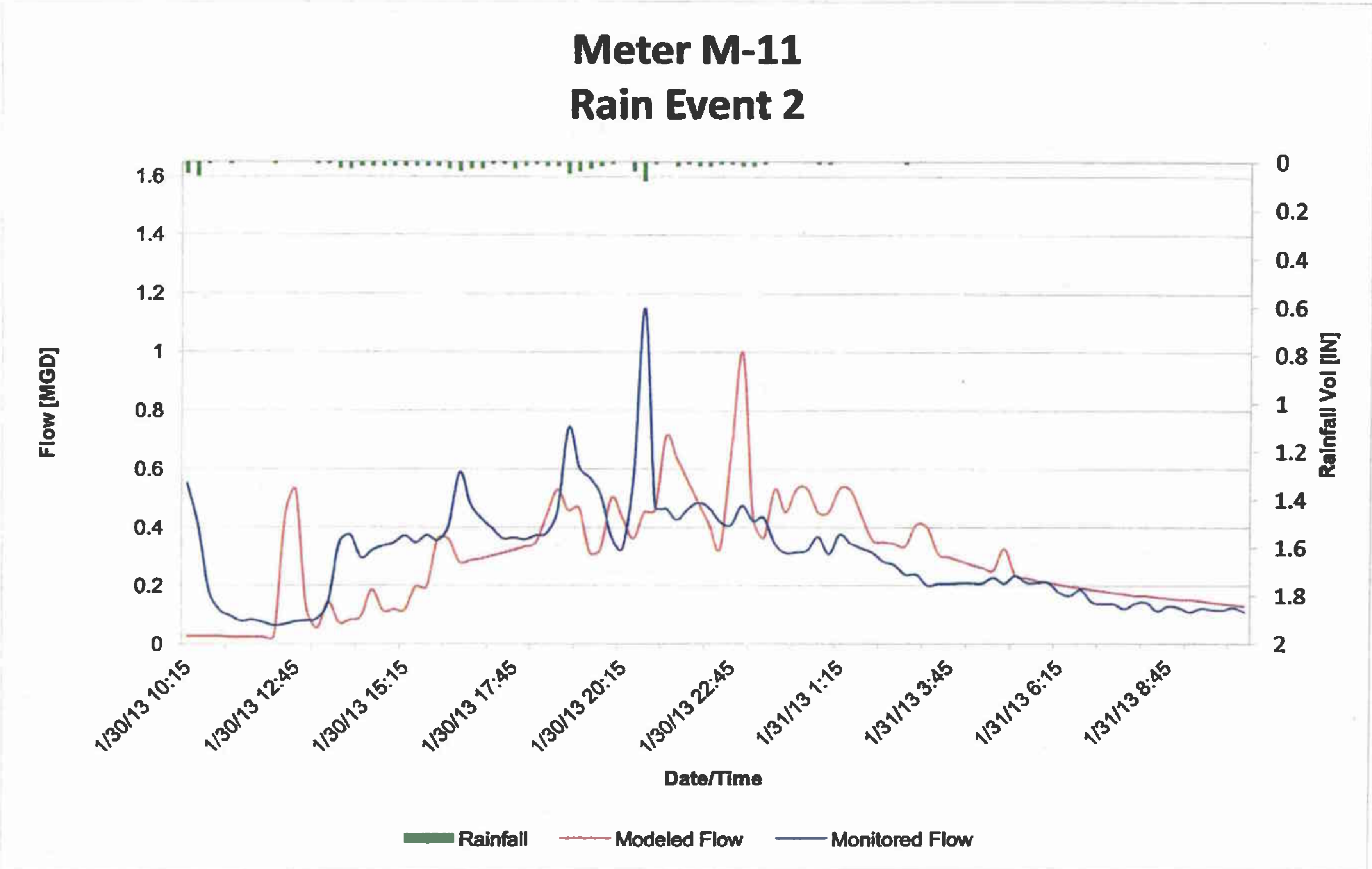
Meter M-10
Rain Event 8
Flow [MGD]
0.6
0.5
0.4
0.3
0.2
0.1
0
Rainfall Vol [IN]
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
5/22/13 16:00
5/22/13 18:30
5/22/13 21:00
5/22/13 23:30
5/23/13 2:00
5/23/13 4:30
5/23/13 7:00
5/23/13 9:30
5/23/13 12:00
5/23/13 14:30
5/23/13 17:00
5/23/13 19:30
5/23/13 22:00
5/24/13 0:30
5/24/13 3:00
5/24/13 5:30
5/24/13 8:00
5/24/13 10:30
Date/Time
Rainfall
Modeled Flow
Monitored Flow

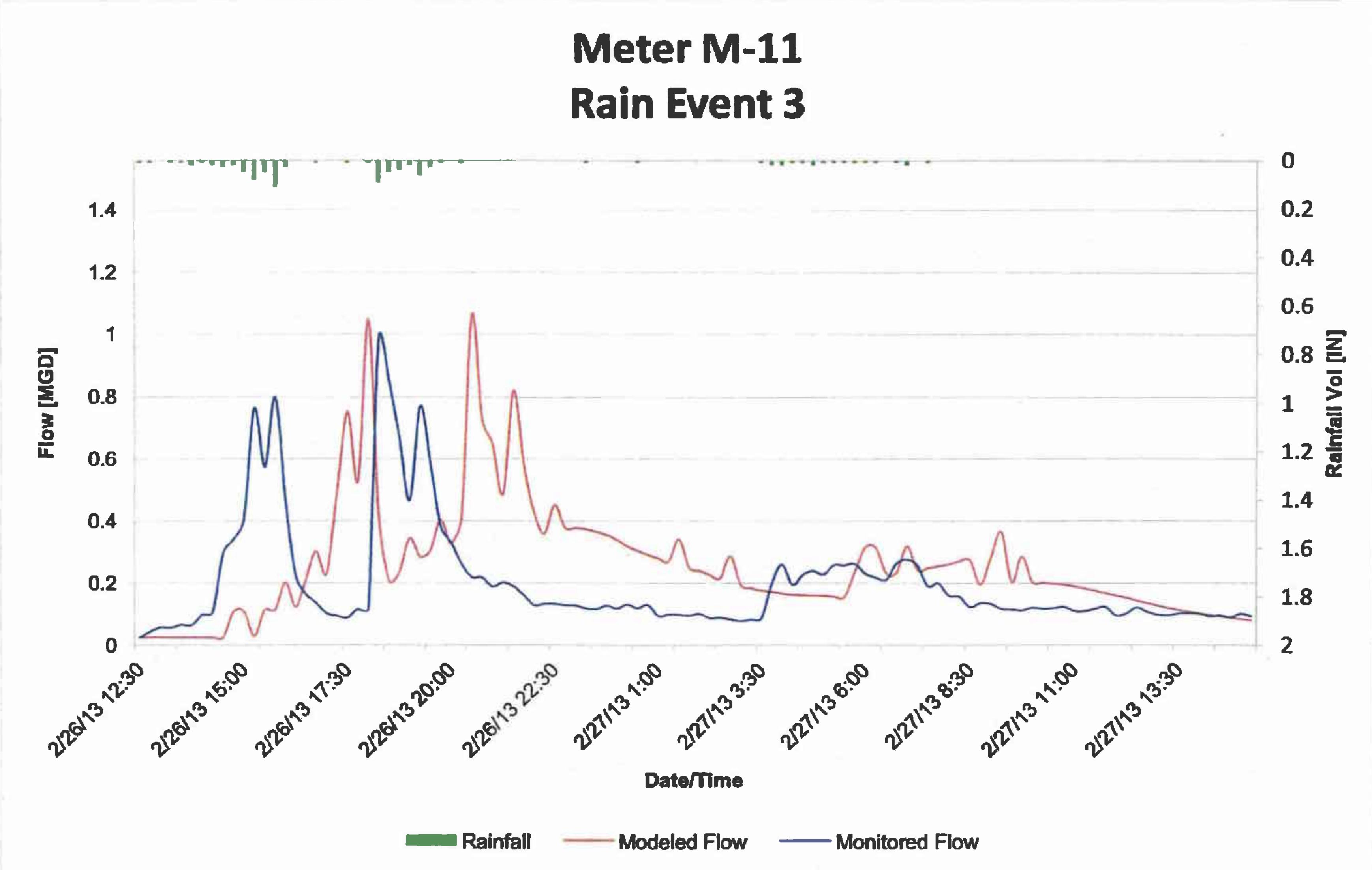
M-11
SUMMER MODEL
RAIN EVENTS

No.	Start Date	End Date	Total Rain	Max Int	Peak MOD Flow	Peak MON Flow	% Difference		Modeled Volume	Monitored Volume	% Difference	
1	1/28/13 3:00	1/28/13 20:00	0.53	0.20	0.59	0.53	10.27%	Mod HIGH	0.088	0.077	12.28%	Mod HIGH
2	1/30/13 10:15	1/31/13 8:30	1.08	0.32	1.00	1.15	13.24%	Mod LOW	0.210	0.235	10.60%	Mod LOW
3	2/26/13 12:30	2/27/13 13:15	1.01	0.44	1.06	0.99	6.85%	Mod HIGH	0.160	0.165	2.83%	Mod LOW
4	3/25/13 15:15	3/26/13 6:30	0.77	0.44	0.95	0.23	76.16%	Mod HIGH	0.141	0.053	62.75%	Mod HIGH
5	4/10/13 15:45	4/11/13 5:30	0.58	0.88	1.98	1.18	40.48%	Mod HIGH	0.043	0.034	21.21%	Mod HIGH
6	4/16/13 20:00	4/17/13 4:45	1.13	2.40	4.18	4.20	0.45%	Mod LOW	0.090	0.159	43.37%	Mod LOW
7	5/22/13 23:15	5/23/13 14:30	0.52	0.72	1.638	1.623	0.92%	Mod HIGH	0.067	0.062	7.63%	Mod HIGH

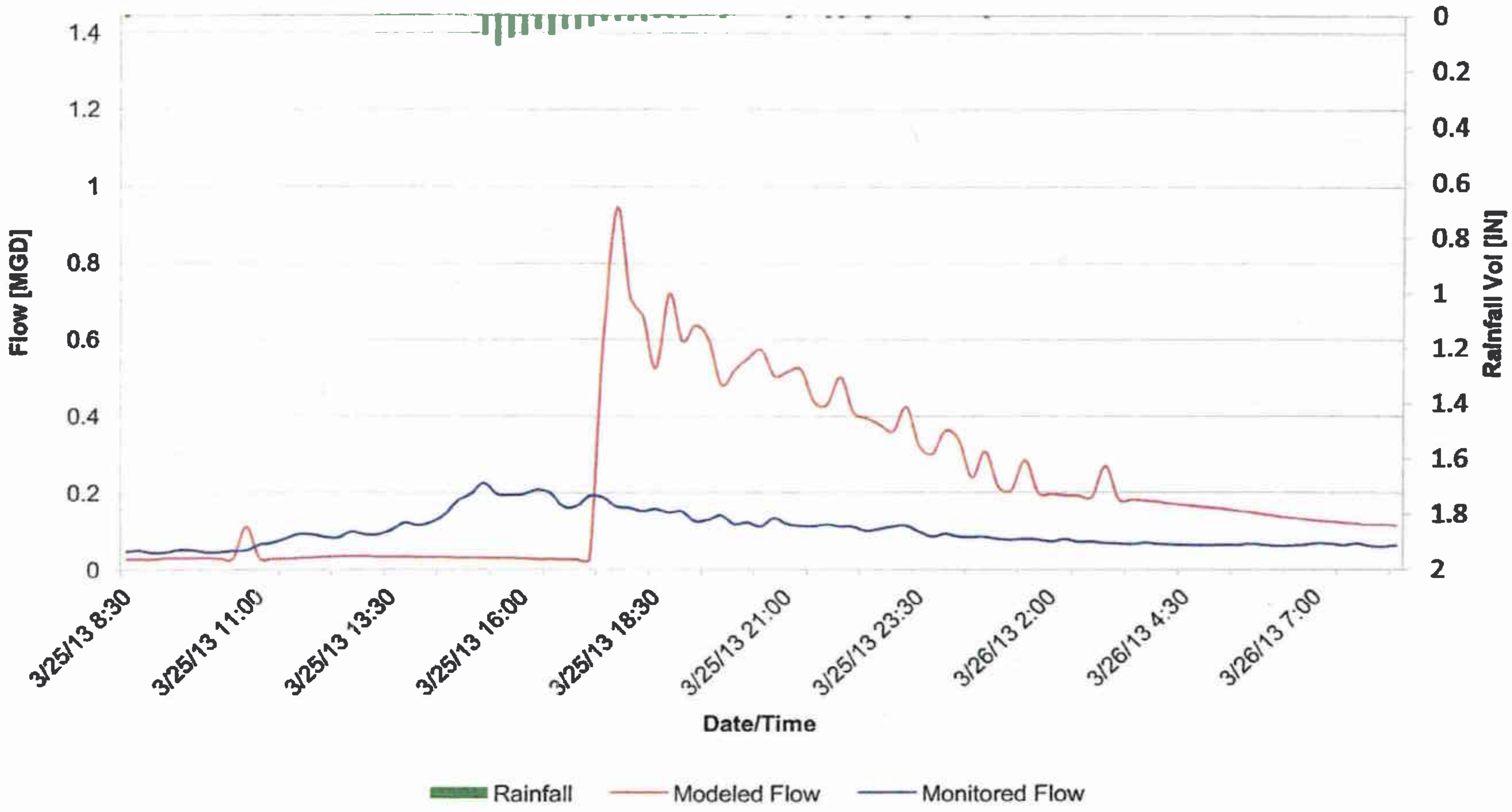


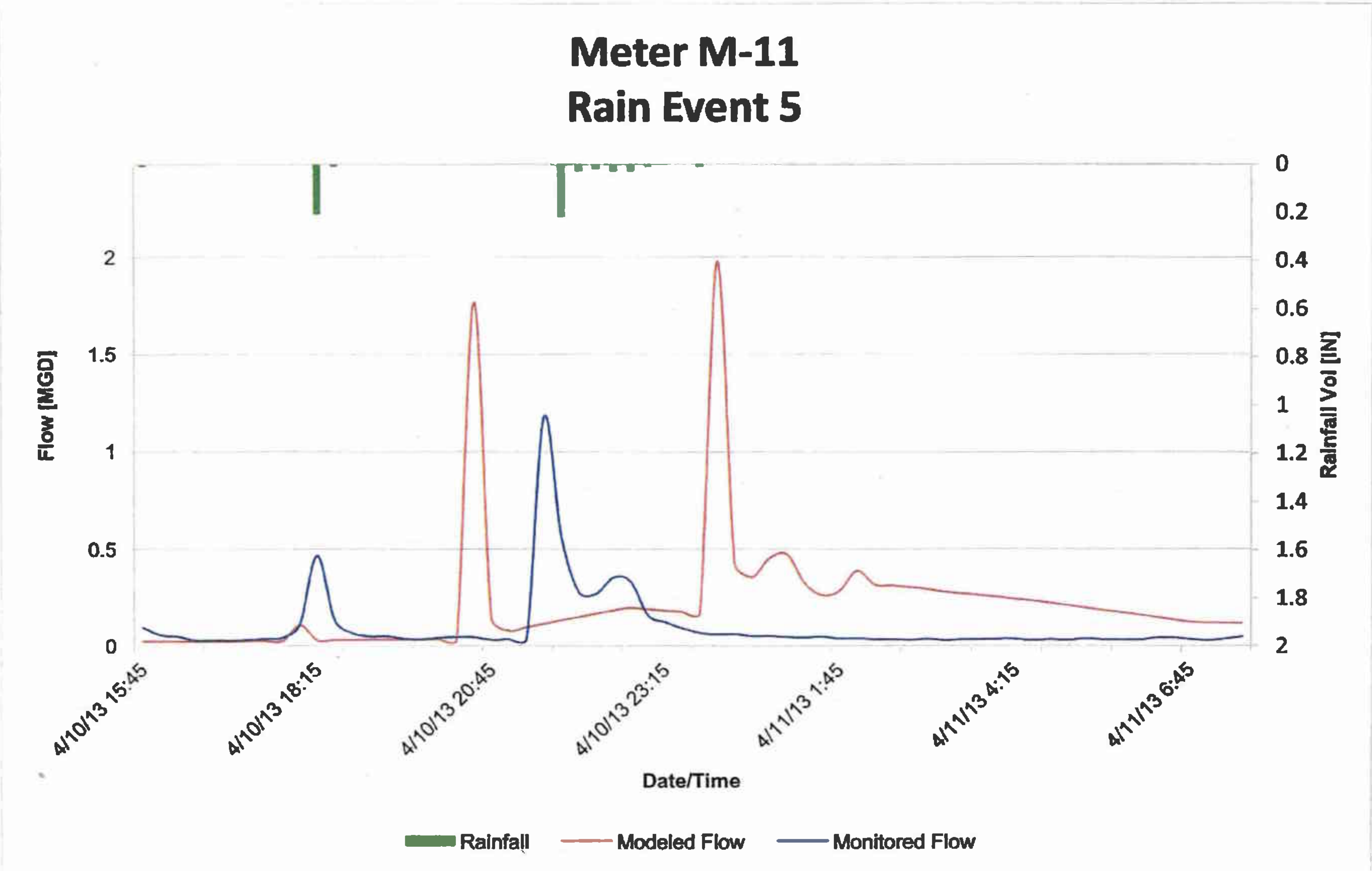
Meter M-11
Rain Event 1
Flow [MGD]
1
0.8
0.6
0.4
0.2
0
Rainfall Vol [IN]
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
1/28/13 3:00
1/28/13 5:30
1/28/13 8:00
1/28/13 10:30
1/28/13 13:00
1/28/13 15:30
1/28/13 18:00
1/28/13 20:30
1/28/13 23:00
1/29/13 1:30
1/29/13 4:00
1/29/13 6:30
1/29/13 9:00
1/29/13 11:30
Date/Time
Rainfall
Modeled Flow
Monitored Flow


Meter M-11
Rain Event 2
Flow [MGD]
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
Rainfall Vol [IN]
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
1/30/13 10:15
1/30/13 12:45
1/30/13 15:15
1/30/13 17:45
1/30/13 20:15
1/30/13 22:45
1/31/13 1:15
1/31/13 3:45
1/31/13 6:15
1/31/13 8:45
Date/Time
Rainfall
Modeled Flow
Monitored Flow

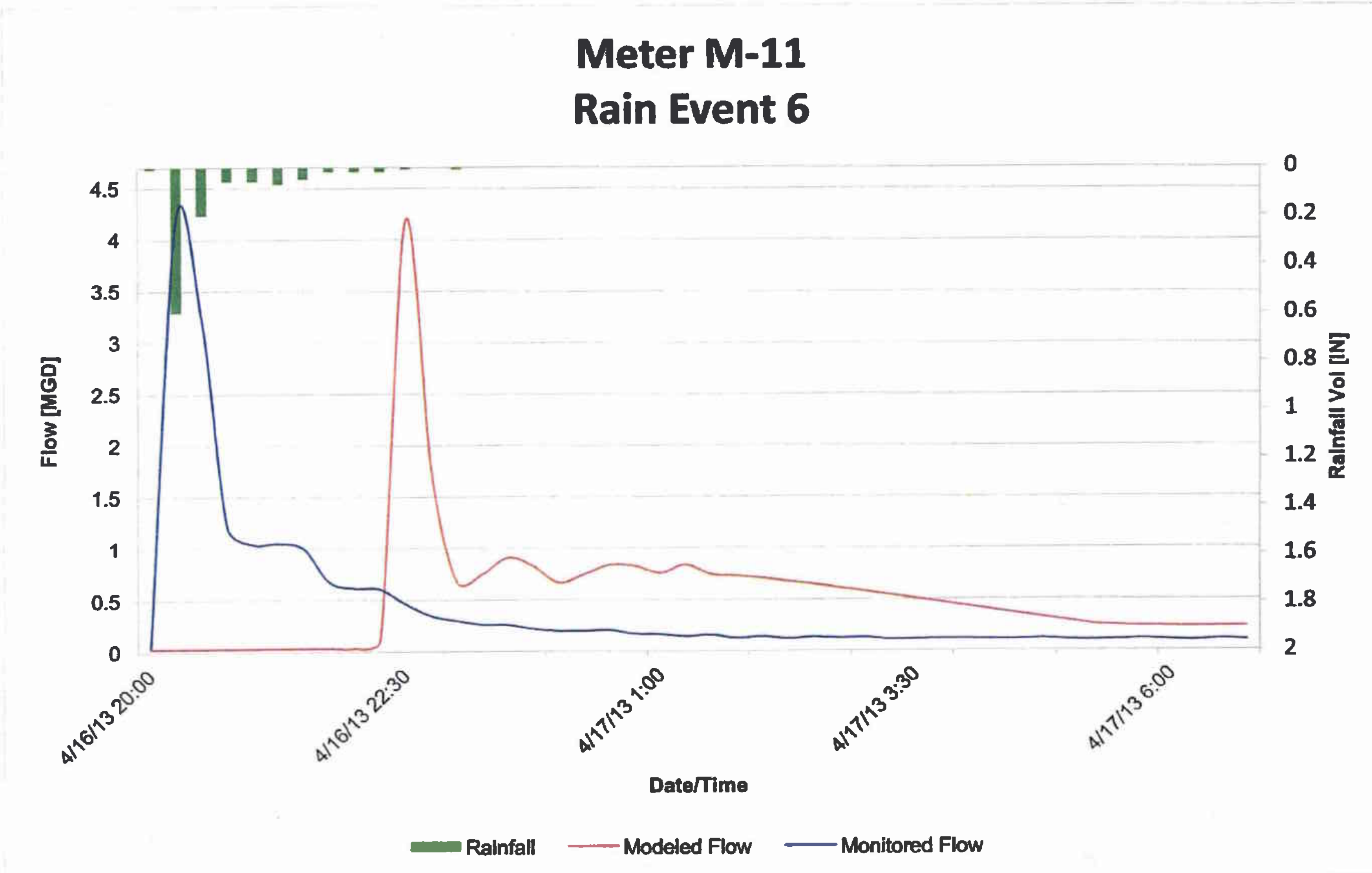

Meter M-11
Rain Event 3
Flow [MGD]
0
0.2
0.4
0.6
0.8
1
1.2
1.4
Rainfall Vol [IN]
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
2/26/13 12:30
2/26/13 15:00
2/26/13 17:30
2/26/13 20:00
2/26/13 22:30
2/27/13 1:00
2/27/13 3:30
2/27/13 6:00
2/27/13 8:30
2/27/13 11:00
2/27/13 13:30
Date/Time
Rainfall
Modeled Flow
Monitored Flow

Meter M-11
Rain Event 4

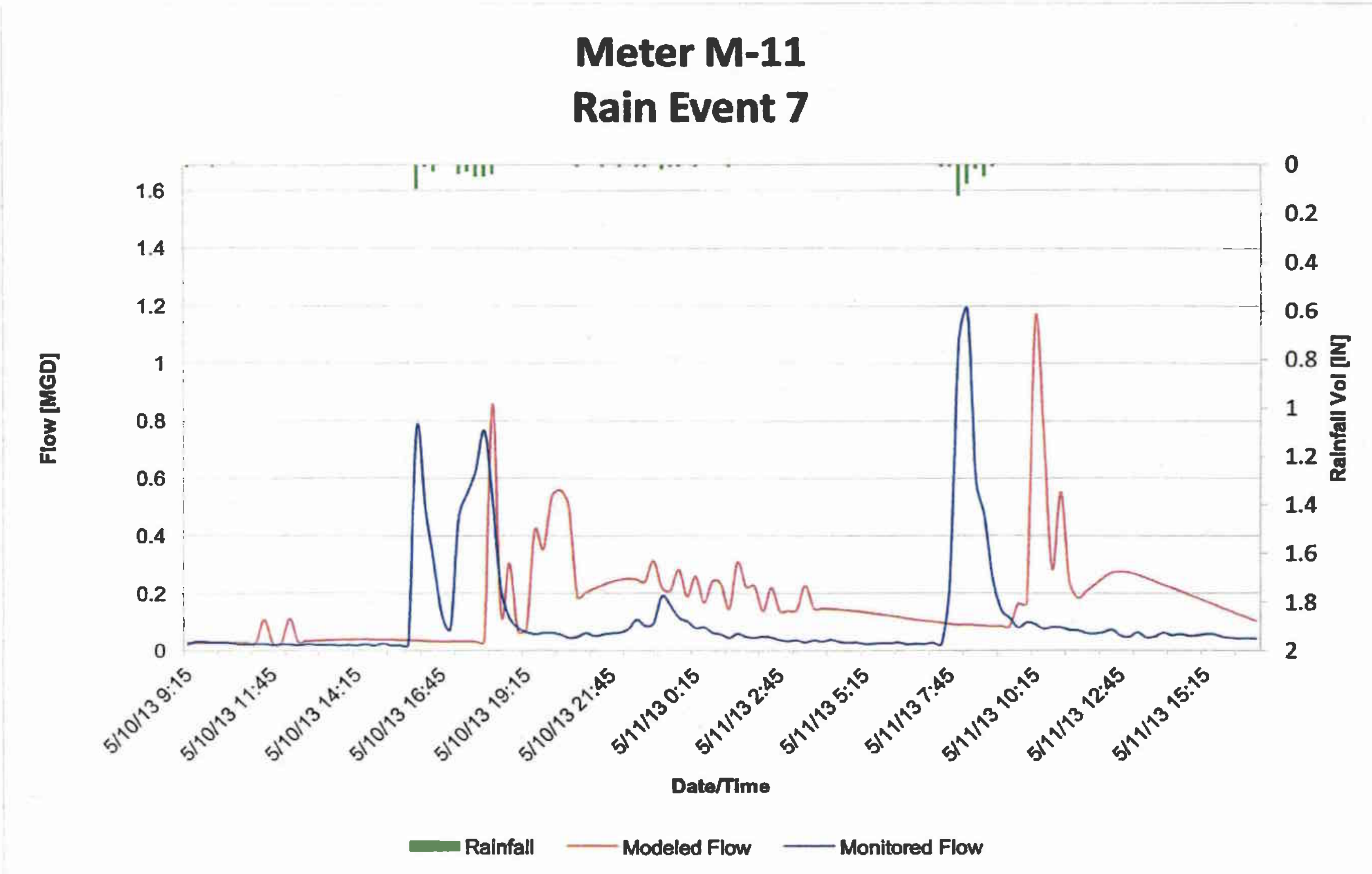




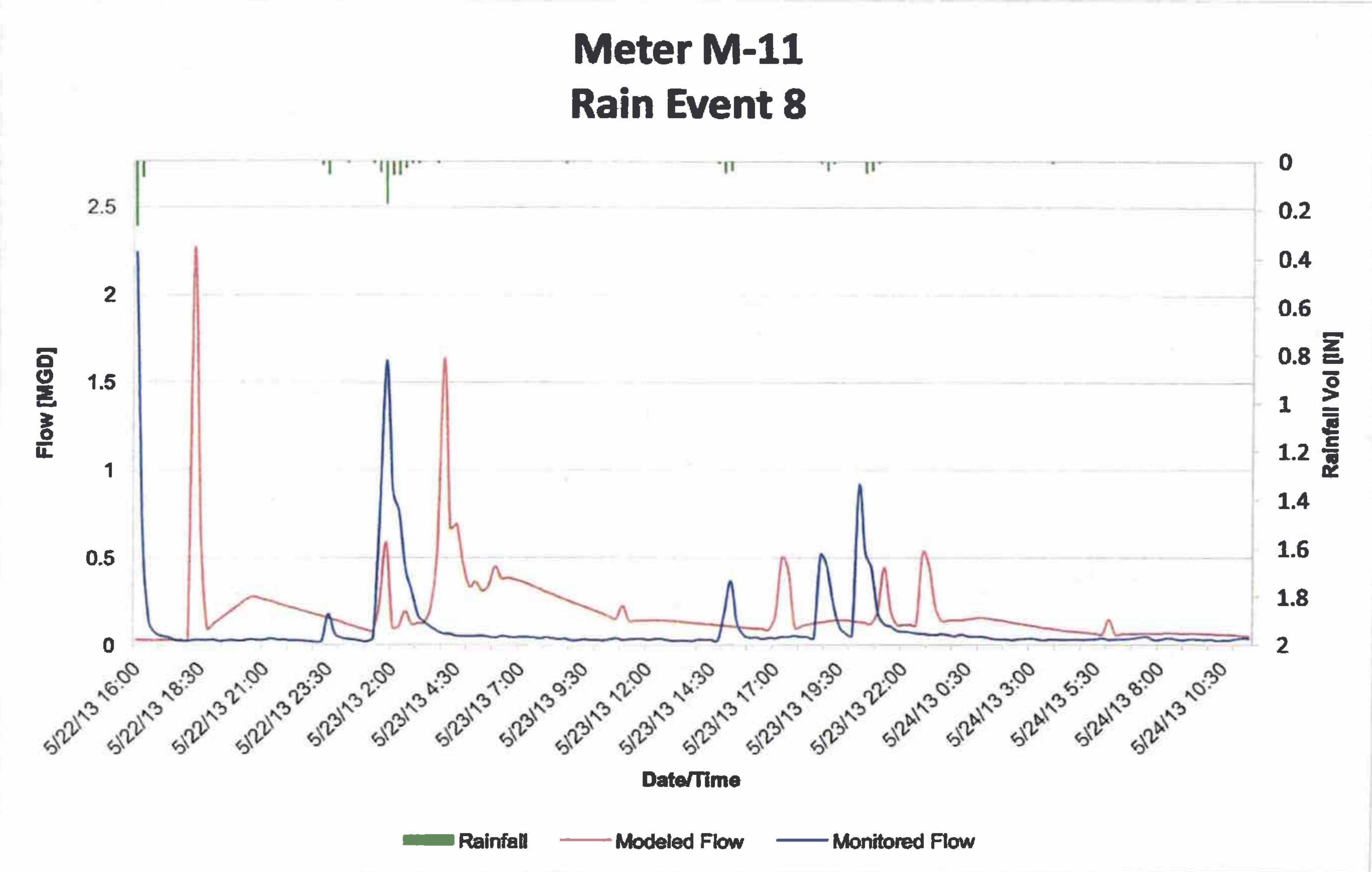
Meter M-11
Rain Event 5
Flow [MGD]
Rainfall Vol [IN]
2
1.5
1
0.5
0
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
4/10/13 15:45
4/10/13 18:15
4/10/13 20:45
4/10/13 23:15
4/11/13 1:45
4/11/13 4:15
4/11/13 6:45
Date/Time
Rainfall
Modeled Flow
Monitored Flow



Meter M-11
Rain Event 6
Flow [MGD]
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
Rainfall Vol [IN]
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
4/16/13 20:00
4/16/13 22:30
4/17/13 1:00
4/17/13 3:30
4/17/13 6:00
Date/Time
Rainfall
Modeled Flow
Monitored Flow

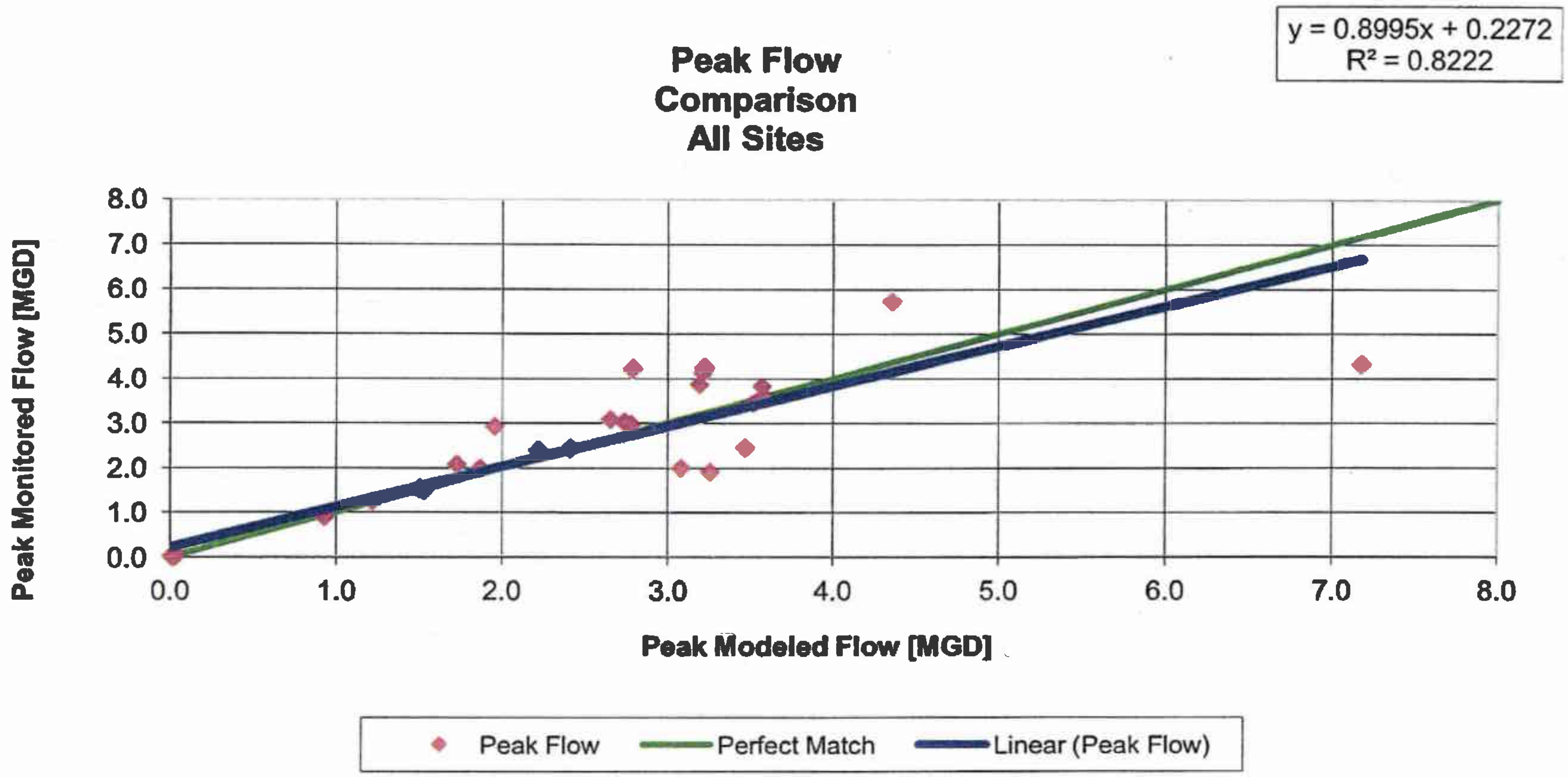


Meter M-11
Rain Event 7
Flow [MGD]
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
Rainfall Vol [IN]
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
5/10/13 9:15
5/10/13 11:45
5/10/13 14:15
5/10/13 16:45
5/10/13 19:15
5/10/13 21:45
5/11/13 0:15
5/11/13 2:45
5/11/13 5:15
5/11/13 7:45
5/11/13 10:15
5/11/13 12:45
5/11/13 15:15
Date/Time
Rainfall
Modeled Flow
Monitored Flow

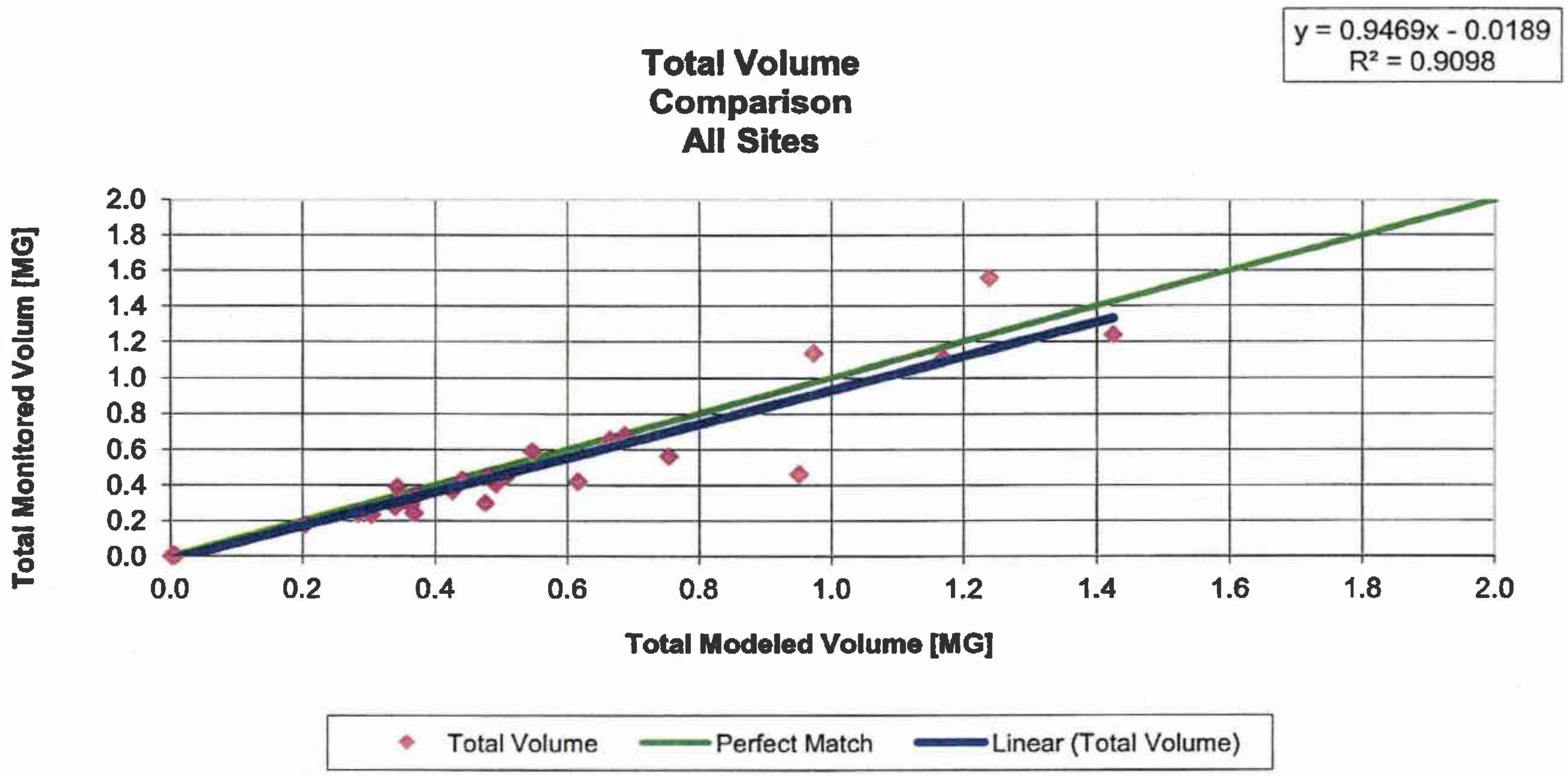

Meter M-11
Rain Event 8
Flow [MGD]
0
0.5
1
1.5
2
2.5
Rainfall Vol [IN]
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
5/22/13 16:00
5/22/13 18:30
5/22/13 21:00
5/22/13 23:30
5/23/13 2:00
5/23/13 4:30
5/23/13 7:00
5/23/13 9:30
5/23/13 12:00
5/23/13 14:30
5/23/13 17:00
5/23/13 19:30
5/23/13 22:00
5/24/13 0:30
5/24/13 3:00
5/24/13 5:30
5/24/13 8:00
5/24/13 10:30
Date/Time
Rainfall
Modeled Flow
Monitored Flow

Appendix H

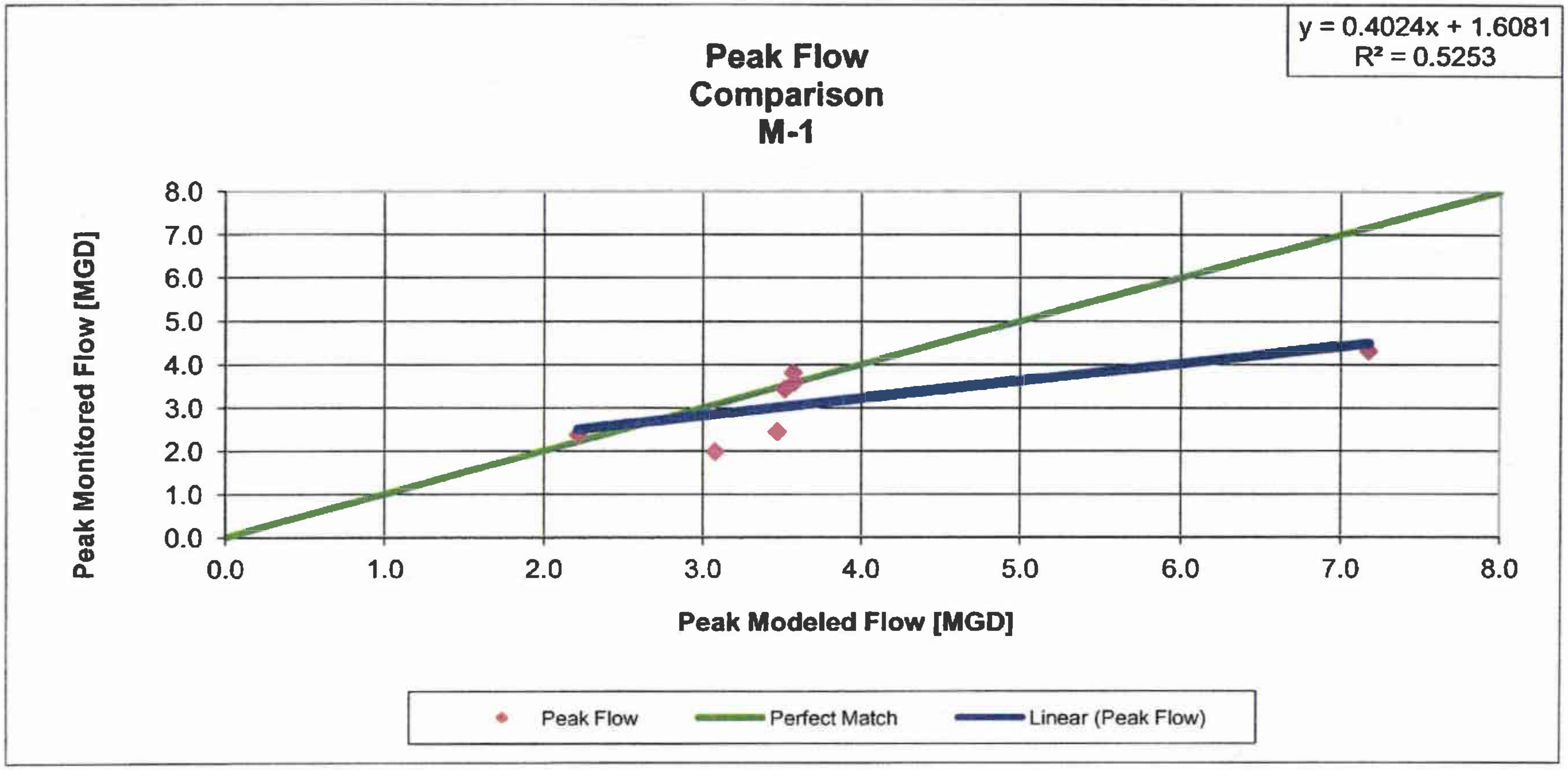
Monitored vs. Modeled Regression Plots

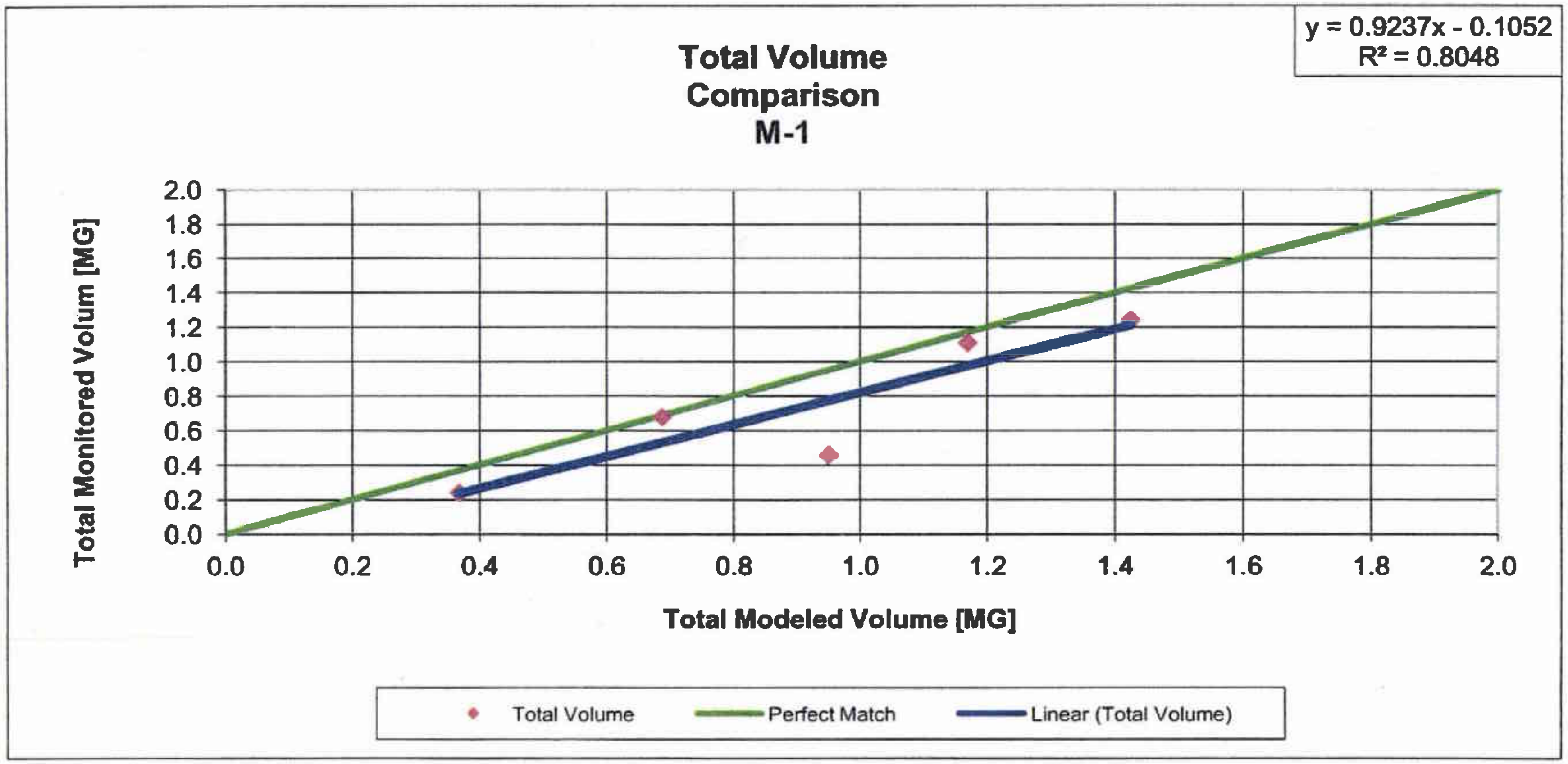


y = 0.8995x + 0.2272
R² = 0.8222
Peak Flow
Comparison
All Sites
Peak Monitored Flow [MGD]
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
Peak Modeled Flow [MGD]
Peak Flow
Perfect Match
Linear (Peak Flow)

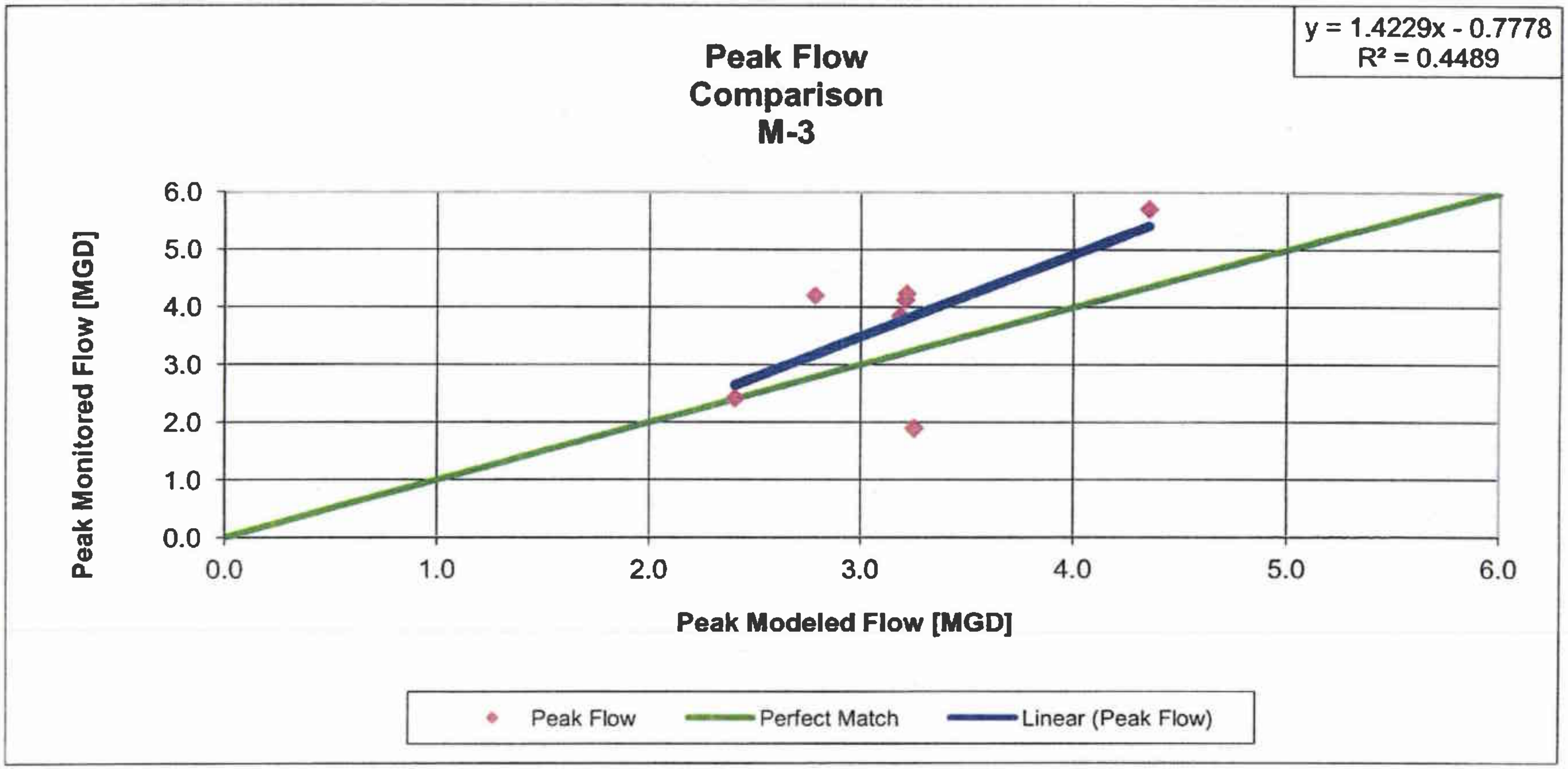


y = 0.9469x - 0.0189
R² = 0.9098
Total Volume
Comparison
All Sites
Total Monitored Volum [MG]
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
2.0
Total Modeled Volume [MG]
Total Volume
Perfect Match
Linear (Total Volume)

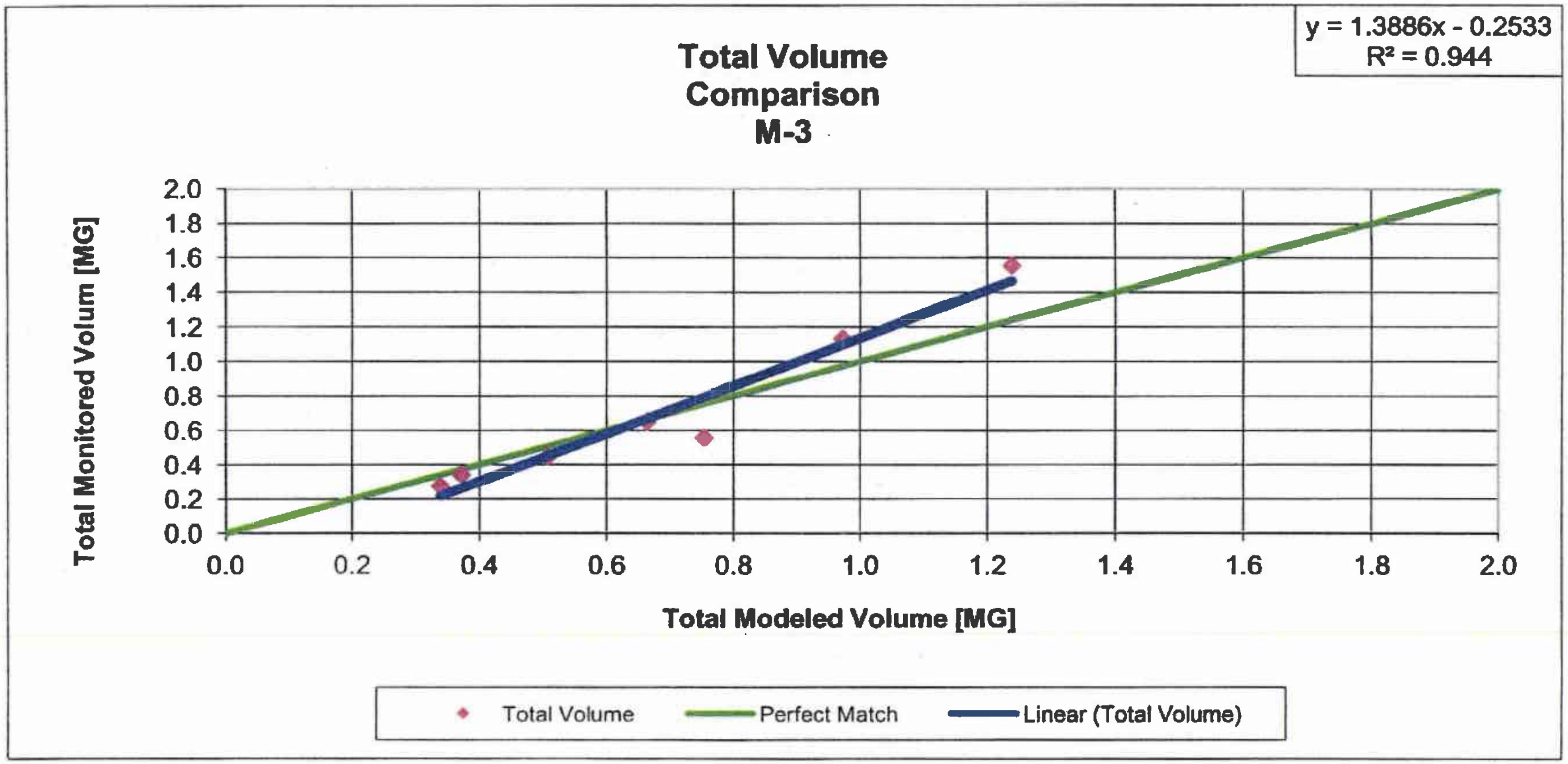

y = 0.4024x + 1.6081
R² = 0.5253
Peak Flow
Comparison
M-1
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
Peak Monitored Flow [MGD]
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
Peak Modeled Flow [MGD]
Peak Flow
Perfect Match
Linear (Peak Flow)



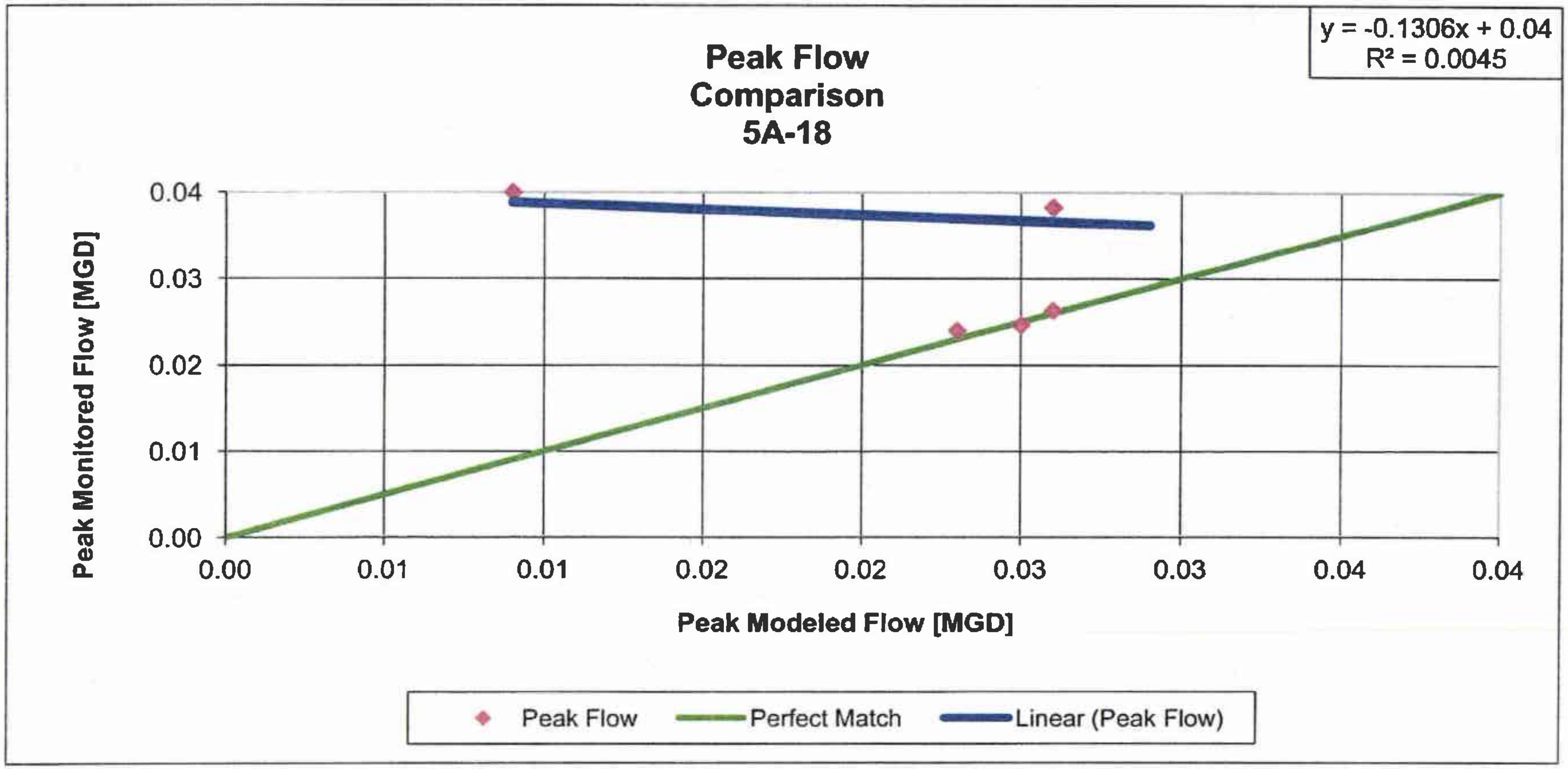
y = 0.9237x - 0.1052
R² = 0.8048
Total Volume
Comparison
M-1
Total Monitored Volum [MG]
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
2.0
Total Modeled Volume [MG]
Total Volume
Perfect Match
Linear (Total Volume)



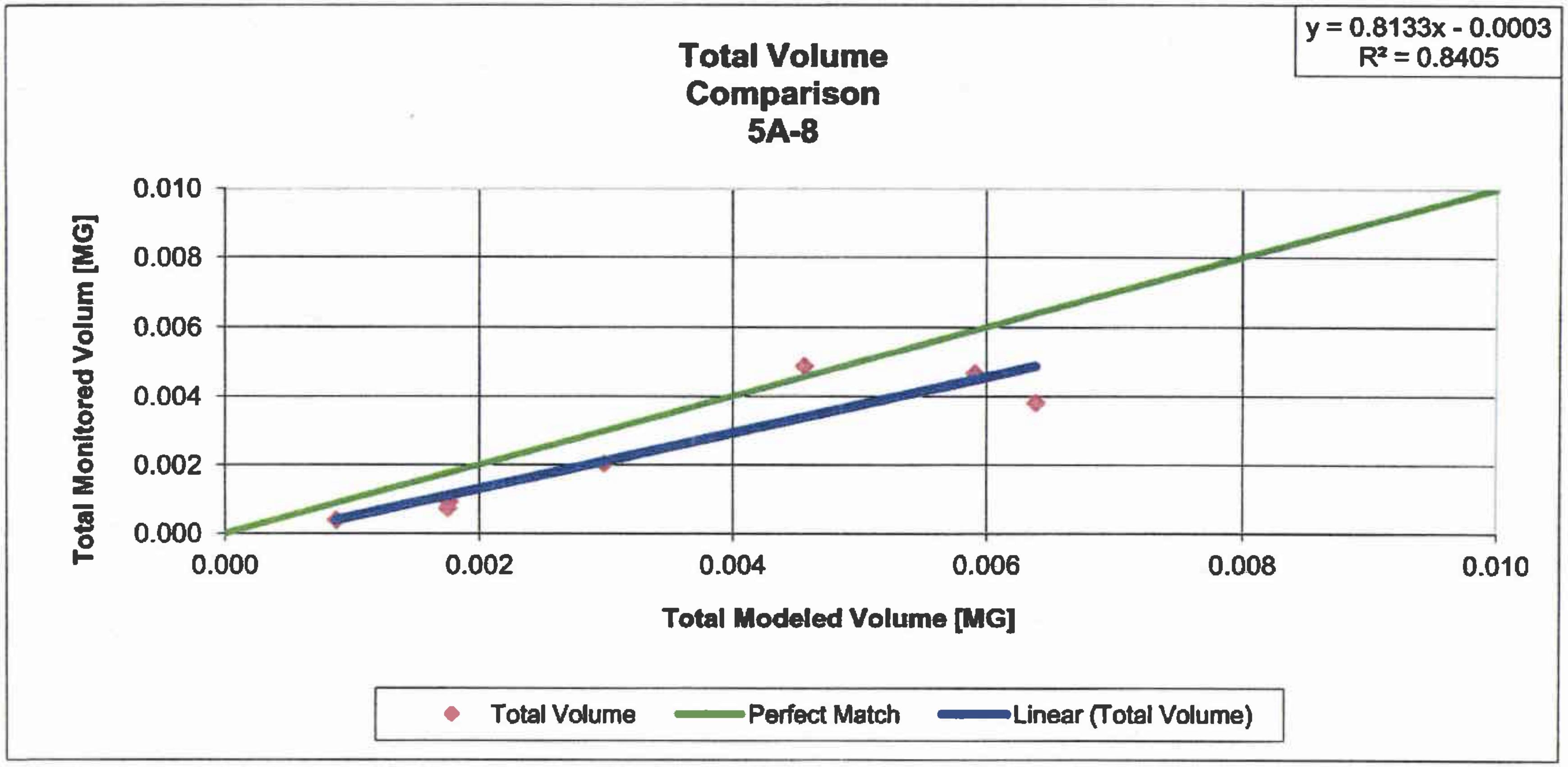
y = 1.4229x - 0.7778
R² = 0.4489
Peak Flow
Comparison
M-3
Peak Monitored Flow [MGD]
6.0
5.0
4.0
3.0
2.0
1.0
0.0
0.0
1.0
2.0
3.0
4.0
5.0
6.0
Peak Modeled Flow [MGD]
Peak Flow
Perfect Match
Linear (Peak Flow)



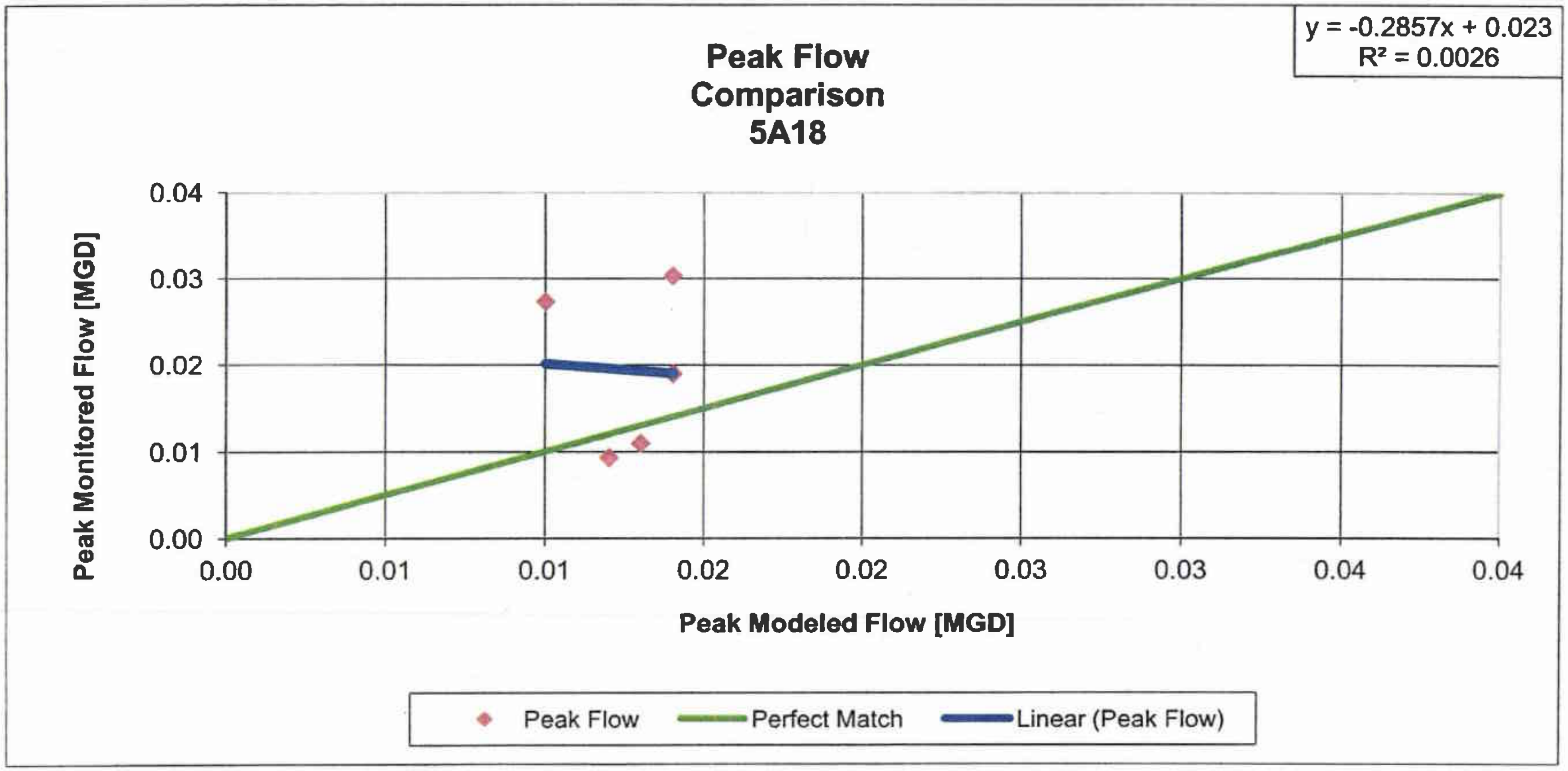
y = 1.3886x - 0.2533
R² = 0.944
Total Volume
Comparison
M-3
Total Monitored Volum [MG]
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
2.0
Total Modeled Volume [MG]
Total Volume
Perfect Match
Linear (Total Volume)

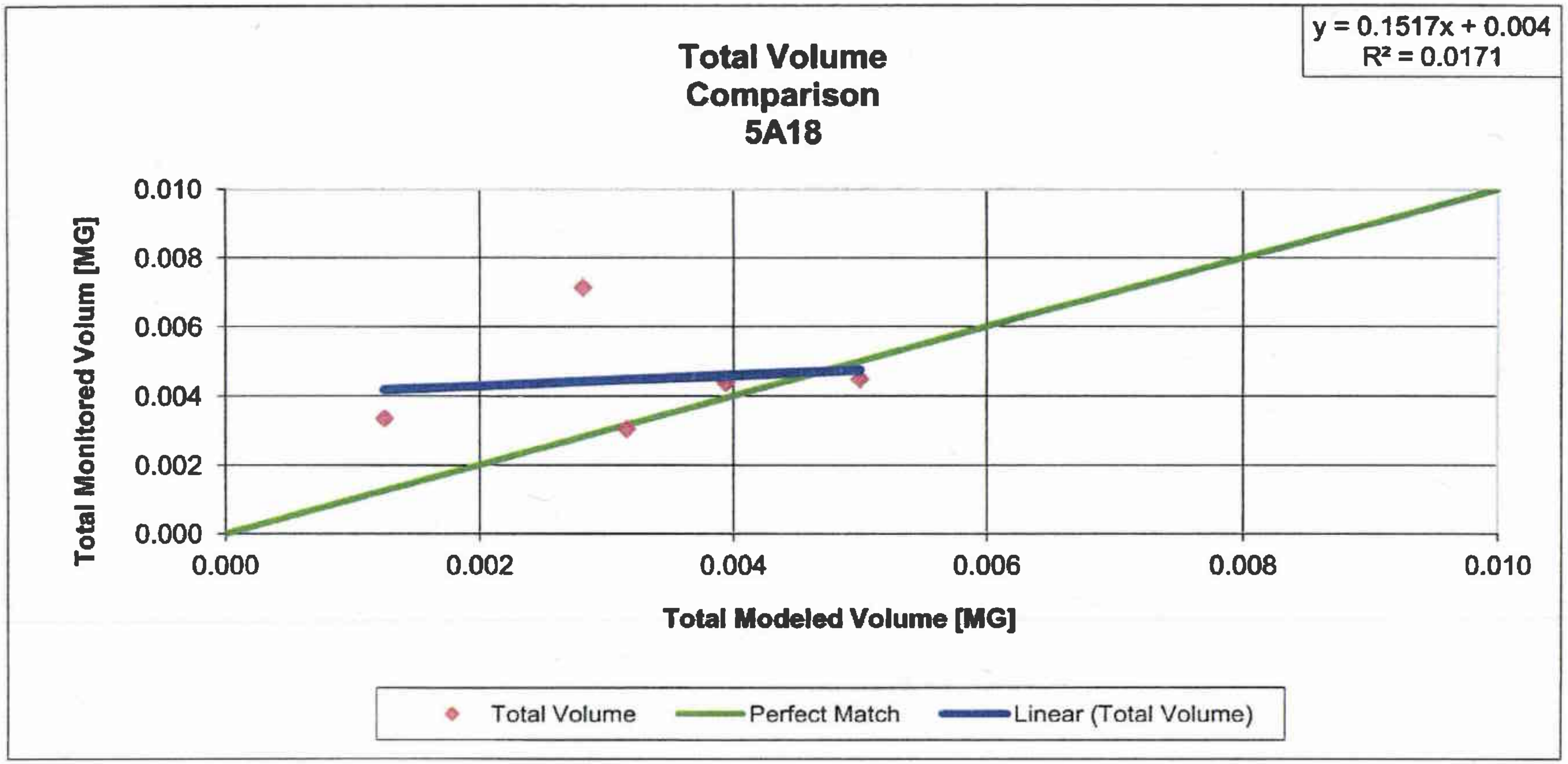


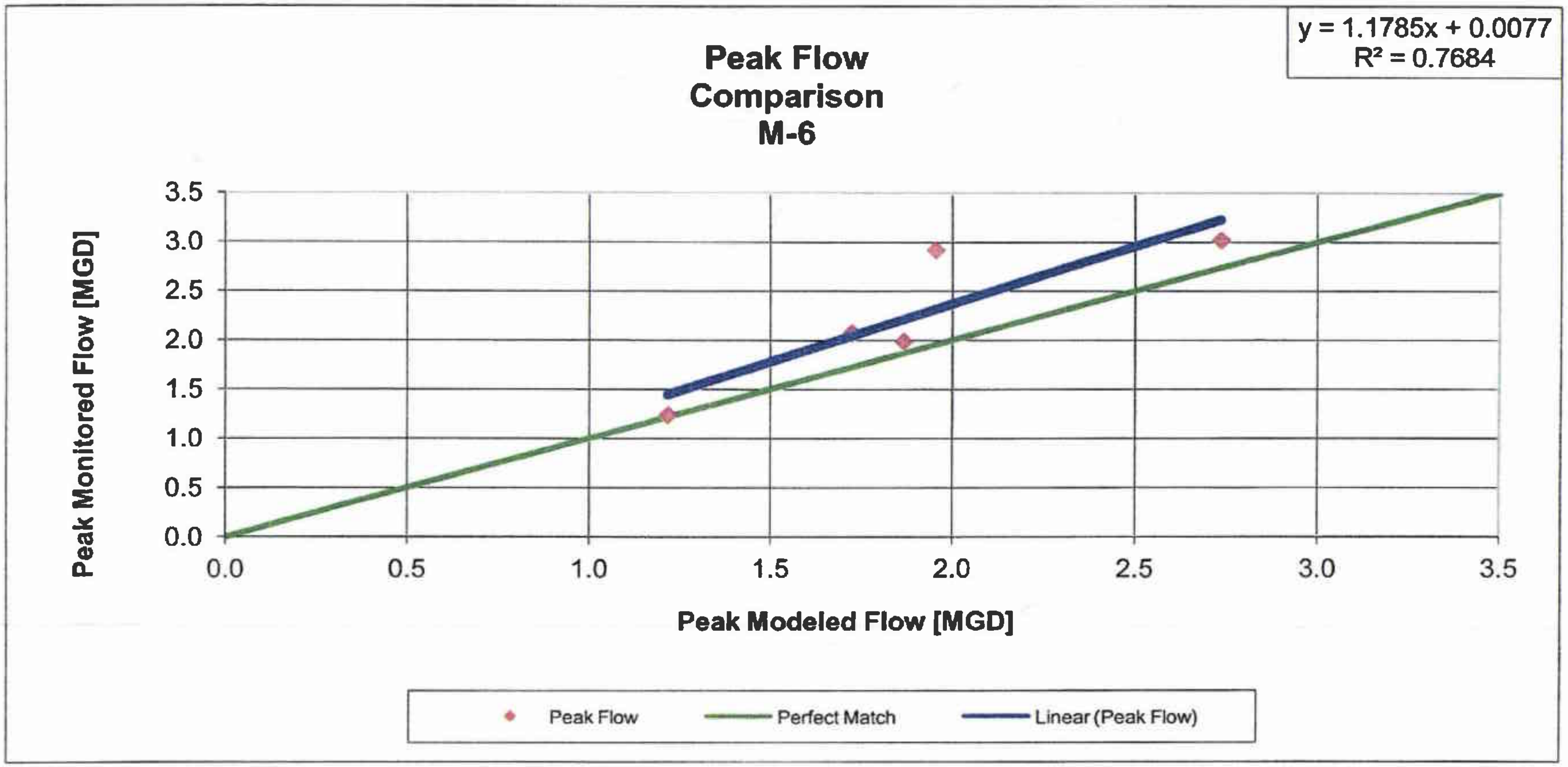
Peak Flow
Comparison
5A-18
y = -0.1306x + 0.04
R² = 0.0045
0.04
0.03
0.02
0.01
0.00
Peak Monitored Flow [MGD]
0.00
0.01
0.01
0.02
0.02
0.03
0.03
0.04
0.04
Peak Modeled Flow [MGD]
Peak Flow
Perfect Match
Linear (Peak Flow)



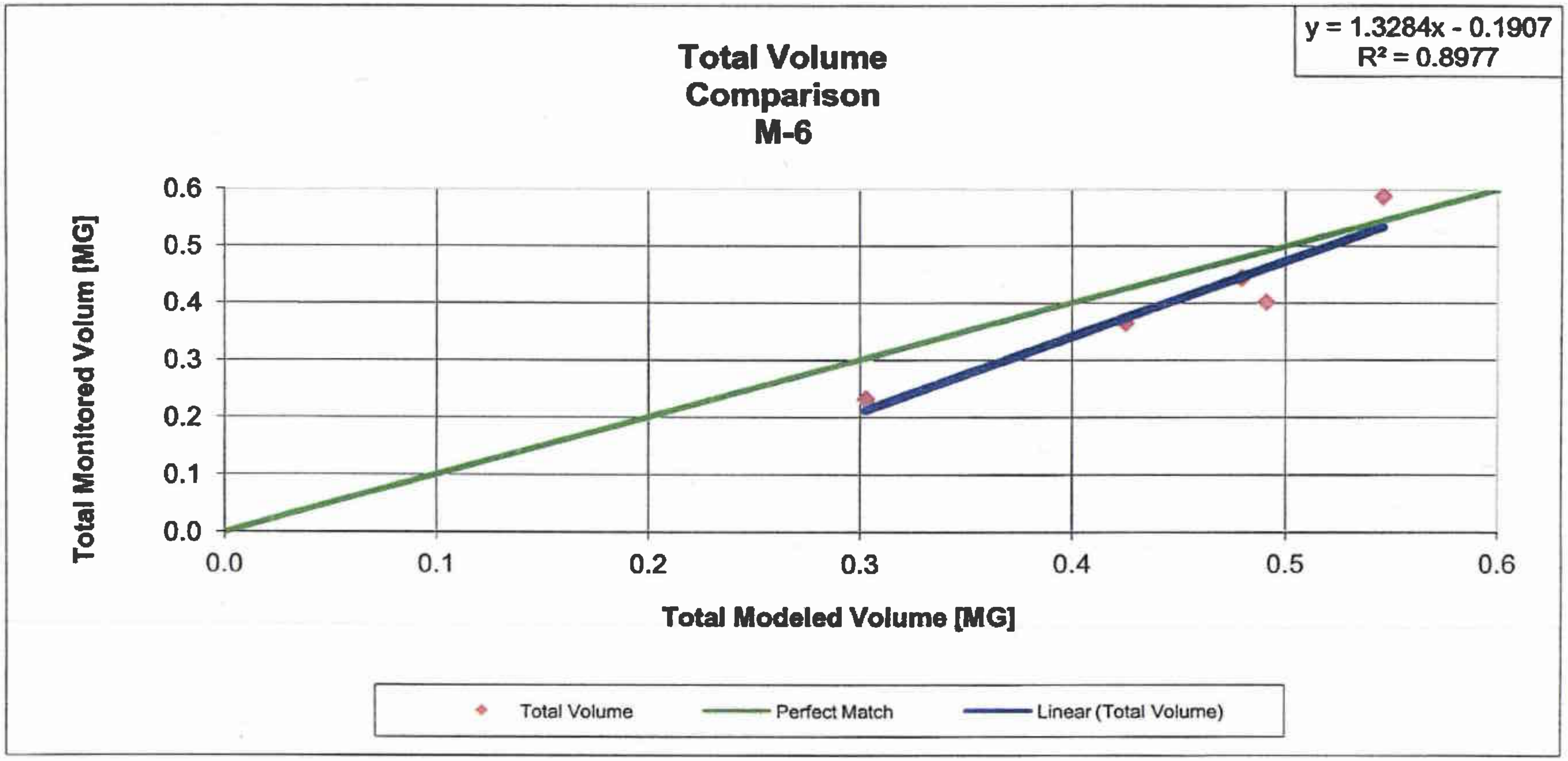
y = 0.8133x - 0.0003
R² = 0.8405
Total Volume
Comparison
5A-8
Total Monitored Volum [MG]
0.010
0.008
0.006
0.004
0.002
0.000
0.000
0.002
0.004
0.006
0.008
0.010
Total Modeled Volume [MG]
Total Volume
Perfect Match
Linear (Total Volume)


y = -0.2857x + 0.023
R² = 0.0026
Peak Flow
Comparison
5A18
Peak Monitored Flow [MGD]
0.04
0.03
0.02
0.01
0.00
0.00
0.01
0.01
0.02
0.02
0.03
0.03
0.04
0.04
Peak Modeled Flow [MGD]
Peak Flow
Perfect Match
Linear (Peak Flow)

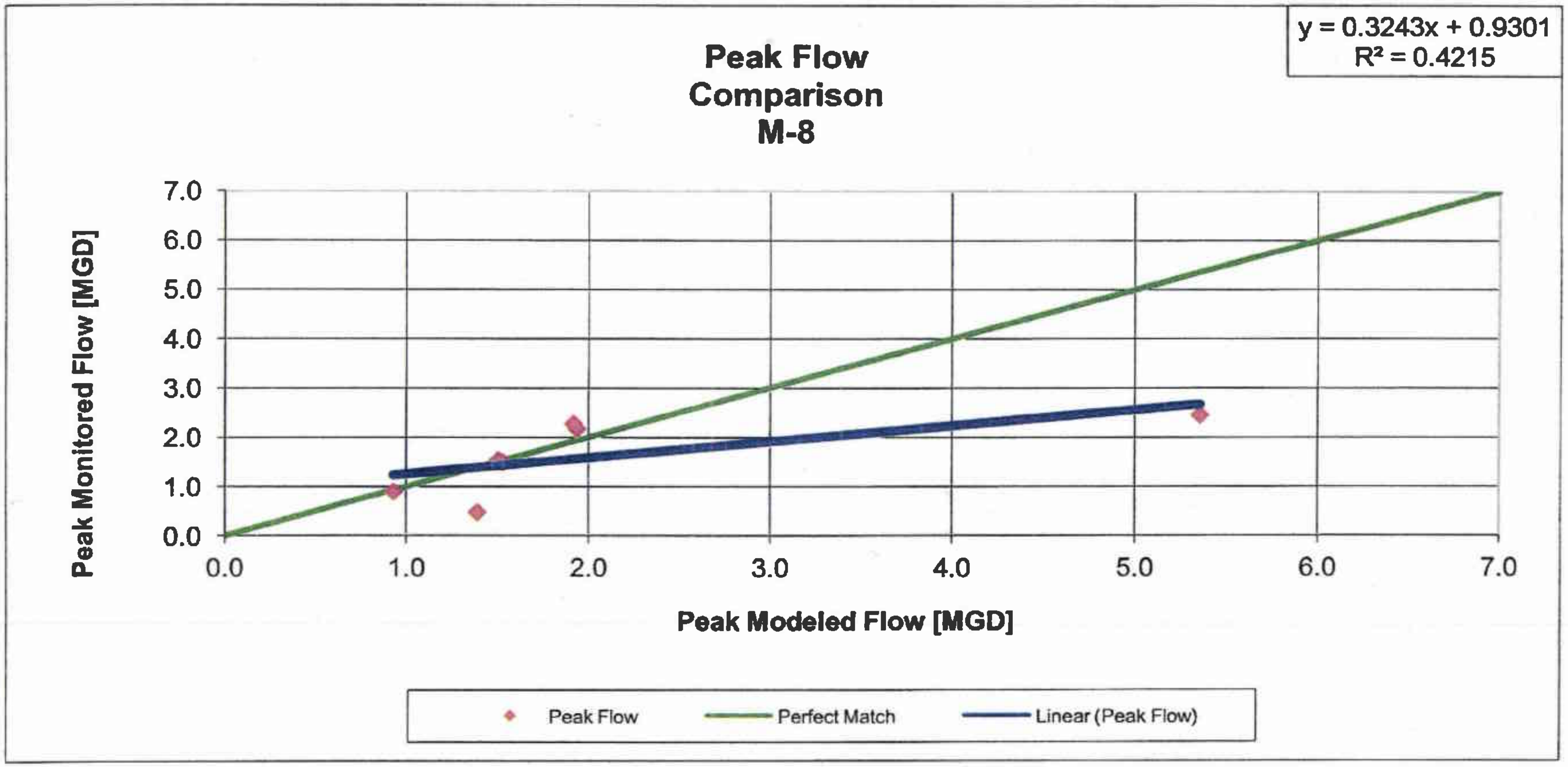

y = 0.1517x + 0.004
R² = 0.0171
Total Volume
Comparison
5A18
0.010
0.008
0.006
0.004
0.002
0.000
Total Monitored Volum [MG]
0.000
0.002
0.004
0.006
0.008
0.010
Total Modeled Volume [MG]
Total Volume
Perfect Match
Linear (Total Volume)



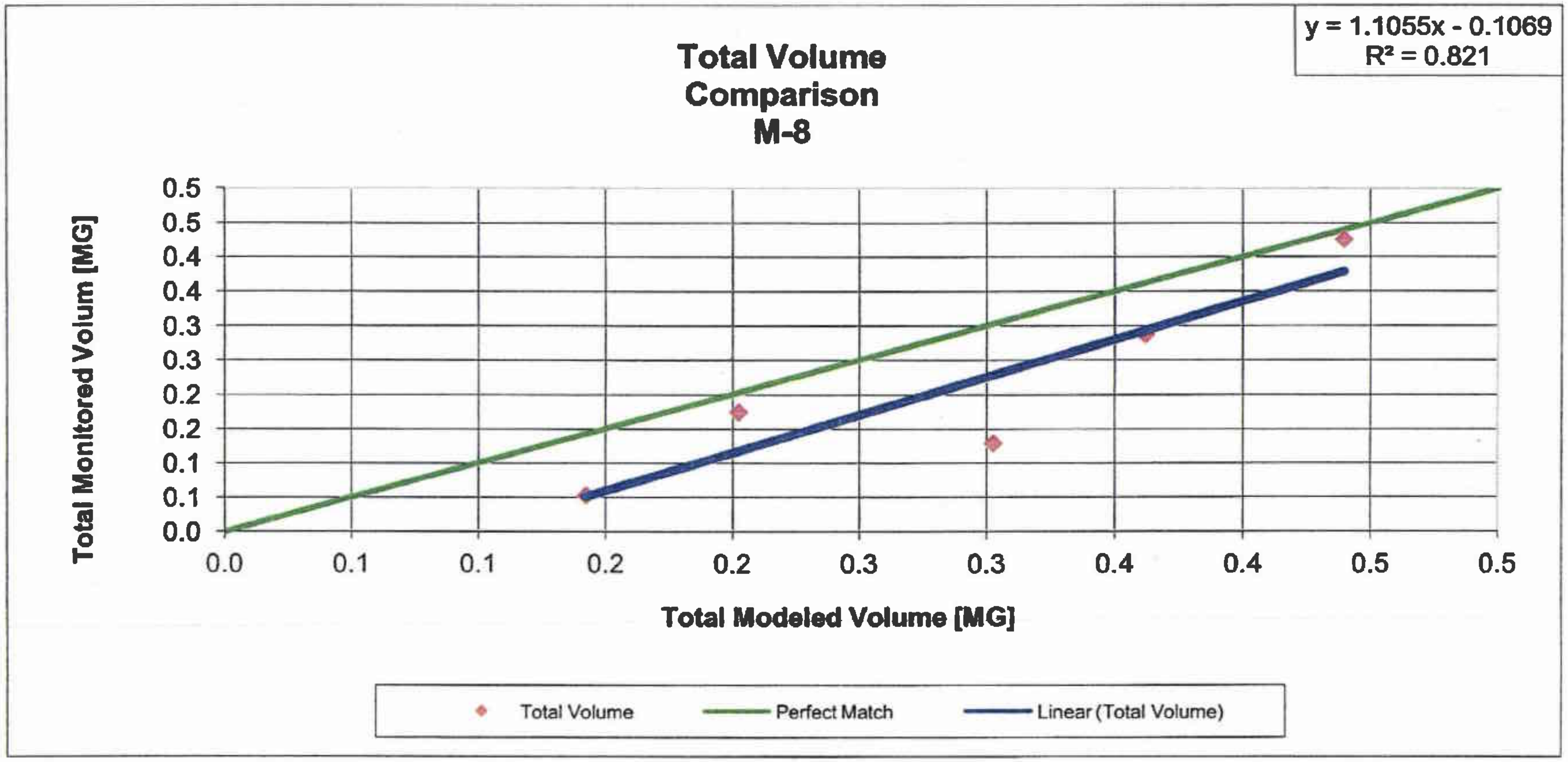
y = 1.1785x + 0.0077
R² = 0.7684
Peak Flow
Comparison
M-6
Peak Monitored Flow [MGD]
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
Peak Modeled Flow [MGD]
Peak Flow
Perfect Match
Linear (Peak Flow)



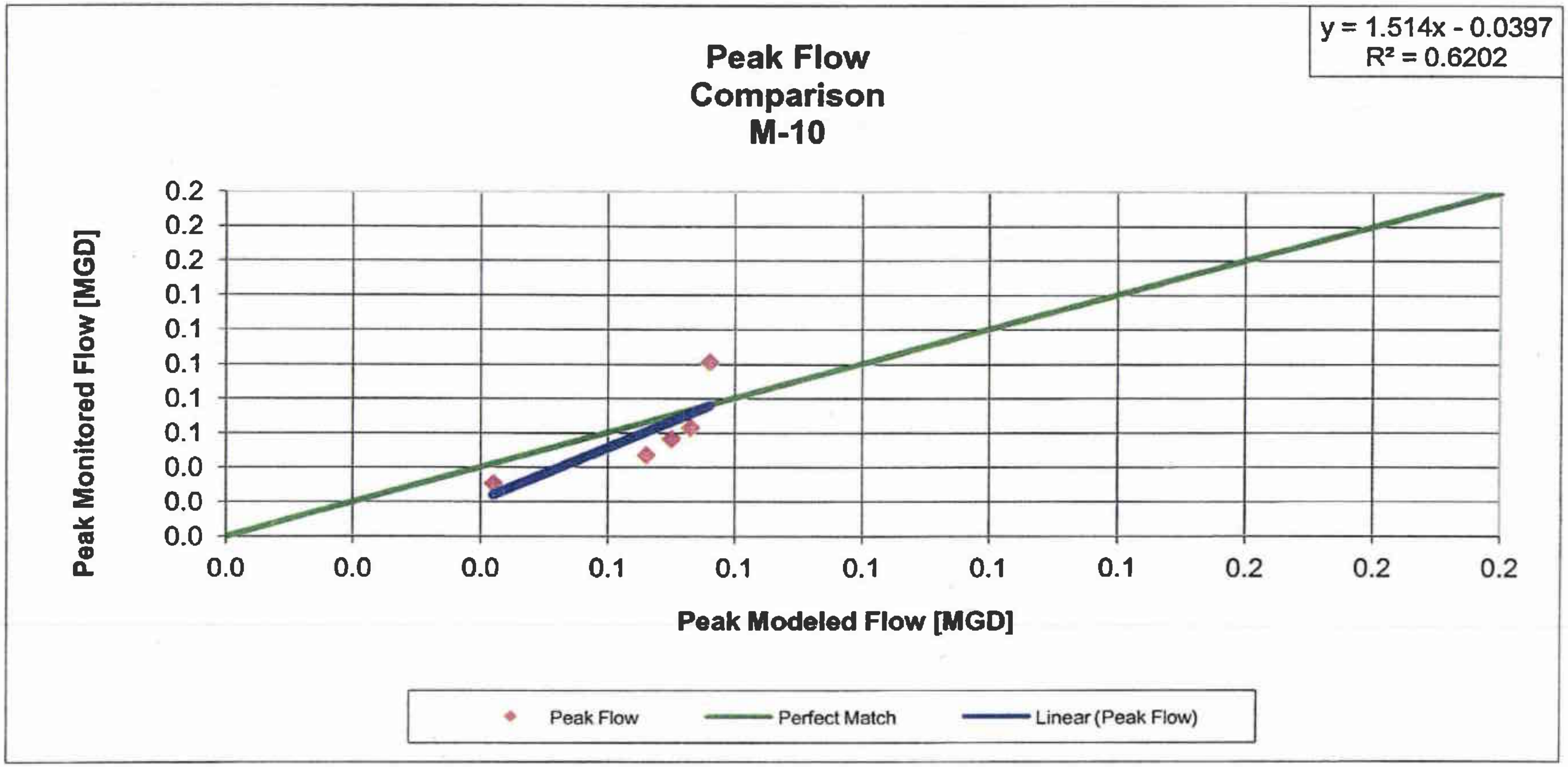
y = 1.3284x - 0.1907
R² = 0.8977
Total Volume
Comparison
M-6
Total Monitored Volum [MG]
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.0
0.1
0.2
0.3
0.4
0.5
0.6
Total Modeled Volume [MG]
Total Volume
Perfect Match
Linear (Total Volume)



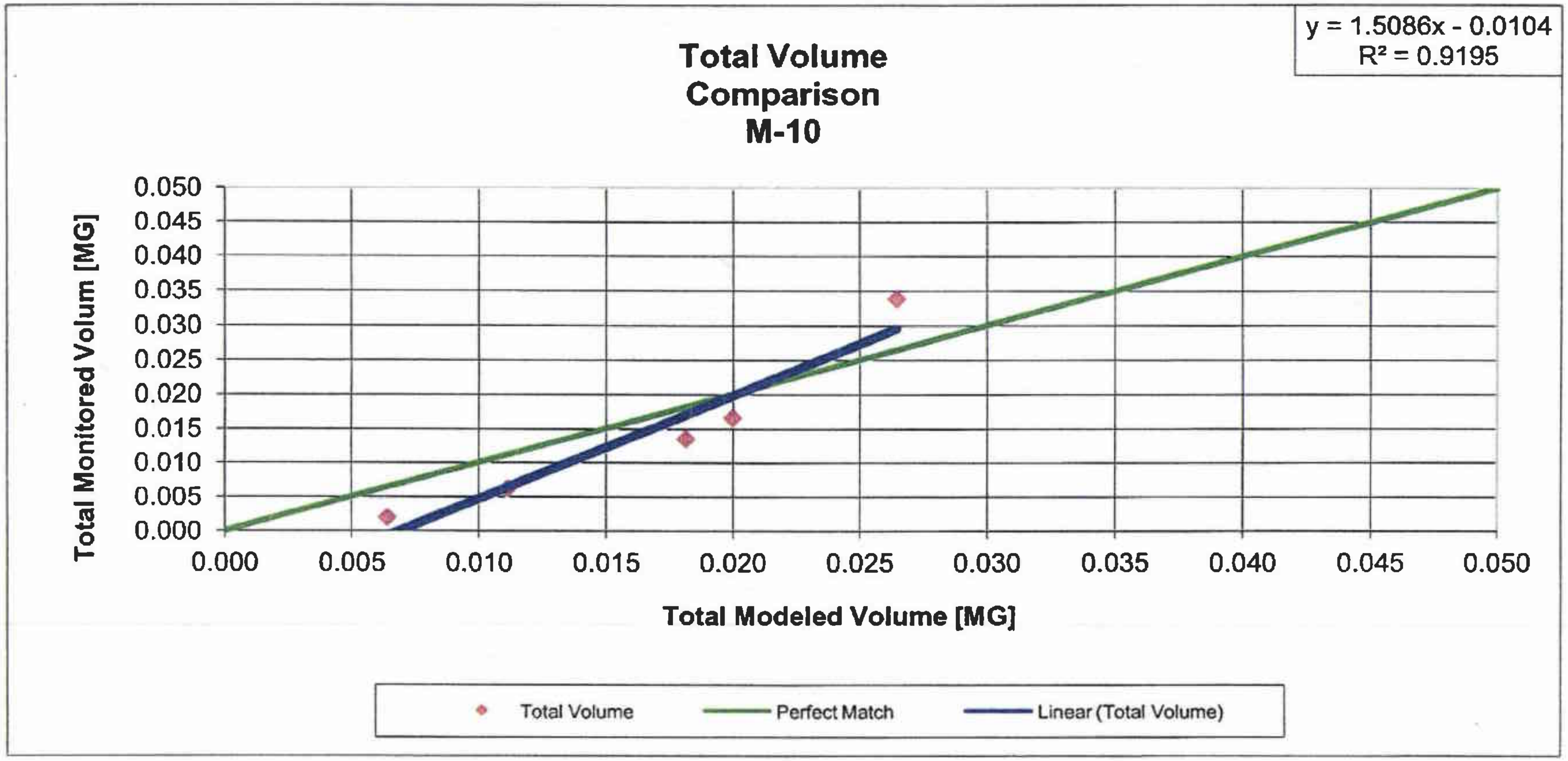
y = 0.3243x + 0.9301
R² = 0.4215
Peak Flow
Comparison
M-8
Peak Monitored Flow [MGD]
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
Peak Modeled Flow [MGD]
Peak Flow
Perfect Match
Linear (Peak Flow)



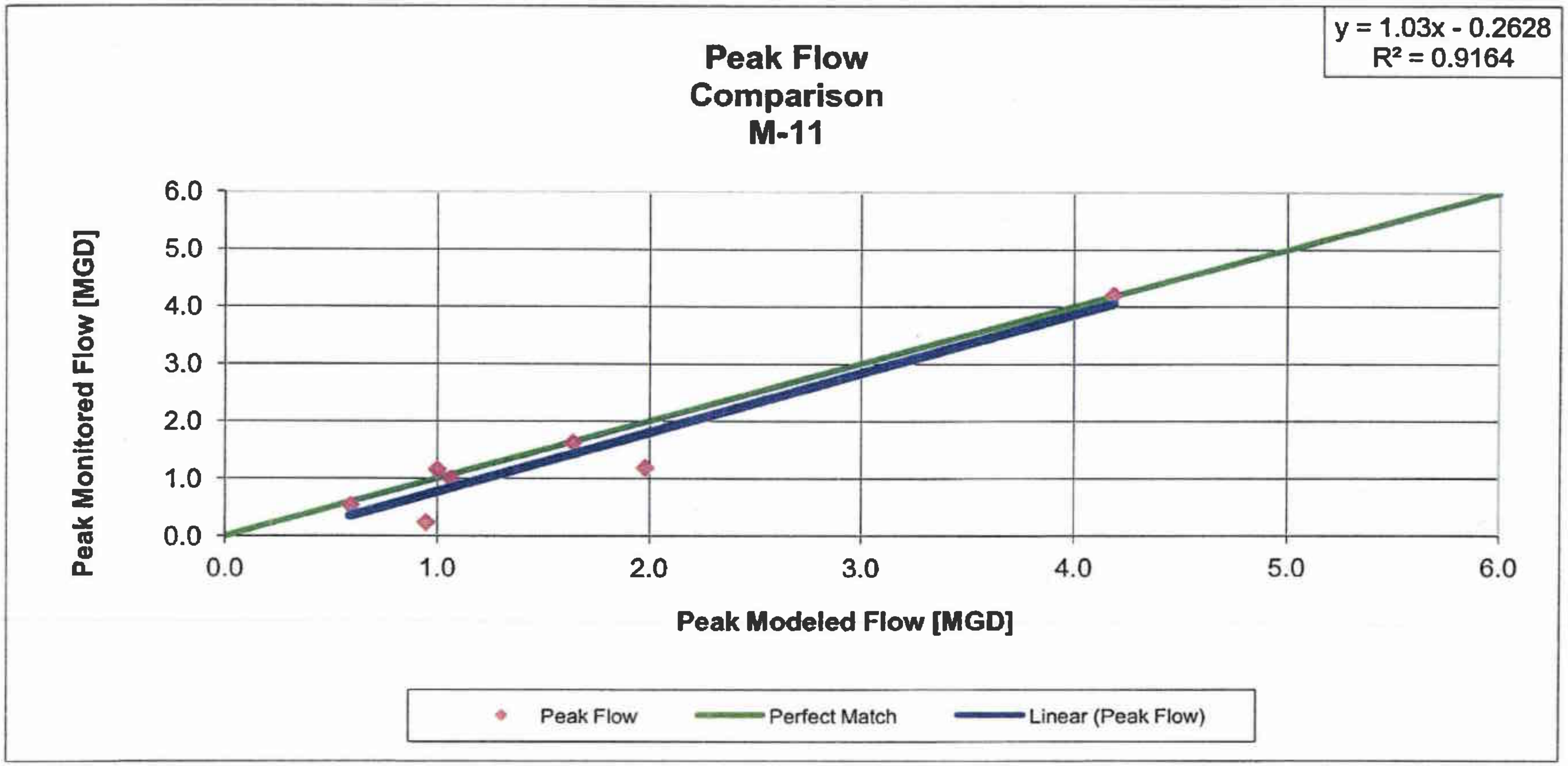
y = 1.1055x - 0.1069
R² = 0.821
Total Volume
Comparison
M-8
Total Monitored Volum [MG]
0.5
0.5
0.4
0.4
0.3
0.3
0.2
0.2
0.1
0.1
0.0
0.0
0.1
0.1
0.2
0.2
0.3
0.3
0.4
0.4
0.5
0.5
Total Modeled Volume [MG]
Total Volume
Perfect Match
Linear (Total Volume)



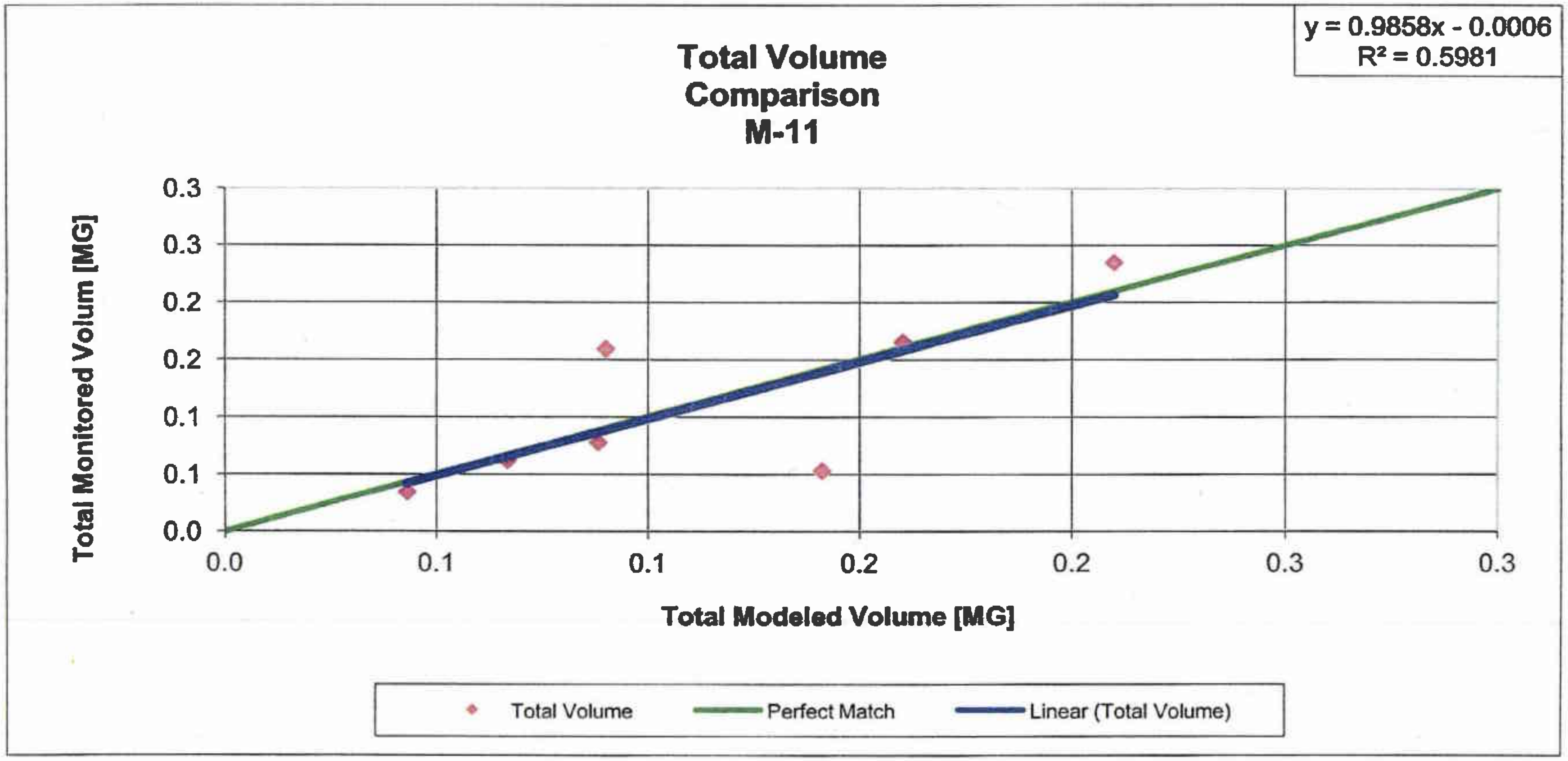
y = 1.514x - 0.0397
R² = 0.6202
Peak Flow
Comparison
M-10
0.2
0.2
0.2
0.1
0.1
0.1
0.1
0.1
0.0
0.0
0.0
Peak Monitored Flow [MGD]
0.0
0.0
0.0
0.1
0.1
0.1
0.1
0.1
0.2
0.2
0.2
Peak Modeled Flow [MGD]
Peak Flow
Perfect Match
Linear (Peak Flow)



y = 1.5086x - 0.0104
R² = 0.9195
Total Volume
Comparison
M-10
Total Monitored Volum [MG]
0.050
0.045
0.040
0.035
0.030
0.025
0.020
0.015
0.010
0.005
0.000
0.000
0.005
0.010
0.015
0.020
0.025
0.030
0.035
0.040
0.045
0.050
Total Modeled Volume [MG]
Total Volume
Perfect Match
Linear (Total Volume)



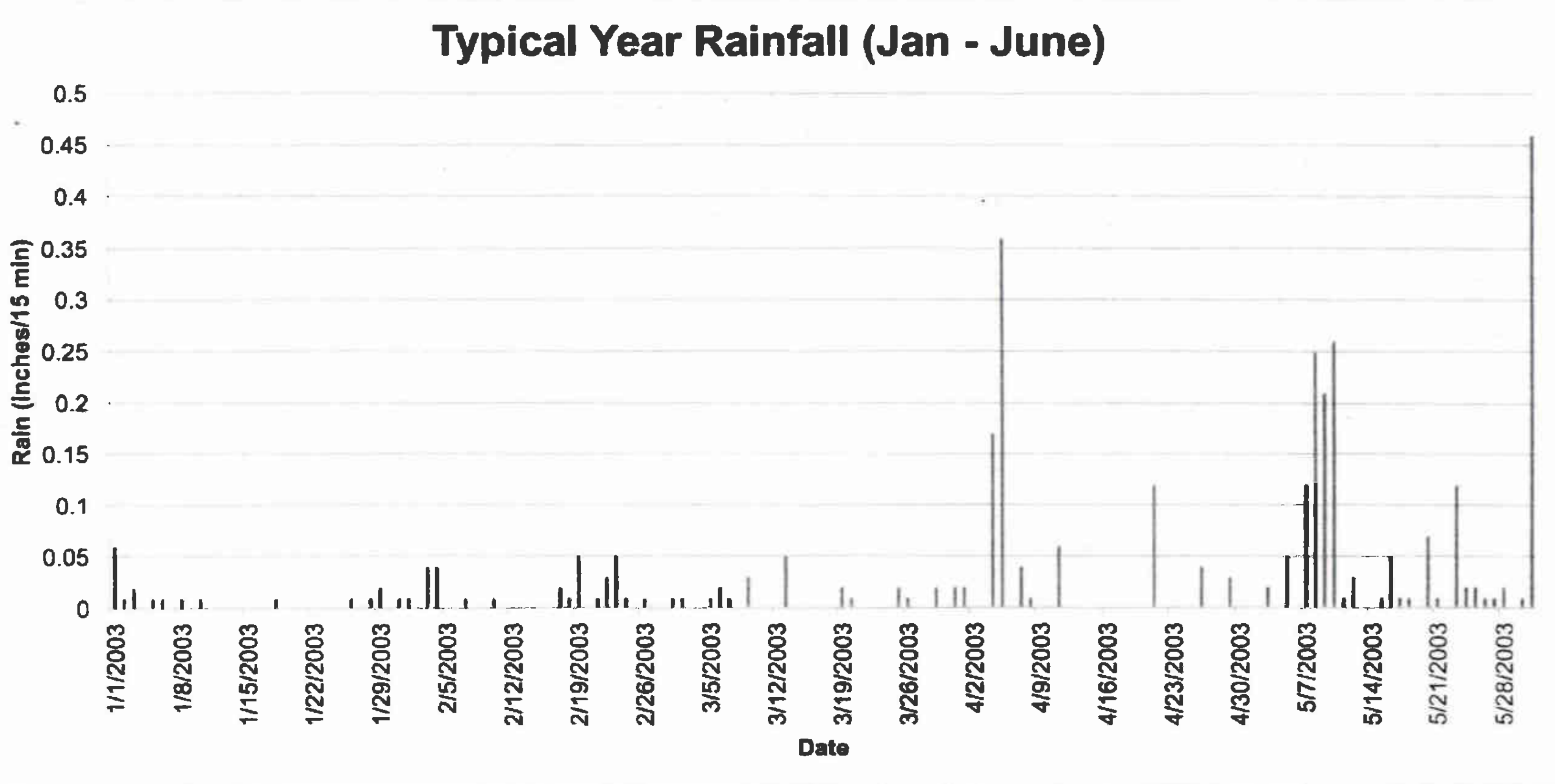
y = 1.03x - 0.2628
R² = 0.9164
Peak Flow
Comparison
M-11
6.0
5.0
4.0
3.0
2.0
1.0
0.0
Peak Monitored Flow [MGD]
0.0
1.0
2.0
3.0
4.0
5.0
6.0
Peak Modeled Flow [MGD]
Peak Flow
Perfect Match
Linear (Peak Flow)



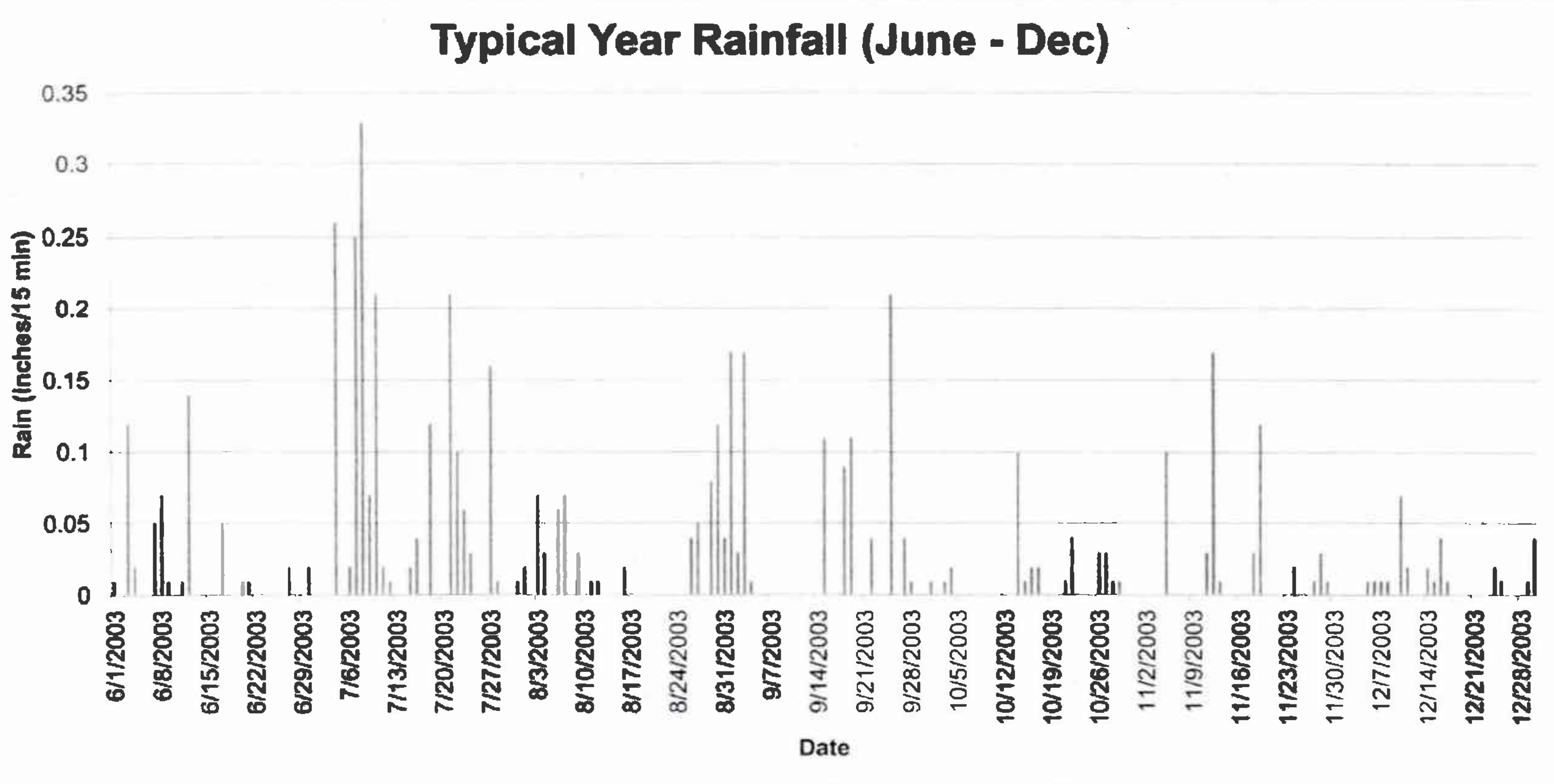
y = 0.9858x - 0.0006
R² = 0.5981
Total Volume
Comparison
M-11
Total Monitored Volum [MG]
0.3
0.3
0.2
0.2
0.1
0.1
0.0
0.0
0.1
0.1
0.2
0.2
0.3
0.3
Total Modeled Volume [MG]
Total Volume
Perfect Match
Linear (Total Volume)

Appendix I

Typical Year Rain Hyetograph



Typical Year Rainfall (Jan - June)
0.5
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
Rain (Inches/15 min)
1/1/2003
1/8/2003
1/15/2003
1/22/2003
1/29/2003
2/5/2003
2/12/2003
2/19/2003
2/26/2003
3/5/2003
3/12/2003
3/19/2003
3/26/2003
4/2/2003
4/9/2003
4/16/2003
4/23/2003
4/30/2003
5/7/2003
5/14/2003
5/21/2003
5/28/2003
Date



Typical Year Rainfall (June - Dec)
Rain (Inches/15 min)
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
6/1/2003
6/8/2003
6/15/2003
6/22/2003
6/29/2003
7/6/2003
7/13/2003
7/20/2003
7/27/2003
8/3/2003
8/10/2003
8/17/2003
8/24/2003
8/31/2003
9/7/2003
9/14/2003
9/21/2003
9/28/2003
10/5/2003
10/12/2003
10/19/2003
10/26/2003
11/2/2003
11/9/2003
11/16/2003
11/23/2003
11/30/2003
12/7/2003
12/14/2003
12/21/2003
12/28/2003
Date

APPENDIX J

INFOSWMM TYPICAL YEAR MODEL REPORT

```
  ------------------------------------------------------------------------
    Comprehensive Storm Water Management Model: based on EPA-SWMM 5.0.022
  ------------------------------------------------------------------------

Warning 08: elevation drop 17.616 exceeds length 16.068 for Conduit CSO_OVERFLOW
 Needed length: 17.616000 ft

  *************************
    Rainfall File Summary
  *************************
  Station      First         Last          Recording  Periods    Periods    Periods
  ID           Date          Date          Frequency  w/Precip   Missing    Malfunc.
  ------------------------------------------------------------------------------------
  RG-324381S012 DEC-21-2002  DEC-30-2003     15 min      1479          0           0

  **********************          Volume         Volume
  Rainfall Dependent I/I       acre-feet       10^6 gal
  **********************       ---------      ---------
  Sewershed Rainfall ......     1940.983        632.498
  RDII Produced ...........      504.005        164.238
  RDII Ratio ..............        0.260

  *************************************************************
    NOTE: The summary statistics displayed in this report are
    based on results found at every computational time step,
    not just on results from each reporting time step.
  *************************************************************

  ********************
    Analysis Options
  ********************
  Flow Units ............... MGD
  Process Models:
    Rainfall/Runoff ........ YES
    Snowmelt ............... NO
    Groundwater ............ NO
    Flow Routing ........... YES
    Ponding Allowed ........ YES
    Water Quality .......... NO
  Flow Routing Method ...... DYNWAVE
  Starting Date ............ DEC-28-2002 00:00:00
  Ending Date .............. JAN-01-2004 00:00:00
  Antecedent Dry Days ...... 5.0
  Report Time Step ......... 00:15:00
  Routing Time Step ........ 1.00 sec

  **************************        Volume         Volume
  Flow Routing Continuity        acre-feet       10^6 gal
  **************************     ---------      ---------
  Dry Weather Inflow .......      1136.535        370.357
  Wet Weather Inflow .......         0.000          0.000
  Groundwater Inflow .......         0.000          0.000
  RDII Inflow ..............       504.006        164.238
  External Inflow ..........         0.000          0.000
  External Outflow .........      1633.636        532.345
  Internal Outflow .........         0.000          0.000
  Storage Losses ...........         0.000          0.000
  Initial Stored Volume ....         0.000          0.000
  Final Stored Volume ......         0.075          0.024
```

Continuity Error (%) 0.416

```
******************************
  Highest Continuity Errors
******************************
Node DU2003.1M                    -3.13%   -11.7581
Node DU2001M                       2.75%    10.6164
Node DU2003M                       1.89%     6.3484
Node DU2002M                      -1.80%    -5.9279
Node DU2005M                       1.14%     2.9112
Node JCT-38                       -0.22%    -0.0834
Node DU6177S                       0.05%     0.0071
Node DU2631M                       0.04%     0.0146
Node DU4004M                       0.02%     0.0121
Node DU2632M                      -0.02%    -0.0069
Node DU1004M                       0.01%     0.0435
Node DU4003M                      -0.01%    -0.0051
Node DU1010M                       0.01%     0.0313
Node DU3097M                       0.01%     0.0032
Node DU2834M                       0.00%     0.0118
Node CSO-4                        -0.00%    -0.0025
Node CSO-3                         0.00%     0.0045
Node DU3107M                      -0.00%    -0.0014
Node DU1016M                       0.00%     0.0071
Node DU3168M                       0.00%     0.0042
                                             2.2300 Mgal


********************************
  Time-Step Critical Elements
********************************
Link DU2001M-DU2003.1M (64.62%)
Link DU2003M-DU2002M (4.96%)
Link CDT-67 (2.70%)
Link DU3158M-CSO3 (0.44%)
Link CSO_OVERFLOW (0.39%)
Link DU1003M-DU1002M (0.09%)
Link DU2633M-DU2634M (0.05%)
Link CSO3-DU3155M (0.02%)
Link DU3155M-DU3156M (0.00%)
Link DU3157M-DU3158M (0.00%)
Link DU1013M-DU1010M (0.00%)
Link DU3156M-DU1016M (0.00%)
Link DU6028M-DU3156M (0.00%)
Node JCT-38 (0.00%)
Link DU7001.1M-DU7001M (0.00%)
Link DU6177S-CSO3OUTFALL (0.00%)
Node DU2632.1M (0.00%)
Node DU7002M (0.00%)
Link DU7001.2M-DU7001.1M (0.00%)
Link DU6177S-DU3157M (0.00%)


*************************************
  Highest Flow Instability Indexes
*************************************
Link DU2003.1M-DU2003M (38)
Link DU2001M-DU2003.1M (23)
Link DU2003M-DU2002M (23)
Link DU2002M-DU2834M (21)
Link DU2005M-DU2001M (21)
Link DU2631M-DU2632M (0)
```

```
Link TO_WWTP (0)
Link DU4001M-CSO4 (0)
Link BYPASS2 (0)
Link DU7001.1M-DU7001M (0)
Link DU2597M-DU7004M (0)
Link CDT-67 (0)
Link DU2632M-DU2633M (0)
Link DU2633M-DU2634M (0)
Link DU2005M-CSO2 (0)
Link DU2006M-DU2005M (0)
Link DU4003M-DU4002.1 (0)
Link DU4299M-DU4298M (0)
Link DU2630.1M-DU2631M (0)
Link DU5001M-DU2632.1M (0)
```

****
Routing Time Step Summary
****

```
Minimum Time Step              :     0.10 sec
Average Time Step              :     0.81 sec
Maximum Time Step              :     1.00 sec
Percent in Steady State        :     0.00
Average Iterations per Step    :     3.43
Total Steps                    :  39030066
Total Iterations               :  133694420
Minimum Possible Steps         :  31881600
```

****
Node Depth Summary
****

Node	Type	Average Depth Feet	Maximum Depth Feet	Maximum Run HGL Feet	Time of Max Occurrence days hr:min	Maximum Output HGL Feet	Time of Max Occurrence days hr:min
CSO-3	JUNCTION	0.55	5.90	746.95	219 12:43	746.28	219 12:45
CSO-4	JUNCTION	0.12	0.31	752.01	219 13:01	752.01	219 13:00
DU1001M	JUNCTION	0.52	1.74	739.51	219 13:01	739.50	219 13:00
DU1002M	JUNCTION	0.65	2.24	740.10	219 13:01	740.08	219 13:00
DU1003M	JUNCTION	0.50	2.21	740.22	219 13:01	740.20	219 13:00
DU1004M	JUNCTION	0.64	2.46	740.67	219 12:43	740.62	219 13:00
DU1010M	JUNCTION	0.61	18.08	757.08	219 12:42	742.51	219 13:00
DU1013M	JUNCTION	0.56	21.20	760.65	219 13:27	743.62	219 13:00
DU1016M	JUNCTION	0.65	60.55	800.35	219 13:25	745.68	174 18:15
DU2001M	JUNCTION	0.65	4.31	752.23	247 13:51	751.77	

326 12:15									
DU2002M	JUNCTION	1.42	2.26	749.43	290	20:47	749.42	326	11:00
DU2003.1M	JUNCTION	1.37	4.68	752.01	326	14:03	751.84	290	21:15
DU2003M	JUNCTION	1.43	2.95	750.07	326	09:44	750.04	326	09:45
DU2006M	JUNCTION	0.20	0.73	753.02	219	12:55	752.99	219	13:15
DU2597M	JUNCTION	0.08	16.59	917.46	219	12:53	901.84	219	13:00
DU2630.1M	JUNCTION	0.10	0.67	903.71	219	12:59	903.71	219	13:00
DU2631M	JUNCTION	0.13	1.17	900.18	219	12:59	900.18	219	13:00
DU2632.1M	JUNCTION	0.34	0.98	899.22	219	12:59	899.22	219	13:00
DU2633M	JUNCTION	0.32	1.13	899.44	219	12:59	899.44	219	13:00
DU2634M	JUNCTION	0.33	1.12	899.41	219	12:59	899.41	219	13:00
DU2815M	JUNCTION	0.44	1.17	748.26	290	20:54	748.26	326	11:15
DU2818M	JUNCTION	0.58	1.38	747.98	290	20:55	747.97	174	22:30
DU2821M	JUNCTION	0.44	1.14	747.59	290	20:56	747.59	290	21:00
DU2826M	JUNCTION	0.53	1.30	748.69	290	20:53	748.68	326	11:15
DU2834M	JUNCTION	0.51	1.34	749.03	290	20:52	749.01	290	21:30
DU3097M	JUNCTION	0.19	1.30	816.20	219	12:57	816.15	219	13:00
DU3098M	JUNCTION	0.13	0.64	814.26	219	12:57	814.26	219	13:00
DU3107.1M	JUNCTION	0.22	21.41	839.38	219	12:42	820.12	219	12:45
DU3107.2M	JUNCTION	0.09	0.43	845.41	219	12:51	845.38	219	13:00
DU3107M	JUNCTION	0.16	0.91	817.46	219	12:53	817.41	219	13:00
DU3155M	JUNCTION	0.43	10.28	751.38	219	13:25	746.16	219	13:00
DU3156M	JUNCTION	0.41	18.07	759.16	219	12:41	746.06	219	13:00
DU3158M	JUNCTION	0.55	4.77	746.79	219	12:43	746.37	219	12:45
DU3168M	JUNCTION	0.35	1.56	746.31	219	13:02	746.08	219	13:00
DU3177M	JUNCTION	0.71	1.66	746.47	219	13:03	746.28	290	21:00
DU3184M	JUNCTION	0.49	1.46	746.65	219	13:04	746.54	290	21:00
DU3191M	JUNCTION	0.76	1.44	746.96	290	20:58	746.96	290	21:00
DU3206M	JUNCTION	0.55	1.34	747.25	290	20:58	747.25	290	21:00
DU4002.1M	JUNCTION	0.07	0.55	802.45	219	13:01	802.45	219	13:00
DU4003M	JUNCTION	0.14	1.30	807.90	219	13:01	807.88	219	13:00
DU4004M	JUNCTION	0.13	0.77	836.34	219	13:01	836.33	219	13:00

DU4006.1M	JUNCTION	0.00	0.00	859.09	0	00:00	859.09	0	00:00
DU4006M	JUNCTION	0.00	0.00	840.08	0	00:00	840.08	0	00:00
DU4033M	JUNCTION	0.00	0.00	838.45	0	00:00	838.45	0	00:00
DU4037M	JUNCTION	0.00	0.00	846.40	0	00:00	846.40	0	00:00
DU4298M	JUNCTION	0.03	14.69	769.26	219	12:35	758.76	174	17:45
DU4299M	JUNCTION	0.14	1.03	759.15	219	13:01	759.13	219	13:00
DU5001M	JUNCTION	0.04	0.19	904.38	326	13:29	904.38	326	13:30
DU5013M	JUNCTION	0.10	0.50	888.30	219	12:51	888.27	219	13:00
DU6025M	JUNCTION	0.06	49.46	792.02	219	12:41	746.06	219	13:00
DU6028M	JUNCTION	0.06	17.39	759.16	219	12:41	746.04	219	13:00
DU6029M	JUNCTION	0.11	10.49	754.61	219	12:43	746.05	219	13:00
DU6177S	JUNCTION	0.02	21.32	759.58	219	12:39	746.60	219	12:45
DU7001.1M	JUNCTION	0.11	0.52	747.52	219	12:59	747.52	219	13:00
DU7001.2M	JUNCTION	0.16	0.89	749.89	219	12:59	749.89	219	13:00
DU7001M	JUNCTION	0.20	0.82	738.25	219	13:01	738.24	219	13:00
DU7002M	JUNCTION	0.07	0.33	791.33	219	12:59	791.33	219	13:00
DU7003M	JUNCTION	0.16	0.94	794.94	219	12:58	794.94	219	13:00
DU7004.1M	JUNCTION	0.11	0.55	805.55	219	12:58	805.55	219	13:00
DU7004M	JUNCTION	0.13	0.82	896.90	219	12:51	896.82	219	13:00
DU7006M	JUNCTION	0.16	0.53	898.65	219	13:05	898.65	219	13:00
JCT-38	JUNCTION	0.28	1.10	899.45	219	12:59	899.45	219	13:00
CSO2	OUTFALL	0.00	0.00	723.91	0	00:00	723.91	0	00:00
CSO3-OUTFALL	OUTFALL	0.02	1.83	728.99	219	12:46	728.98	219	12:45
DU2635M	OUTFALL	0.00	0.00	889.61	0	00:00	889.61	0	00:00
JCT-20	OUTFALL	0.00	0.41	735.41	219	13:00	735.40	219	13:00
WWTP	OUTFALL	0.19	0.62	730.62	219	13:01	730.62	219	13:00
DU2005M	STORAGE	0.22	0.92	751.23	219	13:19	751.19	219	13:15
DU2632M	STORAGE	0.21	1.43	900.23	219	13:00	900.23	219	13:00
DU3157M	STORAGE	0.32	4.40	746.70	219	12:46	746.59	219	12:45
DU4001M	STORAGE	0.28	1.60	753.32	219	13:00	753.28	219	13:00

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Node Inflow Summary
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Node	Type	Maximum Lateral Inflow MGD	Maximum Total Inflow MGD	Time of Max Occurrence days	hr:min	Lateral Inflow Volume 10^6 gal	Total Inflow Volume 10^6 gal
CSO-3	JUNCTION	0.000	15.222	219	12:41	0.000	137.932
CSO-4	JUNCTION	0.000	1.087	219	13:00	0.000	54.149
DU1001M	JUNCTION	0.000	11.307	219	13:01	0.000	445.540
DU1002M	JUNCTION	0.000	11.313	219	13:01	0.000	445.544
DU1003M	JUNCTION	0.000	3.081	219	12:42	0.000	202.866
DU1004M	JUNCTION	0.000	10.231	219	13:01	0.000	391.438
DU1010M	JUNCTION	0.000	10.231	219	13:01	0.000	391.469
DU1013M	JUNCTION	0.000	10.230	219	13:01	0.000	391.472
DU1016M	JUNCTION	0.000	10.231	219	13:01	0.000	391.479
DU2001M	JUNCTION	0.000	4.482	290	20:49	0.000	385.944
DU2002M	JUNCTION	0.000	12.159	290	19:31	0.000	328.718
DU2003.1M	JUNCTION	0.000	4.800	192	20:41	0.000	375.328
DU2003M	JUNCTION	0.000	7.297	4	11:38	0.000	335.066
DU2006M	JUNCTION	8.357	8.357	219	13:20	253.005	255.601
DU2597M	JUNCTION	2.684	2.684	219	12:49	17.716	17.879
DU2630.1M	JUNCTION	5.296	5.296	219	12:59	39.478	39.860
DU2631M	JUNCTION	0.000	5.296	219	12:59	0.000	40.121
DU2632.1M	JUNCTION	0.000	0.967	219	12:58	0.000	40.283
DU2633M	JUNCTION	0.000	0.842	174	16:58	0.000	37.695
DU2634M	JUNCTION	0.000	0.851	174	16:57	0.000	37.695
DU2815M	JUNCTION	0.000	3.831	290	20:54	0.000	249.920
DU2818M	JUNCTION	0.000	3.827	290	20:54	0.000	249.919
DU2821M	JUNCTION	0.000	3.824	290	20:55	0.000	249.918

DU2826M	JUNCTION	0.000	3.841	290	20:53	0.000	249.923
DU2834M	JUNCTION	0.000	4.114	290	20:47	0.000	249.935
DU3097M	JUNCTION	0.000	3.567	219	12:53	0.000	58.163
DU3098M	JUNCTION	0.000	3.427	219	12:57	0.000	58.160
DU3107.1M	JUNCTION	0.000	3.619	219	12:51	0.000	58.161
DU3107.2M	JUNCTION	0.000	3.620	219	12:51	0.000	58.161
DU3107M	JUNCTION	0.000	3.619	219	12:51	0.000	58.162
DU3155M	JUNCTION	0.000	14.179	219	12:41	0.000	137.928
DU3156M	JUNCTION	0.000	14.767	219	12:41	0.000	391.525
DU3158M	JUNCTION	0.000	14.950	219	12:41	0.000	137.931
DU3168M	JUNCTION	0.000	4.067	219	13:05	0.000	249.916
DU3177M	JUNCTION	0.000	3.861	219	13:05	0.000	249.912
DU3184M	JUNCTION	0.000	3.817	290	20:58	0.000	249.914
DU3191M	JUNCTION	0.000	3.819	290	20:57	0.000	249.915
DU3206M	JUNCTION	0.000	3.822	290	20:56	0.000	249.917
DU4002.1M	JUNCTION	0.000	11.062	219	13:01	0.000	62.318
DU4003M	JUNCTION	0.000	11.147	219	13:01	0.000	62.313
DU4004M	JUNCTION	11.147	11.147	219	13:00	61.707	62.325
DU4006.1M	JUNCTION	0.000	0.000	0	00:00	0.000	0.000
DU4006M	JUNCTION	0.000	0.000	0	00:00	0.000	0.000
DU4033M	JUNCTION	0.000	0.000	0	00:00	0.000	0.000
DU4037M	JUNCTION	0.000	0.000	0	00:00	0.000	0.000
DU4298M	JUNCTION	0.000	5.580	219	12:53	0.000	7.694
DU4299M	JUNCTION	0.000	11.061	219	13:01	0.000	62.318
DU5001M	JUNCTION	0.137	0.137	326	13:28	2.564	2.588
DU5013M	JUNCTION	0.000	3.621	219	12:51	0.000	58.161
DU6025M	JUNCTION	0.040	0.559	219	12:41	2.149	2.173
DU6028M	JUNCTION	0.000	5.864	219	12:41	0.000	3.687
DU6029M	JUNCTION	0.031	3.431	219	12:41	1.461	1.478
DU6177S	JUNCTION	0.000	23.332	219	12:40	0.000	14.729
DU7001.1M	JUNCTION	0.000	3.414	219	12:59	0.000	58.159
DU7001.2M	JUNCTION	0.000	3.415	219	12:59	0.000	

							58.159
DU7001M	JUNCTION	0.000	14.684	219	13:01	0.000	503.699
DU7002M	JUNCTION	0.000	3.416	219	12:58	0.000	58.160
DU7003M	JUNCTION	0.000	3.422	219	12:58	0.000	58.160
DU7004.1M	JUNCTION	0.000	3.426	219	12:58	0.000	58.160
DU7004M	JUNCTION	0.000	3.626	219	12:50	0.000	58.161
DU7006M	JUNCTION	0.000	0.967	219	12:59	0.000	40.283
JCT-38	JUNCTION	0.000	0.839	219	13:00	0.000	37.612
CSO2	OUTFALL	0.000	4.736	219	13:19	0.000	3.476
CSO3-OUTFALL	OUTFALL	0.000	18.073	219	12:46	0.000	14.722
DU2635M	OUTFALL	0.000	4.457	219	13:00	0.000	2.241
JCT-20	OUTFALL	0.000	10.112	219	13:00	0.000	8.168
WWTP	OUTFALL	0.000	14.683	219	13:01	0.000	503.699
DU2005M	STORAGE	0.000	8.357	219	13:20	0.000	255.601
DU2632M	STORAGE	0.000	5.296	219	13:00	0.000	40.106
DU3157M	STORAGE	30.944	30.944	219	12:45	151.184	152.653
DU4001M	STORAGE	0.000	11.331	219	13:00	0.000	62.318

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Node Surcharge Summary
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Surcharging occurs when water rises above the top of the highest conduit.

Node	Type	Hours Surcharged	Max. Height Above Crown Feet	Min. Depth Below Rim Feet
CSO-3	JUNCTION	0.47	2.645	24.005
DU1003M	JUNCTION	56.28	0.704	15.547
DU1004M	JUNCTION	0.43	0.301	17.566
DU1010M	JUNCTION	19.52	16.081	9.199
DU1013M	JUNCTION	23.97	19.197	23.903
DU1016M	JUNCTION	38.27	58.553	0.000
DU2001M	JUNCTION	96.20	2.504	12.226
DU2003.1M	JUNCTION	1645.02	3.178	12.562
DU2597M	JUNCTION	0.29	15.754	0.893
DU2633M	JUNCTION	36.36	0.133	12.367
DU2634M	JUNCTION	28.17	0.117	14.092
DU3097M	JUNCTION	0.06	0.051	6.789
DU3107.1M	JUNCTION	0.65	20.155	0.000
DU3155M	JUNCTION	15.19	8.067	19.673
DU3156M	JUNCTION	17.36	16.067	11.838
DU3158M	JUNCTION	0.50	2.563	24.099
DU4298M	JUNCTION	2.14	13.043	0.000
DU6025M	JUNCTION	17.91	48.964	0.000

DU6028M	JUNCTION	0.65	15.390	0.000
DU6029M	JUNCTION	0.16	8.898	6.862
DU6177S	JUNCTION	0.53	15.737	0.000
JCT-38	JUNCTION	10.44	0.101	12.349

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Node Flooding Summary
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Flooding refers to all water that overflows a node, whether it ponds or not.

Node	Hours Flooded	Maximum Rate MGD	Time of Max Occurrence days hr:min	Total Flood Volume 10^6 gal	Maximum Ponded Depth Feet
DU6028M	0.01	4.314	219 12:41	0.000	17.39
DU6177S	0.01	4.919	219 12:40	0.000	21.32

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Storage Volume Summary
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Storage Unit	Average Volume 1000 ft3	Avg Pcnt Full	E&I Pcnt Loss	Maximum Volume 1000 ft3	Max Pcnt Full	Time of Max Occurrence days hr:min	Maximum Outflow MGD
DU2005M	0.011	2.54	0.00	0.046	11	219 13:19	8.848
DU2632M	0.001	0.78	0.00	0.036	20	219 13:00	5.296
DU3157M	0.013	2.48	0.00	0.176	34	219 12:46	33.452
DU4001M	0.000	0.00	0.00	0.000	0	0 00:00	11.197

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Outfall Loading Summary
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Outfall Node	Flow Freq. Pcnt.	Avg. Flow MGD	Max. Flow MGD	Total Volume 10^6 gal
CSO2	5.95	0.338	4.736	3.476
CSO3-OUTFALL	5.35	1.665	18.073	14.722
DU2635M	2.71	0.557	4.457	2.241
JCT-20	3.89	1.216	10.112	8.168
WWTP	98.94	1.522	14.683	503.699
System	23.37	5.298	49.598	532.305

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   Link Flow Summary
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                                               Maximum  Time of Max        Maximum  Time of
Max     Max/   Maximum  Time of Max       Max/  Time of Max     Maximum
                                          |Run Flow|   Occurrence  |Output Flow|
Occurrence    Full   |Veloc|   Occurrence    Full   Occurrence  Top Width
  Link                    Type                 MGD  days hr:min             MGD   days
hr:min    Flow    ft/sec  days hr:min   Depth  days hr:min           ft

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  BYPASS1                 CONDUIT        1.760   219  12:53           1.637   219
13:00    0.88     2.64   219  12:47     0.86   219  12:56         1.25
  BYPASS2                 CONDUIT        6.013   219  13:00           5.380   219
13:00    1.10     8.17   219  13:00     0.88   219  13:00         1.25
  CDT-67                  CONDUIT        0.842   174  16:58           0.839   219
13:00    0.45     1.95   271  08:42     1.00    97  20:32         1.00
  CSO3-DU3155M            CONDUIT       14.179   219  12:41          12.293   219
12:45    0.83     6.98   219  12:41     1.00     4  10:22         2.00
  CSO4-DU1003M            CONDUIT        1.080   219  13:01           1.071   219
13:00    0.14     3.51   271  08:34     0.63   219  13:01         1.25
  CSO_OVERFLOW            CONDUIT       10.112   219  13:00           9.626   219
13:00    0.23    32.56   247  12:20     0.44   219  13:00         1.25
  DU-3107.2M-DU3107.1M CONDUIT           3.619   219  12:51           3.230   219
13:00    0.26     6.38   219  12:51     0.67   219  12:51         1.25
  DU1001M-DU7001M         CONDUIT       11.302   219  13:01          11.162   219
13:00    1.08     5.78   219  13:01     0.71   219  13:01         2.25
  DU1002M-DU1001M         CONDUIT       11.307   219  13:01          11.180   219
13:00    2.45     5.73   219  13:01     0.94   219  13:01         2.00
  DU1003M-DU1002M         CONDUIT        3.080   219  12:42           3.011   219
13:00    0.90     3.88   219  12:42     1.00     4  06:13         1.25
  DU1004M-DU1002M         CONDUIT        8.273   219  13:01           8.189   219
13:00    5.48     4.12   219  13:01     0.97   219  13:01         2.00
  DU1004M-DU1003M         CONDUIT        2.025   219  12:42           1.940   219
13:00    2.72     2.55   219  12:42     1.00     4  08:09         1.25
  DU1010M-DU1004M         CONDUIT       10.231   219  13:01          10.131   219
13:00    1.73     5.04   219  13:01     1.00   174  17:43         2.00
  DU1013M-DU1010M         CONDUIT       10.231   219  13:01          10.131   219
13:00    1.59     5.04   219  13:01     1.00     4  10:18         2.00
  DU1016M-DU1013M         CONDUIT       10.230   219  13:01          10.131   219
13:00    2.03     5.04   219  13:01     1.00     4  10:09         2.00
  DU2001M-DU2003.1M       CONDUIT        4.800   192  20:41           4.326    33
22:30    0.26     5.85   132  08:34     1.00     4  06:26         1.49
  DU2002M-DU2834M         CONDUIT        4.114   290  20:47           4.025   326
11:00    0.70     3.33   219  12:54     0.61   290  20:49         2.00
  DU2003M-DU2002M         CONDUIT       12.159   290  19:31          11.046   247
15:00    0.25     8.43   290  19:31     0.99   174  22:22         1.92
  DU2005M-DU2001M         CONDUIT        4.482   290  20:49           4.345   326
14:30    0.26     8.08   194  18:10     0.81   219  13:19         1.50
  DU2006M-DU2005M         CONDUIT        8.357   219  13:20           8.190   219
13:15    0.46    13.57   219  12:58     0.54   219  13:19         1.50
  DU2597M-DU7004M         CONDUIT        2.684   219  12:49           2.250   219
13:00    1.25     7.62   219  12:49     1.00   219  12:45         0.83
  DU2630.1M-DU2631M       CONDUIT        5.296   219  12:59           5.296   219
13:00    0.24     8.99   219  12:59     0.33   219  12:59         1.99
  DU2631M-DU2632M         CONDUIT        5.296   219  13:00           5.296   219
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13:00     0.30      3.89   219  12:59    0.64   219  12:59         2.00
  DU2632.1M-DU7006M     CONDUIT          0.967   219  12:59           0.967    219
13:00     2.56      2.36   219  12:59    0.75   219  12:59         1.00
  DU2632M-DU2635M       CONDUIT          4.457   219  13:00           4.457    219
13:00     0.10     14.21   219  13:00    0.21   219  13:00         1.92
  DU2633M-DU2634M       CONDUIT          0.851   174  16:57           0.839    219
13:00     1.37      1.87   271  08:42    1.00     4  09:46         1.00
  DU2634M-DU2632.1M     CONDUIT          0.839   219  13:00           0.839    219
13:00     1.90      1.69   174  16:56    0.99   219  12:59         1.00
  DU2815M-DU2818M       CONDUIT          3.827   290  20:54           3.793    326
11:15     0.60      2.83   219  12:57    0.64   290  20:55         2.00
  DU2818M-DU2821M       CONDUIT          3.824   290  20:55           3.793    174
22:30     1.06      2.86   219  12:58    0.63   290  20:56         2.00
  DU2821M-DU3206M       CONDUIT          3.822   290  20:56           3.797    290
21:00     0.60      2.94   219  12:59    0.62   290  20:57         2.00
  DU2826M-DU2815M       CONDUIT          3.831   290  20:54           3.792    326
11:15     0.80      2.96   219  12:56    0.62   290  20:54         2.00
  DU2834M-DU2826M       CONDUIT          3.841   290  20:53           3.798    290
20:45     0.80      2.74   219  12:55    0.66   290  20:53         2.00
  DU3097M-DU3098M       CONDUIT          3.427   219  12:57           3.365    219
13:00     1.11      4.67   219  12:52    0.87   219  12:57         1.25
  DU3098M-DU7004.1M     CONDUIT          3.426   219  12:58           3.372    219
13:00     0.49      9.17   219  12:57    0.48   219  12:58         1.25
  DU3107.1M-DU3107M     CONDUIT          3.619   219  12:51           3.230    219
13:00     1.46      5.00   219  12:50    0.86   219  12:53         1.25
  DU3107M-DU3097M       CONDUIT          1.808   219  12:53           1.682    219
13:00     0.88      2.71   219  12:47    0.86   219  12:56         1.25
  DU3155M-DU3156M       CONDUIT         14.143   219  12:41          12.303    219
12:45     9.57      6.97   219  12:41    1.00     4  10:21         2.00
  DU3156M-DU1016M       CONDUIT         10.231   219  13:01          10.130    219
13:00     0.87      5.04   219  13:01    1.00     4  10:21         2.00
  DU3157M-DU3158M       CONDUIT         14.950   219  12:41          12.273    219
12:45     2.10      7.37   219  12:41    1.00   174  17:42         2.00
  DU3158M-CSO3          CONDUIT         15.222   219  12:41          12.281    219
12:45     0.56      7.72   219  12:41    1.00   174  17:42         2.00
  DU3168M-DU3156M       CONDUIT          7.045   219  13:03           3.807    290
21:00     0.63      4.36   175  00:29    0.89   219  13:02         2.00
  DU3177M-DU3168M       CONDUIT          4.067   219  13:05           3.811    290
21:00     1.23      3.31   290  21:00    0.77   219  13:02         2.00
  DU3184M-DU3177M       CONDUIT          3.861   219  13:05           3.814    290
21:00     0.72      2.50   174  17:46    0.77   219  13:03         2.00
  DU3191M-DU3184M       CONDUIT          3.817   290  20:58           3.815    290
21:00     0.62      3.05   174  17:30    0.62   219  13:04         2.00
  DU3206M-DU3191M       CONDUIT          3.819   290  20:57           3.810    290
21:00     0.64      2.64   290  20:57    0.67   290  20:58         2.00
  DU4002.1M-DU4299M     CONDUIT         11.061   219  13:01          10.861    219
13:00     0.40     23.02   219  12:53    0.63   219  13:01         1.25
  DU4003M-DU4002.1      CONDUIT         11.062   219  13:01          10.864    219
13:00     0.75      7.92   219  13:01    0.65   219  13:01         1.99
  DU4004M-DU4003M       CONDUIT         11.147   219  13:01          10.952    219
13:00     0.46     16.59   219  12:32    0.65   219  13:01         1.50
  DU4006.1M-DU4006M     CONDUIT          0.000     0  00:00           0.000      0
00:00     0.00      0.00     0  00:00    0.00     4  00:00
  DU4006M-DU4033M       CONDUIT          0.000     0  00:00           0.000      0
00:00     0.00      0.00     0  00:00    0.00     4  00:00
  DU4033M-DU4004M       CONDUIT          0.000     0  00:00           0.000      0
00:00     0.00      0.00     0  00:00    0.26   219  13:01         1.30
  DU4037MDU4033M        CONDUIT          0.000     0  00:00           0.000      0
00:00     0.00      0.00     0  00:00    0.00     4  00:00
  DU4298M-DU4001M       CONDUIT          5.580   219  12:53           5.336    174
17:45     1.75      7.15   219  12:53    0.96   219  12:53         1.25
  DU4299M-DU4298M       CONDUIT          5.580   219  12:53           5.336    174
17:45     0.52     12.71   219  12:33    0.85   219  13:01         1.25
```

DU5001M-DU2632.1M	CONDUIT	0.137	326	13:29	0.137	326	13:30	0.17	2.65	326	13:29	0.28	326	13:29	0.67
DU5013M-DU3107.2M	CONDUIT	3.620	219	12:51	3.219	219	13:00	0.47	15.65	219	12:51	0.47	219	12:51	0.99
DU6025M-DU6028M	CONDUIT	0.541	219	12:41	0.039	174	17:45	2.23	4.46	219	12:41	1.00	4	10:20	0.50
DU6028M-DU3156M	CONDUIT	5.845	219	12:41	0.472	245	06:30	0.56	2.93	219	12:41	1.00	174	17:31	2.00
DU6029M-DU6028M	CONDUIT	3.411	219	12:41	0.078	219	12:45	0.26	4.18	219	12:41	1.00	174	17:44	1.50
DU6177S-CSO3OUTFALL	CONDUIT	18.073	219	12:46	18.015	219	12:45	1.28	9.04	219	12:46	0.96	219	12:46	2.00
DU6177S-DU3157M	CONDUIT	23.332	219	12:40	18.016	219	12:45	0.06	11.04	174	16:48	0.82	219	12:46	5.51
DU7001.1M-DU7001M	CONDUIT	3.413	219	12:59	3.411	219	13:00	0.36	10.91	219	12:59	0.42	219	12:59	1.25
DU7001.2M-DU7001.1M	CONDUIT	3.414	219	12:59	3.409	219	13:00	0.66	7.37	219	12:59	0.57	219	12:59	1.25
DU7002M-DU7001.2M	CONDUIT	3.415	219	12:59	3.402	219	13:00	0.15	8.86	219	12:58	0.49	219	12:59	1.25
DU7003M-DU7002M	CONDUIT	3.416	219	12:58	3.399	219	13:00	0.59	8.41	219	12:58	0.51	219	12:58	1.25
DU7004.1M-DU7003M	CONDUIT	3.422	219	12:58	3.384	219	13:00	0.40	6.94	219	12:58	0.60	219	12:58	1.25
DU7004M-DU5013M	CONDUIT	3.621	219	12:51	3.212	219	13:00	0.83	10.22	219	12:48	0.66	219	12:51	1.00
DU7006M-DU7004M	CONDUIT	0.967	219	13:00	0.967	219	13:00	0.55	3.58	219	13:05	0.57	219	12:51	1.00
TO_WWTP	CONDUIT	14.683	219	13:01	14.571	219	13:00	0.17	21.23	219	12:43	0.32	219	13:01	2.10
DU2003.1M-DU2003M	ORIFICE	4.291	326	14:10	4.170	174	21:45					1.00	4	00:00	
DU2632M-DU2633M	ORIFICE	0.839	219	13:00	0.839	219	13:00					1.00	4	05:48	
DU4001M-CSO4	ORIFICE	1.087	219	13:00	1.073	219	13:00					1.00	4	05:34	
DU2005M-CSO2	WEIR	4.736	219	13:19	4.285	219	13:15					0.10	219	13:19	

****
Flow Classification Summary
****

Conduit	Adjusted /Actual Length	Dry	Up Dry	Down Dry	Sub Crit	Sup Crit	Up Crit	Down Crit	Avg. Froude Number	Avg. Flow Change
BYPASS1	1.00	0.00	0.00	0.00	0.99	0.00	0.00	0.00	0.53	0.0000
BYPASS2	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.99	1.63	0.0000
CDT-67	1.00	0.00	0.00	0.00	0.99	0.00	0.00	0.00	0.28	0.0001
CSO3-DU3155M	1.00	0.00	0.00	0.00	0.54	0.00	0.45	0.00	0.41	

0.0000

CSO4-DU1003M	1.00	0.00	0.00	0.00	0.99	0.00	0.00	0.00	0.37	0.0000
CSO_OVERFLOW	1.00	0.95	0.00	0.00	0.00	0.04	0.00	0.00	0.49	0.0000
DU-3107.2M-DU3107.1M	1.00	0.00	0.00	0.00	0.00	0.99	0.00	0.00	1.37	0.0000
DU1001M-DU7001M	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.99	0.86	0.0000
DU1002M-DU1001M	1.00	0.00	0.00	0.00	0.99	0.00	0.00	0.00	0.64	0.0000
DU1003M-DU1002M	1.00	0.00	0.00	0.00	0.99	0.00	0.00	0.00	0.40	0.0000
DU1004M-DU1002M	1.00	0.00	0.00	0.00	0.12	0.00	0.87	0.00	0.48	0.0000
DU1004M-DU1003M	1.00	0.00	0.00	0.00	0.12	0.00	0.87	0.00	0.42	0.0000
DU1010M-DU1004M	1.00	0.00	0.00	0.00	0.99	0.00	0.00	0.00	0.66	0.0000
DU1013M-DU1010M	1.00	0.00	0.00	0.00	0.99	0.00	0.00	0.00	0.57	0.0000
DU1016M-DU1013M	1.00	0.00	0.00	0.00	0.99	0.00	0.00	0.00	0.55	0.0000
DU2001M-DU2003.1M	1.00	0.00	0.00	0.00	0.99	0.00	0.00	0.00	0.38	0.0371
DU2002M-DU2834M	1.00	0.00	0.00	0.00	0.08	0.00	0.00	0.91	0.71	0.0018
DU2003M-DU2002M	1.00	0.00	0.00	0.00	0.99	0.00	0.00	0.00	0.27	0.0110
DU2005M-DU2001M	1.00	0.00	0.00	0.00	0.06	0.61	0.00	0.32	1.90	0.0034
DU2006M-DU2005M	1.00	0.00	0.00	0.00	0.00	0.99	0.00	0.00	3.25	0.0000
DU2597M-DU7004M	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.99	1.75	0.0000
DU2630.1M-DU2631M	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.99	1.87	0.0000
DU2631M-DU2632M	1.00	0.00	0.00	0.00	0.17	0.74	0.00	0.08	1.16	0.0001
DU2632.1M-DU7006M	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.99	0.41	0.0000
DU2632M-DU2635M	1.00	0.96	0.00	0.00	0.00	0.00	0.00	0.03	0.11	0.0000
DU2633M-DU2634M	1.00	0.00	0.00	0.00	0.99	0.00	0.00	0.00	0.23	0.0002
DU2634M-DU2632.1M	1.00	0.00	0.00	0.00	0.99	0.00	0.00	0.00	0.22	0.0000
DU2815M-DU2818M	1.00	0.00	0.00	0.00	0.99	0.00	0.00	0.00	0.48	0.0000
DU2818M-DU2821M	1.00	0.00	0.00	0.00	0.99	0.00	0.00	0.00	0.48	0.0000
DU2821M-DU3206M	1.00	0.00	0.00	0.00	0.99	0.00	0.00	0.00	0.51	0.0000
DU2826M-DU2815M	1.00	0.00	0.00	0.00	0.99	0.00	0.00	0.00	0.53	0.0000
DU2834M-DU2826M	1.00	0.00	0.00	0.00	0.99	0.00	0.00	0.00	0.46	0.0001
DU3097M-DU3098M	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.99	0.97	0.0000
DU3098M-DU7004.1M	1.00	0.00	0.00	0.00	0.00	0.99	0.00	0.00	2.25	0.0000
DU3107.1M-DU3107M	1.00	0.00	0.00	0.00	0.98	0.01	0.00	0.00	0.91	0.0000

DU3107M-DU3097M	1.00	0.00	0.00	0.00	0.99	0.00	0.00	0.00	0.55	0.0000
DU3155M-DU3156M	1.00	0.00	0.00	0.00	0.99	0.00	0.00	0.00	0.34	0.0001
DU3156M-DU1016M	1.00	0.00	0.00	0.00	0.99	0.00	0.00	0.00	0.70	0.0000
DU3157M-DU3158M	1.00	0.00	0.00	0.00	0.99	0.00	0.00	0.00	0.57	0.0000
DU3158M-CSO3	1.00	0.00	0.00	0.00	0.01	0.00	0.98	0.00	0.46	0.0000
DU3168M-DU3156M	1.00	0.00	0.00	0.00	0.95	0.04	0.00	0.00	0.92	0.0000
DU3177M-DU3168M	1.00	0.00	0.00	0.00	0.99	0.00	0.00	0.00	0.52	0.0000
DU3184M-DU3177M	1.00	0.00	0.00	0.00	0.99	0.00	0.00	0.00	0.35	0.0000
DU3191M-DU3184M	1.00	0.00	0.00	0.00	0.99	0.00	0.00	0.00	0.69	0.0000
DU3206M-DU3191M	1.00	0.00	0.00	0.00	0.99	0.00	0.00	0.00	0.33	0.0000
DU4002.1M-DU4299M	1.00	0.00	0.00	0.00	0.00	0.99	0.00	0.00	3.17	0.0000
DU4003M-DU4002.1	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.99	1.29	0.0000
DU4004M-DU4003M	1.00	0.00	0.00	0.00	0.00	0.08	0.00	0.91	4.13	0.0000
DU4006.1M-DU4006M	1.00	0.99	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0000
DU4006M-DU4033M	1.00	0.99	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0000
DU4033M-DU4004M	1.00	0.00	0.99	0.00	0.00	0.00	0.00	0.00	0.00	0.0000
DU4037MDU4033M	1.00	0.99	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0000
DU4298M-DU4001M	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.99	0.14	0.0000
DU4299M-DU4298M	1.00	0.87	0.00	0.00	0.00	0.00	0.00	0.12	0.35	0.0000
DU5001M-DU2632.1M	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.99	1.09	0.0000
DU5013M-DU3107.2M	1.00	0.00	0.00	0.00	0.00	0.99	0.00	0.00	4.20	0.0000
DU6025M-DU6028M	1.00	0.00	0.00	0.00	0.01	0.00	0.00	0.98	0.79	0.0000
DU6028M-DU3156M	1.00	0.00	0.00	0.00	0.99	0.00	0.00	0.00	0.04	0.0000
DU6029M-DU6028M	1.00	0.00	0.00	0.00	0.03	0.00	0.00	0.96	2.00	0.0000
DU6177S-CSO3OUTFALL	1.00	0.00	0.00	0.00	0.93	0.05	0.00	0.00	0.08	0.0000
DU6177S-DU3157M	1.00	0.00	0.95	0.00	0.01	0.04	0.00	0.00	0.05	0.0000
DU7001.1M-DU7001M	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.99	2.76	0.0000
DU7001.2M-DU7001.1M	1.00	0.00	0.00	0.00	0.00	0.99	0.00	0.00	1.90	0.0000
DU7002M-DU7001.2M	1.00	0.00	0.00	0.00	0.00	0.99	0.00	0.00	2.55	0.0000
DU7003M-DU7002M	1.00	0.00	0.00	0.00	0.00	0.99	0.00	0.00	2.50	0.0000
DU7004.1M-DU7003M	1.00	0.00	0.00	0.00	0.00	0.99	0.00	0.00	1.80	0.0000
DU7004M-DU5013M	1.00	0.00	0.00	0.00	0.00	0.99	0.00	0.00	2.79	

0.0000

DU7006M-DU7004M	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.99	0.99
0.0000									
TO_WWTP	1.00	0.00	0.00	0.00	0.00	0.99	0.00	0.00	5.88
0.0000									

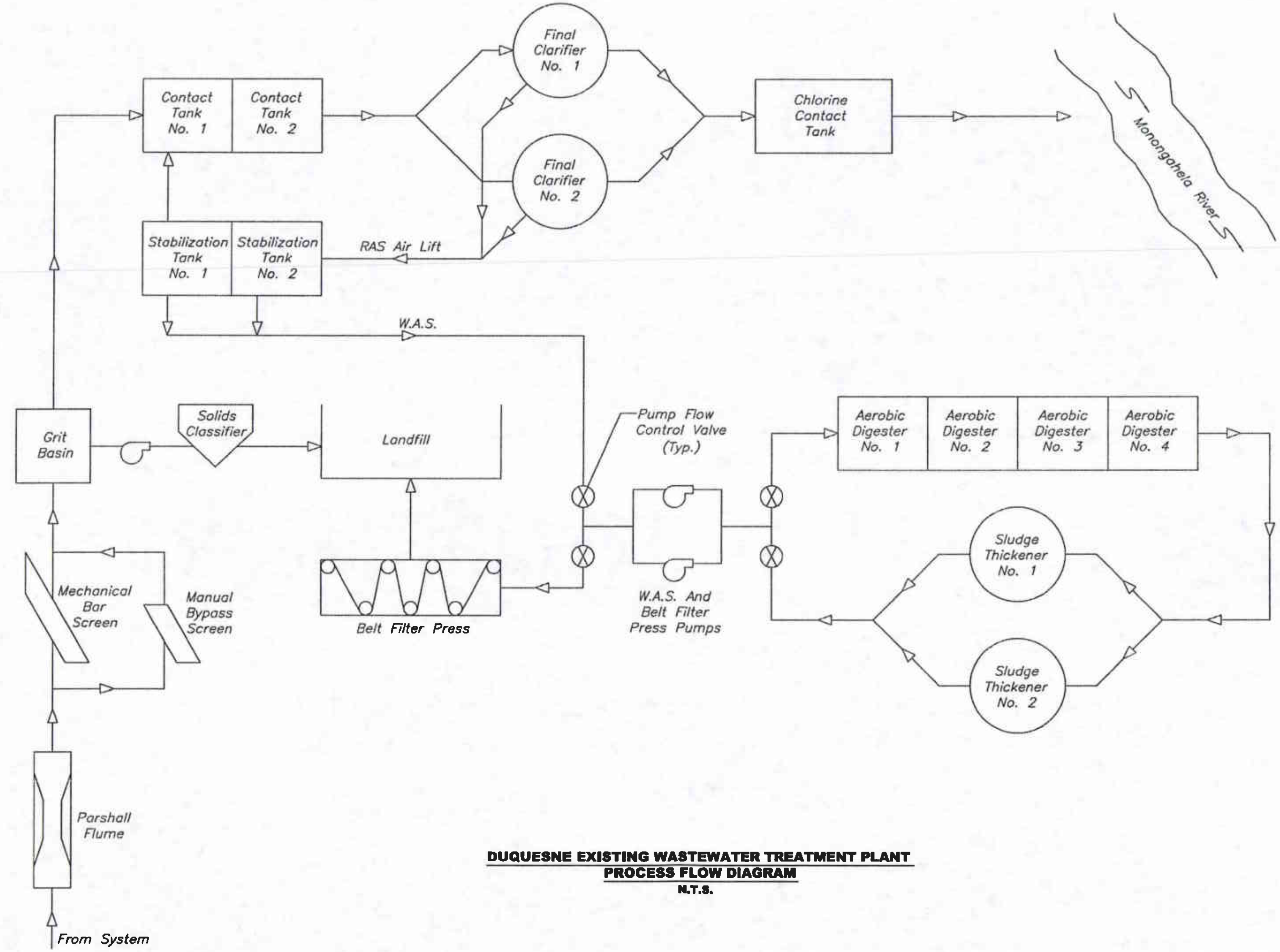
****
Conduit Surcharge Summary
****

Conduit	Hours Full Both Ends	Hours Full Upstream	Hours Full Dnstream	Hours Above Full Normal Flow	Hours Capacity Limited
BYPASS2	0.01	0.01	0.01	0.03	0.01
CDT-67	10.41	10.41	10.41	0.01	0.01
CSO3-DU3155M	15.18	15.18	15.18	0.01	0.03
DU1001M-DU7001M	0.01	0.01	0.01	0.40	0.01
DU1002M-DU1001M	0.01	0.01	0.01	188.39	0.01
DU1003M-DU1002M	153.90	153.90	153.92	0.01	0.01
DU1004M-DU1002M	0.01	0.01	0.01	453.43	0.01
DU1004M-DU1003M	56.23	56.23	56.24	645.59	0.01
DU1010M-DU1004M	0.43	0.43	0.43	61.47	0.43
DU1013M-DU1010M	19.51	19.51	19.51	46.23	19.46
DU1016M-DU1013M	23.96	23.96	23.97	111.77	23.90
DU2001M-DU2003.1M	177.05	177.05	179.59	0.01	0.01
DU2597M-DU7004M	0.12	0.12	0.13	0.35	0.12
DU2632.1M-DU7006M	0.01	0.01	0.01	350.05	0.01
DU2633M-DU2634M	28.08	28.08	28.08	144.70	28.08
DU2634M-DU2632.1M	0.01	0.01	0.01	262.79	0.01
DU2818M-DU2821M	0.01	0.01	0.01	23.45	0.01
DU3097M-DU3098M	0.01	0.01	0.01	0.32	0.01
DU3107.1M-DU3107M	0.01	0.01	0.01	1.12	0.01
DU3155M-DU3156M	17.36	17.36	17.36	348.77	17.18
DU3156M-DU1016M	17.35	17.35	17.36	0.01	0.17
DU3157M-DU3158M	0.49	0.49	0.49	0.46	0.36
DU3158M-CSO3	0.47	0.47	0.47	0.01	0.01
DU3177M-DU3168M	0.01	0.01	0.01	38.47	0.01
DU4298M-DU4001M	0.01	0.01	0.01	4.29	0.01
DU6025M-DU6028M	17.90	17.90	17.91	0.01	0.01
DU6028M-DU3156M	0.65	0.65	0.65	0.01	0.01
DU6029M-DU6028M	0.16	0.16	0.17	0.01	0.01
DU6177S-CSO3OUTFALL	0.01	0.01	0.01	1.48	0.01

Analysis begun on: Thu Jun 19 08:45:42 2014
Analysis ended on: Thu Jun 19 10:16:26 2014
Total elapsed time: 01:30:44

Appendix K

Existing Process Flow Diagram



DUQUESNE EXISTING WASTEWATER TREATMENT PLANT
PROCESS FLOW DIAGRAM
N.T.S.

Date	Revisions	Date	Revisions

KLH ENGINEERS, INC
5173 Campbells Run Road
Pittsburgh, PA 15205
Phone: 412.494.0510
Fax: 412.494.[illegible]
[illegible]

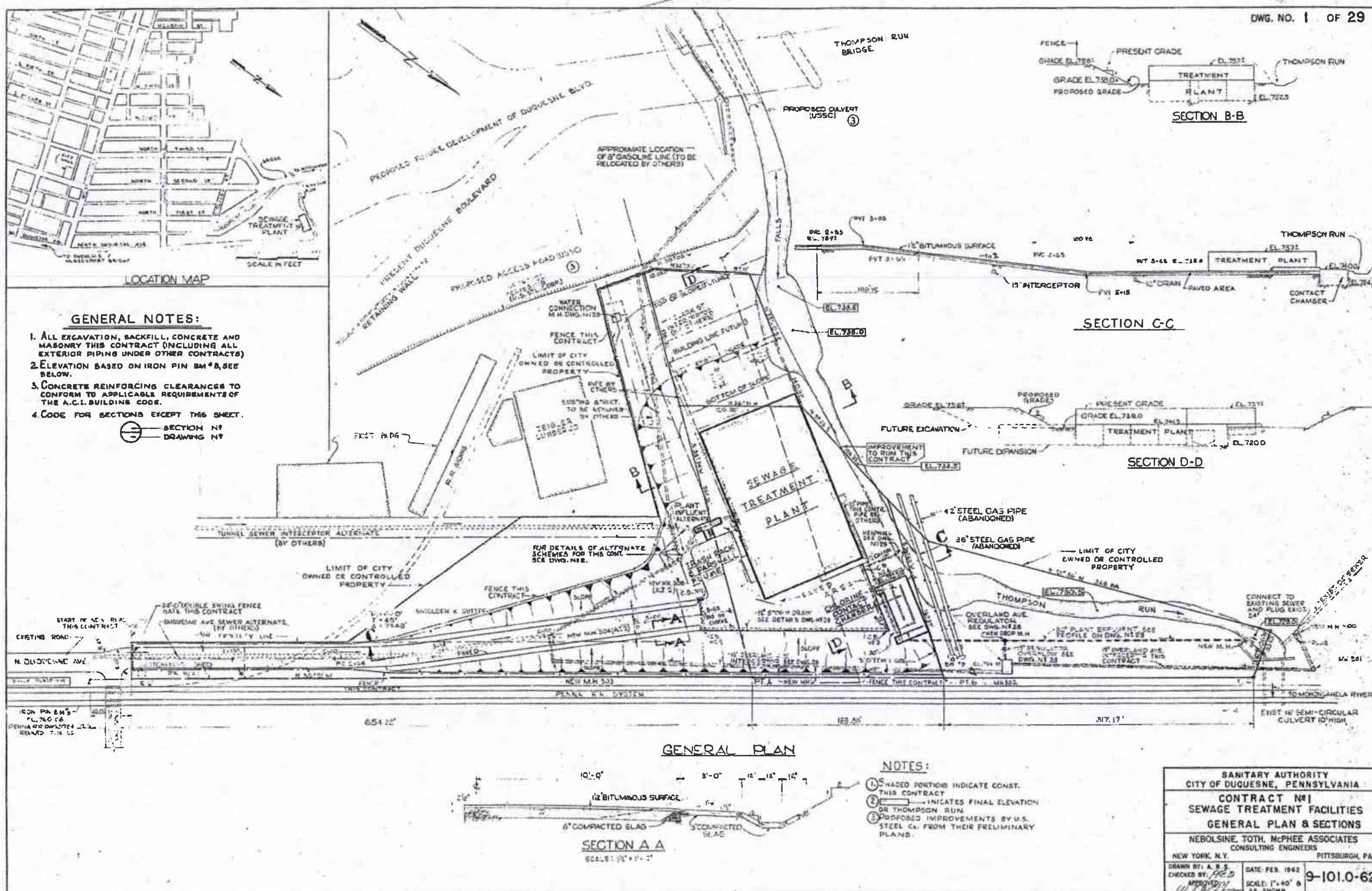
BOROUGH OF DUQUESNE
ALLEGHENY COUNTY, PENNSYLVANIA
EXISTING WASTEWATER TREATMENT PLANT
PROCESS FLOW DIAGRAM

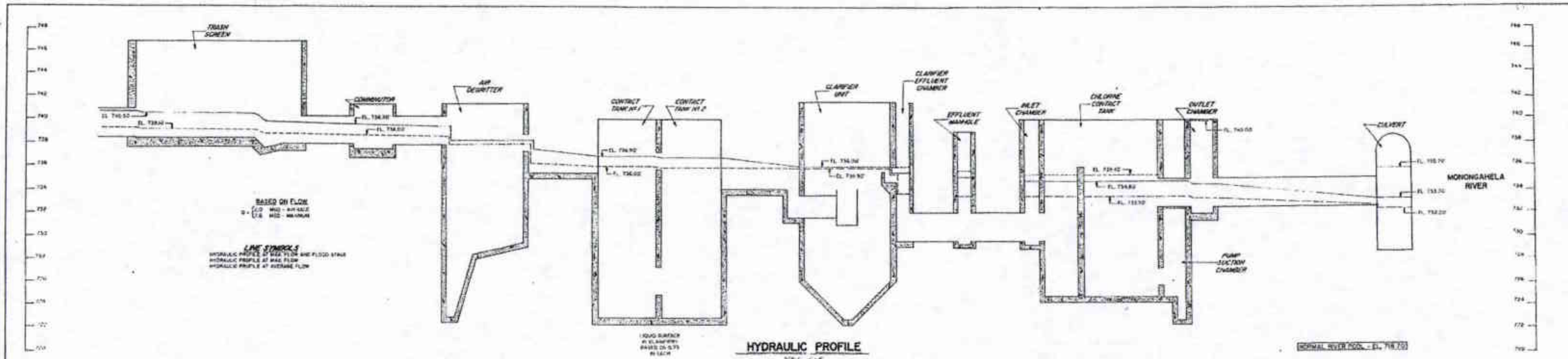
Scale: As Shown
Date: August 2014
Drawn By: EHD
Checked By: BMC
Approved By: SHG

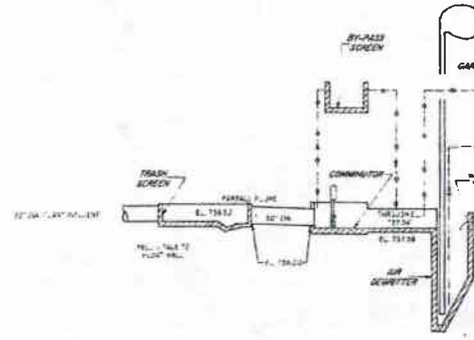
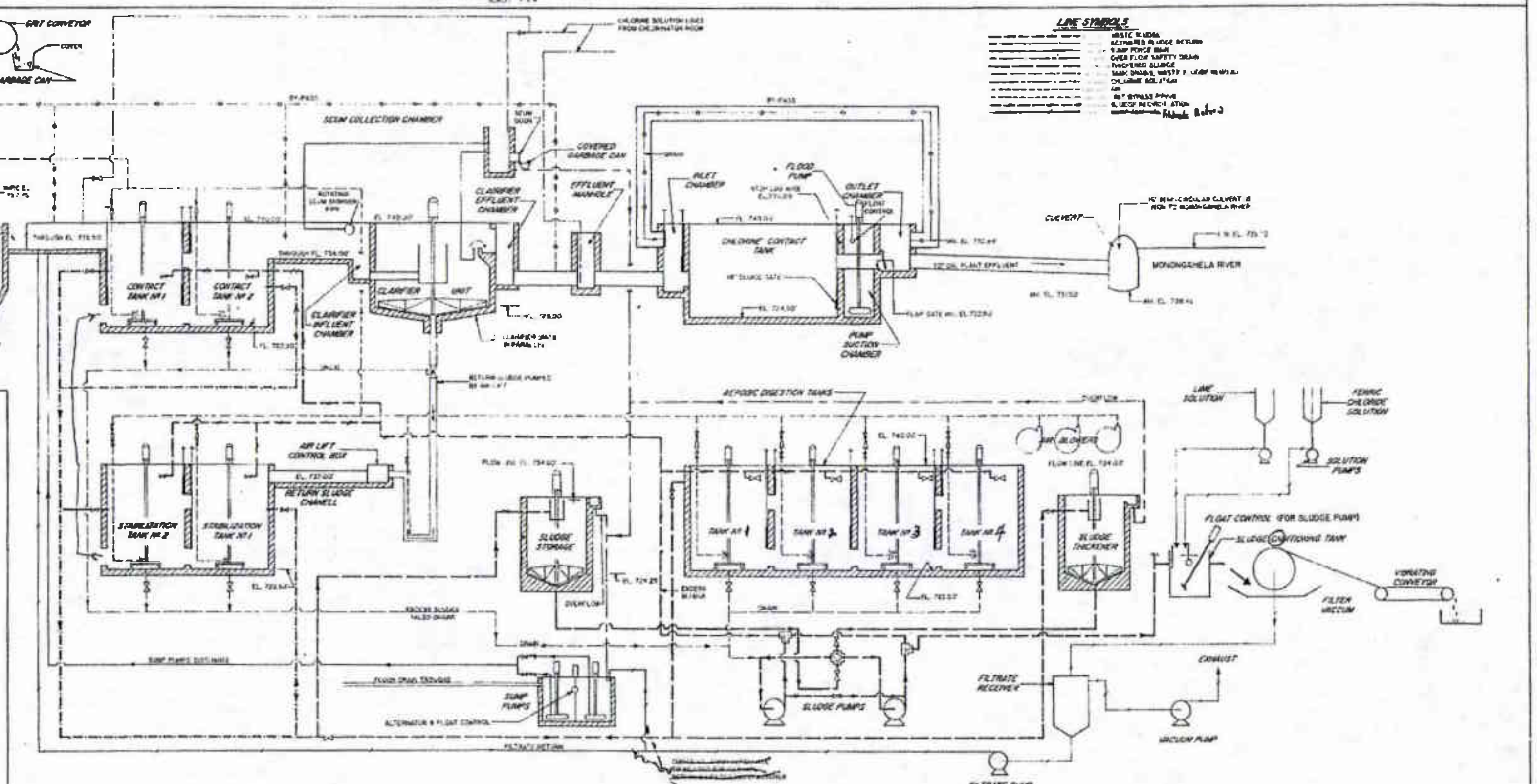
Order No. **220-53**
Drawing No. **EX4**
Sheet No. **1 of 1**

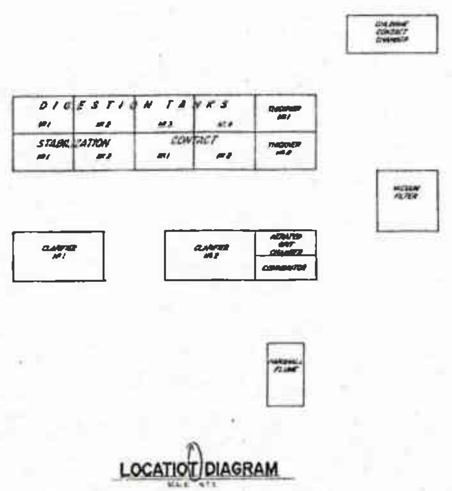
Appendix L

Existing WWTP Plans


DWG. NO. 1 OF 29
LOCATION MAP
SEWAGE TREATMENT PLANT
SCALE IN FEET
GENERAL NOTES:
1. ALL EXCAVATION, BACKFILL, CONCRETE AND MASONRY THIS CONTRACT (INCLUDING ALL EXTERIOR PIPING UNDER OTHER CONTRACTS)
2. ELEVATION BASED ON IRON PIN BM #8, SEE BELOW.
3. CONCRETE REINFORCING CLEARANCES TO CONFORM TO APPLICABLE REQUIREMENTS OF THE A.C.I. BUILDING CODE.
4. CODE FOR SECTIONS EXCEPT THIS SHEET.
SECTION Nº
DRAWING Nº
THOMPSON RUN BRIDGE
PROPOSED CULVERT (USSC) ③
PROPOSED FUTURE DEVELOPMENT OF DUQUESNE BLVD.
PRESENT DUQUESNE BOULEVARD
RETAINING WALL
PROPOSED ACCESS ROAD (USSC) ③
APPROXIMATE LOCATION OF 8" GASOLINE LINE (TO BE RELOCATED BY OTHERS)
SECTION B-B
FENCE
PRESENT GRADE
PROPOSED GRADE
TREATMENT PLANT
THOMPSON RUN
SECTION C-C
12" BITUMINOUS SURFACE
12" INTERCEPTOR
12" DRAIN
PAVED AREA
CONTACT CHAMBER
SECTION D-D
FUTURE EXCAVATION
FUTURE EXPANSION
GRADE EL.738.0
EL.720.0
WATER CONNECTION
FENCE THIS CONTRACT
LIMIT OF CITY OWNED OR CONTROLLED PROPERTY
BUILDING LINE FUTURE
BOTTOM OF SLOPE
EXIST. BLDG.
SEWAGE TREATMENT PLANT
PLANT INFLUENT ALTERNATE
IMPROVEMENT TO RUN THIS CONTRACT
42" STEEL GAS PIPE (ABANDONED)
36" STEEL GAS PIPE (ABANDONED)
TUNNEL SEWER INTERCEPTOR ALTERNATE (BY OTHERS)
FOR DETAILS OF ALTERNATE SCHEMES FOR THIS CONT. SEE DWG. Nº 2.
CHLORINE CONTACT CHAMBER
THOMPSON RUN
OVERLAND AVE. REGULATOR
CONNECT TO EXISTING SEWER AND PLUG EXIST. 24"
EXISTING ROAD
N. DUQUESNE AVE.
NEW M.H. 503
PENNA. R.R. SYSTEM
TO MONONGAHELA RIVER
EXIST. 16' SEMI-CIRCULAR CULVERT 10' HIGH
654.22'
317.17'
GENERAL PLAN
SECTION A-A
12" BITUMINOUS SURFACE
6" COMPACTED SLAG
NOTES:
① SHADED PORTIONS INDICATE CONST. THIS CONTRACT
② INDICATES FINAL ELEVATION OF THOMPSON RUN.
③ PROPOSED IMPROVEMENTS BY U.S. STEEL Co. FROM THEIR PRELIMINARY PLANS.
SANITARY AUTHORITY
CITY OF DUQUESNE, PENNSYLVANIA
CONTRACT Nº 1
SEWAGE TREATMENT FACILITIES
GENERAL PLAN & SECTIONS
NEBOLSINE, TOTH, McPHEE ASSOCIATES
CONSULTING ENGINEERS
NEW YORK, N.Y.
PITTSBURGH, PA.
DATE: FEB. 1962
SCALE: 1"=40' & AS SHOWN
9-101.0-62





REVISIONS		
Date	Description	By

DRAWN BY: HCD DATE: JULY 16, 1992

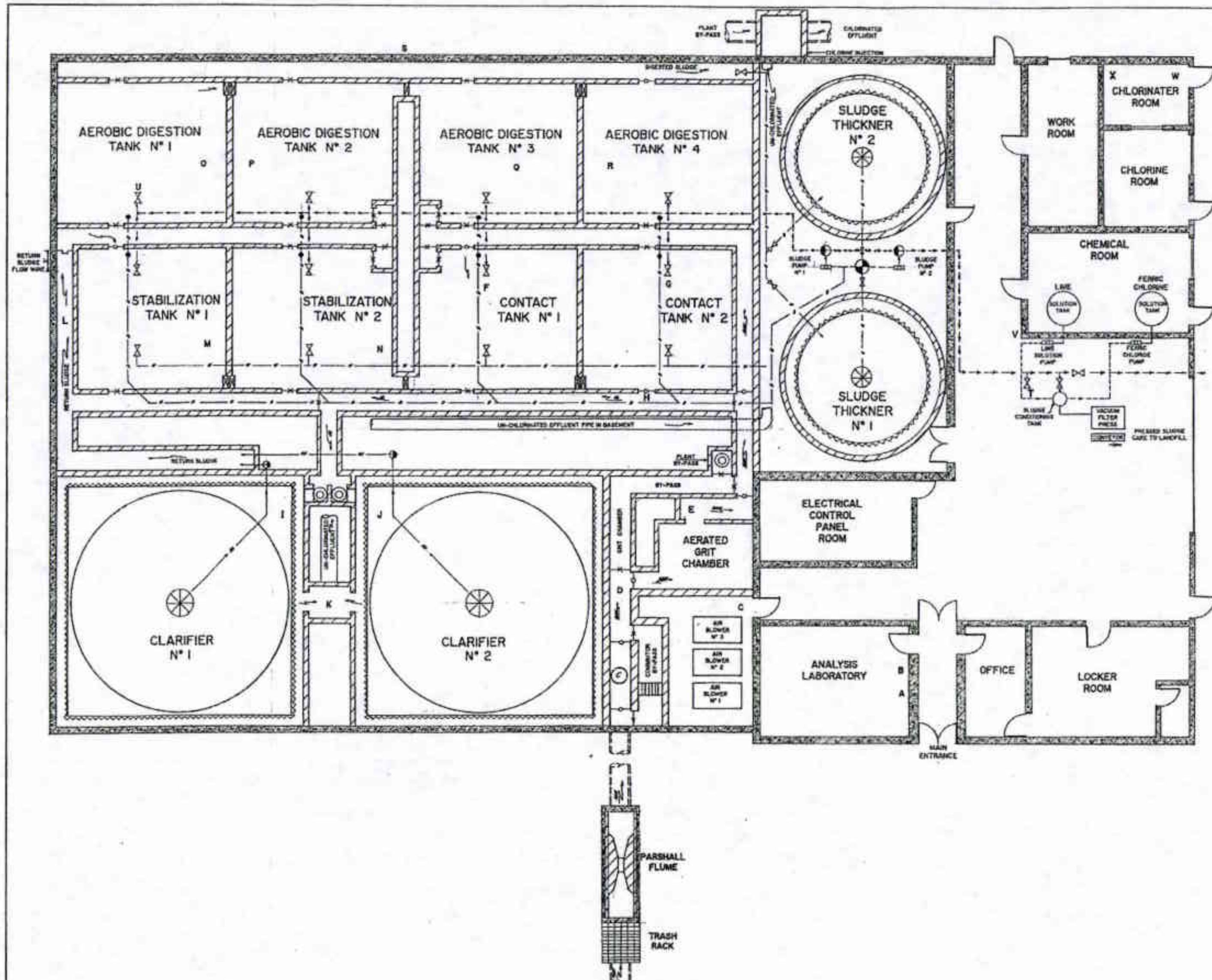
WASTEWATER TREATMENT PLANT
for the
CITY of DUQUESNE
ALLEGHENY COUNTY, PA

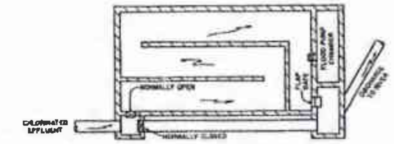
PROCESS CONTROL

GLENN ENGINEERING & ASSOCIATES LTD.
Registered Engineers — North Huntingdon, PA

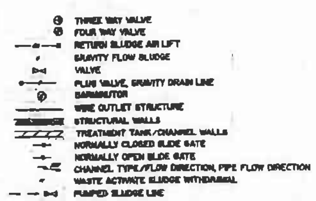
SCALE: AS NOTED

SHEET Nº 1 of 1





CHLORINE CONTACT TANK



SAMPLE POINTS LOCATION & DESIGNATION

POINT/TYPE		LOCATION	WORKSHEET
A	METER	In Laboratory	Plant Influent (Raw) Total Daily Flow, GPD
B	METER	In Laboratory	Air Useage - Total Daily Air Supplied, Cu. Ft.
C	GAUGE	By Blowers	Air Pressure being Supplied to Plant, P.S.I.
D	CHANNEL	By Grit Tank	Plant Influent (Raw) Sample Point
E	TANK	In Grit Tank	Plant Influent (Raw) Sample Point (Alternate)
F	TANK	In Tank C - 1	Contact Tank No. 2 Sample Point
G	TANK	In Tank C - 2	Contact Tank No. 2 Sample Point
H	CHANNEL	By Tank C - 2	Mixed Liquor Sample Point
I	TANK	In Tank CL - 1	Clarifier Tank No. 1 Sample Point
J	TANK	In Tank CL - 2	Clarifier Tank No. 2 Sample Point
K	CHANNEL	By Tank CL - 2	Plant Un-chlorinated Effluent (Final) Sample
L	WEIR	By Tank S- 1	Return Sludge Flow Measurement
M	TANK	In Tank S- 1	Stabilization Tank No. 1 Sample Point
N	TANK	In Tank S- 2	Stabilization Tank No. 2 Sample Point
O	TANK	In Tank D- 1	Digestor Tank No. 1 Sample Point
P	TANK	In Tank D- 2	Digestor Tank No. 2 Sample Point
Q	TANK	In Tank D- 3	Digestor Tank No. 3 Sample Point
R	TANK	In Tank D- 4	Digestor Tank No. 4 Sample Point
S	METER	Between D-2, D-3	Air Flow Volume to each tank, CFM
T	GRAB	At Vacuum Filter	Sludge Return Pipe Outlet
U	GRAB	In Tank D - 1	Sludge Return Pipe Outlet
V	METER	In Hallway	Chlorine Gas Leak Detector
W	GAUGE	In Chlorine Room	Scale Weight of Chlorine Gas Cylinder
X	METER	In Chlorine Room	Feed Rate of Chlorine Gas Injector
Y			
Z	TANK	In Tank CC - 1	Chlorine Contact Tank Sample Point

REVISIONS

Date	Description	By

DRAWN BY: K.E.B. DATE: MARCH 23, 1993

SEWAGE TREATMENT PLANT

SITUATE IN

CITY OF DUQUESNE
ALLEGHENY COUNTY, PA

SAMPLE TEST LOCATIONS

GLENN ENGINEERING & ASSOCIATES LTD.
Registered Engineers - North Huntingdon, Pa.

SCALE: N.T.S.

SHEET Nº 1 of 1

APPENDIX M

EXISTING PROCESS CALCULATIONS

Duquesne WWTP Capacity Analysis

Tank Description	Surface Area	Depth @ T/Wall	Depth @ Q_{av}	Depth @ Q_{max}	Vol Wall		Vol Avg		Vol Max	
	[FT^2]	[FT]	[FT]	[FT]	[FT^3]	[kGAL]	[FT^3]	[kGAL]	[FT^3]	[kGAL]
Stabilization No. 1	495.67	16.70	13.50	14.40	8,277.69	61.92	6,691.55	50.05	7,137.65	53.39
Stabilization No. 2	512.95	16.60	13.50	14.40	8,514.97	63.69	6,924.83	51.80	7,386.48	55.25
Contact No. 1	515.57	17.55	13.50	14.40	9,048.25	67.68	6,960.20	52.06	7,424.21	55.53
Contact No. 2	489.44	16.50	13.50	14.40	8,075.76	60.41	6,607.44	49.42	7,047.94	52.72
Aerobic Digester No. 1	570.15	17.60	---	---	10,034.64	75.06	---	---	---	---
Aerobic Digester No. 2	512.95	17.35	---	---	8,899.68	66.57	---	---	---	---
Aerobic Digester No. 3	517.84	17.50	---	---	9,062.20	67.79	---	---	---	---
Aerobic Digester No. 4	554.57	17.60	---	---	9,760.43	73.01	---	---	---	---
Final Clarifier No. 1	1,156.00	---	9.90	10.00	---	---	9,215.39	68.93	9,306.18	69.61
Final Clarifier No. 2	1,156.00	---	9.90	10.00	---	---	9,215.39	68.93	9,306.18	69.61
Chlorine Contact Tank	1,277.80	17.50	9.00	10.30	---	---	8,398.26	62.82	9,578.56	71.65
Grit Chamber	130.00	---	13.50	---	---	---	1,527.50	11.43	---	---

Final Clarifier Capacity

Design Criteria

Surface Overflow Rate =	800.00	gpd/ft^2	[MMAF]
Surface Overflow Rate =	1,200.00	gpd/ft^2	[PHF]
Weir Loading =	10,000.00	gpd/ft	[MMAF]

Method

Q = (SOR) x (A)

Q = (WL) x (L)

Analysis

A =	2,312.00	ft^2
Q_{av} =	1,849,600.00	gpd
	1.85	mgd
Q_{max} =	2,774,400.00	gpm
	2.77	mgd
Total Weir Length =	272.00	ft
Q_{av} =	2,720,000.00	gpd
	2.72	mgd

Aeration Capacity

Design Criteria

$T_D \geq$ 5.00 hr [MMAF]

Method

Q = V / T_D

Analysis

V_{Qav} =	203,336.36	gallons
Q_{av} =	40,667.27	gph
	0.98	mgd

Chlorine Contact Tank Capacity

Design Criteria

$T_D \geq$	30.00	min	[MMAF]
$T_D \geq$	15.00	min	[PHF]

Method

Q = V / T_D

Analysis

V_{Qav} =	62,819.00	gallons
Q_{av} =	2,093.97	gpm
	3.02	mgd
V_{max} =	71,647.62	gallons
Q_{max} =	4,776.51	gpm
	6.88	**mgd**

Grit Chamber Capacity

Design Criteria

$T_D \geq$ 3.00 min [MMAF]

Method

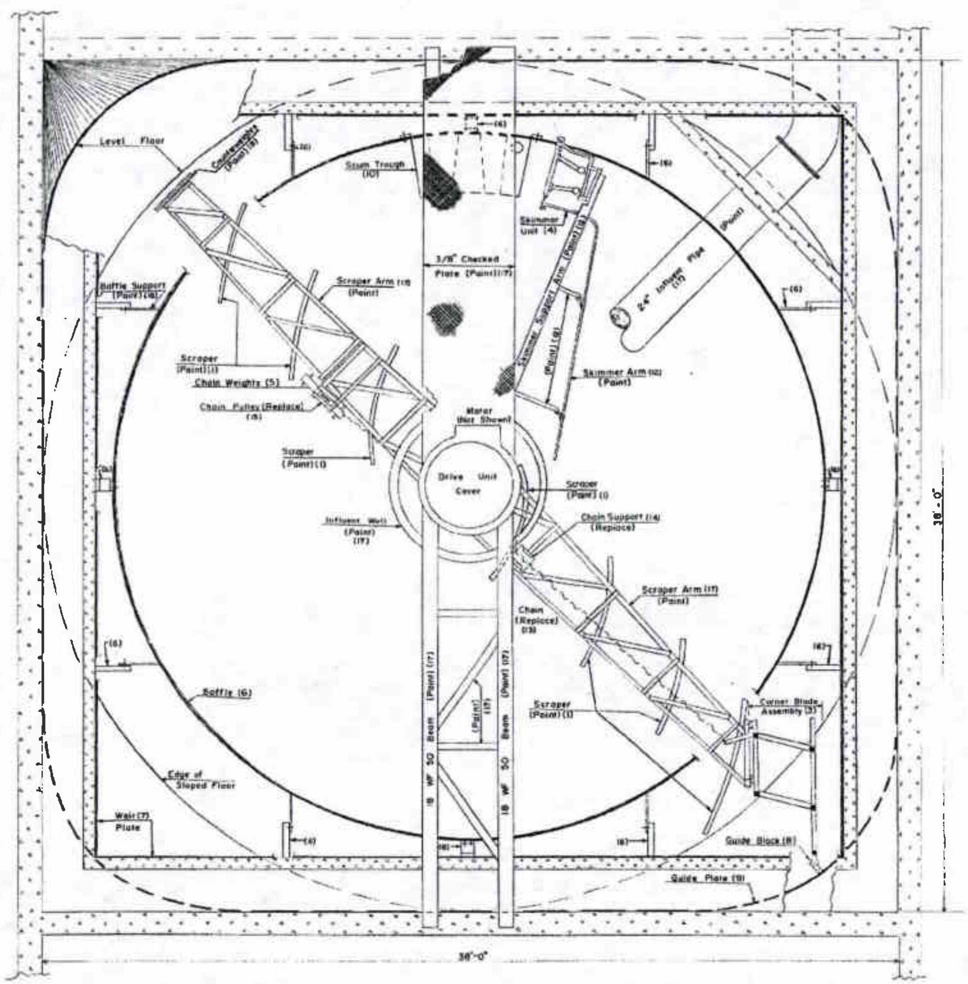
Q = V / T_D

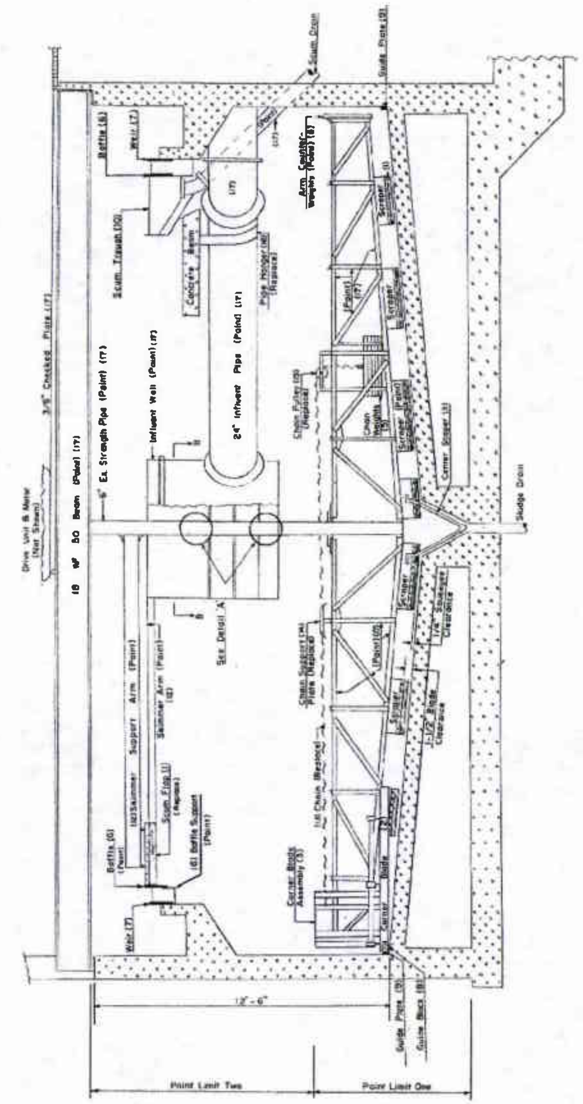
Analysis

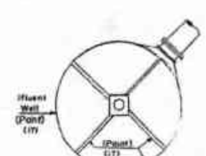
V_{Qav} =	11,425.70	gallons
Q_{av} =	3,808.57	gpm
	5.48	**mgd**

APPENDIX N

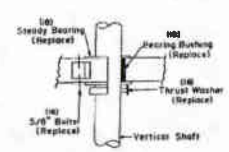
EXISTING FINAL CLARIFIER PLAN AND PROPOSED UPGRADE EQUIPMENT







SECTION 'B'



DETAIL 'A'

NOTES

REPLACE	PAINT	1	FLAPS SCUM & SCRAPER SQUEEZES
REPLACE		2	FLAPS CORNER BLADE
REPLACE	PAINT	3	CORNER ASSEMBLY UNIT
	PAINT	4	SCUM UNIT
	PAINT	5	CHAIN, WEIGHTS & COUNTERWEIGHTS
	PAINT	6	BAFFLE PLATE & SUPPORTS
	CLEAN	7	WEIR PLATE
REPLACE		8	GUIDE BLOCK
	CLEAN	9	GUIDE PLATE
	PAINT	10	SCREEN TROUGH
	CLEAN	11	CENTER SCRAPER BLADES
	PAINT	12	SKIMMER ARMS
REPLACE		13	CHAIN
REPLACE		14	CHAIN SUPPORT
REPLACE		15	CHAIN PULLEY
REPLACE		16	PIPE HANGER
	PAINT	17	MISCELLANEOUS METALS, PIPES
REPLACE		18	BEARINGS / BUSHINGS, MAIN SHAFTS

REVISIONS		
Date	Description	By

DRAWN BY: R.C.H. DATE: SEPTEMBER 1987

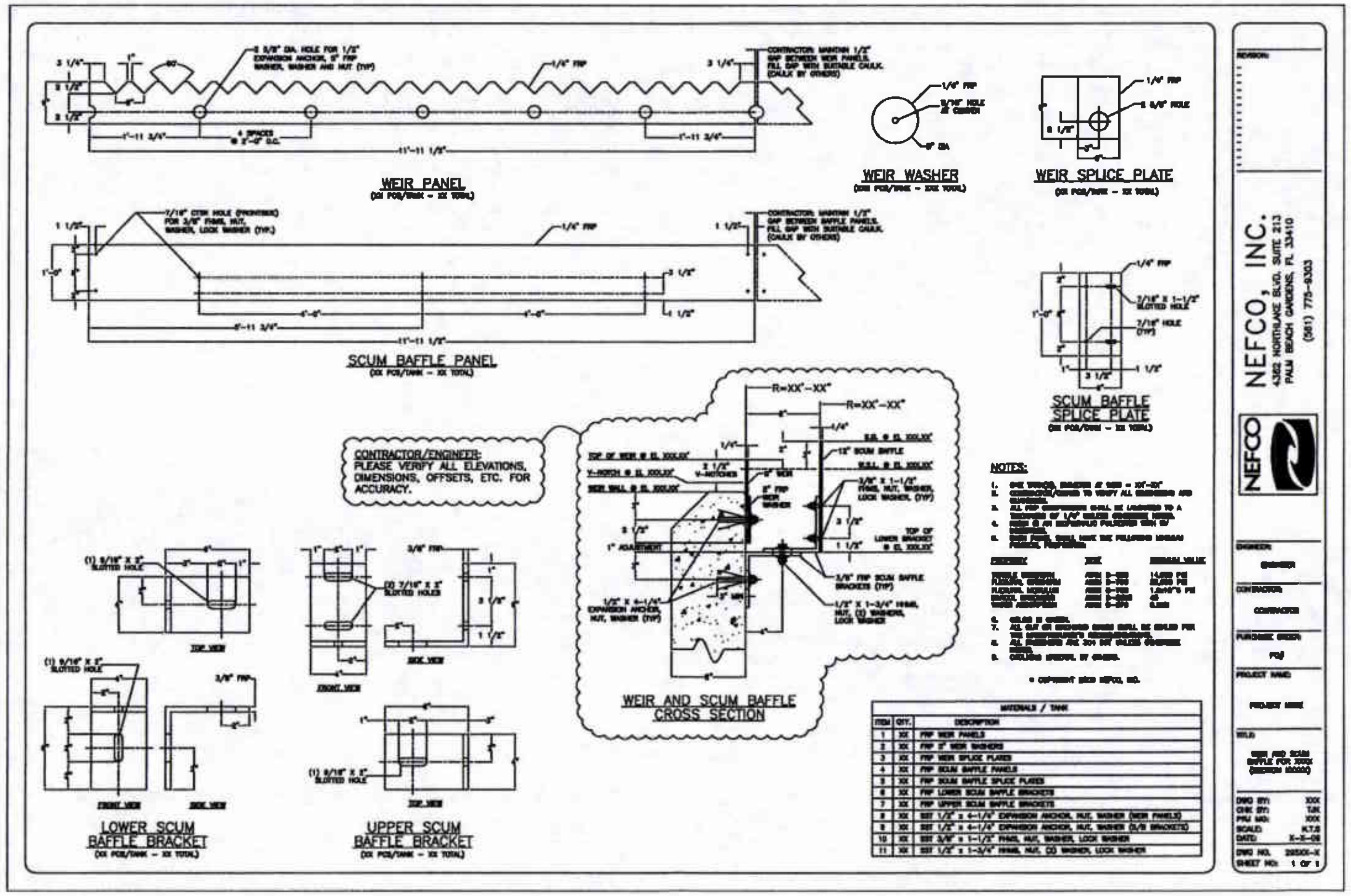
SEWAGE TREATMENT PLANT
CLARIFIER REHABILITION - CD XIII
CITY OF DUQUESNE
ALLEGHENY COUNTY, PA.

TYPICAL TANK
PLAN AND SECTION

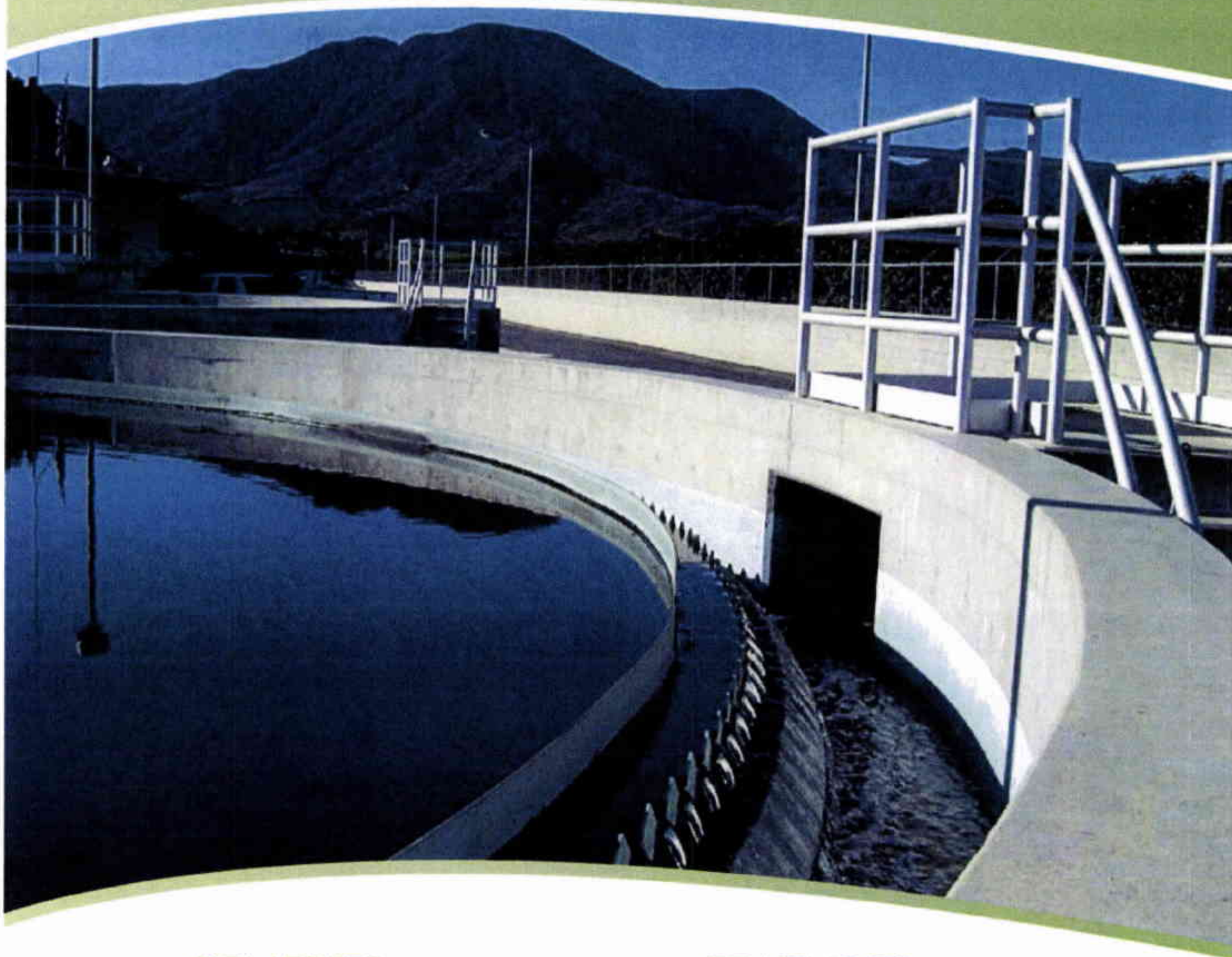
GLENN ENGINEERING & ASSOCIATES LTD.
Registered Engineers — North Versailles, Pa.

SCALE: 3/8" = 1'

SHEET Nº 1 of 1


WEIR PANEL
SCUM BAFFLE PANEL
WEIR WASHER
WEIR SPLICE PLATE
SCUM BAFFLE SPLICE PLATE
R=XX'-XX"
CONTRACTOR/ENGINEER:
PLEASE VERIFY ALL ELEVATIONS, DIMENSIONS, OFFSETS, ETC. FOR ACCURACY.
WEIR AND SCUM BAFFLE CROSS SECTION
NOTES:
LOWER SCUM BAFFLE BRACKET
UPPER SCUM BAFFLE BRACKET
MATERIALS / TANK
ITEM
QTY.
DESCRIPTION
NEFCO, INC.
4362 NORTHLAKE BLVD. SUITE 213
PALM BEACH GARDENS, FL 33410
(561) 775-9303
NEFCO
REVISION:
ENGINEER:
CONTRACTOR:
PURCHASE ORDER:
PROJECT NAME:
TITLE:
DWG BY:
CHK BY:
PRJ NO:
SCALE:
DATE:
DWG NO.
SHEET NO: 1 OF 1

WEIRS AND SCUM BAFFLES



WEIRS AND SCUM BAFFLES

BENEFITS

- Complete range of notch patterns
- Fiberglass construction
- Full range of height and thickness
- Lengths to 20 feet

FEATURES

- Fiberglass construction
- Corrosion resistant
- UV suppressed
- Custom fabrication available
- Available in ISO, VE, NSF61

NEFCO

THE CLEAR DIFFERENCE.

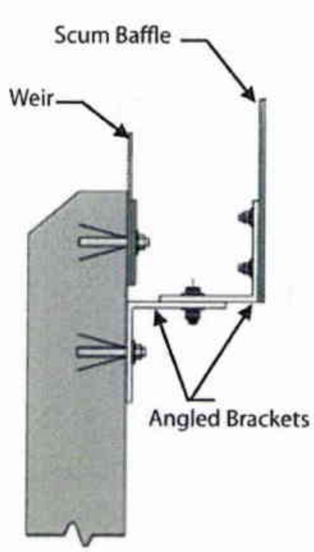
COST-EFFECTIVE WEIR AND SCUM BAFFLE SYSTEMS

THE BASICS

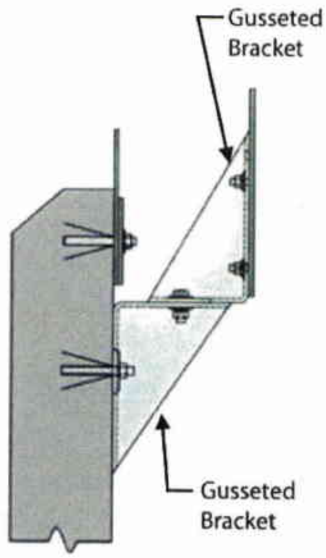
- Custom engineered to clarifier/system dimensions
- Corrosion resistant fiberglass
- Retains floatables and scum
- Maintains even effluent flow into trough
- Stainless steel hardware
- Vast array of shapes and sizes available
- Easily retrofitted to existing systems
- Most cost-effective corrosion resistant material

MOUNTING OPTIONS

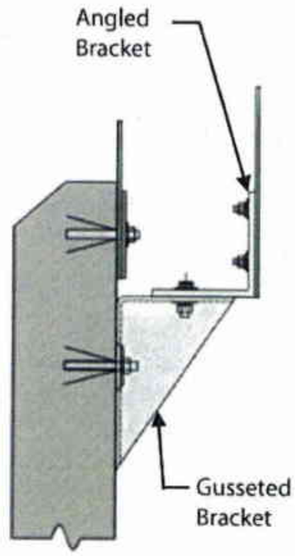
Angled Bracket Configuration



Gusseted Bracket Configuration



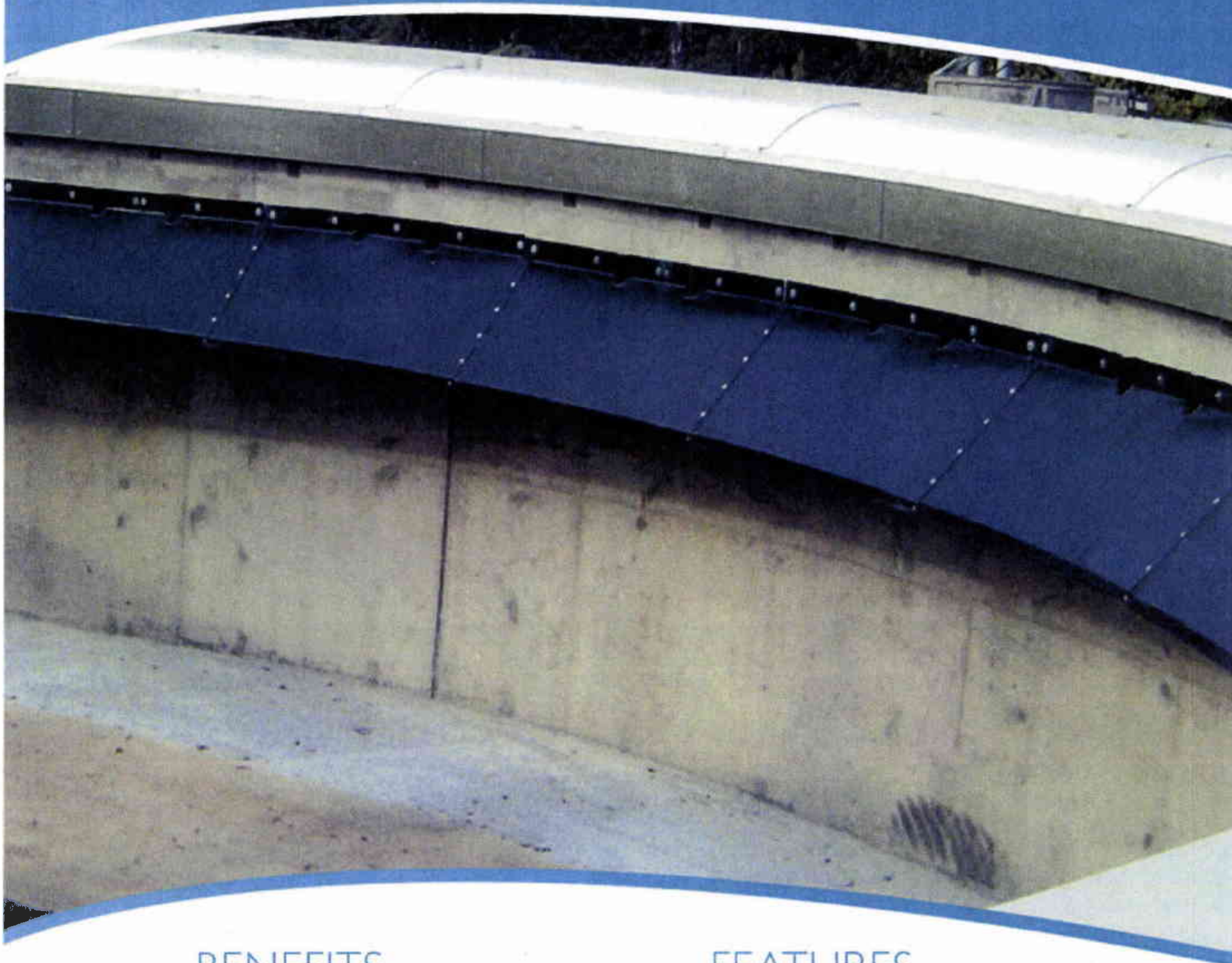
Mixed Bracket Configuration



For more information visit our web site www.nefcoinnovations.com

NEFCO
4362 Northlake Blvd, Ste 213
Palm Beach Gardens, FL 33410
(561) 775-9303

STAMFORD BAFFLE 2.0™



STAMFORD BAFFLE 2.0™

BENEFITS

- Reduces clarifier TSS by as much as 70%
- Reduces turbidity
- Improves hydraulic capacity
- Installs in half the time of other baffles

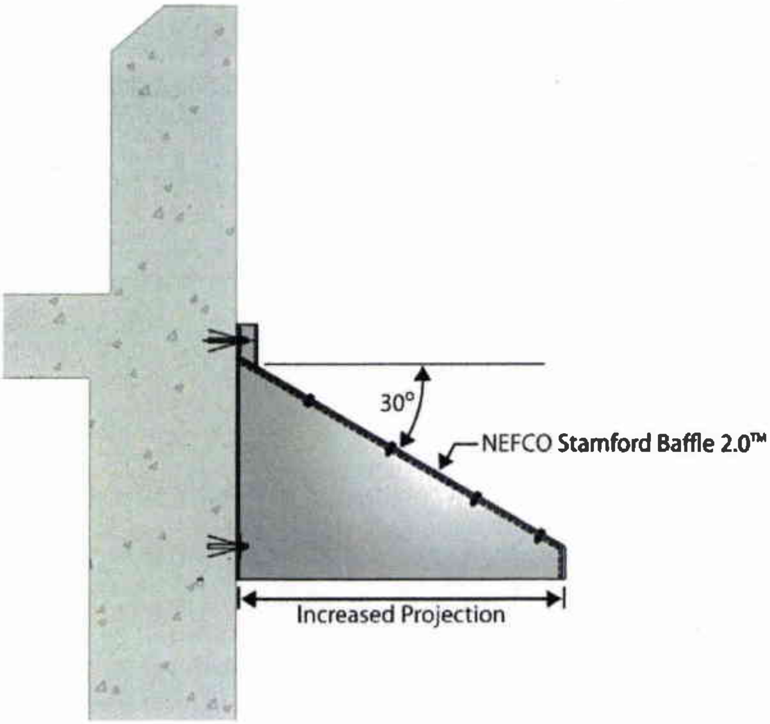
FEATURES

- Increased horizontal projection
- 30° Inclination angle
- Integrally molded bracket
- Rugged construction
- Corrosion resistant
- 5 Year warranty

NEFCO

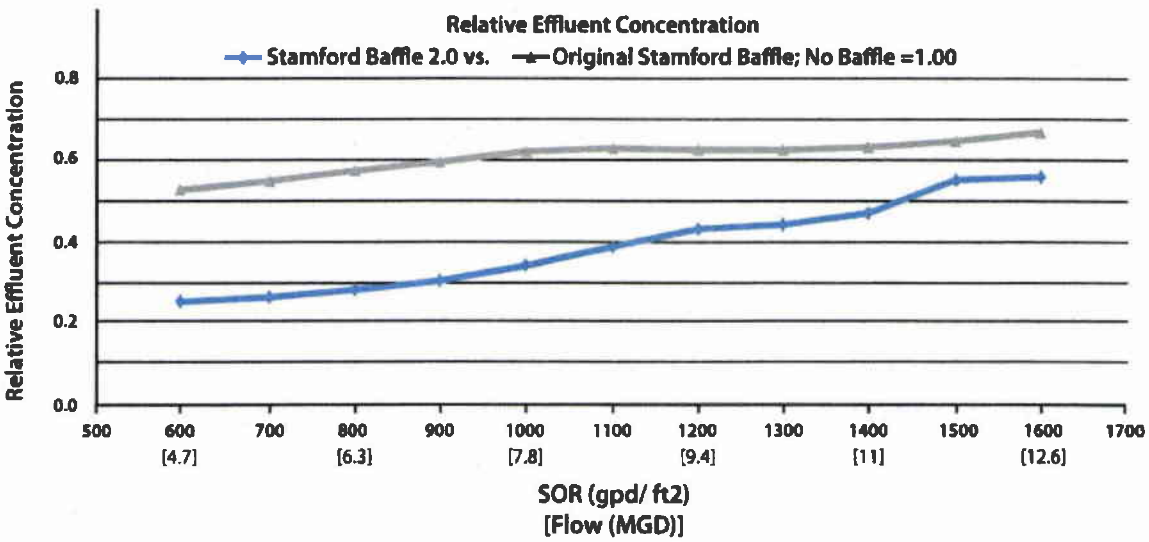
THE CLEAR DIFFERENCE.

THE FIRST IMPROVEMENT IN DENSITY CURRENT BAFFLE PERFORMANCE IN 30 YEARS



THE STUDY

NEFCO has recently completed a multi-year CFD Baffle Design Study that led to the development of Stamford Baffle 2.0, which is over 30% more effective than the original 45° Stamford Baffle. The new 30° baffle will improve clarifier performance by reducing overflow TSS as much as 70%!

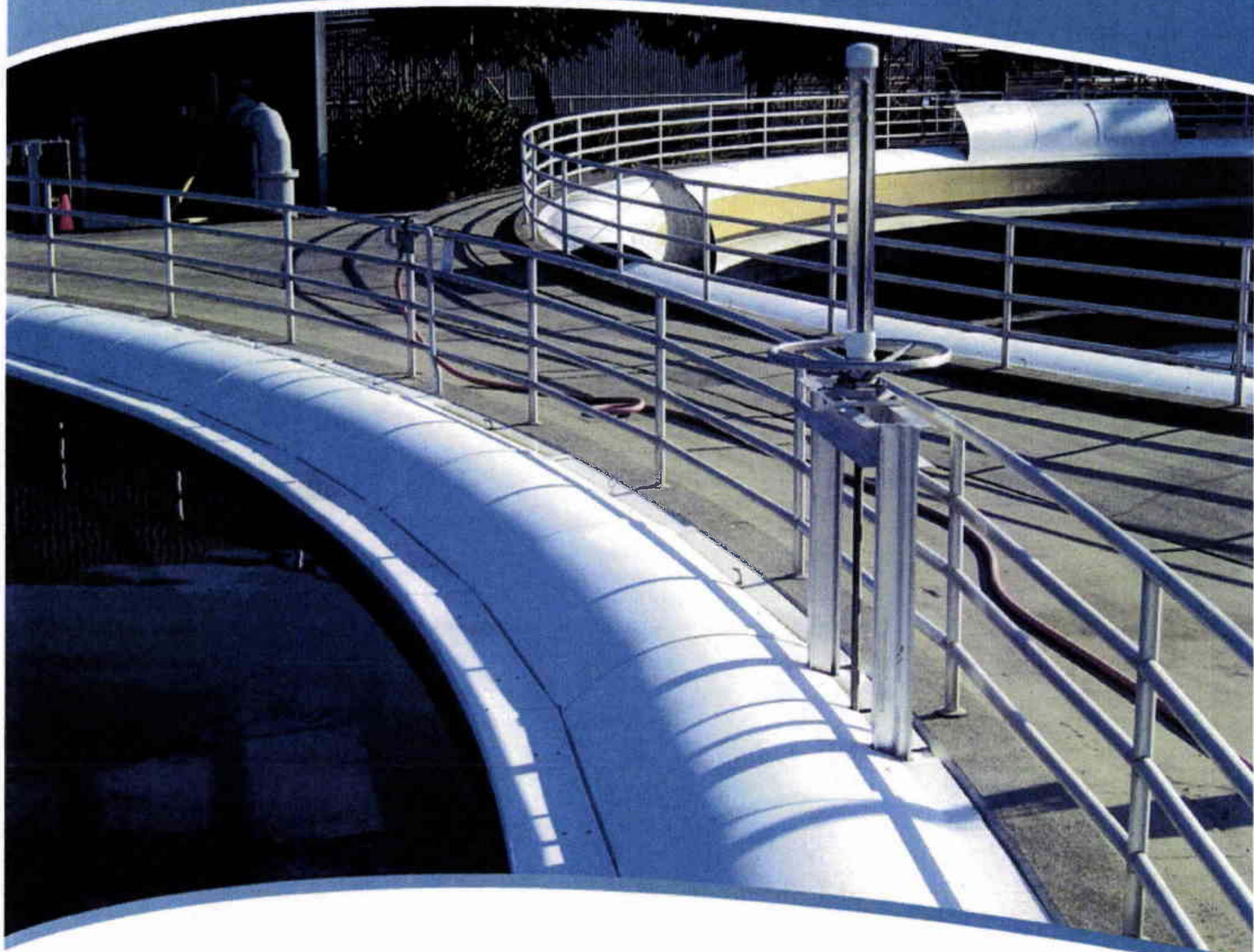


For more information visit our web site www.nefcoinnovations.com

Patent # 5,252,205
Patent # 5,596,483
Additional patents applied for

NEFCO
4362 Northlake Blvd, Ste 213
Palm Beach Gardens, FL 33410
(561) 775-9303

LAUNDER COVER SYSTEMS



LAUNDER COVER SYSTEMS

BENEFITS

- Inhibits algae growth
- Contains odors
- Operates 24/7
- Reduces manpower
- Maintenance free

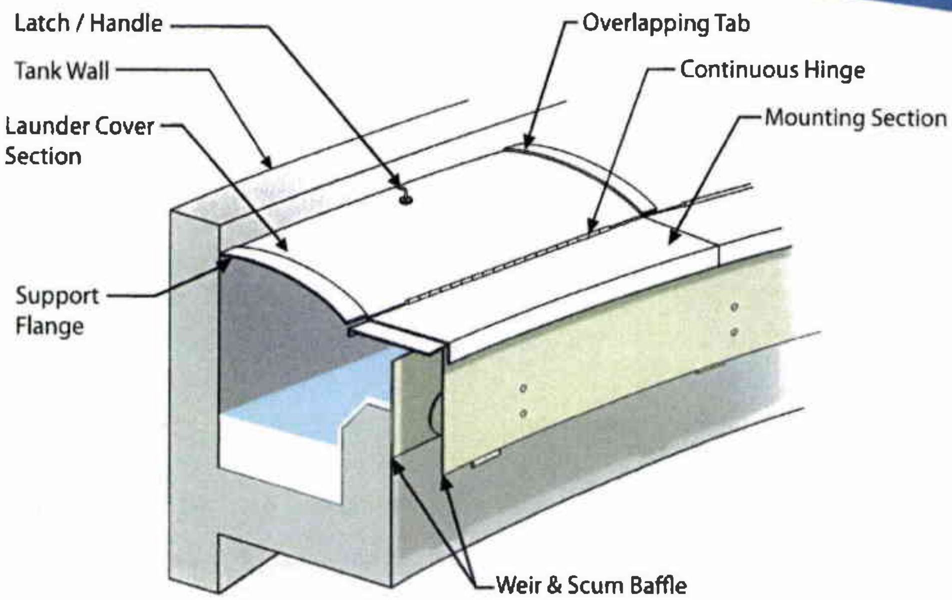
FEATURES

- Hinged cover panels open to tank center
- Stainless steel latch/handle for safety and security
- Attractive arched design
- Restraint cable

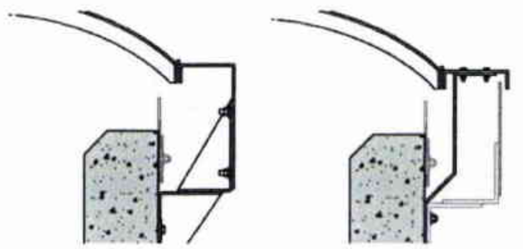
NEFCO

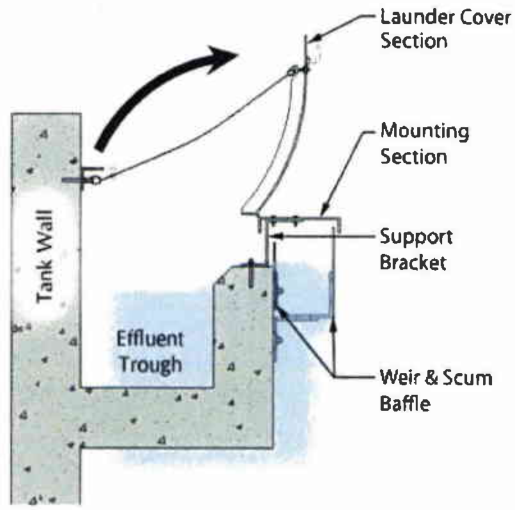
THE CLEAR DIFFERENCE.

REVOLUTIONIZING THE WAY TREATMENT PLANTS DEAL WITH ALGAE



MOUNTING OPTIONS





OTHER COVER PRODUCTS

- Tank-wall mounted
- Weir-wall mounted
- Walk-on
- Inboard launder
- Dual inboard launder
- Channel Covers

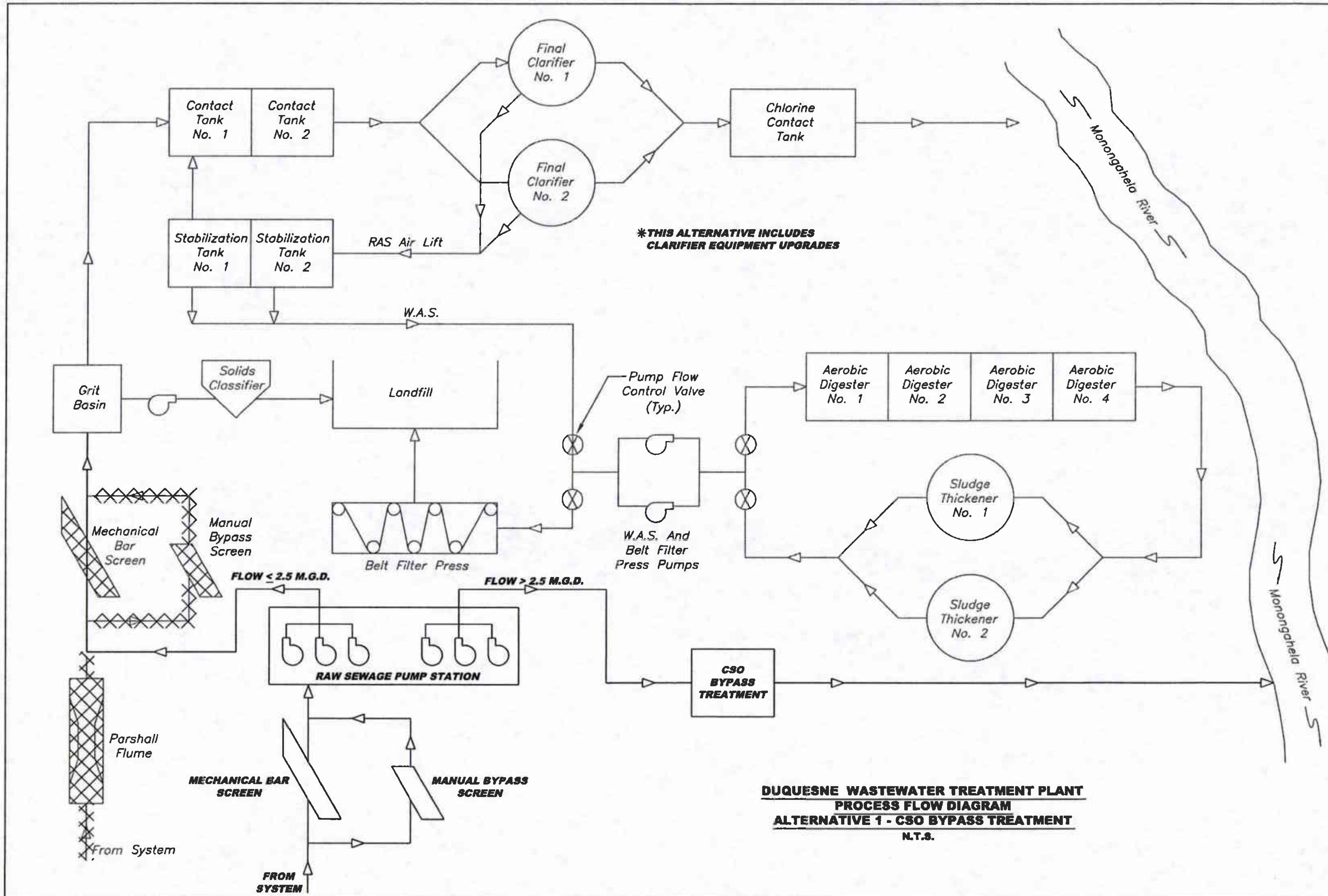
Patent No. 5,670,045
Patent No. 5,965,023
Patent No. 6,216,881
Patent No. 6,712,222
Patent No. 7,473,358
Patent No. 7,591,381

For more information visit our web site www.nefcoinnovations.com

NEFCO
NEFCO
4362 Northlake Blvd, Ste 213
Palm Beach Gardens, FL 33410
(561) 775-9303

APPENDIX O

ALTERNATIVE 1
PROCESS FLOW DIAGRAM



Date	Revisions	Date	Revisions

KLH ENGINEERS, INC
6173 Campbells Run Road
Pittsburgh, PA 15205
info@klhengineers.com

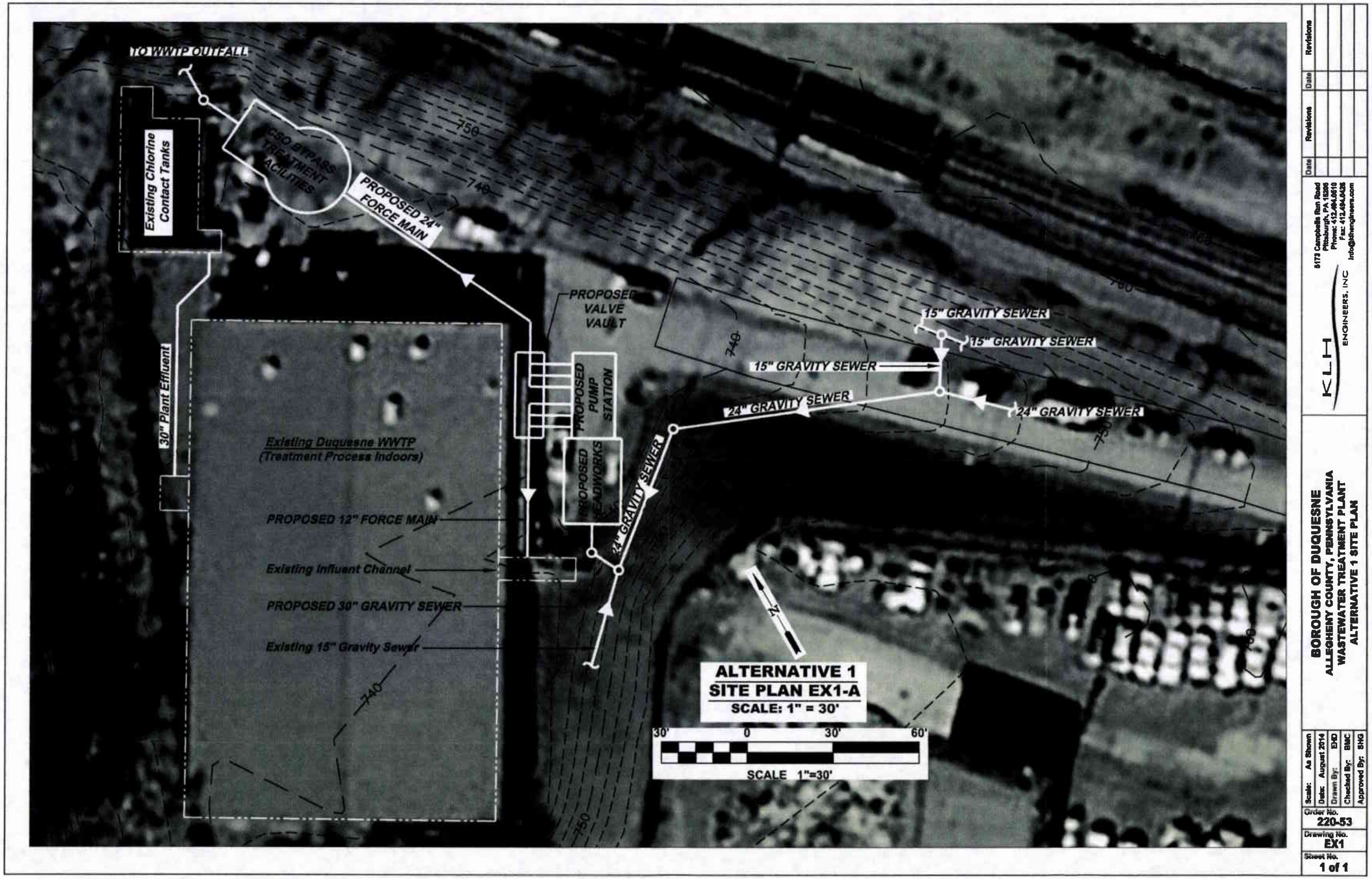
BOROUGH OF DUQUESNE
ALLEGHENY COUNTY, PENNSYLVANIA
EXISTING WASTEWATER TREATMENT PLANT
ALTERNATIVE 1 - PROCESS FLOW DIAGRAM

Scale:	As Shown
Date:	August 2014
Drawn By:	EHD
Checked By:	BMC
Approved By:	SHG

Order No. 220-53
Drawing No. EX5
Sheet No. 1 of 1

APPENDIX P

ALTERNATIVE 1
SITE PLAN

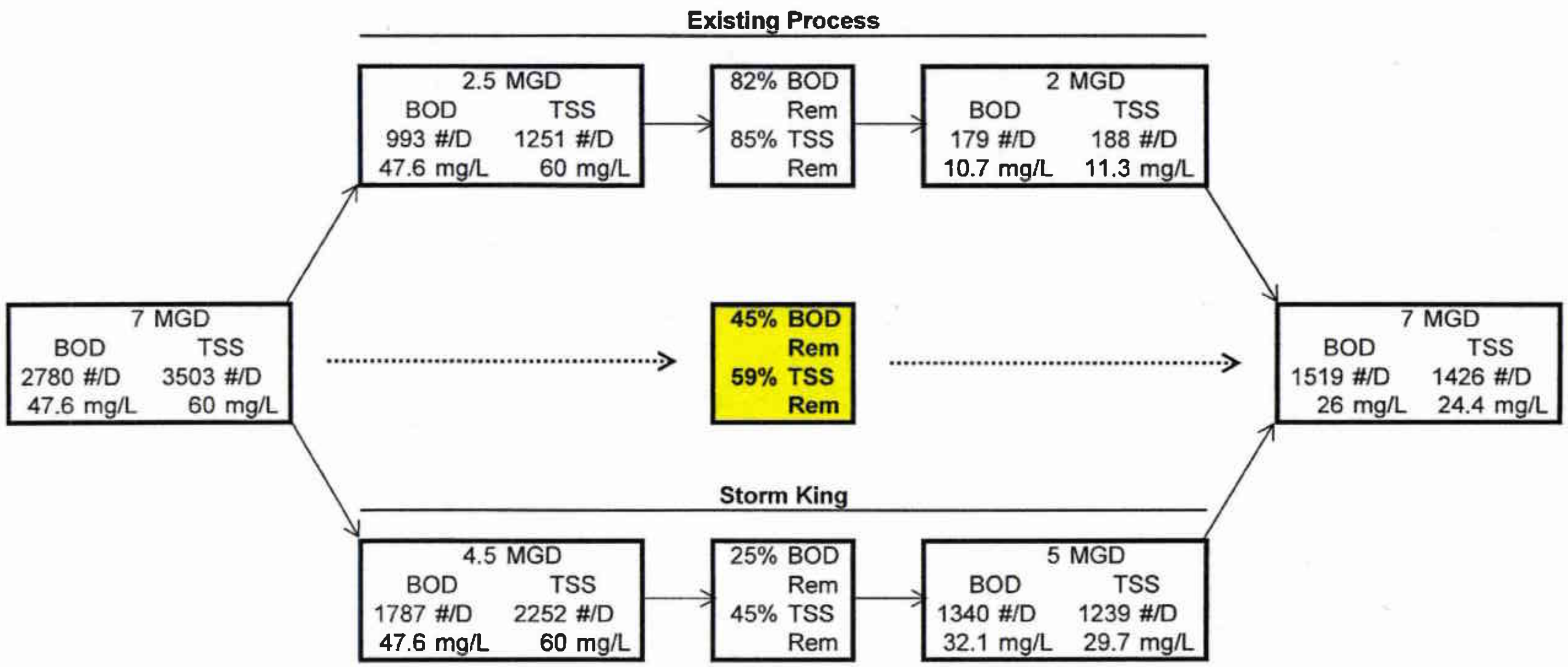


TO WWTP OUTFALL
Existing Chlorine Contact Tanks
CSO BYPASS TREATMENT FACILITIES
PROPOSED 24" FORCE MAIN
PROPOSED VALVE VAULT
PROPOSED PUMP STATION
PROPOSED HEADWORKS
30" Plant Effluent
Existing Duquesne WWTP
(Treatment Process Indoors)
PROPOSED 12" FORCE MAIN
Existing Influent Channel
PROPOSED 30" GRAVITY SEWER
Existing 15" Gravity Sewer
24" GRAVITY SEWER
24" GRAVITY SEWER
24" GRAVITY SEWER
15" GRAVITY SEWER
15" GRAVITY SEWER
15" GRAVITY SEWER
750
740
740
740
750
N
ALTERNATIVE 1
SITE PLAN EX1-A
SCALE: 1" = 30'
30' 0 30' 60'
SCALE 1"=30'
Date
Revisions
Date
Revisions
KLH
ENGINEERS, INC
5173 Campbells Run Road
Pittsburgh, PA 15205
info@klhengineers.com
BOROUGH OF DUQUESNE
ALLEGHENY COUNTY, PENNSYLVANIA
WASTEWATER TREATMENT PLANT
ALTERNATIVE 1 SITE PLAN
Scale: As Shown
Date: August 2014
Drawn By: EHD
Checked By: BMC
Approved By: SHG
Order No. 220-53
Drawing No. EX1
Sheet No. 1 of 1

APPENDIX Q

ALTERNATIVE 1
PROCESS CALCULATIONS

Duquesne WWTP CSO Bypass Treatment
BOD and TSS Removal Mass Balance



Wet Weather Solutions

Hydro International

CSO Solutions for the Future...®

STORM KING® DETAIL INFORMATION

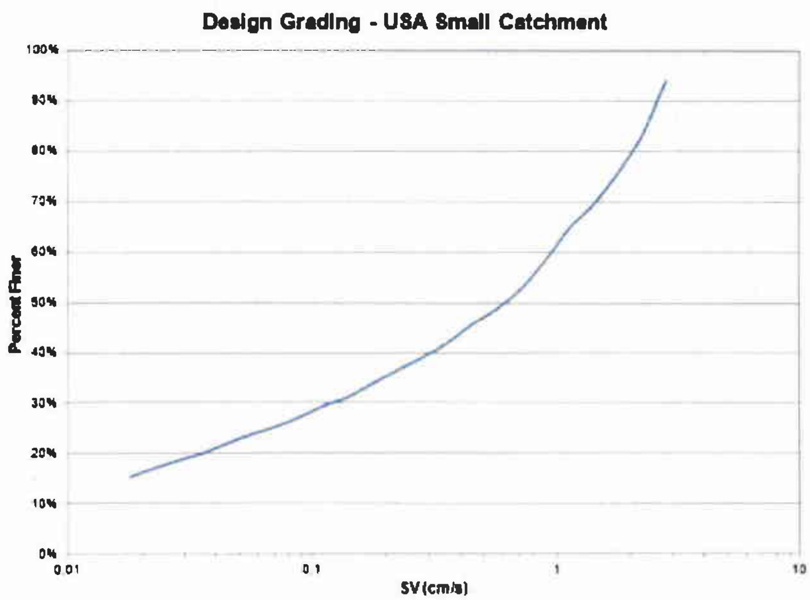
To:	KLH
Project:	Duquesne WWTP
Location:	Duquesne, PA
Hydro Ref:	14-3107-A
Date:	June 25, 2014

The Storm King shall use an induced vortex and a Swirl Cleanse screen with 4mm diameter opening apertures to separate solids from liquids. The Storm King shall be self-activating and shall not require instrumentation or external power. The Storm King shall be reliable, essentially non-clogging, self-cleansing and contain no moving or interchangeable parts.

DESIGN SPECIFICATIONS

A. **Performance Objective:** The Storm King shall treat combined sewage to primary treatment levels while removing gross solids, grit, sand, silts and sediment, and floatable debris greater than 4mm in two directions while providing in vessel disinfection. The equipment shall require no external power source and shall have no moving parts. All captured pollutants (both floatable and settleable solids), shall be removed from a centrally located sump within the separator or via gravity. The Storm King shall provide an induced hydrodynamic mixing regime in the unit with sufficient detention time conducive for high rate disinfection using sodium hypochlorite.

B. **Grading Curve – Particle Settling Velocity vs. Percent Finer**



Hydro International (Wet Weather), 94 Hutchins Drive, Portland ME 04102
Tel: (207) 756-6200 Fax: (207) 756-6212 Web: www.hydro-int.com

C. Treatment Target

Treatment Objective		Peak Design Flow Rate
1.	Total Suspended Solids Reduction	45 - 50%
2.	Total Gross BOD_5 Reduction	25 - 30%
3.	Effluent Fecal/E. coli Concentration	≤200 cfu/100mL
4.	Screening (in two directions)	~4mm
5.	Grit Removal	95% of 106 micron

D. Design Criteria

1.	Peak Design Inflow Rate	12.00	mgd
2.	Spill Flow Rate	11.10	mgd
3.	Underflow Rate	0.90	mgd
4.	Number of Units	1	No.
5.	Chamber Diameter	30	ft.
6.	Inlet Pipe Diameter	30	in.
7.	Underflow Pipe Diameter	8	in.
8.	Overspill Pipe Diameter	6	in.
9.	Separator Headloss at Peak Design Inflow Rate	6	in.
10.	Siphon Driving Head	48	in.
11.	Predicted TSS Removal Efficiency	50	%
12.	Storage Volume before Discharge	86,500	gallons
13.	Bacteria Removal from Underflow	75	%
14.	Maximum Influent Bacteria Concentration	2.0×10^6	cfu/100mL
15.	NaClO Feedrate at Peak Design Flow	15.36	mg/L
16.	Approximate in Vessel Detention Time	9.5	minutes

MATERIALS

A. Unless otherwise noted, the Storm King components and fixing accessories shall be fabricated from 316 stainless steel. The Swirl Cleanse perforated screen shall be fabricated in polymer coated 316 stainless steel. The support frame shall be fabricated in galvanized carbon steel. The treatment device shall be shipped to the site, preassembled to the maximum extent possible. Final assembly of the bolted connections shall be the responsibility of the General Contractor.

B. All welding shall conform to the most recent standards of the American Welding Society and American Society of Mechanical Engineers (ASME).

C. The device shall be designed to withstand all loadings which may occur during fabrication, shipping, installation, and operation of the equipment.

D. The internal components shall be supplied with all weld spatter and flux residue removed, all rough and uneven welds ground smooth, and shall be free of any sharp edges. Components shall have an acid washed surface finish.

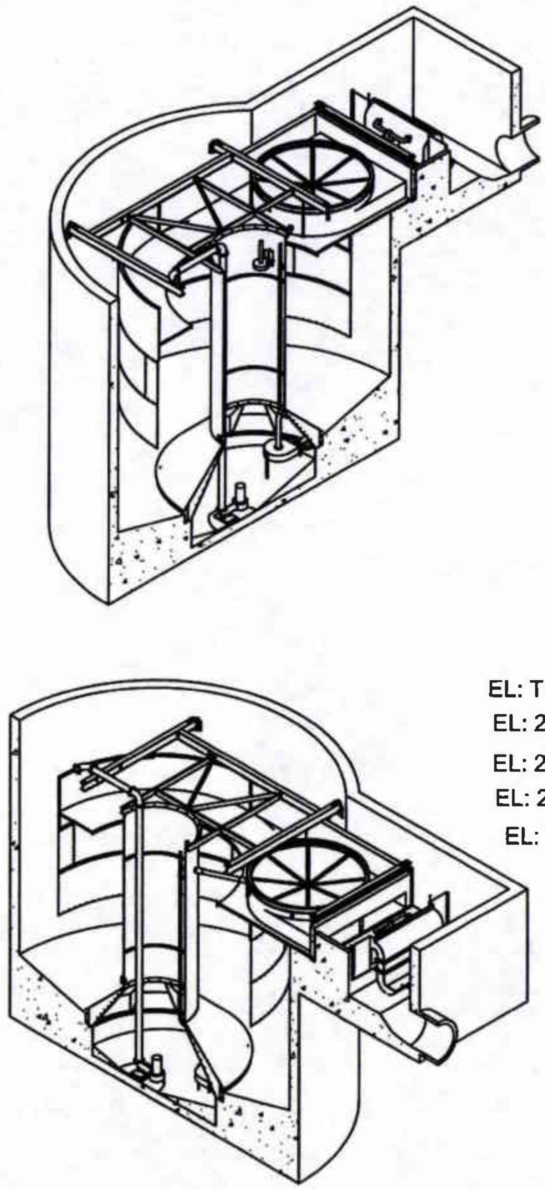
E. All supporting materials shall be installed so as not to impede the smooth circular flow within the unit.

F. Interior tank walls and all benching shall be filleted to form a smooth cylindrical surface.

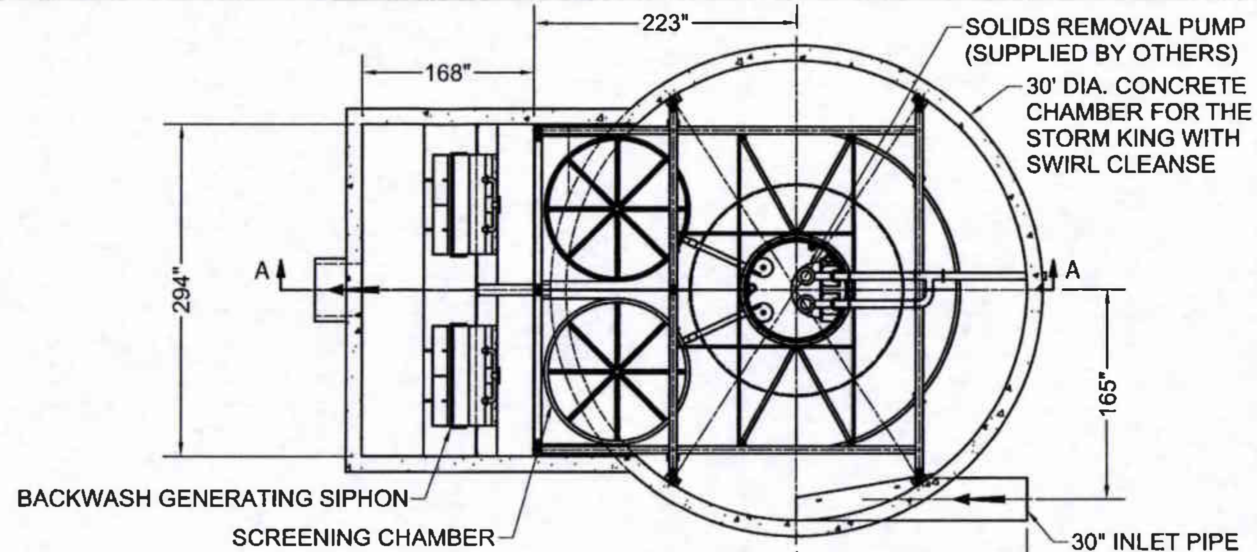
G. Superstructure shall be reinforced concrete supplied by the General Contractor.

H. The Swirl Cleanse component shall capture floatables and neutrally buoyant materials. The Swirl Cleanse shall be back washed automatically by an air-regulated siphon located in the overflow channel. Floatables retained on the screen shall be washed to the center and discharged through the center overspill pipe.

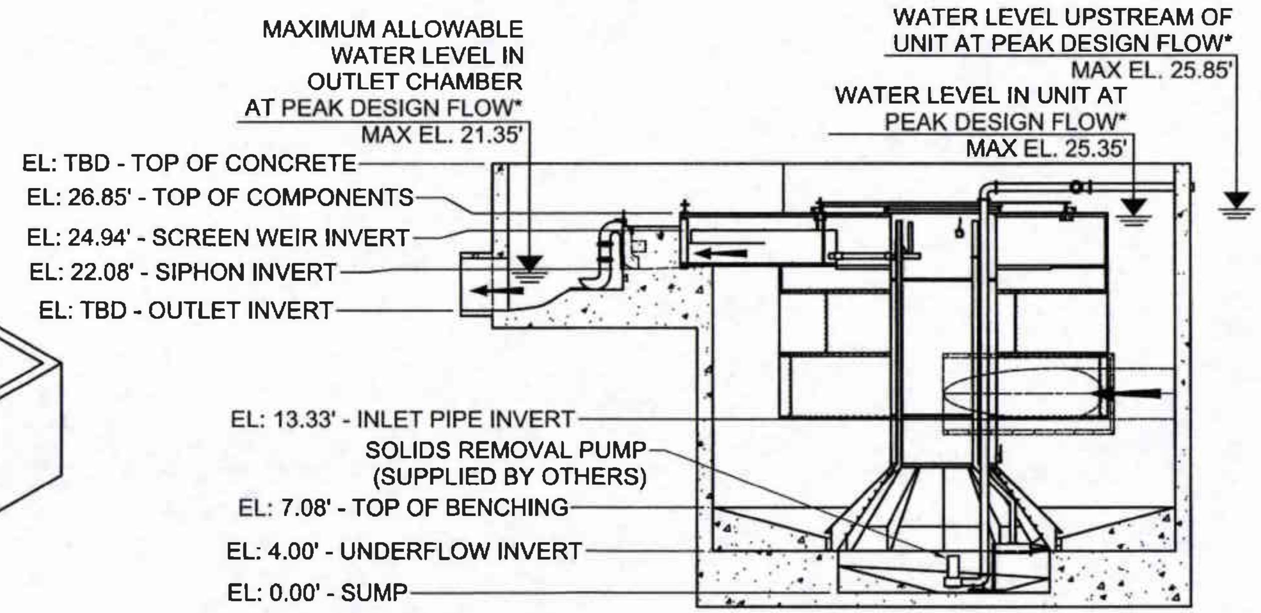
I. The Swirl Cleanse screen to be 14 gauge (minimum) grade 316 stainless steel punched plate containing 6mm holes with 51% open area (flat panel). Each plate is then shaped to fit the chamber and covered in a polythene or powder coat (black) approximately 1mm (1/32 inch) thick reducing the aperture size to 4mm (1/6 inch). The screen will incorporate approximately an 8 degree slope towards the screenings removal outlet.



ISOMETRIC VIEWS



PLAN VIEW



VIEW A-A

* WATER LEVELS ARE CONSERVATIVE. HYDRO CAN PROVIDE A SCALE DRAWING TO SUIT THE SITE REQUIREMENTS UPON REQUEST.

PROJECTION

1. THIS DRAWING IS A SCHEMATIC TYPE DRAWING THAT IS INTENDED FOR INFORMATIONAL PURPOSES ONLY. IF A SCALE DRAWING IS REQUIRED PLEASE NOTIFY HYDRO.

REV	BY	DATE	DESCRIPTION
-	DR	6/24/14	FIRST ISSUE

REVISION HISTORY

Date	Scale
06/24/2014	NTS

Drawn By	Checked By	Approved By
DR	-	LS

Title
30' STORM KING
WITH SWIRL CLEANSE

DUQUESNE CSO
DUQUESNE, PA

GENERAL
ARRANGEMENT

Hydro International

94 Hutchins Drive
Portland, ME 04102
Tel: (207) 756-6200
Fax: (207) 756-6212
email: hiltech@hil-tech.com

DO NOT SCALE DRAWING

UNLESS OTHERWISE SPECIFIED, DIMENSIONS ARE IN INCHES, TOLERENCES ARE:

FRACTIONS ±1/16

DECIMALS ± .06

ANGLES ±1°

Approximate Weight: N/A	
Finish: -	
Treatment: -	
Sheet Size: B	Sheet: 1 OF1

Next Assembly:	N/A	
Ref. No.	14-3107	
Drawing No.	14-3107-01	Rev -

Storm King®

Sedimentation, Screening, & Disinfection in One Device

Product Profile

The Storm King® is an advanced hydrodynamic vortex separator that incorporates an optional self-cleansing, non-powered Swirl Cleanse screening system to provide screening to 4mm in diameter. The Storm King® is a proven technology which combines grit removal, primary treatment equivalency (TSS and BOD removal), floatables control and in-vessel disinfection within a single unit process. The system is ideal for satellite or centralized treatment at overflow sites because it is self-activating, has no moving parts and requires no power to separate solids.

Applications

- Floatables control, primary treatment equivalency and disinfection of combined sewer overflows (CSOs) and wet weather induced flows
- Remote or unmanned treatment facilities
- Treatment of excess wet weather flows at centralized facilities or POTWs
- Retrofit or new wet weather treatment facilities
- Preliminary treatment prior to storage or equalization

Advantages

- No power and no moving parts
- Self-activating with a small footprint
- Fine grit removal and primary treatment equivalency
- Combines three unit processes in a single device
- Higher effluent standards can be achieved with the addition of coagulants and flocculants
- Captured material returned to sanitary flow thereby eliminating the need for residuals handling capabilities at remote sites

How it Works

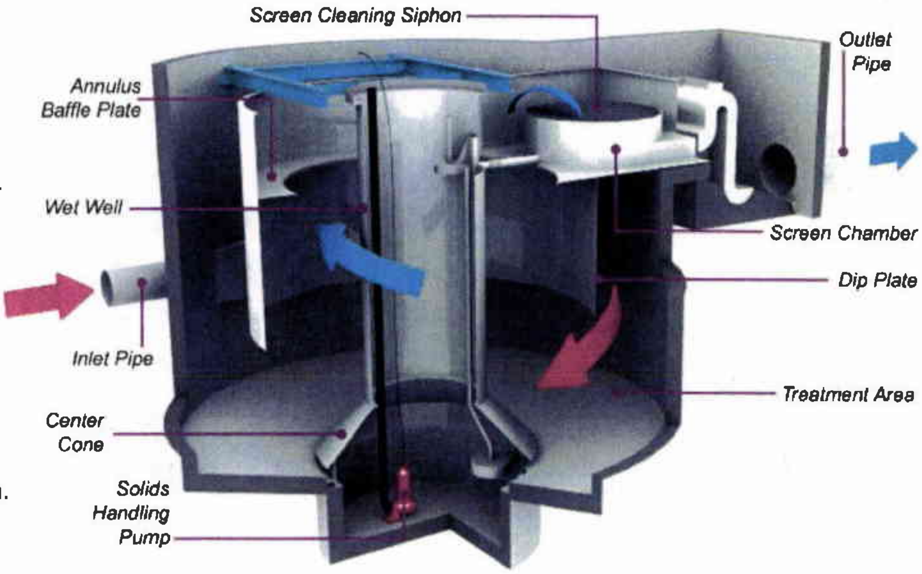
Flow is introduced tangentially into the side of the Storm King® barrel causing the contents to rotate slowly about the vertical axis. The flow spirals down the perimeter allowing solids to settle out by gravity. This process is aided by rotary forces, shear forces and drag forces at the boundary layer on the wall and base of the vessel.

The internal components direct the main flow away from the perimeter and back up the middle of the vessel as a broad spiraling column, rotating at a slower velocity than the outer downward flow. A dip plate locates the shear zone, the interface between the outer downward circulation and the inner upward circulation, where a marked difference in velocity encourages further solids separation. Settled solids are directed to the helical channel located under the center cone and are conveyed out of the main chamber through the underflow outlet.

The flow passes down through the Swirl Cleanse screen which captures all floatables and neutrally buoyant material greater than 4mm in diameter. The air regulated siphon provides an effective backwash mechanism to prevent the screen from blinding. Screened effluent is discharged into a receiving watercourse, a storage facility, or continues on to receive further treatment. (light blue arrow).

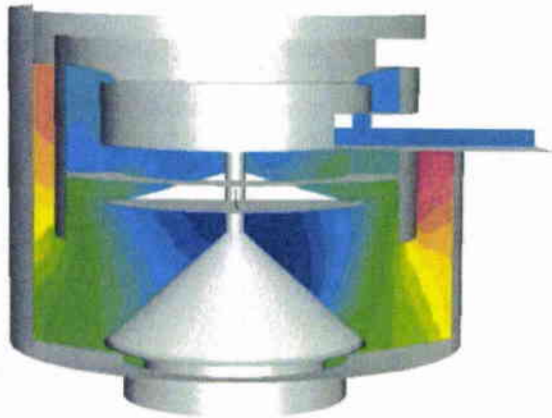
The collected screenings and settled solids from the underflow are pumped or gravity fed from the base of the unit and returned to the sanitary flow to continue on to the wastewater treatment facility.

Bacteria reduction is achieved within the Storm King® by introducing chemicals such as Sodium Hypochlorite, Peracetic Acid, or Chlorine Dioxide into the upstream diversion structure or into the inlet pipe of the vessel. The spiraling action integral to the system combined with the predictable flow path of the separator allows the unit to combine its solids and grit removal duties with disinfection. Dechlorination (if applicable) is performed at the discharge of the siphon.



Performance

- Screening to 4mm in diameter
- Proven high rate disinfection in less than 8 minutes



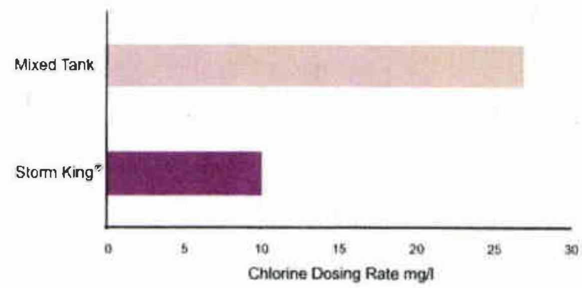
CFD simulation showing predicted fecal coliform kills in Storm King® (survival color code: Red is alive and blue is dead).

Disinfection

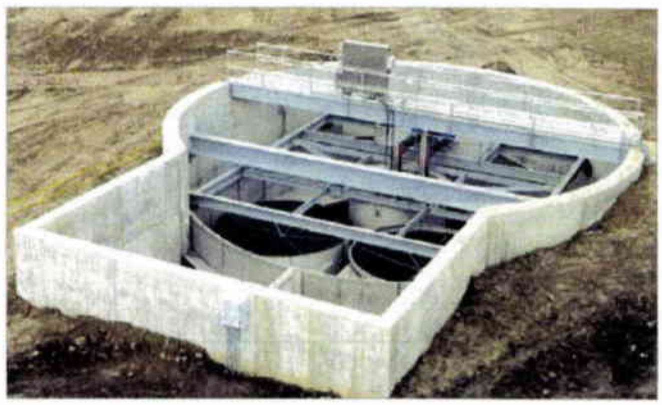
The Storm King® has a long history of providing protection to watercourses. However, it is not widely known that the Storm King® can provide solids removal and disinfection in the same vessel. Taking advantage of the separator's complex flow paths created by the unique internal components, the Storm King® can provide excellent efficiencies while occupying less than 30% of the area required for conventional disinfection solutions.

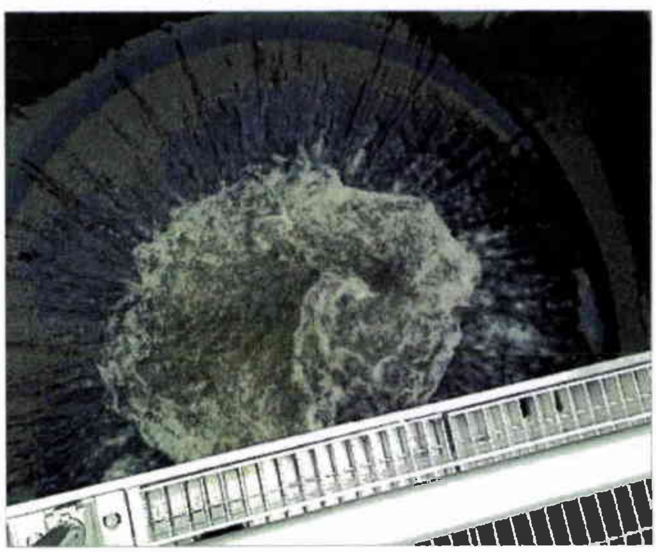
The Storm King® is able to achieve 3 to 4 log kills of total or fecal coliform bacteria within an 8 minute hydraulic retention time and handle commonly available disinfectants such as Sodium Hypochlorite, Peracetic Acid, or Chlorine Dioxide.

Chlorine Dosing Rate Comparison



Comparisons of Disinfection Area Required for Storm King® and Conventional Disinfection Tanks





Maintenance

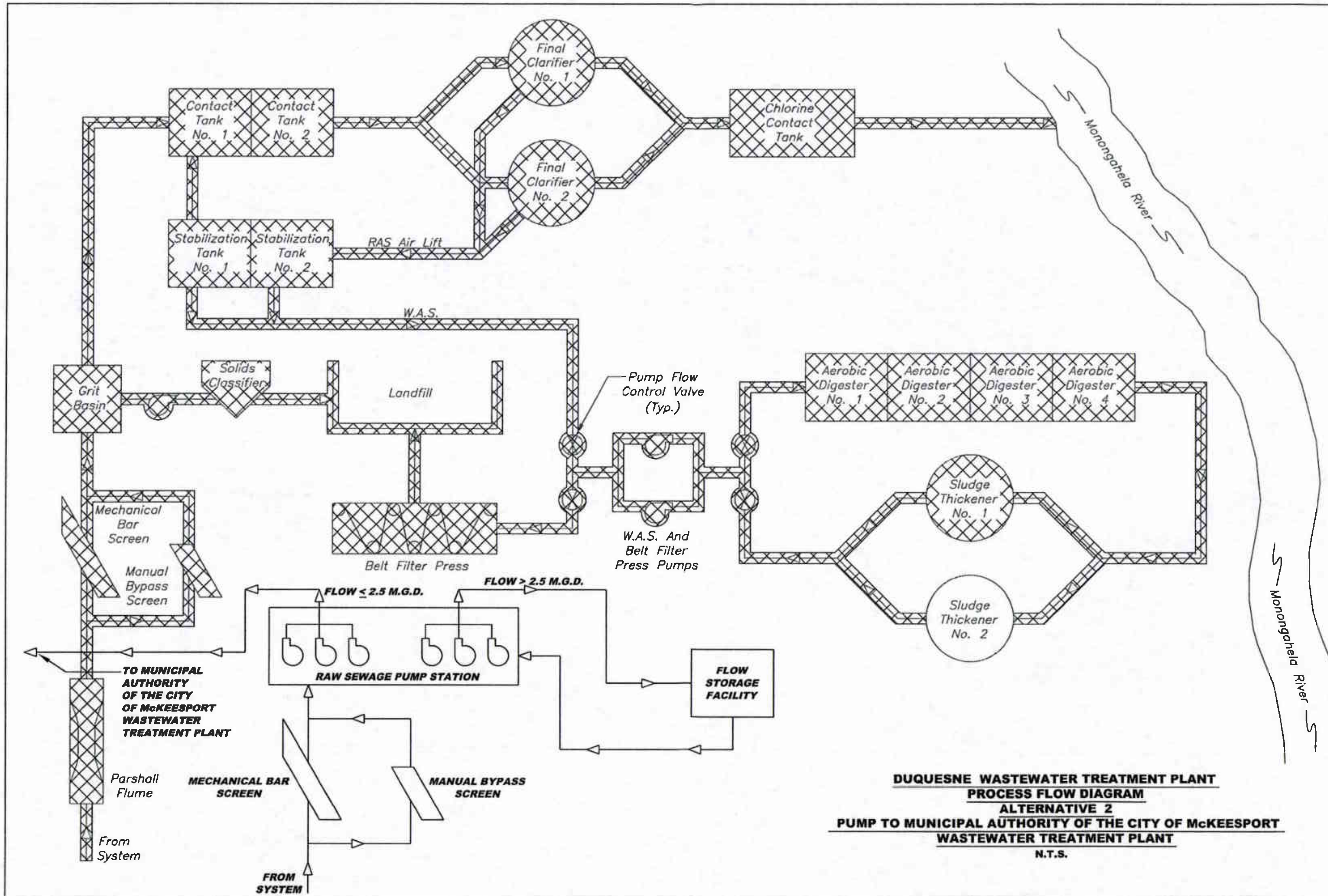
The Storm King® with Swirl Cleanse has no moving parts and typically requires no higher maintenance commitment than the sewer system in which it is placed.

The maintenance requirement is dependent upon the influent characteristics, which in turn are dependent upon the nature of the contributing system.

Once the device has been brought on-line, the Storm King® and Swirl Cleanse screen should be visually inspected after the first two spill events. After the initial inspections, visual inspection of the equipment should be carried out twice per year, or as deemed appropriate for the location.

APPENDIX R

ALTERNATIVE 2
PROCESS FLOW DIAGRAM



DUQUESNE WASTEWATER TREATMENT PLANT
PROCESS FLOW DIAGRAM
ALTERNATIVE 2
PUMP TO MUNICIPAL AUTHORITY OF THE CITY OF McKEESPORT
WASTEWATER TREATMENT PLANT
N.T.S.

BOROUGH OF DUQUESNE
ALLEGHENY COUNTY, PENNSYLVANIA
WASTEWATER TREATMENT PLANT
ALTERNATIVE 2 - PROCESS FLOW DIAGRAM

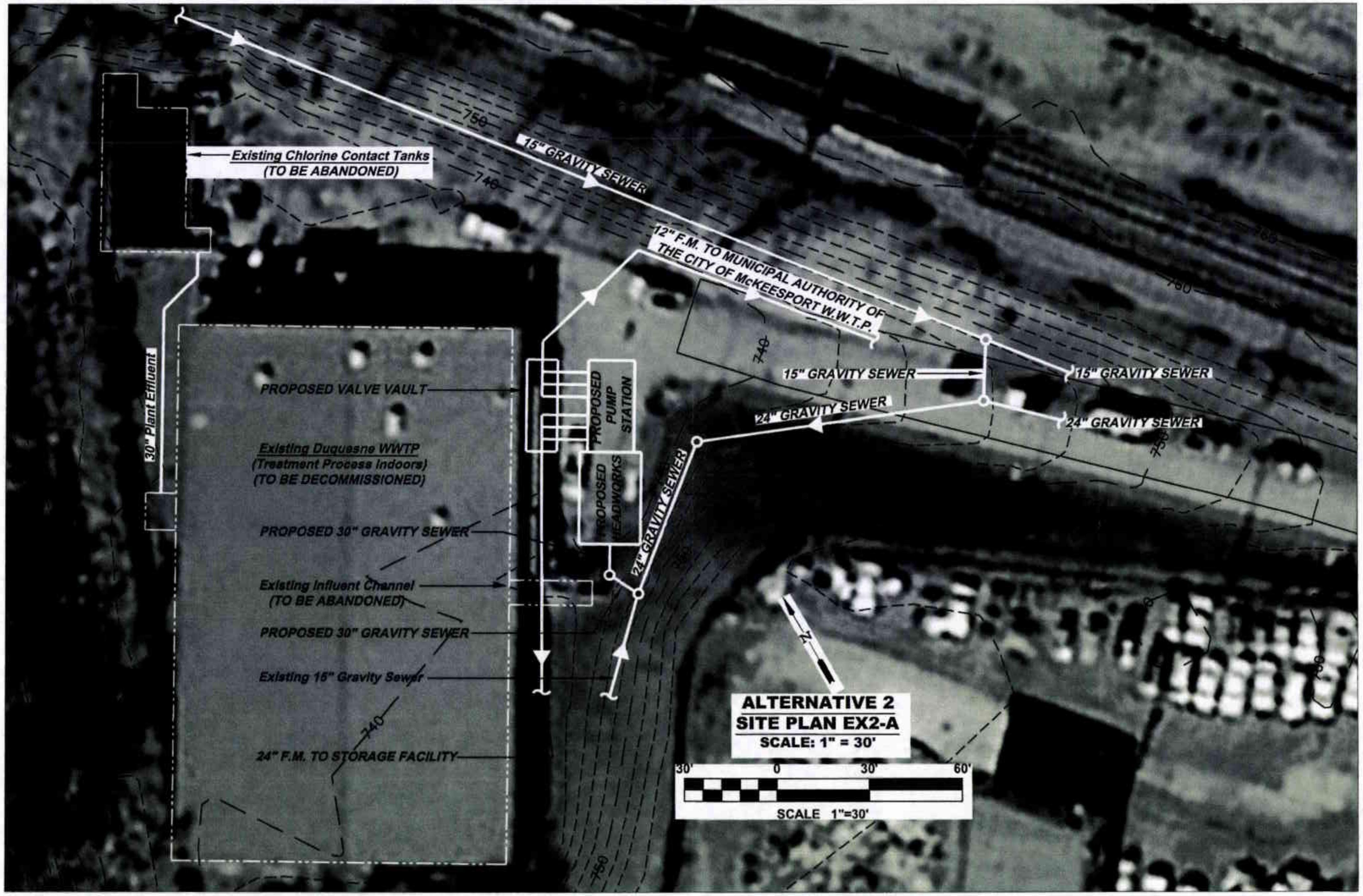
KLH ENGINEERS, INC
5173 Campbells Run Road
Pittsburgh, PA 15205
Phone: 412.494.0610
Fax: 412.494.0426
info@klhengineers.com

Date	Revisions	Date	Revisions

Scale: As Shown
Date: August 2014
Drawn By: EHD
Checked By: BMC
Approved By: SHG
Order No. 220-53
Drawing No. EX6
Sheet No. 1 of 1

APPENDIX S

ALTERNATIVE 2
SITE PLAN



Date	Revisions	Date	Revisions

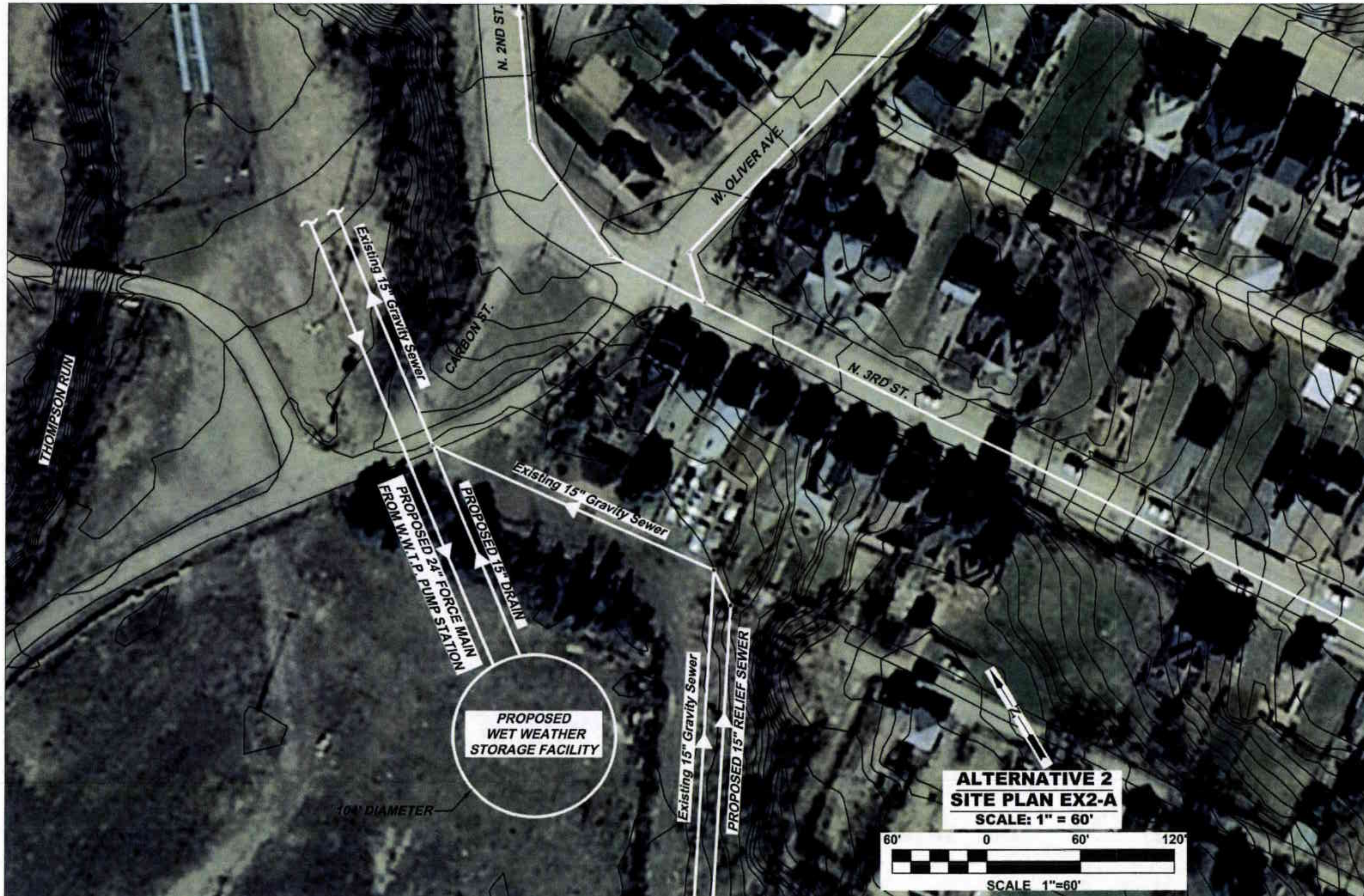
KLH ENGINEERS, INC

9173 Campbells Run Road
Pittsburgh, PA 15205
Phone: 412.494.0510
Fax: 412.494.0426
info@klhengineers.com

BOROUGH OF DUQUESNE
ALLEGHENY COUNTY, PENNSYLVANIA
WASTEWATER TREATMENT PLANT
ALTERNATIVE 2 SITE PLAN

Scale:	As Shown
Date:	August 2014
Drawn By:	EHD
Checked By:	BMC
Approved By:	SHG

Order No. 220-53
Drawing No. EX2
Sheet No. 1 of 2



Date	Revisions	Date	Revisions

KLH ENGINEERS, INC
5173 Campbells Run Road
Pittsburgh, PA 15205
Phone: 412-494-0610
Fax: 412-494-0435
info@klhengrs.com

BOROUGH OF DUQUESNE
ALLEGHENY COUNTY, PENNSYLVANIA
WASTEWATER TREATMENT PLANT
ALTERNATIVE 2 STORAGE SITE PLAN

Scale: As Shown
Date: August 2014
Drawn By: EHD
Checked By: BMC
Approved By: SHG

Order No. 220-53
Drawing No. EX2
Sheet No. 2 of 2

Appendix T

Alternative 2
Force Main Alignment

Sheet No. 1 of 1	Drawing No. FM-EX3	Order No. 220-53	Scale: NTS
			Date: May 2014
			Drawn By: VLB
			Checked By: BMC
			Approved By: SHG

MUNICIPAL AUTHORITY OF THE CITY OF MCKEESPORT
ALLEGHENY COUNTY, PENNSYLVANIA
DRAVOSBURG-DUQUESNE AREA ACT 537 & LONG TERM CONTROL PLAN
FORCE MAIN EXHIBIT

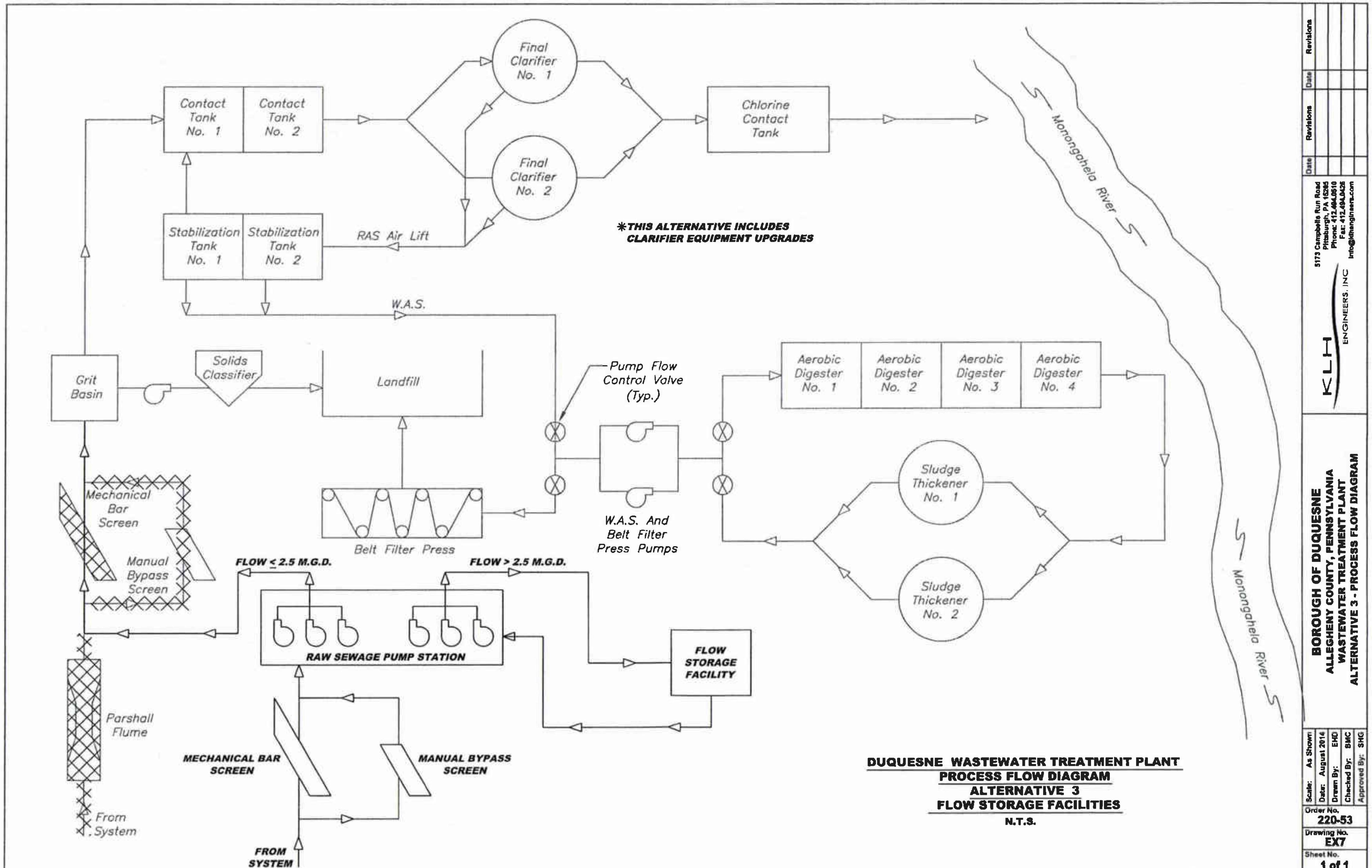
KLH ENGINEERS, INC

5173 Campbells Run Road
Pittsburgh, PA 15205
Phone: 412.494.0510
Fax: 412.494.0426
info@klhengineers.com

Date	Revisions	Date	Revisions

APPENDIX U

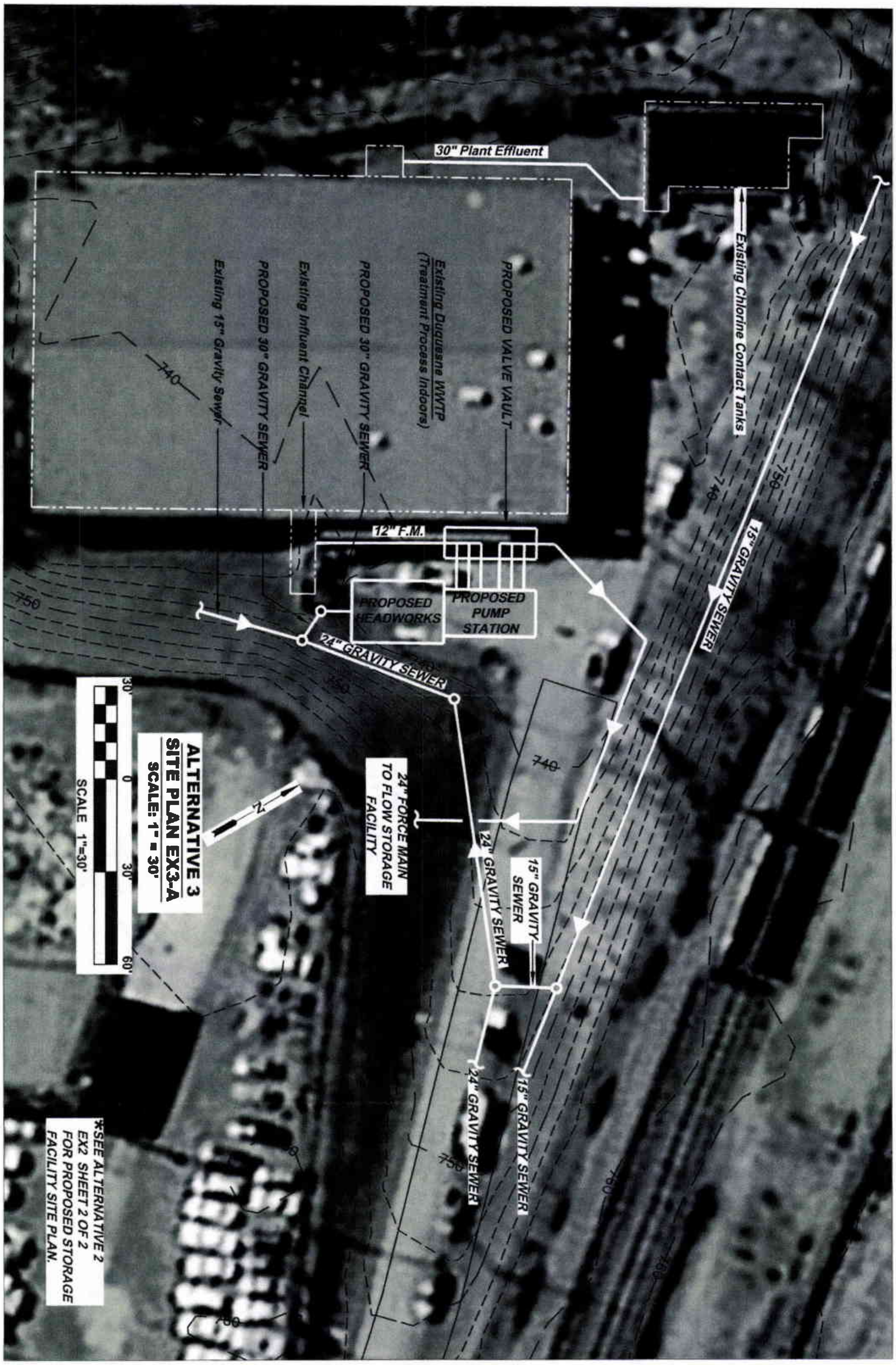
ALTERNATIVE 3
PROCESS FLOW DIAGRAM



Final Clarifier No. 1
Final Clarifier No. 2
Contact Tank No. 1
Contact Tank No. 2
Chlorine Contact Tank
Monongahela River
Stabilization Tank No. 1
Stabilization Tank No. 2
RAS Air Lift
*THIS ALTERNATIVE INCLUDES CLARIFIER EQUIPMENT UPGRADES
W.A.S.
Grit Basin
Solids Classifier
Landfill
Pump Flow Control Valve (Typ.)
Aerobic Digester No. 1
Aerobic Digester No. 2
Aerobic Digester No. 3
Aerobic Digester No. 4
Mechanical Bar Screen
Manual Bypass Screen
Belt Filter Press
W.A.S. And Belt Filter Press Pumps
Sludge Thickener No. 1
Sludge Thickener No. 2
FLOW ≤ 2.5 M.G.D.
FLOW > 2.5 M.G.D.
RAW SEWAGE PUMP STATION
FLOW STORAGE FACILITY
Parshall Flume
From System
MECHANICAL BAR SCREEN
MANUAL BYPASS SCREEN
FROM SYSTEM
DUQUESNE WASTEWATER TREATMENT PLANT
PROCESS FLOW DIAGRAM
ALTERNATIVE 3
FLOW STORAGE FACILITIES
N.T.S.
Date
Revisions
KLH ENGINEERS, INC
BOROUGH OF DUQUESNE
ALLEGHENY COUNTY, PENNSYLVANIA
WASTEWATER TREATMENT PLANT
ALTERNATIVE 3 - PROCESS FLOW DIAGRAM
Scale: As Shown
Date: August 2014
Drawn By: EHD
Checked By: BMC
Approved By: SHG
Order No. 220-53
Drawing No. EX7
Sheet No. 1 of 1

APPENDIX V

ALTERNATIVE 3
SITE PLAN



Scale:	As Shown
Date:	August 2014
Drawn By:	EHD
Checked By:	BMC
Approved By:	SHG

Order No. 220-53
Drawing No. EX3
Sheet No. 1 of 1

BOROUGH OF DUQUESNE
ALLEGHENY COUNTY, PENNSYLVANIA
WASTEWATER TREATMENT PLANT
ALTERNATIVE 3 SITE PLAN

KLH ENGINEERS, INC
5173 Campbells Run Road
Pittsburgh, PA 15205
Phone: 412.494.0510
Fax: 412.494.0426
info@klhengineers.com

Date	Revisions	Date	Revisions

APPENDIX W

PROJECT COST ESTIMATES

Duquesne WWTP Long Term Control Plan

Summary of Alternatives

Planning Cost Estimate

Alternative	Construction Cost	Project Cost
Alternative 1 - Peak Flow Treatment	$ 5,939,000	$ 7,424,000
Alternative 2 - Pump to MACM with Storage	$ 12,408,000	$ 15,511,000
Alternative 3 - WWTP Improvements with Storage	$ 10,325,000	$ 12,907,000

Duquesne WWTP Long Term Control Plan

Conveyance System Upgrades

Planning Cost Estimate

ITEM	COST	
Gravity Relief Sewers	$	170,000
SUBTOTAL CONSTRUCTION COST	**$**	**170,000**
Mobilization/Demobilization/Bonds/Insurance (15%)	$	26,000
Contingency (30%)	$	51,000
TOTAL CONSTRUCTION COST	**$**	**247,000**
Engineering, Permitting, Legal (15%)	$	38,000
Construction Administration (10%)	$	25,000
TOTAL PROJECT COST	**$**	**310,000**

Gravity Relief Sewers

	Description	Qnty	Unit	Cost	Total
Div 2	Sitework				
	Sewer Pipe				
	24" Sewer Pipe				
	0' – 8'	310	LF	$ 114.00	$ 35,340.00
	15" Sewer Pipe				
	8' – 12'	715	LF	$ 132.00	$ 94,380.00
	M.H. 0-6' Deep with Standard Frame and Cover (4' Diameter)	5	EA	$ 2,150.00	$ 10,750.00
	Watertight Manhole Frame and Cover	5	EA	$ 499.00	$ 2,495.00
	Manhole Barrel over 6VF (4' Dia)	12	VF	$ 115.00	$ 1,380.00
	Select Backfill	364	CY	$ 29.00	$ 10,568.89
	Filter Fence	1,025	LF	$ 3.00	$ 3,075.00
	Municipal Road Trench Repair	100	LF	$ 42.00	$ 4,200.00
	Exploratory Excavation	10	EA	$ 270.00	$ 2,700.00
	Closed Circuit TV Inspection-Sewers	1,025	LF	$ 2.00	$ 2,050.00
	Inflow Protectors	5	EA	$ 63.00	$ 315.00
	Mismarked or Unmarked Utility Restoration				
	Natural Gas - 1/2" to 8"	10	EA	$ 52.00	$ 520.00
	Electric - Any Size or Voltage	10	EA	$ 52.00	$ 520.00
	Telephone - Any Size	10	EA	$ 52.00	$ 520.00
	Storm Sewer - Any Size	10	EA	$ 52.00	$ 520.00
	Waterline - Any Size	10	EA	$ 52.00	$ 520.00
	Subtotal Gravity Construction =				**$ 169,854**
	Cost per LF =				**$ 165.71**

Duquesne WWTP Long Term Control Plan

Alternative 1 - Upgrade WWTP

Planning Cost Estimate

ITEM	COST	
General Site Work	$	182,000
Headworks	$	743,000
Influent Pump Station	$	996,000
Peak Flow Treatment	$	1,039,000
Clarifier Efficiency Improvements	$	533,000
SUBTOTAL CONSTRUCTION COST	**$**	**3,493,000**
Electrical Costs (25%)	$	874,000
Mobilization/Demobilization/Bonds/Insurance (15%)	$	524,000
Contingency (30%)	$	1,048,000
TOTAL CONSTRUCTION COST	**$**	**5,939,000**
Engineering, Permitting, Legal (15%)	$	891,000
Construction Administration (10%)	$	594,000
TOTAL PROJECT COST	**$**	**7,424,000**

Site Work

			Qty	Unit	Price per Unit	Materials	Total
Division 2	Site Work						
		E&S Controls	1	lot	$ 10,000.00	$ 10,000.00	$ 10,000.00
		By-Pass Pumping	1	lot	$ 50,000.00	$ 50,000.00	$ 50,000.00
		Site Paving	478	s.y.	$ 50.00	$ 23,888.89	$ 23,888.89
		Lawn Restoration	1	lot	$ 5,000.00	$ 5,000.00	$ 5,000.00
Division 3	Concrete						
		Repairs/Rehabilitation	1	lot	$ 10,000.00	$ 10,000.00	$ 10,000.00
		Manholes (0'-8' Deep)	3	ea	$2,500.00	$ 7,500.00	$ 7,500.00
		Manhole VF over 8' Deep	25	v.f.	$110.00	$ 2,750.00	$ 2,750.00
						$ -	
Division 15	Mechanical						
		24" D.I. Pipe - F.M.	100	L.F.	$ 125.00	$ 12,500.00	$ 12,500.00
		30" PVC Pipe (Buried) - Gravity	300	L.F.	$ 200.00	$ 60,000.00	$ 60,000.00

Subtotal Construction = $ 181,638.89

Headworks										
			Qty	Unit	Price per Unit		Materials		Total	
Division 2	Site Work									
		Excavation	416.7	c.y.	$	50.00	$	20,833.33	$	20,833.33
		Backfill	104.2	c.y.	$	50.00	$	5,208.33	$	5,208.33
		Stone Backfill	66.67	c.y.	$	172.00	$	11,466.67	$	11,466.67
Division 3	Concrete									
		Foundation Slab	84.33	c.y.	$	532.10	$	44,873.77	$	44,873.77
		First Floor Slab	56.22	c.y.	$	1,123.40	$	63,157.55	$	63,157.55
		Walls	53.33	c.y.	$	1,123.40	$	59,914.67	$	59,914.67
Division 4	Masonry									
		Block	1200	s.f.	$	8.35	$	10,020.00	$	14,923.83
Division 5	Metals									
		Aluminum Grating	150	s.f.	$	65.00	$	9,750.00	$	9,750.00
		Aluminum Handrail	200	L.F.	$	70.00	$	14,000.00	$	14,000.00
		4'x4' Aluminum Hatchway	1	each	$	3,500.00	$	3,500.00	$	5,212.91
		Stairs	60	riser	$	185.00	$	11,100.00	$	16,532.39
Division 7	Thermal and Moisture									
		Masonry Insulation	1200	s.f.	$	1.31	$	1,572.00	$	2,341.34
		Roofing	1	Lot	$	25,000.00	$	25,000.00	$	37,235.10
		Alum Fascia	100	s.f.	$	5.35	$	535.00	$	796.83
		Alum Soffit	404	s.f.	$	7.65	$	3,090.60	$	4,603.15
		Alum Gutters	100	L.F.	$	5.00	$	500.00	$	744.70
		Downspouts	48	L.F.	$	4.84	$	232.32	$	346.02
Division 8	Doors and Windows									
		7'x3' Mandoor w/window	1	each	$	1,000.00	$	1,000.00	$	1,489.40
		7'x6' Door	1	each	$	2,500.00	$	2,500.00	$	3,723.51
		10'x14' Rolling Garage	1	each	$	7,000.00	$	7,000.00	$	10,425.83
		3'x3' window	2	each	$	500.00	$	1,000.00	$	1,489.40
		4'x4' skylight	2	each	$	200.00	$	400.00	$	595.76
Division 9	Coatings									
		Paints	10000	s.f.	$	2.00	$	20,000.00	$	29,788.08
Division 11	Equipment									
		Coarse Screen (Mechanical)	1	each	$	234,000.00	$	234,000.00	$	304,200.00
		Coarse Screen (Manual)	1	each	$	7,500.00	$	7,500.00	$	7,500.00
Division 15	Mechanical									
		Sluice Gates	4	each	$	3,500.00	$	14,000.00	$	20,851.66
		HVAC	1	Lot	$	50,000.00	$	50,000.00	$	50,000.00
							Subtotal Construction =		**$**	**742,004.25**

Influent Pump Station and Valve Vault							
			Qty	Unit	Price per Unit	Materials	Total
Division 2	Site Work						
		Excavation	305	c.y.	$ 50.00	$ 15,231.48	$ 15,231.48
		Backfill	76	c.y.	$ 50.00	$ 3,807.87	$ 3,807.87
		Stone Backfill	21	c.y.	$ 172.00	$ 3,612.00	$ 3,612.00
		Shoring/Dewatering	1	LOT	$ 50,000.00	$ 50,000.00	$ 50,000.00
Division 3	Concrete						
		Foundation Slab	62	c.y.	$ 532.10	$ 32,990.20	$ 32,990.20
		Elevated Slabs and Walls		c.y.	$1,123.40	$ -	
Division 5	Metals						
		6'x6' Aluminum Hatchway	2	each	$ 5,000.00	$ 10,000.00	$ 10,000.00
Division 11	Equipment						
		Normal Flow Pumps (1 MGD EA)	3	each	$ 50,000.00	$ 150,000.00	$ 150,000.00
		Storm Pumps (5 MGD EA)	3	each	$ 75,000.00	$ 225,000.00	$ 225,000.00
		MCC	1	each	$ 300,000.00	$ 300,000.00	$ 300,000.00
		PLC and Controls	1	each	$ 100,000.00	$ 100,000.00	$ 100,000.00
		Bridge Crane	1	each	$ 25,000.00	$ 25,000.00	$ 25,000.00
Division 15	Mechanical						
		Wet Well and Valve Vault Piping	1	LOT	$ 80,000.00	$ 80,000.00	$ 80,000.00
						Subtotal Construction = $	995,641.55

Peak Flow Treatment

			Qty	Unit	Price per Unit	Total
Division 2	Site Work					
		Excavation	74.07	c.y.	$ 50.00	$ 3,703.70
		Backfill	18.52	c.y.	$ 50.00	$ 925.93
		Stone Backfill	165.3	c.y.	$ 172.00	$ 28,436.76
		Excavation/Shoring/Dewatering/Backfill	1	LOT	$ 50,000.00	$ 50,000.00
Division 3	Concrete					
		Foundation Slab	110.2	c.y.	$ 532.10	$ 58,637.42
		First Floor Slab	0	c.y.	$ 1,123.40	$ -
		Walls	68.18	c.y.	$ 1,123.40	$ 76,593.41
		Columns/Beams		c.y.		
Division 5	Metals					
		Lintels		each	$ 34.50	
		Aluminum Grating	1488	s.f.	$ 65.00	$ 96,720.00
		Aluminum Handrail	145.2	L.F.	$ 70.00	$ 10,163.01
Division 11	Equipment					
		Storm Water Treatment	1	each	$ 541,000.00	$ 703,300.00
		Solids Removal Pump	2	each	$ 5,000.00	$ 10,000.00
		Chlorine System Upgrades	1	each	$ 50,000.00	$ 50,000.00
						$ 1,038,480.23

Clarifier Upgrades

			Qty	Unit	Price per Unit	Materials	Total
Division 11	Equipment						
		Demolition of Existing Equipment	2	each	$ 10,000.00	$ 20,000.00	$ 20,000.00
		Secondary Clarifier Mechanisms	2	each	$ 84,250.00	$ 168,500.00	$ 387,550.00
		FRP Weirs, Baffles, Launder Covers	2	each	$ 41,750.00	$ 83,500.00	$ 125,250.00

Subtotal Construction = $ 532,800.00

Duquesne WWTP Long Term Control Plan

Alternative 2 - Pump to MACM with Storage

Planning Cost Estimate

ITEM	COST	
General Site Work	$	120,000
Headworks	$	743,000
Property Acquisition and Remediation	$	1,097,000
Pump Station and Valve Vault	$	1,474,000
Storage Tank	$	2,175,000
Force Main to MACM	$	1,689,000
SUBTOTAL CONSTRUCTION COST	**$**	**7,298,000**
Electrical Costs (25%)	$	1,825,000
Mobilization/Demobilization/Bonds/Insurance (15%)	$	1,095,000
Contingency (30%)	$	2,190,000
TOTAL CONSTRUCTION COST	**$**	**12,408,000**
Engineering, Permitting, Legal (15%)	$	1,862,000
Construction Administration (10%)	$	1,241,000
TOTAL PROJECT COST	**$**	**15,511,000**

Site Work							
			Qty	Unit	Price per Unit	Materials	Total
Division 2	Site Work						
		E&S Controls	1	lot	$ 10,000.00	$ 10,000.00	$ 10,000.00
		By-Pass Pumping	1	lot	$ 50,000.00	$ 50,000.00	$ 50,000.00
		Site Paving	478	s.y.	$ 50.00	$ 23,888.89	$ 23,888.89
		Lawn Restoration	1	lot	$ 5,000.00	$ 5,000.00	$ 5,000.00
Division 3	Concrete						
		Repairs/Rehabilitation	1	lot	$ 10,000.00	$ 10,000.00	$ 10,000.00
		Manholes (0'-8' Deep)	3	ea	$2,500.00	$ 7,500.00	$ 7,500.00
		Manhole VF over 8' Deep	25	v.f.	$110.00	$ 2,750.00	$ 2,750.00
						$ -	
Division 15	Mechanical						
		30" PVC Pipe (Buried) - Gravity	50	L.F.	$ 200.00	$ 10,000.00	$ 10,000.00

Subtotal Construction = $ 119,138.89

			Qty	Unit	Price per Unit		Materials		Total	
Headworks										
Division 2	Site Work									
		Excavation	416.7	c.y.	$	50.00	$	20,833.33	$	20,833.33
		Backfill	104.2	c.y.	$	50.00	$	5,208.33	$	5,208.33
		Stone Backfill	66.67	c.y.	$	172.00	$	11,466.67	$	11,466.67
Division 3	Concrete									
		Foundation Slab	84.33	c.y.	$	532.10	$	44,873.77	$	44,873.77
		First Floor Slab	56.22	c.y.	$	1,123.40	$	63,157.55	$	63,157.55
		Walls	53.33	c.y.	$	1,123.40	$	59,914.67	$	59,914.67
Division 4	Masonry									
		Block	1200	s.f.	$	8.35	$	10,020.00	$	14,923.83
Division 5	Metals									
		Aluminum Grating	150	s.f.	$	65.00	$	9,750.00	$	9,750.00
		Aluminum Handrail	200	L.F.	$	70.00	$	14,000.00	$	14,000.00
		4'x4' Aluminum Hatchway	1	each	$	3,500.00	$	3,500.00	$	5,212.91
		Stairs	60	riser	$	185.00	$	11,100.00	$	16,532.39
Division 7	Thermal and Moisture									
		Masonry Insulation	1200	s.f.	$	1.31	$	1,572.00	$	2,341.34
		Roofing	1	Lot	$	25,000.00	$	25,000.00	$	37,235.10
		Alum Fascia	100	s.f.	$	5.35	$	535.00	$	796.83
		Alum Soffit	404	s.f.	$	7.65	$	3,090.60	$	4,603.15
		Alum Gutters	100	L.F.	$	5.00	$	500.00	$	744.70
		Downspouts	48	L.F.	$	4.84	$	232.32	$	346.02
Division 8	Doors and Windows									
		7'x3' Mandoor w/window	1	each	$	1,000.00	$	1,000.00	$	1,489.40
		7'x6' Door	1	each	$	2,500.00	$	2,500.00	$	3,723.51
		10'x14' Rolling Garage	1	each	$	7,000.00	$	7,000.00	$	10,425.83
		3'x3' window	2	each	$	500.00	$	1,000.00	$	1,489.40
		4'x4' skylight	2	each	$	200.00	$	400.00	$	595.76
Division 9	Coatings									
		Paints	10000	s.f.	$	2.00	$	20,000.00	$	29,788.08
Division 11	Equipment									
		Coarse Screen (Mechanical)	1	each	$	234,000.00	$	234,000.00	$	304,200.00
		Coarse Screen (Manual)	1	each	$	7,500.00	$	7,500.00	$	7,500.00
Division 15	Mechanical									
		Sluice Gates	4	each	$	3,500.00	$	14,000.00	$	20,851.66
		HVAC	1	Lot	$	50,000.00	$	50,000.00	$	50,000.00

Subtotal Construction = $ 742,004.25

Influent Pump Station and Valve Vault

			Qty	Unit	Price per Unit	Materials	Total
Division 2	Site Work						
		Excavation	513	c.y.	$ 50.00	$ 25,648.15	$ 25,648.15
		Backfill	128	c.y.	$ 50.00	$ 6,412.04	$ 6,412.04
		Stone Backfill	21	c.y.	$ 172.00	$ 3,612.00	$ 3,612.00
		Shoring/Dewatering	1	LOT	$ 50,000.00	$ 50,000.00	$ 50,000.00
Division 3	Concrete						
		Foundation Slab	62	c.y.	$ 532.10	$ 32,990.20	$ 32,990.20
		Elevated Slabs and Walls	191	c.y.	$1,123.40	$ 214,569.40	$ 214,569.40
Division 5	Metals						
		6'x6' Aluminum Hatchway	2	each	$ 5,000.00	$ 10,000.00	$ 10,000.00
Division 11	Equipment						
		Normal Flow Pumps	3	each	$ 75,000.00	$ 225,000.00	$ 225,000.00
		Storm Pumps	3	each	$ 100,000.00	$ 300,000.00	$ 300,000.00
		MCC	1	each	$ 300,000.00	$ 300,000.00	$ 300,000.00
		PLC and Controls	1	each	$ 100,000.00	$ 100,000.00	$ 100,000.00
		Bridge Crane	1	each	$ 25,000.00	$ 25,000.00	$ 25,000.00
		Grinder Unit	1	each	$ 100,000.00	$ 100,000.00	$ 100,000.00
Division 15	Mechanical						
		Wet Well and Valve Vault Piping	1	LOT	$ 80,000.00	$ 80,000.00	$ 80,000.00

Subtotal Construction = **$ 1,473,231.79**

Storage Tanks

			Qty	Unit	Price per Unit	Materials	Total
Division 2	Site Work						
		Excavation	2909	c.y.	$ 50.00	$ 145,444.10	$ 145,444.10
		Backfill	727	c.y.	$ 50.00	$ 36,361.03	$ 36,361.03
		Stone Backfill	908	c.y.	$ 172.00	$ 156,162.29	$ 156,162.29
Division 3	Concrete						
		Foundation Slab	605	c.y.	$ 532.10	$ 322,069.59	$ 322,069.59
Division 11	Equipment						
		Storage Tanks	1	LOT	$ 950,230.67	$ 950,230.67	$ 950,230.67
		Walkways	1	LOT	$ 200,000.00	$ 200,000.00	$ 200,000.00
		Storage Basin Dewatering Pumps	2	each	$ 30,000.00	$ 60,000.00	$ 60,000.00
Division 15	Mechanical						
		24" D.I. Pipe (Force Main)	2025	L.F.	$ 150.00	$ 303,750.00	$ 303,750.00
							$ 2,174,017.68

Force Main to MACM							
			Qty	Unit	Price per Unit	Materials	Total
Division 2	Site Work						
		Select Backfill	1215	c.y.	$ 30.00	$ 36,444.44	$ 36,444.44
		Filter Fence	16400	L.F.	$ 2.50	$ 41,000.00	$ 41,000.00
		Municipal Road Repavement	1500	s.y.	$ 50.00	$ 75,000.00	$ 75,000.00
		Exploratory Excavation	10	ea	$ 270.00	$ 2,700.00	$ 2,700.00
Division 3	Concrete						
		Manhole 0-8' Deep - 4'-0" Diameter	10	ea	$ 2,150.00	$ 21,500.00	$ 21,500.00
		Watertight Manhole Frame and Cover	5	ea	$ 500.00	$ 2,500.00	$ 2,500.00
Division 15	Mechanical						
		12" D.I. Pipe (Buried)	16400	L.F.	$ 75.00	$ 1,230,000.00	$ 1,230,000.00
		Bore 20" Stl. Casing Pipe	1290	L.F.	$ 190.00	$ 245,100.00	$ 245,100.00
		CCTV Inspection	16400	L.F.	$ 1.50	$ 24,600.00	$ 24,600.00
		Force Main Testing	16400	L.F.	$ 0.60	$ 9,840.00	$ 9,840.00
							Subtotal Construction = $ 1,688,684.44

Duquesne WWTP Long Term Control Plan

Alternative 3 - Upgrade WWTP with Storage

Planning Cost Estimate

ITEM	COST	
General Site Work	$	126,000
Headworks	$	743,000
Property Acquisition and Remediation	$	1,097,000
Pump Station and Valve Vault	$	1,399,000
Storage Tank	$	2,175,000
Clarifier Upgrades	$	533,000
SUBTOTAL CONSTRUCTION COST	**$**	**6,073,000**
Electrical Costs (25%)	$	1,519,000
Mobilization/Demobilization/Bonds/Insurance (15%)	$	911,000
Contingency (30%)	$	1,822,000
TOTAL CONSTRUCTION COST	**$**	**10,325,000**
Engineering, Permitting, Legal (15%)	$	1,549,000
Construction Administration (10%)	$	1,033,000
TOTAL PROJECT COST	**$**	**12,907,000**

Site Work							
			Qty	Unit	Price per Unit	Materials	Total
Division 2	Site Work						
		E&S Controls	1	lot	$ 10,000.00	$ 10,000.00	$ 10,000.00
		By-Pass Pumping	1	lot	$ 50,000.00	$ 50,000.00	$ 50,000.00
		Site Paving	478	s.y.	$ 50.00	$ 23,888.89	$ 23,888.89
		Lawn Restoration	1	lot	$ 5,000.00	$ 5,000.00	$ 5,000.00
Division 3	Concrete						
		Repairs/Rehabilitation	1	lot	$ 10,000.00	$ 10,000.00	$ 10,000.00
		Manholes (0'-8' Deep)	3	ea	$2,500.00	$ 7,500.00	$ 7,500.00
		Manhole VF over 8' Deep	25	v.f.	$110.00	$ 2,750.00	$ 2,750.00
						$ -	
Division 15	Mechanical						
		24" D.I. Pipe - F.M.	50	L.F.	$ 125.00	$ 6,250.00	$ 6,250.00
		30" PVC Pipe (Buried) - Gravity	50	L.F.	$ 200.00	$ 10,000.00	$ 10,000.00
						Subtotal Construction = $	**125,388.89**

Headworks

			Qty	Unit	Price per Unit	Materials	Total
Division 2	Site Work						
		Excavation	416.7	c.y.	$ 50.00	$ 20,833.33	$ 20,833.33
		Backfill	104.2	c.y.	$ 50.00	$ 5,208.33	$ 5,208.33
		Stone Backfill	66.67	c.y.	$ 172.00	$ 11,466.67	$ 11,466.67
Division 3	Concrete						
		Foundation Slab	84.33	c.y.	$ 532.10	$ 44,873.77	$ 44,873.77
		First Floor Slab	56.22	c.y.	$ 1,123.40	$ 63,157.55	$ 63,157.55
		Walls	53.33	c.y.	$ 1,123.40	$ 59,914.67	$ 59,914.67
Division 4	Masonry						
		Block	1200	s.f.	$ 8.35	$ 10,020.00	$ 14,923.83
Division 5	Metals						
		Aluminum Grating	150	s.f.	$ 65.00	$ 9,750.00	$ 9,750.00
		Aluminum Handrail	200	L.F.	$ 70.00	$ 14,000.00	$ 14,000.00
		4'x4' Aluminum Hatchway	1	each	$ 3,500.00	$ 3,500.00	$ 5,212.91
		Stairs	60	riser	$ 185.00	$ 11,100.00	$ 16,532.39
Division 7	Thermal and Moisture						
		Masonry Insulation	1200	s.f.	$ 1.31	$ 1,572.00	$ 2,341.34
		Roofing	1	Lot	$ 25,000.00	$ 25,000.00	$ 37,235.10
		Alum Fascia	100	s.f.	$ 5.35	$ 535.00	$ 796.83
		Alum Soffit	404	s.f.	$ 7.65	$ 3,090.60	$ 4,603.15
		Alum Gutters	100	L.F.	$ 5.00	$ 500.00	$ 744.70
		Downspouts	48	L.F.	$ 4.84	$ 232.32	$ 346.02
Division 8	Doors and Windows						
		7'x3' Mandoor w/window	1	each	$ 1,000.00	$ 1,000.00	$ 1,489.40
		7'x6' Door	1	each	$ 2,500.00	$ 2,500.00	$ 3,723.51
		10'x14' Rolling Garage	1	each	$ 7,000.00	$ 7,000.00	$ 10,425.83
		3'x3' window	2	each	$ 500.00	$ 1,000.00	$ 1,489.40
		4'x4' skylight	2	each	$ 200.00	$ 400.00	$ 595.76
Division 9	Coatings						
		Paints	10000	s.f.	$ 2.00	$ 20,000.00	$ 29,788.08
Division 11	Equipment						
		Coarse Screen (Mechanical)	1	each	$ 234,000.00	$ 234,000.00	$ 304,200.00
		Coarse Screen (Manual)	1	each	$ 7,500.00	$ 7,500.00	$ 7,500.00
Division 15	Mechanical						
		Sluice Gates	4	each	$ 3,500.00	$ 14,000.00	$ 20,851.66
		HVAC	1	Lot	$ 50,000.00	$ 50,000.00	$ 50,000.00
						Subtotal Construction = $	742,004.25

Influent Pump Station and Valve Vault

			Qty	Unit	Price per Unit	Materials	Total
Division 2	Site Work						
		Excavation	513	c.y.	$ 50.00	$ 25,648.15	$ 25,648.15
		Backfill	128	c.y.	$ 50.00	$ 6,412.04	$ 6,412.04
		Stone Backfill	21	c.y.	$ 172.00	$ 3,612.00	$ 3,612.00
		Shoring/Dewatering	1	LOT	$ 50,000.00	$ 50,000.00	$ 50,000.00
Division 3	Concrete						
		Foundation Slab	62	c.y.	$ 532.10	$ 32,990.20	$ 32,990.20
		Elevated Slabs and Walls	191	c.y.	$1,123.40	$ 214,569.40	$ 214,569.40
Division 5	Metals						
		6'x6' Aluminum Hatchway	2	each	$ 5,000.00	$ 10,000.00	$ 10,000.00
Division 11	Equipment						
		Normal Flow Pumps	3	each	$ 50,000.00	$ 150,000.00	$ 150,000.00
		Storm Pumps	3	each	$ 100,000.00	$ 300,000.00	$ 300,000.00
		MCC	1	each	$ 300,000.00	$ 300,000.00	$ 300,000.00
		PLC and Controls	1	each	$ 100,000.00	$ 100,000.00	$ 100,000.00
		Bridge Crane	1	each	$ 25,000.00	$ 25,000.00	$ 25,000.00
		Grinder Unit	1	each	$ 100,000.00	$ 100,000.00	$ 100,000.00
Division 15	Mechanical						
		Wet Well and Valve Vault Piping	1	LOT	$ 80,000.00	$ 80,000.00	$ 80,000.00

Subtotal Construction = $ 1,398,231.79

Storage Tanks

			Qty	Unit	Price per Unit	Materials	Total
Division 2	Site Work						
		Excavation	2909	c.y.	$ 50.00	$ 145,444.10	$ 145,444.10
		Backfill	727	c.y.	$ 50.00	$ 36,361.03	$ 36,361.03
		Stone Backfill	908	c.y.	$ 172.00	$ 156,162.29	$ 156,162.29
Division 3	Concrete						
		Foundation Slab	605	c.y.	$ 532.10	$ 322,069.59	$ 322,069.59
Division 11	Equipment						
		Storage Tanks	1	LOT	$ 950,230.67	$ 950,230.67	$ 950,230.67
		Walkways	1	LOT	$ 200,000.00	$ 200,000.00	$ 200,000.00
		Storage Basin Dewatering Pumps	2	each	$ 30,000.00	$ 60,000.00	$ 60,000.00
Division 15	Mechanical						
		24" D.I. Pipe (Force Main)	2025	L.F.	$ 150.00	$ 303,750.00	$ 303,750.00
							$ 2,174,017.68

Clarifier Upgrades

			Qty	Unit	Price per Unit	Materials	Total
Division 11	Equipment						
		Demolition of Existing Equipment	2	each	$ 10,000.00	$ 20,000.00	$ 20,000.00
		Secondary Clarifier Mechanisms	2	each	$ 84,250.00	$ 168,500.00	$ 387,550.00
		FRP Weirs, Baffles, Launder Covers	2	each	$ 41,750.00	$ 83,500.00	$ 125,250.00

Subtotal Construction = $ 532,800.00

Appendix X

Financial Capability Assessment
Alternative 1

Schedule 6.
AFFORD
(FORM LTCP-EZ)

Schedule 6. CSO AFFORDABILITY

➢ Attach to FORM LTCP-EZ

Attachment Sequence # **06**

Community name shown on FORM LTCP-EZ	NPDES number	Date
City of Duquesne - Municipal Authority of the City of McKeesport *ALTERNATIVE 1*	*PA0026981*	8/25/14

Current Costs	1	Annual operations and maintenance expenses (excluding depreciation). *See instructions.*	1	$488,267
	2	Annual debt service (principal and interest). *See instructions.*	2	$534,660
	3	**Current Costs.** *Add lines 1 and 2.*	3	$1,022,927
Projected Costs (Current Dollars)	4	Projected annual operations and maintenance expenses (excluding depreciation). *See instructions.*	4	$50,000
	5	Present value adjustment factor. *See instructions.*	5	1.0000
	6	Present value of projected costs. *Multiply line 4 by line 5.*	6	$50,000
	7	Projected debt costs. *See instructions.*	7	$7,424,000
	8	Annualization factor. *See instructions.*	8	0.0620
	9	Annual debt service (principal and interest) for projected WWT facilities and CSO controls. *Multiply line 7 by line 8.*	9	$459,920
	10	**Projected Costs.** *Add lines 6 and 9.*	10	$509,920
Total Costs	11	**Total current and projected WWT and CSO costs.** *Add lines 3 and 10*	11	$1,532,846
Cost Per Household	12	Residential WWT flow (MGD). *See instructions*	12	2.500
	13	Total WWT flow (MGD). *See instructions*	13	2.500
	14	Fraction of total WWT flow attributable to residential users. *Divide line 12 by line 13.*	14	1.000
	15	Residential share of total costs. *Mulitply line 11 by line 14.*	15	$1,532,846
	16	Number of households in service area. *See instructions.*	16	1,919
	17	**Cost Per Household (CPH).** *Divide line 15 by line 16.*	17	**$799**
Median Household Income	18	Census Year MHI. *See instructions.*	18	$20,333
	19	MHI adjustment factor. *See instructions.*	19	1.0363
	20	**Adjusted MHI.** *Multiply line 18 by line 19.*	20	$21,072
Residential Indicator	21	Annual WWT/CSO control CPH as % adjusted MHI. *Divide line 17 by line 20, then multiply by 100.*	21	**3.79**
	22	**Residential Indicator.** *See instructions.*	22	High
Bond Rating	23 a	Date of most recent general obligation bond	23a	N/A
	b	Rating agency (Moody's or Standard and Poor's)	23b	N/A
	c	Rating (Moody's Aaa-C or Standard and Poor's AAA-D)	23c	N/A
	24 a	Date of most recent revenue (water or sewer) bond	24a	N/A
	b	Rating agency (Moody's or Standard and Poor's)	24b	N/A
	c	Bond insurance (Yes/No)	24c	N/A
	d	Rating (Moody's Aaa-C or Standard and Poor's AAA-D)	24d	N/A
	25	**Bond Rating Benchmark.** *See instructions.*	25	N/A
Overall Net Debt	26	Direct net debt (G.O. bonds excluding double-barreled bonds). *See instructions.*	26	$1,964,002
	27	Debt of overlapping entities (proportionate share of multijurisdictional debt). *See instructions.*	27	$0
	28	Overall net debt. *Add lines 26 and 27.*	28	$1,964,002
	29	Full market property value (MPV). *See instructions.*	29	$141,660,440
	30	Overall net debt as a percent of full MPV. *Divide line 28 by line 29, then multiply by 100.*	30	1.39
	31	**Net Debt Benchmark.** *See instructions*	31	Strong
Unemployment Rate	32	Unemployment rate for permittee service area. *See instructions.* *Source:* ***Census 2008-2012 American Community Survey***	32	21.7%
	33	Unemployment rate for permitee's county (use if permittee's rate is unavailable). *See instructions.* *Source:* ***Census 2008-2012 American Community Survey***	33	7.5%
	34	Average national unemployment rate. *See instructions.* *Source:* ***Census 2008-2012 American Community Survey***	34	6.7%
	35	**Unemployment Rate Benchmark.** *See instructions.*	35	Weak

Schedule 6.
AFFORD
(FORM LTCP-EZ)

Schedule 6. AFFORD - CSO Affordability

➢ Attach to FORM LTCP-EZ

Attachment Sequence #

Community name shown on FORM LTCP-EZ	NPDES number	Date
City of Duquesne - Municipal Authority of the City of McKeesport **ALTERNATIVE 1**	PA0026981	8/25/14

Median Household Income	36	Median household income - permittee. *Copy from line 20.* Source: **Census 2008-2012 American Community Survey**	36	$21,072
	37	Census Year national MHI. *See instructions.* Source: **Census 2008-2012 American Community Survey**	37	$53,046
	38	MHI adjustment factor. *Copy from line 19.*	38	1.0363
	39	Adjusted national MHI. *Multiply line 37 by line 38.*	39	$54,973
	40	**MHI Benchmark.** *See instructions.*	40	**Weak**
Financial Management Indicators	41	Full market value of real property. *Copy from line 29.*	41	$141,660,440
	42	Property tax revenues. *See instructions.*	42	$1,136,286
	43	Property tax revenues as a percent of full MPV. *Divide line 42 by line 41, then multiply by 100.*	43	0.80
	44	**Property Tax Benchmark.** *See instructions.*	44	**Strong**
Property Tax and Collection Rate	45	Property Taxes Levied. *See instructions.*	45	$1,455,050
	46	Property Tax Revenue Collection Rate. *Divide line 42 by line 45, then multiply by 100.*	46	78.09
	47	**Collection Rate Benchmark.** *See instructions.*	47	**Weak**

				Benchmark	Score
Matrix Score	48	Enter benchmark and corresponding score			
	a	Bond Rating. *From line 25.*	48a		
	b	Net Debt. *From line 31.*	48b	Strong	3
	c	Unemployment Rate. *From line 35.*	48c	Weak	1
	d	Median Household Income. *From line 40.*	48d	Weak	1
	e	Property Tax. *From line 44.*	48e	Strong	3
	f	Collection Rate. *From line 47.*	48f	Weak	1
	g	Sum. *Sum up scores.*	48g		9

49	Permittee indicators score. *Divide line 48g by number of scores.*	49	1.80
50	**Permittee Financial Capability Indicators Benchmark.** *See instructions.*	50	**Mid-Range**
51	Residential indicator benchmark. *Copy from line 22.*	51	High
52	**Financial Capability (High Burden, Medium Burden, or Low Burden).** *See instructions.*	52	**HIGH**

Appendix Y

Financial Capability Assessment
Alternative 2

Schedule 6.
AFFORD
(FORM LTCP-EZ)

Schedule 6. CSO AFFORDABILITY

➢ Attach to FORM LTCP-EZ

Attachment Sequence # **06**

Community name shown on FORM LTCP-EZ	NPDES number	Date
City of Duquesne - Municipal Authority of the City of McKeesport **ALTERNATIVE 2**	PA0026981	8/25/14

Current	1	Annual operations and maintenance expenses (excluding depreciation). *See instructions.*	1	$488,267
Costs	2	Annual debt service (principal and interest). *See instructions.*	2	$534,660
	3	**Current Costs.** *Add lines 1 and 2.*	3	$1,022,927
Projected	4	Projected annual operations and maintenance expenses (excluding depreciation). *See instructions.*	4	$0
Costs	5	Present value adjustment factor. *See instructions.*	5	1.0000
(Current	6	Present value of projected costs. *Multiply line 4 by line 5.*	6	$0
Dollars)	7	Projected debt costs. *See instructions.*	7	$15,511,000
	8	Annualization factor. *See instructions.*	8	0.0620
	9	Annual debt service (principal and interest) for projected WWT facilities and CSO controls. *Multiply line 7 by line 8.*	9	$960,913
	10	**Projected Costs.** *Add lines 6 and 9.*	10	$960,913
Total Costs	11	**Total current and projected WWT and CSO costs.** *Add lines 3 and 10*	11	$1,983,839
Cost Per	12	Residential WWT flow (MGD). *See instructions*	12	2.500
Household	13	Total WWT flow (MGD). *See instructions*	13	2.500
	14	Fraction of total WWT flow attributable to residential users. *Divide line 12 by line 13.*	14	1.000
	15	Residential share of total costs. *Mulitply line 11 by line 14.*	15	$1,983,839
	16	Number of households in service area. *See instructions.*	16	1,919
	17	**Cost Per Household (CPH).** *Divide line 15 by line 16.*	17	**$1,034**
Median	18	Census Year MHI. *See instructions.*	18	$20,333
Household	19	MHI adjustment factor. *See instructions.*	19	1.0363
Income	20	**Adjusted MHI.** *Multiply line 18 by line 19.*	20	$21,072
Residential	21	Annual WWT/CSO control CPH as % adjusted MHI. *Divide line 17 by line 20, then multiply by 100.*	21	**4.91**
Indicator	22	**Residential Indicator.** *See instructions.*	22	**High**
Bond Rating	23 a	Date of most recent general obligation bond	23a	N/A
	b	Rating agency (Moody's or Standard and Poor's)	23b	N/A
	c	Rating (Moody's Aaa-C or Standard and Poor's AAA-D)	23c	N/A
	24 a	Date of most recent revenue (water or sewer) bond	24a	N/A
	b	Rating agency (Moody's or Standard and Poor's)	24b	N/A
	c	Bond insurance (Yes/No)	24c	N/A
	d	Rating (Moody's Aaa-C or Standard and Poor's AAA-D)	24d	N/A
	25	**Bond Rating Benchmark.** *See instructions.*	25	**N/A**
Overall Net	26	Direct net debt (G.O. bonds excluding double-barreled bonds). *See instructions.*	26	$1,964,002
Debt	27	Debt of overlapping entities (proportionate share of multijurisdictional debt). *See instructions.*	27	$0
	28	Overall net debt. *Add lines 26 and 27.*	28	$1,964,002
	29	Full market property value (MPV). *See instructions.*	29	$141,660,440
	30	Overall net debt as a percent of full MPV. *Divide line 28 by line 29, then multiply by 100.*	30	1.39
	31	**Net Debt Benchmark.** *See instructions*	31	**Strong**
Unemploy-ment Rate	32	Unemployment rate for permittee service area. *See instructions.* *Source:* ***Census 2008-2012 American Community Survey***	32	21.7%
	33	Unemployment rate for permitee's county (use if permittee's rate is unavailable). *See instructions.* *Source:* ***Census 2008-2012 American Community Survey***	33	7.5%
	34	Average national unemployment rate. *See instructions.* *Source:* ***Census 2008-2012 American Community Survey***	34	6.7%
	35	**Unemployment Rate Benchmark.** *See instructions.*	35	**Weak**

Schedule 6.
AFFORD
(FORM LTCP-EZ)

Schedule 6. AFFORD - CSO Affordability

➢ Attach to FORM LTCP-EZ

Attachment Sequence #

Community name shown on FORM LTCP-EZ	NPDES number	Date
City of Duquesne - Municipal Authority of the City of McKeesport *ALTERNATIVE 2*	*PA0026981*	8/25/14

Median Household Income	36	Median household income - permittee. *Copy from line 20.* *Source:* ***Census 2008-2012 American Community Survey***	36	$21,072
	37	Census Year national MHI. *See instructions.* *Source:* ***Census 2008-2012 American Community Survey***	37	$53,046
	38	MHI adjustment factor. *Copy from line 19.*	38	1.0363
	39	Adjusted national MHI. *Multiply line 37 by line 38.*	39	$54,973
	40	**MHI Benchmark.** *See instructions.*	40	**Weak**
Financial Management Indicators	41	Full market value of real property. *Copy from line 29.*	41	$141,660,440
	42	Property tax revenues. *See instructions.*	42	$1,136,286
	43	Property tax revenues as a percent of full MPV. *Divide line 42 by line 41, then multiply by 100.*	43	0.80
	44	**Property Tax Benchmark.** *See instructions.*	44	**Strong**
Property Tax and Collection Rate	45	Property Taxes Levied. *See instructions.*	45	$1,455,050
	46	Property Tax Revenue Collection Rate. *Divide line 42 by line 45, then multiply by 100.*	46	78.09
	47	**Collection Rate Benchmark.** *See instructions.*	47	**Weak**

Matrix Score				**Benchmark**	**Score**
	48	Enter benchmark and corresponding score			
	a	Bond Rating. *From line 25.*	48a		
	b	Net Debt. *From line 31.*	48b	Strong	3
	c	Unemployment Rate. *From line 35.*	48c	Weak	1
	d	Median Household Income. *From line 40.*	48d	Weak	1
	e	Property Tax. *From line 44.*	48e	Strong	3
	f	Collection Rate. *From line 47.*	48f	Weak	1
	g	Sum. *Sum up scores.*	48g		9

49	Permittee indicators score. *Divide line 48g by number of scores.*	49	1.80
50	**Permittee Financial Capability Indicators Benchmark.** *See instructions.*	50	**Mid-Range**
51	Residential indicator benchmark. *Copy from line 22.*	51	High
52	**Financial Capability (High Burden, Medium Burden, or Low Burden).** *See instructions.*	52	**HIGH**

APPENDIX Z

FINANCIAL CAPABILITY ASSESSMENT
ALTERNATIVE 3

Schedule 6.
AFFORD
(FORM LTCP-EZ)

Schedule 6. CSO AFFORDABILITY

➢ Attach to FORM LTCP-EZ

Attachment Sequence # **06**

Community name shown on FORM LTCP-EZ	NPDES number	Date
City of Duquesne - Municipal Authority of the City of McKeesport ***ALTERNATIVE 3***	*PA0026981*	8/25/14

Current Costs	1	Annual operations and maintenance expenses (excluding depreciation). *See instructions.*	1	$488,267
	2	Annual debt service (principal and interest). *See instructions.*	2	$534,660
	3	**Current Costs.** *Add lines 1 and 2.*	3	$1,022,927
Projected Costs (Current Dollars)	4	Projected annual operations and maintenance expenses (excluding depreciation). *See instruction*	4	$50,000
	5	Present value adjustment factor. *See instructions.*	5	1.0000
	6	Present value of projected costs. *Multiply line 4 by line 5.*	6	$50,000
	7	Projected debt costs. *See instructions.*	7	$12,907,000
	8	Annualization factor. *See instructions.*	8	0.0620
	9	Annual debt service (principal and interest) for projected WWT facilities and CSO controls. *Multiply line 7 by line 8.*	9	$799,594
	10	**Projected Costs.** *Add lines 6 and 9.*	10	$849,594
Total Costs	11	**Total current and projected WWT and CSO costs.** *Add lines 3 and 10*	11	$1,872,520
Cost Per Household	12	Residential WWT flow (MGD). *See instructions*	12	2.500
	13	Total WWT flow (MGD). *See instructions*	13	2.500
	14	Fraction of total WWT flow attributable to residential users. *Divide line 12 by line 13.*	14	1.000
	15	Residential share of total costs. *Mulitply line 11 by line 14.*	15	$1,872,520
	16	Number of households in service area. *See instructions.*	16	1,919
	17	**Cost Per Household (CPH).** *Divide line 15 by line 16.*	17	**$976**
Median Household Income	18	Census Year MHI. *See instructions.*	18	$20,333
	19	MHI adjustment factor. *See instructions.*	19	1.0363
	20	**Adjusted MHI.** *Multiply line 18 by line 19.*	20	$21,072
Residential Indicator	21	Annual WWT/CSO control CPH as % adjusted MHI. *Divide line 17 by line 20, then multiply by 100*	21	**4.63**
	22	**Residential Indicator.** *See instructions.*	22	High
Bond Rating	23 a	Date of most recent general obligation bond	23a	N/A
	b	Rating agency (Moody's or Standard and Poor's)	23b	N/A
	c	Rating (Moody's Aaa-C or Standard and Poor's AAA-D)	23c	N/A
	24 a	Date of most recent revenue (water or sewer) bond	24a	N/A
	b	Rating agency (Moody's or Standard and Poor's)	24b	N/A
	c	Bond insurance (Yes/No)	24c	N/A
	d	Rating (Moody's Aaa-C or Standard and Poor's AAA-D)	24d	N/A
	25	**Bond Rating Benchmark.** *See instructions.*	25	N/A
Overall Net Debt	26	Direct net debt (G.O. bonds excluding double-barreled bonds). *See instructions.*	26	$1,964,002
	27	Debt of overlapping entities (proportionate share of multijurisdictional debt). *See instructions.*	27	$0
	28	Overall net debt. *Add lines 26 and 27.*	28	$1,964,002
	29	Full market property value (MPV). *See instructions.*	29	$141,660,440
	30	Overall net debt as a percent of full MPV. *Divide line 28 by line 29, then multiply by 100.*	30	1.39
	31	**Net Debt Benchmark.** *See instructions*	31	Strong
Unemployment Rate	32	Unemployment rate for permittee service area. *See instructions.* *Source:* ***Census 2008-2012 American Community Survey***	32	21.7%
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	34	Average national unemployment rate. *See instructions.* *Source:* ***Census 2008-2012 American Community Survey***	34	6.7%
	35	**Unemployment Rate Benchmark.** *See instructions.*	35	Weak

Schedule 6.
AFFORD
(FORM LTCP-EZ)

Schedule 6. AFFORD - CSO Affordability

➢ Attach to FORM LTCP-EZ

Attachment Sequence #

Community name shown on FORM LTCP-EZ	NPDES number	Date
City of Duquesne - Municipal Authority of the City of McKeesport ***ALTERNATIVE 3***	*PA0026981*	8/25/14

Median Household Income	36	Median household income - permittee. *Copy from line 20.* *Source:* ***Census 2008-2012 American Community Survey***	36	$21,072
	37	Census Year national MHI. *See instructions.* *Source:* ***Census 2008-2012 American Community Survey***	37	$53,046
	38	MHI adjustment factor. *Copy from line 19.*	38	1.0363
	39	Adjusted national MHI. *Multiply line 37 by line 38.*	39	$54,973
	40	**MHI Benchmark.** *See instructions.*	40	**Weak**
Financial Management Indicators	41	Full market value of real property. *Copy from line 29.*	41	$141,660,440
	42	Property tax revenues. *See instructions.*	42	$1,136,286
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	44	**Property Tax Benchmark.** *See instructions.*	44	**Strong**
Property Tax and Collection Rate	45	Property Taxes Levied. *See instructions.*	45	$1,455,050
	46	Property Tax Revenue Collection Rate. *Divide line 42 by line 45, then multiply by 100.*	46	78.09
	47	**Collection Rate Benchmark.** *See instructions.*	47	**Weak**

				Benchmark	**Score**
Matrix Score	48	Enter benchmark and corresponding score			
	a	Bond Rating. *From line 25.*	48a		
	b	Net Debt. *From line 31.*	48b	Strong	3
	c	Unemployment Rate. *From line 35.*	48c	Weak	1
	d	Median Household Income. *From line 40.*	48d	Weak	1
	e	Property Tax. *From line 44.*	48e	Strong	3
	f	Collection Rate. *From line 47.*	48f	Weak	1
	g	Sum. *Sum up scores.*	48g		9

	49	Permittee indicators score. *Divide line 48g by number of scores.*	49	1.80
	50	**Permittee Financial Capability Indicators Benchmark.** *See instructions.*	50	**Mid-Range**
	51	Residential indicator benchmark. *Copy from line 22.*	51	High
	52	**Financial Capability (High Burden, Medium Burden, or Low Burden)**. *See instructions.*	52	**HIGH**

PAWC RESPONSE TO TUS-17 [Attachment 3]

MUNICIPAL AUTHORITY OF THE CITY OF MCKEESPORT
BOROUGH OF DRAVOSBURG

Combined Sewer System
Long Term Control Plan
August 2014

KLH
ENGINEERS, INC
5173 CAMPBELLS RUN ROAD
PITTSBURGH, PA 15205-9733

MUNICIPAL AUTHORITY OF THE CITY OF MCKEESPORT

BOROUGH OF DRAVOSBURG

COMBINED SEWER SYSTEM LONG TERM CONTROL PLAN

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ABBREVIATIONS

AAF	Annual Average Flow
BNR	Biological Nutrient Removal
BOD	Biological Oxygen Demand
CSO	Combined Sewer Overflow
CSS	Combined Sewer System
DEP	Pennsylvania Department of Environmental Protection
EDU	Equivalent Dwelling Unit
EPA	United States Environmental Protection Agency
FEMA	Federal Emergency Management Agency
GPD	Gallons Per Day
GPM	Gallons Per Minute
LF	Linear Feet
LTCP	Long-Term Control Plan
lb/day	Pounds Per Day
mg/L	Milligrams Per Liter
MGD	Million Gallons Per Day
/100ml	Colony Forming Units Per 100 Milliliter
MMF	Maximum Monthly Average Flow
NH_3-N	Ammonia Nitrogen
NO_2	Nitrite
NO_3	Nitrate
NPDES	National Polluant Discharge Elimination System
PDF	Peak Daily Flow
PIF	Peak Instantaneous Flow
PHF	Peak Hourly Flow
PLC	Programmable Logic Controller
POTW	Publicly Owned Treatment Works
SBR	Sequencing Batch Reactor
SCS	United States Natural Resources Conservation Service
SOR	Surface Overflow Rate
SWMM	Storm Water Management Model
TF	Trickling Filter
TKN	Total Kjeldahl Nitrogen
TMDL	Total Maximum Daily Load
TN	Total Nitrogen
TP	Total Phosphorus
TSS	Total Suspended Solids
UV	Ultraviolet
VFD	Variable Frequency Drive
WWTP	Wastewater Treatment Plant

1.0 EXECUTIVE SUMMARY

The Long-Term Control Plan (LTCP) was completed in order to address wastewater treatment plant (WWTP) and combined sewer system (CSS) upgrades necessary to meet Federal and State regulatory requirements. The goal of the LTCP is to decrease volume of combined sewage overflows on an annual basis and subsequently, increase the volume that receives treatment at the WWTP.

The focus of this LTCP update is to:

1. Develop WWTP design loadings required in order to address combined sewer overflow (CSO) regulatory requirements.

2. Evaluate the capacity of the existing Borough of Dravosburg WWTP processes relative to design loadings.

3. Complete evaluation of feasible alternatives developed to address WWTP process deficiencies relative to design loadings.

It was determined that no CSS upgrades are required to convey the 10-year, 24-hour design storm flow while maintaining greater than 85% capture of all combined flow during a typical year, given a free discharge at the WWTP pump station. Detailed evaluation was completed for two (2) alternatives.

- Alternative 1 – Modify existing WWTP to Sequencing Batch Reactor (SBR).

- Alternative 2 – Pump Station to MACM WWTP + existing tanks as flow storage.

Detailed evaluation of the proposed alternatives led to the recommendation of Alternative 2 for Borough's LTCP upgrades. The total estimated project cost is $5,503,000. This alternative is recommended for the following reasons:

- Alternative 1 project cost is $3,371,000 more than the recommended Alternative 2.

- Alternative 2 eliminates operation and maintenance requirements of a WWTP.

The following LTCP schedule is proposed.

Milestone	Date
Submit draft LTCP	September 1, 2014
Submit final LTCP with MACM ACT 537	November 1, 2015
DEP approval of LTCP and ACT 537	January 1, 2016
Obtain funding for design related services	January 1, 2017
Begin design of upgrades	January 1, 2017
Apply for MACM WWTP re-rate	July 1, 2017
Apply for Part II Permit for pump station	July 1, 2018
Receive Part II Permit for pump station	January 1, 2019
Obtain funding for construction	January 1, 2021
Begin construction for CSS upgrades	March 1, 2021
Complete construction	March 1, 2023
Submit post construction compliance monitoring plan	September 1, 2023

*DEP LTCP approval and Part II Permit dates are beyond the control of the Borough and KLH, therefore schedule dates will be adjusted based on actual DEP milestone completion dates.

2.0 INTRODUCTION

2.1 BACKGROUND

The Borough of Dravosburg is located in Allegheny County, Pennsylvania; it is situated along the Monongahela River. The population was 1,792 at the 2010 Census. For all intents and purposes, 100% of the Borough is provided sewer service and the service area does not go beyond the corporate limits. The Borough's combined sewer system (CSS) presently serves 609 customers. Utilizing the U.S. Census data for 2010, which indicates an average of 2.01 persons per household, it is estimated that the WWTP serves approximately 1,224 persons. The WWTP is located in the eastern area of Dravosburg and discharges directly into the Monongahela River. The plant is owned by the Municipal Authority of the City of McKeesport and operated under NPDES Permit No. PA0028401.

The Borough has selected to utilize the EPA CSO Control Policy "presumption" approach criteria ii through their Long Term Control Plan (LTCP) process. The criteria are as follows:

> *"The elimination or capture for treatment of no less than 85% by volume of combined sewage collected in the CSS during precipitation events on a system-wide annual average basis."*

In order to assess the overflow volumes relative to total CSS conveyance on an annual average basis, the Borough completed a system characterization survey, a comprehensive flow monitoring study (from January 1, 2013 through July 1, 2013), and computer modeling, utilizing SWMM, of CSS hydraulic and hydrologic characteristics. The results of the flow monitoring and modeling study are described through this report.

This report will summarize sewer system upgrades/modifications required in order to allow for the "presumption" approach criteria to be met.

The monitoring and modeling established peak flow instantaneous flow as 3.812 MGD, based on 10-year, 24-hour rain event with no manhole overflows. This peak flow value is far in excess of the existing WWTP's peak capacity, but the system was capable of conveying the flow to the WWTP. Therefore, no sewer system upgrades or modifications will be necessary to meet the EPA CSO Control Policy.

The focus of this Long-Term Control Plan is to:

1. Develop WWTP design loadings required in order to address combined sewer overflow (CSO) regulatory requirements.
2. Evaluate the capacity of the existing Borough of Dravosburg WWTP processes relative to design loadings.

3. Complete evaluation of feasible alternatives developed to address WWTP process deficiencies relative to design loadings.

2.2 DOCUMENT INTENTION

This document is intended for planning purposes only. Evaluation of specific processes is limited to confirming feasibility and estimating planning level project costs. Once this LTCP update report is approved, the basis of design study can commence. This study will focus on the process modeling, detailed equipment evaluation, and development of process control logic for the recommended alternative. The Basis of Design Report will serve as the basis for all design phase work.

3.0 SYSTEM CHARACTERIZATION

3.1 SERVICE AREA

The Borough of Dravosburg presently serves 609 customers. The system includes 8.5 miles of interceptor and collector sewers, two (2) pump stations, and one (1) diversion chamber, and two (2) CSO outfalls. The only un-sewered service areas are in the northern section of Pittsburgh-McKeesport Boulevard from Sixth Street to Bettis Road, Luscombe Lane, and the homes around Sandy Lake. The Borough's collection system is split into the following sewersheds:

Dravosburg Sewersheds

Table 3.1

Sewershed	Flow Type	Location from WWTP
Dravosburg	Combined	North
Bettis Road	Sanitary	North-Eastern
Richland Ave	Sanitary	North-Western
Scott Drive	Sanitary	Western
Clay Street	Sanitary	Eastern

3.2 DIVERSION CHAMBERS

The CSS includes two (2) CSO outfalls. The CSO identification numbers and locations are listed in Table 3.2 below. The locations of these CSO's are shown on the drawing set included in Appendix A.

Dravosburg CSO's

Table 3.2

CSO ID No.	Location	Comments
001	WWTP	WWTP Outfall
002	Along SR 837 at WWTP	Diversion Chamber to WWTP Outfall

3.3 PUMP STATIONS

The Dravosburg sewage collection system and WWTP has two (2) pump stations. The first is the Bettis Road Pump Station which collects sanitary only flow from the north-central portion of the Borough. The pump station houses two (2) identical pumps rated for 0.252 MGD (175 GPM) at 75-feet total dynamic head (TDH).

There is a second pump station located at the headworks of the plant. The influent station pumps flow from the wet well to the grit chamber influent channel. The pump station has three (3) dry-pit submersible pumps. Two (2) of the pumps are identical, rated at 0.576 MGD (400 GPM) at 31-feet TDH. The third pump is rated for 0.72 MGD (500 GPM) at 33-feet TDH.

During wet weather flow, the two (2) smaller pumps produce the same flow rate as the single larger pump. The WWTP is rated for an average flow rate of 0.48 MGD, and wet weather flow equal to 1.5 times average, or 0.72 MGD.

3.3.1 Interceptor Sewer

The Dravosburg conveyance system consists of the following.

Dravosburg Conveyance System

Table 3.3

Pipe Diameter [inches]	Length [feet]
8	24,577
10	7,957
12	7,396
15	320
18	2,376
20	360
24	1,440
60	428
72	2,227
Brick Eggshape	613
6-inch Forcemain	1,100
Total [feet]	**48,794**
Total [miles]	**9.24**

A copy of the Dravosburg field survey data is included in Appendix B.

3.4 CSS UPGRADES REQUIRED

Flow monitoring and SWMM modeling was completed for the Borough's CSS. It was determined that no upgrades are required within the system to allow for conveyance of the peak core flow, 85% capture, and no manhole overflows given 10-year, 24-hour rain event and a free discharge at the WWTP pump station.

4.0 FLOW MONITORING STUDY

4.1 SITE SELECTION

Flow monitoring site locations were selected based on their importance in the collection system. Meters were installed and maintained by Drnach Environmental, Inc. (DE). Monitoring sites were selected to ensure all areas of the system were accounted for. In total, five (5) meters were required to account for all flow. These areas are as follows:

- Scott Drive Area (West)
- Clay Street Area(East)
- Bettis Road Area (North East)
- Richland Avenue Area (North West)
- Total North Area

The total north area meter accounted for the Bettis Road area, Richland Avenue area, and the remaining portion in the center of Dravosburg. By subtracting the Bettis and Richland flows from the total meter, the inflow from the center portion of Dravosburg was determined. DE site inspection forms are included in Appendix C. Table 4.1 shows the flow monitoring sites and monitoring period.

Dravosburg Flow Monitoring Sites

Table 4.1

Sites	Location	Monitoring Period	Comments
M-3	Front of WWTP	January 1 – June 1, 2013	Total North Area
M-4A	Behind 181 Duquesne Ave	January 1 – June 1, 2013	Bettis Road Area
M-5	110 Maple Ave	January 1 – June 1, 2013	Richland Avenue Area
M-6A	Washington Ave SW of WWTP	January 1 – June 1, 2013	Scott Drive Area
M-7A	Gravel road adjacent WWTP	January 1 – June 1, 2013	Clay Street Area

A map illustrating the metered areas of Dravosburg is included in Appendix A.

4.2 EQUIPMENT DESCRIPTION

The meters installed, by DE, for the flow monitoring study were area-velocity (A-V) meters. The A-V meters are capable of measuring head and flow velocity over the full range of sewer flow, from free-flow to surcharged as well as reverse flow.

Rain gauges utilized were tipping-bucket type.

4.3 FIELD QUALITY CONTROL

The A-V meters were installed, maintained, and downloaded by DE. Each site was visited on a weekly basis in order to ensure that the equipment was functioning properly. This approach allowed for issues to be corrected without significant loss of data and time.

4.4 OFFICE QUALITY ASSURANCE

Flow data provided to Dravosburg was reviewed by KLH Engineers, Inc. (KLH) in order to ensure that the data was reliable. Reliability of flow data was evaluated in terms of precision and accuracy.

Precision, repeatability of measurements, is best evaluated through use of scattergraphs. KLH reviewed scattergraphs provided by DE in order to confirm that the data being provided had a reasonable level of precision. Drnach scattergraphs and hydrographs for the meter sites are included in Appendix D.

Accuracy, how well meter values compare to actual values, was also evaluated. This evaluation is more difficult given that the actual flow or velocities at any given time are difficult to know for certain. However, accuracy was evaluated from a magnitude standpoint. Comparisons of total daily flows from the meter sites to the WWTP were made as well as individual site evaluations with respect to hydraulic evaluation tools such as Manning's Equation.

The data from all sites was determined by KLH to have reasonable levels of precision and accuracy and therefore the data was considered to be reliable for the purposes of this study.

4.5 RAIN EVENT SUMMARY

The major rainfall monitoring began on January 1, 2013 and ended on June 1, 2013. During this time period three (3) significant rain events occurred. These events are listed in Table 4.2 below. A significant rain event was defined as an event where rainfall depth was greater than or equal to one inch.

Significant Rain Events

Table 4.2

Event No.	Start Date	End Date	Duration [hrs]	Depth [in]
1	1/30/2013	1/31/2013	22.25	1.08
2	2/26/2013	2/27/2013	24.75	1.01
3	4/16/2013	4/17/2013	8.75	1.13

During this time period, the total rainfall depth was 13.08 inches. Annual average rainfall for the National Oceanic and Atmospheric Administration (NOAA) McKeesport, PA site (nearest rain gage site to Dravosburg) is 37.05 inches. The rainfall recorded during the monitoring period is a slightly less than the annual average rain event.

$$(13.08 \text{ inches}) \times (12 \text{ months/year}) \div (5 \text{ months}) = 31.39 \text{ inches/year}$$

5.0 COMBINED SEWER SYSTEM MODELING

5.1 METHODOLOGY

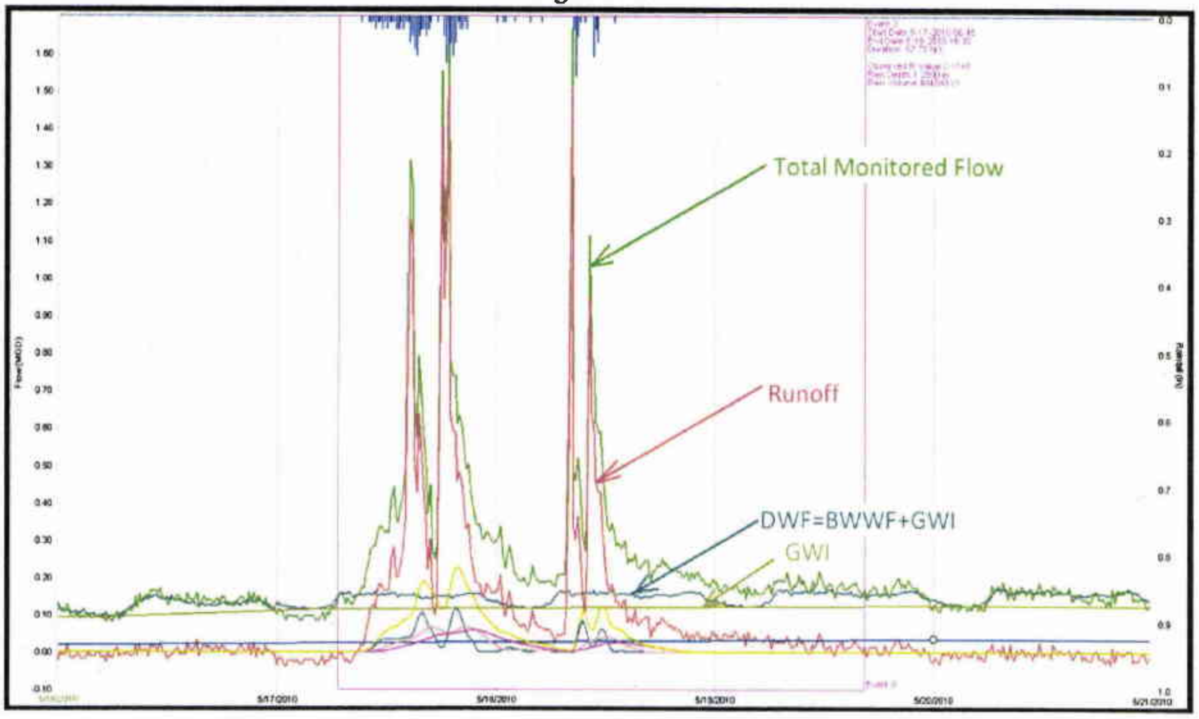
The Dravosburg CSS was modeled utilizing Innovyze InfoSWMM (SWMM). SWMM is a dynamic rainfall-runoff simulation model used for single event or long-term (continuous) simulation of runoff quantity and quality from primarily urban areas. The runoff component of SWMM operates on a collection of sub-catchment areas that receive precipitation and generate runoff and pollutant loads. The routing portion of SWMM transports this runoff through a system of pipes, channels, storage/treatment devices, pumps, and regulators.

5.1.1 Model Hydrology

There are three (3) major components of the total sewer flow in combined sewer system. Dry weather flow (DWF) includes two components (groundwater infiltration and base wastewater flow). The third component is runoff. Groundwater infiltration (GWI) represents groundwater that enters the collection system through defective pipes, pipe joints, and leaking manhole walls during dry weather. Base wastewater flow (BWWF) is the residential, industrial and commercial flow discharged to the sewer system for collection and treatment. GWI and BWWF together comprise the base flow, or dry weather portion of sewer flow. Runoff represents the wet-weather contribution that enters a combined sewer system during and after a rainfall event.

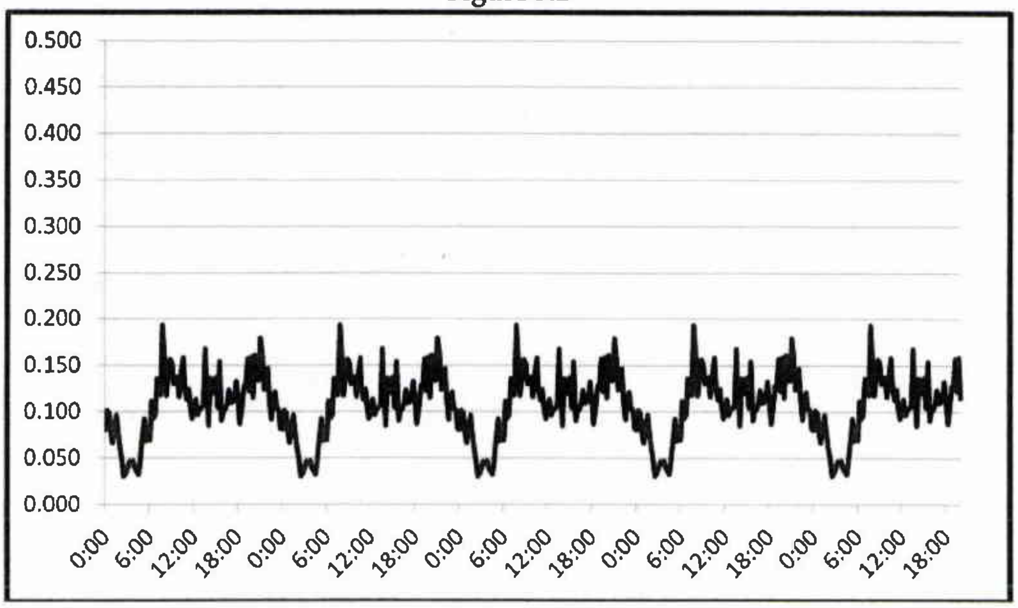
Accurate dry weather flow plays an important role in hydrologic and hydraulic (H&H) modeling. Dry weather flow loadings were determined through analysis of flow monitoring data during dry weather days from each flow monitoring location as well as the total system flow monitored at the WWTP. Hydrograph decomposition is the process of analyzing a total monitored sewer flow hydrograph and estimating the three components of wastewater flow (Runoff, BWWF and GWI). Hydrograph decomposition was performed using EPA Sanitary Sewer Overflow Analysis and Planning (SSOAP) Toolbox. Although SSOAP Toolbox is mainly used in sanitary sewer overflow analysis, its capability of hydrograph decomposition can also be utilized in combined sewer overflow analysis. Figure 5.1 illustrates the hydrograph decomposition of monitored wastewater flow. The average base flow (BWWF and GWI) time series is projected through the monitored wet weather hydrograph. The area between the wet-weather hydrograph and the average base flow time series represents the Runoff volume.

Hydrograph Decomposition of Total Monitored Flow
Figure 5.1



Generally, the dry weather flow varies with time in a day, with two peaks at about 7:00AM and 7:00PM, two bottoms at about 3:00AM and 3:00PM. The dry weather flows were loaded in corresponding upstream manholes. Figure 5.2 shows the typical dry weather flow pattern.

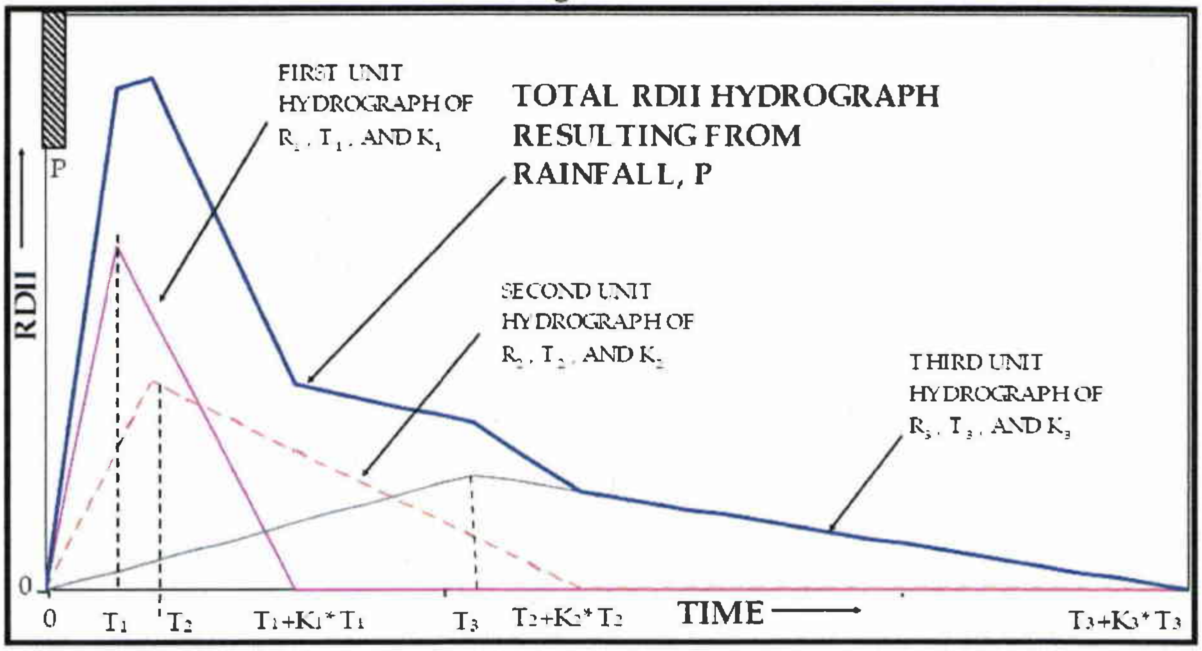
Typical Dry Weather Flow Pattern
Figure 5.2



Wet weather flows were simulated using InfoSWMM by utilizing the RTK unit hydrograph method. Figure 5.3 illustrates how SWMM generates three unit hydrographs based on the RTK parameters for a given unit rainfall input. It also demonstrates that the total RDII unit hydrograph is the summation of three individual unit hydrographs. The three unit hydrographs can be related with fast (first unit hydrograph), medium (second unit hydrograph), and slow (third unit hydrograph) RDII responses typically observed in the sanitary sewer system. In some cases, only one or two unit hydrographs are required to adequately define observed RDII hydrographs.

Summation of Three Unit Hydrographs

Figure 5.3



The following general guidelines should be followed in selecting the RTK parameters to ensure that the calculated RDII hydrograph meets the goal of visual curve fittings:

- Total R value = $R_1 + R_2 + R_3$, if all three unit hydrographs used.
- The T and K parameters should be similar for rainfall events for a given sewershed tributary to the flow monitor since they depend on the geometry and sewer system layout.
- In all cases, $T_1 < T_2 < T_3$.
- In most cases, $K_1 < K_2 < K_3$.
- The necessity to change T and K significantly for a particular event to match the observed flows is often a sign that the rainfall data being used is not representative of the rainfall that fell over the basin for the event or the system experienced operational challenges resulting in an altered shape of the hydrograph.

- The event specific R-values will vary, generally being higher for wet antecedent moisture conditions and lower for dryer antecedent conditions. Similarly, R-values will typically be higher in a wet season.
- T and K for the three triangular unit hydrograph should generally be within the ranges shown in Table 5.1.

Ranges of Values for Unit Hydrograph Parameters
Table 5.1

Curve	T (Hours)	K
1	0.5 – 2	1 – 2
2	3 – 5	2 – 3
3	5 – 10	3 – 7

5.1.2 Model Hydraulics

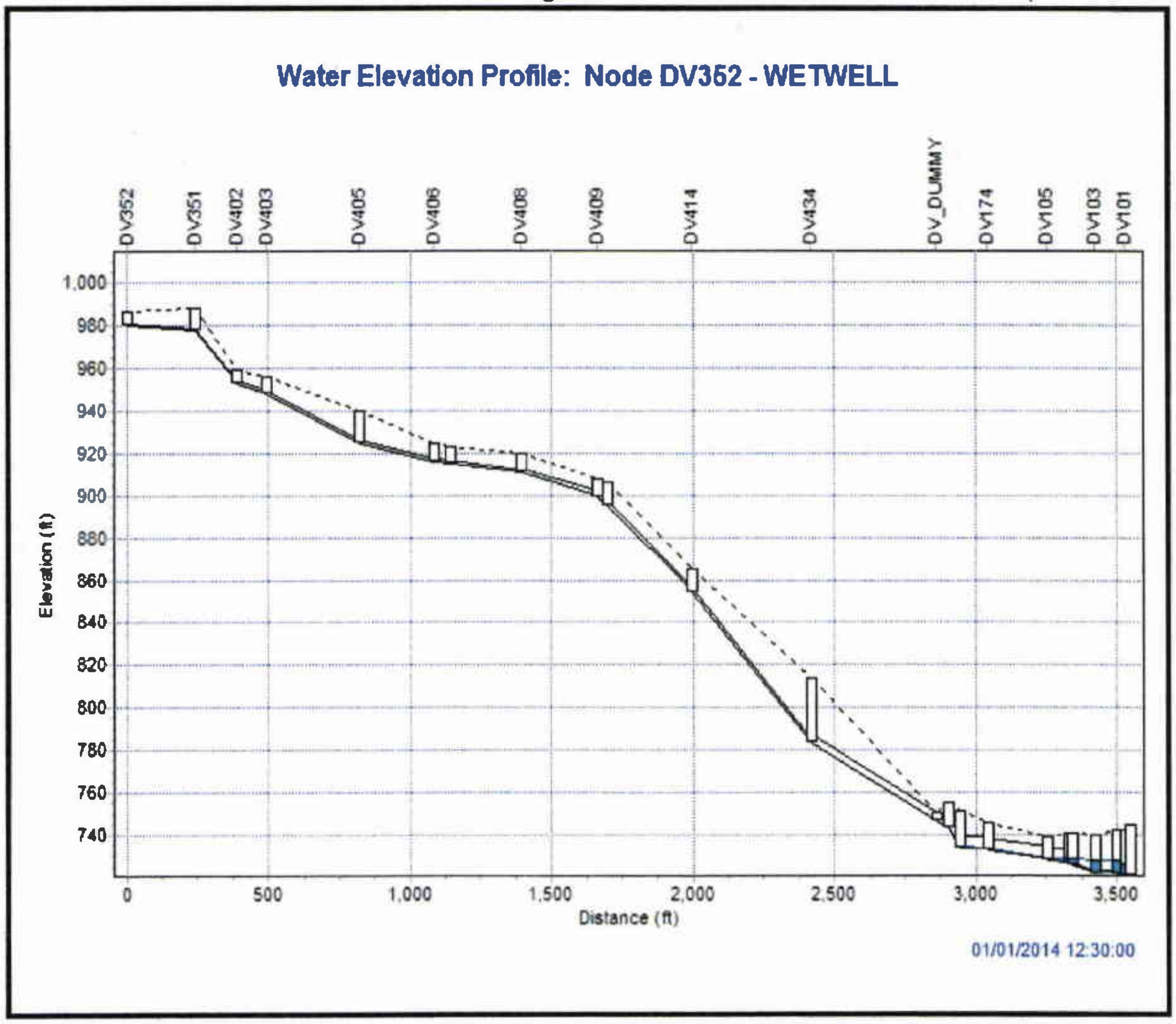
Flows in the collection system, which include dry-weather flows and the wet-weather flows, are routed through the hydraulic configuration of the model. The hydraulic configuration of a model is the representation of the various hydraulic elements of the system, which can broadly be classified as nodes and links. Nodes in the model are the manholes, diversion chambers, wet well, and outfalls, while the links are the conduits, orifices, diversion weirs, and pumps connecting the nodes.

The purpose of a diversion chamber is to intercept and convey all of the dry-weather flow, and a regulated fraction of wet-weather flow, to the wastewater treatment plant. The diverted dry- and wet-weather flow is conveyed by a connector pipe to the interceptor, while wet-weather flows in excess of the design capacity of the regulator are diverted through a diversion weir or overflow pipe to a receiving stream. Wet wells are drainage system nodes that provide storage volume. Physically they could represent storage facilities as small as a catch-basin or as large as a lake. The volumetric properties of a storage unit are described by a function or table of surface area versus height. Outfalls are terminal nodes of the drainage system used to define final downstream boundaries under Dynamic Wave flow routing or discharge overflow to the receiving stream.

An orifice diversion structure is a modification of the dam structure consisting of a fixed plate or gate. At the entrance to the connector pipe, the gate or plate is designed to place additional hydraulic restrictions beyond that of the connector pipe on flow diverted to the interceptor. Usually the incoming municipal pipe and the overflow pipe are the same size while the connector pipe to the interceptor is smaller. As higher flows increase the hydraulic grade line (HGL) or water level in the structure, wet-weather overflow in excess of the engineered conveyance capacity of the regulator device and connector pipe is diverted through an outfall pipe to a receiving stream. Pumps are links used to lift water to higher elevations. A pump curve describes the relation between a pump's flow rate and conditions at its inlet and outlet nodes.

The Dravosburg interceptor system consists of north, west, and east sections with the treatment plant in the south. Example profiles of the interceptor are shown in Figure 5.4.

Interceptor Profile Between Manhole DV352 and Outfall WWTP-OF
Figure 5.4



Hydraulic routing of dry and wet weather flows was accomplished utilizing dynamic wave. Dynamic wave is the full solution of the Saint-Venant Equations, which describe one-dimensional unsteady flow through conservation of mass and momentum. The dynamic wave method is capable of estimating hydraulic parameters for free-flow, open channel with backwater effects, surcharged, full pipe, and reverse flow conditions. Although analysis utilizing this method is complex and time consuming, it is well suited to CSS which are subject to a variety of hydraulic conditions.

5.2 MODEL DEVELOPMENT

The major characteristics of interceptors in the model, which include conduit length, size, manhole invert, manhole depth, were developed using KLH survey data. Unlike sub-catchment hydrological parameters, the major characteristics of interceptors were deemed fixed and were not adjusted during model validation process, unless reliable investigation showed that there was an update for the manhole or conduit.

Additionally, field data collected by DE were used. Data collected by DE are manhole inspection with site photographs, precipitation data, and flow monitoring data.

Totally, the model contains 5 sub-catchments, 29 manhole structures, 30 conduits, one (1) outfall structure, one (1) orifice, three (3) storage structure. Appendix E shows a system map of the Dravosburg model. Appendix F shows the model components details in text format.

5.3 VALIDATION

Model validation is the process of adjusting both hydrologic (flow development) and hydraulic (flow routing) variables to best match actual measured flow data. The result is a hydrologic and hydraulic model of an existing collection system that best represents dry weather conditions and the flow responses to wet weather conditions and hydraulic grade lines (HGL) within the sewer system. A properly validated hydrologic and hydraulic model provides a valuable tool for many types of analyses including simple capacity analyses and CSO alternatives evaluation.

The Dravosburg model will be used as a predictive tool to characterize the sewage collection system under existing and future conditions. Therefore, it is imperative that the model accurately represents wastewater flows in the collection systems. To calibrate the Dravosburg model, extensive basin-wide flow monitoring was conducted to collect the required data. This data, once subjected to quality assurance procedures, was compared to the modeled response at the monitored locations. The model input parameters were then subject to validation to facilitate a closer correlation between the observed data and the simulated response.

5.3.1 Validation Criteria

The accuracy of the developed model during wet-weather events is essential when recommending appropriate wet-weather control facilities. To make sure that the model accurately represents the best available information, rigorous wet-weather validation criteria were applied to the Dravosburg model using a large quantity of quality-assured monitoring data.

Hydrologic validation was conducted for all of the monitored sites to properly simulate the wet-weather response from the monitored sewershed. Hydrologic validation of a monitored sewershed was based on the maximum number of successfully monitored wet-weather events.

The number of events used for validation depends on the monitoring period and flow monitoring quality.

Using time series plots, graphical comparisons were made of peak flow and volume for each wet-weather event occurring during the validation period. Statistical comparison plots were developed to illustrate the goodness-of-fit between the modeled response and the monitored data. For a large number of storm events monitored locations, the simulated storm volumes and peak flows vs. the corresponding monitored volumes and peak flows were plotted. Regression plots were also generated to make statistical comparisons of the simulated flows and the monitored flows. The statistics include a regression trendline of model results compared to the metering results, a calculation of the slope and intercept of the trendline. An R-square value calculation is performed to provide a measure of the models accuracy to predict flow monitoring results. Storm events with missing, incomplete and/or errant flow monitoring data, unreasonable responses in either the simulated flows or monitored flows or inaccurate or unreasonable precipitation data were identified and deemed "outliers." These outlier storm events were deleted for the regression analysis, so they did not affect the results of the regression analysis. The iterative process of optimizing the runoff and RDII parameters was continued until the validation objectives were achieved.

While using any monitored flow data to validate a hydraulic model, the variability of the monitored data needs to be considered. This is to say that even under optimal conditions within a monitoring manhole, the accuracy of monitored data is typically +/-10 percent, and the variability can be higher in a hydraulically challenged site such as high velocities, surface turbulence and varying backwater interferences. Depending on the hydraulic conditions present at a monitoring site, there can be ample variation in the performance of a monitoring site in terms of flow monitoring data collected during dry- and wet-weather flow from that site. This variability was accounted for when using the observed flow monitoring data during the hydrologic validation of the sites.

The purpose of the validation process for monitored combined sewersheds is to determine the runoff parameters to achieve the following primary goals of model validation:

- On the statistical regression plots, a regression line with slope close to one (1) indicates that the modeled storm event volumes and peak flow rates are consistent with the monitored volumes and peak flow rates.
- On the statistical regression plots, an intercept of the regression line close to zero (0) indicates that the modeled event volumes and peak flow rates were not biased (i.e., consistently over-simulating or under-simulating) with respect to the monitored volumes and peak flow rates.
- On the statistical regression plots, an R-square value of the regression line close to one (1) indicates that the degree of scatter in the data points in the regression plot is low.

- On the time series plots, matching as closely as possible the ratio of the time to peak, shape and magnitude for the monitored and simulated events.

For small number of storm events monitored locations, the statistical method may not generate stable regression plots. In these cases, model validation was evaluated for individual storms and overall storms. The validation criteria are the percentage of model peak higher than meter peak (P_{per}) and the percentage of model volume higher than meter volume (V_{per}). These criteria where used in conjunction when determining whether or not a particular portion of the system was adequately validated. The iterative process of optimizing the runoff parameters was continued until the validation objectives were achieved. The definition of P_{per} and V_{per} were shown in Equation 2 and Equation 3.

$$P_{per} = \frac{P_o - P_m}{P_o} \times 100\% \qquad \text{Equation 2}$$

$$V_{per} = \frac{V_o - V_m}{V_o} \times 100\% \qquad \text{Equation 3}$$

Where:

P_o = Observed (meter) hydrograph peak;

P_m = Modeled hydrograph peak;

V_o = Observed (meter) hydrograph total volume;

V_m = Modeled hydrograph total volume;

The purpose of the validation process for monitored combined and separate sub-catchments is to determine the runoff parameters to achieve the primary goals of model validation. Generally speaking, peaks and volumes within 15 percent are considered to be well validated.

It is important to emphasize that with the large number of storms used to validate the model, data scatter is expected and acceptable in the regression plots, especially for simulated vs. monitored storm peak flow rates. Because of the large number of storm events considered in the analyses, a higher degree of scatter in the data points (with a corresponding lower R-square value) needs to be allowed, as long as there is no overall bias demonstrated in these plots. With the long-term continuous simulation modeling approach, simulation of individual storms is not significant when compared with the accuracy of the overall model simulation over the course of the total model duration. The criterion is to make sure that there is no overall bias in the simulations, and that over-simulation and under-simulation of individual storms balance out over the course of the long-term simulation.

5.3.2 Model Validation QA/QC Procedures

QA/QC procedures were utilized during both the hydrologic and hydraulic validation processes to verify that the model yields meaningful, accurate, and reliable results consistent with the modeling goals and objectives. The following general QA/QC procedures were performed during the model validation processes:

- Checked for warnings and error messages in the model output file and resolved all major warnings and errors.
- Checked the model's run report for inconsistencies and/or unexpected results.
- Checked the model's overall continuity error and resolved items resulting in an overall continuity error greater than 2%.
- Checked individual continuity errors and resolved items resulting in individual continuity errors greater than 5%.
- Checked model stability using the following methods:
  - Visually checked the dynamic performance of the hydraulic grade line along profile views of sewers.
  - Visually checked the output hydrographs at key hydraulic locations across the simulated area.
  - Checked for dry pipes under both dry weather and wet weather flow conditions and resolved any improperly loaded conditions.
  - Checked the performance of system appurtenances such as pumps, weirs, orifices, and storage elements and verified that they are performing as expected.
  - Checked manholes where flows are lost from the system and verified that these losses are as expected.

5.3.3 Model Validation

For the validation process, all of the wet weather events where data were available were initially utilized at each monitoring location. During the QA/QC process, certain events were noted to have various data problems, including uncharacteristic responses, and these events were generally defined as outliers. Table 5.2 shows the kept events number, outlier events number and the total events number for each site.

Number of Kept, Outlier, and Total Events by Site
Table 5.2

	Kept	Outlier	Total
M-3	6	1	7
M-4A	7	0	7
M-5	7	0	7
M-6A	7	0	7
M-7A	6	1	7

Figure 5.5 and Figure 5.6 present the overall validation results for all the monitoring sites in the Dravosburg system for event volume and event peak flow, respectively. The plots show all of the validation events and a trendline for the validation events. The data used to generate these figures is derived from the individual modeling and monitoring site.

Figure 5.5 shows the regression plot between the simulated event volume and monitored event volume for all the monitored sites in the Dravosburg system. As the plot shows, the slope of the regression line is 1.1563, which suggests that there is good correlation between the simulated and monitored event volumes. The small value of 0.0144 for the intercept suggests that there is no relative bias in the simulation of the event volumes. The R-squared value of the regression plots is 0.9242, suggesting that there is a very small scatter in the data points around the regression. The source of the scatter is attributed to non-uniform hydrologic responses in the collection system and inaccuracies in flow monitoring and rainfall data collection.

Event Volume Regression Plot for All Sites in the Dravosburg System

Figure 5.5

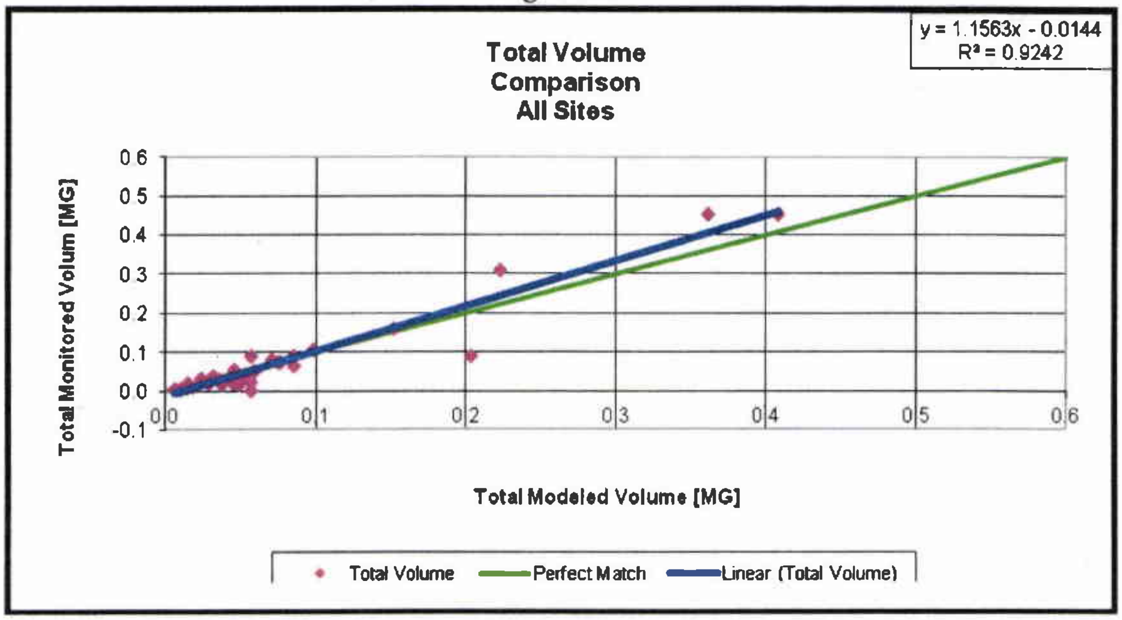
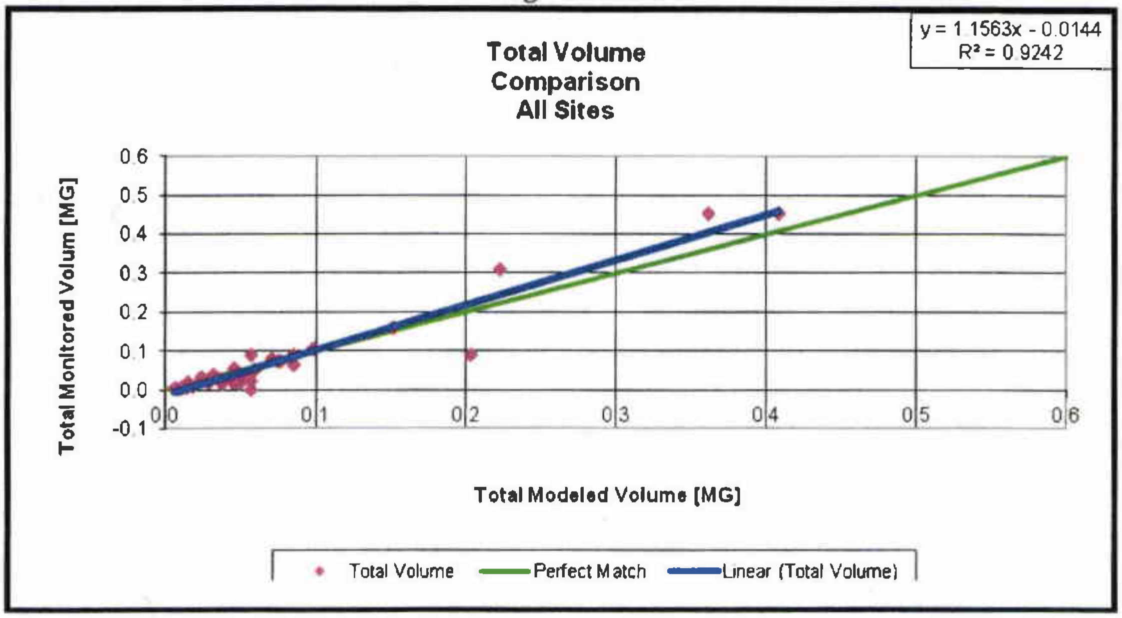


Figure 5.6 shows the regression plot between the simulated event peak flow and monitored peak flow for all the monitored locations in the Dravosburg system. As the plot shows, the slope of the regression lines is 0.8658 which suggests that there is good correlation between the simulated and monitored event peak flows. The small value of 0.0836 for the intercept suggests that there is no relative bias in the simulation of the event peak flows. The R-squared value of the peak flow regression plot is 0.9238 suggesting that there is a small scatter in the data points. The source of the scatter is attributed to non-uniform hydrologic responses in the collection system and inaccuracies in flow monitoring and rainfall data collection.

Event Peak Regression Plot for All Sites in the Dravosburg System
Figure 5.6



To illustrate modeling details, Appendix G shows the modeled and monitored volumes and peaks for each site and each event, as well as the monitored and modeled hydrographs. Appendix H shows the regression plots for each site. Because some sites have a small number of monitoring events, the statistical method may not generate stable regression plots. This does not mean the validation is poor, as long as the total volume and peak differences are in reasonable range.

Overall, the model is considered to be well validated and suitable for evaluating the system performance in various rain events.

5.4 HISTORICAL RAINFALL ANALYSIS

As previously stated, the "presumption" approach evaluates overflows on an annual average basis.

> *"The elimination or capture for treatment of no less than 85% by volume of combined sewage collected in the CSS during precipitation events on a system-wide annual average basis."*

The ALCOSAN typical year 15-minute interval rainfall data was used for this analysis. This data was used because it is readily available to KLH and it is representative of the annual average conditions for Dravosburg. This data is included in Appendix I.

5.5 LONG-TERM CONTINUOUS SIMULATION RESULTS

In order to determine whether or not the Dravosburg CSS can capture for treatment at least 85 percent of CSS rainfall dependent flow volume, on an annual average basis, a year-long continuous model simulation was completed using the increased ALCOSAN Pixel Eight typical year rainfall. All flow volume from the separate sewer system areas must be captured for treatment. Therefore, this volume is not part of Equation 4 below.

Equation 4 was utilized for percent capture evaluation.

$$\% \text{ Capture} = [V_{WWTP} / (V_{WWTP} + V_{CSO})] \times 100\% \qquad \text{Equation 4}$$

Where

V_{WWTP} - Total volume of CSS flow conveyed to the WWTP during wet weather,
V_{CSO} = Total volume of overflow from the CSO,

These volumes were determined based on the one year simulation.

V_{WWTP} = 19.87 MG
V_{CSO} = 1.82 MG
%Capture = [19.87 / (19.87 + 1.82)] x 100% = 91.6%

Based on the continuous simulation modeling, the Dravosburg CSS, on a system-wide annual average basis, will meet the "presumption" approach criteria ii, after completion of WWTP improvements described in the following sections. Maintaining a free discharge boundary condition at the WWTP influent pump station will allow for the "presumption" approach to be met. The SWMM model report is included in Appendix J.

6.0 EXISTING FACILITY

6.1 EXISTING NPDES PERMIT REQUIREMENTS

The existing WWTP provides screening, grit removal, conventional aeration, secondary treatment and disinfection prior to discharging treated effluent to Monongahela River. The operation and discharge is regulated under the terms of the current NPDES Permit Number PA0028401. The permit limits are listed in Table 6.1. The WWTP design flow is 0.48 MGD.

Existing Effluent Limits
Table 6.1

PARAMETER	LOADING (lbs)			CONCENTRATION (mg/L)			
	Average Monthly	Average Weekly	Units	Average Monthly	Average Weekly	Instant. Maximum	Units
Flow	-	-	-	Monitor and Report			-
CBOD-5 Day	100	150	lb/day	25	37.5	50	mg/L
Suspended Solids	120	180	lb/day	30	45	60	mg/L
Total Residual Chlorine				1.0		3.3	mg/L
Fecal Coliform							
May 1 to Sept 30				200			/ 100ml
Oct. 1 to April 30				2,000			/ 100ml
pH	Within Limits of 6.0 to 9.0 Standard Units At All Times.						

6.2 EXISTING HYDRAULIC LOADINGS

6.2.1 Average Flows

The facility has an average daily design capacity of 0.48 MGD. Analysis of flow data from the past five (5) years shows that monthly average flow has not exceeded 0.48 MGD for three (3) consecutive months, and therefore the WWTP is technically not hydraulically overloaded. However monthly average flows have exceeded 0.48 MGD five (5) times over the past five (5) years. The maximum monthly average flow observed over the past five (5) years is 0.820 MGD.

Analysis of flow data from the past five (5) years shows that the annual average flow for the WWTP is 0.274 MGD. Table 6.2 summarizes average flows for the five (5) years.

Existing Hydraulic Loadings
Table 6.2

Year	Max. Mo. Ave. Flow (MGD)	Annual Ave. Flow (MGD)
2009	0.237	0.192
2010	0.820*	0.432
2011	0.566	0.312
2012	0.383	0.207
2013	0.399	0.227

**The Year 2010 Chapter 94 Report was provided with a disclaimer from Glenn Engineering & Associates, LTD stating that accuracy of data may have been compromised by the admitted falsifying of records by the former Sewage Plant Operator.*

6.2.2 Peak Flows

The capacity of the raw sewage pump station limits peak flows that can be received by the WWTP. The peak pump capacity with the two (2) small pumps running is equivalent to the flow produced by the single larger pump. This limiting capacity is 0.72 MGD.

6.3 EXISTING MASS LOADINGS

6.3.1 Historical Loadings

WWTP raw sewage organic loading data was evaluated for the past five (5) years. Organic loadings are summarized in Table 6.3 below.

Existing Influent Organic Loadings
Table 6.3

Year	Max. Month (lb. BOD/day)	Annual Ave. (lb. BOD/day)
2009	229	162
2010	1,149*	580
2011	235	126
2012	150	99
2013	115	71

**The Year 2010 Chapter 94 Report was provided with a disclaimer from Glenn Engineering & Associates, LTD stating that accuracy of data may have been compromised by the admitted falsifying of records by the former Sewage Plant Operator.*

The WWTP's current rated organic capacity as reported in the Chapter 94 report is 2,780 lb/day. Given the 5-year annual average BOD loading of 208 lb/day and the 5-year annual average flow of 0.274 MGD, the average BOD concentration is 91 mg/L. The Borough's wastewater would be classified as low strength which is not uncommon for old CSS's.

6.4 EXISTING PROCESS

A process flow diagram for the existing WWTP is included in Appendix K of this report. A site plan for the existing WWTP is included in Appendix L. Calculations associated with the existing processes are included in Appendix M.

6.4.1 Preliminary Treatment

Preliminary treatment consists of a comminutor with a static bypass bar screen. These facilities were constructed in the Year 1965.

The design capacity of the comminutor channel is unknown however the WWTP's peak flows are limited to 0.72 MGD.

Comminutor/Bypass Channel
Photograph 6.1

6.4.2 Raw Sewage Pumping

Flow comes into the existing wet well via the comminutor channel. Prior to entering the wet well, flow passes through a comminutor, with a static screen provided for bypass flow. The flow is then lifted up to the grit chamber by three (3) centrifugal pumps. Two (2) of the pumps operating simultaneously have the same pumping capacity as the third, larger pump. The raw sewage pumps have a peak pumping capacity of approximately 0.72 MGD. This capacity assumes that one pump is a backup and not operational. This pump station was constructed in the late 1950's, and the pumps were recently refurbished.

Raw Sewage Pumps
Photograph 6.2

6.4.3 Grit Removal

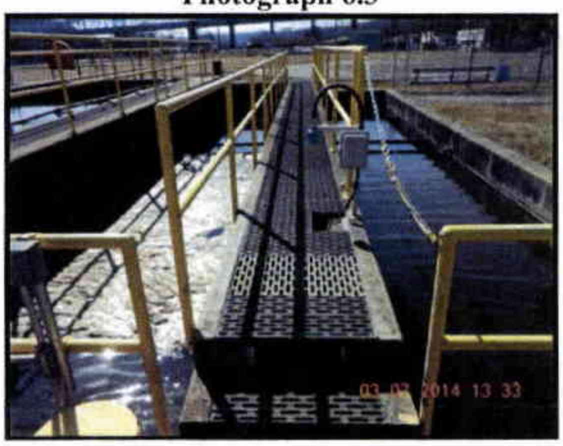
Wastewater is pumped from the raw sewage pump station to an open channel flowing to the grit basin. The grit basin's peak capacity is 2.51 MGD based on a 3 minute minimum detention time. It is noted that the square configuration of this basin is not conducive to plug flow. Plug flow is desirable in aerated grit basin in order to reduce potential for basin short-circuiting.

6.4.4 Secondary Treatment

The grit basin effluent flows by gravity to two (2) aeration basins where biological treatment takes place. Each basin measures 90-feet long by 30-feet wide and have an average flow water surface depth of 15-feet.

Aeration basin effluent flows by gravity to two (2) rectangular final settling tanks. The settling tanks have a peak capacity of 0.680 MGD, based on total weir length and surface overflow rate.

Final Clarifiers
Photograph 6.3



6.4.5 Disinfection

Final settling tank effluent flows by gravity into two (2) chlorine contact tanks. Each tank is 23.5 feet long by 5 feet wide. Total calculated peak capacity is 0.396 MGD. These tanks were constructed in 1965.

Chlorine Contact Tank
Photograph 6.4

6.4.6 Solids Handling

Sludge in each final tank settles to the end hopper, where it is then transferred to an intermediate sludge well via a telescoping valve. Scum removed from the surface of the final tanks is also conveyed to the sludge well. Return sludge is pumped from the sludge well back to the aeration basins by a set of two (2) Chicago Dry-Pit Solids Handling Pumps (Model LM4 HBB). The capacity of each of these pumps is 500 GPM at 33-feet of head.

The Authority has a third party company pump out the sludge well as necessary. The WWTP does not have an additional sludge holding facilities.

7.0 TREATMENT PLANT UPGRADES

7.1 DESIGN HYDRAULIC LOADINGS

In order to meet the EPA CSO Control Policy, "presumption" approach as well as DEP design standards, three criteria were evaluated:

1. Percent capture – at least 85% of CSS volume (resulting from rain events), on an annual average basis, must be captured and conveyed to the WWTP for full biological treatment.
2. Peak core flow – Peak core flow = CSS peak dry weather flow x 3.5 + separate sewer system peak (given design rain event).
3. Design rain event – application of a design rain event is critical to ensure that upgrades completed to address percent capture and peak core flow will not result in manhole overflows.

The peak core flow for this system is 3.43 MGD. This peak flow includes 350% of the CSS dry weather flow and 100% of the separate sewer flow peak (given the design 10-year, 24-hour rain event). The peak core flow must receive full treatment; therefore, the design peak flow for the facility upgrades must be equal or greater than 3.43 MGD. KLH evaluated CSO regulator modifications required to ensure that both peak core flow and percent capture criteria are met. These modifications resulted in the 91.6% capture which was described in the Flow Monitoring and System Modeling section of this report. Application of the 10-year, 24-hour rain event, to the sewer system, including the modified CSO regulator, results in a modeled peak flow at the WWTP of 3.812 MGD. Since this peak flow is in excess of the peak core flow, it is an acceptable design peak. Design flows are summarized in Table 7.1 below.

Design Hydraulic Loadings
Table 7.1

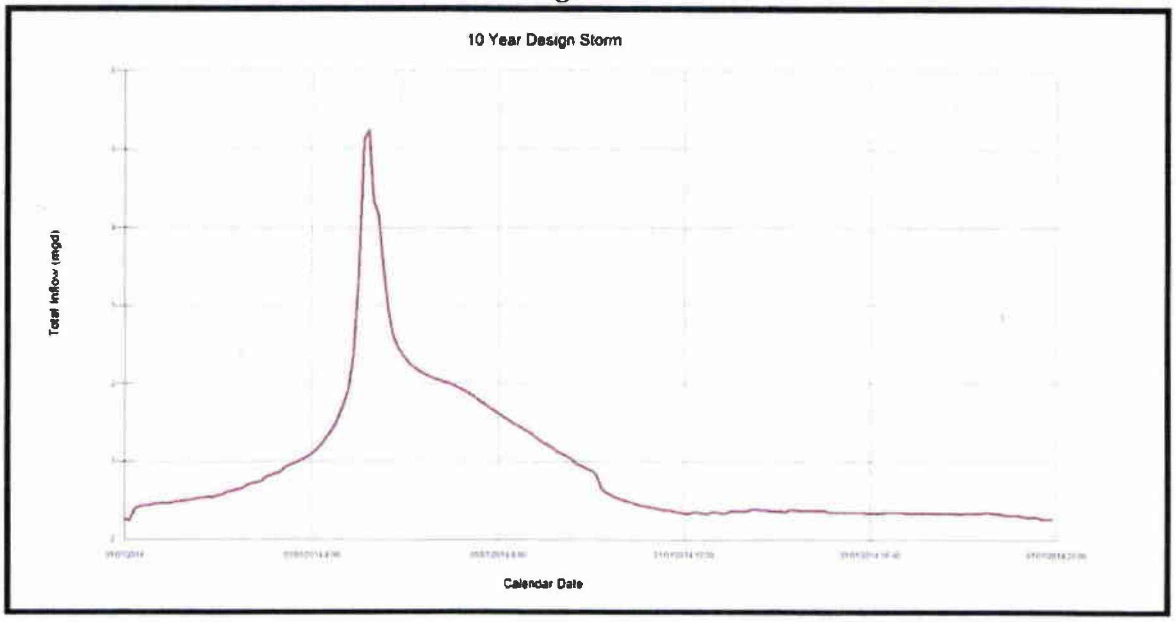
Design Flow	WWTP (MGD)
Peak Instantaneous	3.812
Peak Hourly	2.924
Peak Daily	0.985
Max Monthly Ave	0.60
Annual Average	0.36

All design flows were based on 30-year population projection. No significant growth is anticipated within the Borough over the next 30 years. Consistent with past Chapter 94 reports, 2 EDUs/year over the next 30 years was included. Development of each design flow is further described below.

7.1.1 Peak Instantaneous Flow (PIF)

As discussed above, PIF is governed by the design rain event. The design hydrograph resulting from the SWMM modeling is shown in Figure 7.1 below.

Design Hydrograph
Figure 7.1



7.1.2 Peak Hourly Flow (PHF)

PHF was also estimated based on SWMM modeling.

7.1.3 Peak Daily Flow (PDF)

Application of design rain event to the SWMM model resulted in a PDF of 0.985 MGD. Recent Borough flow records indicate that PDFs of nearly 0.722 MGD have been observed, which is consistent with the maximum influent pumping capacity.

7.1.4 Maximum Monthly Average Flow (MMAF)

MMAF is a critical design parameter for evaluating WWTP treatment capacity. As discussed under Section 6.2.1 monthly average flows have exceeded the WWTP design average (0.48 MGD) 5 times over the past 10 years. Also the maximum monthly average flow observed over the past 10 years was 0.820 MGD, but the accuracy of this data is in question. Since the MACM took over the WWTP in the Year 2011, the reported maximum monthly average flow has been 0.566 MGD. The Monitoring and Modeling Sections established MMF as 0.60 MGD, which is based on the maximum 3-month average flow in the past three (3) years, plus an additional factor of safety of 1.2, to account for reduction in CSO volumes.

Projected growth was also included in the design MMAF flow. No significant growth is projected for the Borough for the next 30 years.

Design average flow which corresponds to MMAF was established at 0.60 MGD for the purposes of this study in order to accommodate increase conveyance of CSS flow to the WWTP.

The increase in design average flow from 0.48 MGD to 0.60 MGD will require a hydraulic re-rate.

7.1.5 Annual Average Flow (AAF)

AAF of 0.36 MGD was estimated based on the typical year rainfall distribution applied to the SWMM model.

7.2 DESIGN MASS LOADINGS

Design mass loadings were developed based on review of existing WWTP loading data with respect to industry standard typical values. It must be noted that by significantly increasing percent capture, there may be a significant increase in mass loadings. However, given the fact that the Borough's current loads are far below the WWTP's design capacity, it is reasonable to conclude that no organic re-rate will be necessary. Industry standard loadings for low to medium strength sewage and combined sewage were evaluated with respect to WWTP influent data available from the recent NPDES Permit Renewal.

Design Mass Loadings
Table 7.2

Parameter	Design Concentration (mg/L)	Design Loading (lb/day)
BOD	190	951
TSS	210	1,051
NH_3-N	25	125
TKN	40	200
TP	7	35

7.3 DESIGN EFFLUENT LIMITS

Tables 7.3 lists the design effluent limits. These limits apply only to construction of new treatment processes. These arte preliminary effluent limits provided by DEP.

Design Effluent Limits
Table 7.3

PARAMETER	LOADING (lbs)			CONCENTRATION (mg/L)			
	Average Monthly	Average Weekly	Units	Average Monthly	Average Weekly	Instant. Maximum	Units
Flow	-	-	-	Monitor and Report			-
CBOD-5 Day	125	250	lb/day	25		50	mg/L
Suspended Solids	150	300	lb/day	30		60	mg/L
Total Residual Chlorine				0.5		1.6	mg/L
Ammonia Nitrogen							
May 1 to Sept 30				25			mg/L
Oct. 1 to April 30				M&R			mg/L
Fecal Coliform							
May 1 to Sept 30				200			/ 100ml
Oct. 1 to April 30				2,000			/ 100ml
pH	Within Limits of 6.0 to 9.0 Standard Units At All Times.						

Note: Mass loadings are based on 0.60 MGD design flow.

7.4 ALTERNATIVES EVALUATION

7.4.1 Development of Alternatives

Alternatives were developed for evaluation with the primary focus of providing treatment to 85 percent of CSS flow captured during rain events on an annual average basis. In order to meet the 85 percent criteria, a hydraulic re-rate will be required. During the development of each alternative, it was high priority to maintain as much of the existing processes as possible. Three (3) alternatives were initially considered, but only two (2) were developed for detailed evaluation. The third alternative, to pump Dravosburg flow to the Duquesne WWTP, was discounted due to limited capacity at the Duquesne WWTP.

1. Alternative 1 – Convert existing process to a Sequencing Batch Reactor (SBR) process. Modification of existing process to handle all average and peak flow. This alternative includes construction of a new headworks and influent pump station, as well as modifications to the existing process using existing tanks. Additionally, this alternative includes upgrading the existing process to meet re-rate requirements. The following items are included in Alternative 1.

- New automatic bar screen and by-pass channel with static screen.
- New headworks building.
- New raw sewage pump station and controls.
- New raw sewage pump station piping and valve vault.
- New pump flow meter.
- Site gravity and force main piping.
- New grit removal system.
- Retrofit existing aeration basins to serve as SBRs.
- All SBR equipment and piping.
- Retrofit existing final clarifiers to serve as sludge holding tanks.
- Retrofit existing chlorine contact tanks to serve as UV disinfection.

2. Alternative 2 – Pump to McKeesport WWTP and convert existing WWTP to peak flow storage. This alternative includes construction of a new raw sewage pump station to convey all flow up to 1.0 MGD to the Municipal Authority of the City of McKeesport (MACM) WWTP. All flow above 1.0 MGD will be pumped by separate storm pumps and stored in the existing Dravosburg WWTP aeration basins. The following items are included in Alternative 2.

- New automatic bar screen and by-pass channel with static screen.
- New headworks building.
- New raw sewage pump station and controls.
- Average flow pumps and storm pumps.
- New raw sewage pump station piping and valve vault.
- New pump flow meter.
- Site gravity and force main piping.
- Force main piping to the MACM WWTP.
- Retrofit existing aeration basins to serve as peak flow storage.
- New diffusers in the peak flow storage basins.

7.4.2 Evaluation of Alternatives

The following sections summarize design considerations associated with each alternative. Both Alternatives 1 and 2 will meet the current permit requirements and will allow for treatment of design flows. Table 7.4 lists the advantages and disadvantages associated with each alternative.

Alternatives Comparison
Table 7.4

Alternative No.	Alternative	Advantages	Disadvantages
1	SBR	1. Process is very flexible and easy to operate. 2. Low manpower requirement. 3. Large biomass volume provides process protection against shock mass loadings. 4. Produces a well stabilized sludge. 5. Lower sludge production. 6. Proven technology. 7. DEP is comfortable with SBR process.	1. Effluent quality depends on decanter reliability. 2. Process control is dependent on PLC operation.
2	Pump Station To MACM WWTP	1. Operation and maintenance of WWTP eliminated. 2. Lower manpower requirement.	1. Large pump station will require various sized pumps

7.4.2.1 Alternative 1 – Upgrade Existing Process

Alternative 1 includes three (3) main components:

1. Construction of a new raw sewage pump station.
2. Modification of the existing WWTP to a SBR plant capable of handling higher peak flows.
3. Modification of the existing chlorine contact tanks to serve as a UV disinfection facility.

A process flow diagram associated with Alternative 1 is included in Appendix N. A site plan associated with Alternative 1 is included in Appendix O. Calculations associated with Alternative 1 are included in Appendix P.

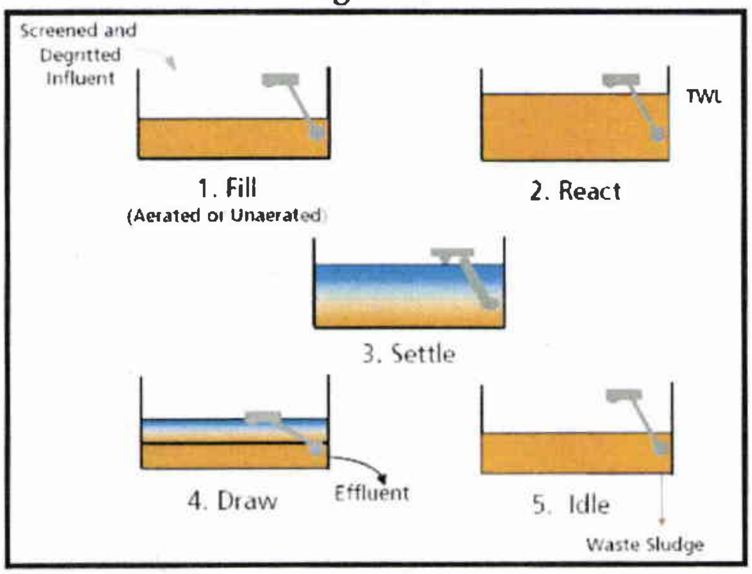
A mechanical bar screen, sized for 3.812 MGD, is recommended prior to the new raw sewage pump station. This screen will protect the grit basin, eliminate static screen cleaning requirement, and remove more fibrous materials from the flow stream than the existing static screens are capable of. While the existing comminutor provides pump protection by shredding fibrous solids, it does not remove these materials from the flow stream. The fibrous solids and other large inert solids that can be passed or shredded by the comminutor may still cause operation and maintenance issues in the downstream processes. Automatic bar screen clear openings of 1/4 inch are recommended. A by-pass channel with a static bar screen is recommended so that the automatic bar screen can be taken out of service for maintenance. This screen will be sized for at least 3.812 MGD.

The existing raw sewage pump station does not have adequate volume to handle the projected peak flows. As such, a new pump station is proposed. This station will be located adjacent to the existing final clarifiers and will require new gravity sewers to reroute influent flow. In addition to the structure and pumps, new pump controls and associated electrical equipment will be included. Also a new pump discharge flow meter is recommended, located in an adjacent underground valve vault. This flow meter is used for DEP reporting, therefore accuracy is critical.

A new grit removal system is proposed at the head of the SBR tanks. This basin will be sized for a 0.6 MGD average and 3.812 MGD peak. Flow will be pumped from the new raw sewage pump station directly to the grit basin influent channel. The basin will consist of an above grade concrete tank. Grit pumps and grit dewatering equipment will be housed in a new building. Effluent from the grit basin will be conveyed by gravity to the proposed 2-basin SBR.

The conventional SBR treatment process typically involves a five-stage cycle that occurs in the reactor tank. The first stage is the fill stage when the wastewater influent fills the tank and mixes with mixed liquor settled during the fifth stage. Aeration characterizing the second or react stage can also occur during the initial stage. The react stage results in organic and nitrogenous oxidation. Aeration and mixing are terminated and the third or settle stage allows the settling of solids. The fourth or draw stage involves the decanting of effluent after settling. During the last stage the tank remains idle and solids are withdrawn from the bottom. Parallel reactor cycle times overlap such that the system is continuously accepting forward flow. Figure 7.2 shows conventional SBR operation.

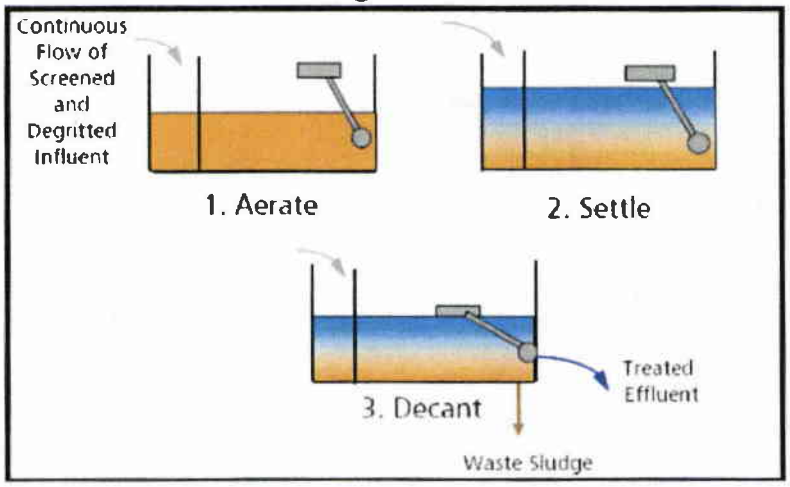
Conventional SBR
Figure 7.2



Some SBR systems involve a semi-batch process where all stages occur in one tank as influent is continually accepted and baffled in an effort to reduce short-circuiting equalized flow and prevent disturbance of quiescent settling conditions. The five cycle stages of the true SBR cycle are combined into three in the semi-batch mode of operation. The first two stages of the true batch process comprise the first stage of the semi-batch version. Sedimentation is considered the second stage of the semi-batch cycle, while the last is a combination of the decanting and idle stages of the true batch method. Figure 7.3 shows continuous flow SBR operation.

Continuous Flow SBR

Figure 7.3



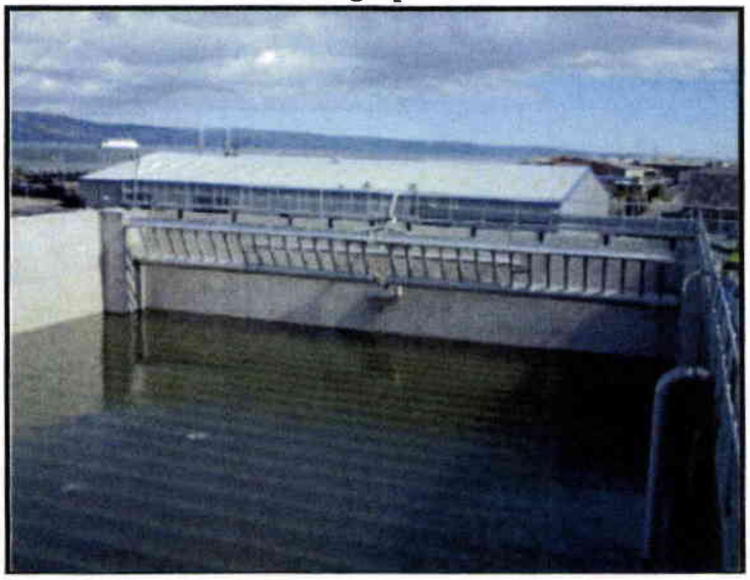
For either process system the cycle times can be adjusted to accommodate incorporating alternating phases of aerobic-anoxic/anaerobic (air on-air off) conditions in the cycles for BNR capabilities. Both systems provide a high degree of treatment by eliminating the negative impacts caused by extreme flow fluctuations and are considered viable options at the preliminary design stage.

Preference has been given to the continuous flow semi-batch style process. The manufacturer associated with the continuous flow style is ITT-ABJ. The reasons for the partiality include:

- Continuous flow type provides a more flexible adjustment to the sudden changes in flow. True batch characteristics are maintained for flows up to 3.5 times the design flow whereas continuous flow units allowing for "fill decant" mode during peak flow conditions over 3.5 times the design flow without disturbing the sludge blanket.
- As a result of the continuous acceptance of influent, the overall volume of the system is typically reduced by 20 to 30 percent of the true batch counterpart which needs the additional volume to equalize peak flows.
- The continuous flow system can be converted to a true batch system with the appropriate valving at low flows.

For these reasons the continuous flow system as manufactured by ITT-ABJ was the basis for the calculation of basin sizes and developing the cost estimates for Alternative 2. Photograph 7.1 is an example of an ITT-ABJ SBR basin. The photograph shows the floor mounted aeration diffusers and the decanter mechanisms.

SBR
Photograph 7.1



Flow from the SBR will be discharge directly to the UV disinfection facility. The UV system must be sized for the peak decant rate, which is 4.4 MGD. The existing chlorine contact tank structures can be utilized for the UV channels. Use of these tanks will reduce required excavation and concrete costs, however maintenance of existing treatment processes will be challenging during construction. Further evaluation of this option should be completed during design.

The UV disinfection facility must be constructed at an elevation high enough to protect it from the 100-year flood. According to Federal Emergency Management Agency (FEMA), Flood Insurance Rate Map, the 100-year flood elevation for the WWTP site is 746. Water level in the UV channels will be controlled by appropriately sized weirs. The weir crest elevation should be at least 1.5 feet above the water surface elevation based on a 4.4 MGD peak decant flow through the outfall sewer given 100-year flood elevation tail water. A new outfall sewer will be required in order to accommodate the increased peak discharge.

Sludge from the SBRs will be wasted directly to the sludge holding tanks. The existing final will be converted into sludge holding tanks. The clarifier equipment will be removed. The existing tanks will provide approximately 58,000 gallons of capacity. Construction of digester tank(s) is not recommended. The Authority can continue to haul sludge to the MACM WWTP as required.

7.4.2.2 Alternative 2 – Pump Station to MACM WWTP

Alternative 2 includes the following main components:

1. Construction of a new raw sewage pump station, including normal flow and peak flow pump capacity.
2. Construction of new force main.
3. Modification of existing aeration basins to serve as peak flow storage basins.

A process flow diagram associated with Alternative 2 is included in Appendix Q. A site plan associated with Alternative 2 is included in Appendix R.

A mechanical bar screen, sized for 3.812 MGD, is recommended prior to the new raw sewage pump station. Automatic bar screen clear openings of 1/4 inch are recommended. A by-pass channel with a static bar screen is recommended so that the automatic bar screen can be taken out of service for maintenance. This screen will be sized for at least 3.812 MGD.

A submersible pump station is proposed for the new raw sewage pump station. This type of pump intake structure minimizes required footprint, as well as capital and operating cost. The pump station will be required to pump a total flow of at least 3.812 MGD. This will consist of normal flow pumps with a total pumping capacity of 1.0 MGD to the MACM WWTP, as well as peak flow pumps capable of conveying at least 4.24 MGD to the proposed peak flow storage basins. Four (4) to six (6) pumps will be required, two (2) to three (3) of each normal flow and peak flow pumps. Flow in excess of 1.0 MGD will cause rising water levels in the wet well and, in turn, activate the peak flow pumps.

In conjunction with the new pump station, a force main to the MACM WWTP will be required. The force main is estimated to be 8-inch diameter and will span 4,600 lineal feet. The force main will require a bore under the river to reach the MACM WWTP, estimated to be 800-feet in length. A copy of the proposed force main alignment can be found in Appendix S.

7.4.2.3 Cost Evaluation

Study level total project cost estimates were completed for the evaluated alternatives. The costs are as summarized in Table 7.5 below: Detailed cost estimates are included in Appendix T.

WWTP Upgrade Costs
Table 7.5

Alternative	Year 2014 Construction Cost	Year 2014 Total Project Cost
Alt 1 - WWTP Upgrades	$7,099,000	$8,874,000
Alt 2 – Pump Station	$4,401,000	$5,503,000

7.4.2.4 Recommended Alternative

Detailed evaluation of the proposed alternatives led to the recommendation of Alternative 2 for Borough's LTCP upgrades. The total estimated project cost is $5,503,000. This alternative is recommended for the following reasons:

- Alternative 1 project cost is $3,371,000 more than the recommended Alternative 2.
- Alternative 2 eliminates operation and maintenance requirements of a WWTP.

Alternative 2 is recommended however given the "High Burden" classification associated with this work, completion of the proposed upgrades on a typical project timeline may not be feasible. Project financing will drive the schedule for implementing Alternative 2 upgrades.

8.0 PROJECT PLANNING

The following LTCP schedule is proposed.

LTCP Schedule
Table 8.1

Milestone	Date
Submit draft LTCP	September 1, 2014
Submit final LTCP with MACM ACT 537	November 1, 2015
DEP approval of LTCP and ACT 537	January 1, 2016
Obtain funding for design related services	January 1, 2017
Begin design of upgrades	January 1, 2017
Apply for MACM WWTP re-rate	July 1, 2017
Apply for Part II Permit for pump station	July 1, 2018
Receive Part II Permit for pump station	January 1, 2019
Obtain funding for construction	January 1, 2021
Begin construction for CSS upgrades	March 1, 2021
Complete construction	March 1, 2023
Submit post construction compliance monitoring plan	September 1, 2023

*DEP LTCP approval and Part II Permit dates are beyond the control of the Borough and KLH, therefore schedule dates will be adjusted based on actual DEP milestone completion dates.

9.0 SUMMARY AND CONCLUSIONS

In order to address the "presumption" approach percent capture criteria the following upgrades are recommended:

- Construct Alternative 2 – A new pump station and force main to the City of McKeesport Municipal Authority WWTP.

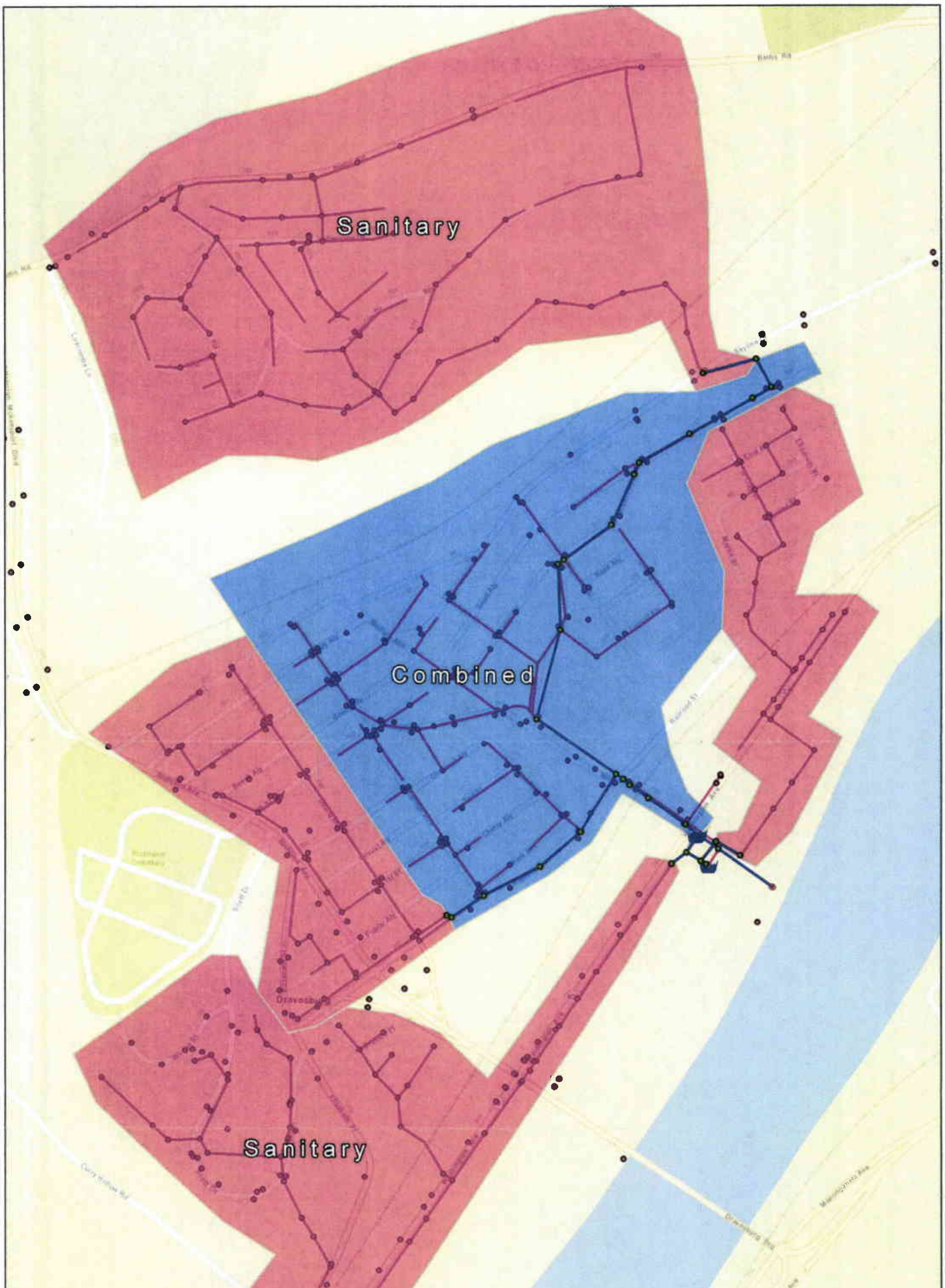
No CSS upgrades are required to convey the 10-year, 24-hour design storm flow while maintaining greater than 85% capture during a typical year.

The work associated with Alternative 2 has an estimated total project cost of $5,503,000.

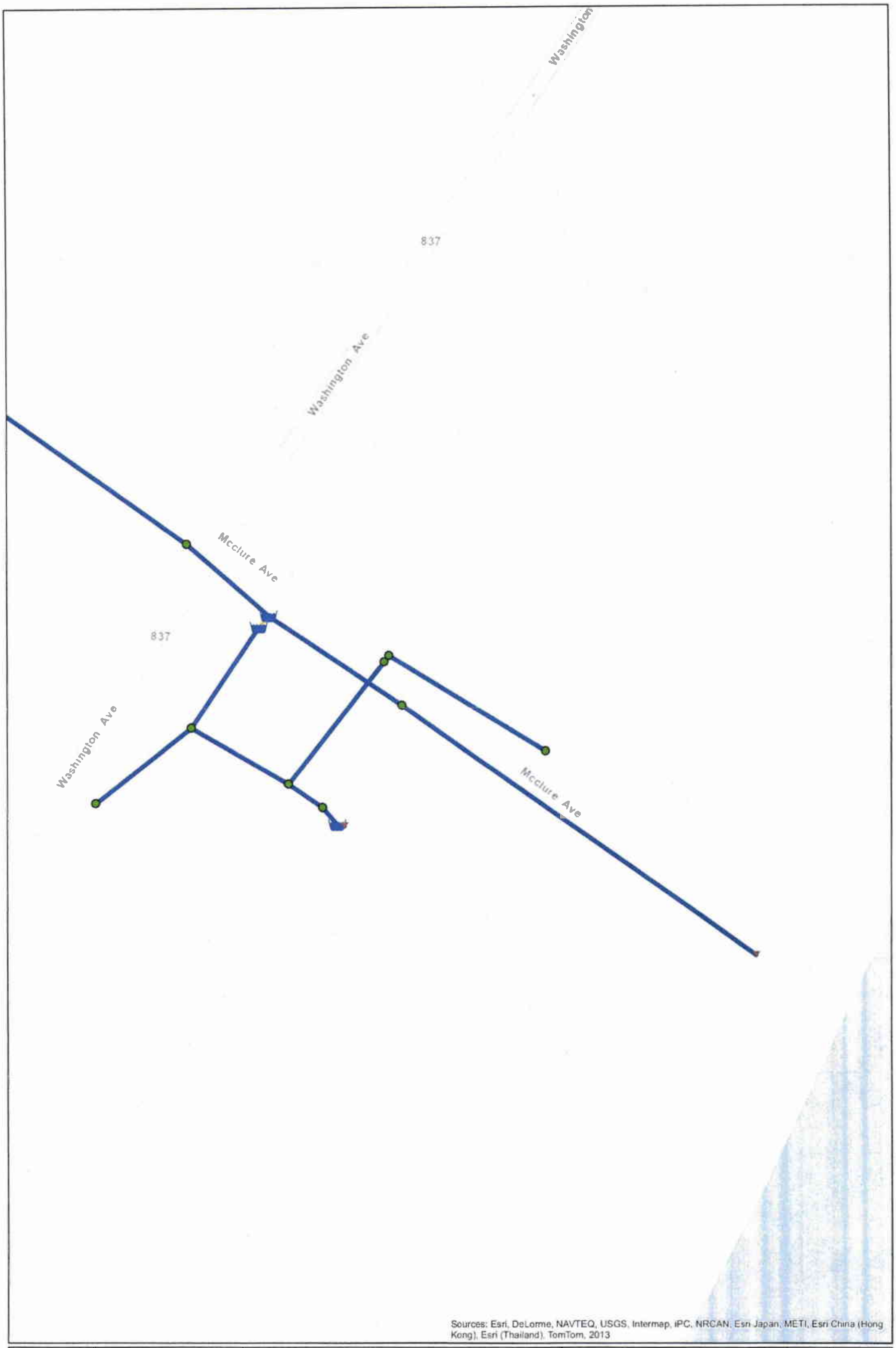
Appendix A

System Map
CSO Location Map
Tributary Area Map


WEST MIFFLIN BOROUGH
MONONGAHELA RIVER
FLOW
REVISIONS
DATE
DESCRIPTION
G.I.S.
MAPPING
BOROUGH OF DRAVOSBURG
ALLEGHENY COUNTY, PA
COMBINED SEWER
SYSTEM
G.I.S. MAPPING
1 of 1



220-53 Exhibit	0 325 650 Feet	CITY OF DRAVOSBURG ALLEGHENY COUNTY, PENNSYLVANIA SEWER TYPES	KLH ENGINEERS, INC.



220-53

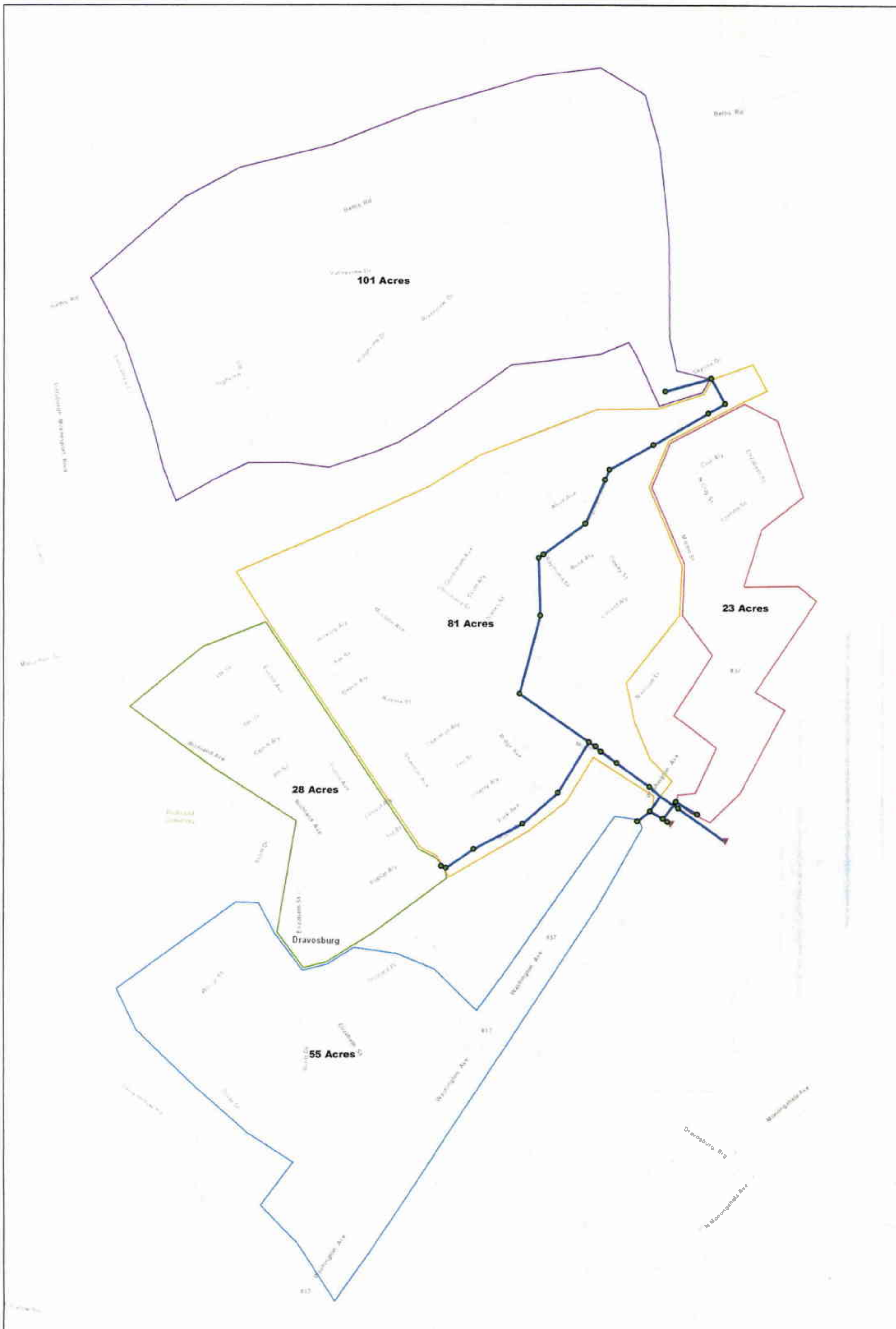
Exhibit

0 40 80
Feet

CITY OF DRAVOSBURG
ALLEGHENY COUNTY, PENNSYLVANIA
CSO LOCATION

KLH
ENGINEERS INC

N



Sources: Esri, DeLorme, NAVTEQ, USGS, Intermap, iPC, NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), TomTom, 2013

220-53 Exhibit

0 360 720 Feet

CITY OF DRAVOSBURG
ALLEGHENY COUNTY, PENNSYLVANIA
FLOW TRIBUTARY AREAS

KLH ENGINEERS, INC.

APPENDIX B

DRAVOSBURG SURVEY FIELD BOOK

SOKKIA

220-53
AS OF
11/11/13

MADE IN CHINA

220 MACM

SOKKIA

TRANSIT
FIELD BOOK

220
MACM

No. 8152-00

(08-29-13)

DRAVOSBURG
220-53_082713

VRS LOCATIONS (5" TOPO POINT, AH=5,905')

200	(OUTFALL) INV/72"RCP	(100)	AH=14.275'
201	SANMH	(176)	AH=5.905'
202	"	(101)	"
203	"	(102)	"
204	"	(105)	"
205	"	(104)	"
206	"	(173)	"
207	"	(171)	"
208	"	(434)	"
209	"	(414)	"
210	"	(416)	"
211	"	(409)	"
212	"	(408)	"
213	"	(407)	"
214	"	(406)	"

84°F. [illegible] 3 PM CREW: MARK W.

(13)

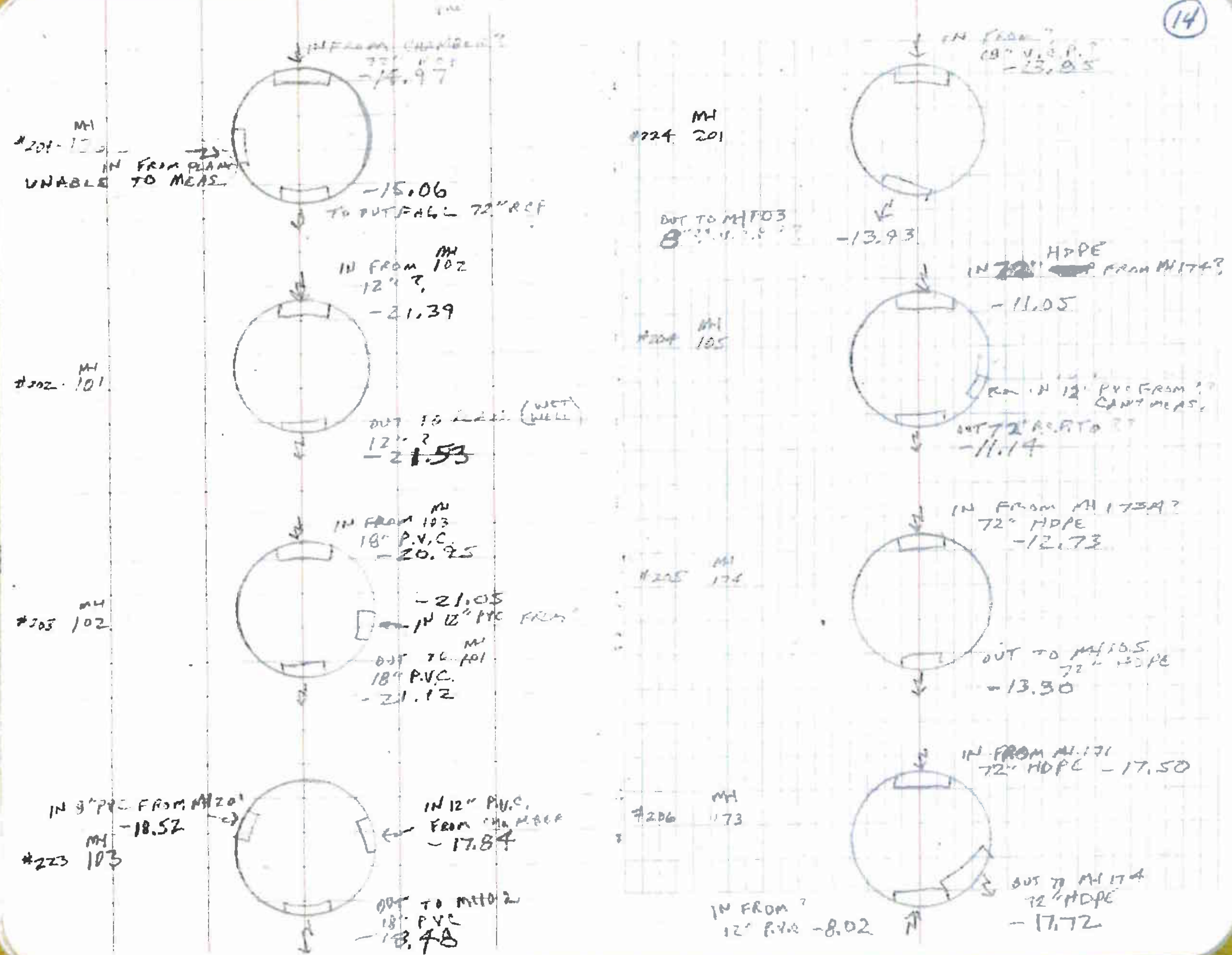
(CONT.) VRS LOCATIONS

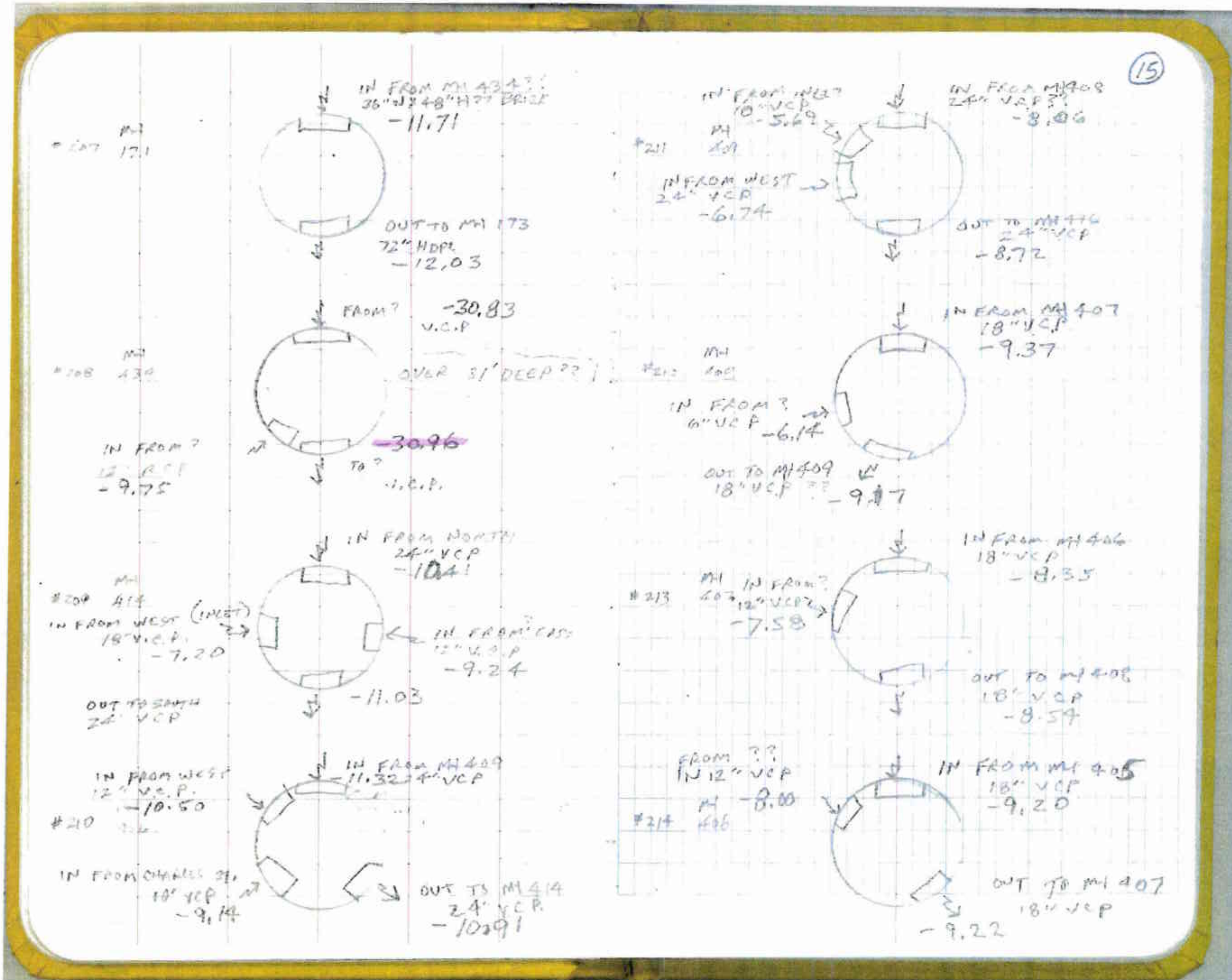
215	SANMH	(405)
216	"	(403)
217	"	(402)
218	"	(107)
219	"	(144)
220	"	(108)
221	"	(156)
222	"	(157)
223	"	(103)
224	"	(301)
225	TWC	(TOP OF CONC. ENCASED OUTFALL)

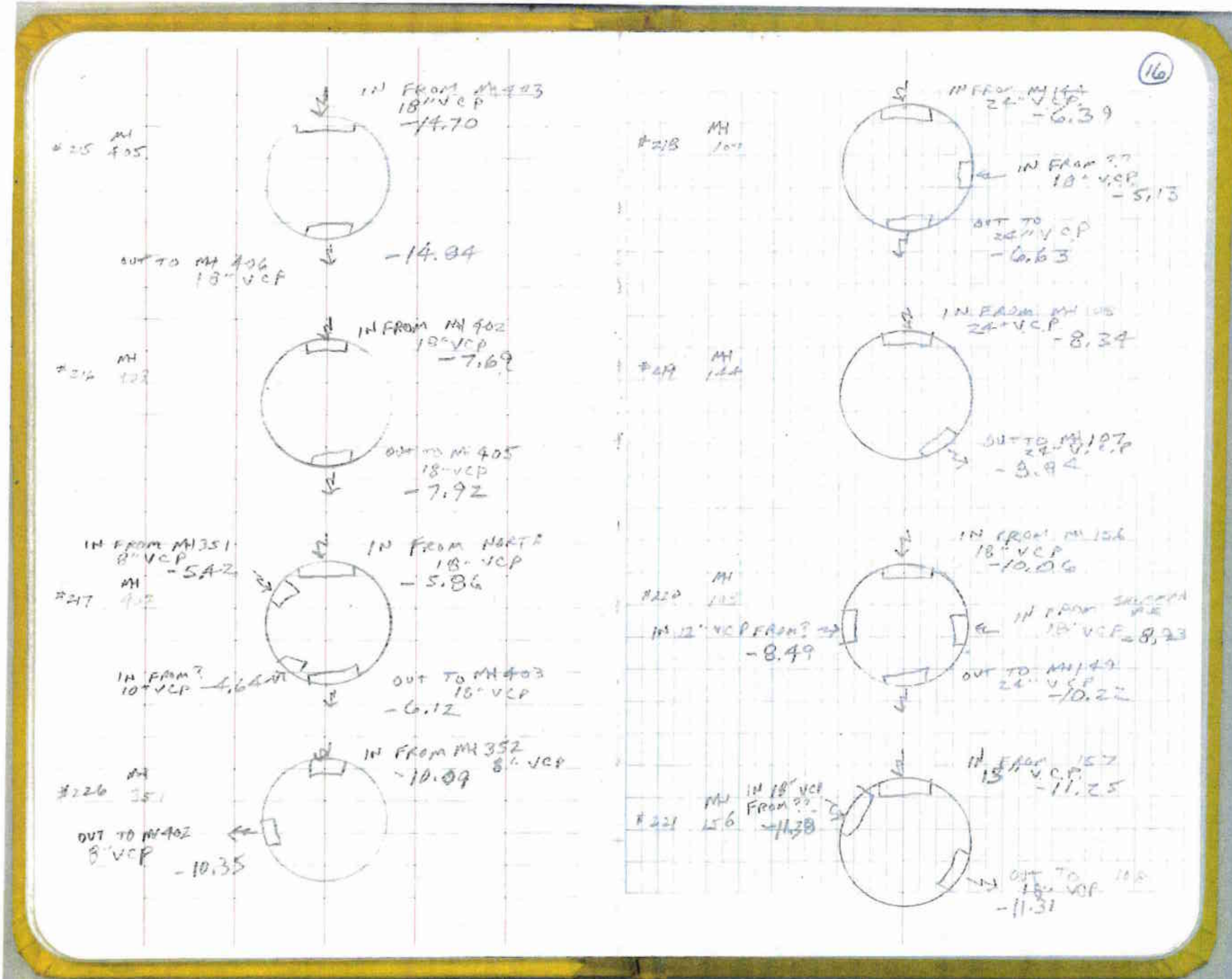
(09-04-13)

226	SAN MH	(351)
227	"	(352) PAVED OVER

VOID NOT SANITARY (ELEC. OR TELE.?)


IN FROM CHAMBER?
-17.97
MH
#201 - 12[illegible]
IN FROM PLANT
UNABLE TO MEAS.
-15.06
TO OUTFALL 72" RCP
IN FROM MH 102
12" ?
-21.39
MH
#202 - 101
OUT TO [illegible] (WET WELL)
12" ?
-21.53
IN FROM MH 103
18" P.V.C.
-20.75
-21.05
IN 12" PVC FROM
MH
#203 102
OUT TO MH 101
18" P.V.C.
-21.12
IN 8" PVC FROM MH 201
-18.52
MH
#223 103
IN 12" PVC.
FROM CHAMBER
-17.84
OUT TO MH 102
18" PVC
-18.48
IN FROM ?
18" V.C.P. ?
-13.85
MH
#224 201
OUT TO MH 103
8" [illegible]
-13.93
HDPE
IN 72" FROM MH 174?
-11.05
MH
#204 105
IN 12" PVC FROM ??
CAN'T MEAS.
OUT 72" RCP TO ??
-11.14
IN FROM MH 173A?
72" HDPE
-12.73
MH
#205 174
OUT TO MH 105
72" HDPE
-13.30
IN FROM MH 171
72" HDPE -17.50
MH
#206 173
OUT TO MH 174
72" HDPE
-17.72
IN FROM ?
12" PVC -8.02

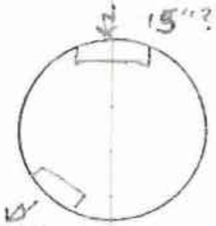

15
#207 MH 171
IN FROM MH 434 ?
36"W X 48"H ?? BRICK
-11.71
OUT TO MH 173
72" HDPE
-12.03
#208 MH 434
FROM ?
-30.83
V.C.P
OVER 31' DEEP ??
IN FROM ?
12" RCP
-9.75
-30.96
TO ?
V.C.P.
#209 MH 414
IN FROM NORTH
24" VCP
-10.41
IN FROM WEST (INLET)
18" V.C.P.
-7.20
IN FROM EAST ?
12" V.C.P
-9.24
-11.03
OUT TO SOUTH
24" VCP
#210
IN FROM WEST
12" V.C.P.
-10.50
IN FROM MH 409
-11.32 24" VCP
IN FROM CHARLES ST.
18" VCP
-9.14
OUT TO MH 414
24" VCP
-10.91
#211 MH 409
IN FROM INLET
10" VCP
-5.69
IN FROM MH 408
24" VCP ??
-8.06
IN FROM WEST
24" VCP
-6.74
OUT TO MH 416
24" VCP
-8.72
#212 MH 408
IN FROM MH 407
18" VCP
-9.37
IN FROM ?
6" VCP
-6.14
OUT TO MH 409
18" VCP ??
-9.47
#213 MH 407
IN FROM ?
12" VCP
-7.58
IN FROM MH 406
18" VCP
-8.35
OUT TO MH 408
18" VCP
-8.54
#214 MH 406
FROM ??
IN 12" VCP
-8.00
IN FROM MH 405
18" VCP
-9.20
OUT TO MH 407
18" VCP
-9.22



16
#215 MH 405
IN FROM MH 403
18" VCP
-14.70
OUT TO MH 406
18" VCP
-14.84
#216 MH
IN FROM MH 402
18" VCP
-7.69
OUT TO MH 405
18" VCP
-7.92
IN FROM MH 351
8" VCP
-5.42
IN FROM NARTA
18" VCP
-5.86
#217 MH
IN FROM?
10" VCP
-4.64
OUT TO MH 403
18" VCP
-6.12
#226 MH
IN FROM MH 352
8" VCP
-10.09
OUT TO MH 402
8" VCP
-10.35
#218 MH
IN FROM MH 144
24" VCP
-6.39
IN FROM ??
18" VCP
-5.13
OUT TO
24" VCP
-6.63
#219 MH 144
IN FROM MH
24" VCP
-8.34
OUT TO MH 197
24" VCP
-9.94
#220 MH
IN FROM MH 156
18" VCP
-10.06
IN 12" VCP FROM ??
-8.49
18" VCP -8.93
OUT TO MH 149
24" VCP
-10.22
#221 MH 156
IN 18" VCP
FROM ??
-11.38
IN FROM
15" V.C.P.
-11.25
OUT TO
18" VCP
-11.31

#222 MH 157

FROM SOUTH
15"? V.C.P ?
-11.76

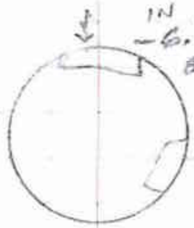


OUT 15" V.C.P
TO MH 156 -11.77

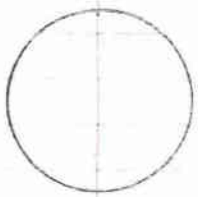
(11-07-13)

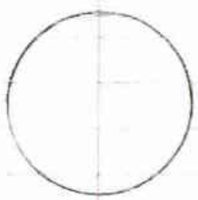
IN FROM WEST
-6.52
8" VCP

#2̶3̶7̶ MH 352
#235



→ OUT TO MH 351
-6.55
8" VCP

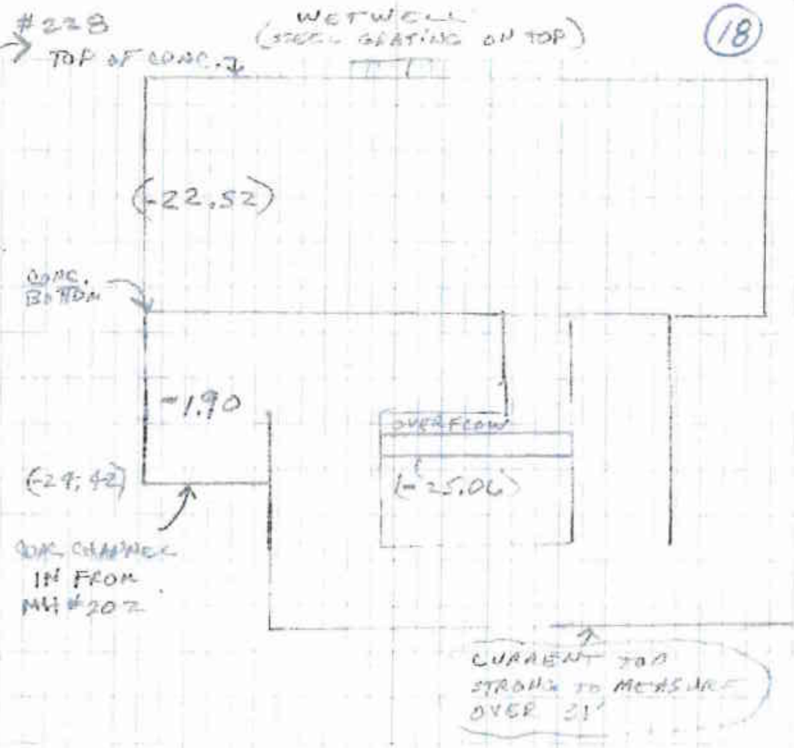


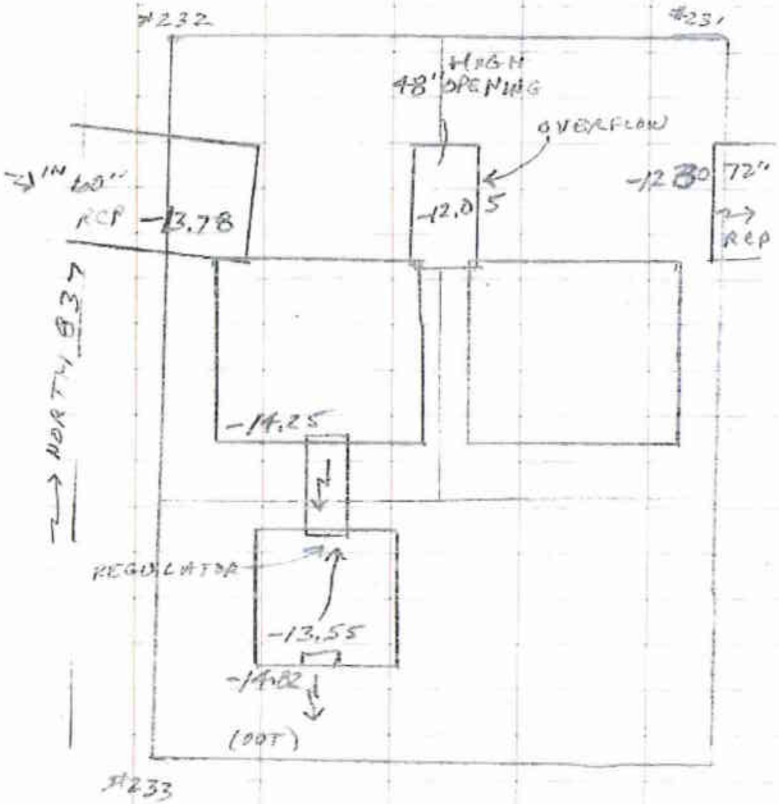


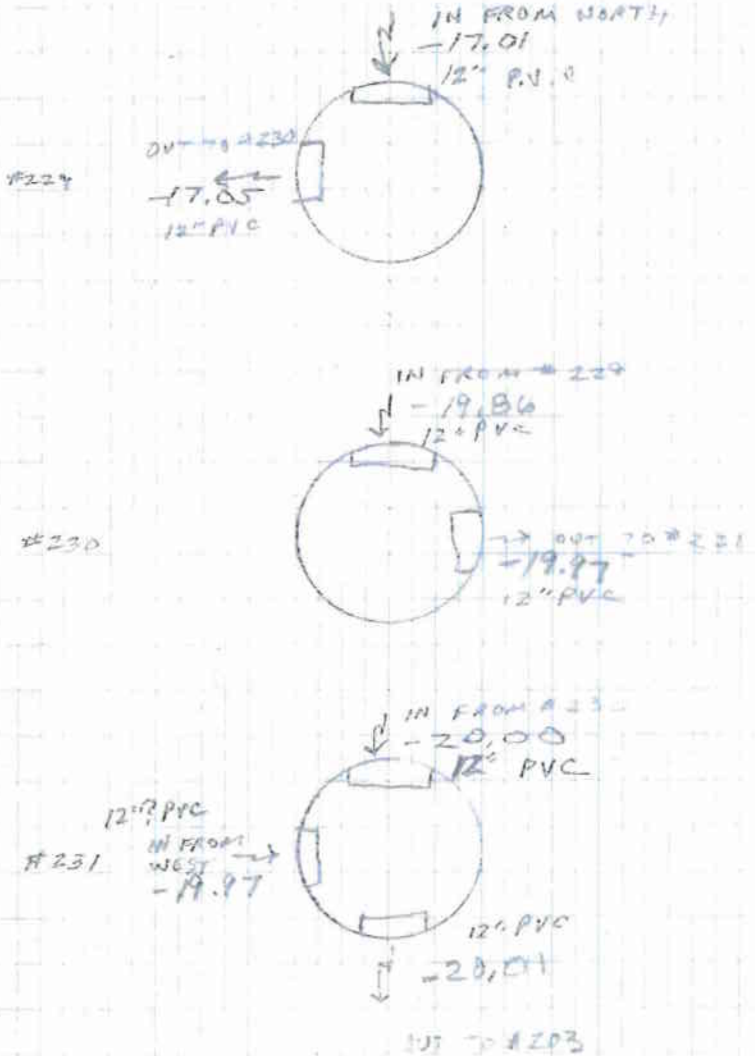
(11-0--13)

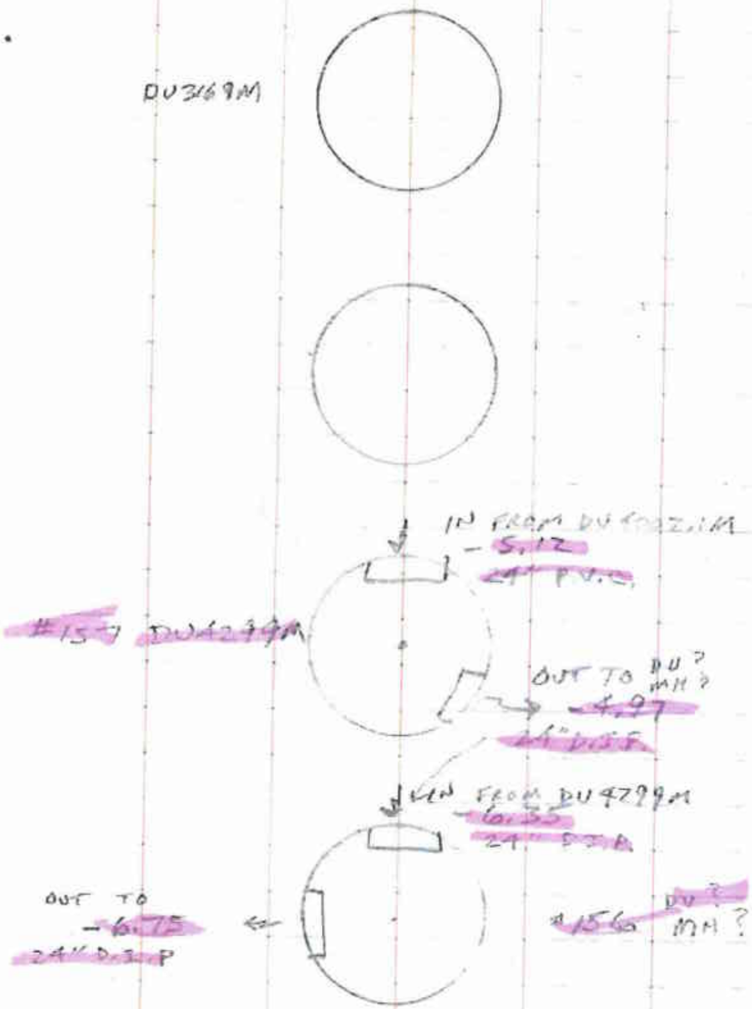
228	TWC	@ WETWELL
229	SANMH	
230	SANMH	
231	SANMH	
232-234	TWC	@ FLOW PIT (SEE SKETCH NEXT PG.)

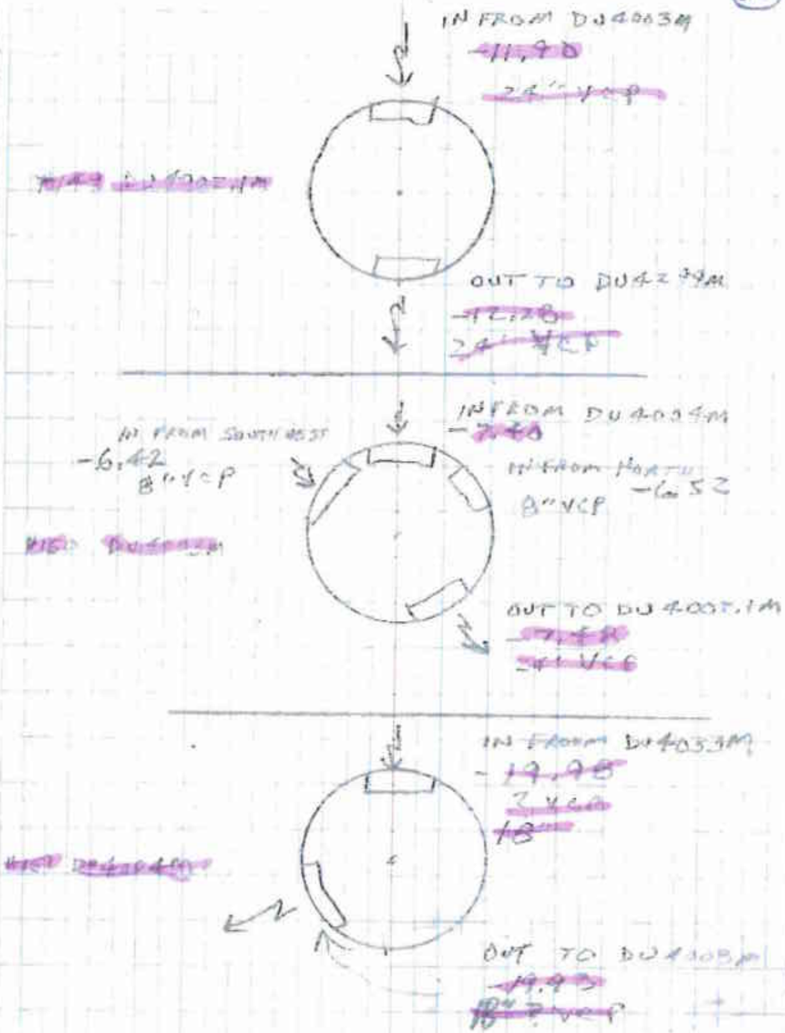
235 SAN MH #352
USE INSTEAD OF #227
SEE SKETCH PG #17




#232
#231
48" HIGH OPENING
OVERFLOW
IN 60"
RCP -13.78
-12.05
-12.30 72"
RCP
NORTH 837
-14.25
REGULATOR
-13.55
-14.82
(OUT)
#233


IN FROM NORTH
-17.01
12" P.V.C
OUT TO #230
#229
-17.05
12" PVC
IN FROM #229
-19.86
12" PVC
#230
OUT TO #231
-19.97
12" PVC
IN FROM #233
-20.00
12" PVC
12" PVC
IN FROM WEST
#231
-19.97
12" PVC
-20.01
OUT TO #203


DU3169M
IN FROM DU
- 5.12
#15
OUT TO DU? MH?
IN FROM DU4799M
OUT TO
- 6.75
24" D.I.P
#156 DU? MH?


IN FROM DU4003M
-11.90
OUT TO DU4299M
-12.28
IN FROM DU4004M
IN FROM SOUTHWEST
-6.42
8" VCP
IN FROM NORTH
-6.52
8" VCP
OUT TO DU4005.1M
IN FROM DU4033M
-19.98
OUT TO
-19.93

APPENDIX C

DRNACH METER SITE INSPECTION FORMS

DRNACH ENVIRONMENTAL, INC.

MANHOLE INSPECTION FORM

Project Name	Dravosburg Flow
Manhole Identification	M-6A
Surveyor's Name	Alexander Matscherz
Site Description	Next to road in front of Dravosburg Plant.
Street	378 Clairton Dravosburg Road
Date	August 29, 2013

Site Photo

Frame And Cover

Cover:	Solid	Pick holes:	No

At Grade:	X	Below:		Above:	

Diameter (in.):	29.5
DS Rim to Invert (in):	168

Interior

Brick:		Precast:	X	Other:	

Ladder Present:	Yes	Safe:	Yes

Infiltration Observed

Describe:

Inlets

Size:	Pipe Material:	Notes:
12 inch	VCP	Metering point
inch		
inch		
inch		
inch		

Interior Photo

Outlets

Size:	Pipe Material:	Notes:
12 inch	VCP	
inch		

GPS Information

Accuracy:	Elevation:	Latitude:	Longitude:
20 feet	737 feet	40.349284	79.886014

Notes

DRNACH ENVIRONMENTAL, INC.

MANHOLE INSPECTION FORM

Project Name	Dravosburg Flow	**Manhole Identification**	M-7A

Surveyor's Name: Alexander Matscherz

Site Description: In gravel road next to Dravosburg Plant.

Street: McClure Street

Date: August 29, 2013

Site Photo

Frame And Cover

Cover:	Solid	Pick holes:	No

At Grade: X	Below:	Above:

Diameter (in.):	28.75
DS Rim to Invert (in):	246

Interior

Brick:	Precast: X	Other:

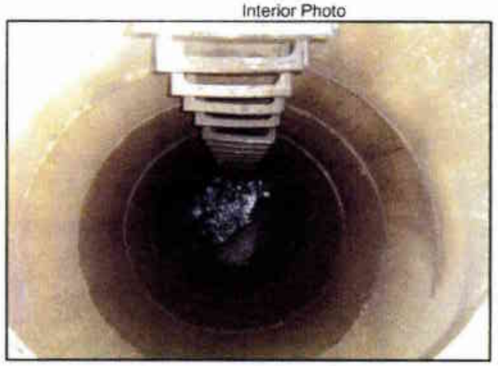
Ladder Present:	Yes	Safe:	Yes

Infiltration Observed Describe:

Inlets

Size:	Pipe Material:	Notes:
12 inch	PVC	
12 inch	PVC	
inch		
inch		
inch		

Interior Photo



Outlets

Size:	Pipe Material:	Notes:
12 inch	PVC	Metering point
inch		

GPS Information

Accuracy:	Elevation:	Latitude:	Longitude:
20 feet	744 feet	40.349557	79.885361

Notes

DRNACH ENVIRONMENTAL, INC. **MANHOLE INSPECTION FORM**

Project Name	Dravosburg Flow	**Manhole Identification**	M-3

Surveyor's Name
Alexander Matscherz

Site Description
In grass in front of Dravosburg Plant.

Street
378 Clairton Dravosburg Road

Date
August 29, 2013

Site Photo

Frame And Cover

Cover:	Solid	Pick holes:	No
At Grade: X	Below:	Above:	

Diameter (in.):	28.75
DS Rim to Invert (in):	220

Interior

Brick:	Precast: X	Other:

Ladder Present:	Yes	Safe:	Yes

Infiltration Observed Describe:

nlets

Size:		Pipe Material:	Notes:
12	inch	PVC	Metering point
12	inch	PVC	
	inch		
	inch		
	inch		

Interior Photo

Outlets

Size:		Pipe Material:	Notes:
18	inch	PVC	
	inch		

GPS Information

Accuracy:	20 feet	Elevation:	741 feet	Latitude:	40.349416	Longitude:	79.885779

Notes

DRNACH ENVIRONMENTAL, INC.

MANHOLE INSPECTION FORM

Project Name	Dravosburg Flow
Manhole Identification	M-4A
Surveyor's Name	Alexander Matscherz
Site Description	In back yard of 181 Duquesne Avenue
Street	181 Duquesne Avenue
Date	August 29, 2013

Site Photo

Frame And Cover

Cover:	Solid	Pick holes:	No
Diameter (in.):	30		

At Grade:		Below:		Above:	X

DS Rim to Invert (in):	120

Interior

Brick:		Precast:	X	Other:	

Ladder Present:	Yes	Safe:	Yes

Infiltration Observed Describe:

Inlets

Size:		Pipe Material:	Notes:
8	inch	VCP	Metering point
	inch		
	inch		
	inch		
	inch		

Interior Photo

Outlets

Size:		Pipe Material:	Notes:
8	inch	VCP	
	inch		

GPS Information

Accuracy:	20 feet	Elevation:	990 feet	Latitude:	40.35562	Longitude:	79.884906

Notes

DRNACH ENVIRONMENTAL, INC.

MANHOLE INSPECTION FORM

Project Name	Dravosburg Flow
Manhole Identification	M-5
Surveyor's Name	Alexander Matscherz
Site Description	Middle of road in front of Dravosburg United Methodist.
Street	110 Maple Avenue
Date	August 29, 2013

Site Photo

Frame And Cover

Cover:	Solid	Pick holes:	No
At Grade: X	Below:	Above:	

Diameter (in.):	26.5
DS Rim to Invert (in):	136

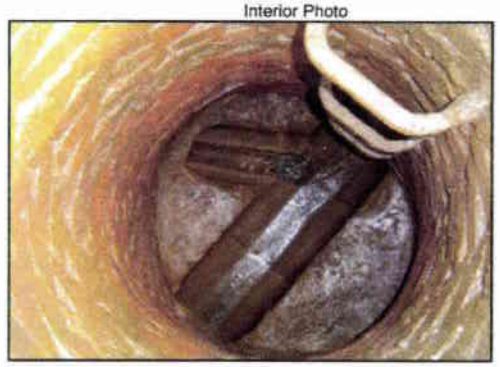
Interior

Brick: X	Precast:	Other:

Ladder Present:	Yes	Safe:	Yes

Infiltration Observed Describe:

Interior Photo



Inlets

Size:		Pipe Material:	Notes:
21	inch	VCP	
15	inch	VCP	Metering point
	inch		
	inch		
	inch		

Outlets

Size:		Pipe Material:	Notes:
21	inch	VCP	
	inch		

GPS Information

Accuracy:	Elevation:	Latitude:	Longitude:
20 feet	844 feet	40.348521	79.889621

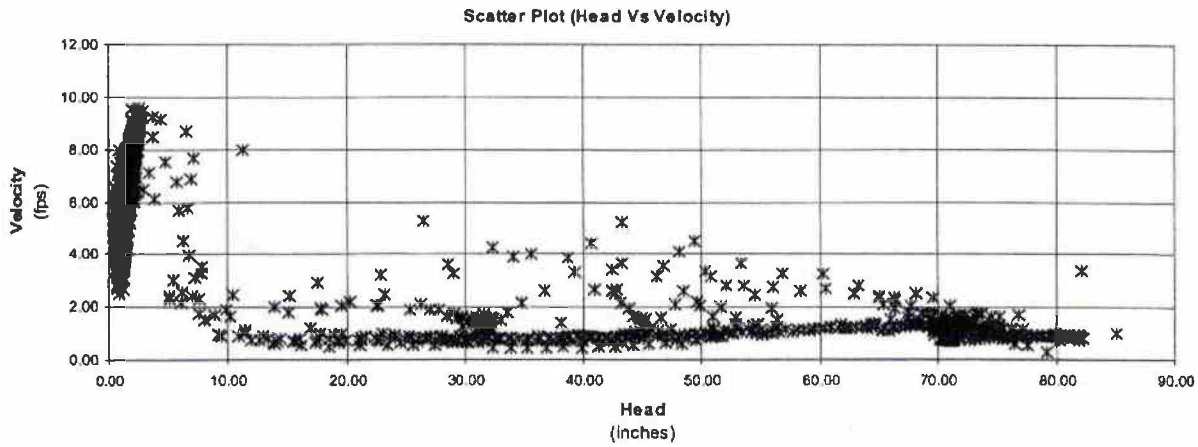
Notes

APPENDIX D

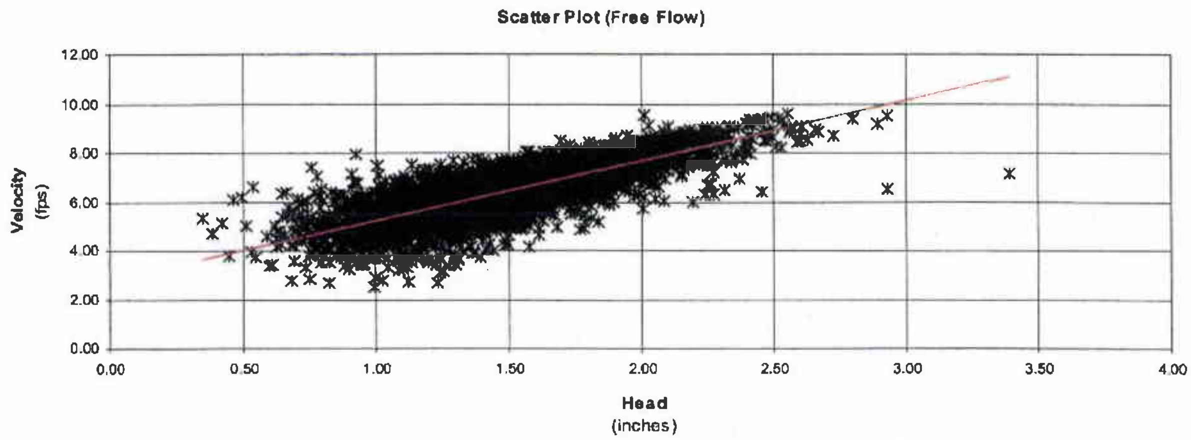
DRNACH SCATTERGRAPHS

Line Size: 12 " Manhole Depth: 0 "

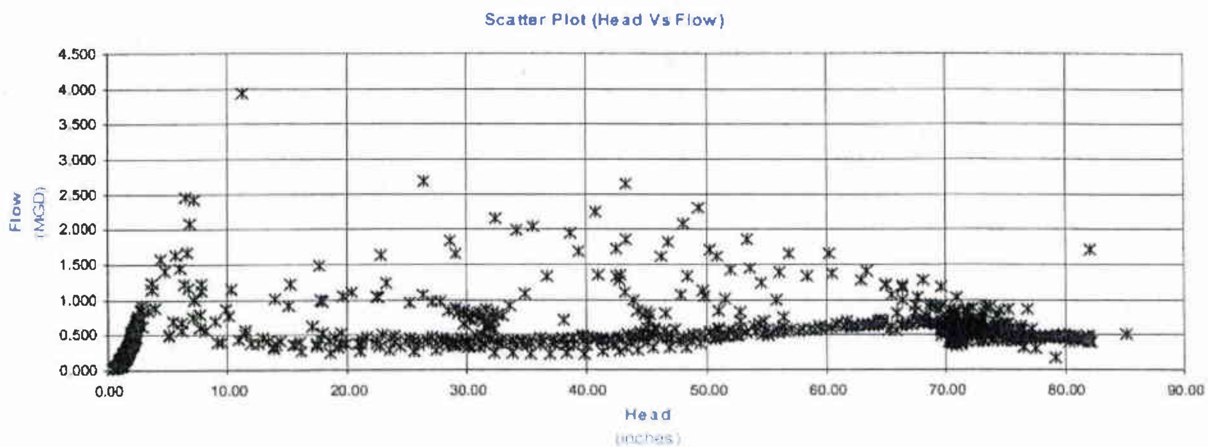
M-3 January 1, 2013 through January 31, 2013



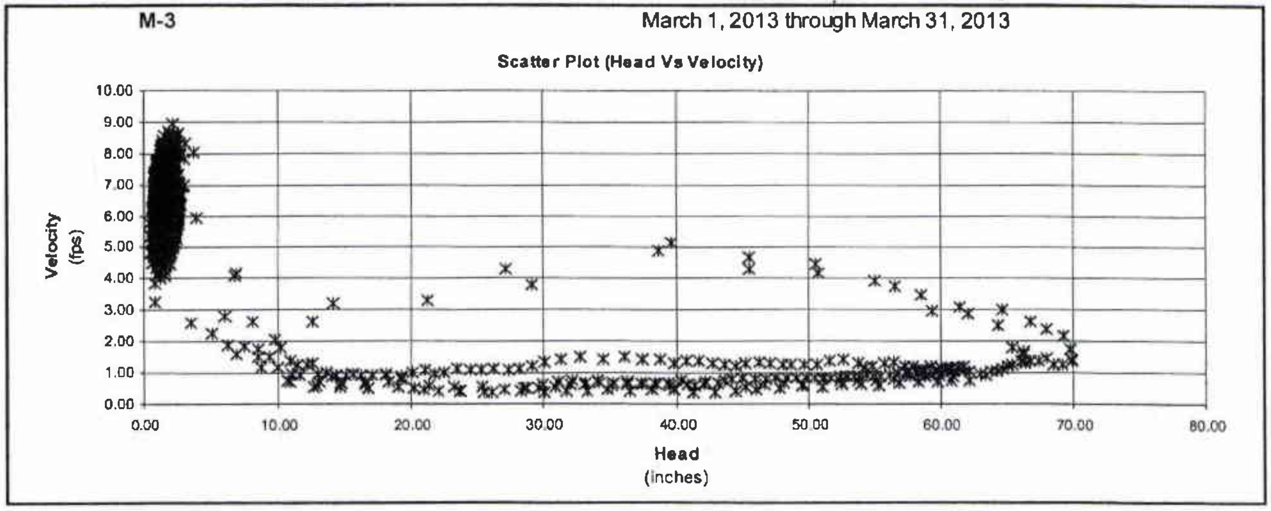
M-3 January 1, 2013 through January 31, 2013

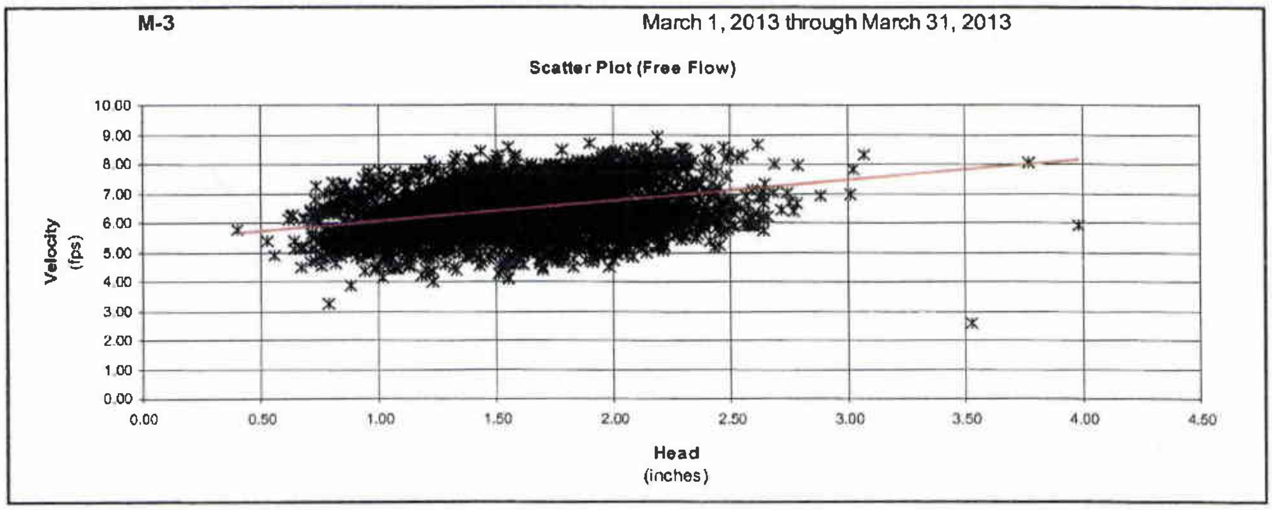


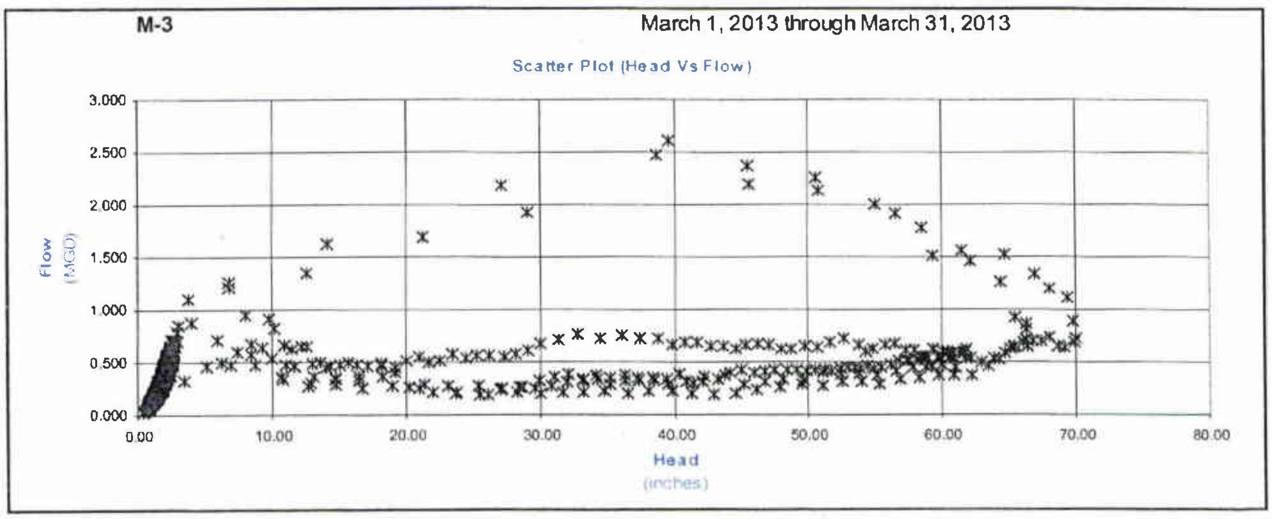
M-3 January 1, 2013 through January 31, 2013



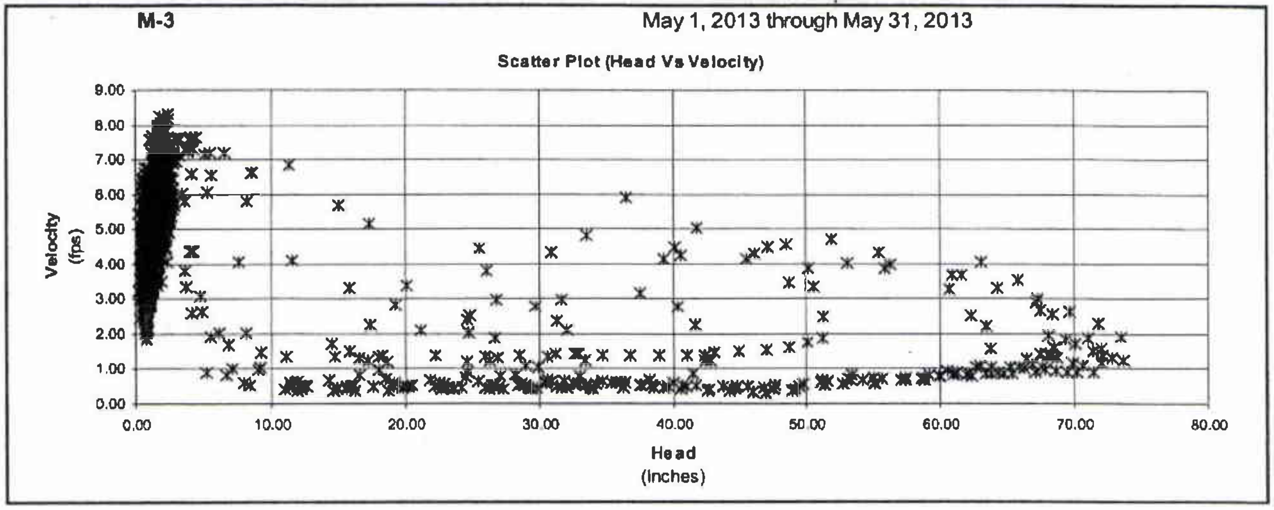
Line Size: 12 " Manhole Depth: 0 "

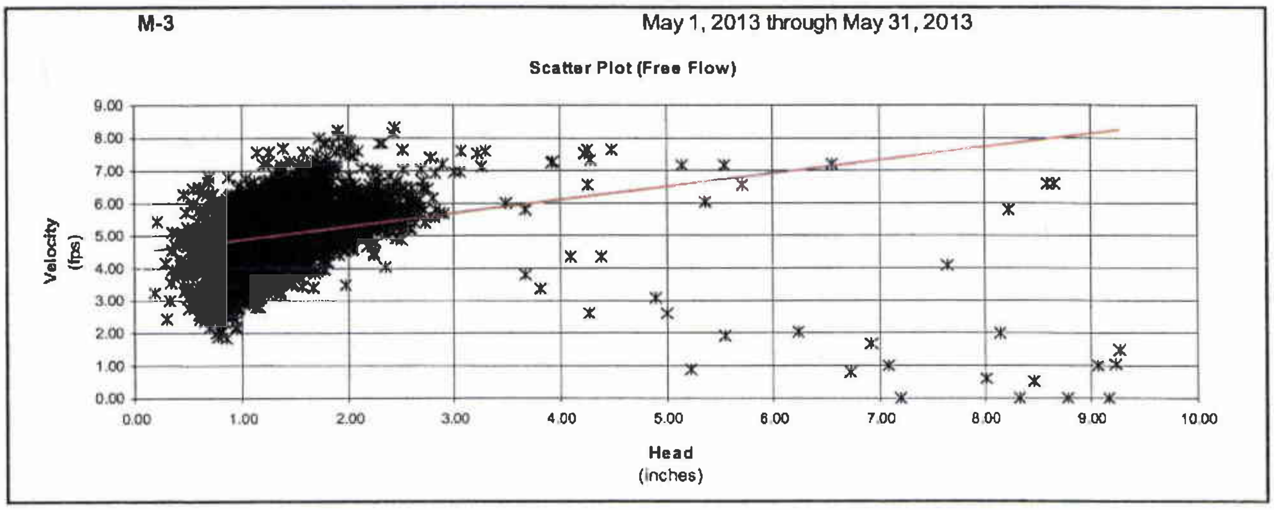


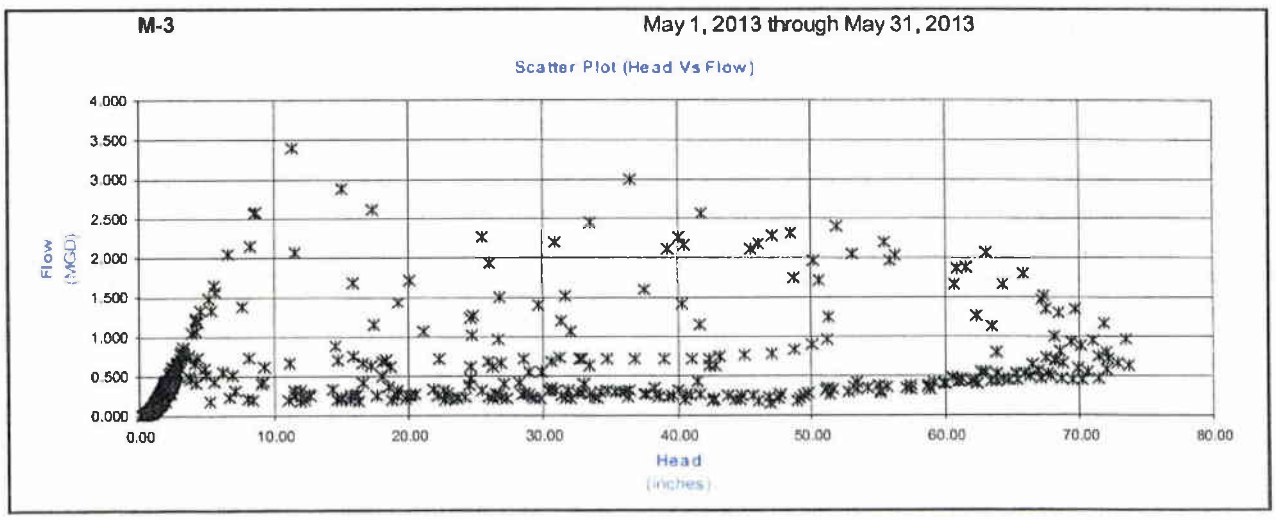




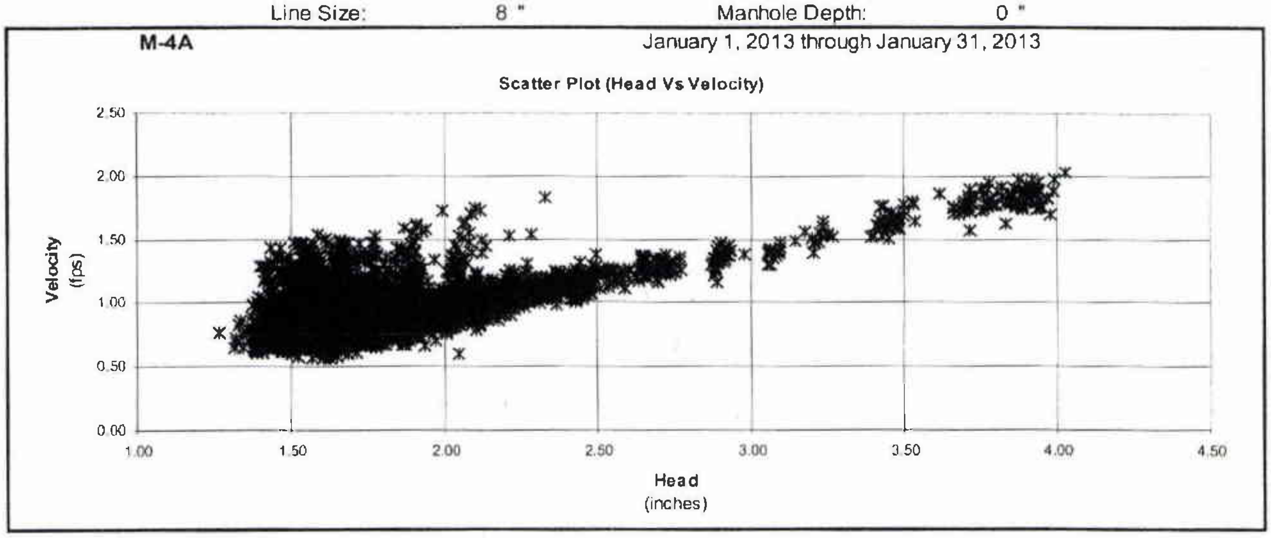
Line Size: 12 " Manhole Depth: 0 "

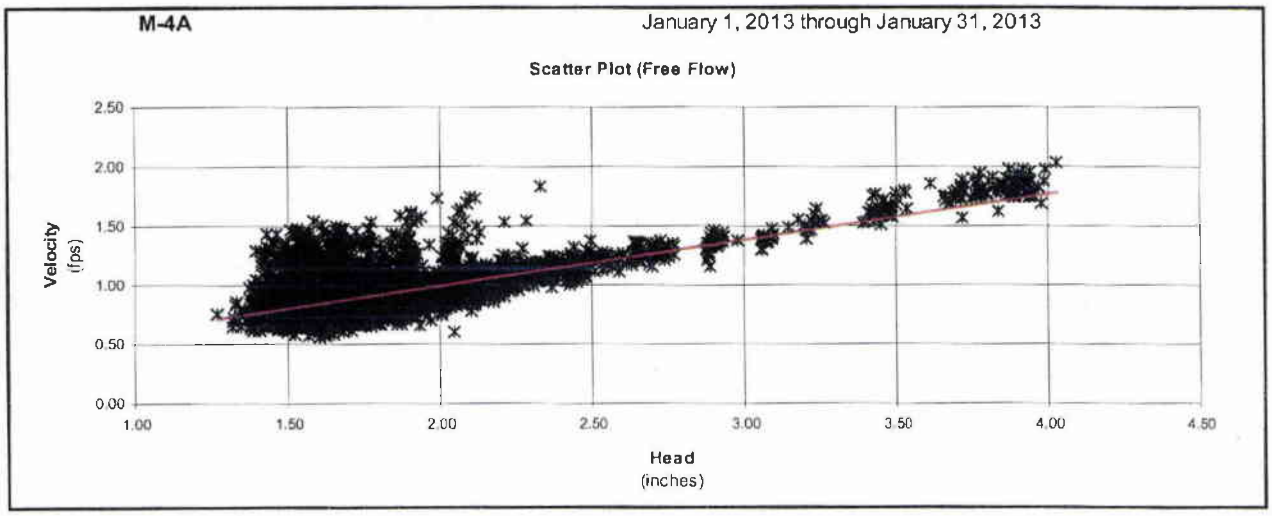


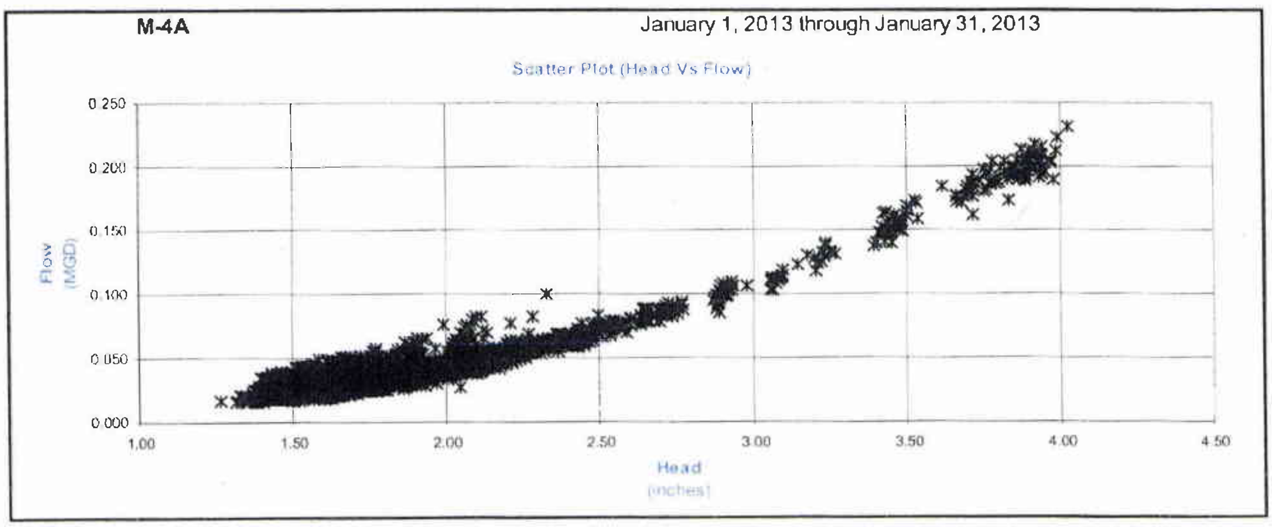




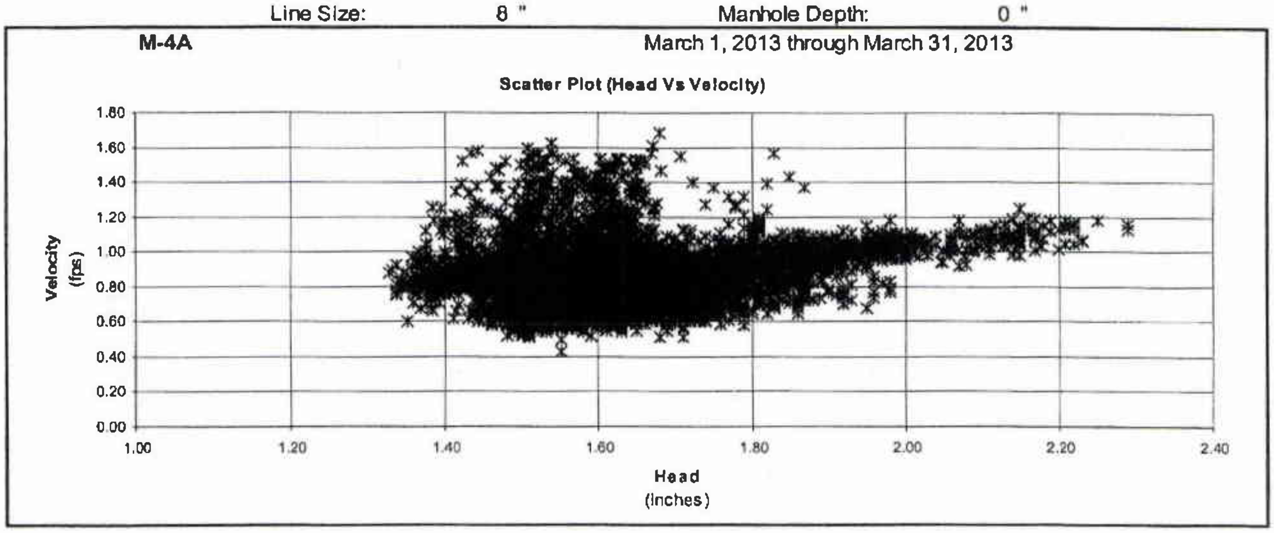
Line Size: 8 " Manhole Depth: 0 "

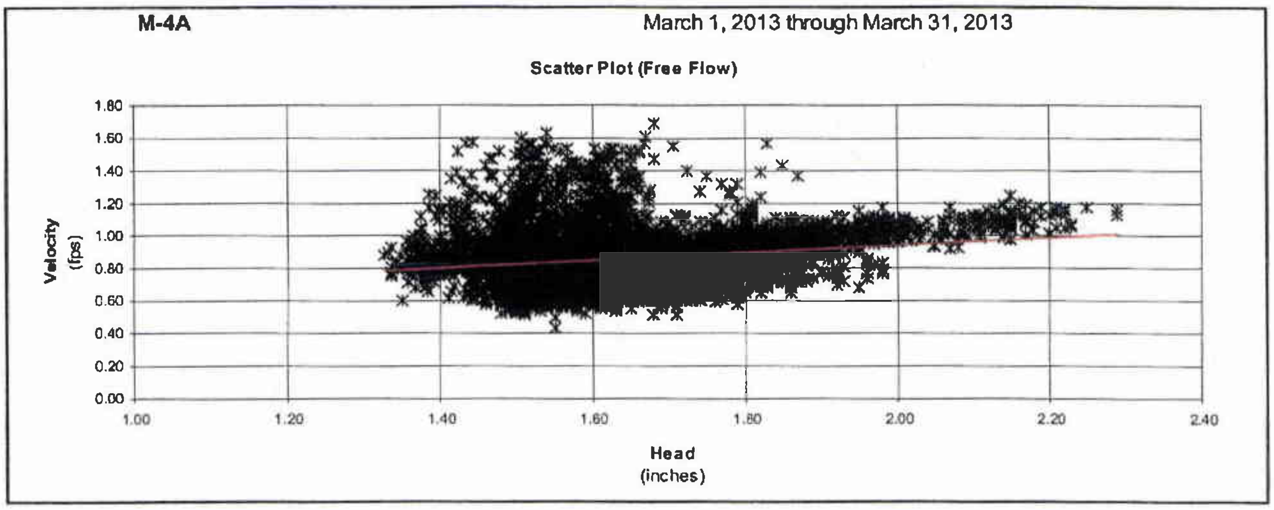


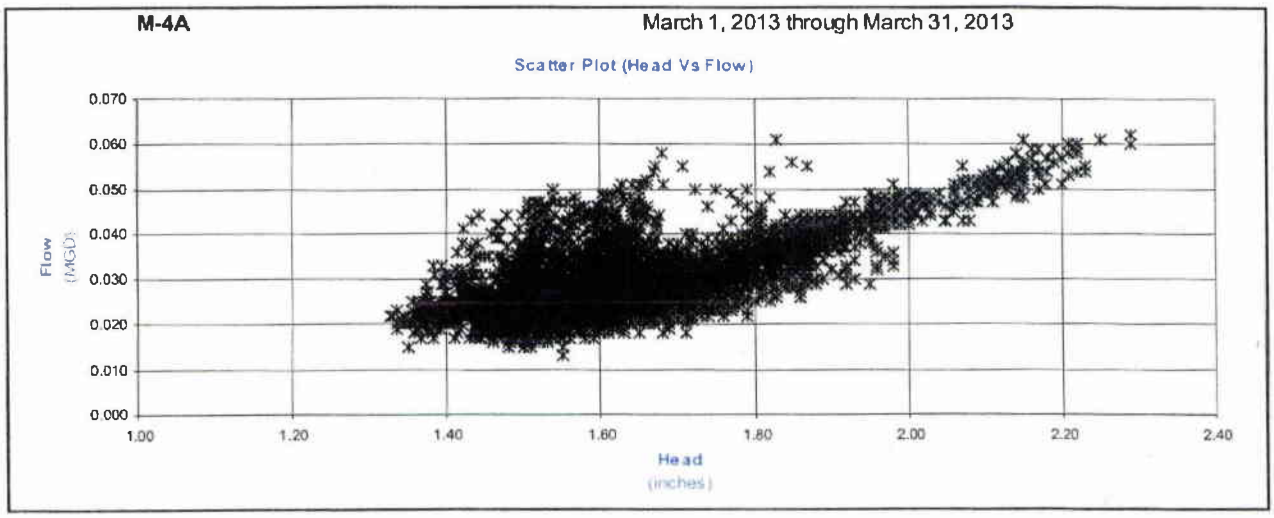




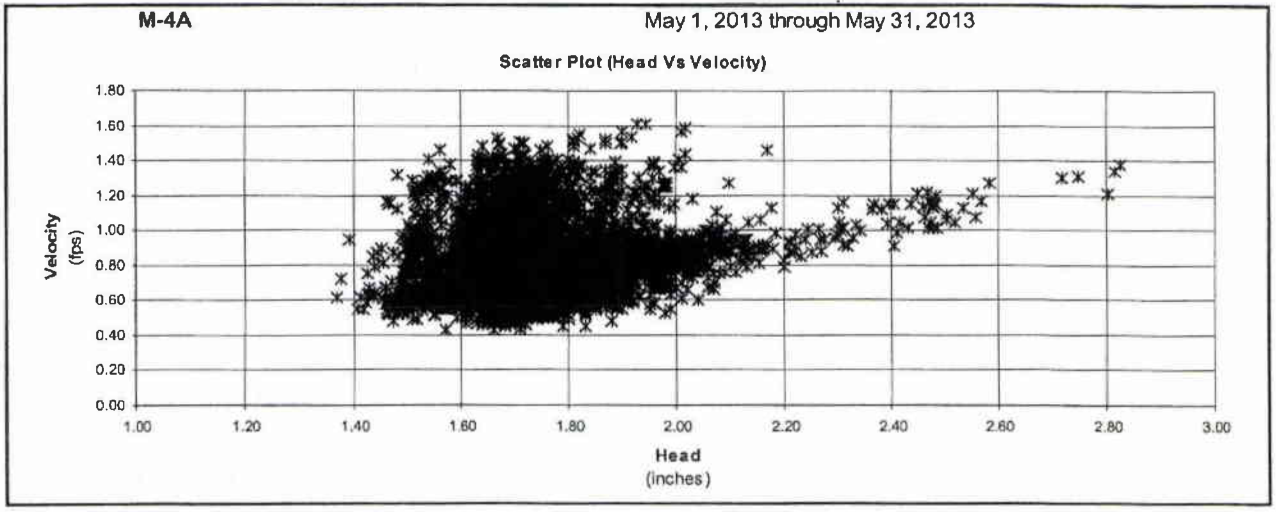
Line Size: 8 " Manhole Depth: 0 "

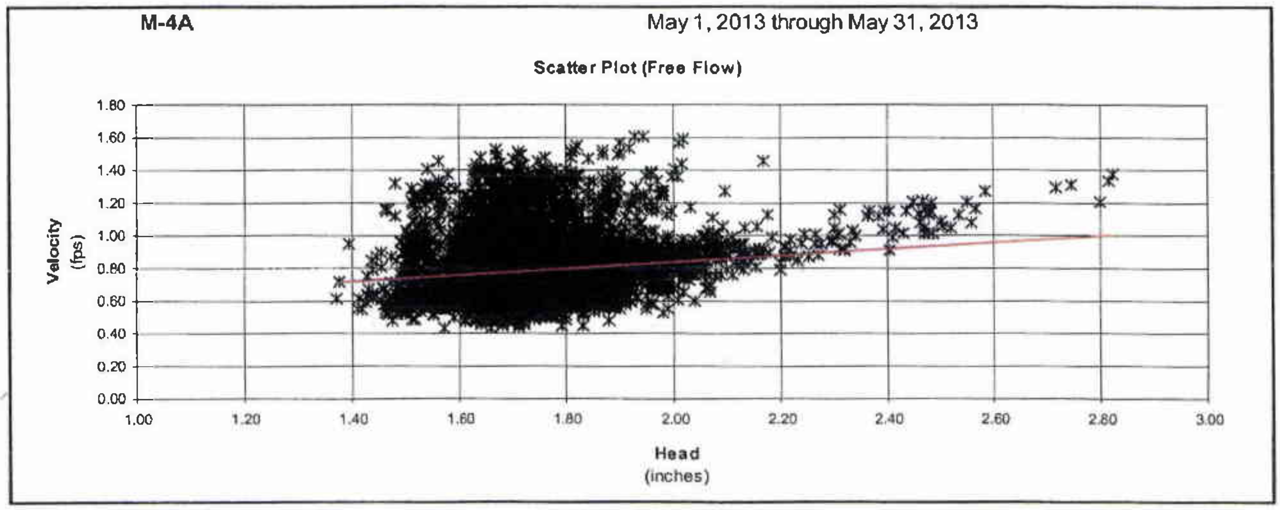


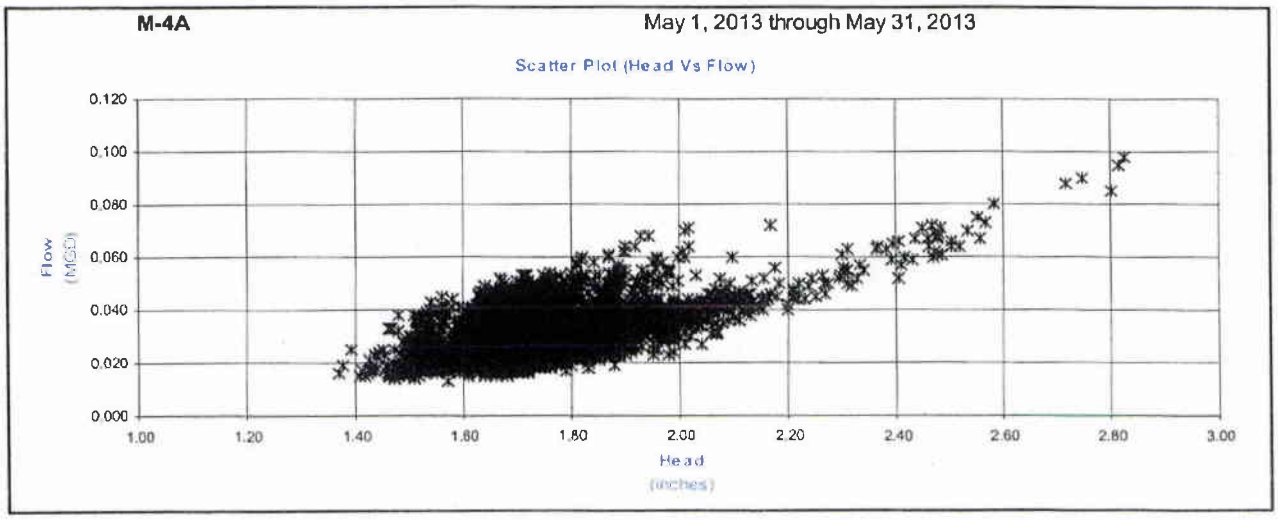




Line Size: 8 " Manhole Depth: 0 "



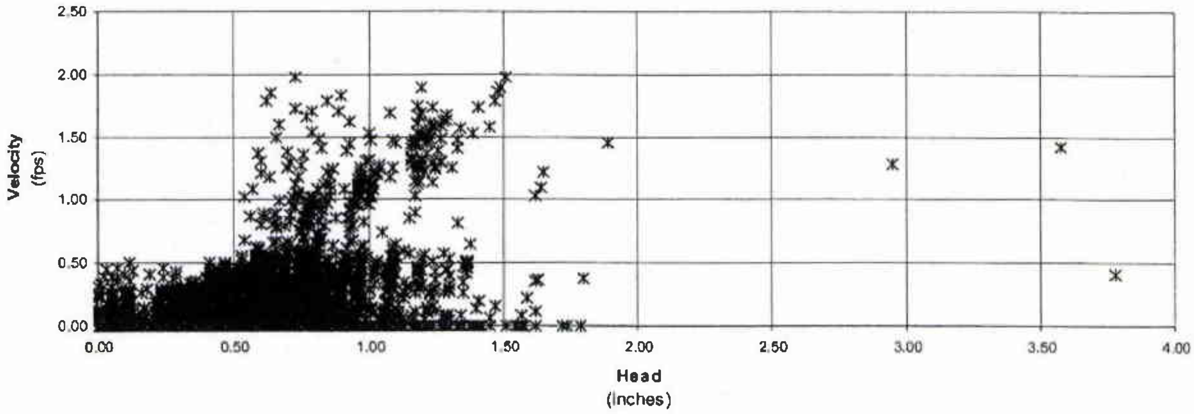




Line Size: 15 "   Manhole Depth: 0 "

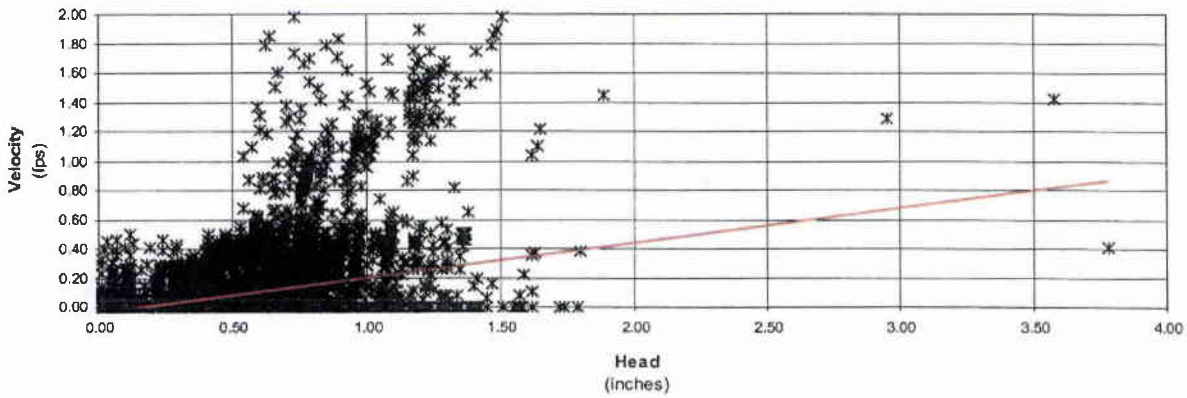
M-5   January 1, 2013 through January 31, 2013

Scatter Plot (Head Vs Velocity)



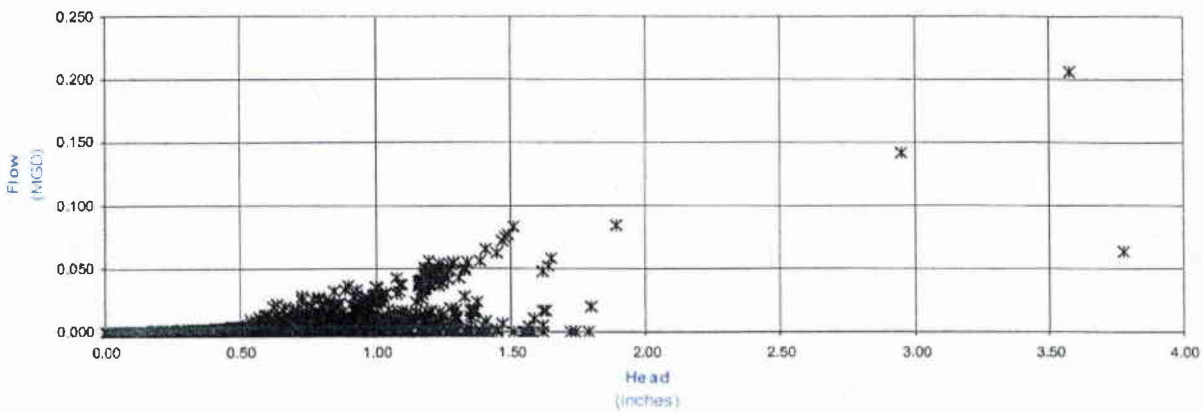
M-5   January 1, 2013 through January 31, 2013

Scatter Plot (Free Flow)

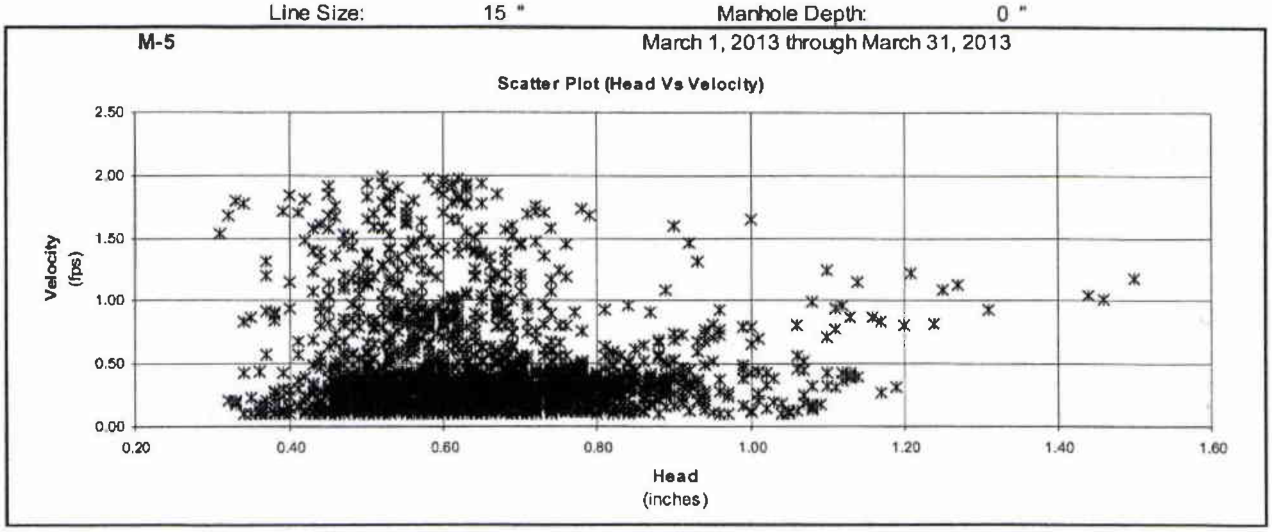


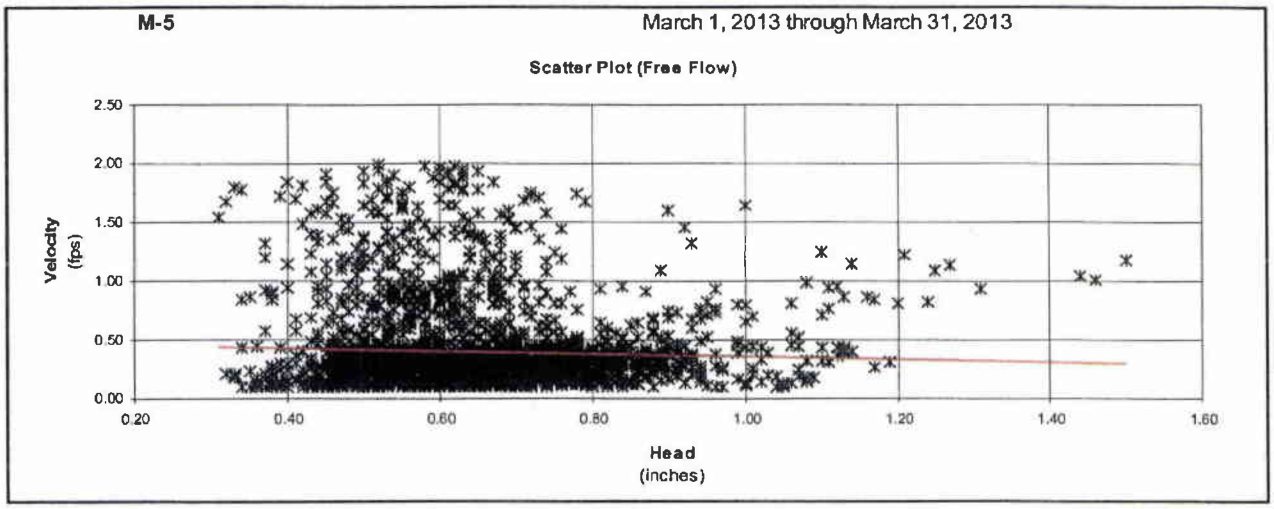
M-5   January 1, 2013 through January 31, 2013

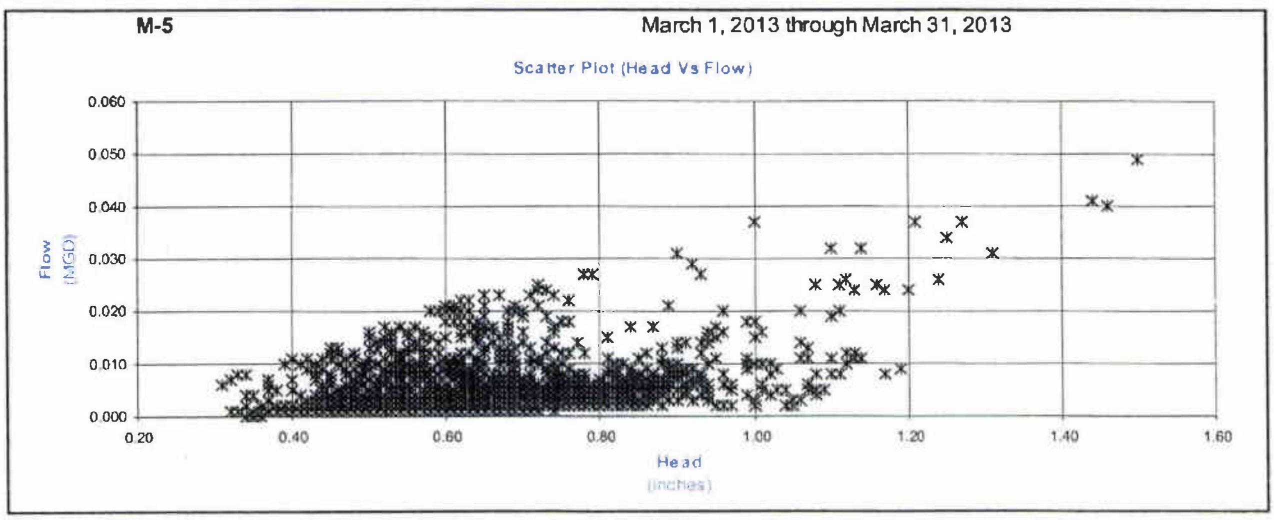
Scatter Plot (Head Vs Flow)



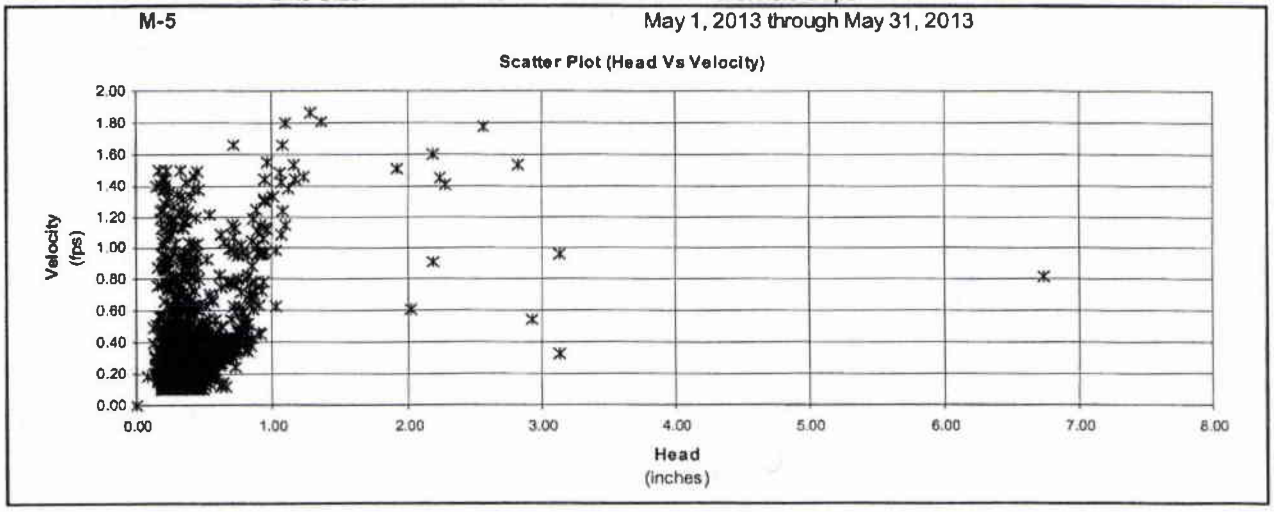
Line Size: 15 " Manhole Depth: 0 "

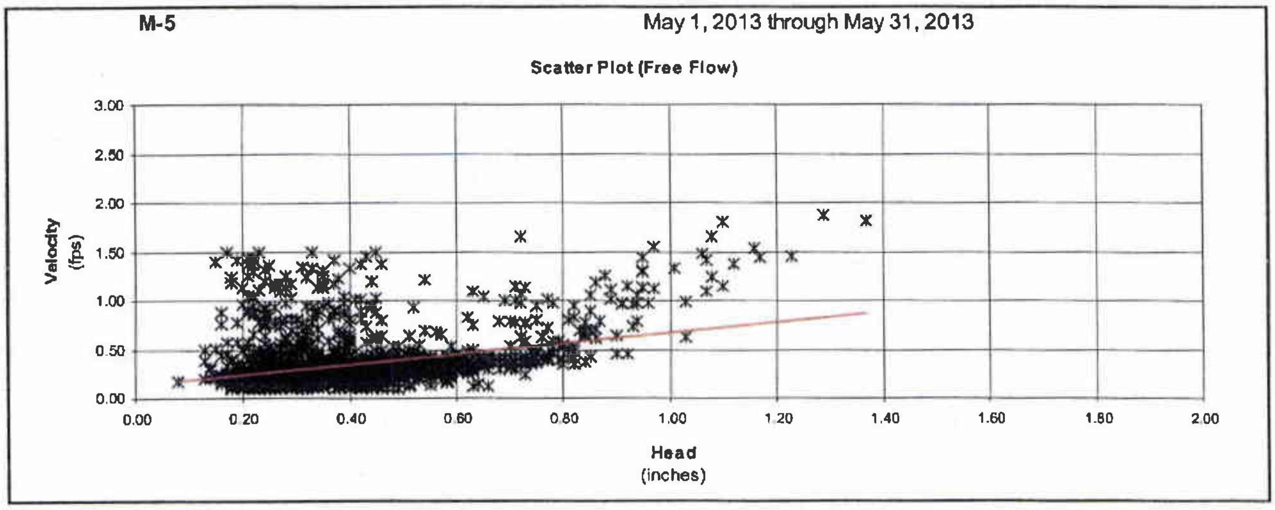


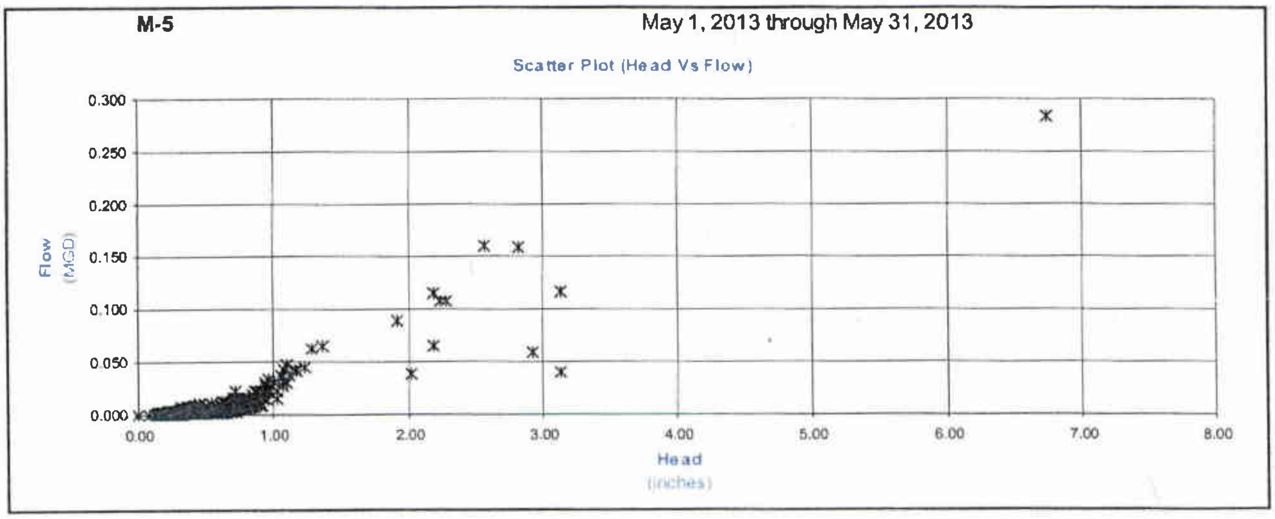




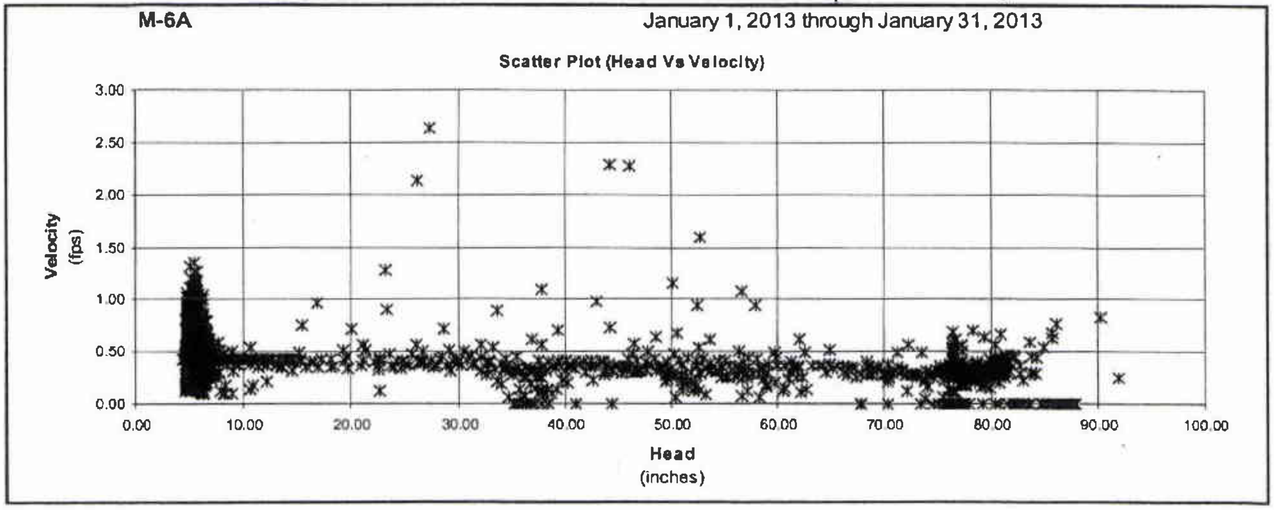
Line Size: 15 " Manhole Depth: 0 "

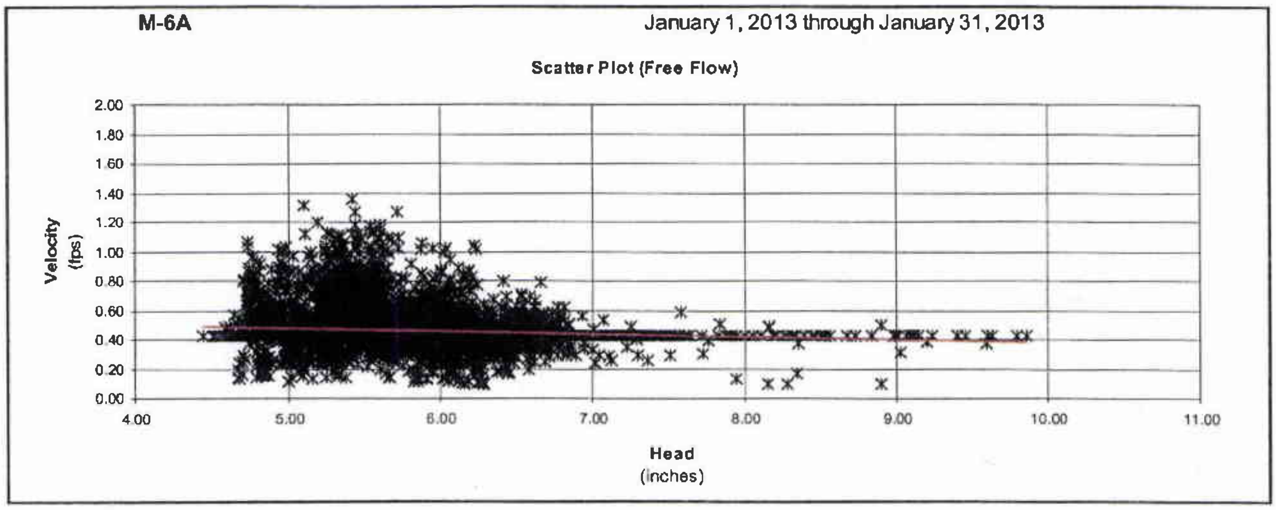


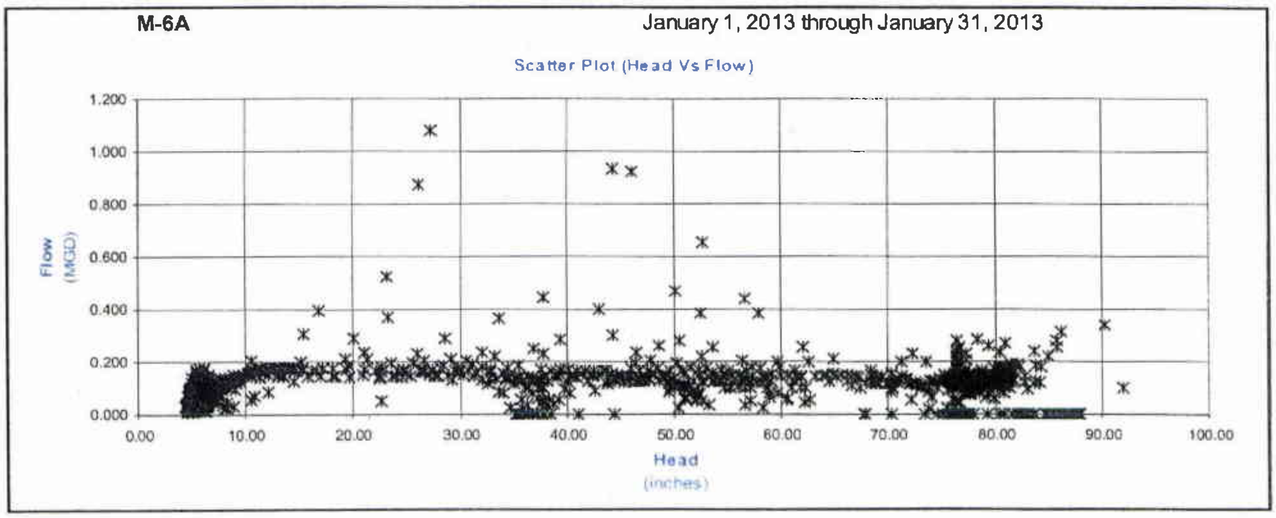




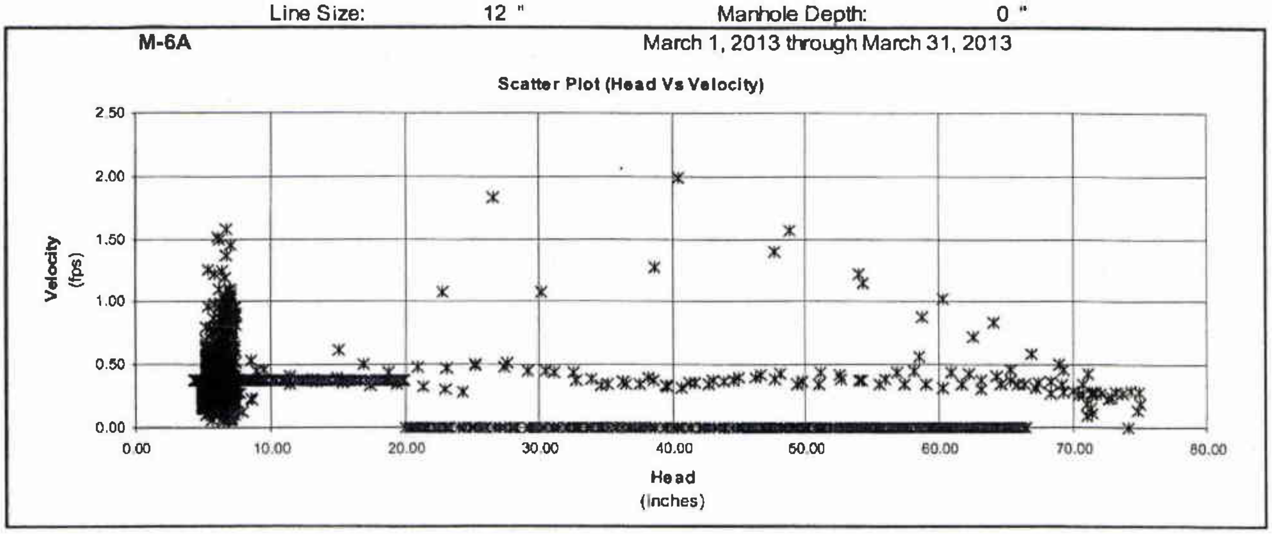
Line Size: 12 " Manhole Depth: 0 "

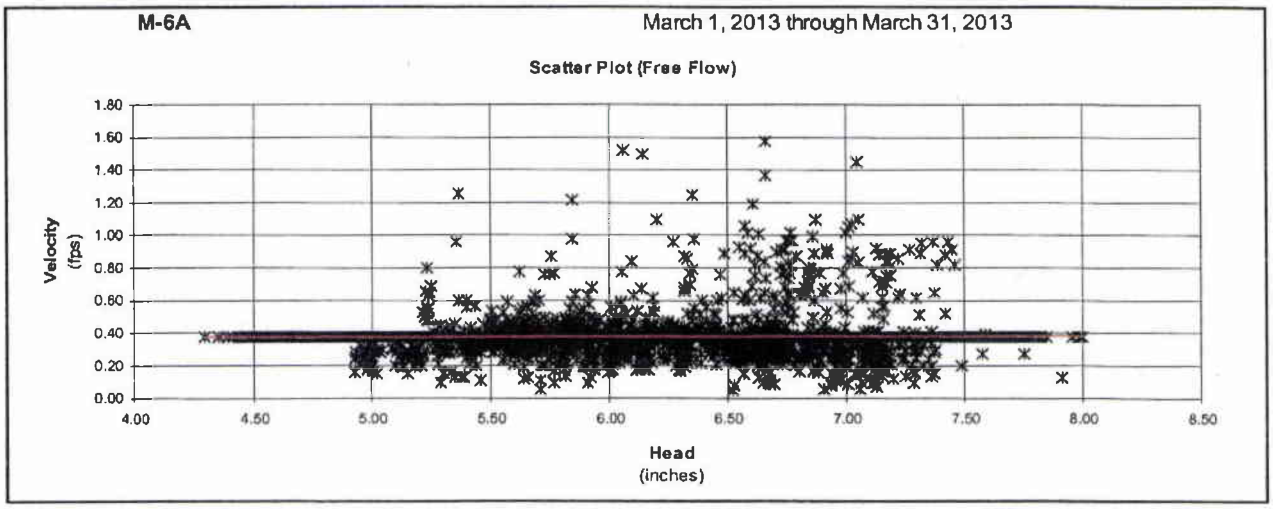


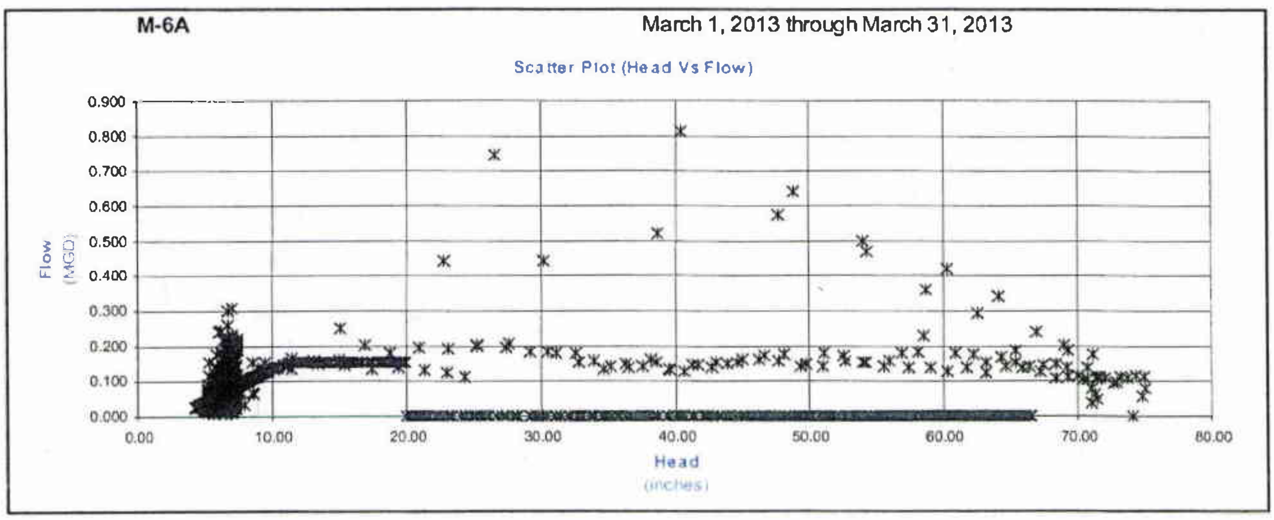




Line Size: 12 " Manhole Depth: 0 "







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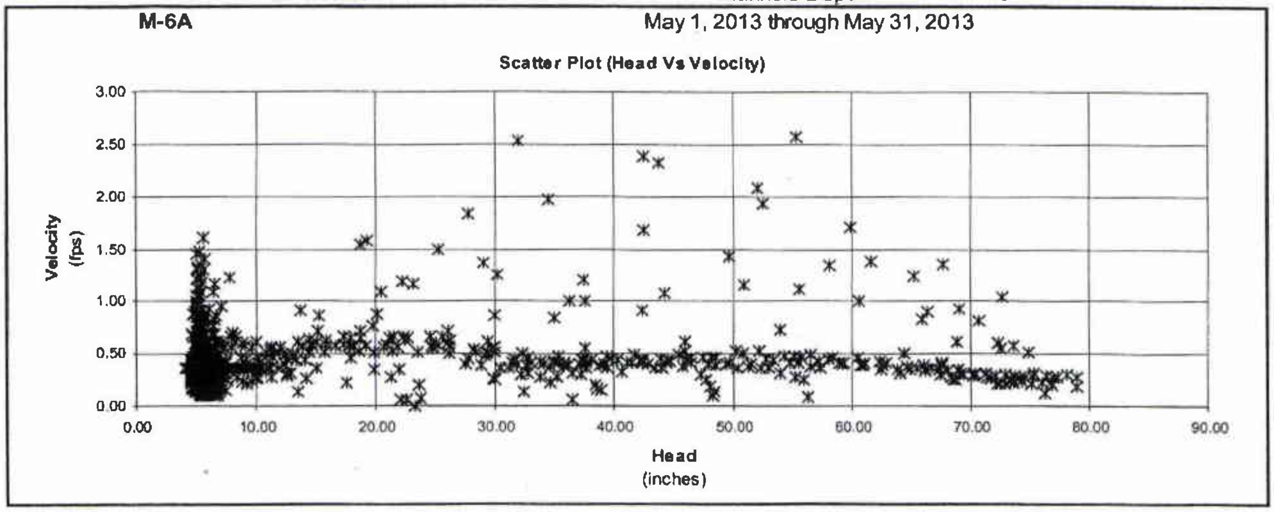
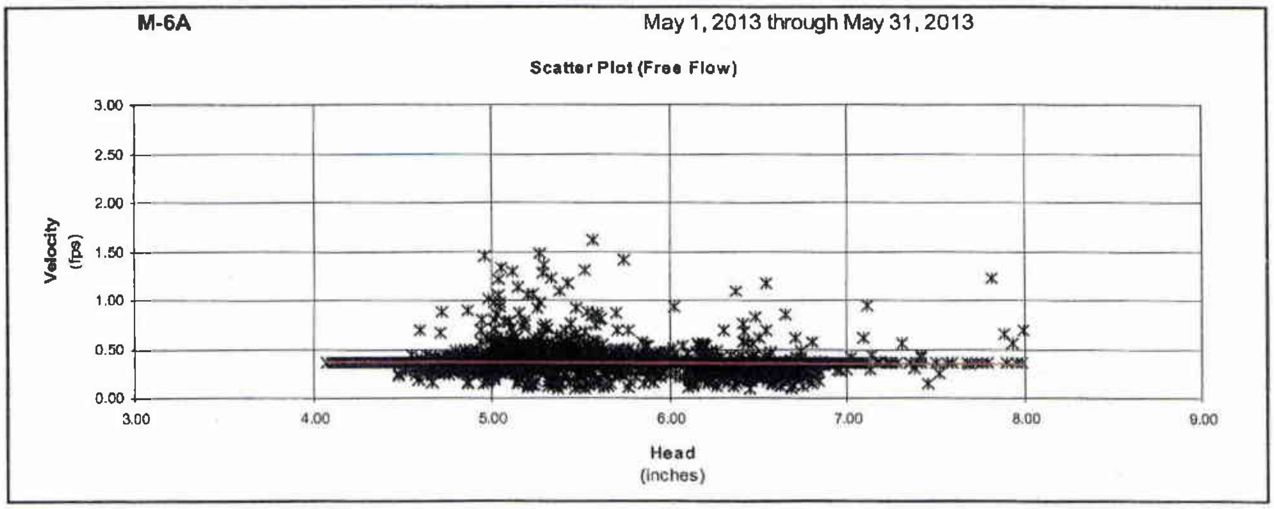
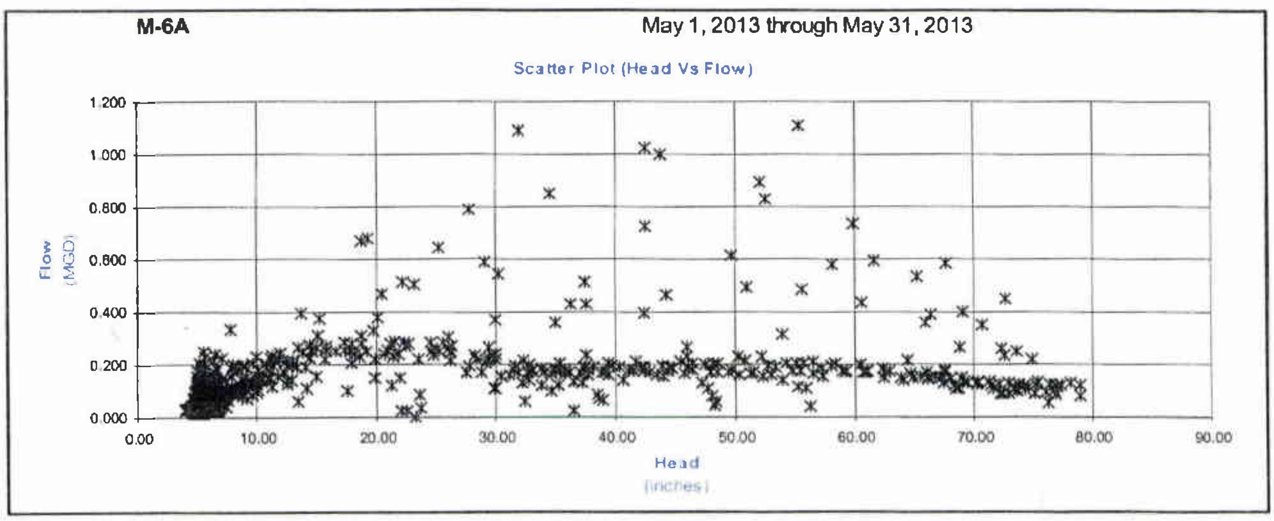
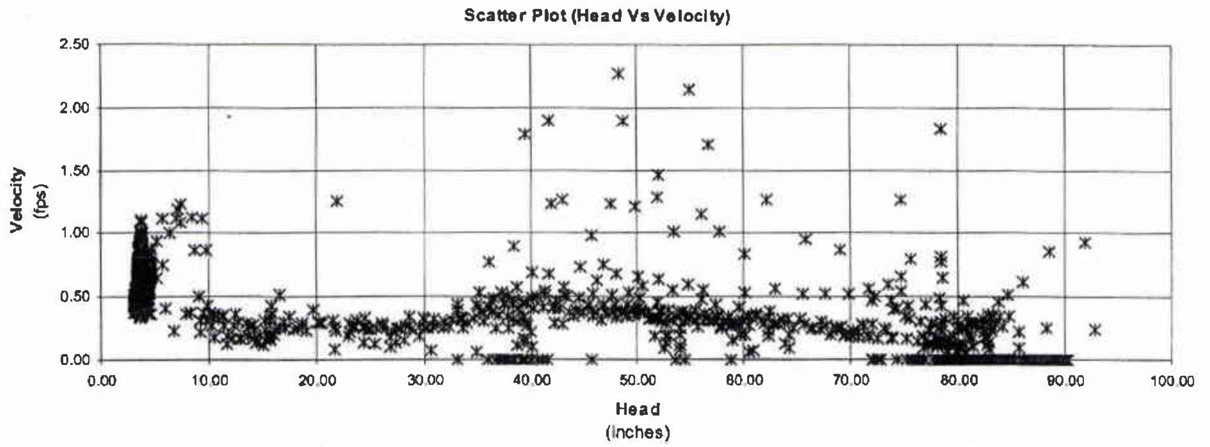




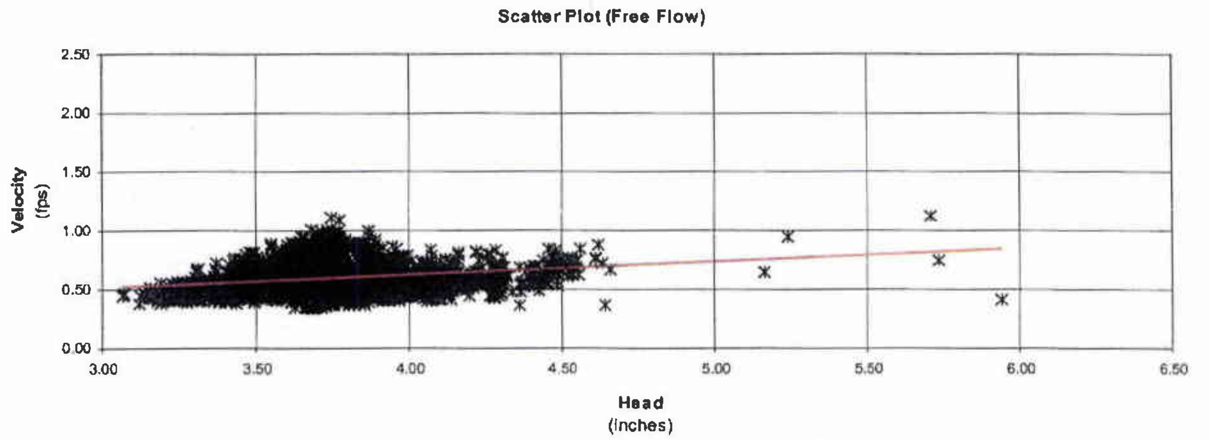


Line Size: 12 " Manhole Depth: 0 "

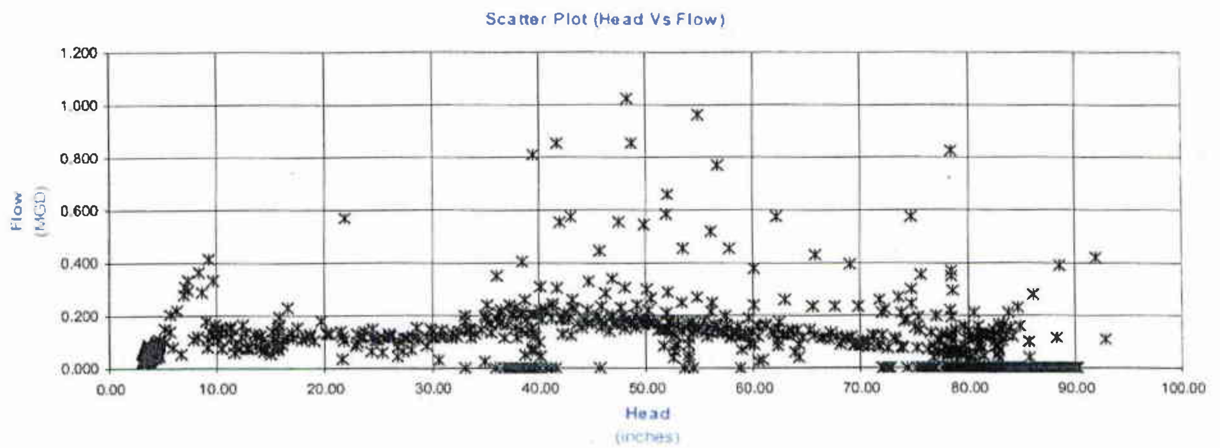
M-7A January 1, 2013 through January 31, 2013



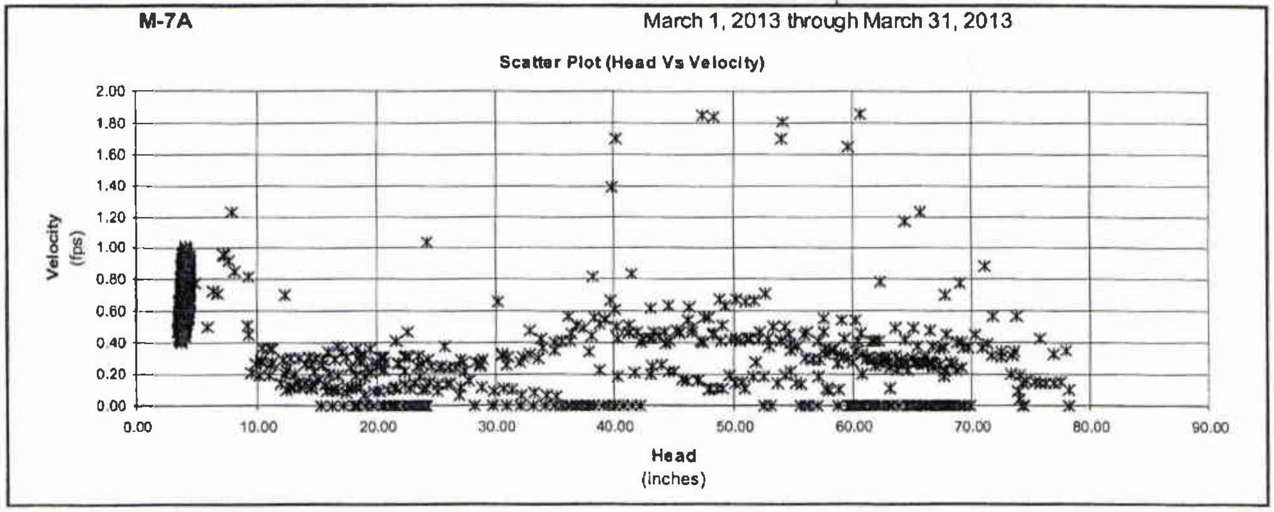
M-7A January 1, 2013 through January 31, 2013

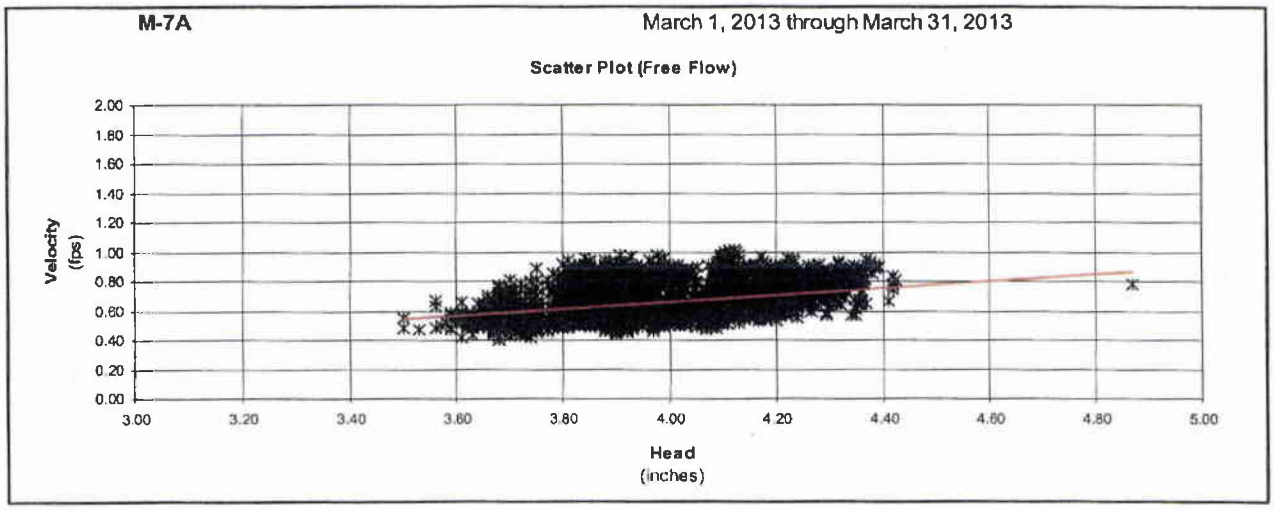


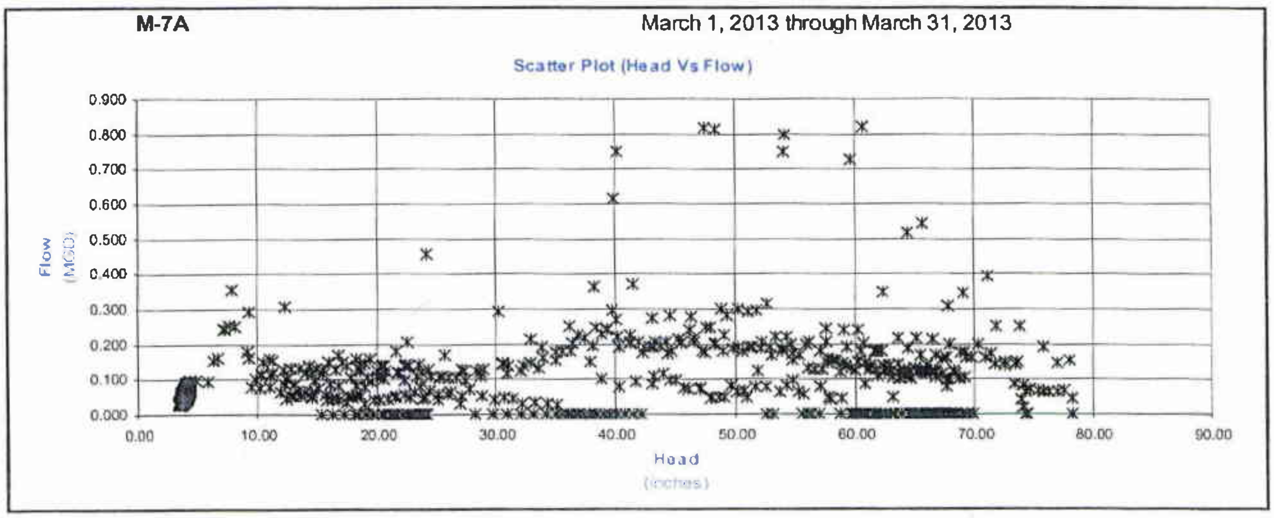
M-7A January 1, 2013 through January 31, 2013



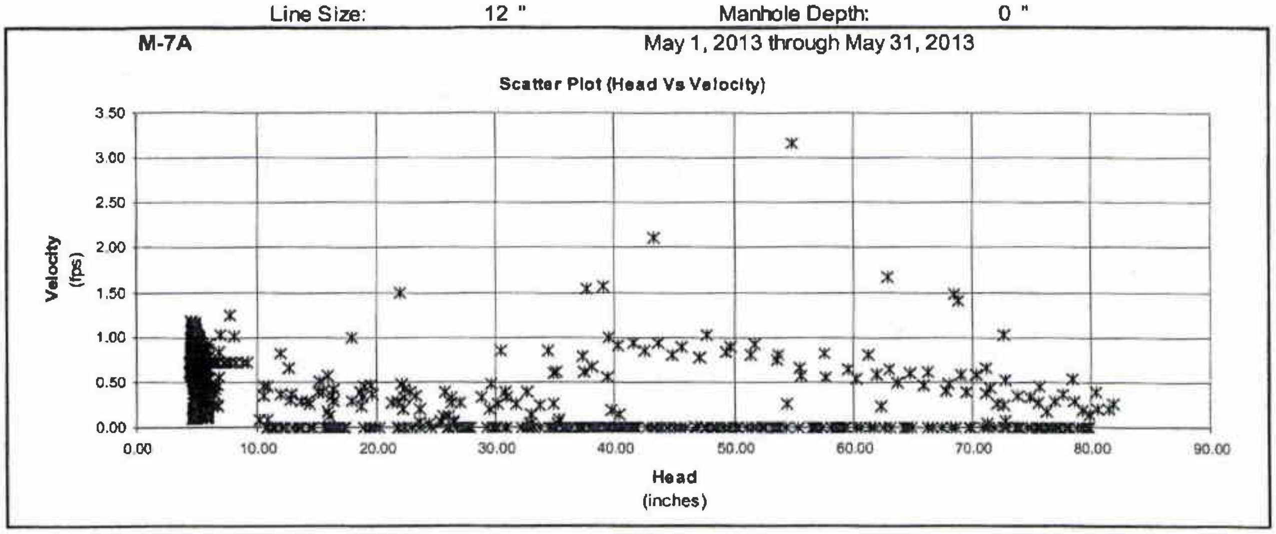
Line Size: 12 " Manhole Depth: 0 "

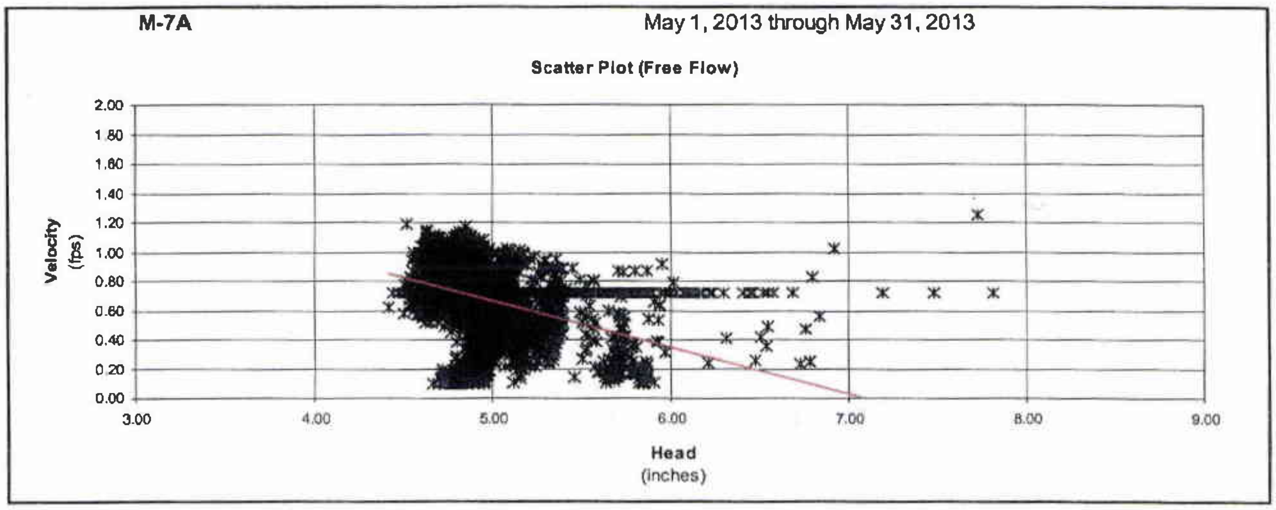


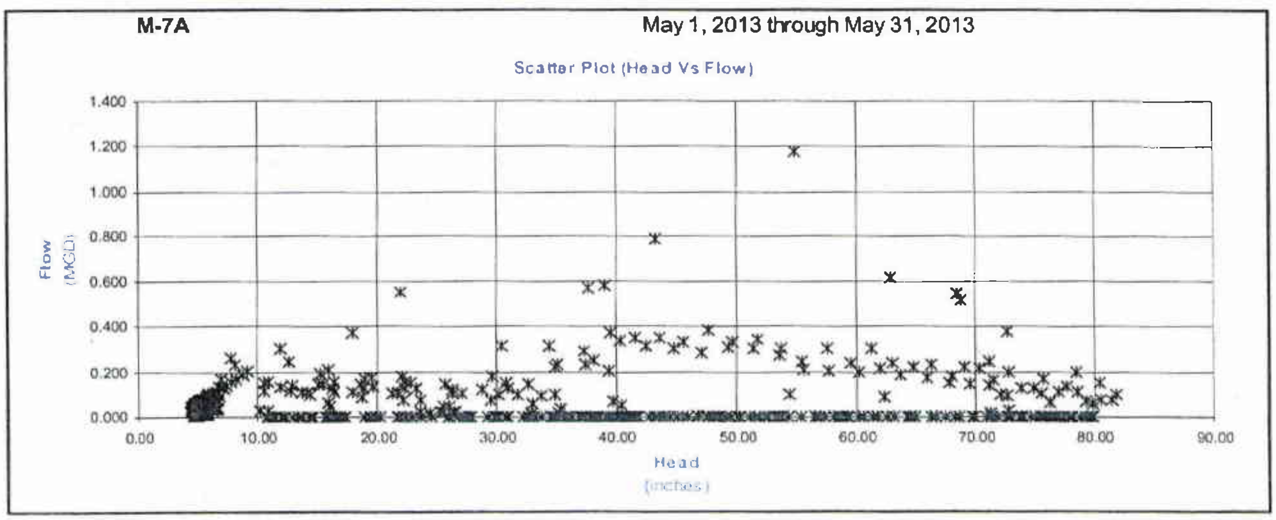




Line Size: 12 " Manhole Depth: 0 "

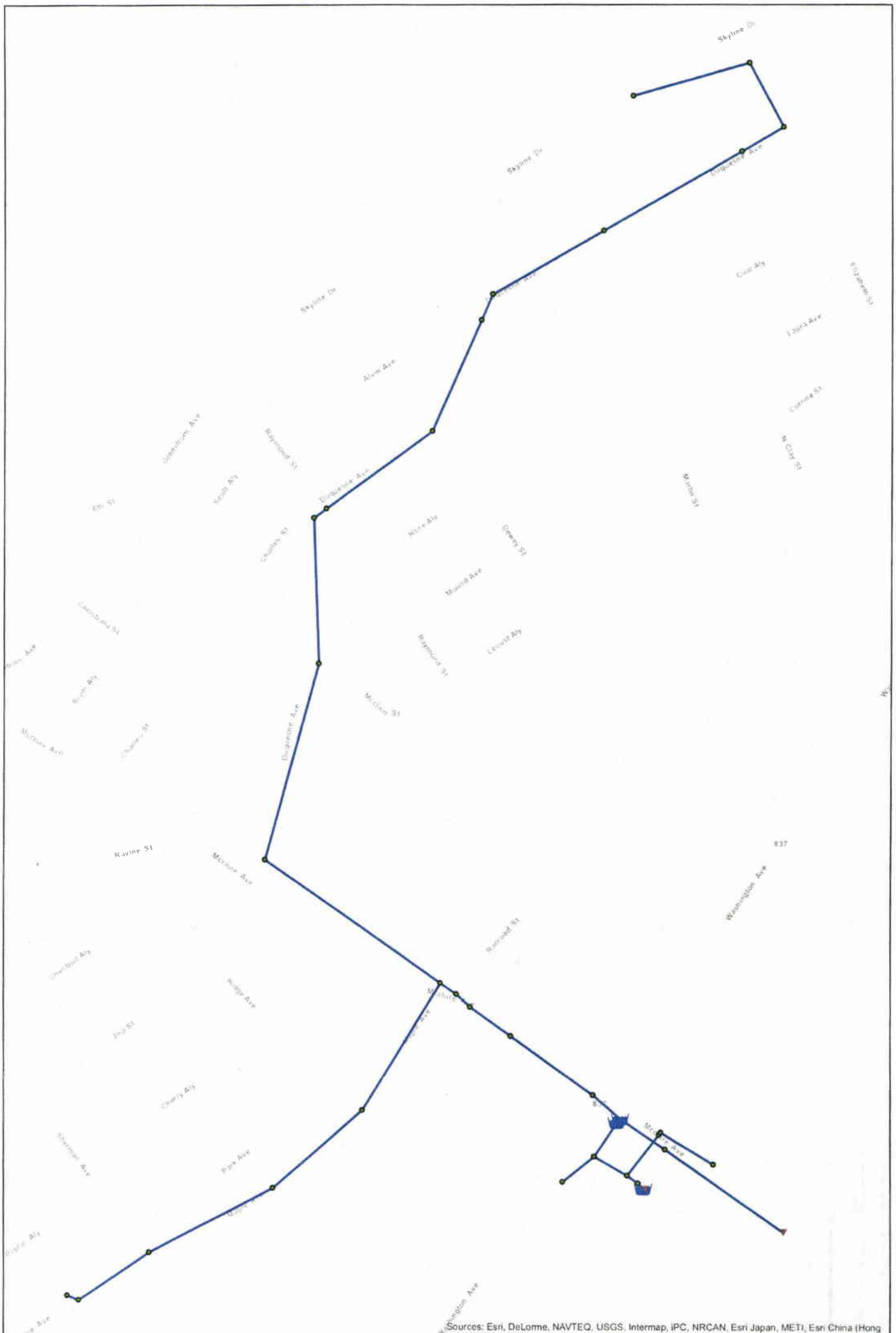






APPENDIX E

DRAVOSBURG MODEL SYSTEM MAP



220-53 **Exhibit**	0 140 280 Feet	**CITY OF DRAVOSBURG** **ALLEGHENY COUNTY, PENNSYLVANIA** **MODEL SYSTEM MAP**	KLH ENGINEERS, INC.	N

APPENDIX F

DRAVOSBURG MODEL PHYSICAL CHARACTERISTICS (LIST)

MODEL HYDRAULIC CHARACTERISTICS

Storage Nodes

Storage ID	Invert Elevation (ft)	Maximum Depth (ft)
DV_VAULT	726.68	14.25
REGULATOR_PIT	725.643	14.82
WETWELL	720.735	24.42

Outfall Nodes

Outfall ID	TYPE	Invert Elevation (ft)
DV100	0: Free	723.852
DUMMY_OUTFALL	0: Free	715

Conduits

Conduit ID	LENGTH (ft)	Manning's N	Upstream Offset (ft)	Downstream Offset (ft)	Average Loss Coeff.	Flap Gate Installed	Shape Type	Diameter (ft)	Width
DV176-DV100	300.511	0.013	0	0	0.05	No	0: Circular	6	
DV102-DV101	28.827	0.013	0	0.14	0.05	No	0: Circular	1	
DV101-DV_WETWELL	15.599	0.013	0	0	0.05	No	0: Circular	1	
DV103-DV102	77.943	0.013	0.04	0.17	0.05	No	0: Circular	1.5	
DV300-DV102	107.549	0.013	0	0.09	0.05	No	0: Circular	1	
DV_CHAM-DV103	84.148	0.013	0	0.64	0.05	No	0: Circular	1	
DV201-DV103	54.234	0.013	0	0	0.05	No	0: Circular	0.667	
DV105-DV_CHAM	75.444	0.013	0	0.47	0.05	No	0: Circular	6	
DV174-DV105	210.376	0.013	0	0.09	0.05	No	0: Circular	6	
DV173-DV174	103.178	0.013	0	0.57	0.05	No	0: Circular	6	
DV171-DV173	38.479	0.013	0	0.22	0.05	No	0: Circular	6	
DV434-DV171	444.357	0.013	0	0.32	0.05	No	2: Rect-Closed	4	3
DV414-DV434	420.288	0.013	0	0	0.05	No	0: Circular	2	
DV416-DV414	300.414	0.013	0.41	0.62	0.05	No	0: Circular	2	
DV409-DV416	31.797	0.013	0	0	0.05	No	0: Circular	2	
DV408-DV409	271.638	0.013	0.2	0.66	0.05	No	0: Circular	2	
DV407-DV408	249.924	0.013	0	0	0.05	No	0: Circular	1.5	
DV406-DV407	57.691	0.013	0	0.19	0.05	No	0: Circular	1.5	
DV405-DV406	265.176	0.013	0	0.02	0.05	No	0: Circular	1.5	
DV403-DV405	330.934	0.013	0	0.14	0.05	No	0: Circular	1.5	
DV402-DV403	100.111	0.013	0	0.28	0.05	No	0: Circular	1.5	
DV351-DV402	148.37	0.013	0	0.7	0.05	No	0: Circular	0.667	
DV352-DV351	240.749	0.013	0	0.26	0.05	No	0: Circular	0.667	
DV144-DV107	244.914	0.013	0	0.24	0.05	No	0: Circular	2	
DV108-DV144	290.159	0.013	0	0.5	0.05	No	0: Circular	2	
DV156-DV108	175.84	0.013	0	0.16	0.05	No	0: Circular	1.5	
DV157-DV156	25.357	0.013	0	0	0.05	No	0: Circular	1.5	0
DV_CHAM-DV176	111.652	0.013	1.74	0.09	0.05	No	0: Circular	6	
CDT-13	41.128	0.013	0	0.32	0.05	No	2: Rect-Closed	4	3
DV107-DV_DUMMY	310.255	0.013	0	0	0.05	No	0: Circular	2	
DV229-DV230	127.508	0.013		0	0.05	No	0: Circular	1	
DV230-DV300	5.482	0.013			0.05	No	0: Circular	1	
WETWELL-DUMMY_OUTFALL	5.188	0.01			0	No	0: Circular	6	

Manholes

Junction ID	Invert Elevation (ft)	Max Depth (ft)
DV352	980.275	6.55
DV351	977.567	10.35
DV201	721.89	13.93
DV103	721.677	18.52
DV157	830.341	11.77
DV156	829.875	11.31
DV108	823.894	10.22
DV144	797.003	8.84
DV107	774.089	6.63
DV402	952.878	6.12
DV403	947.717	7.92
DV405	924.804	14.84
DV406	915.654	9.22
DV407	914.833	8.54
DV408	910.669	9.37
DV409	899.298	8.72
DV416	894.836	11.32
DV414	854.103	11.03
DV434	783.08	30.96
DV171	742.859	12.03
DV173	733.376	17.72
DV174	732.656	13.3
DV105	728.304	11.14
DV102	721.402	21.12
DV101	720.905	21.53
DV176	726.774	15.06
DV_DUMMY	746.176	4
DV300	722.133	20.01
DV230	722.17	19.97
DV229	722.402	17.05

APPENDIX G

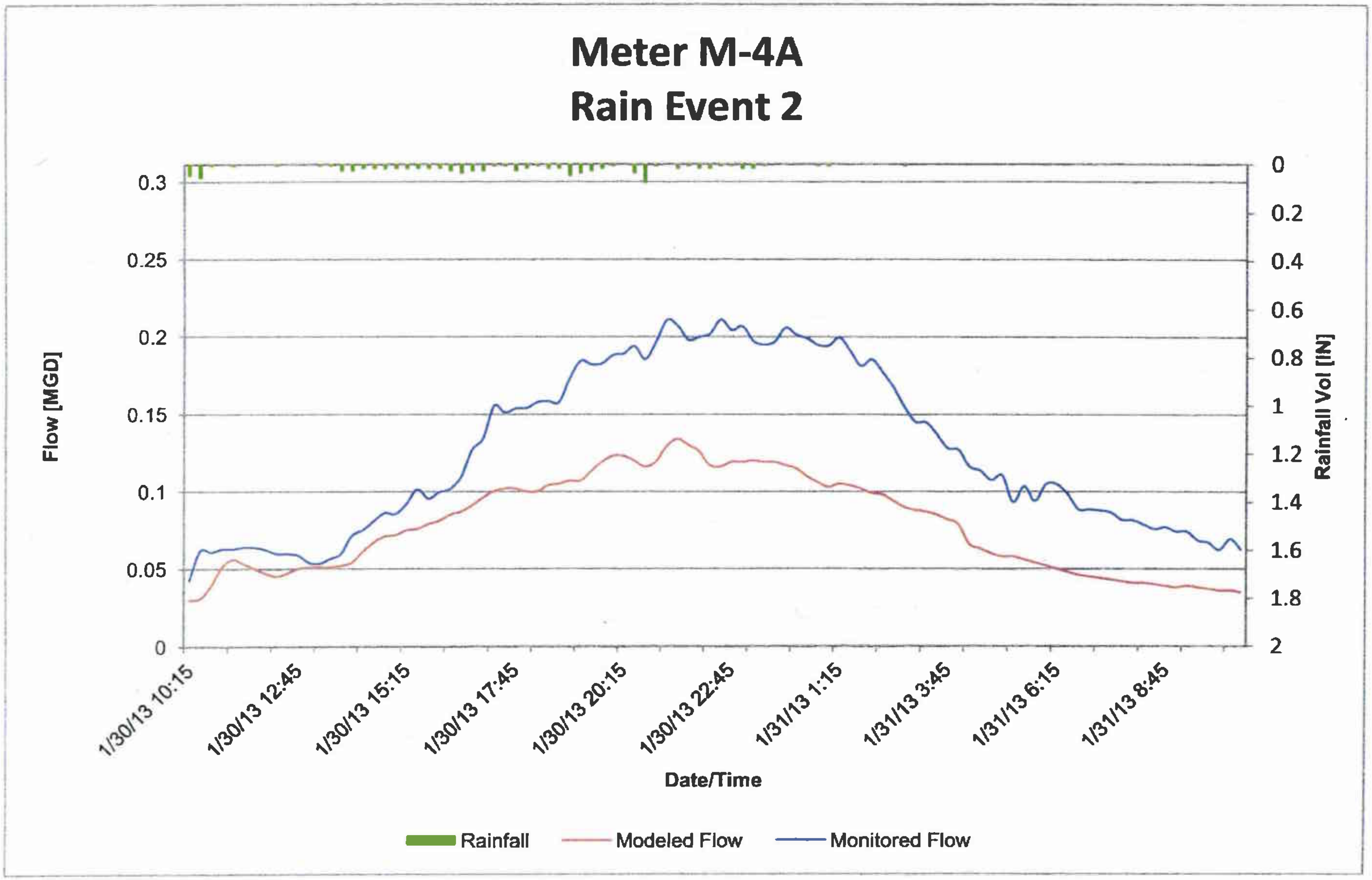
MONITORED VS. MODELED HYDROGRAPHS

Meter M-3
SUMMER MODEL
RAIN EVENTS

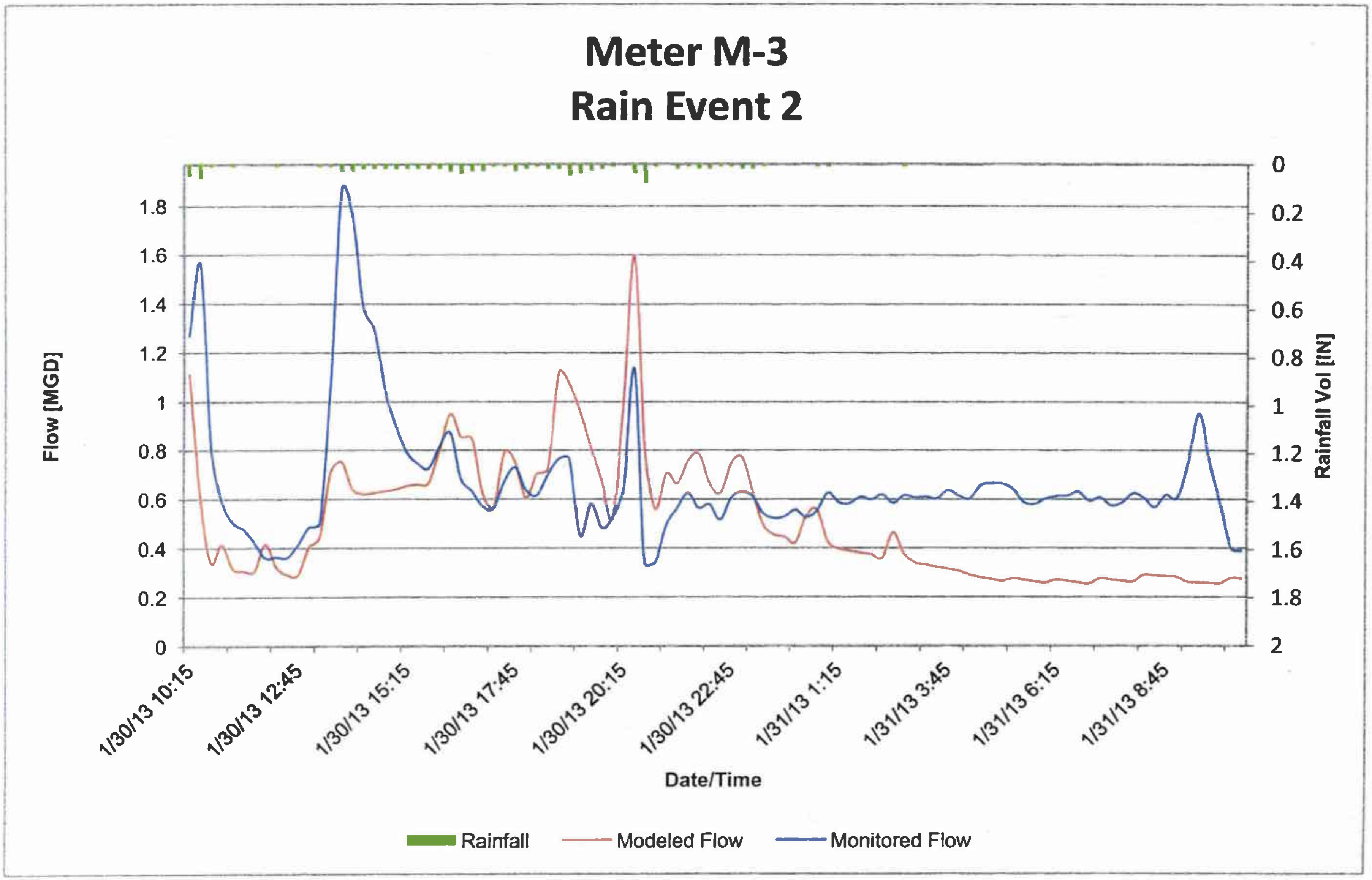
No.	Start Date	End Date	Total Rain	Max Int	Peak MOD Flow	Peak MON Flow	% Difference		Modeled Volume	Monitored Volume	% Difference	
1	1/28/13 3:00	1/29/13 13:00	0.55	0.20	1.07	1.72	37.88%	Mod LOW	0.236	0.334	29.25%	Mod LOW
2	1/30/13 10:15	1/31/13 10:30	1.08	0.32	1.60	1.87	14.69%	Mod LOW	0.408	0.451	9.55%	Mod LOW
3	2/26/13 12:30	2/27/13 15:15	1.01	0.44	1.87	1.92	2.16%	Mod LOW	0.362	0.453	20.15%	Mod LOW
4	3/25/13 8:30	3/26/13 8:30	0.78	0.44	1.81	0.00	100.00%	Mod HIGH	0.275	0.000	100.00%	Mod HIGH
5	4/10/13 15:45	4/11/13 7:30	0.58	0.88	3.03	2.23	26.34%	Mod HIGH	0.099	0.106	6.61%	Mod LOW
6	4/16/13 20:00	4/17/13 6:45	1.13	2.40	3.43	2.97	13.50%	Mod HIGH	0.204	0.090	55.65%	Mod HIGH
7	5/10/13 9:15	5/11/13 16:45	0.79	0.52	1.765	2.164	18.45%	Mod LOW	0.254	0.255	0.35%	Mod LOW
8	5/22/13 16:00	5/24/13 11:30	1.13	1.08	2.466	2.477	0.44%	Mod LOW	0.272	0.360	24.48%	Mod LOW
	(yellow)	No Monitored Flow										

Meter M-4A
SUMMER MODEL
RAIN EVENTS

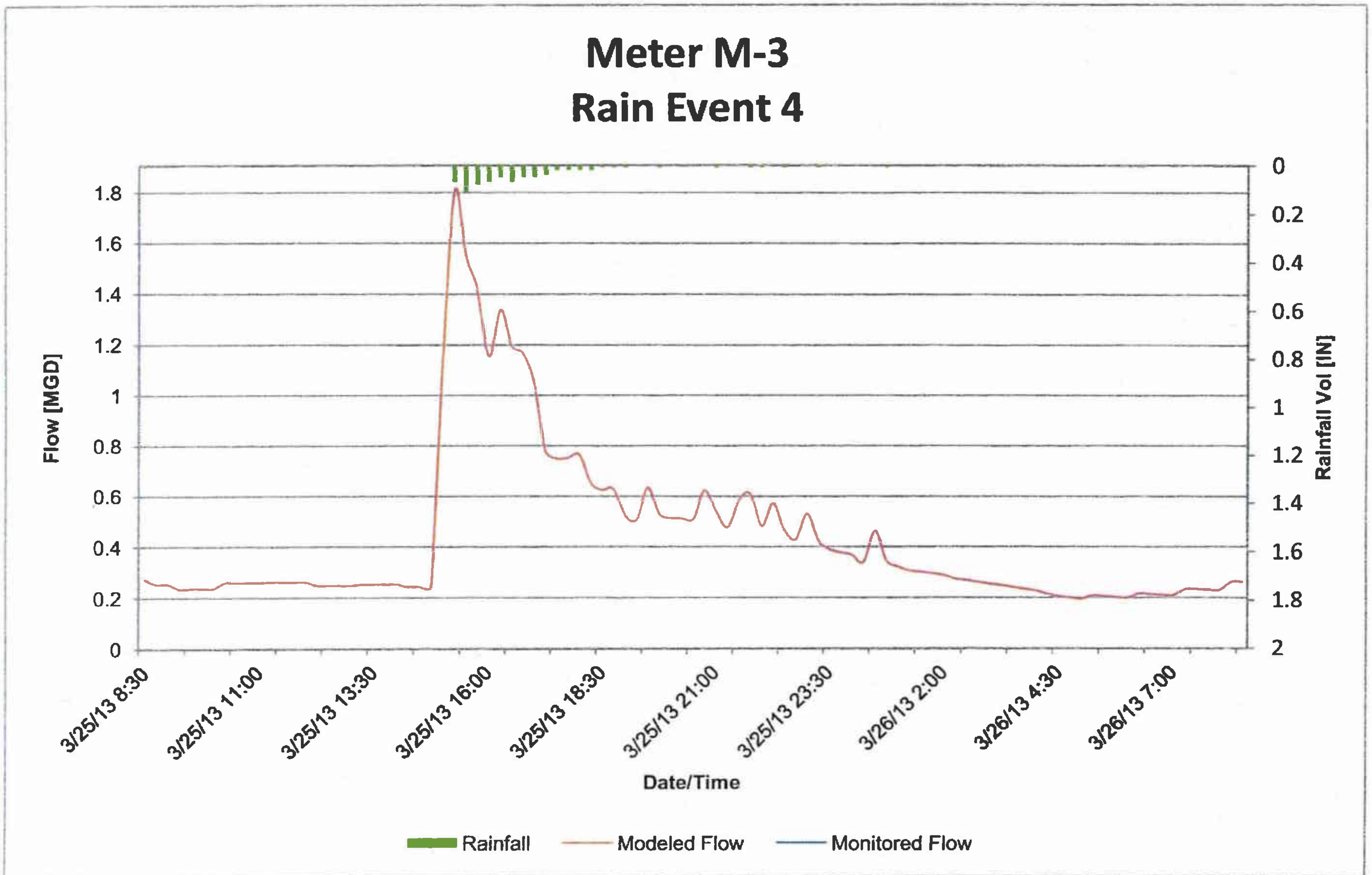
No.	Start Date	End Date	Total Rain	Max Int	Peak MOD Flow	Peak MON Flow	% Difference		Modeled Volume	Monitored Volume	% Difference	
1	1/28/13 3:00	1/28/13 20:00	0.53	0.20	0.09	0.09	3.33%	Mod HIGH	0.029	0.024	15.20%	Mod HIGH
2	1/30/13 10:15	1/31/13 8:30	1.08	0.32	0.13	0.21	36.59%	Mod LOW	0.057	0.088	34.88%	Mod LOW
3	2/26/13 12:30	2/27/13 13:15	1.01	0.44	0.14	0.10	24.75%	Mod HIGH	0.047	0.030	35.23%	Mod HIGH
4	3/25/13 15:15	3/26/13 6:30	0.77	0.44	0.13	0.06	58.33%	Mod HIGH	0.038	0.016	58.94%	Mod HIGH
5	4/10/13 15:45	4/11/13 5:30	0.58	0.88	0.11	0.07	30.86%	Mod HIGH	0.014	0.011	23.23%	Mod HIGH
6	4/16/13 20:00	4/17/13 4:45	1.13	2.40	0.21	0.23	9.70%	Mod LOW	0.024	0.032	25.32%	Mod LOW
7	5/22/13 23:15	5/23/13 14:30	0.52	0.72	0.125	0.069	44.53%	Mod HIGH	0.019	0.009	52.55%	Mod HIGH
8	5/10/13 9:15	5/11/13 20:45	0.79	0.52	0.191	0.071	63.00%	Mod HIGH	0.045	0.020	56.00%	Mod HIGH
9	5/22/13 16:00	5/24/13 15:30	1.13	1.08	0.281	0.094	66.43%	Mod HIGH	0.049	0.017	65.14%	Mod HIGH

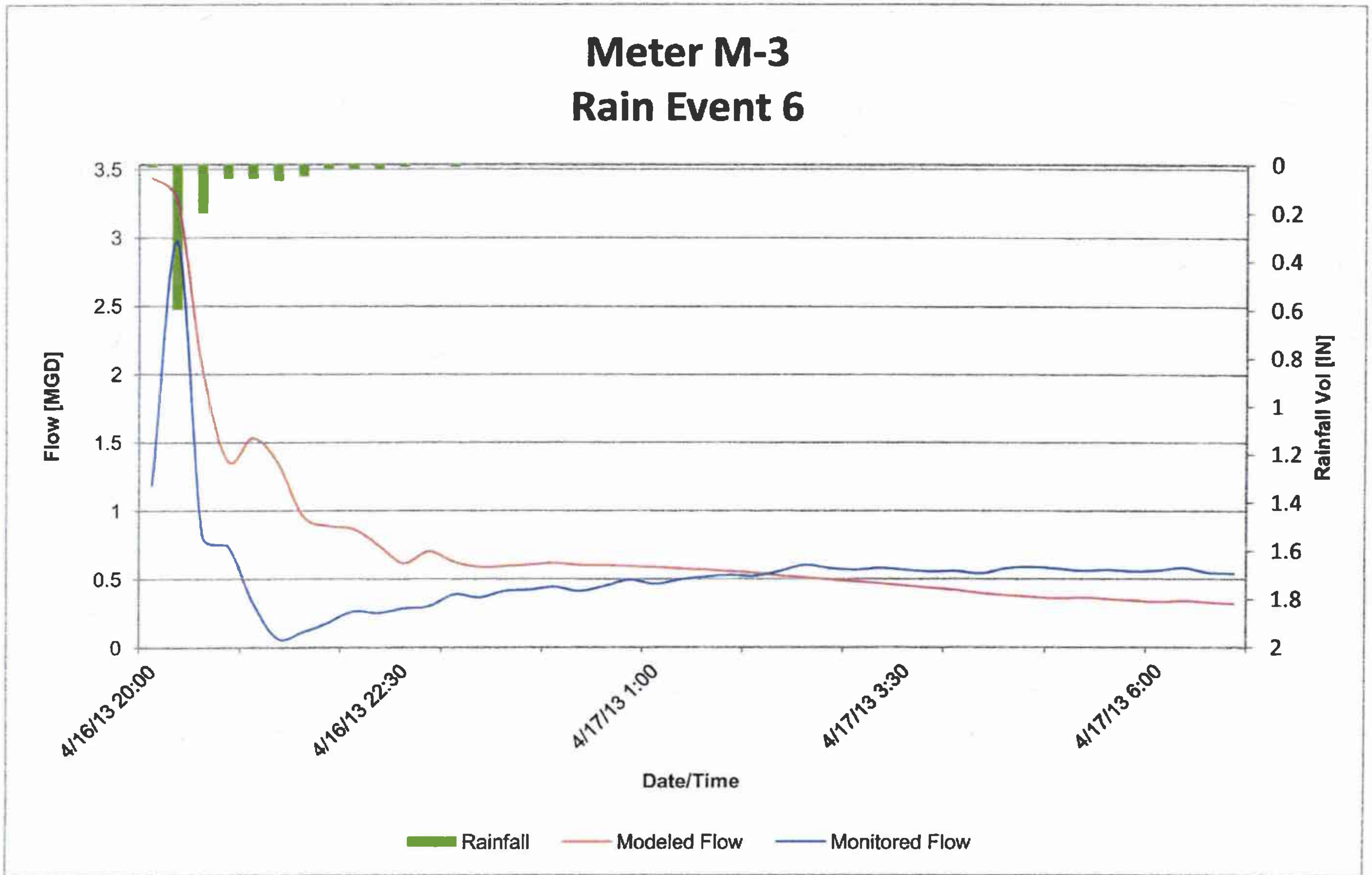


Meter M-4A
Rain Event 2
Flow [MGD]
0.3
0.25
0.2
0.15
0.1
0.05
0
Rainfall Vol [IN]
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
1/30/13 10:15
1/30/13 12:45
1/30/13 15:15
1/30/13 17:45
1/30/13 20:15
1/30/13 22:45
1/31/13 1:15
1/31/13 3:45
1/31/13 6:15
1/31/13 8:45
Date/Time
Rainfall
Modeled Flow
Monitored Flow

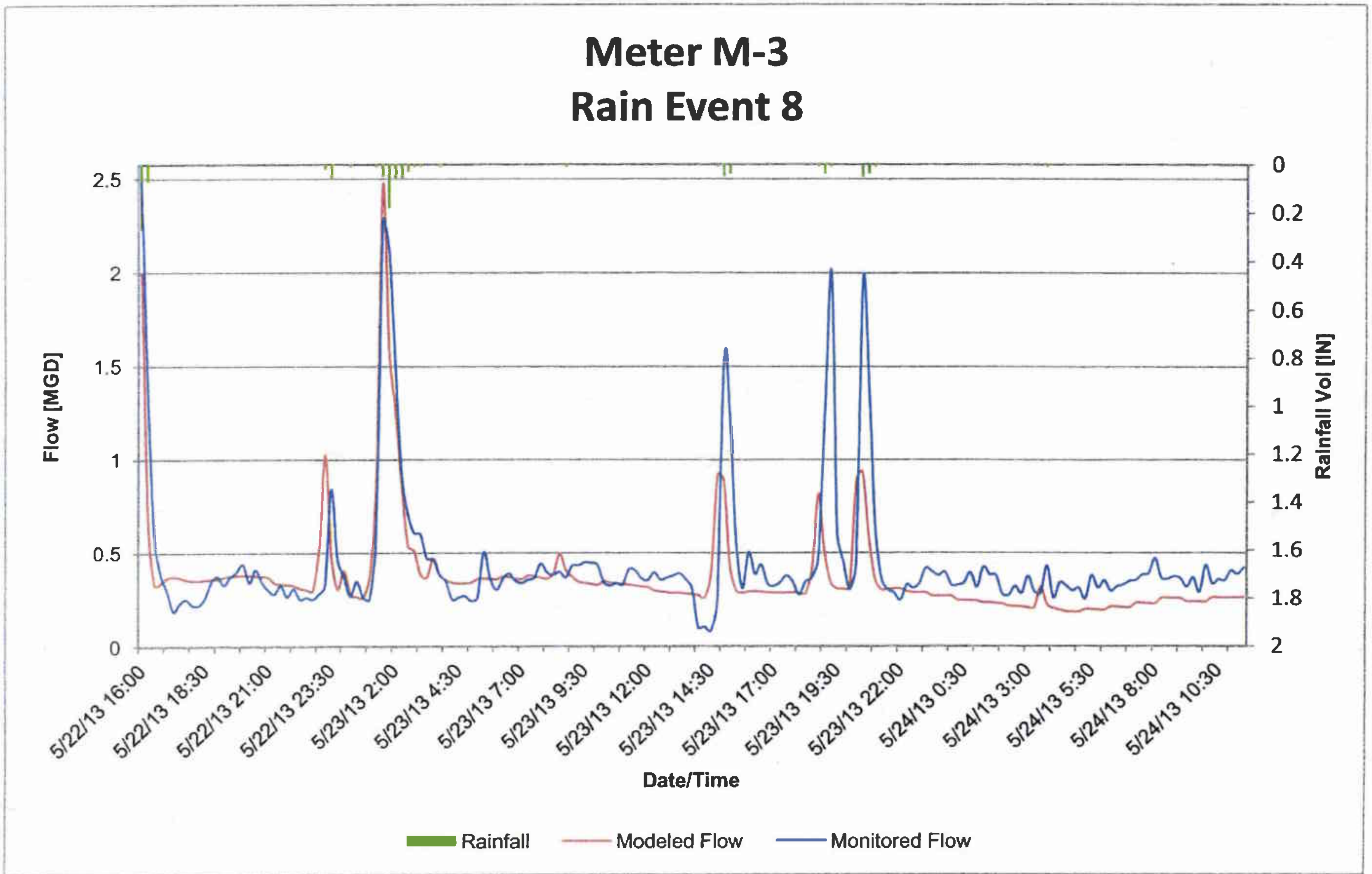


Meter M-3
Rain Event 2
Flow [MGD]
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
Rainfall Vol [IN]
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
1/30/13 10:15
1/30/13 12:45
1/30/13 15:15
1/30/13 17:45
1/30/13 20:15
1/30/13 22:45
1/31/13 1:15
1/31/13 3:45
1/31/13 6:15
1/31/13 8:45
Date/Time
Rainfall
Modeled Flow
Monitored Flow

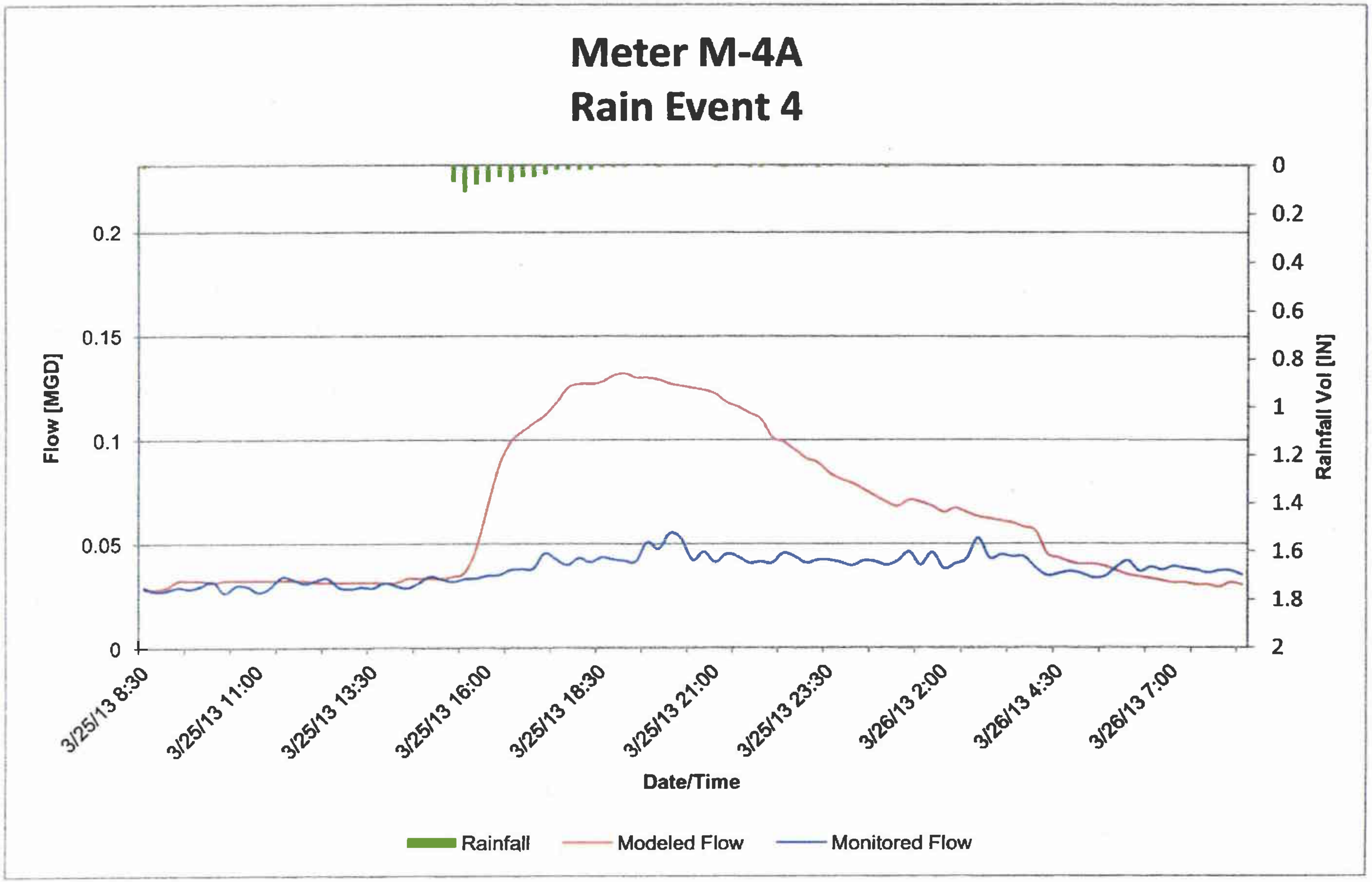

Meter M-3
Rain Event 4
Flow [MGD]
Rainfall Vol [IN]
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
3/25/13 8:30
3/25/13 11:00
3/25/13 13:30
3/25/13 16:00
3/25/13 18:30
3/25/13 21:00
3/25/13 23:30
3/26/13 2:00
3/26/13 4:30
3/26/13 7:00
Date/Time
Rainfall
Modeled Flow
Monitored Flow

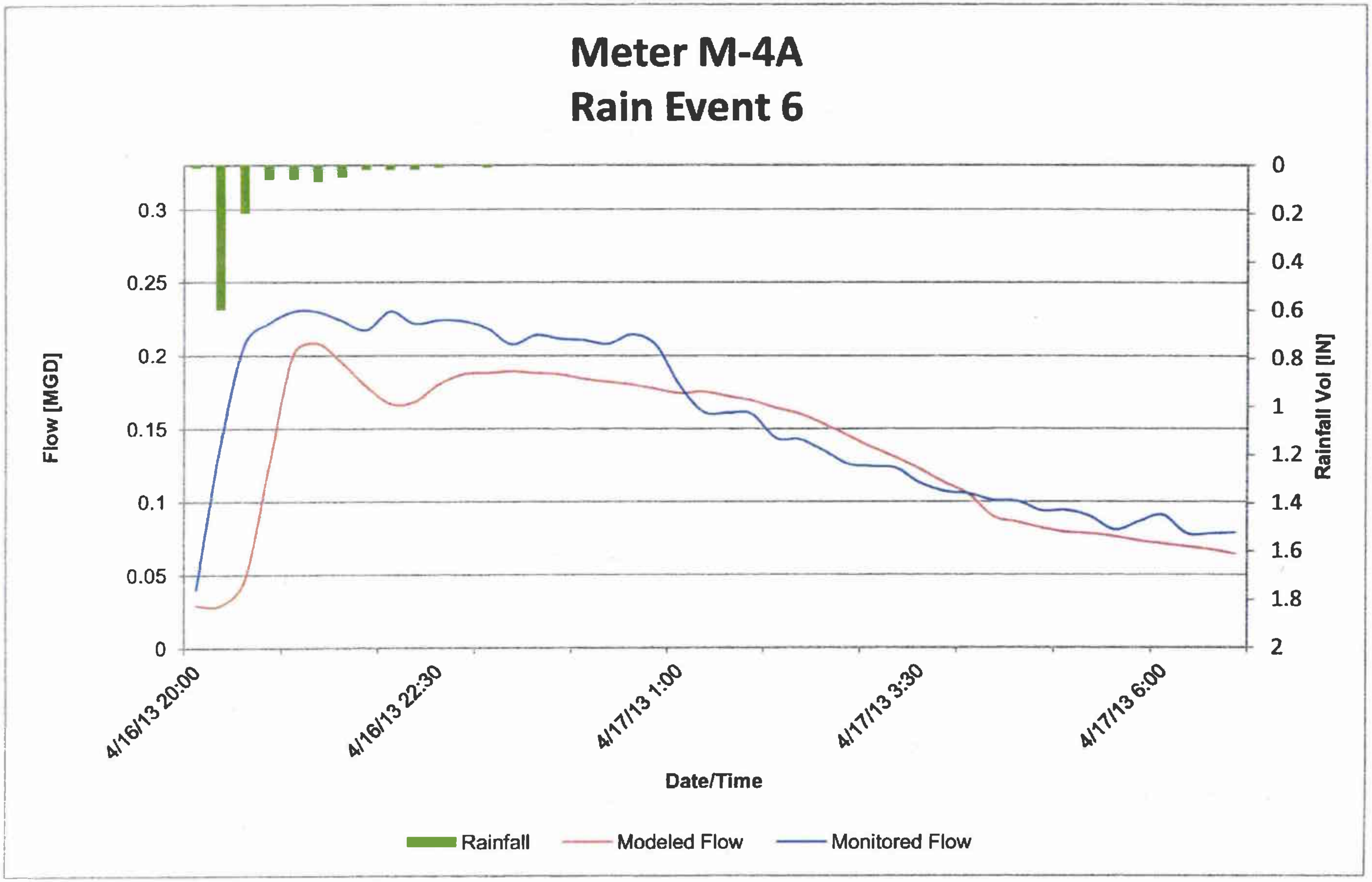


Meter M-3
Rain Event 6
Flow [MGD]
3.5
3
2.5
2
1.5
1
0.5
0
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
Rainfall Vol [IN]
4/16/13 20:00
4/16/13 22:30
4/17/13 1:00
4/17/13 3:30
4/17/13 6:00
Date/Time
Rainfall
Modeled Flow
Monitored Flow

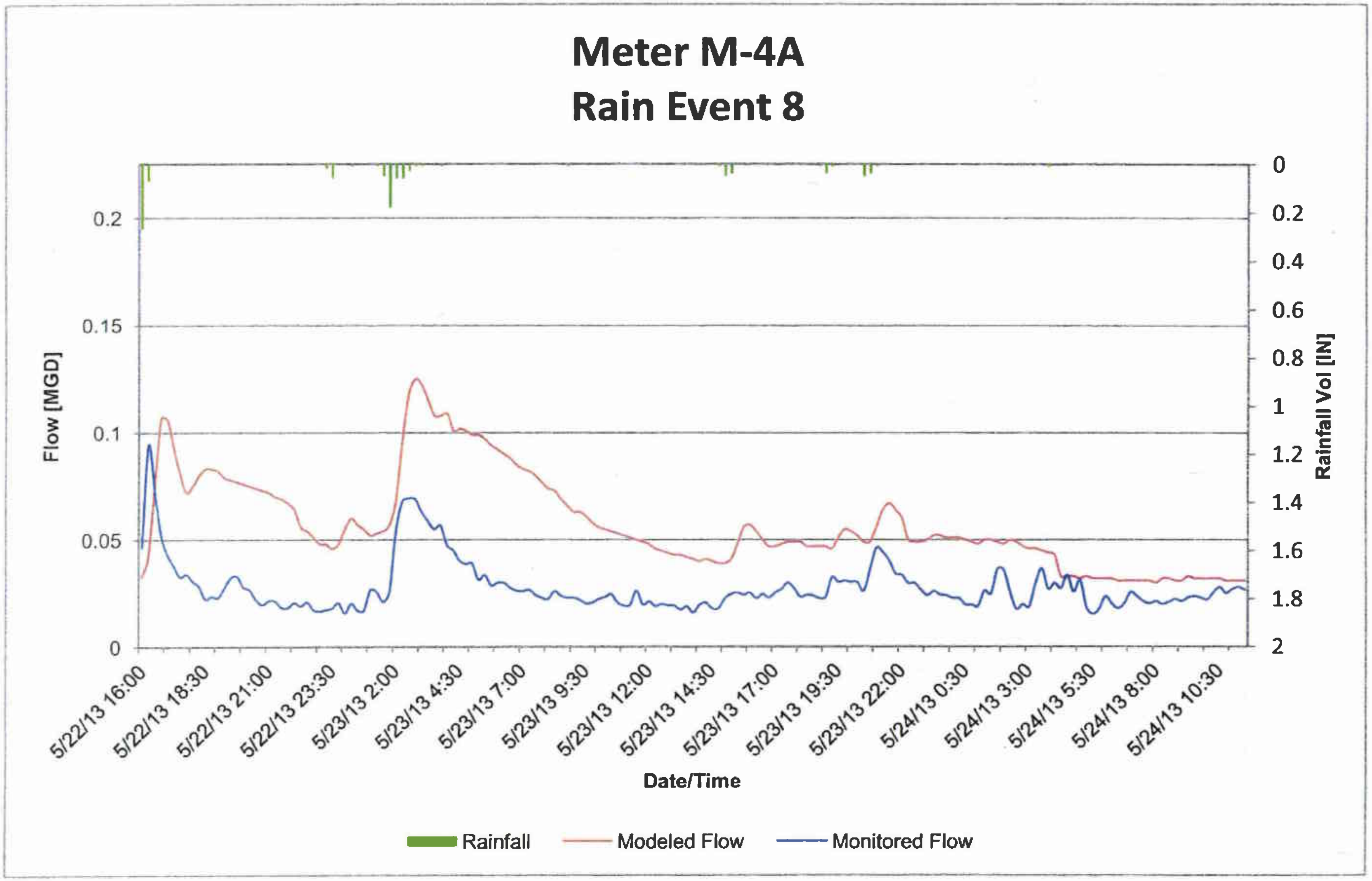


Meter M-3
Rain Event 8
Flow [MGD]
2.5
2
1.5
1
0.5
0
Rainfall Vol [IN]
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
5/22/13 16:00
5/22/13 18:30
5/22/13 21:00
5/22/13 23:30
5/23/13 2:00
5/23/13 4:30
5/23/13 7:00
5/23/13 9:30
5/23/13 12:00
5/23/13 14:30
5/23/13 17:00
5/23/13 19:30
5/23/13 22:00
5/24/13 0:30
5/24/13 3:00
5/24/13 5:30
5/24/13 8:00
5/24/13 10:30
Date/Time
Rainfall
Modeled Flow
Monitored Flow


Meter M-4A
Rain Event 4
Flow [MGD]
0.2
0.15
0.1
0.05
0
Rainfall Vol [IN]
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
3/25/13 8:30
3/25/13 11:00
3/25/13 13:30
3/25/13 16:00
3/25/13 18:30
3/25/13 21:00
3/25/13 23:30
3/26/13 2:00
3/26/13 4:30
3/26/13 7:00
Date/Time
Rainfall
Modeled Flow
Monitored Flow



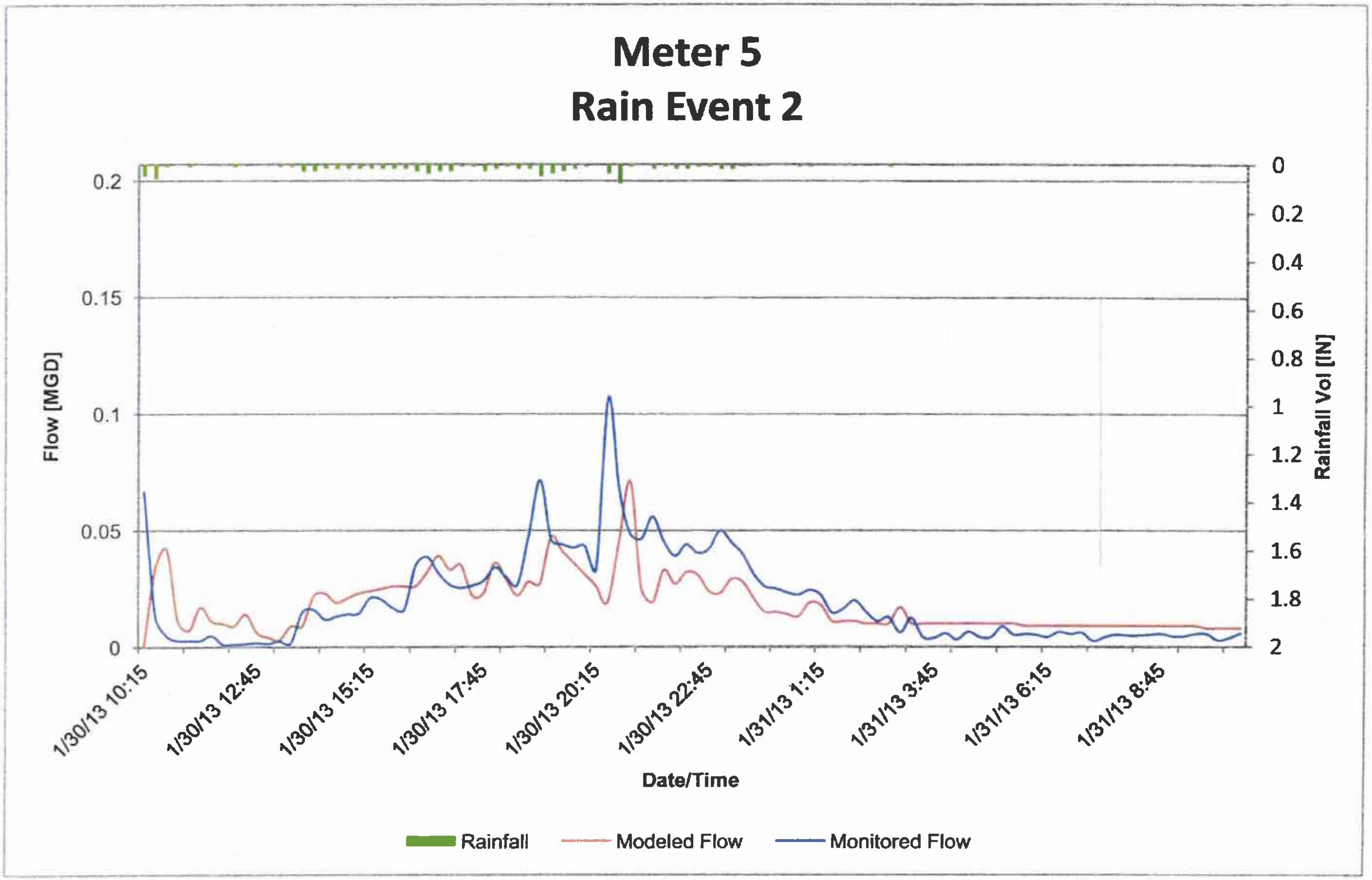
Meter M-4A
Rain Event 6
0.3
0.25
0.2
0.15
0.1
0.05
0
Flow [MGD]
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
Rainfall Vol [IN]
4/16/13 20:00
4/16/13 22:30
4/17/13 1:00
4/17/13 3:30
4/17/13 6:00
Date/Time
Rainfall
Modeled Flow
Monitored Flow

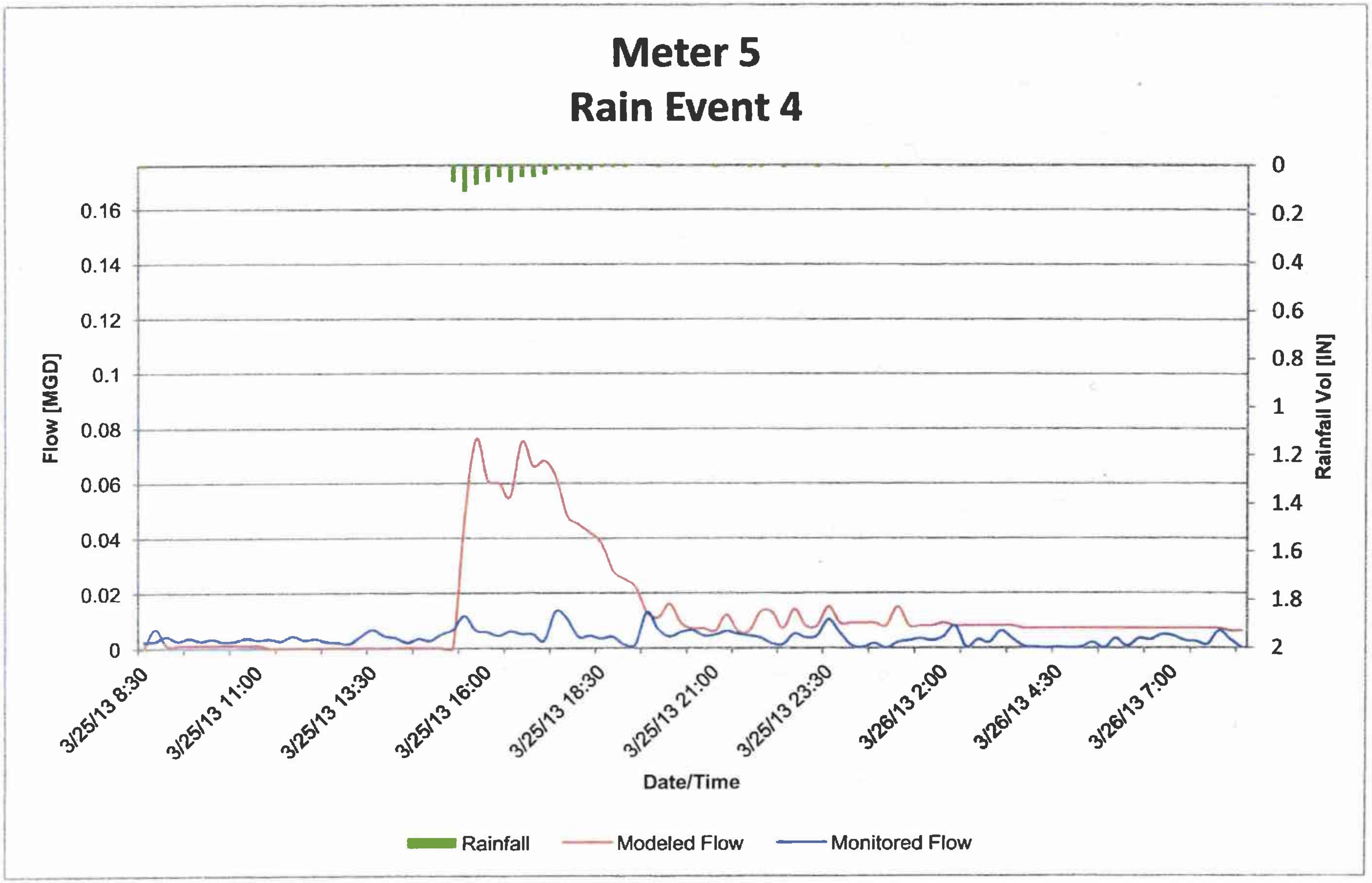


Meter M-4A
Rain Event 8
Flow [MGD]
0.2
0.15
0.1
0.05
0
Rainfall Vol [IN]
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
5/22/13 16:00
5/22/13 18:30
5/22/13 21:00
5/22/13 23:30
5/23/13 2:00
5/23/13 4:30
5/23/13 7:00
5/23/13 9:30
5/23/13 12:00
5/23/13 14:30
5/23/13 17:00
5/23/13 19:30
5/23/13 22:00
5/24/13 0:30
5/24/13 3:00
5/24/13 5:30
5/24/13 8:00
5/24/13 10:30
Date/Time
Rainfall
Modeled Flow
Monitored Flow

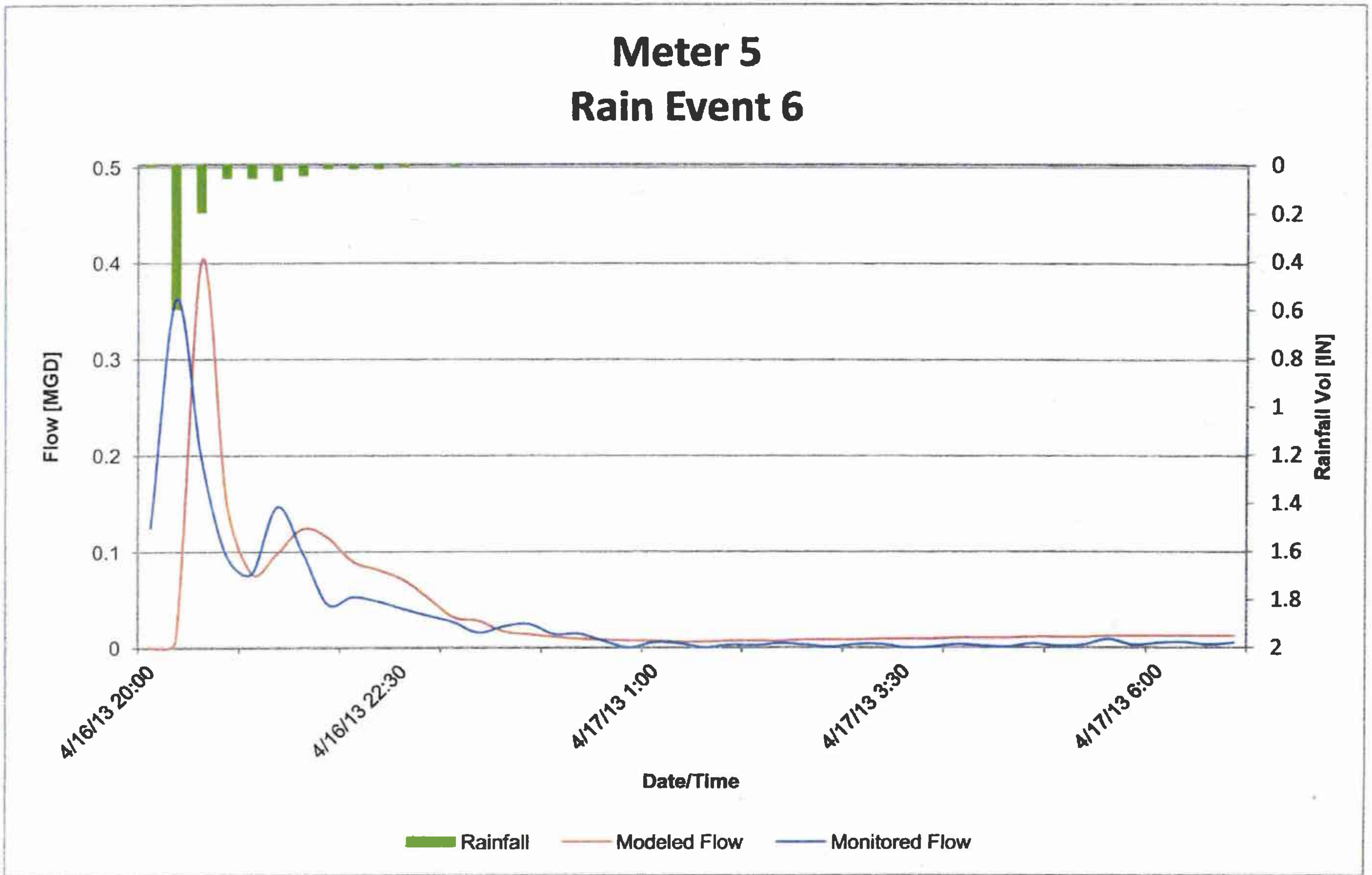
Meter 5
SUMMER MODEL
RAIN EVENTS

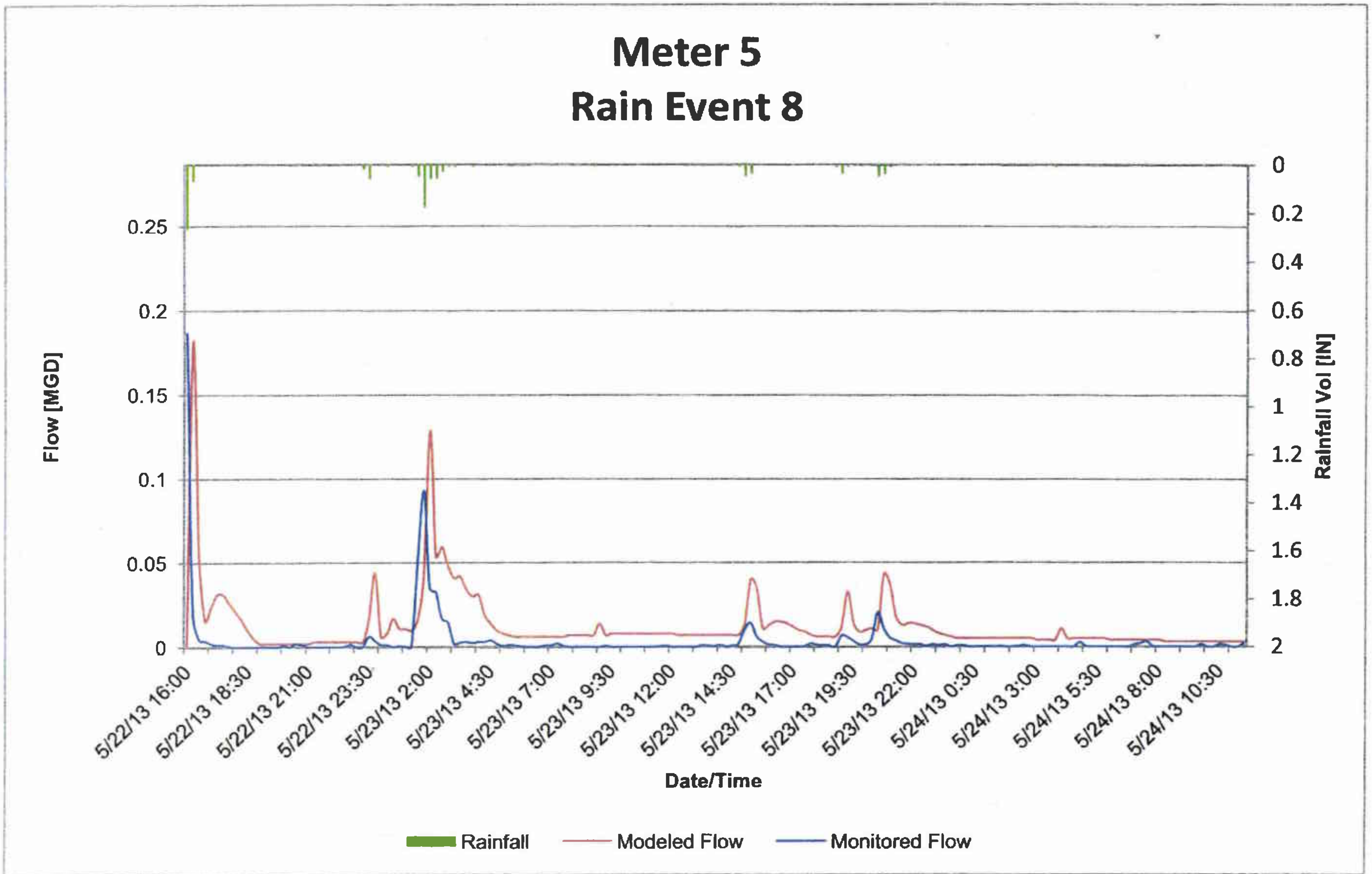
No.	Start Date	End Date	Total Rain	Max Int	Peak MOD Flow	Peak MON Flow	% Difference		Modeled Volume	Monitored Volume	% Difference	
1	1/28/13 3:00	1/28/13 20:00	0.53	0.20	0.04	0.04	4.55%	Mod HIGH	0.007	0.002	67.11%	Mod HIGH
2	1/30/13 10:15	1/31/13 8:30	1.08	0.32	0.07	0.11	33.64%	Mod LOW	0.015	0.018	16.34%	Mod LOW
3	2/26/13 12:30	2/27/13 13:15	1.01	0.44	0.09	0.07	23.08%	Mod HIGH	0.014	0.008	45.71%	Mod HIGH
4	3/25/13 15:15	3/26/13 6:30	0.77	0.44	0.08	0.01	82.46%	Mod HIGH	0.011	0.002	81.77%	Mod HIGH
5	4/10/13 15:45	4/11/13 5:30	0.58	0.88	0.15	0.14	7.16%	Mod HIGH	0.006	0.002	62.53%	Mod HIGH
6	4/16/13 20:00	4/17/13 4:45	1.13	2.40	0.40	0.36	10.17%	Mod HIGH	0.014	0.014	3.03%	Mod LOW
7	5/22/13 23:15	5/23/13 14:30	0.52	0.72	0.129	0.093	27.91%	Mod HIGH	0.007	0.003	60.39%	Mod HIGH
8	5/10/13 9:15	5/11/13 20:45	0.79	0.52	0.064	0.095	32.87%	Mod LOW	0.007	0.004	46.53%	Mod HIGH
9	5/22/13 16:00	5/24/13 15:30	1.13	1.08	0.122	0.187	34.64%	Mod LOW	0.011	0.006	44.62%	Mod HIGH


Meter 5
Rain Event 2
Flow [MGD]
0.2
0.15
0.1
0.05
0
Rainfall Vol [IN]
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
1/30/13 10:15
1/30/13 12:45
1/30/13 15:15
1/30/13 17:45
1/30/13 20:15
1/30/13 22:45
1/31/13 1:15
1/31/13 3:45
1/31/13 6:15
1/31/13 8:45
Date/Time
Rainfall
Modeled Flow
Monitored Flow



Meter 5
Rain Event 4
Flow [MGD]
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
Rainfall Vol [IN]
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
3/25/13 8:30
3/25/13 11:00
3/25/13 13:30
3/25/13 16:00
3/25/13 18:30
3/25/13 21:00
3/25/13 23:30
3/26/13 2:00
3/26/13 4:30
3/26/13 7:00
Date/Time
Rainfall
Modeled Flow
Monitored Flow

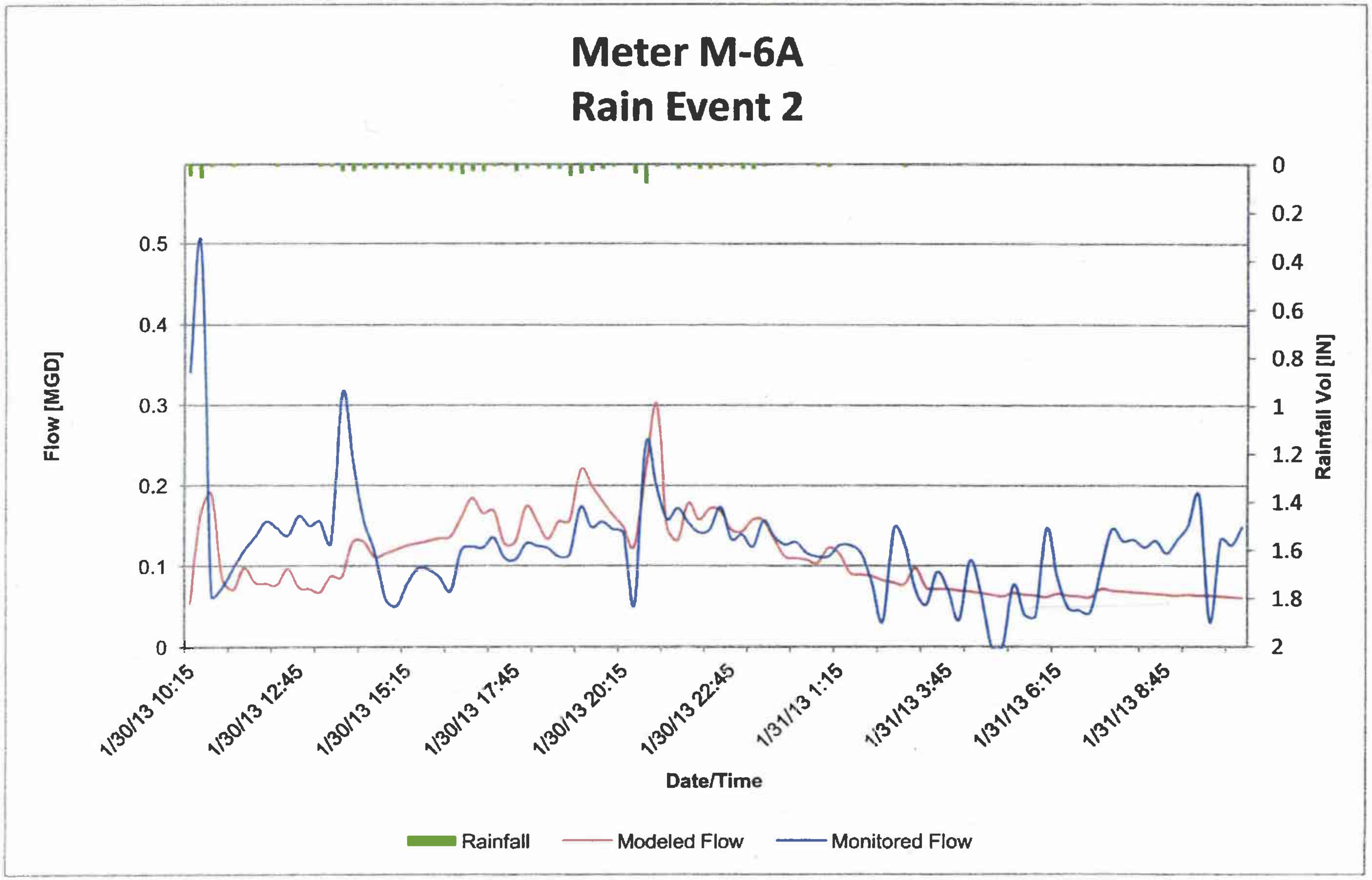

Meter 5
Rain Event 6
0.5
0.4
0.3
0.2
0.1
0
Flow [MGD]
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
Rainfall Vol [IN]
4/16/13 20:00
4/16/13 22:30
4/17/13 1:00
4/17/13 3:30
4/17/13 6:00
Date/Time
Rainfall
Modeled Flow
Monitored Flow



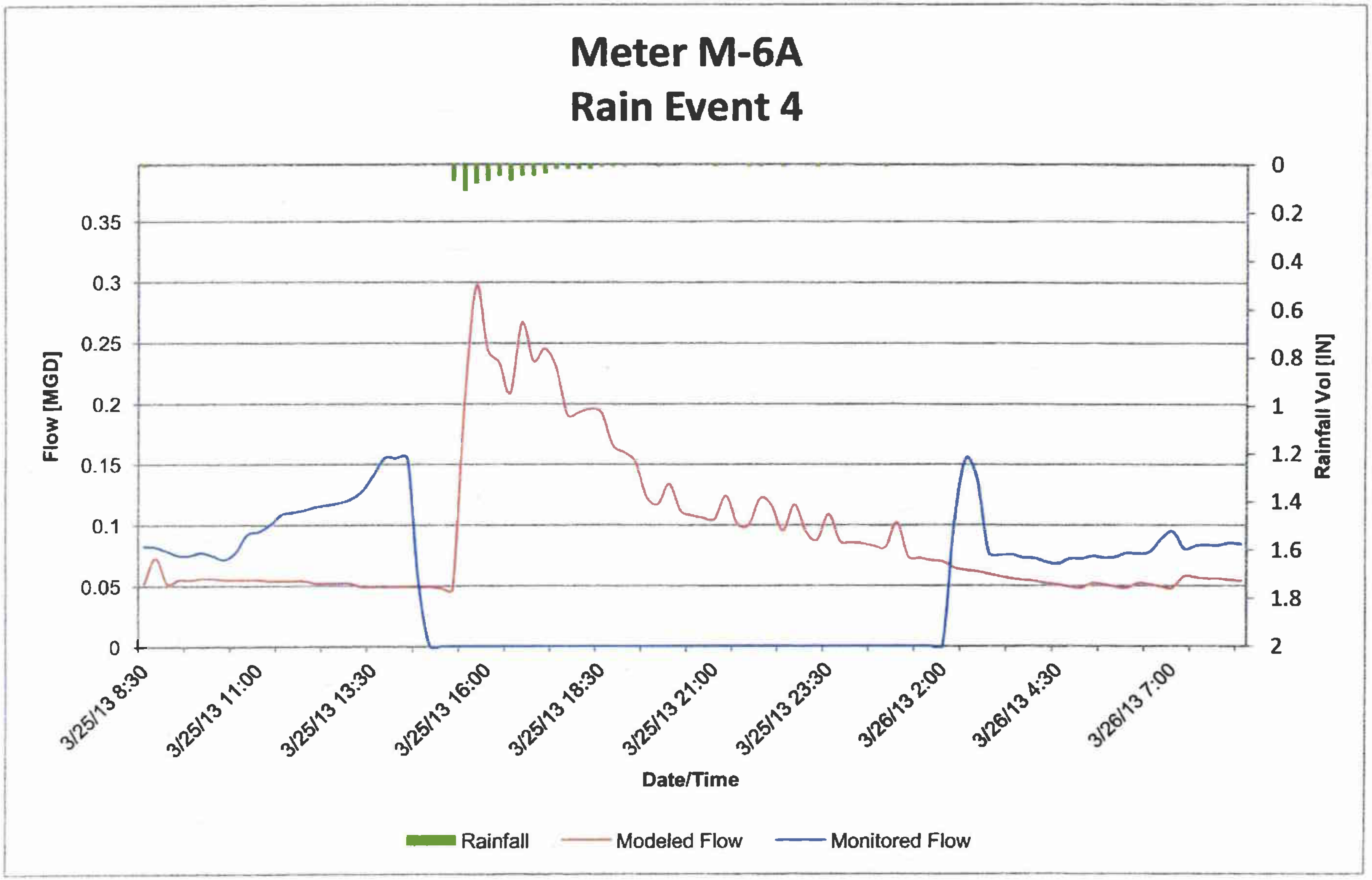
Meter 5
Rain Event 8
Flow [MGD]
0.25
0.2
0.15
0.1
0.05
0
Rainfall Vol [IN]
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
5/22/13 16:00
5/22/13 18:30
5/22/13 21:00
5/22/13 23:30
5/23/13 2:00
5/23/13 4:30
5/23/13 7:00
5/23/13 9:30
5/23/13 12:00
5/23/13 14:30
5/23/13 17:00
5/23/13 19:30
5/23/13 22:00
5/24/13 0:30
5/24/13 3:00
5/24/13 5:30
5/24/13 8:00
5/24/13 10:30
Date/Time
Rainfall
Modeled Flow
Monitored Flow

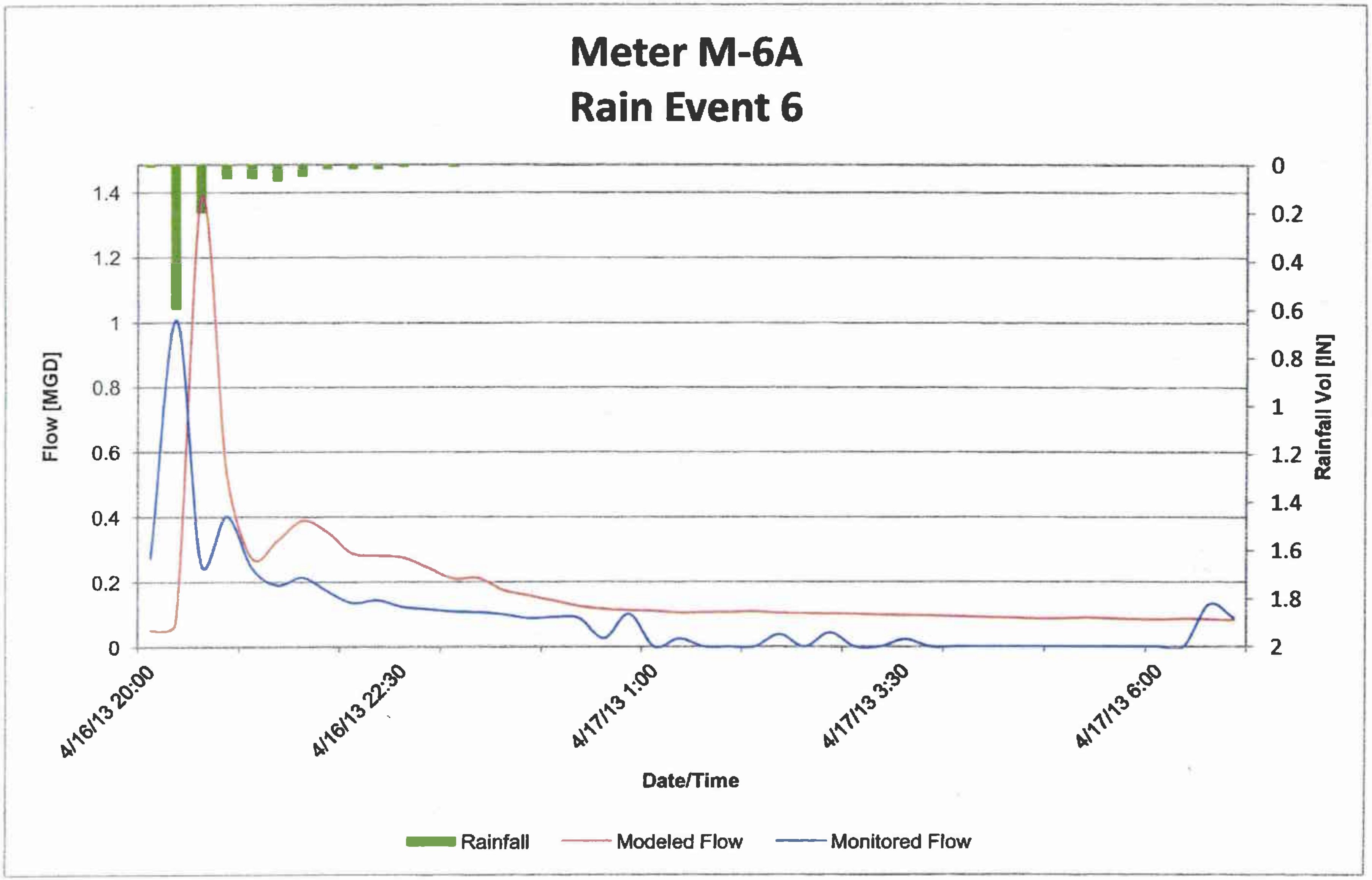
Meter M-6A
SUMMER MODEL
RAIN EVENTS

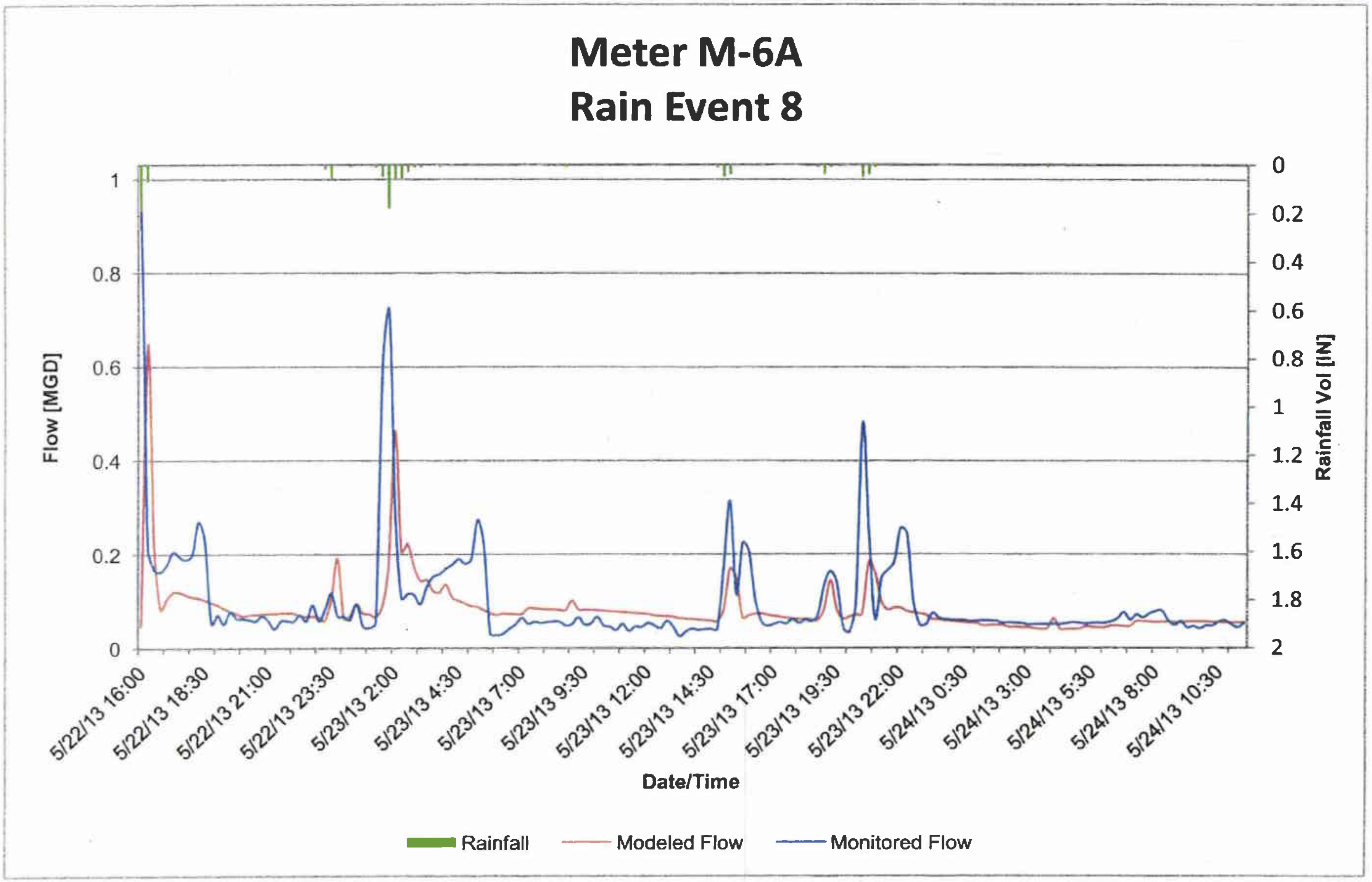
No.	Start Date	End Date	Total Rain	Max Int	Peak MOD Flow	Peak MON Flow	% Difference		Modeled Volume	Monitored Volume	% Difference	
1	1/28/13 3:00	1/28/13 20:00	0.53	0.20	0.20	0.37	45.84%	Mod LOW	0.046	0.054	14.41%	Mod LOW
2	1/30/13 10:15	1/31/13 8:30	1.08	0.32	0.30	0.50	39.40%	Mod LOW	0.086	0.088	3.11%	Mod LOW
3	2/26/13 12:30	2/27/13 13:15	1.01	0.44	0.34	0.44	23.58%	Mod LOW	0.075	0.073	2.61%	Mod HIGH
4	3/25/13 15:15	3/26/13 6:30	0.77	0.44	0.30	0.16	47.81%	Mod HIGH	0.057	0.000	100.00%	Mod HIGH
5	4/10/13 15:45	4/11/13 5:30	0.58	0.88	0.55	0.61	10.33%	Mod LOW	0.029	0.018	38.09%	Mod HIGH
6	4/16/13 20:00	4/17/13 4:45	1.13	2.40	1.39	1.01	27.20%	Mod HIGH	0.053	0.037	29.14%	Mod HIGH
7	5/22/13 23:15	5/23/13 14:30	0.52	0.72	0.463	0.722	35.90%	Mod LOW	0.032	0.038	14.50%	Mod LOW
8	5/22/13 16:00	5/24/13 15:30	1.13	1.08	0.779	0.931	16.33%	Mod LOW	0.071	0.081	12.44%	Mod LOW



Meter M-6A
Rain Event 2
Flow [MGD]
0.5
0.4
0.3
0.2
0.1
0
Rainfall Vol [IN]
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
1/30/13 10:15
1/30/13 12:45
1/30/13 15:15
1/30/13 17:45
1/30/13 20:15
1/30/13 22:45
1/31/13 1:15
1/31/13 3:45
1/31/13 6:15
1/31/13 8:45
Date/Time
Rainfall
Modeled Flow
Monitored Flow


Meter M-6A
Rain Event 4
Flow [MGD]
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
Rainfall Vol [IN]
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
3/25/13 8:30
3/25/13 11:00
3/25/13 13:30
3/25/13 16:00
3/25/13 18:30
3/25/13 21:00
3/25/13 23:30
3/26/13 2:00
3/26/13 4:30
3/26/13 7:00
Date/Time
Rainfall
Modeled Flow
Monitored Flow

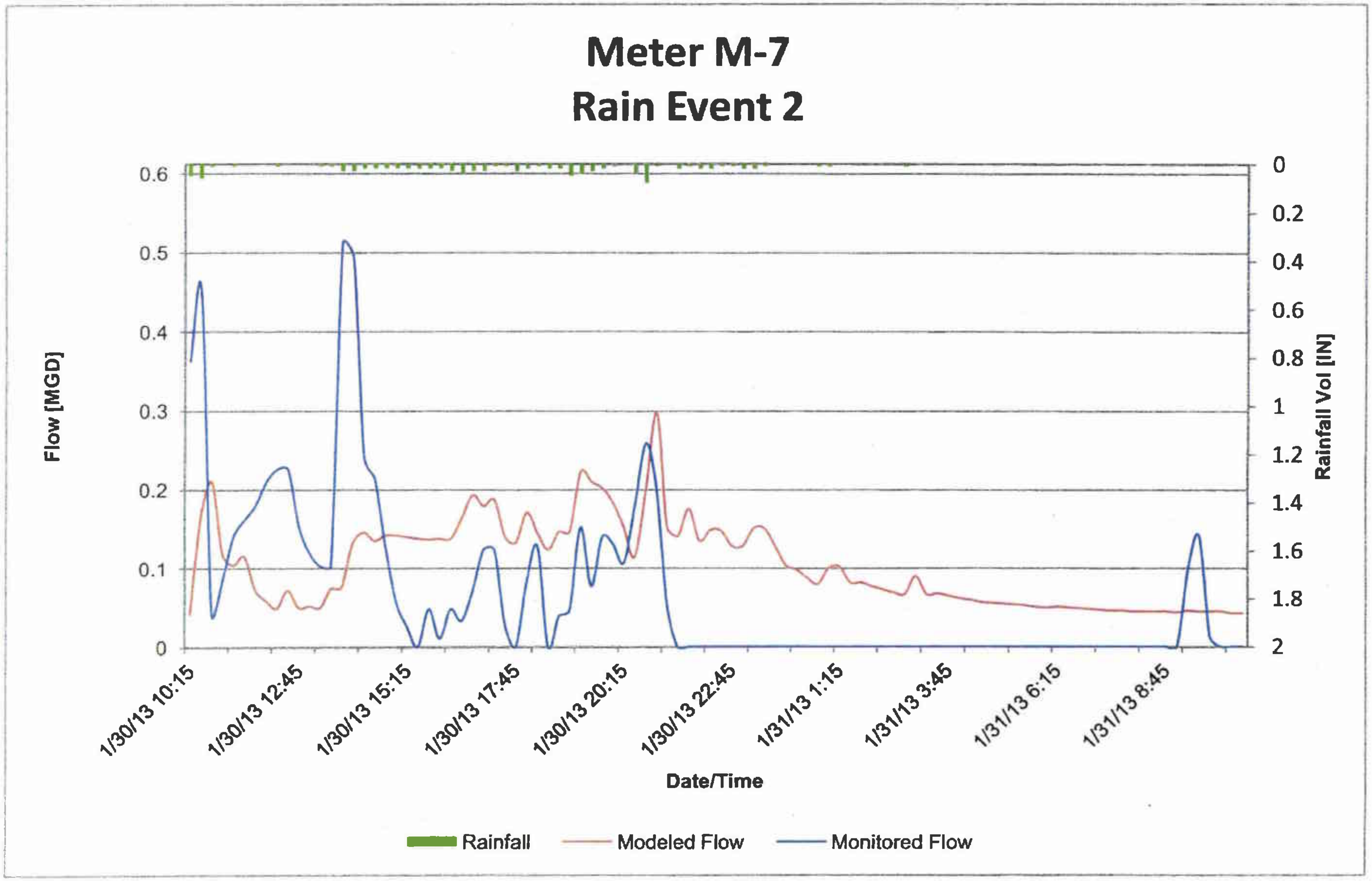

Meter M-6A
Rain Event 6
Flow [MGD]
1.4
1.2
1
0.8
0.6
0.4
0.2
0
Rainfall Vol [IN]
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
4/16/13 20:00
4/16/13 22:30
4/17/13 1:00
4/17/13 3:30
4/17/13 6:00
Date/Time
Rainfall
Modeled Flow
Monitored Flow



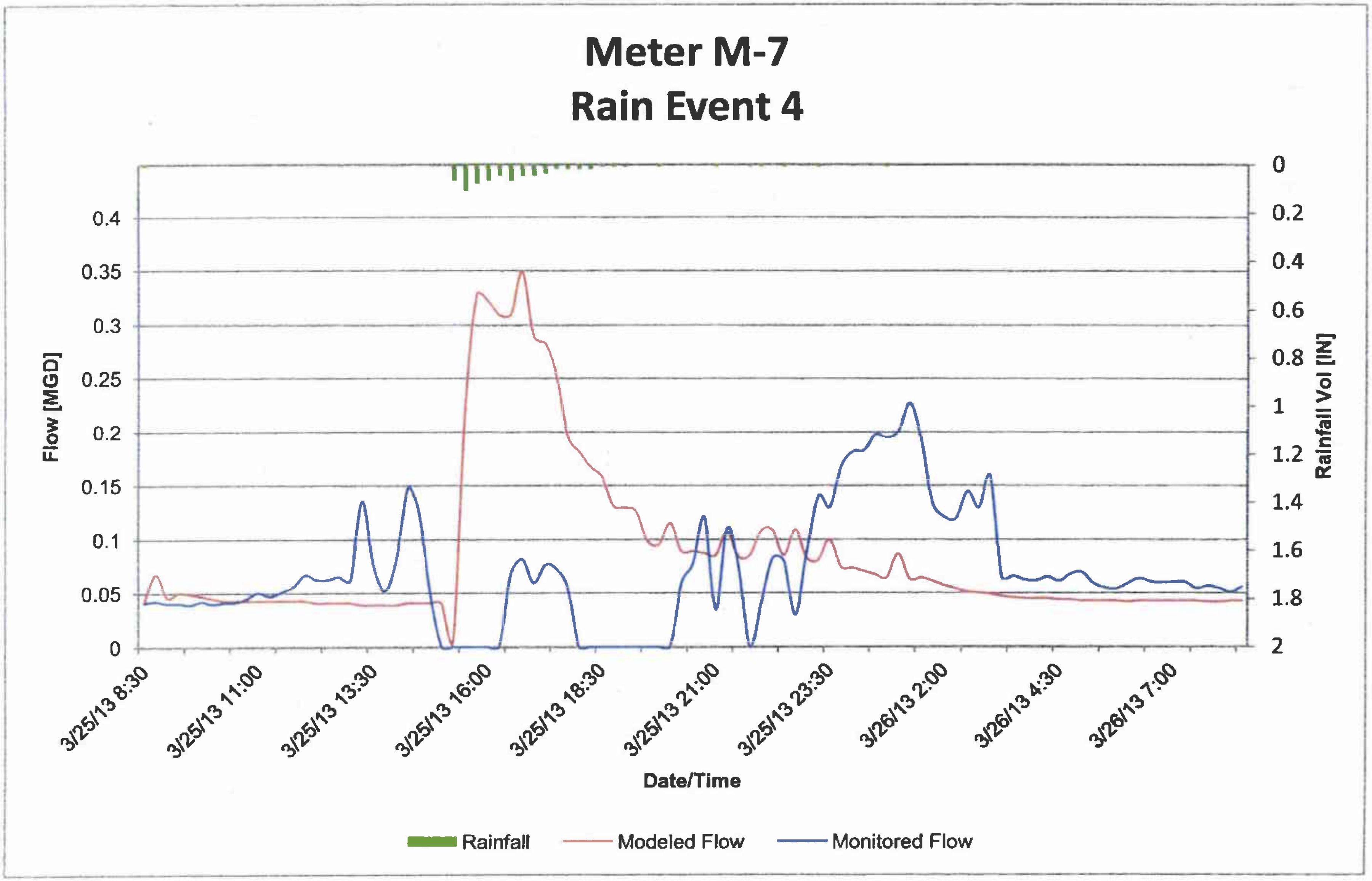
Meter M-6A
Rain Event 8
Flow [MGD]
1
0.8
0.6
0.4
0.2
0
Rainfall Vol [IN]
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
5/22/13 16:00
5/22/13 18:30
5/22/13 21:00
5/22/13 23:30
5/23/13 2:00
5/23/13 4:30
5/23/13 7:00
5/23/13 9:30
5/23/13 12:00
5/23/13 14:30
5/23/13 17:00
5/23/13 19:30
5/23/13 22:00
5/24/13 0:30
5/24/13 3:00
5/24/13 5:30
5/24/13 8:00
5/24/13 10:30
Date/Time
Rainfall
Modeled Flow
Monitored Flow

Meter M-7
SUMMER MODEL
RAIN EVENTS

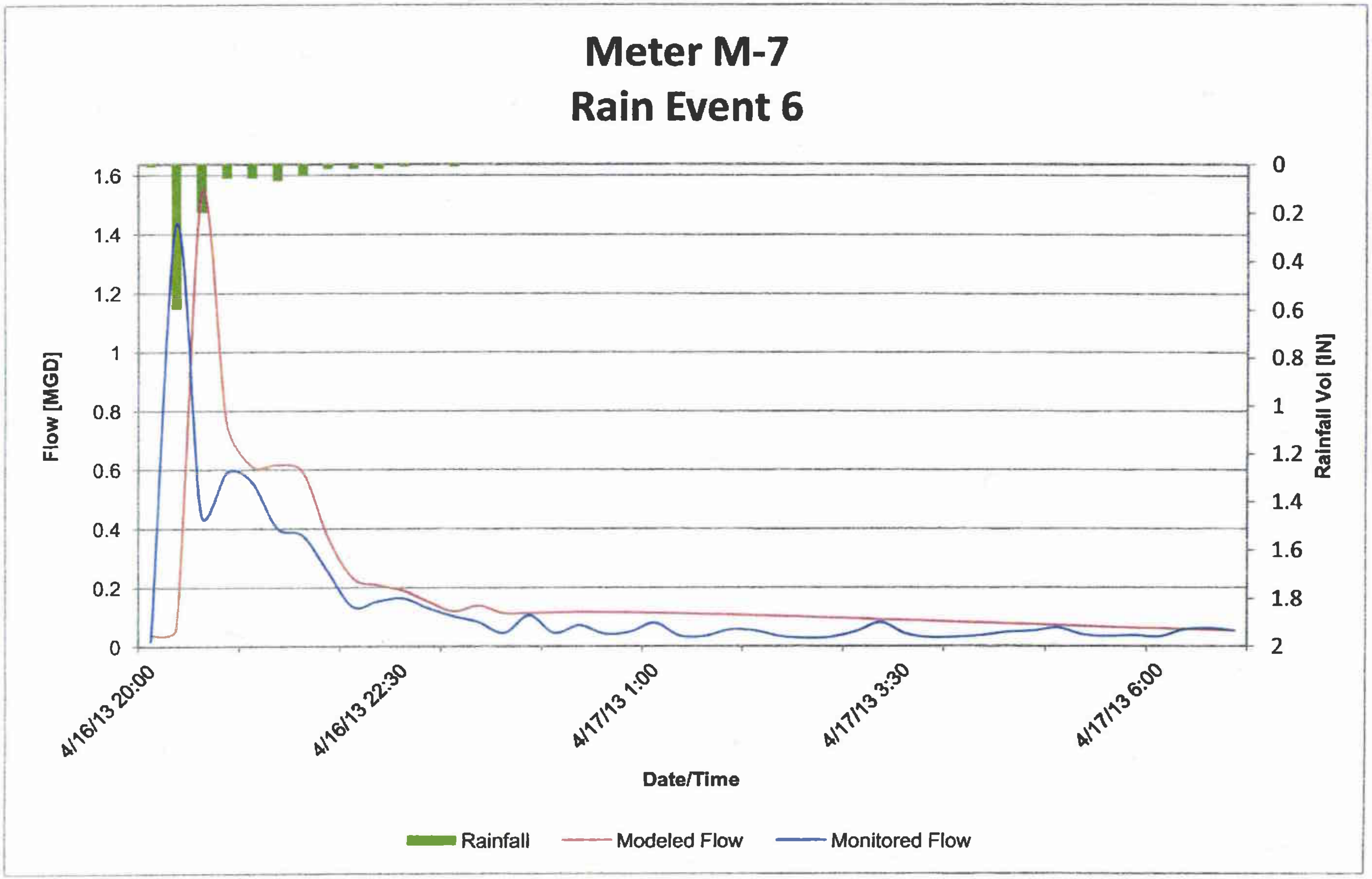
No.	Start Date	End Date	Total Rain	Max Int	Peak MOD Flow	Peak MON Flow	% Difference		Modeled Volume	Monitored Volume	% Difference	
1	1/28/13 3:00	1/29/13 13:00	0.55	0.20	0.20	0.59	66.55%	Mod LOW	0.050	0.043	15.74%	Mod HIGH
2	1/30/13 10:15	1/31/13 10:30	1.08	0.32	0.30	0.51	41.83%	Mod LOW	0.085	0.062	26.76%	Mod HIGH
3	2/26/13 12:30	2/27/13 15:15	1.01	0.44	0.42	0.67	37.82%	Mod LOW	0.076	0.073	4.69%	Mod HIGH
4	3/25/13 8:30	3/26/13 8:30	0.78	0.44	0.35	0.23	35.05%	Mod HIGH	0.059	0.023	61.10%	Mod HIGH
5	4/10/13 15:45	4/11/13 7:30	0.58	0.88	0.59	0.00	100.00%	Mod HIGH	0.034	0.000	100.00%	Mod HIGH
6	4/16/13 20:00	4/17/13 6:45	1.13	2.40	1.54	1.43	6.83%	Mod HIGH	0.060	0.051	14.91%	Mod HIGH
7	5/10/13 9:15	5/11/13 16:45	0.79	0.52	0.378	0.191	49.47%	Mod HIGH	0.057	0.019	66.89%	Mod HIGH
8	5/22/13 16:00	5/24/13 11:30	1.13	1.08	0.724	0.665	8.20%	Mod HIGH	0.070	0.051	26.82%	Mod HIGH
		No Monitored Flow										



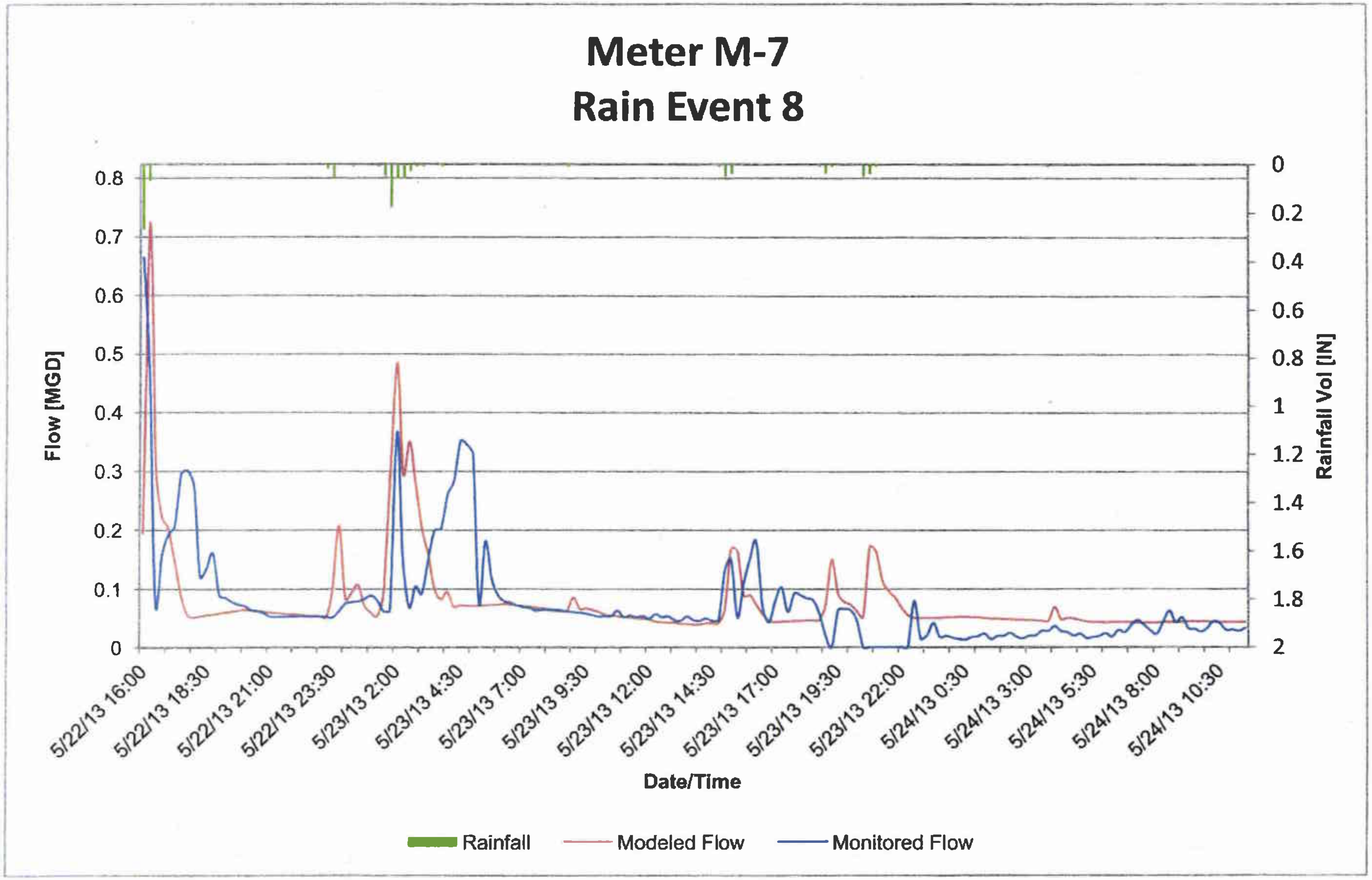
Meter M-7
Rain Event 2
Flow [MGD]
0.6
0.5
0.4
0.3
0.2
0.1
0
Rainfall Vol [IN]
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
1/30/13 10:15
1/30/13 12:45
1/30/13 15:15
1/30/13 17:45
1/30/13 20:15
1/30/13 22:45
1/31/13 1:15
1/31/13 3:45
1/31/13 6:15
1/31/13 8:45
Date/Time
Rainfall
Modeled Flow
Monitored Flow



Meter M-7
Rain Event 4
Flow [MGD]
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
Rainfall Vol [IN]
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
3/25/13 8:30
3/25/13 11:00
3/25/13 13:30
3/25/13 16:00
3/25/13 18:30
3/25/13 21:00
3/25/13 23:30
3/26/13 2:00
3/26/13 4:30
3/26/13 7:00
Date/Time
Rainfall
Modeled Flow
Monitored Flow



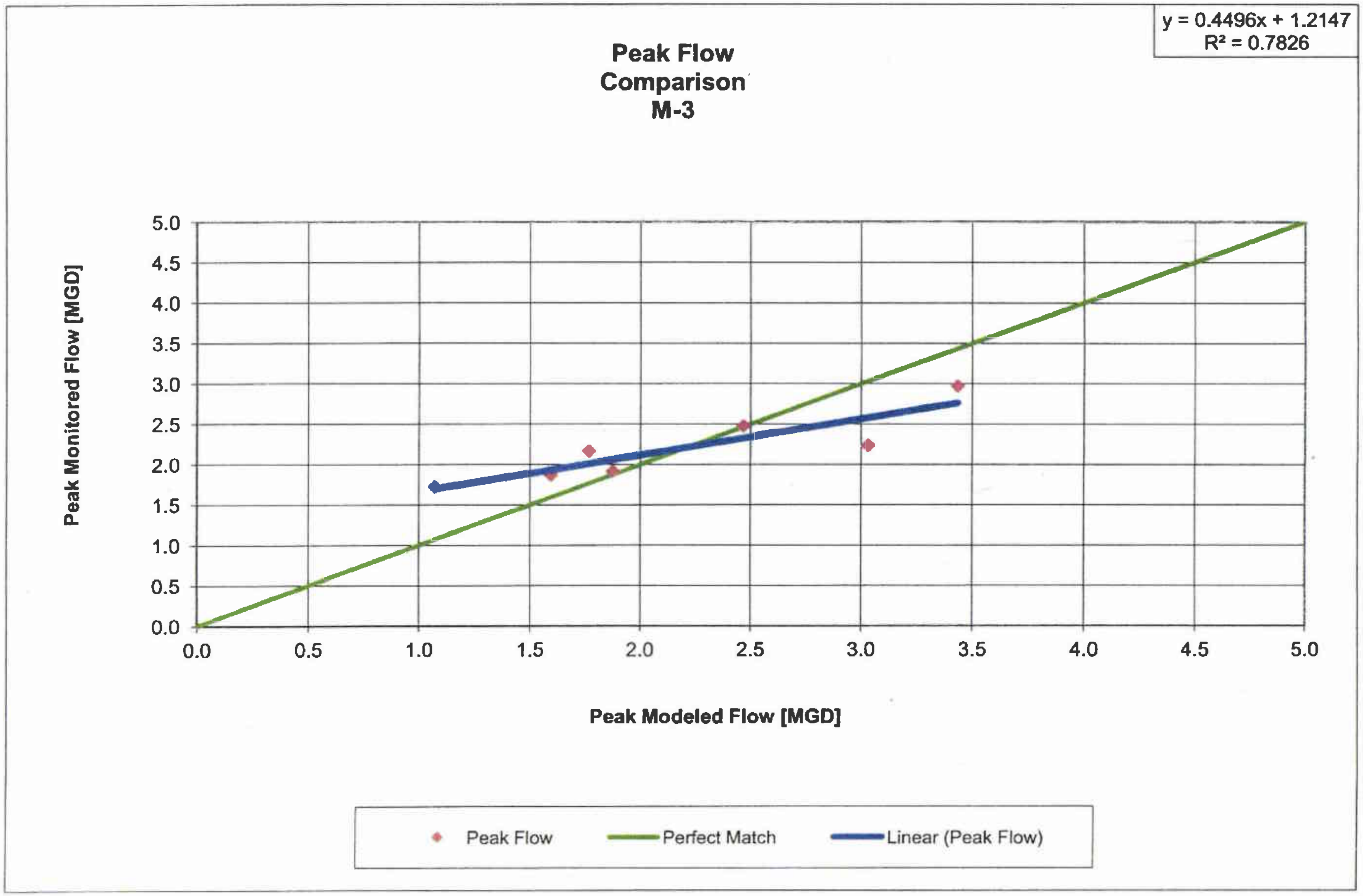
Meter M-7
Rain Event 6
Flow [MGD]
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
Rainfall Vol [IN]
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
4/16/13 20:00
4/16/13 22:30
4/17/13 1:00
4/17/13 3:30
4/17/13 6:00
Date/Time
Rainfall
Modeled Flow
Monitored Flow



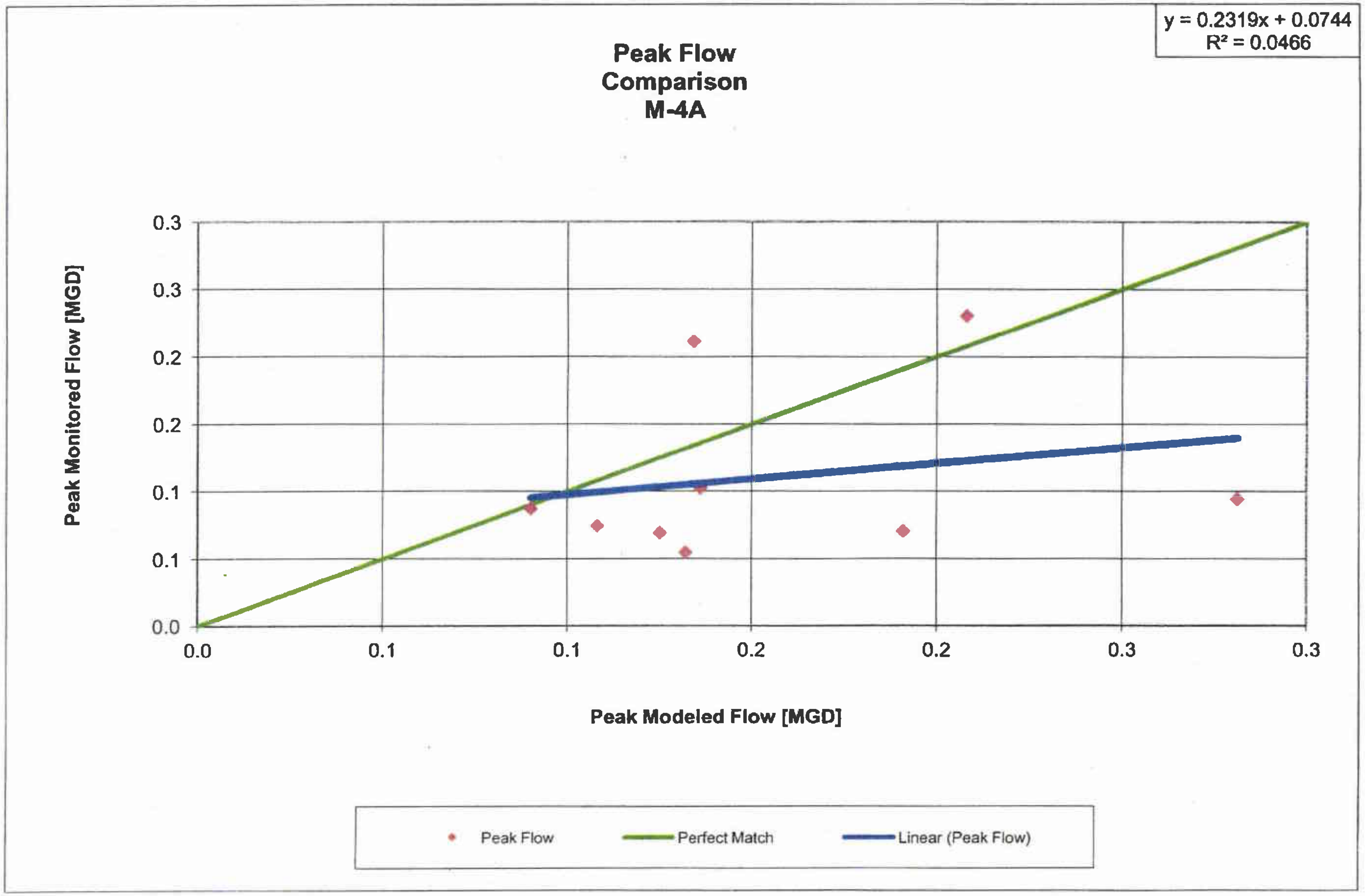
Meter M-7
Rain Event 8
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
Flow [MGD]
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
Rainfall Vol [IN]
5/22/13 16:00
5/22/13 18:30
5/22/13 21:00
5/22/13 23:30
5/23/13 2:00
5/23/13 4:30
5/23/13 7:00
5/23/13 9:30
5/23/13 12:00
5/23/13 14:30
5/23/13 17:00
5/23/13 19:30
5/23/13 22:00
5/24/13 0:30
5/24/13 3:00
5/24/13 5:30
5/24/13 8:00
5/24/13 10:30
Date/Time
Rainfall
Modeled Flow
Monitored Flow

APPENDIX H

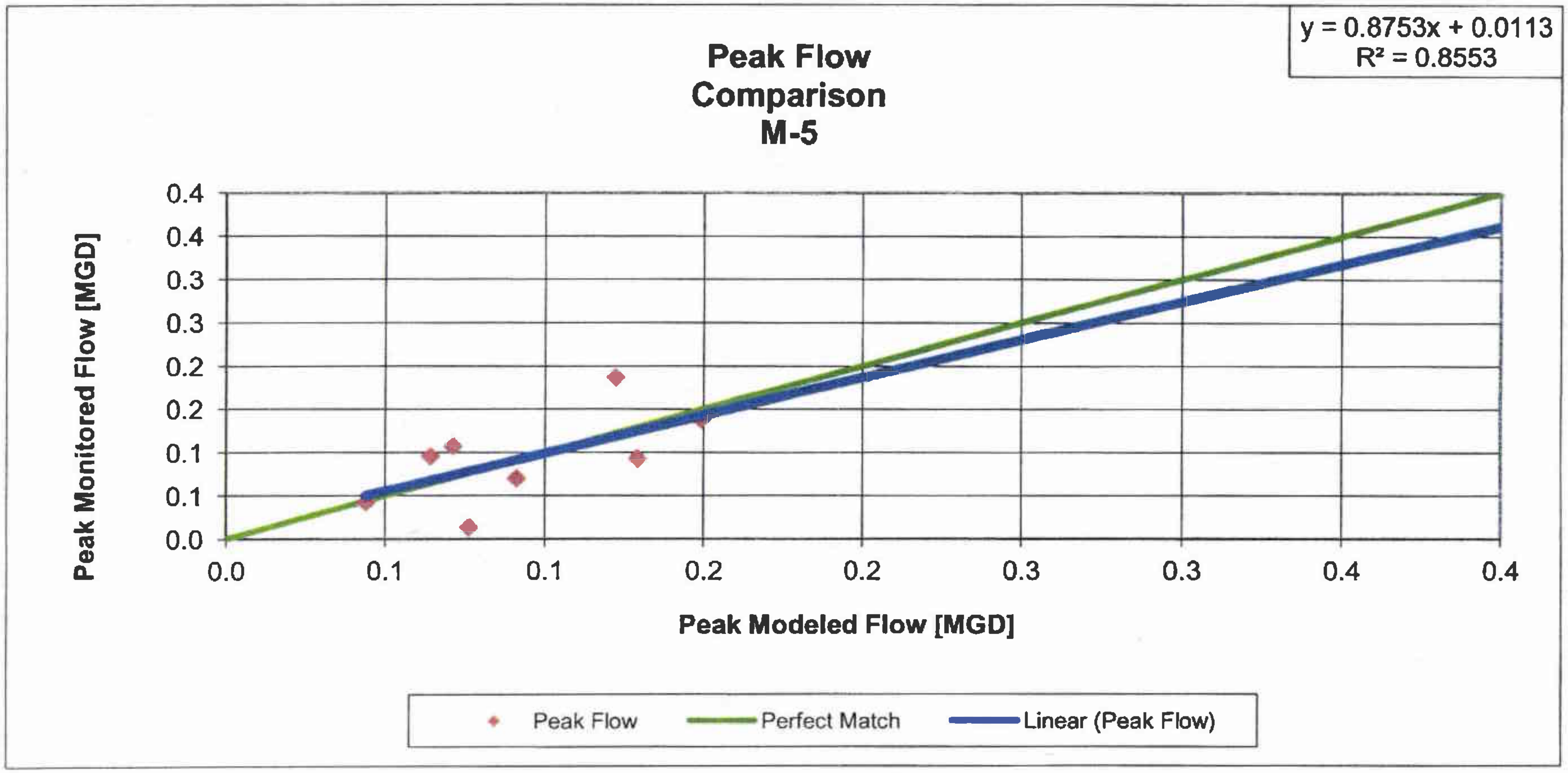
MONITORED VS. MODELED REGRESSION PLOTS



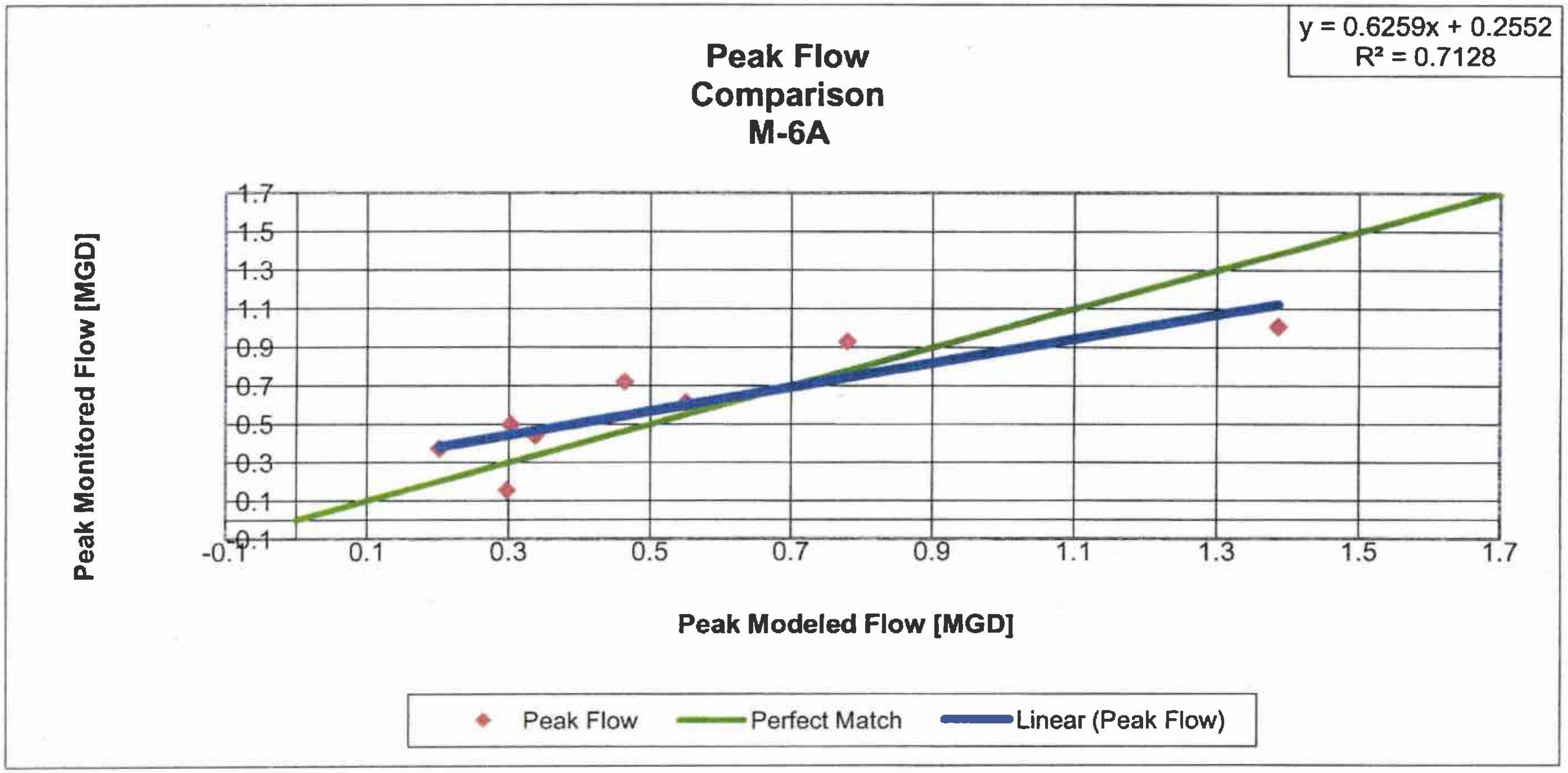
y = 0.4496x + 1.2147
R² = 0.7826
Peak Flow
Comparison
M-3
Peak Monitored Flow [MGD]
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
Peak Modeled Flow [MGD]
Peak Flow
Perfect Match
Linear (Peak Flow)



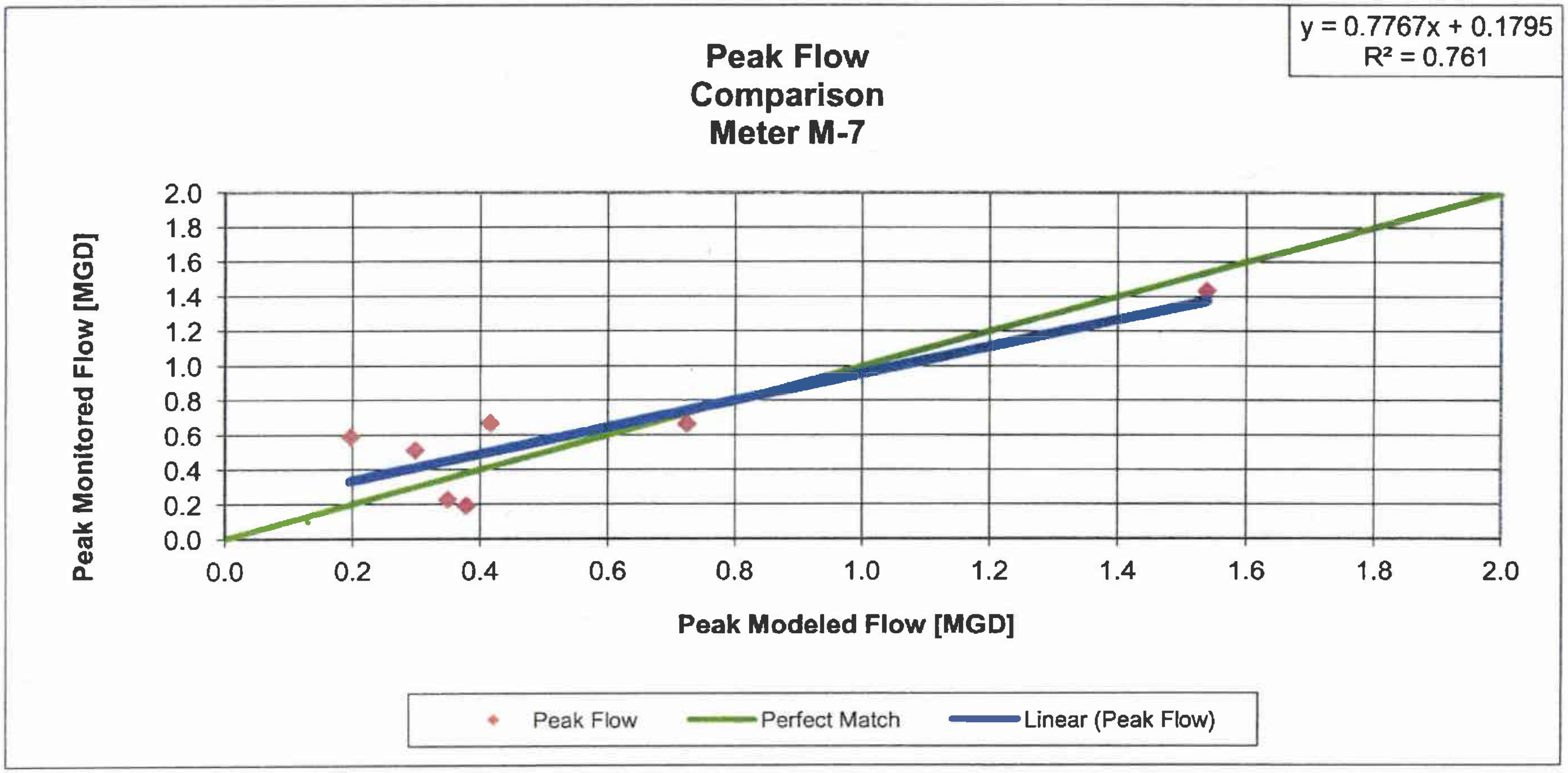
y = 0.2319x + 0.0744
R² = 0.0466
Peak Flow
Comparison
M-4A
Peak Monitored Flow [MGD]
0.3
0.3
0.2
0.2
0.1
0.1
0.0
0.0
0.1
0.1
0.2
0.2
0.3
0.3
Peak Modeled Flow [MGD]
Peak Flow
Perfect Match
Linear (Peak Flow)



y = 0.8753x + 0.0113
R² = 0.8553
Peak Flow
Comparison
M-5
0.4
0.4
0.3
0.3
0.2
0.2
0.1
0.1
0.0
Peak Monitored Flow [MGD]
0.0
0.1
0.1
0.2
0.2
0.3
0.3
0.4
0.4
Peak Modeled Flow [MGD]
Peak Flow
Perfect Match
Linear (Peak Flow)



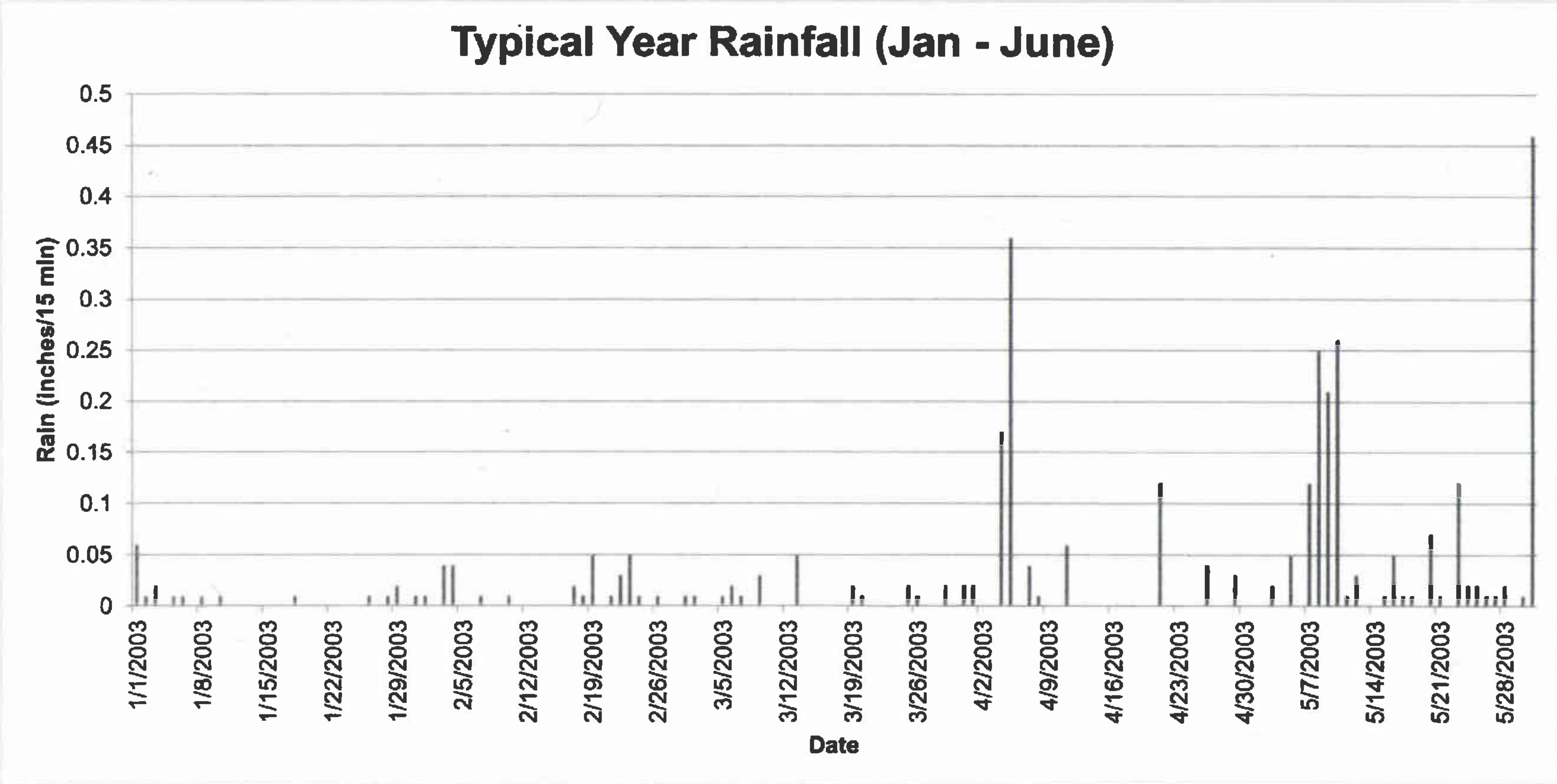
Peak Flow
Comparison
M-6A
y = 0.6259x + 0.2552
R² = 0.7128
Peak Monitored Flow [MGD]
1.7
1.5
1.3
1.1
0.9
0.7
0.5
0.3
0.1
-0.1
-0.1
0.1
0.3
0.5
0.7
0.9
1.1
1.3
1.5
1.7
Peak Modeled Flow [MGD]
Peak Flow
Perfect Match
Linear (Peak Flow)



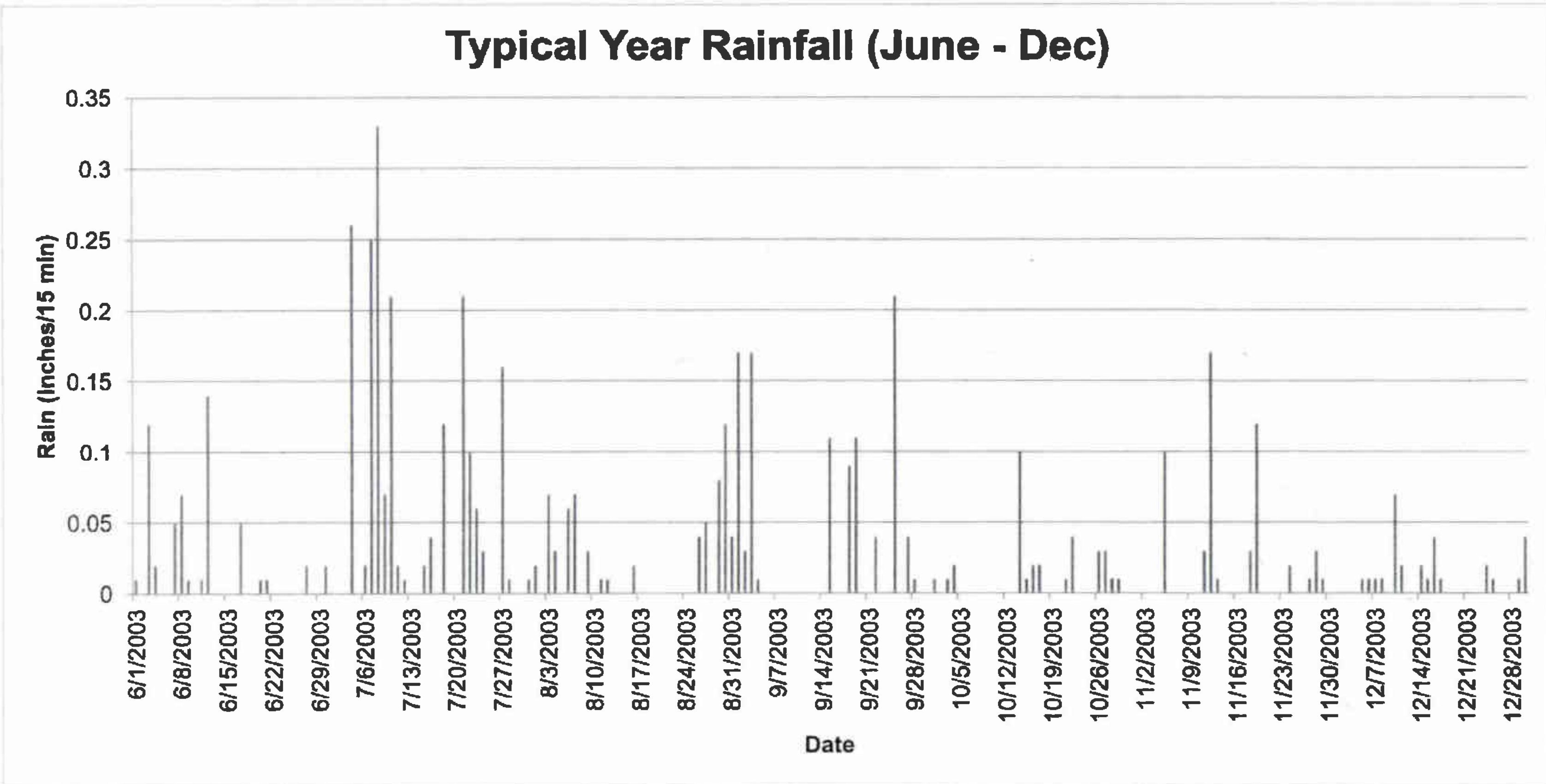
y = 0.7767x + 0.1795
R² = 0.761
Peak Flow
Comparison
Meter M-7
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
Peak Monitored Flow [MGD]
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
2.0
Peak Modeled Flow [MGD]
Peak Flow
Perfect Match
Linear (Peak Flow)

APPENDIX I

TYPICAL YEAR RAIN HYETOGRAPH



Typical Year Rainfall (Jan - June)
Rain (inches/15 min)
0.5
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
1/1/2003
1/8/2003
1/15/2003
1/22/2003
1/29/2003
2/5/2003
2/12/2003
2/19/2003
2/26/2003
3/5/2003
3/12/2003
3/19/2003
3/26/2003
4/2/2003
4/9/2003
4/16/2003
4/23/2003
4/30/2003
5/7/2003
5/14/2003
5/21/2003
5/28/2003
Date


Typical Year Rainfall (June - Dec)
Rain (Inches/15 min)
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
6/1/2003
6/8/2003
6/15/2003
6/22/2003
6/29/2003
7/6/2003
7/13/2003
7/20/2003
7/27/2003
8/3/2003
8/10/2003
8/17/2003
8/24/2003
8/31/2003
9/7/2003
9/14/2003
9/21/2003
9/28/2003
10/5/2003
10/12/2003
10/19/2003
10/26/2003
11/2/2003
11/9/2003
11/16/2003
11/23/2003
11/30/2003
12/7/2003
12/14/2003
12/21/2003
12/28/2003
Date

APPENDIX J

INFOSWMM TYPICAL YEAR MODEL REPORT

```
  --------------------------------------------------------------------------
    Comprehensive Storm Water Management Model: based on EPA-SWMM 5.0.022
  --------------------------------------------------------------------------

Warning 08: elevation drop 5.735 exceeds length 5.186 for Conduit WETWELL-
DUMMY_OUTFALL
 Needed length: 5.735000 ft
Warning 02: maximum depth 4.320 increased for Node DV_DUMMY

  *************************
    Rainfall File Summary
  *************************
  Station    First        Last         Recording   Periods    Periods
Periods
  ID         Date         Date         Frequency  w/Precip    Missing
Malfunc.
  ---------------------------------------------------------------------------
----
  RG-274385S001 DEC-21-2002  DEC-30-2003     15 min      1497          0
0


  **********************            Volume        Volume
  Rainfall Dependent I/I         acre-feet     10^6 gal
  **********************         ---------     ---------
  Sewershed Rainfall ......        666.662       217.242
  RDII Produced ...........         47.369        15.436
  RDII Ratio ..............          0.071


  *************************************************************
    NOTE: The summary statistics displayed in this report are
    based on results found at every computational time step,
    not just on results from each reporting time step.
  *************************************************************

  ********************
    Analysis Options
  ********************
  Flow Units ............... MGD
  Process Models:
    Rainfall/Runoff ........ YES
    Snowmelt ............... NO
    Groundwater ............ NO
    Flow Routing ........... YES
    Ponding Allowed ........ YES
    Water Quality .......... NO
  Flow Routing Method ...... DYNWAVE
  Starting Date ............ DEC-25-2002 00:00:00
  Ending Date .............. JAN-05-2004 11:45:00
  Antecedent Dry Days ...... 5.0
  Report Time Step ......... 00:15:00
  Routing Time Step ........ 15.00 sec
```

```
Link DV144-DV107 (0.00%)
Node DV103 (0.00%)
Node DV402 (0.00%)
Link DV171-DV173 (0.00%)
Link DV300-DV102 (0.00%)
Link DV352-DV351 (0.00%)
Link DV176-DV100 (0.00%)
Link DV157-DV156 (0.00%)


*************************************
  Highest Flow Instability Indexes
*************************************
Link WETWELL-DUMMY_OUTFALL (0)
Link DV101-DV_WETWELL (0)
Link DV102-DV101 (0)
Link DV_CHAM-DV103 (0)
Link DV230-DV300 (0)
Link DV351-DV402 (0)
Link DV406-DV407 (0)
Link DV300-DV102 (0)
Link DV103-DV102 (0)
Link DV201-DV103 (0)
Link DV173-DV174 (0)
Link DV229-DV230 (0)
Link DV171-DV173 (0)
Link DV176-DV100 (0)
Link DV105-DV_CHAM (0)
Link DV157-DV156 (0)
Link IN_VAULT (0)
Link DV_CHAM-DV176 (0)
Link DV409-DV416 (0)
Link DV416-DV414 (0)

*****************************
  Routing Time Step Summary
*****************************
Minimum Time Step           :     0.10 sec
Average Time Step           :     1.93 sec
Maximum Time Step           :     2.36 sec
Percent in Steady State     :     0.00
Average Iterations per Step :     1.97
Total Steps                 :  16520888
Total Iterations            :  32536306
Minimum Possible Steps      :  13800891


**********************
  Node Depth Summary
**********************

  ---------------------------------------------------------------------------
--------------------
                                  Average  Maximum  Maximum  Time of Max
Maximum  Time of Max
                                    Depth    Depth  Run HGL   Occurrence
Output HGL   Occurrence
```

DV414	JUNCTION	0.04	0.12	854.23	157	12:18	854.22	157	12:15
DV416	JUNCTION	0.44	0.52	895.36	157	12:18	895.36	157	12:15
DV434	JUNCTION	0.01	0.04	783.12	157	12:20	783.12	157	12:15
DV_DUMMY	JUNCTION	0.01	0.05	746.23	329	13:20	746.23	329	13:15
DUMMY_OUTFALL	OUTFALL	0.05	0.19	715.19	195	03:52	715.16	157	11:45
DV100	OUTFALL	0.00	0.58	724.43	157	11:50	724.34	157	11:45
DV_VAULT	STORAGE	0.26	2.26	728.94	157	11:50	728.87	157	11:45
REGULATOR_PIT	STORAGE	0.16	2.50	728.14	157	11:50	728.06	157	11:45
WETWELL	STORAGE	0.04	0.40	721.14	195	03:52	721.07	157	11:45

****
Node Inflow Summary
****

Node	Type	Maximum Lateral Inflow MGD	Maximum Total Inflow MGD	Time of Max Occurrence days	hr:min	Lateral Inflow Volume 10^6 gal	Total Inflow Volume 10^6 gal
DV101	JUNCTION	0.000	4.743	157	11:37	0.000	128.363
DV102	JUNCTION	0.000	4.717	157	11:50	0.000	128.348
DV103	JUNCTION	0.000	4.146	157	11:36	0.000	111.037
DV105	JUNCTION	0.000	7.387	157	11:50	0.000	91.985
DV107	JUNCTION	0.000	0.315	157	11:50	0.000	0.778
DV108	JUNCTION	0.000	0.315	157	11:50	0.000	0.778
DV144	JUNCTION	0.000	0.315	157	11:50	0.000	0.778
DV156	JUNCTION	0.000	0.327	157	11:35	0.000	0.778
DV157	JUNCTION	0.315	0.315	157	11:45	0.758	0.778
DV171	JUNCTION	0.000	0.409	329	13:20	0.000	13.491

Node	Type	Hours Surcharged	Max. Height Above Crown Feet	Min. Depth Below Rim Feet
DV101	JUNCTION	30.69	6.184	14.206
DV102	JUNCTION	12.51	4.463	14.987
DV103	JUNCTION	10.60	4.302	12.578
DV201	JUNCTION	27.74	12.750	0.513
DV229	JUNCTION	9.82	40.596	0.000
DV230	JUNCTION	11.67	9.775	9.195
DV300	JUNCTION	12.12	11.162	7.848
REGULATOR_PIT	STORAGE	3.83	1.499	12.321

****
Node Flooding Summary
****

No nodes were flooded.

****
Storage Volume Summary
****

Storage Unit	Average Volume 1000 ft3	Avg Pcnt Full	E&I Pcnt Loss	Maximum Volume 1000 ft3	Max Pcnt Full	Time of Max Occurrence days hr:min	Maximum Outflow MGD
DV_VAULT	0.000	0.00	0.00	0.000	0	0 00:00	7.699
REGULATOR_PIT	0.000	0.00	0.00	0.000	0	0 00:00	3.709
WETWELL	0.000	0.00	0.00	0.000	0	0 00:00	6.487

****
Outfall Loading Summary
****

Outfall Node	Flow Freq. Pcnt.	Avg. Flow MGD	Max. Flow MGD	Total Volume 10^6 gal
DUMMY_OUTFALL	98.12	0.367	6.487	126.529
DV100	0.14	0.780	5.014	0.139
System	49.13	1.146	9.960	126.669

```
  DV402-DV403           CONDUIT          0.330   157  12:15          0.330
157  12:15    0.02      5.26   157  12:15   0.10   157  12:15          0.89
  DV403-DV405           CONDUIT          0.330   157  12:15          0.330
157  12:15    0.02      5.97   157  12:15   0.10   157  12:15          0.91
  DV405-DV406           CONDUIT          0.330   157  12:15          0.330
157  12:15    0.03      4.11   157  12:13   0.12   157  12:15          1.01
  DV406-DV407           CONDUIT          0.330   157  12:16          0.330
157  12:15    0.05      3.16   157  12:16   0.15   157  12:16          1.04
  DV407-DV408           CONDUIT          0.330   157  12:16          0.329
157  12:15    0.04      2.31   157  12:16   0.18   157  12:17          1.16
  DV408-DV409           CONDUIT          0.329   157  12:17          0.326
157  12:15    0.01      4.79   157  12:17   0.07   157  12:17          1.27
  DV409-DV416           CONDUIT          0.329   157  12:17          0.326
157  12:15    0.01      1.60   157  12:17   0.16   157  12:18          1.46
  DV414-DV434           CONDUIT          0.329   157  12:18          0.323
157  12:15    0.01      11.39  157  12:17   0.04   157  12:19          0.79
  DV416-DV414           CONDUIT          0.329   157  12:18          0.324
157  12:15    0.01      7.30   157  12:18   0.06   157  12:18          1.47
  DV434-DV171           CONDUIT          0.329   157  12:20          0.317
157  12:15    0.00      3.95   157  12:20   0.01   157  12:20          3.00
  DV_CHAM-DV103         CONDUIT          3.709   101  02:50          2.943
157  12:00    0.81      8.88   195  03:51   1.00   100  21:18          1.00
  DV_CHAM-DV176         CONDUIT          5.015   157  11:50          3.646
157  11:45    0.02      6.43   157  11:50   0.09   157  11:50          5.00
  WETWELL-DUMMY_OUTFALL CONDUIT            6.487   195  03:52          4.901
157  11:45    0.00      27.33  329  10:46   0.05   195  03:52          2.39
  IN_VAULT              ORIFICE          3.284   101  02:50          2.943
157  12:00                                  1.00   100  21:07


  *******************************
    Flow Classification Summary
  *******************************

  ----------------------------------------------------------------------------
--------------
                    Adjusted    --- Fraction of Time in Flow Class ----
Avg.     Avg.
                    /Actual          Up     Down   Sub    Sup    Up     Down
Froude   Flow
  Conduit            Length    Dry   Dry    Dry    Crit   Crit   Crit   Crit
Number   Change
  ----------------------------------------------------------------------------
--------------
  CDT-13                1.00   0.00  0.00   0.00   0.00   0.00   0.00   0.98
2.52   0.0000
  DV101-DV_WETWELL      1.00   0.00  0.00   0.00   0.00   0.98   0.00   0.00
1.56   0.0000
  DV102-DV101           1.00   0.00  0.00   0.00   0.02   0.69   0.00   0.27
1.34   0.0000
  DV103-DV102           1.00   0.00  0.00   0.00   0.01   0.00   0.00   0.97
0.72   0.0000
  DV105-DV_CHAM         1.00   0.00  0.00   0.00   0.00   0.01   0.00   0.97
1.80   0.0000
  DV107-DV_DUMMY        1.00   0.00  0.13   0.00   0.54   0.32   0.00   0.00
0.96   0.0000
```

Conduit Surcharge Summary
****

Conduit	Hours Full Both Ends	Hours Full Upstream	Hours Full Dnstream	Hours Above Full Normal Flow	Hours Capacity Limited
DV101-DV_WETWELL	0.01	0.01	0.01	13.40	0.01
DV102-DV101	25.22	25.22	25.23	10.41	11.57
DV103-DV102	11.70	11.70	11.70	5.70	6.23
DV201-DV103	27.70	27.70	27.72	6.57	6.57
DV229-DV230	9.81	9.81	9.83	0.47	0.46
DV230-DV300	11.67	11.67	11.68	0.01	0.15
DV300-DV102	12.11	12.11	12.12	0.01	0.03
DV_CHAM-DV103	3.83	3.83	3.83	0.01	0.01

Analysis begun on: Thu May 22 08:45:38 2014
Analysis ended on: Thu May 22 09:11:52 2014
Total elapsed time: 00:26:14

Appendix K

Existing Process Flow Diagram

APPENDIX L

EXISTING SITE PLAN

APPENDIX M

EXISTING PROCESS CALCULATIONS

Dravosburg WWTP Capacity Analysis

Tank Description	Surface Area	Depth Max	Depth @ Q_{av}	Vol Max		Vol Avg	
	[FT²]	[FT]	[FT]	[FT³]	[kGAL]	[FT³]	[kGAL]
Aeration Tank No. 1	2,700.00	15.00	15.00	40,500.00	302.94	40,500.00	302.94
Aeration Tank No. 2	2,700.00	15.00	15.00	40,500.00	302.94	40,500.00	302.94
Final Clarifier No. 1	408.00	10.67	9.50	4,353.36	32.56	3,876.00	28.99
Final Clarifier No. 2	408.00	10.67	9.50	4,353.36	32.56	3,876.00	28.99
CL Contact Tank No. 1	116.33	6.75	4.25	785.19	5.87	494.38	3.70
CL Contact Tank No. 2	116.32	6.75	4.25	785.16	5.87	494.36	3.70
Grit Chamber		---		700.00	5.24	700.00	5.24

**For capacity analysis, assume depth @ Q_{av} in all volume calculations*

Chlorine Contact Tank Capacity

Design Criteria			
$T_D \geq$	30.00	min	[MMAF]
$T_D \geq$	15.00	min	[PHF]
Method			
Q =	V / T_D		
Assumptions			
$T_D \geq$	26.888 min		[MMAF]
Analysis			
V_{Qav} =	7,395.78	gallons	
Q_{av} =	275.06	gpm	
	396,090.30	**gpd**	
V_{Qav} =	7,395.78	gallons	
Q_{max} =	493.05	gpm	
	709,995.32	**gpd**	

Final Clarifier Capacity

Design Criteria			
Surface Overflow Rate =	800.00	gpd/ft²	[MMAF]
Surface Overflow Rate =	1,200.00	gpd/ft²	[PHF]
Weir Loading =	10,000.00	gpd/ft	[MMAF]
Method			
Q =	(SOR) x (A)		
Q =	(WL) x (L)		
Analysis			
A =	816.00	ft²	
Q_{av} =	**652,800.00**	**gpd**	
Q_{max} =	**979,200.00**	**gpd**	
Total Weir Length =	68.00	ft	
Q_{av} =	**680,000.00**	**gpd**	

Aeration Capacity

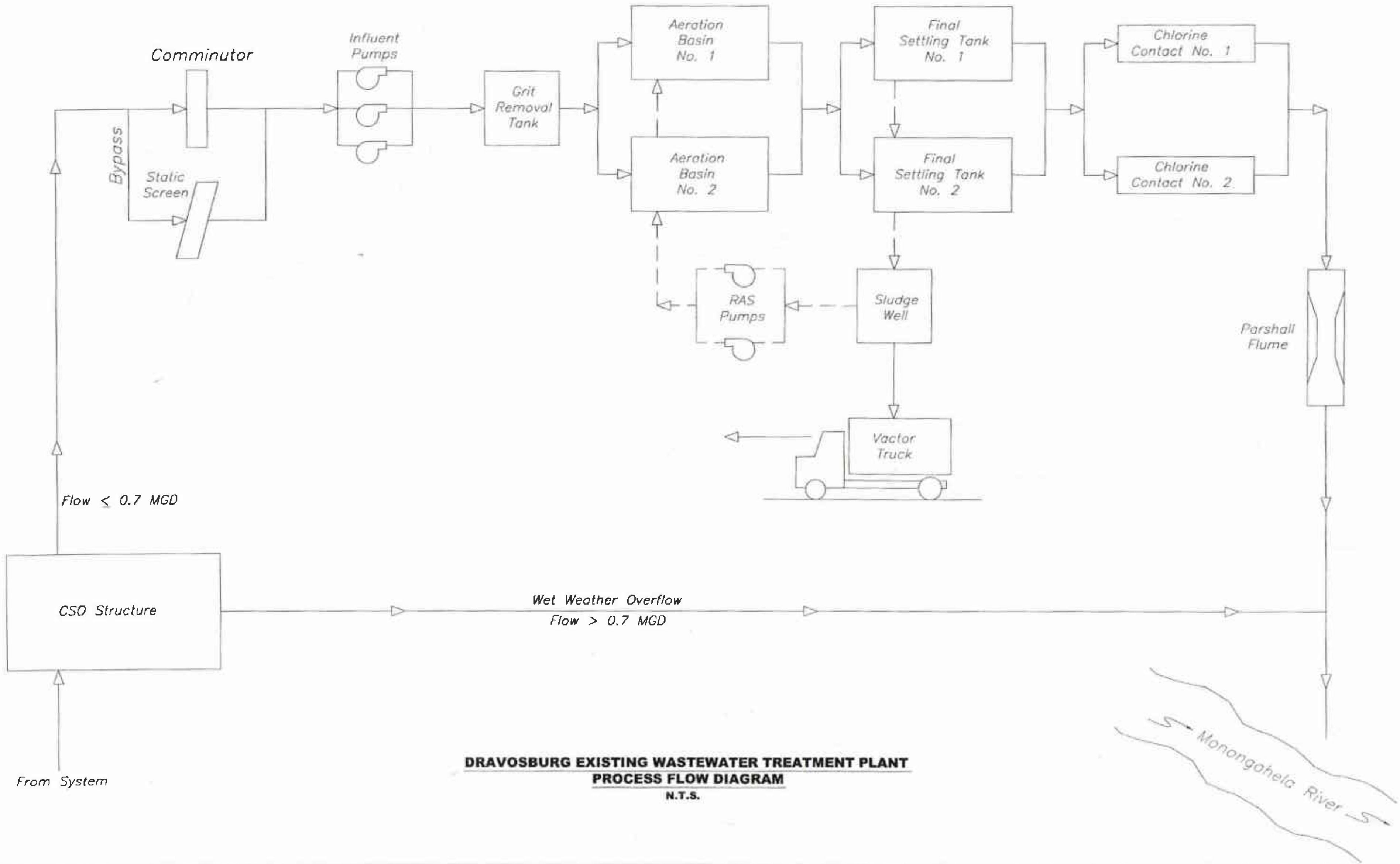
Design Criteria			
$T_D \geq$	6.00	hr	[MMAF]
Method			
Q =	V / T_D		
Analysis			
V_{Qav} =	605,880.00	gallons	
Q_{av} =	100,980.00	gph	
	2.42	**mgd**	

Grit Chamber Capacity

Design Criteria			
$T_D \geq$	3.00	min	[MMAF]
Method			
Q =	V / T_D		
Analysis			
V_{Qav} =	5,236.00	gallons	
Q_{av} =	1,745.33	gpm	
	2.51	**mgd**	

APPENDIX N

ALTERNATIVE 1
PROCESS FLOW DIAGRAM



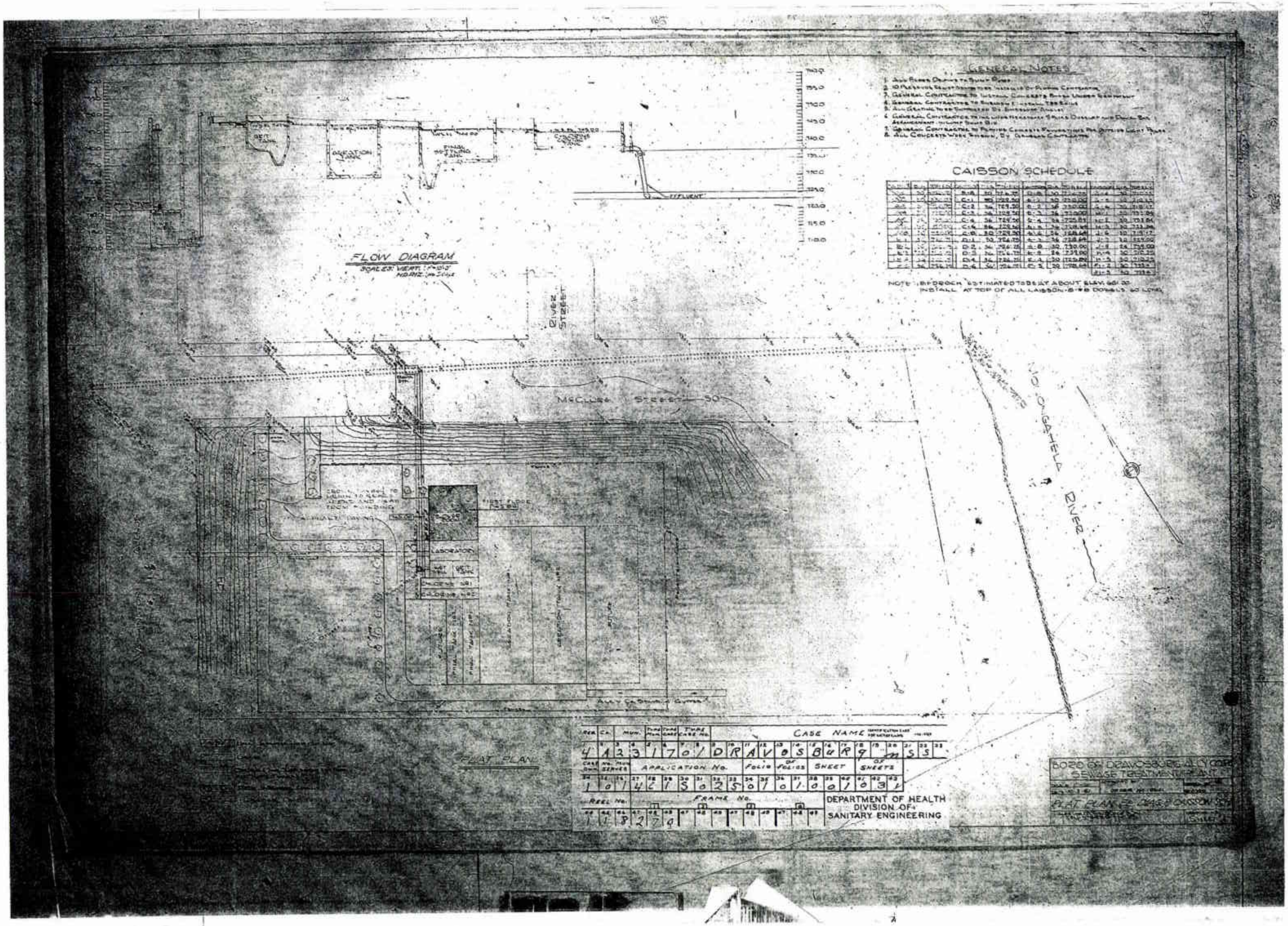
DRAVOSBURG EXISTING WASTEWATER TREATMENT PLANT
PROCESS FLOW DIAGRAM
N.T.S.

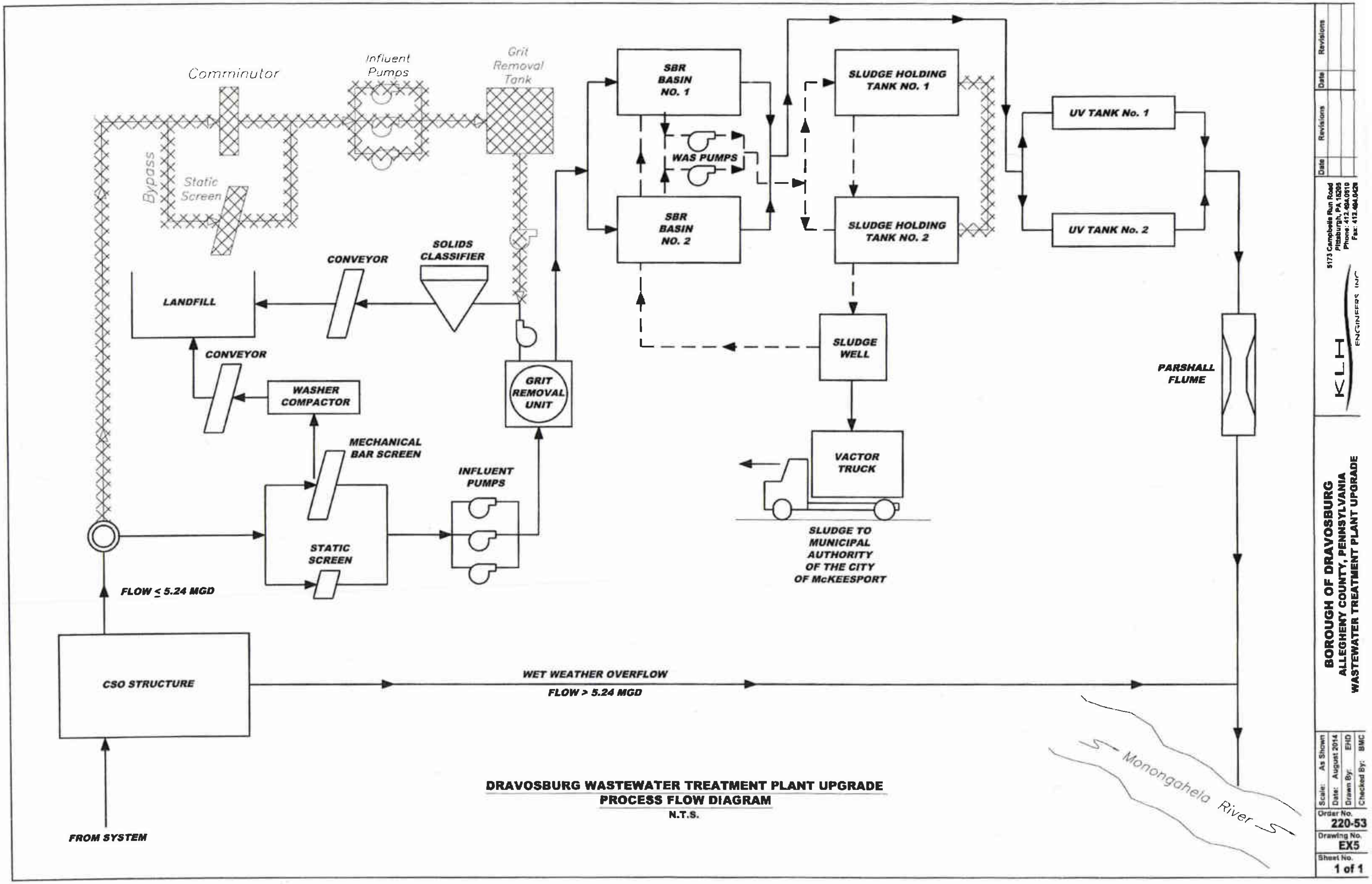
Date	Revisions	Date	Revisions

KLH ENGINEERS INC
5173 Campbells Run Road
Pittsburgh, PA

BOROUGH OF DRAVOSBURG
ALLEGHENY COUNTY, PENNSYLVANIA
EXISTING WASTEWATER TREATMENT PLANT

Scale: As Shown
Date: August 2014
Drawn By: EHD
Checked By: BMC
Order No. 220-53
Drawing No. EX3
Sheet No. 1 of 1

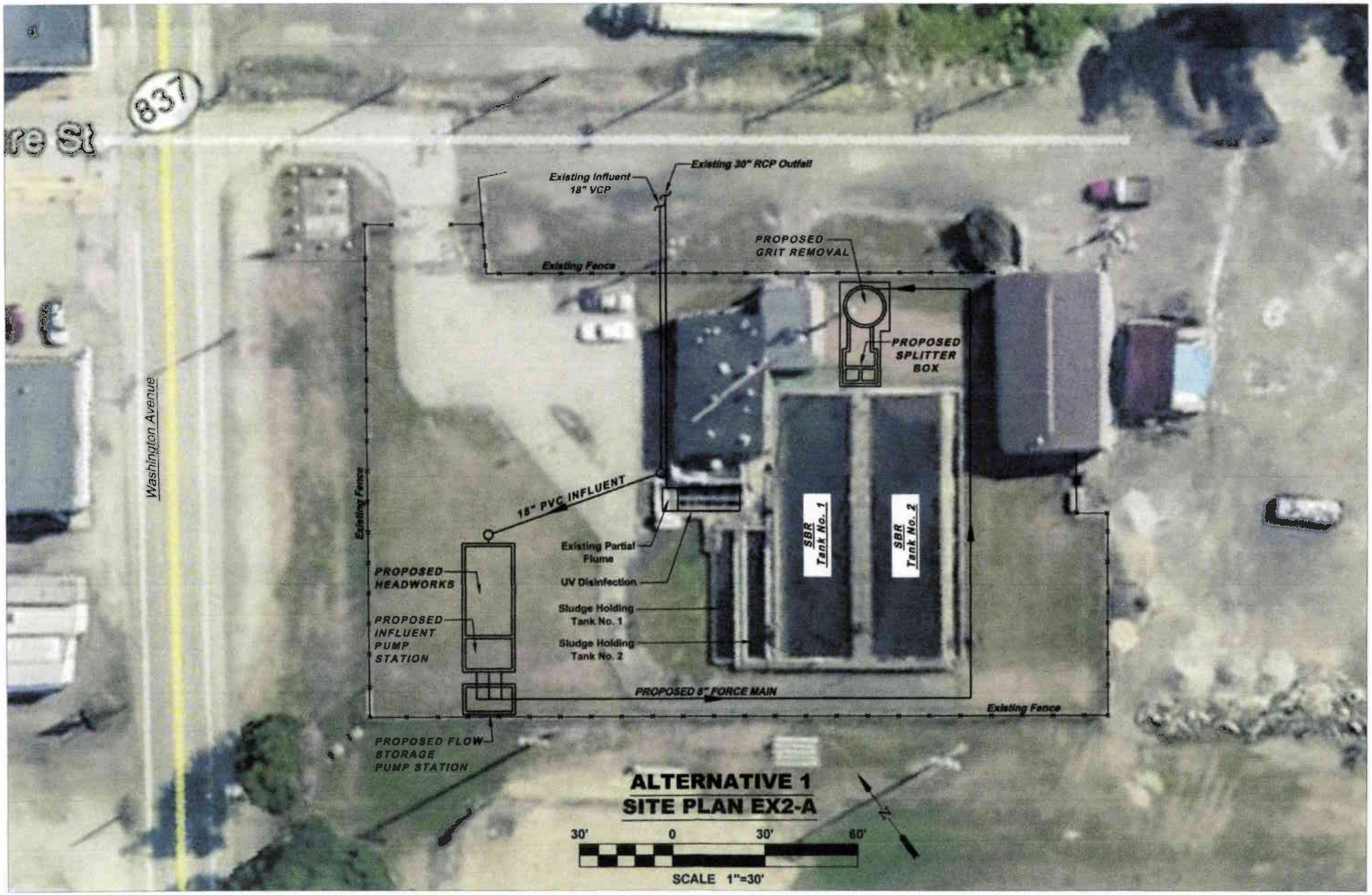

GENERAL NOTES
CAISSON SCHEDULE
FLOW DIAGRAM
EFFLUENT
AERATION TANK
RIVER STREET
McCLURE STREET
MONONGAHELA RIVER
PLAT PLAN
CASE NAME
REG. | CO. | MUN. | TYPE MUN. | TYPE CASE | TYPE CASE NO.
4 1 2 3 1 7 0 1 D R A V O S B U R G M S S
CASE OWN. | NO. MUN. SERVED | APPLICATION No. | FOLIO | OF FOLIOS | SHEET | OF SHEETS
1 0 1 4 C 1 S 0 2 5 0 1 0 1 0 0 1 0 3 1
REEL No. | FRAME No.
1 1 8 2 7 9
DEPARTMENT OF HEALTH
DIVISION OF
SANITARY ENGINEERING
BORO OF DRAVOSBURG ALLY CO.
SEWAGE TREATMENT PLANT



DRAVOSBURG WASTEWATER TREATMENT PLANT UPGRADE
PROCESS FLOW DIAGRAM
N.T.S.

Appendix O

Alternative 1
Site Plan



ALTERNATIVE 1
SITE PLAN EX2-A

Date	Revisions	Date	Revisions

KLH ENGINEERS, INC.
5173 Campbells Run Road
Pittsburgh, PA 15205

BOROUGH OF DRAVOSBURG
ALLEGHENY COUNTY, PENNSYLVANIA
LONG TERM CONTROL PLAN

Scale:	As Shown
Date:	July 2014
Drawn By:	EHD
Checked By:	BMC

Order No. 220-53
Drawing No. EX2
Sheet No. 1 of 1

APPENDIX P

ALTERNATIVE 1
PROCESS CALCULATIONS

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SANITAIRE ICEAS Detailed Design Calculations
BOD Removal, Nitrification, and De-Nitrification Process

SANITAIRE Project #24970-14a
Dravosburg, PA

Design Parameters

A. Flow

Average Daily Flow	600,000 GPD
Peak Dry Weather Flow	1,100,000 GPD
Peak Wet Weather Flow	2,200,000 GPD

B. Treatment

	Influent Quality	Effluent Requirement
BOD_5 (20°C), mg/l	190	10
Suspended Solids, mg/l	210	10
TKN, mg/l	40	
NH_3-N, mg/l		1
TN, mg/l		
Phosphorus	7	1

C. Environment

Alkalinity (Minimum Requirement)	180 mg/l
Max Wastewater Temperature	20 °C
Min Wastewater Temperature	10 °C
Ambient Air Temperature	20 - 90 °F
Site Elevation	740 ft

D. ICEAS Process Design Criteria

F / M	0.042 BOD_5 / MLSS / day
SVI (after 30 minutes settling)	150 ml/g
Number of ICEAS Basins	2
Top Water Level	16.25 ft

E. Cycle Timing

		Normal	Storm
Air-On	min	96	48
Air-Off	min	72	24
Settle	min	48	36
Decant	min	72	36
Total	hrs	4.8	2.4

SANITAIRE
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F. Detailed Calculations

Mass of Biomass

$$BODL = \frac{Q \times BODin \times 8.34}{1{,}000{,}000} = \frac{300{,}000 \times 190 \times 8.34}{1{,}000{,}000} = \mathbf{475\ lb/day/basin}$$

where: BODL = BOD Load (lb/day/basin)
Q = Average Dry Weather Flow per basin (gal/day)
BODin = Influent BOD concentration (mg/l)
1,000,000 = Conversion (l/mg)
8.34 = Conversion (lb/gal)

Mass of Biomass

$$MBOD = \frac{BOD_L}{F/M} = \frac{475}{0.042} = \mathbf{11{,}346\ lb/basin}$$

where: MBOD = Mass of Biomass for BOD Removal (lb/day/basin)
F / M = Food to Microorganism ratio (day^{-1})

Volume of Biomass

$$Vbio = MBOD \times SVI = 11{,}346 \times 2.4 = \mathbf{27{,}231\ ft^3/basin}$$

where: Vbio = Volume of Biomass (ft^3/basin)
SVI = Sludge Volume Index (ft^3/lb)

Maximum Volume Above Bottom Water Level

Peak Dry Weather Flow:

$$Vbwld = \frac{PDWF \times (NCT - NDT)}{24 \times 7.48} = \frac{550{,}000 \times (4.8 - 1.20)}{24 \times 7.48} = \mathbf{11{,}029\ ft^3/basin}$$

where: Vbwld = Maximum Volume Above BWL at Peak Dry Weather Flow (ft^3/basin)
PDWF = Peak Dry Weather Flow (gal/day)
NCT = Normal Cycle Time (hr/cycle)
NDT = Decant Time (hr/cycle)
7.48 = Conversion (gal/ft^3)
24 = Conversion (hours/day)

Peak Wet Weather Flow:

$$Vbwls = \frac{PWWF \times (SCT - SDT)}{24 \times 7.48} = \frac{1{,}100{,}000 \times (2.4 - 0.60)}{24 \times 7.48} = \mathbf{11{,}029\ ft^3/basin}$$

where: Vbwls = Maximum Volume Above BWL at Peak Wet Weather (Storm) Flow (ft^3/basin)
PWWF = Peak Wet Weather Flow (gal/day)
SCT = Storm Cycle Time (hr/cycle)
SDT = Storm Decant Time (hr/cycle)

MVAB (Maximum Volume Above Bottom Water Level) is larger of Peak Dry Weather and Peak Wet Weather Calculation

$$MVAB = \mathbf{11{,}029\ ft^3/basin}$$

Decant Rates

Peak Dry Weather Flow:

$$PDR = \frac{MVAB \times 7.48}{NDT} + \frac{PDWF}{1{,}440} = \frac{11{,}029 \times 7.48}{72.0} + \frac{550{,}000}{1{,}440} = \mathbf{1{,}528\ gal/min}$$

where: PDR = Normal Decant Rate (gal/min)
NDT = Normal Decant Time (min/cycle)
1440 = Conversion (min/day)

Peak Wet Weather Flow:

$$PWR = \frac{MVAB \times 7.48}{SDT} + \frac{PWWF}{1{,}440} = \frac{11{,}029 \times 7.48}{36.0} + \frac{1{,}100{,}000}{1{,}440} = \mathbf{3{,}056\ gal/min}$$

where: PWR = Peak Decant Rate (gal/min)
SDT = Storm Decant Time (min/cycle)

Decanter Sizing

Peak Dry Weather Flow:

$$DLa = \frac{PDR}{\text{Weir Loading Rate} \times 7.48} = \frac{1{,}528}{20 \times 7.48} = \mathbf{10.21\ ft}$$

where: DLa = Decanter Length for Average Dry Weather Flow (ft)
20 = Weir Loading Rate (ft^3/min/ft of decanter weir)

Peak Wet Weather Flow:

$$DLp = \frac{PWR}{\text{Weir Loading Rate} \times 7.48} = \frac{3{,}056}{25 \times 7.48} = \mathbf{16.34\ ft}$$

where: DLp = Decanter Length for Peak Wet Weather (Storm) Flow (ft)
25 = Weir Loading Rate (ft^3/min/ft of decanter weir)

Design Decanter Length = **17.5 ft**

Basin Working Volume

$$BWV = MVAB + Vbio + Vc = 11{,}029 + 27{,}231 + 66 = \mathbf{38{,}326\ ft^3/basin}$$

where: BWV = Basin Working Volume (ft^3/basin)
Vc = Volume of chemical sludge due to Phosphorus removal (ft^3/basin)
(Please refer to phosphorus removal calculation.)

Basin Area

$$BA = \frac{BWV}{TWL - BZ} = \frac{38{,}326}{16.3 - 3.0} = \mathbf{2{,}893\ ft^2/basin}$$

where: BA = Basin Area (ft^2)
TWL = Top Water Level (ft)
BZ = Buffer Zone (ft) (Safety Factor)

Sludge Depth

$$SD = \frac{Vbio}{BA} = \frac{27{,}231}{2{,}893} = \mathbf{9.41\ ft}$$

where: SD = Sludge Depth (ft)

Decanter Draw Down

$$DD = \frac{MVAB}{BA} = \frac{11{,}029}{2{,}893} = \mathbf{3.81\ ft}$$

where: DD = Draw Down (ft)

Bottom Water Level

$$BWL = SD + BZ + Vd = 9.41 + 3.00 + 0.02 = \mathbf{12.44\ ft}$$

where: BWL = Bottom Water Level (ft)
Vd = Depth of Chemical Sludge for Phosporus precipitation (ft)

Top Water Level

$$TWL = BWL + DD = 12.44 + 3.81 = \mathbf{16.25\ ft}$$

where: TWL = Top Water Level (ft)

Hydraulic Retention Time

$$HRT = \frac{BA \times MAFD \times 7.48}{QT}$$

where: HRT = Hydraulic Retention Time (days)
MAFD = Maximum Average Flow Depth (ft)
QT = Fill Rate at Average Dry Weather Flow (gal/day)

$$MAFD = \frac{Q \times [(NCT \times 60) - NDT]}{BA \times 1{,}440 \times 7.48} + BWL = \frac{300{,}000 \times [(4.8 \times 60) - 72.0]}{2{,}893 \times 1{,}440 \times 7.48} + 12.44 = \mathbf{14.52\ ft}$$

$$HRT = \frac{2{,}893 \times 14.52 \times 7.48}{300{,}000} = \mathbf{1.05\ days}$$

MLSS Concentration at Bottom Water Level

$$MLSS = \frac{Mbio \times 1{,}000{,}000}{BWL \times (BA - CA) \times 62.42} = \frac{11{,}346 \times 1{,}000{,}000}{12.44 \times (2{,}893 - 4.04) \times 62.42} = \mathbf{5{,}062\ mg/l}$$

where: MLSS = Mixed Liquor Suspended Solids concentration at Bottom Water Level (mg/l)
62.42/1E+06 = Conversion (lb/mg x l/ft^3)
CA = Area Increment due to chemical sludge (ft^2/basin)

Mass of Sludge Produced

$$\Delta M = \left(\frac{Y \times (BODin - BODout)}{1 + (B \times \theta^{(T-20)} \times SRT)} + Zio + Zno \right) \times \frac{Q \times 8.34}{1{,}000{,}000}$$

$$\Delta M = \left(\frac{0.6 \times (190 - 10.0)}{1 + (0.07 \times 1.04^{(10-20)} \times 28.1)} + 84.0 + 21.0 \right) \times \frac{3.0E{+}05 \times 8.34}{1{,}000{,}000} = \mathbf{379\ lb/day/basin}$$

(Lawrence-McCarty Equation as presented in WEF MOP/8 4th Edition, pg 11-11, Eqn. 11.7)

where: ΔM = Mass of Sludge Produced (lb/day/basin)
Y = Volatile cell yield (VSS/BOD removed)
q = Arrhenius Temperature Correction Factor
B = Decay Rate (day^{-1})
BODout = Anticipated Effluent BOD (mg/l)
SRT = Solids Retention Time (days)
Zio = Influent nonvolatile suspended solids (mg/l)
Zno = Influent volatile nonbiodegradable solids (mg/l)
T = Minimum Wastewater Temperature (°C)

Volume of Sludge Produced

$$Vws = \frac{\Delta M + Csludge}{SFws \times 8.34} = \frac{379 + 27}{0.0085 \times 8.34} = \mathbf{5{,}727\ gal/day/basin}$$

where:		
	Vws =	Volume of Waste Sludge (gal/day/basin)
	SFws =	Solids Fraction in Waste Sludge
	8.34 =	Density (lb/gal)
	Csludge =	Mass of chemical sludge produced (lb/day/basin) (Please refer to phosphorus removal calculation)

Observed Yield Factor

$$Yobs = \frac{\Delta M}{BOD_L} = \frac{379}{475} = 0.80\ \frac{\mathbf{MLSS}}{\mathbf{BOD}}$$

Observed Yield Factor (lb/day MLSS/lb/day BODremoved)

Mean Cell Residence Time

$$MCRT = \frac{Mbio}{\Delta M + ((Q - Vws) \times SSout \times 8.34 / 1E{+}06)}$$

$$MCRT = \frac{11{,}346}{379 + ((300{,}000 - 5{,}727) \times 10.0 \times 8.34 / 1{,}000{,}000)} = \mathbf{28.1\ days}$$

where:		
	MCRT =	Mean Cell Residence Time (days)
	SSout =	Anticipated Effluent Total Suspended Solids (mg/l)
	8.34E-06 =	Conversion (lb/mg x l/gal)

Sludge Age for Nitrification

Refer to Metcalf and Eddy, Edition IV pages 614 and 705

Constants and Temperature Corrections:

Coefficient	Base Value	Theta	Temperature Corrected	Symbol
Maximum Specific Growth Rate of Nitrifying bacteria, g VSS/g VSS.day	0.75	1.07	0.381	$\mu_{nm}(T)$
Half-Velocity constant for nitrifiers	0.74	1.053	0.442	Kn(T)
Nitrifier decay rate	0.08	1.04	0.054	Kdn(T)
Dissolved Oxygen, mg/l	2		2	DO
Half-Velocity Constant for Dissolved Oxygen, mg/l	0.5		0.5	Ko
Minimum Water Temperature, °C	10		10	T
Safety Factor	1.5		1.5	SF

Calculations:

$$\mu_n = \left(\mu_{nm}(T) \times \frac{TENH_3}{TENH_3 + Kn(T)} \times \frac{DO}{DO + Ko} \right) - Kdn(T)$$

$$\mu_n = \left(0.381 \times \frac{1.0}{1.0 + 0.442} \times \frac{2.0}{2.0 + 0.5} \right) - 0.054 = \mathbf{0.158\ days^{-1}}$$

$$SRTmin = \frac{1}{\mu_n} = \frac{1}{0.158} = \mathbf{6.3\ days}$$

$$SRTaerobic = SRTmin \times SF = 6.3 \times 1.5 = \mathbf{9.5\ days}$$

$$SRToverall = \frac{SRTaerobic \times 24}{TA} = \frac{9.5 \times 24}{8.0} = \mathbf{28.6\ days}$$

Design sludge age not adequate for nitrification.

where: $\mu nm(T)$ = Maximum Temperature Corrected Nitrifier Growth Rate ($days^{-1}$)

μ_n = Specific Nitrifier Growth Rate at Temperature, DO, and Effluent NH_3 (g/g-days)

SRTmin = Minimum Sludge age required for Nitrification (days)

SRTaerobic = Design Aerobic Sludge Age (days)

SF = Safety Factor

SRToverall = Sludge Age accounting for entire ICEAS cycle (days)

TA = Aeration Time (hrs/day)

$TENH_3$ = Anticipated Effluent Ammonia (mg/l)

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Waste Sludge Pump Capacity

$$WSP = \frac{Vws \times NCT}{24 \times SPT} = \frac{5{,}727 \times 4.8}{24 \times 10.41} = \mathbf{110\ gal/min}$$

where: WSP = Waste Sludge Pump Capacity(gal/min)
SPT = Sludge Pumping Time (min/cycle)

Biological Phosphorus Removal

$$TPb = TPi - [Yobs \times (BODin - BODout)] \times TPps = 7.0 - [0.80 \times (190 - 10.0) \times 0.03] = \mathbf{2.70\ mg/l}$$

where: TPb = Concentration of the Total Phosphorus in the Effluent after biological removal (mg/l)
TPi = Concentration of the Total Phosphorus in the Influent (mg/l)
TPps = Percent of Total Phosphorus in Biomass

Chemical Dosing

$$CD = CDt \times (TPb - TPe) \times (1 + SF)$$

where: CDt= Theoretical Weight Ratio Chemical Dosage
SF= Safety Factor for Chemical Dosing (%)
TPe = Required Phosphorus concentration in effluent (mg/l)

Alum Dosage Based on percentage removal (PR) of Phosphorus:
Refer to ASCE Design of Municipal Wastewater Treatment Plants (4th Edition) pg 16-67

PR	CDt
PR < 85	13
85 ≤ PR ≤ 95	16
PR > 95	22

$$PR = \frac{TPb - TPe}{TPb} \times 100 = \frac{2.70 - 1.0}{2.70} \times 100 = \mathbf{63\%}$$

CDt= 13

$$CD = 13 \times (2.70 - 1.0) \times (1 + 25\%) = \mathbf{27.6\ mg/l}$$

...Rounded to the next 5 mg/l

$$CD = \mathbf{30\ mg/l}$$

Mass of Chemical Sludge

$$Csludge = \frac{Q \times CD \times 0.091 \times 4 \times 8.34}{1{,}000{,}000} = \frac{300{,}000 \times 30 \times 0.091 \times 4 \times 8.34}{1{,}000{,}000} = \mathbf{27\ lb/day/basin}$$

where: 0.091 = Fraction of Alum reacting with Phosphorus
4 = Mass of Precipitate formed per Mass of Alum

Volume of Chemical Sludge

$$Vcs = Csludge \times SVI = 27 \times 2.4 = \mathbf{66\ ft^3/basin}$$

where: Vcs = Volume of Chemical Sludge (ft^3/basin)

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SANITAIRE ICEAS Aeration Design Calculations
BOD Removal, Nitrification, and De-Nitrification Process

SANITAIRE Project #24970-14a
Dravosburg, PA

Carbonaceous Oxygen Demand

$$AOR1 = A \times \frac{Q \times BODin}{1{,}000{,}000} \times 8.34 = 1.20 \times \frac{300{,}000 \times 190}{1{,}000{,}000} \times 8.34 = \mathbf{570\ lb/day/basin}$$

where AOR1 = Actual Oxygen Required for BOD oxidation (lb/day/basin)
A = O2 / BOD
Q = Average flow (gal/day/basin)
BODin = Influent BOD received (mg/l)
1,000,000 = Conversion (g x mg)
8.34 = Conversion (lb x gal)

A = 1.20 O2/BOD

Nitrification Oxygen Demand

$$AOR2 = \Delta N \times 4.60 = 72.5 \times 4.60 = \mathbf{333\ lb/day/basin}$$

where AOR2 = Actual Oxygen required for Ammonia Oxidation (lb/day/basin)

$$\Delta N = \frac{[\ (NH3in - NH3out) - (BODin - BODout) \times Yobs \times Ns\ ] \times Q \times 8.34}{1{,}000{,}000}$$

$$\Delta N = \frac{[\ (40.0 - 1.0) - (190.0 - 10.0) \times 0.80 \times 0.07\ ] \times 300{,}000 \times 8.34}{1{,}000{,}000} = \mathbf{72.5\ lb/day/basin}$$

where AOR2 = Actual Oxygen required for Ammonia Oxidation (lb/day/basin)
TKNin = Influent TKN concentration (mg/l)
4.6 = Mass of O_2 per Mass of Ammonia Oxidized
NLOAD = Mass of TKN applied lb/day/basin
NH3out = Effluent ammonia required (mg/l)
Ns = Sludge Nitrogen content (N / sludge)
BODout = Effluent BOD (mg/l)

SANITAIRE
a xylem brand

Total Actual Oxygen Transfer

$$AOR = AOR1 + AOR2 = 570 + 333 = \mathbf{904\ lb/day/basin}$$

where AOR = Total Actual Oxygen Required (lb/day/day/basin)

Total Standard Oxygen Transfer

$$SOR = \frac{AOR}{AOR / SOR} = \frac{904}{0.4766} = \mathbf{1{,}897\ lb/day/basin}$$

$$\frac{AOR}{SOR} = \frac{\alpha \times \theta^{(TSite - 20)} \times (\beta \times C^{*}sat_{20} \times Psite / Pstd \times Csurf_{T} / Csurf_{20} - D.O.)}{C^{*}sat_{20}}$$

$$\frac{AOR}{SOR} = \frac{0.65 \times 1.024^{(20 - 20)} \times (0.95 \times 10.31 \times 14.34 / 14.70 \times 9.07 / 9.07 - 2.0)}{10.31} = \mathbf{0.4766}$$

where SOR = Standard Condition Oxygen Requirement (lb/day/day/basin
α = Alpha factor
θ = Temperature coefficient
Tsite = Water temperature (°C)
β = Beta factor
Psite = Site Atmospheric Pressure
Pstd = Standard atmospheric pressure (psig)
$C^{*}sat_{20}$ = Dissolved oxygen solubility at standard conditions (mg/l)
$Csurf_{T}$ = Dissolved oxygen solubility at site water temperature (mg/l)
$Csurf_{20}$ = Dissolved oxygen solubility at 20°C (mg/l)
D.O. = Residual dissolved oxygen concentration (mg/l)

Aeration System Standard Oxygen Transfer Rate

$$SOTR = \frac{SOR}{TA} = \frac{1{,}897}{8} = \mathbf{237\ lb/hr}$$

where SOTR = Standard oxygen transfer rate (lb/day/hr)
TA = Aeration Time, hrs/day

SANITAIRE
a xylem brand

Aeration Depth

Average Aeration Depth

$$MADad = \frac{Q \times [(NCT \times 60) - (NDT + NST)]}{2 \times 1{,}440 \times 7.48 \times BA} + BWL$$

$$MADad = \frac{300{,}000 \times [(4.8 \times 60) - (72 + 48)]}{2 \times 1{,}440 \times 7.48 \times 2{,}890} + 12.44 = \mathbf{13.25\ ft}$$

where AADad = Average Aeration Depth at Average Dry Weather Flow (gpd)
Q = Average Dry Weather Flow (gpd/basin)
NCT = Normal Cycle Time (hr)
NDT = Normal Decant Time (min)
NST = Normal Settling Time (min)
BA = Basin Area (ft^2)
1440 = Conversion (min/day)
7.48 = Conversion (gal/ft^3)
2 = Calculate Aeration Depth at Middle of Normal Reaction Phase (NCT - NST - NDT)

Maximum Aeration Depth

$$MADpw = \frac{PWWF \times [(SCT \times 60) - (SDT + SST)]}{1{,}440 \times 7.48 \times BA} + BWL$$

$$MADpw = \frac{1{,}100{,}000 \times [(2.4 \times 60) - (36 + 36)]}{1{,}440 \times 7.48 \times 2{,}890} + 12.44 = \mathbf{14.98\ ft}$$

where MADpw = Maximum Aerartion Depth at Peak Wet Weather Flow (gpd)
PWWF = Peak Wet Weather Flow (gpd/basin)
SCT = Storm Cycle Time (hr)
SDT = Storm Decant Time (min)
SST = Storm Settle time (min)
MAD = Maximum Aeration Depth (ft)

MAD is larger of MADad and MADpw

MAD = **15.40 ft**

Air Flow Requirement

$$\text{Process Air} = \frac{SOTR \times 10{,}000}{\rho \times SOTE \times Opw \times 60} = \frac{237 \times 10{,}000}{0.075 \times 26.05 \times 23.2 \times 60} = \mathbf{872\ scfm}$$

where Process Air = Process air flow requirement (scfm)

ρ = Air density (0.075 lb/day/ft^3)
SOTE = Standard Oxygen Transfer Efficiency @ Submergence of 12.25 ft
Opw = Fraction of Oxygen in air by Weight
10,000 = Conversion (100% * 100%)
60 = Conversion (min/hr)

Mixing Air = MI x BA = 0.13 x 2,890 = **362 scfm**

where Mixing Air = Mixing air flow requirement (scfm)
MI = recommended air flow per unit area of basin (scfm/ft^2)

Blower Unit Capacity

Blower unit capacity (BUC) is the larger of the process air requirement and the mixing air requirement.

Process Air 872 scfm

Mixing Air 362 scfm

Use 1 blower per tank

BUC = **880 scfm**

Blower Pressure

psig = MAD x 0.432 + H_L = 14.98 x 0.432 + 1.00 = **7.7 psig**

where psig = blower pressure (rounded to next psig)
0.432 = water density (psi/ft)
H_L = Cumulative piping and diffuser headloss (psig)

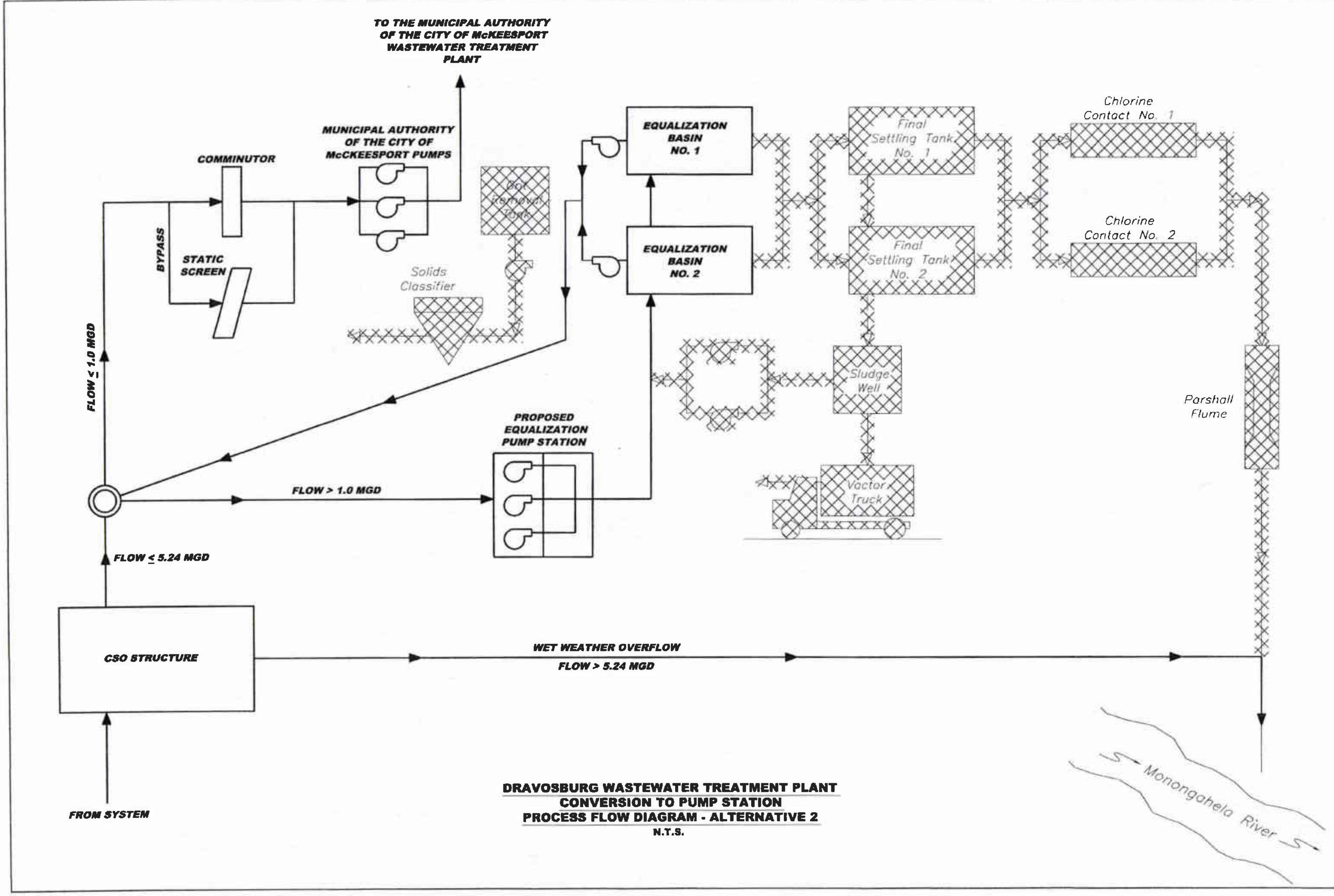
Average Blower Power

Blower power based on vendor curves, BUC, and Average Aeration Depth (12.25 ft)

$Power_{avg}$ = **40.0 bhp**

APPENDIX Q

ALTERNATIVE 2
PROCESS FLOW DIAGRAM



DRAVOSBURG WASTEWATER TREATMENT PLANT
CONVERSION TO PUMP STATION
PROCESS FLOW DIAGRAM - ALTERNATIVE 2
N.T.S.

Date	Revisions	Date	Revisions

KLH ENGINEERS, INC
5173 Campbells Run Road
Pittsburgh, PA 15205
Phone: 412.494.0510
Fax: 412.494.0428

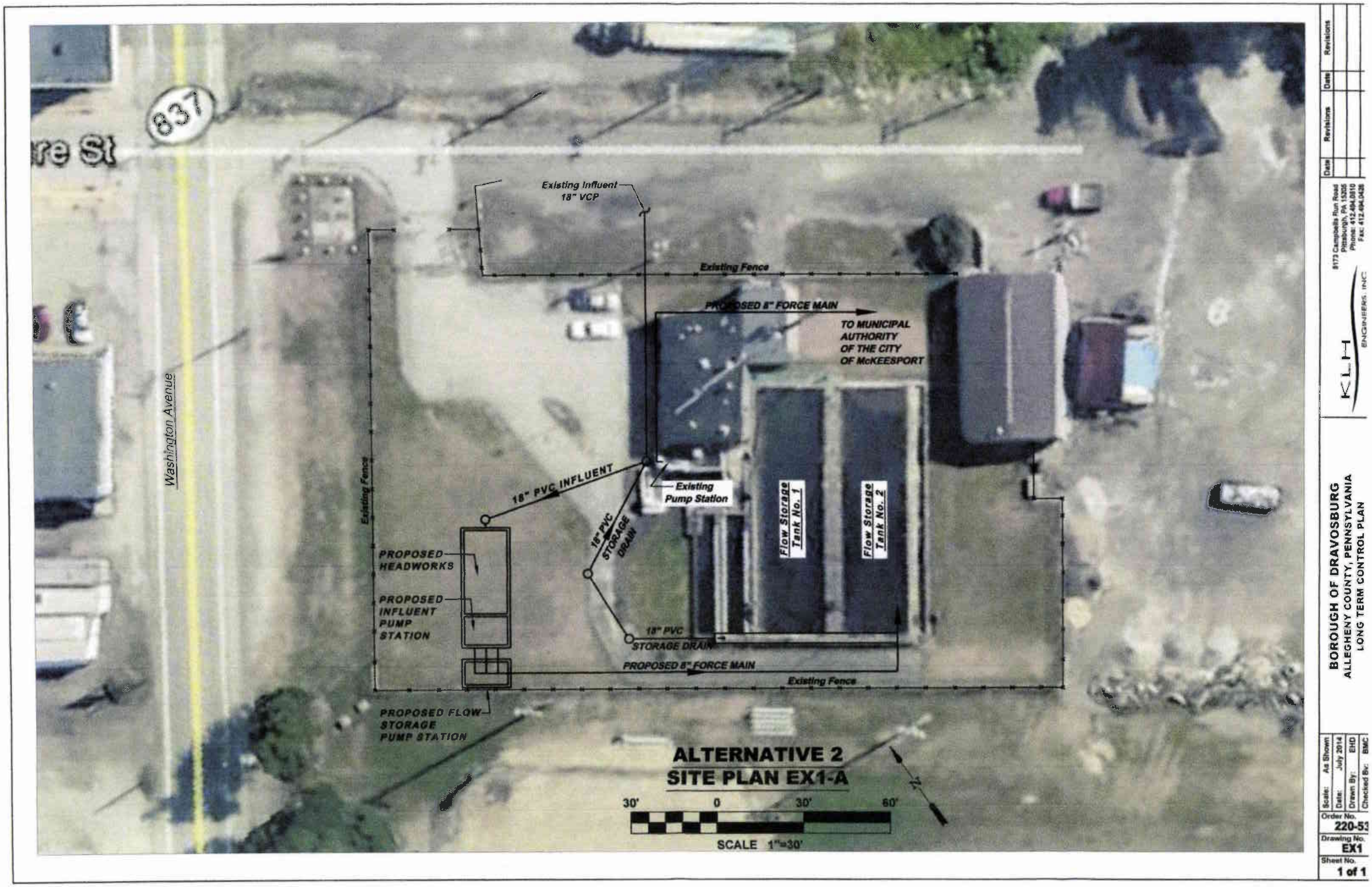
BOROUGH OF DRAVOSBURG
ALLEGHENY COUNTY, PENNSYLVANIA
WASTEWATER TREATMENT PLANT CONVERSION TO PUMP STATION

Scale: As Shown
Date: August 2014
Drawn By: EHD
Checked By: BMC

Order No. 220-53
Drawing No. EX4
Sheet No. 1 of 1

APPENDIX R

ALTERNATIVE 2
SITE PLAN


837
re St
Washington Avenue
Existing Influent
18" VCP
Existing Fence
PROPOSED 8" FORCE MAIN
TO MUNICIPAL
AUTHORITY
OF THE CITY
OF McKEESPORT
18" PVC INFLUENT
Existing
Pump Station
18" PVC
STORAGE
DRAIN
Flow Storage
Tank No. 1
Flow Storage
Tank No. 2
Existing Fence
PROPOSED
HEADWORKS
PROPOSED
INFLUENT
PUMP
STATION
18" PVC
STORAGE DRAIN
PROPOSED 8" FORCE MAIN
Existing Fence
PROPOSED FLOW
STORAGE
PUMP STATION
ALTERNATIVE 2
SITE PLAN EX1-A
30' 0 30' 60'
SCALE 1"=30'
N
Date
Revisions
Date
Revisions
KLH
ENGINEERS, INC
5173 Campbells Run Road
Pittsburgh, PA 15205
Phone: 412.494.0810
Fax: 412.494.0435
BOROUGH OF DRAVOSBURG
ALLEGHENY COUNTY, PENNSYLVANIA
LONG TERM CONTROL PLAN
Scale: As Shown
Date: July 2014
Drawn By: EHD
Checked By: BMC
Order No.
220-53
Drawing No.
EX1
Sheet No.
1 of 1

Appendix S

Alternative 2
Force main Alignment

Date	Revisions	Date	Revisions

KLH ENGINEERS INC
5173 Campbells Run Road
Pittsburgh, PA 15205
Phone: 412.494.0510
Fax: 412.494.0426

MUNICIPAL AUTHORITY OF THE CITY OF MCKEESPORT
ALLEGHENY COUNTY, PENNSYLVANIA
DRAVOSBURG-DUQUESNE AREA ACT 537 & LONG TERM CONTROL PLAN

Scale:	NTS
Date:	May 2014
Drawn By:	VLB
Checked By:	BMC

Order No. 220-53

Drawing No. FM-EX

Sheet No. 1 of 1

APPENDIX T

PROJECT COST ESTIMATES

Dravosburg WWTP Long Term Control Plan

Alternative 1 - Upgrade WWTP

Planning Cost Estimate

ITEM	COST	
General Site Work	$	138,000
Headworks Building	$	863,000
SBR Tank Conversion	$	864,000
Influent Pump Station	$	1,199,000
Grit Removal	$	504,000
Sludge Holding Facilities	$	130,000
Ultraviolet Disinfection	$	477,000
SUBTOTAL CONSTRUCTION COST	**$**	**4,175,000**
Electrical Costs (25%)	$	1,044,000
Mobilization/Demobilization/Bonds/Insurance (15%)	$	627,000
Contingency (30%)	$	1,253,000
TOTAL CONSTRUCTION COST	**$**	**7,099,000**
Engineering, Permitting, Legal (15%)	$	1,065,000
Construction Administration (10%)	$	710,000
TOTAL PROJECT COST	**$**	**8,874,000**

Site Work

			Qty	Unit	Price per Unit	Materials	Total
Division 2	Site Work						
		E&S Controls	1	lot	$ 10,000.00	$ 10,000.00	$ 10,000.00
		By-Pass Pumping	1	lot	$ 50,000.00	$ 50,000.00	$ 50,000.00
		Site Paving	385	s.y.	$ 50.00	$ 19,259.26	$ 19,259.26
		Lawn Restoration	1	lot	$ 5,000.00	$ 5,000.00	$ 5,000.00
Division 3	Concrete						
		Repairs/Rehabilitation	1	lot	$ 10,000.00	$ 10,000.00	$ 10,000.00
		Manholes (0'-8' Deep)	3	ea	$2,500.00	$ 7,500.00	$ 7,500.00
		Manhole VF over 8' Deep	25	v.f.	$110.00	$ 2,750.00	$ 2,750.00
						$ -	
Division 15	Mechanical						
		8" D.I. Pipe (Buried) - F.M.	250	L.F.	$ 50.00	$ 12,500.00	$ 12,500.00
		18" D.I. Pipe (Buried) - F.M.	100	L.F.	$ 200.00	$ 20,000.00	$ 20,000.00

Subtotal Construction = $ 137,009.26

Headworks

			Qty	Unit	Price per Unit	Materials	Total
Division 2	Site Work						
		Excavation	972.2	c.y.	$ 50.00	$ 48,611.11	$ 48,611.11
		Backfill	243.1	c.y.	$ 50.00	$ 12,152.78	$ 12,152.78
		Stone Backfill	28.11	c.y.	$ 172.00	$ 4,834.92	$ 4,834.92
		Excavation/Shoring/Dewatering/Backfill	1	LOT	$ 50,000.00	$ 50,000.00	$ 50,000.00
Division 3	Concrete						
		Foundation Slab	84.33	c.y.	$ 532.10	$ 44,871.99	$ 44,871.99
		First Floor Slab	56.22	c.y.	$ 1,123.40	$ 63,157.55	$ 63,157.55
		Walls	85.92	c.y.	$ 1,123.40	$ 96,522.53	$ 96,522.53
Division 4	Masonry						
		Block	1200	s.f.	$ 8.35	$ 10,020.00	$ 14,923.83
Division 5	Metals						
		Aluminum Grating	150	s.f.	$ 65.00	$ 9,750.00	$ 9,750.00
		Aluminum Handrail	200	L.F.	$ 70.00	$ 14,000.00	$ 14,000.00
		4'x4' Aluminum Hatchway	1	each	$ 3,500.00	$ 3,500.00	$ 5,212.91
		Stairs	82	riser	$ 185.00	$ 15,170.00	$ 22,594.26
Division 7	Thermal and Moisture						
		Masonry Insulation	1200	s.f.	$ 1.31	$ 1,572.00	$ 2,341.34
		Roofing	1	Lot	$ 25,000.00	$ 25,000.00	$ 37,235.10
		Alum Fascia	100	s.f.	$ 5.35	$ 535.00	$ 796.83
		Alum Soffit	404	s.f.	$ 7.65	$ 3,090.60	$ 4,603.15
		Alum Gutters	100	L.F.	$ 5.00	$ 500.00	$ 744.70
		Downspouts	48	L.F.	$ 4.84	$ 232.32	$ 346.02
Division 8	Doors and Windows						
		7'x3' Mandoor w/window	1	each	$ 1,000.00	$ 1,000.00	$ 1,489.40
		7'x6' Door	1	each	$ 2,500.00	$ 2,500.00	$ 3,723.51
		10'x14' Rolling Garage	1	each	$ 7,000.00	$ 7,000.00	$ 10,425.83
		3'x3' window	2	each	$ 500.00	$ 1,000.00	$ 1,489.40
		4'x4' skylight	2	each	$ 200.00	$ 400.00	$ 595.76
Division 9	Coatings						
		Paints	10000	s.f.	$ 2.00	$ 20,000.00	$ 29,788.08
Division 11	Equipment						
		Coarse Screen (Mechanical)	1	each	$ 234,000.00	$ 234,000.00	$ 304,200.00
		Coarse Screen (Manual)	1	each	$ 7,500.00	$ 7,500.00	$ 7,500.00
Division 15	Mechanical						
		Sluice Gates	4	each	$ 3,500.00	$ 14,000.00	$ 20,851.66
		HVAC	1	Lot	$ 50,000.00	$ 50,000.00	$ 50,000.00

Subtotal Construction = $ 862,762.69

SBR Tanks

			Qty	Unit	Price per Unit	Materials	Total
Division 3	Concrete						
		Walls	68.15	c.y.	$1,123.40	$ 76,557.63	$ 76,557.63
Division 11	Equipment						
		SBR Equipment	1	each	$ 510,000.00	$ 510,000.00	$ 663,000.00
		SCADA and SIMS	1	each	$ 80,000.00	$ 80,000.00	$ 104,000.00
Division 15	Mechanical						
		WAS Sludge Piping	200	LF	$ 100.00	$ 20,000.00	$ 20,000.00

Subtotal Construction = **$ 863,557.63**

Influent Pump Station and Valve Vault							
			Qty	Unit	Price per Unit	Materials	Total
Division 2	Site Work						
		Excavation	513	c.y.	$ 50.00	$ 25,648.15	$ 25,648.15
		Backfill	128	c.y.	$ 50.00	$ 6,412.04	$ 6,412.04
		Stone Backfill	21	c.y.	$ 172.00	$ 3,612.00	$ 3,612.00
		Excavation/Shoring/Dewatering/Backfill	1	LOT	$ 100,000.00	$ 100,000.00	$ 100,000.00
		Anchoring					
Division 3	Concrete						
		Foundation Slab	62	c.y.	$ 532.10	$ 32,990.20	$ 32,990.20
		Elevated Slabs and Walls	191	c.y.	$1,123.40	$ 214,569.40	$ 214,569.40
Division 5	Metals						
		6'x6' Aluminum Hatchway	2	each	$ 5,000.00	$ 10,000.00	$ 10,000.00
Division 11	Equipment						
		Influent Pumps	3	each	$ 100,000.00	$ 300,000.00	$ 300,000.00
		MCC	1	each	$ 300,000.00	$ 300,000.00	$ 300,000.00
		PLC and Controls	1	each	$ 100,000.00	$ 100,000.00	$ 100,000.00
		Bridge Crane	1	each	$ 25,000.00	$ 25,000.00	$ 25,000.00
Division 15	Mechanical						
		Wet Well and Valve Vault Piping	1	LOT	$ 80,000.00	$ 80,000.00	$ 80,000.00
						Subtotal Construction =	**$ 1,198,231.79**

Grit Removal

			Qty	Unit	Price per Unit		Materials		Total	
Division 2	Site Work									
		Excavation	188.15	c.y.	$	49.00	$	9,219.26	$	9,219.26
		Backfill	47.037	c.y.	$	49.00	$	2,304.81	$	2,304.81
		Stone Backfill	80.22	c.y.	$	172.00	$	13,797.84	$	13,797.84
		Fill Existing Grit Basin	25.87	c.y.	$	30.00	$	776.10	$	776.10
		Remove Existing Grit Equipment	1	LOT	$	5,000.00	$	5,000.00	$	5,000.00
Division 3	Concrete									
		Foundation Slab	37.62	c.y.	$	532.10	$	20,017.60	$	20,017.60
		Elevated Slabs and Walls	53.51	c.y.		$1,123.40	$	60,113.13	$	60,113.13
Division 5	Metals									
		Aluminum Grating	508	s.f.	$	23.00	$	11,684.00	$	11,684.00
		Aluminum Handrail	100	L.F.	$	75.21	$	7,521.00	$	7,521.00
Division 11	Equipment									
		Grit Unit Equipment	1	each	$	259,000.00	$	259,000.00	$	336,700.00
		Davit Crane	1	each	$	5,000.00	$	5,000.00	$	7,447.02
Division 15	Mechanical									
		Stop Plate	2	each	$	10,000.00	$	20,000.00	$	20,000.00
		Weir Plate	2	each	$	2,000.00	$	4,000.00	$	4,000.00
		16" D.I. Pipe (Flanged)	20	L.F.	$	160.00	$	3,200.00	$	4,766.09
							Subtotal Construction =		$	**503,346.86**

UV Disinfection

			Qty	Unit	Price per Unit	Materials	Total
Division 2	Site Work						
		Convert CCT to UV	1	LOT	$ 250,000.00	$ 250,000.00	$ 250,000.00
Division 11	Equipment						
		UV Equipment	1	each	$ 174,500.00	$ 174,500.00	$ 226,850.00

Subtotal Construction = $ **476,850.00**

Sludge Holding

			Qty	Unit	Price per Unit	Materials	Total
Division 2	Site Work						
		Equipment Removal	1	LOT	$ 30,000.00	$ 30,000.00	$ 30,000.00
Division 11	Equipment						
		Diffusers	1	each	$ 100,000.00	$ 100,000.00	$ 100,000.00

Subtotal Construction = **$ 130,000.00**

Dravosburg WWTP Long Term Control Plan

Alternative 2 - Pump Dravosburg to MACM

Planning Cost Estimate

ITEM	COST	
General Site Work	$	181,000
Pump Station and Valve Vault	$	1,449,000
Force Main to MACM	$	748,000
Aeration/Storage Tank Rennovations	$	210,000
SUBTOTAL CONSTRUCTION COST	**$**	**2,588,000**
Electrical Costs (25%)	$	647,000
Mobilization/Demobilization/Bonds/Insurance (15%)	$	389,000
Contingency (30%)	$	777,000
TOTAL CONSTRUCTION COST	**$**	**4,401,000**
Engineering, Permitting, Legal (15%)	$	661,000
Construction Administration (10%)	$	441,000
TOTAL PROJECT COST	**$**	**5,503,000**

Site Work							
			Qty	Unit	Price per Unit	Materials	Total
Division 2	Site Work						
		E&S Controls	1	lot	$ 10,000.00	$ 10,000.00	$ 10,000.00
		By-Pass Pumping	1	lot	$ 50,000.00	$ 50,000.00	$ 50,000.00
		Fill Final Clarifiers (Stone)	323	c.y.	$ 30.00	$ 9,690.00	$ 9,690.00
		Site Paving	385	s.y.	$ 50.00	$ 19,259.26	$ 19,259.26
		Lawn Restoration	1	lot	$ 5,000.00	$ 5,000.00	$ 5,000.00
Division 3	Concrete						
		Repairs/Rehabilitation	1	lot	$ 10,000.00	$ 10,000.00	$ 10,000.00
		Manholes (0'-8' Deep)	3	ea	$2,500.00	$ 7,500.00	$ 7,500.00
		Manhole VF over 8' Deep	25	v.f.	$110.00	$ 2,750.00	$ 2,750.00
		Fill Final Clarifiers (Cap)	31	c.y.	$ 532.10	$ 16,495.10	$ 16,495.10
						$ -	
Division 15	Mechanical						
		8" D.I. Pipe (Buried) - F.M.	150	L.F.	$ 50.00	$ 7,500.00	$ 7,500.00
		18" D.I. Pipe (Buried) - F.M.	210	L.F.	$ 200.00	$ 42,000.00	$ 42,000.00
						Subtotal Construction = $	**180,194.36**

Influent Pump Station and Valve Vault

			Qty	Unit	Price per Unit	Materials	Total
Division 2	Site Work						
		Excavation	513	c.y.	$ 50.00	$ 25,648.15	$ 25,648.15
		Backfill	128	c.y.	$ 50.00	$ 6,412.04	$ 6,412.04
		Stone Backfill	21	c.y.	$ 172.00	$ 3,612.00	$ 3,612.00
		Excavation/Shoring/Dewatering/Backfill	1	LOT	$ 100,000.00	$ 100,000.00	$ 100,000.00
Division 3	Concrete						
		Foundation Slab	62	c.y.	$ 532.10	$ 32,990.20	$ 32,990.20
		Elevated Slabs and Walls	191	c.y.	$1,123.40	$ 214,569.40	$ 214,569.40
Division 5	Metals						
		6'x6' Aluminum Hatchway	2	each	$ 5,000.00	$ 10,000.00	$ 10,000.00
Division 11	Equipment						
		Normal Flow Pumps	3	each	$ 50,000.00	$ 150,000.00	$ 150,000.00
		Storm Pumps	3	each	$ 100,000.00	$ 300,000.00	$ 300,000.00
		MCC	1	each	$ 300,000.00	$ 300,000.00	$ 300,000.00
		PLC and Controls	1	each	$ 100,000.00	$ 100,000.00	$ 100,000.00
		Bridge Crane	1	each	$ 25,000.00	$ 25,000.00	$ 25,000.00
		Grinder Unit	1	each	$ 100,000.00	$ 100,000.00	$ 100,000.00
Division 15	Mechanical						
		Wet Well and Valve Vault Piping	1	LOT	$ 80,000.00	$ 80,000.00	$ 80,000.00

Subtotal Construction = **$ 1,448,231.79**

Force Main to MACM

			Qty	Unit	Price per Unit	Materials	Total
Division 2	Site Work						
		Select Backfill	3025	c.y.	$ 30.00	$ 90,750.00	$ 90,750.00
		Filter Fence	4600	L.F.	$ 2.50	$ 11,500.00	$ 11,500.00
		Municipal Road Repavement	4533	s.y.	$ 50.00	$ 226,666.67	$ 226,666.67
		Exploratory Excavation	10	ea	$ 270.00	$ 2,700.00	$ 2,700.00
Division 3	Concrete						
		Manhole 0-8' Deep - 4'-0" Diameter	10	ea	$ 2,150.00	$ 21,500.00	$ 21,500.00
		Watertight Manhole Frame and Cover	5	ea	$ 500.00	$ 2,500.00	$ 2,500.00
Division 15	Mechanical						
		8" D.I. Pipe (Buried)	4600	L.F.	$ 50.00	$ 230,000.00	$ 230,000.00
		Bore 20" Stl. Casing Pipe	800	L.F.	$ 190.00	$ 152,000.00	$ 152,000.00
		CCTV Inspection	4600	L.F.	$ 1.50	$ 6,900.00	$ 6,900.00
		Force Main Testing	4600	L.F.	$ 0.60	$ 2,760.00	$ 2,760.00
						Subtotal Construction =	**$ 747,276.67**

Storage Tanks							
			Qty	Unit	Price per Unit	Materials	Total
Division 11	Equipment						
		Storage Basin Dewatering Pumps	2	each	$ 30,000.00	$ 60,000.00	$ 60,000.00
		Replace Aeration Diffusers	1	LOT	$ 150,000.00	$ 150,000.00	$ 150,000.00
							$ 210,000.00

PAWC RESPONSE TO TUS-17 [Attachment 4]

THE MUNICIPAL AUTHORITY OF THE CITY OF MCKEESPORT

COMBINED SEWER OVERFLOW LONG TERM CONTROL PLAN
DECEMBER 2007

KLH
ENGINEERS, INC.
5173 CAMPBELLS RUN ROAD
PITTSBURGH, PA 15205-9733

MUNICIPAL AUTHORITY OF THE CITY OF MCKEESPORT

COMBINED SEWER OVERFLOW LONG TERM CONTROL PLAN

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1 INTRODUCTION

The Municipal Authority of the City of McKeesport (MACM) owns and operates the McKeesport Wastewater Treatment Plant (WWPT) and the system of interceptors, pump stations, and force mains which collect and convey sewage from the service communities. Along the interceptor system a total of 28 combined sewer overflows (CSO's) provide points of discharge for excess wet weather flow from combined sewer systems (CSS). The map provided on the following page illustrates the location of all CSO's. The facilities described herein are permitted under NPDES Permit #PA0026913.

The NPDES permit states that "the long term goal of the Long Term Control Plan (LTCP) requirements in this permit is to achieve compliance with the Pennsylvania water quality standards upon completion of the LTCP implementation." The LTCP shall at minimum incorporate the following requirements:

1) Continued implementation of the Nine Minimum Controls
2) Protection of sensitive areas
3) Public participation in developing the LTCP

In addition to the above stated minimum requirements, this report identifies the sewage related deficiencies/problems within the watershed, develops various alternatives for resolving the recognized problems and addresses future, growth related, deficiencies.

Insert System Map

2 CHARACTERIZATION, MONITORING AND MODELING OF THE COMBINED SEWER SYSTEM

The characterization of the MACM's system begins with the identification of its main components, a definition of its main components, and their hydrologic and hydraulic characteristics. It continues with an analysis of dry weather and wet weather related wastewater flows, the capture, conveyance and treatment of such flows and concludes with an assessment of the system's functionality and an outline of its deficiencies.

The MACM's characterization objectives have been pursued through a combination of procedures, measures, and activities conducted during the preparation of the LTCP. They consist of the following:

1) Examination of existing data
2) Monitoring of CSO's and receiving water
3) Modeling of the CSS and receiving water.
4) Characterization of the CSS

2.1. EXAMINATION OF EXISTING DATA

In order to meet the requirement set forth in the NPDES permit relative to the CSS, the following reports were prepared and submitted for review and/or approval copies of which are appended as follows:

- CSO Management and Control Study, Appendix A
- Implementation and Documentation of the Nine Minimum Controls for CSO's, Appendix B

In preparation for development of the LTCP the Authority's CSO control system was assessed. This assessment was completed and the findings summarized in the "CSO Management and Control Study". This study was submitted to the PaDEP in January of 1996.

The assessment of the available information concluded that in order to conduct a comprehensive characterization of the Authority's CSS, it would be necessary to obtain additional data and information that had not been developed previously. This resulted in the development of a comprehensive investigation and monitoring plan, which would better assess existing conditions and establish goals for the CSS.

Three major areas were identified for new data collection:

- Delineation of the collection system areas that converge to the specific discharge points into the intercepting sewers.
- Flows and loads from each of these areas under dry and wet weather conditions.
- Receiving water characteristics under dry and wet weather conditions

These programs are described in detail in the following sections.

2.2 MONITORING OF CSOs AND RECEIVING WATERS

2.2.1 Delineation of Drainage Areas

Delineation of the collection system areas was a necessary step in the preparing for the hydraulic characterization of the CSS. The correct determination of actual drainage areas is crucial for the characterization of the CSS, flow predictions in relation to storm events, flow rate and total amount of combined sewage bypassing through the regulators into the receiving waters. By only using the rare available maps of the existing system, it wasn't possible to determine the direction of flow throughout the entire collection system. The Authority's staff conducted a field survey by checking the manholes in the areas that were not obvious for their drainage direction; performed dye testing and interviewed the City of McKeesport Public Works Staff that maintain the collection system. The collected information was then used to develop the hydraulic model of the CSS that would depict the actual conditions. This was particularly difficult due to the lack of records, a history of unregulated taps and interconnections between CSS and exclusive storm lines. The drainage areas for each collection point (regulator) in the City of McKeesport are delineated based on the rare existing records, best knowledge of the Authority's and City of McKeesport Public Works Department's Staff, and limited field investigation. The map provided on the following page illustrates drainage areas for each collection point.

Insert Drainage Area Map

2.2.2 CSO Monitoring

The object of the CSO monitoring program was to collect dry and wet weather data on the Authority's CSS. This data was than used to determine the hydraulic and pollutant loading to receiving waters and to assess impacts of those loading on receiving water quality. The monitoring program had to be selective, yet at the same time produce a representative sample of data that could be used in order to achieve the objectives of the report.

CSO monitoring consists of the monitoring and collection of the flow and water quality data during dry and wet weather conditions. Selection of the CSO monitoring stations was based on the number of overflow events as recorded by the Authority's staff during 1998. The following table presents the frequency of overflow events in 1998, which was used as the primary selection criteria during the CSO's ranking process.

CSO Overflow Frequency and Ranking

CSO	January				February			March		April			May				June
	7	8	12	22	6	13	24	8		16	20	30	4	5	6	11	1
002																	
003	1,110.0	437.0				731.0		16.0			87.0						579.0
004	73.0	608.0				707.0											
005																	23.0
006																	37.0
007																	
008		539.0	8.0	3.0		193.0		80.0	78.0	15.0	52.0						61.0
009	70.0					214.0		31.0				6.5					
010																	91.0
011																	
012																	
013																	
014																	32.0
015																	
016																	
017																	100.0
018																	
019																	
020																	
021	168.0											73.0					
022																	
023	184.0	1,345.0			734.0	3,339.0								583.0	362.0	169.0	
024	614.0	1,010.0	2.0	7.0	65.0	299.0	60.0			82.0		30.0	24.0			68.0	307.0
025																	
026																	
027																	
028																	
029																	
030	209.0	2,028.0		39.0	1,451.0	1,270.0		118.0									
031	412.0	2,803.0		15.0	1,884.0	897.0											
032	218.0	2,028.0	20.0		531.0	1,270.0		64.0		634.0			158.0			116.0	412.0
033	50.0	403.0			220.0	383.0		50.0		184.0			24.0			28.0	

CSO	July			August			September				October			November			December		Volume	Events	Rank
	1	20	22	10	11	17	7	8	18	22 - 23	6	18	21	19	20	26	8	21 - 22			
002																			-	-	
003				451.0			287.0	67.0	13.0									173.0	3,881.0	-	
004							362.0	15.0							6.0	9.0		65.0	2,084.0	8	I
005	11.0						58.0	24.0			9.0				2.0		2.0		127.0	7	
006							138.0	9.0			16.0				3.0		3.0		205.0	6	
007					7.0		138.0	18.0											702.0	4	
008						18.0	146.0	20.0	6.0		32.0			2.0					774.0	15	I
009	14.0	19.0	31.0				268.0	6.0	7.0		13.0				7.0	2.0		38.0	652.5	15	I
010							37.0												128.0	1	III
011																			-	-	III
012																			-	-	III
013				202.0			41.0	7.0		930.0	38.0			2.0	7.0	2.0		38.0	1,263.0	8	I
014							37.0	18.0	6.0	391.0	11.0				2.0				487.0	7	II
015							41.0	7.0		322.0	13.0			2.0	3.0				398.0	8	III
016																			-	-	III
017							115.0	20.0	7.0	322.0	38.0				7.0				607.0	7	II
018							444.0	78.0			28.0				18.0				584.0	4	III
019																			-	-	III
020							104.0	6.0		73.0	11.0								194.0	4	III
021				363.0			587.0	37.0		147.0	84.0	48.0			14.0	9.0	5.0	65.0	1,606.4	12	I
022																			-	-	
023							877.0	179.0							8.0			308.0	8,168.0	11	I
024	9.0	2.0	391.0	586.0	47.0	12.0	1,000.0	127.0			284.0	64.0	67.0		28.0	151.0	48.0	397.0	9,991.0	-	
025							382.0	37.0			64.0								483.0	3	II
026							360.0	64.0			61.0				4.0				489.0	4	II
027							181.0	7.0			38.0				3.0				207.0	4	III
028	30.0	41.0	70.0				339.0	78.0	15.0		75.0				6.0				653.0	8	II
029							30.0	5.0			9.0	7.0			2.0				53.0	5	III
030							882.0	43.0			78.0				18.0				5,931.0	10	II
031		77.0	402.0		34.0		888.0	30.0			423.0				32.0		11.0	151.0	8,180.0	10	I
032	65.0		72.0		48.0		569.0	39.0			137.0				18.0				6,407.0	17	I
033							104.0	8.0			32.0				2.0				1,489.0	12	II

Overflow frequency was then compared to the total discharge volume before the final selection was made. Also the monitoring plan had to include locations from all interceptors (Long Run, Youghiogheny, Upper and Lower Monongahela). Finally the following eight CSO structures were selected for monitoring:

Upper Mon Interceptor:	CSO 004 Rebecca Street
	CSO 009 Windsor Street
Lower Mon Interceptor:	CSO 031 White Street
	CSO 032 Cliff Street
Youghiogheny Interceptor:	CSO 013 Fifth Avenue
	CSO 021 Twelfth Avenue
	CSO 023 28th Avenue
Long Run Interceptor:	CSO 024 Eden Park Boulevard

The Authority hired an experienced contractor to perform the flow monitoring, including the collection and presentation of data. Prior to the installation of flow meters, the selected sites were inspected for hydraulic and physical accessibility. A pair of flow meters was installed at each selected site. Where installation allowed, one flow meter was installed in the interceptor discharge line while the other meter was installed in a overflow line. Where one of these installations was not hydraulically or physically possible, a flow meter was installed in a regulator chamber influent line. The flow meters used in the monitoring were area-velocity type, with a submerged pressure transducer and electromagnetic sensors for velocity measurement. Detailed information on the equipment, selected sites, monitoring protocols and QC/QA procedures used in monitoring is presented in Appendix C.

After several months meters were to be pulled and calibrated. Since several overflow events had already been recorded, it was decided that after the calibration, the available flow meters be installed in new locations as per established ranking.

A total of eight flow meters were installed in four regulators as follows:

Upper Mon Interceptor:	CSO 008 Perry Street
Lower Mon Interceptor:	CSO 030 Evans Street
Lower Mon Interceptor:	CSO 026 Walnut Street
Youghiogheny Interceptor:	CSO 018 Ninth Street

Again, the total flow at the WWTP was continuously monitored, and all regulators were inspected during rain events, estimating the total volume of bypassing for each regulator during the overflow events.

2.2.3 Monitoring Duration

A total of sixteen flow meters were installed in eight diversion structures on May 28, 1999. Due to drought conditions it was not clear how long the monitors would be kept in the place before being moved to different locations. After recording several rain events and related overflows, the flow meters were pulled out in September of 1999. After the calibration, eight flow meters were then installed in new locations. During this period, from October 1999 through January 2000, a permanent flow meter at the WWTP was measuring the total flow being conveyed to the plant. Also, during all rain events the remaining regulators were inspected and the Authority's experienced crew estimated overflows' volumes utilizing chalking measurements.

A range of storm sizes occurred during these periods. Rainfall data is a vital part of a CSS monitoring program. It is necessary for analyzing the CSS, calibrating and validating CSO models, and developing design conditions for predicting current and future CSO's. The rain data was obtained from recording gauges located at the WWTP and Long Run Pump Station. Also rain data from the Westmoreland County Water Treatment Plant, located within the City of McKeesport's limits, was used to compare to the recorded data during the characterization phase. The rain gauges for rainfall monitoring were all tipping bucket type, with 0.01 inch per tip.

2.2.4 Analysis of Flow Data

CSS flow and rainfall data were evaluated to develop an understanding of the hydraulic response of the system to wet weather events and to achieve the objectives of the monitoring program. An analysis of the monitored flow and rain data as presented in the following pages intends to answer basic questions for the monitored outfalls as suggested in Chapter 5 of the EPA "CSO Guidance for Monitoring and Modeling".

- *Which CSO outfalls contribute the majority of the overflow volume?*
- *What size storm can be contained by the regulator serving each outfall? What rainfall amount is needed to initiate overflow? Does this containment capacity vary from storm to storm?*
- *Approximately how many overflows would occur and what would be their volume, based on rainfall record from different year?*

2.2.5 Wastewater Quality Sampling

Characterization of the CSS requires information on the quality, as well as the quantity of the overflows. Ideally, a comprehensive water quality monitoring program parallel to the flow monitoring should be followed by the development of the CSO quality models, which would be used to characterize and predict the loads of the CSS or of the individual source areas.

A limited water quality sampling was conducted in order to understand the actual physical, biological and chemical character of the sewage during the rain events.

One composite sampler, owned by the Authority, was used to obtain water quality data from the regulators selected by the flow monitoring criteria. After each rain event, the samples were collected and analyzed, and then the sampler was moved to a different location. The data for the initial flush and extended overflow for the selected locations are presented in Appendix D. The results of the analysis of limited number of samples shows a general nature of domestic sewage during the storm events with no unexpected pollutants.

2.2.6 River Water Quality Study

The purpose of this water quality study is to determine the impact of bypass events on the water quality of the receiving waters by comparing water quality data obtained during dry and wet weather conditions.

The CSO regulators located along the interceptors regulate the flow of combined sewage during storm events. After reaching a preset level in the regulator chambers, a portion of flow is conveyed over the weir to the Youghiogheny and Monongahela rivers. Since one of the objectives of the LTCP is to evaluate the impact of CSO's and "gain *sufficient understanding of the receiving water to support evaluation of proposed CSO control alternatives*", a comprehensive study of water quality conditions of the receiving rivers along with Long Run and Crooked Run was conducted during the preparation of LTCP.

The receiving water sampling was conducted once during dry and wet weather conditions. The data was then used to demonstrate that the existing CSS or proposed CSO control measures were capable of attaining the water quality standards for the receiving waters. Also, at the same time, an assessment of the McKeesport CSS was conducted based on the presumption that *no less than 85% by volume of the combined sewage is collected in the CSS and treated during precipitation events on a system-wide annual average basis.*

However, the receiving water sampling and the analysis of the collected samples for the first time provided valuable information on the biological and chemical composition of the Youghiogheny River, Monongahela River and Long Run within the limits of the City of McKeesport. This sampling also provided the opportunity to assess the effects of CSO discharges and the chemical constituents contained therein on the survival of fish and invertebrates and the change in the chemical constituents of the receiving water bodies due to the CSO discharges.

A brief summary of this analysis is presented in this section, the portion of the study with the chemical and biological data are appended to this report in Appendix E.

A total of nine sampling stations were defined in order to provide a profile of the water both coming into the City of McKeesport and leaving the city and to provide a profile of the water within the city's limits as compared to samples above the potential influence of the CSO's.

Each location was sampled from near the right bank, near the left bank, and from the center of the river. Water for chemical analysis and water and sediments for biological laboratory analysis were collected from all of these locations. Also, bentic Macroinvertebrates collection and electrofishing was conducted at the same locations. The preconditions for the sampling during dry weather was to have an antecedent dry period of a minimum 72 hours, while the preconditions for the wet weather sampling were established as 48 hours dry antecedent period and at least 0.3" of rain in a six hour period.

The following are conclusions of the biological and chemical analysis of the receiving waters sampling:

1. Sediment from all samples location exhibited toxicity to *Chironomous tentants.*

2. The toxicity of the sediment associated with the Youghiogheny and Monongahela Rivers can probably be attributed to the high amount of barge and recreational boat traffic. However, the limited chemical analysis performed prevents a positive identification of the causative agent(s) of the toxicity in the sediment.

3. By comparing the results of the sediment toxicity test and the bentic macroinvertebrate study, it can be concluded that organisms are slowly adapting to the conditions found in all three waterway systems.

4. Essentially the Biological Field Study indicates that the lower Monongahela and the lower Long Run sampling stations are impaired when compared to the upper stations. The Youghiogheny thus far does not indicate impairment related to any point source.

5. None of the river location samples exhibited acute toxicity to Ceriodaphnia dubia: The 48-hour LC_{50} and 95 percent confidence interval is >100 percent.

6. All river location samples did not exhibit acute toxicity to the fathead minnow: The 48-hour LC_{50} and 95 percent confidence interval is >100 percent.

7. The chemical analysis performed on all of the river location samples did not yield conditions that could be considered causative agents of toxicity. The analytical results were compared to the limits established in the *Pennsylvania Code Title 25. Environmental Protection January 2000. Appendix A Table 1 "Water Quality Criteria for Toxic Substances".*

Where analytical parameters were not included on this table, typical NPDES criteria for effluent was used. A review of the chemical analysis run on the various samples follows:

a. pH values all fell within the normally acceptable pH range of 6 to 9.

b. Dissolved oxygen values all exceeded 5.0 mg/l

c. Total residual chlorine values all were less then detectable.

d. Total suspended solids values varied due to the nature of samples. Wet weather samples often produced high values, often times in excess of 100 mg/l.

e. Ammonia levels in the waters were typically below 0.2 mg/l.
f. Total arsenic values were all less than 0.01 mg/l. Typically they were at the levels at or below the detection level of 0.005 mg/l.

g. All other tested metals: cadmium, copper, lead, mercury, nickel, silver, zinc, selenium and chromium were at or near the detection levels

h. Fecal coliform values varied over a large range. These seem to be typical of the values encountered in river samples.

i. Oil and grease values determined on all of the river water samples were below the detection level of 1.4 mg/l. The higher levels of oil and grease were expected during the wet weather events.

j. Floatable levels were all fairly low.

k. Volatile Organic Compounds were all at the levels less than detectable.

The results of the testing show that with the exception of fecal coliform, the CSO's have no impact on the receiving waters. The fecal coliform concentrations in the receiving waters as recorded during the wet weather sampling are shown on the following map.

Insert Receiving Water Fecal Coliform Concentration Map

Both Monongahela and Youghiogheny rivers are qualified as warm water fishery streams (WWF). According to the DEP's Title 25. Environmental Protection - Chapter 93. Water Quality Standards, the maximum fecal coliform level for the period October 1 through April 30 shall be a geometric mean of 2,000 per 100 milliliters (ml) based on five consecutive samples collected on different days". By reviewing the collected data during the wet weather sampling in relation to the DEP's imposed water quality standards the following can be concluded:

1. Fecal concentration (1,900 #/100ml) in the Monongahela River that enters City of McKeesport limits despite the CSO's discharge along the Monongahela River and WWTP Outfall actually decreases (1,300 #/100ml) up to the point of the confluence with the Youghiogheny River.

2. Fecal concentrations in the Youghiogheny River entering the City's limits are minimal.

3. The concentration of fecal after its confluence with Long Run rises to 12,000#/100ml along the right bank. This increase is most likely due to bypassing that occurs at the Long Run Pump Station overflow structure.

4. Due to high volumes of the Youghiogheny River during wet weather (flow 10,000-20,000 cfs) it is expected that the fecal concentrations decrease in the short period of time. This is apparent from the sampling results which show a decrease in the fecal concentrations from 12,000 to 3,400 at the sampling station YR 007 located downstream of the sampling station YR 006.

5. The results of samplings conducted at station YR 008 located right before its confluence with the Monongahela River show additional concentration of fecal coming from the CSO's located along the right bank of Youghiogheny River.

6. Finally, the result of the sampling at the furthest downstream sampling station LM 009, located at the exit of the City of McKeesport limits, shows an overall decrease in fecal concentration. The exiting concentration at the time of sampling was 4,800#/100 ml for the sample taken at the right bank.

The water quality study, based on river sampling during dry and wet weather, shows that except for the fecal coliform, the CSO's have no impact on rivers quality. The continued operation of the nine minimum controls, adjustments of the regulators to capture 350% of an average dry weather flow and other immediate measures are expected to further reduce fecal concentration during rain events. This LTCP will recommend various system improvements, including the elimination of the Long Run SSO bypass. These improvements will result in a CSO system that will be substantially improved. After these improvements are implemented, as a part of a post-compliance monitoring program, the Authority will conduct post-construction fecal study, which will reexamine fecal levels in the receiving rivers.

2.3 MODELING OF CSS

The final step toward the CSS characterization was the development of the CSS Hydraulic Model. The model is used to understand the hydraulic response of the CSS for a variety of flow inputs. The completed model provides an excellent tool for the evaluation of the CSS.

This dynamic model was constructed using Hydra 6.0 a commercial hydraulic modeling software package from Pizer, Inc., which is well known as an industry standard for the analysis, design and management of storm, combined and sanitary sewer system. The model was built using existing construction records and field investigations. Some of the crucial parameters such as the setting of the existing regulator's mechanisms, existing siphon chambers' flow patterns, and pump stations' regimen were obtained from the Authority staff field investigations.

After constructing the model's physical characteristics base flow information was entered. The sewage conveyed through the system of interceptors comes from the entire City of McKeesport, and adjacent communities. The base flow from the neighboring communities that discharge into the system of interceptors is obtained from the municipal authorities of those communities. The flow from within the City of McKeesport is, for the most part, determined from the flow monitoring conducted during several months in 1999. The flow from the tributary collection lines that were not monitored was estimated based on the number of residential and commercial units in the contributing areas.

2.4 COMBINED SEWER SYSTEM CHARACTERIZATION

The first step in characterization of the Authority CSS was to determine base flow conditions. A combination of metered and estimated flow data was used to establish average dry weather conditions. During the flow monitoring period (May 28, 1999 through January 1, 2000), there was a total of 118 days without precipitation. This did not include days without precipitation that followed days with recorded precipitation. A 24-hour period was established to eliminate any impact of remaining runoff that would eventually drain to the collection point or the possible impact of an inflow or high water table infiltration into the collection system.

The average dry weather flow recorded during this period at the WWTP was 7.77 mgd. Under dry weather conditions, the combined sewer system routinely conveys sewage to the WWTP for the treatment. This flow was used as a reference point in determining the flows from other, non-metered combined sewage drainage areas and the flows contributed by neighboring communities.

A detailed explanation of the procedure used in establishing a base dry weather flow is presented in Appendix F, April 30, 2004 DEP Response Letter.

As a part of the Act 537 Plan preparation, the Authority conducted a year long flow monitoring study to determine the amount of flow accepted from neighboring communities. This data was compared to the data obtained during the preparation of the original LTCP. The average dry weather flow to the WWTP during the one-year period was 7.198 mgd, which was less than the LTCP's established base average dry weather flow. Because of the significantly longer monitoring period the MACM's average dry weather flow system hydraulic characterization has been revised in the following manner:

- The flows from the neighboring communities were adjusted to reflect the revised base average dry weather flow.
- Total flow of 2.69 mgd from the three monitored locations (Long Run Interceptor, Versailles Trunk, and Port Vue Area) of was deducted from the average base flow of 7.77 to reflect the flows conveyed through the regulators (7.77 – 2.69) = 5.08 mg.
- The total flow of 5.08 mgd was then distributed to all the regulators based on the percentages of the total flow established by the 1999 monitoring.

This new, adjusted, flow distribution was used in defining the system's hydraulic characterization and for the proposed improvements of the MACM's system. Detailed report and hydraulic profile of the existing system's characteristics for the average dry weather flow conditions are presented in Appendix G.

The model was then used to predict the CSS reaction to various hypothetical conditions. These scenarios are utilized to ensure that the CSS complies with the requirement that each regulator is capable of conveying at minimum 350% of the average dry weather flow from the combined sewers drainage area and the 2-year 24 hour peak flow from the exclusively sanitary flow contributing areas. The model is adjusted in a way to reflect existing settings. Detailed report and hydraulic profile of the proposed system's characteristics for the maximum flow conditions are presented in Appendix H.

The following tables provide interceptor characteristics and capacities and, where shaded, the areas of insufficient design capacity, defined as the inability to convey 350% of the average design flow.

Lower Monongahela Interceptor

Segment	Full Flow Capacity (mgd)	Average Dry Weather Flow (mgd)	Proposed Average Dry Weather Flow (mgd)	350% of Average Dry Weather Flow (mgd)	Proposed 350% of Average Dry Weather Flow (mgd)
Cliff to 43		1.39	1.39	4.59	4.59
44 to 43	12.49	1.39	1.39	4.59	4.59
43 to 42	17.16	1.39	1.39	4.59	4.59
42 to 41	17.36	1.39	1.39	4.59	4.59
41 to 40	15.37	2.59	2.59	8.00	8.00
40 to 38	28.37	2.59	2.59	8.00	8.00
38 to 37	44.49	2.51	2.51	8.07	8.07
37 to 35	46.61	2.60	2.60	8.40	8.40
35 to 33	47.05	2.60	2.60	8.40	8.40
33 to 31	37.99	2.60	2.60	8.40	8.40
31 to 30	20.06	2.61	2.61	8.44	8.44
30 to 29	43.15	2.61	2.61	8.44	8.44
29 to 27	30.64	2.64	2.64	8.54	8.54
27 to 22	33.91	2.64	2.64	8.54	8.54
22 to 21	16.01	2.64	2.64	8.54	8.54
21 to 18	122.38	2.64	2.64	8.54	8.54
18 to 17	30.96	7.04	5.46	24.64	19.11
17 to Siphon	30.35	7.04	5.46	24.64	19.11
Siphon					
Siphon to WWTP	28.76	7.04	5.46	24.64	19.11

Upper Monongahela Interceptor

Segment	Full Flow Capacity (mgd)	Average Dry Weather Flow (mgd)	Proposed Average Dry Weather Flow (mgd)	350% of Average Dry Weather Flow (mgd)	Proposed 350% of Average Dry Weather Flow (mgd)
16 to 15	1.10	0.01	0.01	0.15	0.15
15 to 14	1.18	0.01	0.01	0.15	0.15
14 to 13	1.22	0.01	0.01	0.15	0.15
13 to 12	1.77	0.01	0.01	0.18	0.18
12 to 11	2.83	0.04	0.04	0.18	0.18
11 to 10	1.50	0.05	0.05	0.29	0.29
10 to 9	2.16	0.05	0.05	0.29	0.29
9 to 8	1.61	0.05	0.05	0.29	0.29
8 to 7	2.11	0.06	0.06	0.31	0.31
7 to 6	1.92	0.06	0.06	0.33	0.33
6 to 5	1.95	0.07	0.07	0.35	0.35
5 to 4	3.46	0.24	0.24	0.97	0.97
4 to 3	2.78	0.24	0.24	0.97	0.97
3 to 2	2.41	0.24	0.24	0.97	0.97
2 to WWTP	4.29	0.24	0.24	0.97	0.97

Upper Youghiogheny Interceptor

Segment	Full Flow Capacity (mgd)	Average Dry Weather Flow (mgd)	Proposed Average Dry Weather Flow (mgd)	350% of Average Dry Weather Flow (mgd)	Proposed 350% of Average Dry Weather Flow (mgd)
1 to 109	3.95	0.66	0.66	2.31	2.31
109 to 108	3.95	0.66	0.66	2.31	2.31
108 to 107	3.97	0.66	0.66	2.31	2.31
107 to 106	3.97	0.66	0.66	2.31	2.31
106 to 105	3.97	0.66	0.66	2.31	2.31
105 to 95	3.94	0.66	0.66	2.31	2.31
95 to 94	4.62	1.85	0.66	6.47	2.31
94 to Siphon	4.71	1.85	0.66	6.47	2.31
Siphon			0.66	6.47	2.31
Siphon to 93	2.52	1.85	0.66	6.47	2.31
93 to 92	4.59	1.85	0.66	6.47	2.31
92 to 104	4.74	1.85	0.66	6.47	2.31
104 to 91	4.60	1.85	0.66	6.47	2.31
91 to 90	4.59	1.85	0.66	6.47	2.31
90 to 89	4.62	1.85	0.66	6.47	2.31
89 to 88	4.69	1.85	0.66	6.47	2.31
88 to 87	6.29	1.85	0.66	6.47	2.31
87 to 86	6.28	1.85	0.66	6.47	2.31
86 to 85	6.32	1.85	0.66	6.47	2.31
85 to 84	7.16	2.73	1.54	9.55	5.39

Lower Youghiogheny Interceptor

Segment	Full Flow Capacity (mgd)	Average Dry Weather Flow (mgd)	Proposed Average Dry Weather Flow (mgd)	350% of Average Dry Weather Flow (mgd)	Proposed 350% of Average Dry Weather Flow (mgd)
78 to 77	37.12	2.73	1.54	9.55	5.39
77 to 76	9.23	2.73	1.54	9.55	5.39
76 to 75	9.21	3.65	1.54	12.78	5.39
75 to 74	10.90	3.65	1.54	12.78	5.39
74 to 102	11.40	3.65	1.54	12.78	5.39
102 to 71	14.12	3.65	1.54	12.78	5.39
71 to 70	13.67	3.96	1.85	13.86	6.48
70 to 69	15.58	3.97	1.86	13.89	6.48
69 to 68	11.10	3.97	1.86	13.89	6.48
68 to 67	14.12	3.97	1.86	13.89	6.48
67 to 66	31.80	4.84	2.73	16.94	9.56
66 to 65	13.52	4.84	2.73	16.94	9.56
65 to 64	17.50	4.84	2.73	16.94	9.56
64 to 63A	4.64	4.91	2.80	17.18	9.80
63A to 63	12.96	4.92	2.81	17.22	9.84
63 to 62	0	4.92	2.81	17.22	9.84
62 to 18	32.34	4.93	2.82	16.10	9.87

Long Run Interceptor

Segment	Full Flow Capacity (mgd)	Average Dry Weather Flow (mgd)	Proposed Average Dry Weather Flow (mgd)	350% of Average Dry Weather Flow (mgd)	Proposed 350% of Average Dry Weather Flow (mgd)
186 to 185	5.72	0.73	0.73	2.56	2.56
185 to 184	3.82	0.73	0.73	2.56	2.56
184 to 183	4.15	0.73	0.73	2.56	2.56
183 to 182	4.02	0.73	0.73	2.56	2.56
182 to 181	3.78	0.73	0.73	2.56	2.56
181 to 180	3.72	0.73	0.73	2.56	2.56
180 to 178A	4.24	0.73	0.73	2.56	2.56
178A to 178	5.03	1.10	1.10	3.85	3.85
178 to 177	5.31	1.10	1.10	3.85	3.85
177 to 176	5.11	1.10	1.10	3.85	3.85
176 to 175	5.08	1.10	1.10	3.85	3.85
175 to 174	5.56	1.10	1.10	3.85	3.85
174 to 173	5.52	1.10	1.10	3.85	3.85
173 to 172	**3.72**	**1.10**	**1.10**	**3.85**	**3.85**
172 to 188	**3.11**	**1.10**	**1.10**	**3.85**	**3.85**
188 to 187	**3.66**	**1.10**	**1.10**	**3.85**	**3.85**
187 to 171	4.75	1.10	1.10	3.85	3.85
171 to 170	**3.78**	**1.10**	**1.10**	**3.85**	**3.85**
170 to 169	**3.59**	**1.10**	**1.10**	**3.85**	**3.85**
169 to 168	**3.59**	**1.10**	**1.10**	**3.85**	**3.85**
168 to 167	4.02	1.10	1.10	3.85	3.85
167 to 166	5.60	1.10	1.10	3.85	3.85
166 to 179	8.69	1.10	1.10	3.85	3.85
179 to 165	**3.46**	**1.10**	**1.10**	**3.85**	**3.85**
165 to 164	5.47	1.10	1.10	3.85	3.85
164 to 163A	5.52	1.10	1.10	3.85	3.85
163A to 162A	**2.75**	**1.10**	**1.10**	**3.85**	**3.85**
162A to 162	**0.68**	**1.10**	**1.10**	**3.85**	**3.85**
162 to 161	**1.48**	**1.10**	**1.10**	**3.85**	**3.85**
161 to 160	5.52	1.10	1.10	3.85	3.85
160 to 159	3.90	1.10	1.10	3.85	3.85
159 to 158	**3.11**	**1.10**	**1.10**	**3.85**	**3.85**
158 to 157	**2.88**	**1.10**	**1.10**	**3.85**	**3.85**
157 to 156	**3.33**	**1.10**	**1.10**	**3.85**	**3.85**
156 to 155	**3.59**	**1.10**	**1.10**	**3.85**	**3.85**
155 to 154	**3.59**	**1.10**	**1.10**	**3.85**	**3.85**
154 to 150	**2.79**	**1.19**	**1.19**	**4.16**	**4.16**
150 to PS	10.16	1.19	1.19	4.16	4.16

Comparing the 350% average dry weather flows through the regulators with the flows monitored during the preparation of this report, some conclusions about the characteristics of the rain that would cause such a flow may be drawn from the following tables. Shaded rows in the following tables represent storms that would cause overflow events after regulators have been set to convey 350% average dry weather flow.

Of the 28 CSO's the 12 most significant are discussed in detail. The remaining 16 regulators convey flow from much smaller areas and their contribution to the overall CSS loading has been historically minimal when compared the others. Flow monitoring of these 12 regulators were as follows; eight regulators were monitored during the summer season and data recorded for short-in-duration and relatively high intensity storms, and four regulators were monitored during the fall-winter season with typically longer and lower-intensity storms. Utilizing hydraulic model, the hydraulic grade line during the 350% average dry weather flow conditions were compared to the basement elevations of the closest buildings, for potential flooding. A summary of survey of the building elevations is presented in Appendix I.

The Authority has permanently installed flow monitors on the overflow lines of all regulators. This data is continuously collected for and reported to the DEP in annual Municipal Wasteload Management Reports.

In order to further characterize and generalize the CSS response, these storms were compared to generic storms for different return periods. A generic Intensity-Duration-Frequency chart can be used to determine average rainfall intensity for any specified duration and recurrence interval within the U.S. An example of this chart is presented in Appendix J.

The analysis of summer storms used for the characterization of the eight regulators shows that the greatest storm during this period occurred on 7/28/99 with a duration of 4 hours, average intensity of 0.505 inches/hour.

The following is a brief analysis of each of the monitored regulators:

Regulator No. 021 – 12th Street – 350% of Dry Weather Flow = 1.06 MGD

Storm Date	Antecedent Dry Period [days]	Duration [hours]	Total Depth [inches]	Average Intensity [in/hour]	Max Hour Intensity [in/hour]	QMax Monitored [MGD]	QMax Overflow [MGD]	Overflow Volume [MG]	Storm Rank
6/29/99	0.6	4	0.41	0.105	0.21	0.67	0	0	1
7/30/99	1.1	1	0.30	0.300	0.30	1.38	1.05	0.044	2
7/09/99	2.0	4	0.36	0.090	0.17	1.43	0.85	0.060	3
6/27/99	12	1	0.49	0.490	0.49	2.56	1.57	0.083	4
7/29/99	0.4	3	0.82	0.27	0.39	2.85	1.67	0.120	5
7/28/99	3.0	4	2.02	0.505	1.0	3.26	2.20	0.145	6
8/01/99	0.3	3	0.49	0.160	0.40	3.66	2.65	0.160	7
7/02/99	2.0	7	0.76	0.108	0.55	5.71	4.85	0.950	8

The regulator captured only one storm in its entirety. All other storms caused the bypassing of storm-diluted sewage. The regulator's setting will be continuously controlled to ensure that at minimum flow up to a minimum of 1.21 MGD is conveyed to the interceptor.

Regulator No. 023 – 28th Street – 350% of Dry Weather Flow = 3.08 MGD

Storm Date	Antecedent Dry Period [days]	Duration [hours]	Total Depth [inches]	Average Intensity [in/hour]	Max Hour Intensity [in/hour]	QMax Monitored [MGD]	QMax Overflow [MGD]	Overflow Volume [MG]	Storm Rank
6/29/99	0.6	4	0.41	0.105	0.21	2.13	0.25	0.022	3
7/30/99	1.1	1	0.30	0.300	0.30	1.87	0.75	0.032	2
7/09/99	2.0	4	0.36	0.090	0.17	3.28	0.72	0.059	4
6/27/99	12.0	1	0.49	0.490	0.49	1.48	1.08	0.068	1
7/29/99	0.4	3	0.82	0.27	0.39	5.05	3.22	0.509	6
7/28/99	3.0	4	2.02	0.505	1.00	4.17	1.77	0.181	5
8/01/99	0.3	3	0.49	0.16	0.40	9.60	8.47	0.430	8
7/02/99	2.0	7	0.76	0.108	0.55	6.93	5.33	0.299	7

The 28th Street regulator is located in the vicinity of the 28th Street Pumping Station which contains a total of three pumps, which pump sewage through a 20-inch cast iron force main which discharges to the Lower Youghiogheny Interceptor. Total capacity of the two smallest pumps at the pump station is 5.76 MGD. The model shows that under the maximum designed weather flow conditions, this pump station would receive peak flow 8.52 MGD, which is over its nominal capacity. The pumping station's third pump increases total capacity to 8.64 MGD. The third pump is set to automatically turn on if the flow into the pump station increases the capacity of the two operating pumps. This pump station will be upgraded to allow capture and conveyance of the maximum design flow. The regulator's setting will be adjusted to ensure that all the flow up to a minimum of 3.08 MGD is conveyed to the interceptor.

Regulator No. 013 – 5th Street – 350% of Dry Weather Flow = 0.0006 MGD

Storm Date	Antecedent Dry Period [days]	Duration [hours]	Total Depth [inches]	Average Intensity [in/hour]	Max Hour Intensity [in/hour]	QMax Monitored [MGD]	QMax Overflow [MGD]	Overflow Volume [MG]	Storm Rank
6/29/99	0.6	4	0.41	0.105	0.21	0.006	0.006	0.0004	1
7/30/99	1.1	1	0.30	0.300	0.30	0.49	0.48	0.022	3
7/09/99	2.0	4	0.36	0.090	0.17	2.18	1.17	0.163	5
6/27/99	12.0	1	0.49	0.490	0.49	0.19	0.15	0.011	2
7/29/99	0.4	3	0.82	0.270	0.39	2.23	1.82	0.683	6
7/28/99	3.0	4	2.02	0.505	1.00	2.75	2.08	0.426	7
8/01/99	0.3	3	0.49	0.160	0.40	1.95	1.59	0.477	4
7/02/99	2.0	7	0.76	0.108	0.55	2.83	1.58	0.214	8

The 5th Street Regulator captures the combined sewage from a predominantly urban, commercial area. The dry weather flow through the regulator was, most of the time almost, undetectable by the installed flow meters. During storm events the flow through the regulator increased more then several thousand times, thus conveying the sewage with extremely low "domestic sewage" characteristics.

Regulator No. 004 – Rebecca Street – 350% of Dry Weather Flow = 0.63 MGD

Storm Date	Antecedent Dry Period [days]	Duration [hours]	Total Depth [inches]	Average Intensity [in/hour]	Max Hour Intensity [in/hour]	QMax Monitored [MGD]	QMax Overflow [MGD]	Overflow Volume [MG]	Storm Rank
6/29/99	0.6	4	0.41	0.105	0.21	0.32	0	0	1
7/30/99	1.1	1	0.30	0.300	0.30	0.46	0	0	2
7/09/99	2.0	4	0.36	0.090	0.17	1.73	1.43	0.093	5
6/27/99	12.0	1	0.49	0.490	0.49	1.40	0.83	0.040	4
7/29/99	0.4	3	0.82	0.27	0.39	0.54	0	0	3
7/28/99	3.0	4	2.02	0.505	1.00	N/A	N/A	N/A	N/A
8/01/99	0.3	3	0.49	0.16	0.40	2.88	2.40	0.112	6
7/02/99	2.0	7	0.76	0.108	0.55	11.37	10.85	0.750	7

Regulator No.004 located at Rebecca Street at the end of the Upper Monongahela Interceptor, conveys the flow from the 10th and Upper 10th Ward, as well as a portion of the sanitary sewage from Port Vue. The table shows that the lowest peak flow that would cause a CSO event is a 1-hour, 0.49 inch storm. For comparison, a 2-year, 1-hour storm is 1.2 inches. The regulator's setting will be continuously monitored to ensure that all the flow up to a minimum of 0.63 MGD is conveyed to the interceptor.

Regulator No. 009 – Windsor Street – 350% of Dry Weather Flow = 0.036 MGD

Storm Date	Antecedent Dry Period [days]	Duration [hours]	Total Depth [inches]	Average Intensity [in/hour]	Max Hour Intensity [in/hour]	QMax Monitored [MGD]	QMax Overflow [MGD]	Overflow Volume [MG]	Storm Rank
6/29/99	0.6	4	0.41	0.105	0.21	0.14	0	0	2;3
7/30/99	1.1	1	0.30	0.300	0.30	0.14	.05	0.002	2;3
7/09/99	2.0	4	0.36	0.090	0.17	0.84	0	0	4
6/27/99	12	1	0.49	0.490	0.49	0.08	0	0	1
7/29/99	0.4	3	0.82	0.27	0.39	1.56	1.01	0.118	6
7/28/99	3	4	2.02	0.505	1.0	N/A	N/A	N/A	7
8/01/99	0.3	3	0.49	0.16	0.40	N/A	N/A	N/A	6
7/02/99	2	7	0.76	0.108	0.55	1.36	0.911	0.038	5

The Windsor Street Regulator captures flow from relatively large area when compared to the population served. This explains the rather large difference between dry and wet weather flow through the regulator. Similar to the 5th Street regulator, the Windsor Street regulator captures a much higher percentage of dry weather flow.

Regulator No. 032 – Cliff Street – 350% of Dry Weather Flow = 4.57 MGD

Storm Date	Antecedent Dry Period [days]	Duration [hours]	Total Depth [inches]	Average Intensity [in/hour]	Max Hour Intensity [in/hour]	QMax Monitored [MGD]	QMax Overflow [MGD]	Overflow Volume [MG]	Storm Rank
6/29/99	0.6	4	0.41	0.105	0.21	2.79	1.86	0.537	1
7/30/99	1.1	1	0.30	0.300	0.30	6.31	0.04	0.004	4
7/09/99	2.0	4	0.36	0.090	0.17	3.19	0.80	0.088	2
6/27/99	12.0	1	0.49	0.490	0.49	4.85	3.736	0.522	3
7/29/99	0.4	3	0.82	0.270	0.39	15.44	15.33	4.182	6
7/28/99	3.0	4	2.02	0.505	1.00	15.45	15.45	3.896	7
8/01/99	0.3	3	0.49	0.16	0.40	6.63	3.97	0.339	5
7/02/99	2.0	7	0.76	0.108	0.55	N/A	N/A	N/A	N/A

Cliff Street Regulator No. 032, in combination with Regulator No. 033, conveys sewage to the Cliff Street Pumping Station. The capacity of the pump station (with the two smallest pumps pumping) is approximately 6.0 MGD. 350 % of average dry flow is approximately 5 MGD. The data in the preceding table shows that smaller rain events are captured and conveyed to the pump station. The Authority will adjust the regulator setting so that no overflow occurs until the runoff from the drainage area reaches a minimum of 4.57 MGD.

Regulator No. 031 – White Street – 350% of Dry Weather Flow = 2.31 MGD

Storm Date	Antecedent Dry Period [days]	Duration [hours]	Total Depth [inches]	Average Intensity [in/hour]	Max Hour Intensity [in/hour]	QMax Monitored [MGD]	QMax Overflow [MGD]	Overflow Volume [MG]	Storm Rank
6/29/99	0.6	4	0.41	0.105	0.21	2.44	0.15	0.012	2
7/30/99	1.1	1	0.30	0.300	0.30	2.77	0.04	0.001	3
7/09/99	2.0	4	0.36	0.090	0.17	9.20	3.94	0.365	4
6/27/99	12.0	1	0.49	0.490	0.49	2.97	1.62	0.070	1
7/29/99	0.4	3	0.82	0.270	0.39	23.62	22.45	2.398	8
7/28/99	3.0	4	2.02	0.505	1.00	15.78	13.83	1.445	7
8/01/99	0.3	3	0.49	0.160	0.40	9.62	6.56	0.319	5
7/02/99	2.0	7	0.76	0.108	0.55	11.18	8.13	1.097	6

The White Street Regulator captures the flow from the large area of Central McKeesport. The high flows during relatively moderate storms show a high dilution factor for the discharged sewage. The Authority will continuously monitor the regulator's setting so no overflow occurs until the runoff from the drainage area reaches a minimum of 2.31 MGD.

Regulator No. 024 – Eden Park – 350% of Dry Weather Flow = 0.32 MGD

Storm Date	Antecedent Dry Period [days]	Duration [hours]	Total Depth [inches]	Average Intensity [in/hour]	Max Hour Intensity [in/hour]	QMax Monitored [MGD]	QMax Overflow [MGD]	Overflow Volume [MG]	Storm Rank
6/29/99	0.6	4	0.41	0.105	0.21	2.07	1.03	0.087	2
7/30/99	1.1	1	0.30	0.300	0.30	1.41	0	0.000	1
7/09/99	2.0	4	0.36	0.090	0.17	2.08	1.24	0.109	3
6/27/99	12	1	0.49	0.490	0.49	N/A	N/A	N/A	
7/29/99	0.4	3	0.82	0.27	0.39	5.24	N/A	N/A	5
7/28/99	3	4	2.02	0.505	1.0	17.76	11.28	0.697	7
8/01/99	0.3	3	0.49	0.16	0.40	7.26	0	0.000	6
7/02/99	2	7	0.76	0.108	0.55	4.98	3.36	0.179	4

The preceding table shows significant increase in flow through the regulator during even the smallest rain events. It can be assumed that storm water from a large upstream area is collected and conveyed to either the adjacent storm water culvert through the regulator or to the Long Run Pumping Station. If flows less that 350% of average dry weather flow are handled by the pump station. However, the pump station also receives flow from the Long Run Interceptor. The Long Run Interceptor conveys the domestic sewage from White Oak Borough and residential developments within the City of McKeesport. The Long Run Pumping Station has three pumps each with a capacity of approximately 1 MGD, which establishes the capacity of the pumping station as approximately 2 MGD. During storm events, influent flow often exceeds its full capacity. The operators then lower the gate, blocking the flow into the pumping station, causing the flow to backup and bypass through the sanitary sewer overflow located near the pumping station. This LTCP proposes rehabilitation of the Long Run Interceptor and an upgrade of the Long Run Pump Station which will increase its capacity to 8.5 MGD with a new force main which will convey the flow directly to the treatment plant.

Regulator No. 008 – Perry Street – 350% of Dry Weather Flow = 0.119 MGD

Storm Date	Antecedent Dry Period [days]	Duration [hours]	Total Depth [inches]	Average Intensity [in/hour]	Max Hour Intensity [in/hour]	QMax Monitored [MGD]	QMax Overflow [MGD]	Overflow Volume [MG]	Storm Rank
11/02/99	8.0	11	0.87	0.08	0.15	0.88	0.70	0.158	6
11/20/99	16.0	5	0.16	0.03	0.09	0.18	0.06	0.003	1
11/25/99	0.5	25	1.47	0.06	0.20	1.05	0.75	0.203	7
12/0599	1.5	6	0.23	0.04	0.11	0.64	0,09	0.010	4
12/10/99	3.0	5	0.35	0.07	0.17	0.81	0.67	0.066	5
12/14/99	0.3	14	1.12	0.08	0.34	N/A	N/A	N/A	N/A
12/20/99	5.0	8	0.20	0.03	0.07	0.25	0.15	0.015	2
01/03/00	1.0	8	0.44	0.06	0.13	0.43	0.28	0.027	3

Flow through the Perry Street, Walnut Street, Evans Street and 9th Street regulators were monitored during the months of October, November, December 1999 and January 2000. The average dry weather flow to the WWTP during these months was 8.41 MGD, higher than 7.77 MGD as established for a period June-December of 1999. The established monitored average dry weather flows were then adjusted. None of the monitored storms exceeded average intensity of 0.08 inches/hour. All precipitation events during the monitoring period were less than 2-year return period storms.

Due to the low average dry weather flow through the Perry Street Regulator, overflow events occur frequently with the discharge being highly diluted. In the past, due to malfunctioning of the Perry Street Ejector Station there have been reports of dry weather overflows. Since that time the Authority replaced the ejectors with a more reliable submersible pumps and added a stand-by generator.

Regulator No. 025 – Walnut Street – 350% of Dry Weather Flow = 0.08 MGD

Storm Date	Antecedent Dry Period [days]	Duration [hours]	Total Depth [inches]	Average Intensity [in/hour]	Max Hour Intensity [in/hour]	QMax Monitored [MGD]	QMax Overflow [MGD]	Overflow Volume [MG]	Storm Rank
11/02/99	8.0	11	0.87	0.08	0.15	4.76	4.18	0.528	7
11/20/99	16.0	5	0.16	0.03	0.09	0.72	0.19	0.008	2
11/25/99	0.5	25	1.47	0.06	0.20	1.73	1.88	4.575	6
12/0599	1.5	6	0.23	0.04	0.11	0.94	0.41	0.017	3
12/10/99	3.0	5	0.35	0.07	0.17	1.23	0.94	0.067	4
12/14/99	0.3	14	1.12	0.08	0.34	9.26	8.49	0.840	8
12/20/99	5.0	8	0.20	0.03	0.07	0.54	0.08	0.005	1
01/03/00	1.0	8	0.44	0.06	0.13	1.29	0.67	0.039	5

The Walnut Street Regulator is another example of a low average dry weather flow that increases during precipitation events. The higher dilution rate in this case ensures that the more frequent overflows have less of an impact to the water quality in the Monongahela River.

Regulator No. 030 – Evans Street – 350% of Dry Weather Flow = 1.53 MGD

Storm Date	Antecedent Dry Period [days]	Duration [hours]	Total Depth [inches]	Average Intensity [in/hour]	Max Hour Intensity [in/hour]	QMax Monitored [MGD]	QMax Overflow [MGD]	Overflow Volume [MG]	Storm Rank
11/02/99	8.0	11	0.87	0.08	0.15	5.97	5.25	0.916	8
11/20/99	16.0	5	0.16	0.03	0.09	0.87	0.23	0.086	2
11/25/99	0.5	25	1.47	0.06	0.20	2.27	0.943	0.440	6
12/0599	1.5	6	0.23	0.04	0.11	1.00	0.38	0.024	3
12/10/99	3.0	5	0.35	0.07	0.17	1.20	0.50	0.042	5
12/14/99	0.3	14	1.12	0.08	0.34	2.90	2.18	0.346	7
12/20/99	5.0	8	0.20	0.03	0.07	0.77	0.10	0.008	1
01/03/00	1.0	8	0.44	0.06	0.13	1.14	0.45	0.082	4

Unlike some other regulators that have a high average dry weather to wet weather flow ratio, the Evans Street Regulator captures and conveys all flow during the majority of low intensity storm events. The Authority will continue to maintain the regulator's setting so no overflow occurs until the runoff from the drainage area reaches at least a minimum of 1.53 MGD.

Regulator No. 018 – 9th Street – 350% of Dry Weather Flow = 2.79 MGD

Storm Date	Antecedent Dry Period [days]	Duration [hours]	Total Depth [inches]	Average Intensity [in/hour]	Max Hour Intensity [in/hour]	QMax Monitored [MGD]	QMax Overflow [MGD]	Overflow Volume [MG]	Storm Rank
11/02/99	8.0	11	0.87	0.08	0.15	7.68	2.10	0.656	7
11/20/99	16.0	5	0.16	0.03	0.09	2.58	0.21	0.075	2
11/25/99	0.5	25	1.47	0.06	0.20	6.65	1.95	0.805	6
12/0599	1.5	6	0.23	0.04	0.11	3.19	0.48	0.009	3
12/10/99	3.0	5	0.35	0.07	0.17	4.19	1.23	0.105	4
12/14/99	0.3	14	1.12	0.08	0.34	10.26	2.17	1.056	8
12/20/99	5.0	8	0.20	0.03	0.07	2.53	0.40	0	1
01/03/00	1.0	8	0.44	0.06	0.13	4.46	1.27	0.120	5

The 9th Street Regulator is another example of a relatively small ratio between dry and wet weather flow. This regulator should be adjusted to capture the flow during small rain events, while the larger storms will trigger the runoff that will cause bypassing to the receiving river. The storms that will cause bypassing are presented in the shaded areas in the previous table.

2.4.1 Total Volume Estimation

In order to estimate relations between the total flow entering the CSS and the total flow treated at the WWTP, the actual data collected during 1998 and 1999 were analyzed. The overflows were estimated utilizing the "chalking" method after each rain event. Flow at the WWTP was measured by the permanent flow meter. In December of 2002, the Authority installed permanent flow meters at all CSO outfalls and collected data through 2003.

In 1998 the total estimated overflow during the wet weather was 78.537 million gallons. The total flow treated at the plant during wet weather, (wet weather days are considered only the days of the actual storm - no post storm days were added to the total amount of flow during wet weather), was 1,209.3 millions gallons, which is approximately 94% of total flow that entered the CSS during wet weather days in 1998. Based on the 1999 data, total estimated overflow was 125.2 million gallons. A total of 1,023.3 million gallons was treated at the WWTP or approximately 89.1% of total wet weather flow. In 2003, a total of 2,173 million gallons was treated during at the WWTP during wet weather events. Total flow discharged through the CSO's was at the same time 277 million gallons or 88.7%

As part of this LTCP, it must be determined if the current CSO controls adequately meet the water quality based requirements of the CWA. The CSO Control Policy identifies two general approaches to determine attainment of WQS: *the demonstration approach* and *the presumption approach*. The water quality studies demonstrated that the CSO's discharge have no impact on rivers water quality except for the fecal coliform concentration. Also, the records of the CSO's bypassing for the last two year were examined in order to determine whether the existing CSS meets the criteria established under the presumptive approach. It is based on the assumption that an LTCP that meets certain minimum defined performance criteria"... *would be presumed to provide an adequate level of control to meet the water quality-based requirements of CWA...*". Under the presumption approach, the controls adopted in the LTCP must meet one of three criteria. The first of these criteria is based on limiting the number of overflow events per year, the second is based on treating a percentage of flow during precipitation events, and the third is based on the removal of the mass of pollutants. In accordance with the presumptive approach as described in the CSO Control Policy, this LTCP is based upon meeting the second of these criteria, which requires the following:

> *"The elimination or the capture for treatment of no less than 85% by volume of combined sewage collected in the CSS during the precipitation events on a system-wide annual average basis".*

In order to demonstrate or "characterize" the level of compliance with these criteria a "System Summary During Precipitation Events" was compiled for 1997 and 1998, and 2003. This data is presented in the following table.

CSS Wet Weather Flow Summary

Outfall No.	Location	Total Estimated Flow 1999 [MG]	Total Estimated Flow 1998 [MG]	Total Metered Flow 2003 [MG]
003	Long Run			33.700
004	Rebecca Street	9.063	2.078	8.620
005	Erie Street	0.948	0.118	5.820
006	Ann Street	0.849	0.220	3.390
007	Dale Street	0.668	0.686	1.890
008	Perry Street	2.060	0.798	8.360
009	Windsor Street	2.381	0.768	4.010
010	Morgan Alley	0.386	0.043	1.410
012	Fourth Avenue	0.007	0.000	2.300
013	Fifth Avenue	3.534	1.263	4.000
014	Sixth Avenue	0.985	0.487	0.000
015	Seventh Avenue	0.801	0.388	4.560
017	Ninth Street	1.206	0.607	0.000
018	Ninth Street	4.086	0.564	5.510
019	Yough Alley	0.000	0.000	0.000
020	Eleventh Avenue	0.144	0.194	0.000
021	Twelfth Avenue	4.567	1.535	5.240
022	Thirteenth Avenue	0.000	0.000	0.000
023	Twenty-Eight Avenue	13.997	8.231	17.840
024	Eden Park Boulevard	22.868	20.165	30.380
025	Walnut Street	1.951	0.483	2.780
026	Walnut Street	1.509	0.489	12.05
027	Huey Street	1.013	0.207	1.890
028	Martin Street	3.582	0.653	19.150
029	Center Street	0.830	0.053	0.560
030	Evans Avenue	8.903	5.930	18.420
031	White Street	19.033	8.176	20.150
032	Cliff Street	17.521	6.389	58.310
033	Cliff Street	2.321	1.466	7.140
TOTAL OVERFLOW [MG]		**125.213**	**78.537**	**277.48**
WWTP WET WEATHER FLOW		**1,023.300**	**1,209.300**	**2173.5**

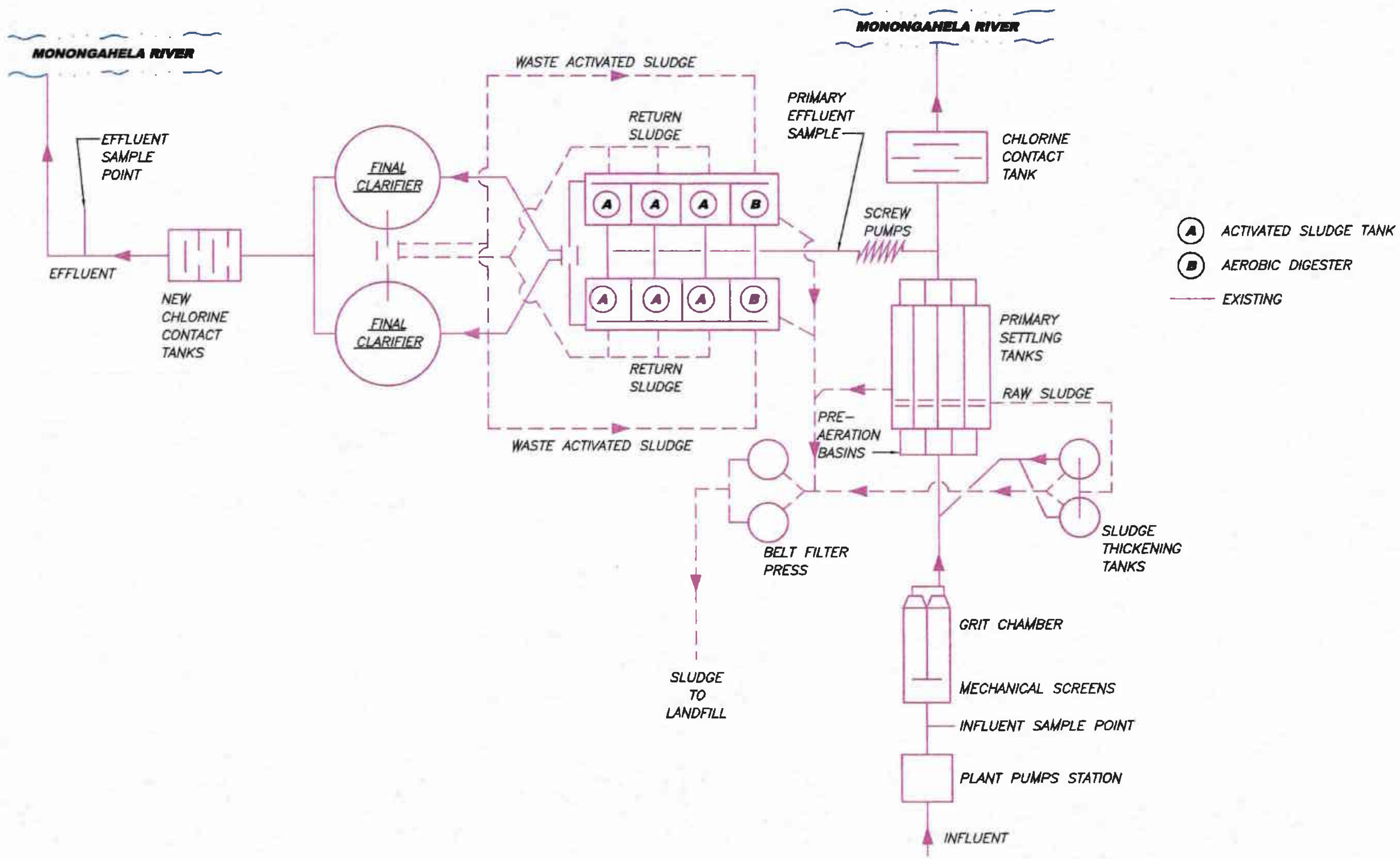
As shown, the annual percentage of system volume captured for treatment during precipitation events for both of these years is over 89%. This is above the minimum percentage capture of 85% that is required under the presumption approach. Along with the minimum percentage of capture, the CSO Control Policy defines the minimum level of treatment for this captured sewage as follows:

- *Primary clarification; removal of floatable and settable solids may be achieved by any combination of treatment technologies or methods that are shown to be equivalent to primary clarification;*

- *Solids and floatables disposal; and*
- *Disinfection of effluent, if necessary to meet WQS, protect designated uses and protect human health, including removal of harmful disinfection chemical residuals, where necessary.*

A WWTP Flow Diagram is provided on the following page. The diagram illustrates all combined sewage, which is captured and conveyed to the WWTP, receives primary and secondary treatment, and disinfection.

Based upon the percentage of capture of the CSS and the treatment provided at the WWTP, the Municipal Authority of the City of McKeesport CSS can be characterized as currently meeting the presumption approach criteria for attainment of WQS, in accordance with the CSO Control Policy.



Date	Revisions	Date	Revisions

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MUNICIPAL AUTHORITY OF THE CITY OF MCKEESPORT
ALLEGHENY COUNTY, PENNSYLVANIA
LONG TERM CONTROL PLAN - PLANT FLOW DIAGRAM
THE MCKEESPORT WASTEWATER TREATMENT PLANT

Scale: As Shown
Date: DEC. 2007
Drawn By: WBM
Checked By: SHG
Approved By: SHG

Sheet No.

Drawing No.

3 PUBLIC PARTICIPATION

Because the Authority's CSS collects, conveys, and treats combined sewage from within the City of McKeesport, and several adjacent communities, the operation of such a system requires continuous consultation with public representatives from the City of McKeesport and neighboring communities. A broad public campaign has accompanied all actions related to the preparation of the LTCP. Details of the proposed CSS upgrade were defined through numerous meetings with representatives from each of the tributary communities.

Opportunities for public involvement have also been important in the ongoing development of various CSO control measures of which the LTCP is a part. Due to the significant costs associated with such system improvements, the impact on system rates must be considered. A summary of the LTCP was submitted to the public representatives for review and comment to keep them included in the decision-making process.

A public hearing on the LTCP was held on August 3, 2000. Since then, the Authority has implemented various programs in order to explain the current operation and future needs of the combined sewer system to the broader public. The focus of the Authority's effort is on the effects of the CSO's on designated sensitive areas. The ongoing implementation of the nine minimum controls, the public's awareness of the Authority's proposed capital improvement projects, its positive feedback to the Authority, and the implementation of the proposed system improvements will ensure that the main objectives of the CSO control policy will be implemented and the goals, set in the CSO documents, achieved.

In order to further inform the public, the Authority developed a website, www.mckeesport-macm.org. This web site was developed to help the Authority to introduce to the public the nature of the CSS, provide information on the Authority's ongoing activities and educate them about the simple measures that every citizen can take to contribute to the continuous efforts to improve the water quality of the receiving streams.

4 CONSIDERATION OF SENSITIVE AREAS

As stated in the CSO Control Policy, the EPA "expects a permitee's LTCP to give the highest priority to controlling overflows to sensitive areas". These "sensitive areas" have been designated under the CSO Control Policy as those which are " Outstanding National Resources Waters, National Marine Sanctuaries, waters with threatened or endangered species and their habitat, waters with primary contact recreation, public drinking water intakes or their designated protection areas, and shellfish beds". During overflow events, combined sewage has been discharged into the Youghiogheny and Monongahela Rivers, both of which are listed under Pennsylvania Code Title 25 - Chapter 93: Water Quality Standards as a warm water fishery (WWF). Long Run, which receives overflow discharge from the Eden Park Regulator, is listed as a trout stocking fishery (TSF). The major problem in the Long Run area is caused by the sanitary sewer overflow located at the Long Run Interceptor. During heavy storms, when flow into the Long Run Pumping Station exceeds its capacity the overflow is activated. The impact of these discharges is explained in the water quality analysis in this report. All proposed combined sewer system alternatives include improvements to the Long Run Pumping Station and the interceptor, which will significantly increase capacity. The recommended alternative proposes an expansion of the Long Run Pumping Station and the force main from 2.1 mgd to an estimated maximum flow of 8.5 mgd. Sanitary flow would be conveyed directly to the treatment plant without mixing with the combined sewer system. The sanitary sewer overflow events will be minimized which is expected to improve the water quality of Long Run and subsequently the Youghiogheny and Monongahela Rivers.

Another sensitive area that falls under the above designation is the intake of the Municipal Authority of Westmoreland County McKeesport Water Treatment Plant. This intake is located on the Youghiogheny River, downstream of the Eden Park Regulator and 28th Street Regulator. The plant has a continuous inflow monitoring program, which allows for an automatic response of the process operation to changes in the quality of water during overflow events. The plant operator stated that this is a routine procedure and no difficulties related to fecal coliform in water treatment have been reported in recent history. The river sampling conducted during the preparation of this report showed that during a wet weather event the fecal concentration in the Youghiogheny River increases especially along the east bank due to the occurrence of a SSO at the Long Run SSO structure and CSO at the 28th Street Regulator. The fecal concentration at the east bank of Youghiogheny River, Sampling Station YR 006, was 12,000/ #100 ml. This station is located downstream of the 28th Street regulator outfall. As stressed in the water quality analysis, due to the high volume of the Youghiogheny River during wet weather events (10,000 cfs to 20,000 cfs) it is expected that the fecal concentration decrease in a short period of time. The major contributor to the deterioration of water quality at this location is sanitary overflow at the Long Run Interceptor. It is prudent to expect that the proposed Long Run Interceptor's System upgrade will improve water quality at this "sensitive location".

In addition to this improvement, the separation of storm water lines at the 31st Street and 36th Street basins, located upstream of this area and constructed after the river quality sampling was conducted, will contribute to a decrease in the combined sewage flow during precipitation events, which will further reduce risk for any undesirable effects to the water supply source caused by these events.

Also, the proposed construction of the Long Run force main will not just convey sanitary flow from the adjacent communities directly to the WWTP, thus eliminating Long Run SSO, but will free significant capacity in the Upper Youghiogheny Interceptor allowing more flow at the 28th Street regulator to be conveyed to the interceptor. The current "350% average dry weather flow" regulator setting can be evaluated during the post construction compliance monitoring period. It is expected that all these measures combined would have a positive impact on the water quality in the sensitive areas.

A third area that can be designated as sensitive is The City of McKeesport McKees Point Marina, located on the lower Youghiogheny River near its confluence with the Monongahela River. This area is used for boating and other recreational purposes. Although the possibility of a discharge event during normal recreational usage is unlikely, the fact that the area would be designated even "minimally" sensitive requires that the Authority give a high priority to addressing the control of these CSO's. The CSO's that have the highest impact on this area are located along the Youghiogheny River from 5th to 12th Avenue. The 5th Avenue regulator outfall is located in close proximity to the marina. During overflow events a flag with a CSO warning is posted at sensitive locations. Currently the Authority provides the marina with a flagpole for raising the CSO flag in the event of a CSO. As a part of the Nine Minimum Control Implementations, signs have been posted near accessible outfalls, while information on CSO's and an educational pamphlet are posted at an appropriate location at the marina. Also, the Authority has developed a Standard Operating Procedure protocol for communication with sensitive areas during CSO events. Having established this permanent communication, upon assessment that a CSO event may occur within the Authority's system, this information will be immediately passed on to the marina and WTP. A copy of this SOP protocol is presented in Appendix K.

All three areas designated in this report as sensitive areas are affected in similar ways by the CSO's with outfalls on the east bank of Youghiogheny River and the Long Run SSO. The proposed improvements will have a positive impact on the overall water quality during wet weather events. A year long post construction compliance monitoring period will include water quality sampling at the same station and under the similar conditions conducted during the preparation of this report. The results of this analysis will help to draw conclusions about the impact of the completed CSS improvements at the water quality in the designated sensitive areas.

5 IMPLEMENTATION OF THE NINE MINIMUM CONTROLS

One of the simple but very important ways to meet the objectives of the CSO Control Policy is the continuous implementation of the nine minimum controls. The Authority has developed measures and undertaken multiple tasks in accordance with "Combined Sewer Overflows-Guidance for Nine Minimum Controls" (EPA, 1995). The following presents an overview of the authority's efforts to develop and implement various controls as described in the original May 1998 "CSO Implementation of the Nine Minimum Controls", and the subsequent submittals (February 1999, October 1999, March 2000, July 2002 and October 2002) developed through the document's review process.

NMC 1 – Proper Operation and Regular Maintenance Program

The intent of this control is to establish written procedures for CSO Operation and Maintenance (O&M) management activities throughout the entire collection system and to incorporate those procedures into a CSS O&M Program. The Authority has developed a CSO O&M Program with simple and instructive procedures for the routine and non-routine operation and maintenance of the CSS. The Program consists of various written standard operating procedures, organization charts, instructions and procedures related to planning, budgeting, training, equipment maintenance, record keeping and reporting. A copy of the Municipal Authority of the City of McKeesport CSS Operation and Maintenance Program is presented in Appendix L of this report.

Copies of the filed inspection and maintenance logs have been and will continue to be submitted to the DEP to document all conducted routine and non-routine activities.

NMC 2 – Maximum use of the Collection System for Storage

As the second minimum control, maximum use of the collection system, means making simple modifications to the CSS to maximize storage of weather flows until downstream treatment facilities can handle them. The Authority's staff continuously monitors and inspects the pump stations, interceptors and all the regulator structures. These inspections enable them to identify any physical deficiencies that restrict the use of the system's available storage capacity. As reported in earlier submittals, the Authority conducts joint inspections and cleaning of the collection system. The City of McKeesport, who owns, operates, and maintains the collection system, has committed to developing the collection system map, which will include descriptions and locations of catch basin structures. The Authority utilizes a Vac-Truck for cleaning while the Public Works Department of the City of McKeesport provides the inspection crew as available. All inspections, findings and corrective measures, if needed, are being documented on the inspection log sheets. A copy of the letter from the City of McKeesport describing the planned activities is presented in Appendix M.

As a part of the anticipated Phase I of the Corp of Engineers (COE) project, the Authority has replaced regulators and outfall pipes to accommodate for a new pool elevation and adequate protection from river intrusion. This work included the installation of Tideflex type gates at the majority of the outfalls. Appendix N is comprised of as-constructed record drawings of the Phase I COE project.

Phase II of this project consists of the replacement of the existing outfall pipes along the Lower Monongahela Interceptor. The design of Phase II is complete. Appendix O is comprised of construction drawings for the Phase II COE project. It is anticipated that this project will be constructed in 2007 – 2008.

Another simple control option is the adjustment of regulator settings and the raising of the overflow weirs in order to develop higher storage levels. The current settings at the regulators allow for capturing and conveying to the WWTP a minimum of 350% of average dry weather flow. Some of the regulators that accept flow from a relatively large area with very little average dry weather flow are set to capture and convey flow in excess of 350% average dry weather flow. This pertains in particular to regulators along the Lower Youghiogheny Interceptor: 5th Street, 6th Street, 7th Street, and 11th Street. The current settings of the regulators allow that much more than 350% of average dry weather flow is captured and if the conveyance system allows conveyed to the WWTP.

A summary of the regulators' current settings is presented in Appendix F. A comparison between the calculated Hydraulic Grade Line (HGL) for these flows and the basement elevations of the adjacent buildings is presented in Appendix I. After the construction of the proposed facilities, and during the post-construction monitoring compliance period the Authority will analyze the regulators' current settings and their performance and adjust the settings to allow for utilizing the maximum capacity of the collection system upstream of the regulator.

NMC 3 – Review and Modification of Pretreatment Programs

The activities related to this control were explained in the original NMC submittal (May 1998). This Plan is provided as Appendix B. In summary, based on the established discharge limits and sampling results, the non-domestic discharges are in compliance with the existing pretreatment program. The Authority was last issued an NPDES Permit on August 7, 2002, which required a reevaluation of its local limits within one year of permit issuance.

NMC 4 – Maximization of Flow to the POTW for Treatment

The intent of this control is to implement practices, procedures and minor modifications to the CSS and wastewater treatment plant to enable as much wet weather flow as possible to reach the treatment facilities for proper treatment. This control has been discussed at great length in the original NMC and subsequent updates.

The Authority, with all the measures undertaken in the past, has met the objective by developing a wet weather strategy that has been in practice for several years. As described in the Authority's CSS Operation and Maintenance Program, provided as Appendix L, the treatment of flows up to 20 mgd that has been in place for a last couple of years.

The system-wide improvements as proposed in Section 7, Evaluation of Alternatives, will more than double the flow to the WWTP. The impact of these improvements will be monitored during the post-construction monitoring compliance period, analyzed and reported in a post-construction monitoring compliance report.

NMC 5 – Elimination of CSO's During Dry Weather

This measure's intent in accordance with the "Guidance for Nine Minimum Controls" is to closely monitor overflows and implement all measures necessary to ensure that there are no CSO's occurring during dry weather periods. In accordance with the CSS O&M Program, the Authority's staff conducts scheduled and non-scheduled inspections of all CSS facilities. All the inspections and the subsequent maintenance work are documented and will be reported to the Department annually.

The Municipal Authority of the City of McKeesport has constructed a submersible pumping station at Perry Street, which replaced the 75 gallons per minute (gpm) pneumatic ejector station. The ejector station is located downstream of the Perry Street CSO regulator conveying sanitary flow and a portion of storm runoff from the adjacent regulator drainage area. In the past, due to pneumatic ejector malfunctions, dry weather overflows were a regular occurrence. Since the submersible pump station and generator were constructed dry weather overflows through the Perry Street regulator have been eliminated.

The Authority has also installed a stand-by power generator at the Cliff Street Pump Station. Failures of this pump station caused by a loss of power in the past have resulted in dry weather overflows at the adjacent Cliff Street Regulators. Since the generator was installed dry weather overflows through the adjacent Cliff Street regulators have been eliminated.

NMC 6 – Controls of Solids and Floatable Materials

The intent of this measure is to reduce solids and floatables using relatively simple methods. The Authority is planning to install these controls in all the regulators. Due to delay in the US COE project's implementation, and the uncertainty surrounding the project status, the Authority opted to install the controls in these regulators regardless of the implementation schedule. The installation of the bar screens and baffles have been completed. These controls present a permanent solution for those regulators that will not be replaced during Phase I or Phase II of the USCOE Project, while the newly constructed regulator chambers contain a new, slightly different type of design. The design drawings for the installed screening and floating controls, along with photos of the installed screens, and a set of design drawings of the structures as for Phase I and Phase II of the COE project are presented in Appendices N and O, respectively.

The procedures for the routine and non-routine inspection of these structures including the collection system's catch basins and sewers flushing in cooperation with the City of McKeesport is presented in the CSS O&M Program.

NMC 7 – Pollution Prevention Program

The objective of this control is to reduce to the greatest extent possible the amount of contaminants that may enter the sewer system. Having this objective in mind, the Authority in recent years has initiated closer cooperation with all the communities, including the City of McKeesport, which contribute to the flow that has been conveyed to the plant. An effort has been made, and formal contacts have been established with various formal and non-formal groups throughout these communities. An example of such activities is the Authority's cooperation with "McKeesport Collaborative", one of the formal citizen's groups with important influence in the community. The DEP has been informed of the success of the information brochure that was printed and distributed throughout the community. This brochure explains the nature of a combined sewer system and combined sewer outflow, identifies various preventive measures that could be taken by all members of the community including local litter campaigns. This information is permanently posted on the Authority's web site. Samples of the brochure and the letter from the McKeesport Cooperative are provided in Appendix P.

The City of McKeesport has developed a schedule for the effective street sweeping operations. A copy of the City's letter regarding the street sweeping schedule and other activities related to this control are also included in Appendix P.

The City of McKeesport also purchased and installed twenty five 55-gallon drums to use as trash receptacles at the locations where the public may congregate.

Also included in Appendix P are photographs showing the characteristic markings on the catch basins to inform residents that sewers are inappropriate waste disposal sites.

NMC 8 – Public Notification of Overflow Occurrences and their Impacts

The public should be notified of CSO occurrences and CSO impacts as they may cause harm, particularly in the sensitive areas. The Authority on a demand from the Allegheny County Health Department in the event of a potential wet weather event, displays a CSO flag at three locations: the WWPT, McKees Point Marina, and the Boat Club along the Monongahela River. The photographs enclosed with Appendix P show a displayed CSO flag. Also the Authority has installed signs and information on the outfall structures, which should alert the public of a potential health impact of CSO discharges. A copy of the characteristic sign is enclosed in Appendix P.

The Authority continuously reaches out to the surrounding communities in order to provide valuable information of the CSS system. The Authority is developing a children's education program that will inform school students and children about the environmental impact of CSO's, the nature of wastewater treatment, and explain the importance of the implementation of these controls. Most of the information on the operation of the Authority's CSS can be found on the Authority web site: www.mckeesport-macm.org. This web site is regularly updated with information on the status of the Authority's system, activities and any useful information to the public.

NMC 9 – Monitoring to Characterize CSO Impacts and the Efficacy of Controls

This control involves visual inspection or other simple methods to determine the occurrence and apparent impact of a CSO. The Authority has developed a broad flow monitoring program and installed area-velocity flow meters on all outfall structures. The installation, data collection and analysis is conducted by an experienced outside contractor. The data is summarized and submitted to the DEP in the Annual CSO Reports.

6 MAXIMIZING TREATMENT AT THE EXISTING WWTP

The CSO Control Policy encourages municipalities to consider the use of the Publicly Owned Treatment Works (POTW's) capacity for CSO control as part of the LTCP. The Authority continuously undertakes actions to improve the operation of all aspects of its CSS.

6.1 GENERAL

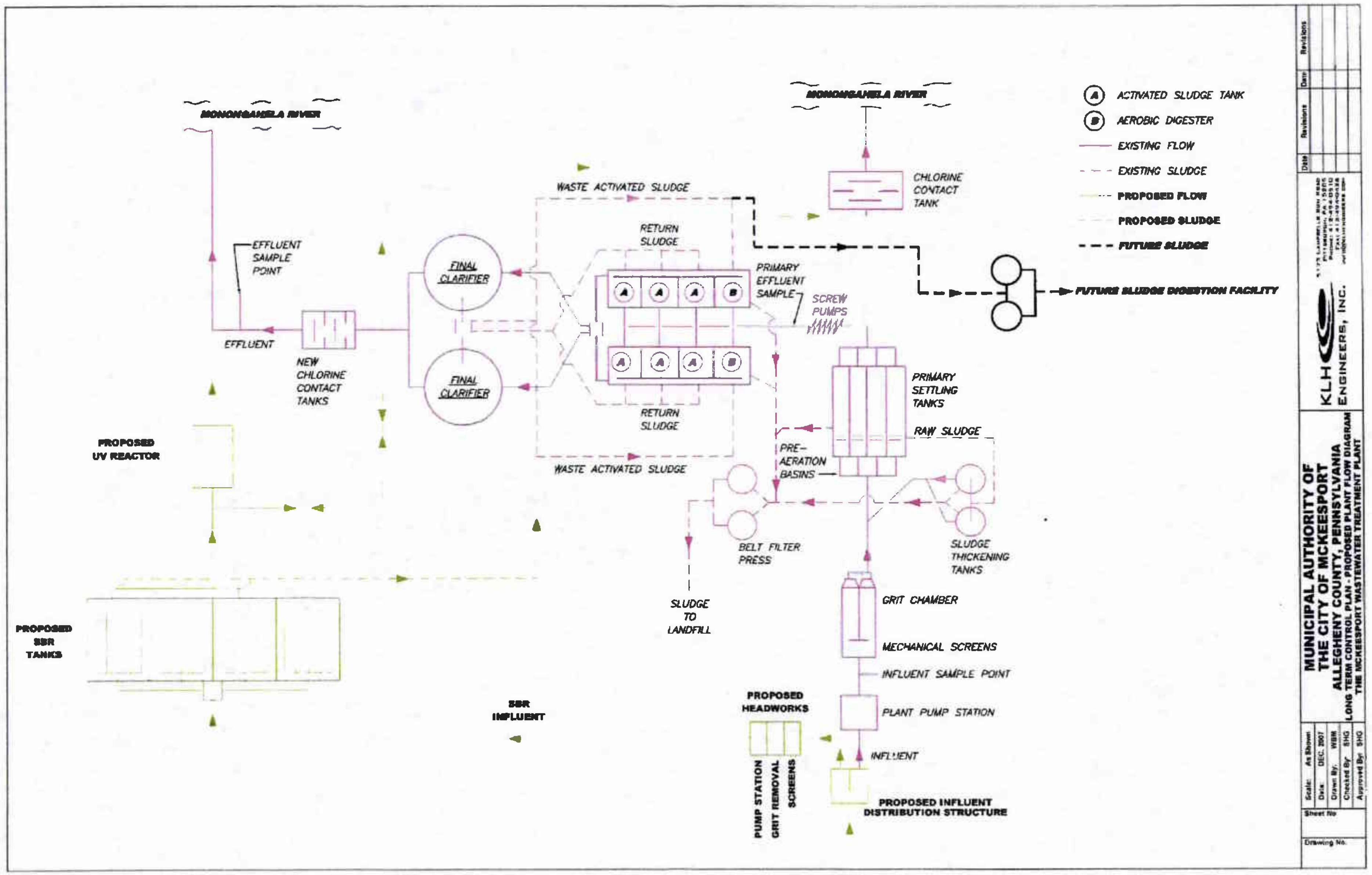
The Wastewater Treatment Plant (WWTP) for the Municipal Authority of the City of McKeesport was originally designed to provide 50 % removal of Biochemical Oxygen Demand (BOD). In 1977 the WWTP was expanded to provide a secondary treatment, which consisted of conventional activated sludge. The following drawing shows the current Plant Flow Diagram. The expanded WWTP was designed to remove 85% of the BOD, 90% of the suspended solids, and 99% of the settable solids at influent concentrations of 203 mg/l, 247 mg/l, and 7.8 ml/l, respectively. The plant design average flow is 11.5 MGD based on the present population and projected population growth for the service area.

6.2 DESCRIPTION OF EXISTING FACILITY

The Monongahela and Youghiogheny Interceptors join at the junction manhole located at the influent to the WWTP. A 54" sluice gate controls the flow of wastewater into the WWTP. The 54" gate can be regulated manually through the use of a power unit and gear reduction. Based upon implementation of the recommendations in previous CSO studies, the wet weather flow into the WWTP provided secondary treatment has been increased to 20 MGD.

6.2.1 Raw Sewage Pumps

Raw sewage enters the WWTP pump station wet well. The sewage is pumped by four variable speed 2500 to 5000 GPM pumps. The combined capacity of the four (4) raw sewage pumps is 29 MGD. The reason for the increased pump station flow capacity is to provide the ability to pump the selected maximum flow (20 MGD) with only three (3) of the four (4) pumps operating; the fourth pump acting as a standby unit. The pumps discharge to the Screen and Grit Building via a 30-inch cast iron force main. At a pumping rate of 20 MGD (three pumps operating) the water level in the flume preceding the screens is to the top of the channel. The addition of the fourth pump floods the grit/screen room floor.


MONONGAHELA RIVER
MONONGAHELA RIVER
ACTIVATED SLUDGE TANK
AEROBIC DIGESTER
EXISTING FLOW
EXISTING SLUDGE
PROPOSED FLOW
PROPOSED SLUDGE
FUTURE SLUDGE
WASTE ACTIVATED SLUDGE
CHLORINE CONTACT TANK
RETURN SLUDGE
EFFLUENT SAMPLE POINT
FINAL CLARIFIER
PRIMARY EFFLUENT SAMPLE
SCREW PUMPS
FUTURE SLUDGE DIGESTION FACILITY
EFFLUENT
NEW CHLORINE CONTACT TANKS
FINAL CLARIFIER
PRIMARY SETTLING TANKS
RETURN SLUDGE
RAW SLUDGE
PROPOSED UV REACTOR
PRE-AERATION BASINS
WASTE ACTIVATED SLUDGE
BELT FILTER PRESS
SLUDGE THICKENING TANKS
SLUDGE TO LANDFILL
GRIT CHAMBER
PROPOSED SBR TANKS
MECHANICAL SCREENS
INFLUENT SAMPLE POINT
SBR INFLUENT
PROPOSED HEADWORKS
PLANT PUMP STATION
INFLUENT
PUMP STATION
GRIT REMOVAL
SCREENS
PROPOSED INFLUENT DISTRIBUTION STRUCTURE
Revisions
Date
KLH ENGINEERS, INC.
MUNICIPAL AUTHORITY OF THE CITY OF MCKEESPORT
ALLEGHENY COUNTY, PENNSYLVANIA
LONG TERM CONTROL PLAN - PROPOSED PLANT FLOW DIAGRAM
THE MCKEESPORT WASTEWATER TREATMENT PLANT
Scale: As Shown
Date: DEC. 2007
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Approved By: SHG
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6.2.2 Pretreatment

The grit chambers at the McKeesport plant are of the horizontal flow type. The chambers are mechanically cleaned. The equipment was recently replaced to improve reliability. The velocity of flow through the chambers is controlled by proportional weirs at the end of each chamber. Daily production of grit during dry weather is 1/8 to 1/2 barrel. Wet weather results in grit production increasing to 12 barrels or more. After grit removal, the sewage then flows to two (2) mechanical flash mixers. Previously Lime and Ferric Chloride are added to the flash mixers. However this practice has been discontinued. Wastewater flows to four (4) diffused air flocculation basins where the sewage is slowly mixed for approximately 37 minutes at the design flow of 11.5 MGD.

6.2.3 Flocculation-Preaeration

Generally, detention times in the aerated flocculation tanks range from 20 to 30 minutes while preaeration requires a detention time of 10 to 45 minutes. Air requirements for preaeration ranges from 0.1 to 0.4 cubic feet per gallon of sewage while air requirements for flocculation range from 0.08 to 0.15 cubic feet per gallon of sewage. The flocculation-preaeration tanks at McKeesport have a detention time of 37.5 minutes and air supply of 0.26 cubic feet per gallon of waste both at the design average flow of 11.5 MGD. In accordance with the DEP's "Domestic Wastewater Facilities Manual" the detention period for flocculation should never be less than 20 minutes at the peak hourly flow. Applying to the geometry of the existing flocculator basins, the wet weather maximum peak flow is 21.6 mgd.

6.2.4 Primary Clarifiers

The wastewater settles in four (4) rectangular primary clarifiers with a detention time of two (2) hours at the design flow. The equipment, weirs and launders were recently replaced to improve reliability. The surface is skimmed and the settled solids moved to a hopper using a system of flights and chains. Only two or three of the four primary clarifiers are operated during the summer due to low flows. If the temperature is extreme - say 90° F - only two settling tanks are utilized. With an intense rainfall one additional primary clarifiers is placed into operation.

After a prolonged dry spell a rapid and significant rainfall results in the primary clarifiers turning black as the interceptor system is flushed clean. The primary clarifiers will stay black for several days. To remove and/or treat the black septic flow, the primary tanks are drained to the influent of the WWTP and hosed from the top after the storm event. The tanks will not self clean with the introduction of clean raw wastewater. Therefore, the primary tanks must be drained. If a tank is in operation for more than a day for a storm event, the tank must be hosed from within due to the accumulation of debris.

An example of the primary tank operation is three tanks are operating. A high flow after a prolonged dry spell results in the tanks turning black. Tank #4 is placed into operation while Tank #1 is shut off and the sludge is pumped from the tank. The tank is then drained to the WWTP influent. The same procedure is used for tank #2 while tank #1 remains shut off in order to not recontaminate that tank. The same is done for primary tank #3.

The maximum hourly (wet weather) peak flow is determined in accordance with the requirements for surface overflow rates for primary clarifiers. A total surface area of the existing four primary tanks is 10,192 sqf, which based on the required standard of 2,500 gpd/sqf, yields the hourly maximum peak flow of 25.5 mgd for all four tanks, or 19.1 mgd when one unit is out of service.

It is obvious from the above presented data that the Authority already utilizes all primary units to their maximum capacity.

6.2.5 Screw Pumps

The Authority recently, as part of their maximization of WWTP wet weather flow strategy program, replaced all three screw pumps. Each screw pump was provided with a variable speed drive. This allowed the operational staff to maximize flow to the secondary treatment unit. The original screw pumps had not variable speed capacity and the operation of two pumps produced too large of flows and impacted the secondary treatment system.

Three (3) screw pumps each with a reported capacity of 9 MGD lift wastewater from the primary effluent channel to the activated sludge tanks. Unless a second screw pump is started the wet weather flow begins to bypass over a weir gate to the abandoned chlorine contact tank at 10 MGD. The standard wet weather operating practice is to operate the second screw pump and provide secondary treatment to 20 MGD.

6.2.6 Secondary Treatment

The activated sludge process can give various degrees of treatment depending on the modification of the process being used. The treatment process used at McKeesport is designed for the following removal efficiencies:

BOD	-	85%
Suspended Solids	-	90%
Settleable Solids	-	99%

These design efficiencies are for the entire treatment system. The removal efficiencies just through the secondaries are somewhat less. The removal efficiencies through the secondaries, alone, should approximate the following:

BOD	-	78%
Suspended Solids	-	80%
Settleable Solids	-	99%

The mixed liquor continuously overflows the aeration tank weirs and flows in two (2) circular final clarifiers having a detention time of 4.2 hours at design flow where the solids portion settles to the bottom. The clear supernatant overflows the clarifier weirs and flows to chlorination and discharge. The solids which concentrate on the bottom of the clarifiers are returned by pumps to the aeration tanks.

This sludge is called return activated sludge (RAS). Excess sludge, which is accumulated in the system, is wasted to the sludge handling units by the waste sludge pumps. This wasted sludge is referred to as waste activated sludge (WAS) and is handled along with the raw sludge produced in the primary units.

6.2.7 Return Sludge Pumps and Wetwell

Three (3) horizontal, centrifugal, non-clog return sludge pumps are provided to pump return activated sludge to the aeration tanks. These pumps are each controlled by a variable frequency drive (VFD) which can vary the pump capacity from 2000 gpm (575 rpm) to 4000 gpm (690 rpm) at 26 feet TDH. The VFD is normally automatically controlled and is based on the aeration tanks influent flow. Return sludge is conveyed from the final clarifier to a RAS wet well, which is constructed integral with the Blower Building basement. As part of the Authority's maximization of WWTP wet weather flow strategy program, the instrument control system was replaced and upgraded in 1999. The system allows the operators to control and measure the primary clarifier effluent flow to each aeration tank. Operators can adjust flow by use of controls conveniently located in the aeration tank pipe tunnel. RAS volumes and flow rates can be automatically proportioned based on the influent flow rate.

6.2.8 Process Aeration System

The aeration system provides the active biomass with oxygen.

1. Blowers - Three (3) process air blowers are provided. Each is capable of compressing 4000 ICFM of air to a discharge pressure of 8.0 PSIG when operating at an elevation of 740 and 100EF air temperature.

2. As part of the Authority's maximization of WWTP wet weather flow strategy program, the original turbine aerators were replaced with a fine bubble diffusion system. Fine bubble aeration was installed in four of the eight aeration tanks. Aeration tanks No. 1, 2, 5 and 6 have fine bubble diffusion. The remaining tanks, two of which are utilized as aerobic digesters, retain the original turbine aerators. The installation has increased the efficiency of the introduction of oxygen into the wastewater.

6.2.9 Channel Aeration System

A channel aeration system is provided to supply air to the mixed liquor troughs and channels. This air provided agitation to keep solids in suspension as the mixed liquor flows toward the final clarifiers. The channel aeration system also supplies air to the RAS wetwell to prevent settlement and to help keep the sludge fresh.

Blowers - Two (2) channel air blowers are provided. Each blower is capable of compressing 1125 ICFM of air to a discharge pressure of 2.25 PSIG when operated at an elevation of 740 and air temperature of 100EF. The blowers are controlled either manually or by the computer.

6.2.10 Activated Sludge Modifications

Each of these modifications is briefly discussed as follows;

1. Conventional Activated Sludge with Plug Flow - The McKeesport plant can be operated with a flow regime that approaches plug flow. Rather than operate the plant's secondary process as eight (8) separate completely mixed reactors, as is normally done, the plant's secondary process can be operated as two (2) compartmented aeration tanks. By setting the proper gate and valve positions, half of the plant flow can be divert into Tank #4 to flow through Tanks #3, 2 and 1 before going to Clarifier #1. The other half of the flow can be diverted to Tank #8 to flow through Tanks #7, 6, and 5 before going to Clarifier #2. The return sludge is split into two portions; one-half being returned to Tank #4 and the other half being returned to Tank #8. Process air is divided equally among all eight (8) aeration tanks.

2. Tapered Aeration - The idea behind the tapered aeration modification is to add more air at the head end of the plant, where the settled sewage and return sludge first come together, and less air as the flow proceeds through each successive tank. One advantage of the tapered aeration modification is that it conserves on air and may reduce operating costs over conventional treatment.

3. Step Aeration - In the step aeration modification, settled sewage is introduced at each tank along the length of the bank of aeration tanks. Again, the flow regime approaches plug flow with the mixed liquor proceeding through each tank in the bank of tanks before going to the final clarifiers. The objective of this treatment scheme is to even out the oxygen demand along the length of each bank of aeration tanks. An equal quantity of air is introduced into each aeration tank, with the oxygen demanding settled sewage being spread out to more efficiently use the oxygen. The entire flow of return sludge is introduced into aeration tanks number four and number eight. In some cases, aeration tanks number four and number eight may receive no settled sewage, in which case they provide for sludge reaeration.

4. Contact Stabilization - The Contact-Stabilization modification of the activated sludge process is based on the theory that organic removal proceeds in two steps. It is felt that in the first step the dissolved organics and the colloidal and other suspended particles are absorbed by the activated sludge. In the second step, the organics are oxidized and assimilated by the sludge. The first step proceeds rapidly, requiring " 30 minutes while the second step proceeds more slowly, requiring 3 to 6 hours. In implementing the Contact-Stabilization modification at McKeesport, the aeration tanks are divided into three groups; four (4) tanks for stabilization, two (2) tanks for contact, and two (2) tanks for aerobic digestion.

In the modifications discussed above, some of the advantages may include: increased loading capabilities, better utilization of air, and resistance to shock loading. If the Authority were capable of processing more than 20 MGD (the headworks, primary units and the secondary clarifiers limit the flow), the aeration tank solids may be lost. Contact stabilization or step aeration may be able to save these solids. These modifications may be implemented at McKeesport if the operator sees any of these advantages over the normal method of operation.

The problem with the operation of the biological treatments system is the wide range in flows – 6.8 MGD for weeks with rapid increases to 20 MGD. To accommodate these low flow periods the Authority should consider several process modifications.

- Remove a primary clarifier from operation to avoid long detention times and resultant odors
- Operate only three (3) of the six (6) aeration tanks

The activated sludge system is a process subject to degradation treating high flows. The high flows will impact the process in one or more of the following manners.

- Wash out solids and overload the final clarifiers
- Wash out solids causing a shift in the food: microorganism ratio
- Dilute the wastewater pollution loadings over a sustained period causing a shift in food: microorganism ratio and the oxygen uptake.
- Reduce hydraulic detention times
- Shift the wastewater temperature causing changes in the rate of assimilation of organic pollutants and causing density currents in the final clarifiers.

The logistics of placing empty non-operating aeration tanks into service on wet weather flows and balancing the MLSS loading is not practical. It is impossible to maintain a viable inventory of MLSS in the new tanks in such a short fill time. Even if the inventory were available and could be introduced evenly the microorganisms could not acclimate themselves to produce a good effluent in the limited time frame a storm event would occur.

The opposite would occur after the passing of the storm event. Leaving too many aeration tanks in service without a solids inventory adjustment would result in the following problems.

- Shift in food: microorganism ratio with resultant increase in SRT possibly causing foam formation on the final clarifiers
- Utilization of excessive energy resulting from too many tanks operating and non-essential nitrification
- Overloading the headworks as the aeration tanks are drained
- Stressing the solids handling facility as the excess solids pass through the system

To eliminate these operating problems the Authority has developed the following wet weather flow strategy. The strategy has been in practice for several months and has produced effluents meeting NPDES permit standards. As flows approach 14 MGD the screw pump speeds are increased to pump the increasing flows to the aeration system. As the screw pump has the characteristic of pumping more flow as the influent well water level increases the screw pumps do not need constant operational attendance.

One or possibly two of the influent gates to empty aeration/aerobic digester tanks are opened. The primary effluent is allowed to fill the tanks. Each tank has a volume of 343,000 gallons. With a flow rate of 20 MGD (13,889 GPM) it will take 25 minutes to fill each tank. This tends to minimize the surge of an intense short duration summer storm. Once the tank(s) are full the primary effluent exits through the effluent opening and contacts the MLSS exiting the operational activated sludge aeration tanks. Although no testing has been done it is thought some absorption of BOD does occur during the short contact time in the MLSS channel between the aeration channels and the final clarifiers.

Upon subsidence of a wet weather flow (flow decreases below 15 MGD) the wet weather tanks are removed from service and drained back to the wet well.

6.2.11 Chlorination System

After settling, the effluent is chlorinated and flows to a dual compartment chlorine contact chamber having a detention time of 15 minutes at a peak rate of pumping through the plant. The major components of the chlorination system are;

1. Chlorinators - Two (2) vacuum-feed chlorinators are provided to feed chlorine, at a set rate, to each of a number of points in the treatment system. The chlorinators are manually paced based on measured total residual chlorine. The capacity of each chlorinator is 500 pounds of chlorine per day. At the design flow of 11.5 MGD, the capacity of the chlorinators enables the operator to vary the chlorine concentration (before the chlorine demand is exerted) from 0.8 mg/l to 8.3 mg/l. The Chlorinators are fed by one (1) one-ton chlorine cylinders.

2. Chlorine Distributors - Flow Indicators - Six (6) chlorine distributor - flow indicators are provided to split and measure chlorine being added to various points in the system. The points to which chlorine solution flow is distributed are (corresponding to each distributor-meter);

    a. Manhole#1 (Head of Plant)
    b. Digesters and Old Contact Tank
    c. Preaeration - Flocculation Tanks
    d. Thickeners
    e. Chlorine Contact Tank
    f. RAS Wetwell and Final Clarifier Influent

3. Diffusers (optional)- Chlorine diffusers are provided at the terminal end of each chlorine line to mix the chlorine solution with the flow stream.

4. Contact Tanks - These tanks are located adjacent to the primary clarifier effluent and are not normally utilized. Each section of the original two-section chlorine contact tank, which may still be used in emergencies, is 30'-00" x 51'-4" x 6'-0" (SWD). Each section has a volume of 69,100 gallons (total of 138,200 gallons) and will provide a detention time of 15 minutes for 13.3 MGD of flow. This tank may be used when the secondary process must be by-passed. When the chlorine contact tanks are utilized in this manner chlorine is applied manually and the TSS level being discharged to the river is approximately 50 mg/l.

5. The original chlorine tank has a separate outfall to the river. The Authority is proposing to reactivate this outfall. In the event of its activation it will be sampled and tested. The quality of the combined outfall will be mathematically calculated.

6. New Contact Tank - The new chlorine contact tank is built in two (2) separate sections, each section being 51'-00" x 52'-00" x 8'-6" (SWD). The effective capacity of each section is 168,600 gallons for a total capacity of 337,200 gallons. At the design flow of 11.5 MGD, the detention time is 42 minutes. At 20 MGD the detention time is 24.3 minutes.

7. Miscellaneous Components - A scale with total capacity of 8000 pounds is supplied to maintain a record of chlorine use. A hoist and monorail system is provided to load, unload, and move the chlorine cylinders. A double solids strainer is provided on the process water line to the chlorinators.

6.2.12 Sludge Handling

Raw sludge and waste activated sludge can be added to two (2) sludge thickening tanks having a detention time of 0.4 days at a sludge flow of 0.54 mgd. The current practice is to pump all sludges to one of the aeration tanks which acts as an aerobic digester. The thickened sludge is dewatered by a 2.5 meter belt filter press after mixing with flocculating chemicals. The moisture content of the dewatered sludge is approximately 80%. The dewatered sludge is disposed of by landfilling. A second belt filter press is currently under design.

The sludge thickeners could be available in the future for use as disinfection tanks possibly in combination with a wet weather flow pumping station and a screening system.

7 EVALUATION OF ALTERNATIVES

The Authority's combined sewer system can be characterized as meeting the presumption approach criteria for the attainment of WQS in accordance with the CSO Control Policy. In addition to this, the study of the water quality of the receiving waters during dry and wet weather events demonstrated that the CSO's have no significant impact on rivers except for the fecal concentration. Also, the McKeesport CSS serves less than 75,000 persons, which is considered to be a "small community system". These facts will influence all future decisions about the extent of treatment of the combined sewage.

The Authority continues to make an effort to achieve water quality goals in each receiving water segment. The simple controls are already being conducted through the implementation of the "Nine Minimum Controls". The implementation of the additional control measures proposed in this report will further improve water quality beyond requirements set for the "small community system". Since the adjacent communities contribute to the total flow treated or overflowed in the range of 20%-40%, all of the future work will have to be coordinated with these communities. The Authority has submitted the proposed alternatives for the system-wide improvements to the DEP through the Act 537 process. The concepts and alternatives presented in this LTCP mirror those presented in the Act 537 Plan.

The alternatives discussed go beyond the treatment requirements already achieved in accordance with the requirements set in the demonstrative and presumption approach of the CSO Control Policy. These alternatives are explained in details in the CSS Capital Improvement Plan Executive Summary presented in Appendix Q. The alternatives focus on an overall reduction of the combined sewage entering the interceptors, reconstruction of the existing regulator structures, which reduce the total volume of sewage overflows, and increasing the capacity of the WWTP to allow for the treatment of flow in excess of the 20 MGD

7.1 SOURCE CONTROLS

7.1.1 Catch Basin Cleaning/Solid Waste Management/Street Sweeping

One of the first measures considered during the preparation of the LTCP is the "source controls". This affects the quantity and quality of runoff entering the collection system. Since the Authority does not own the collection system, it is difficult to evaluate the actions that could be undertaken before the runoff enters system. However the implementation of this control is defined through the implementation of various controls specified in "Implementation of the Nine Minimum Controls" section.

7.1.2 Roof Leader Disconnection

In urban parts of the City, with a little open, pervious space, roof leaders were commonly connected to the CSS. Again, "technically" these connections lead mostly into the collection system that is not owned by the Authority. The possibility of rerouting these lines will be researched as a part of the LTCP. Based upon the findings of this research, the Authority will propose adequate measures and report them in the Annual CSO Reports.

7.2 COLLECTION SYSTEM CONTROLS

Collection system controls and modifications affect CSO flows and loads. As stated in the CSO Control Policy "*This category of control measures can reduce CSO volume and frequency by removing or diverting runoff, maximizing the volume of flow stored in the collection system, or maximizing the capacity of the system to convey flow to a POTW…*".

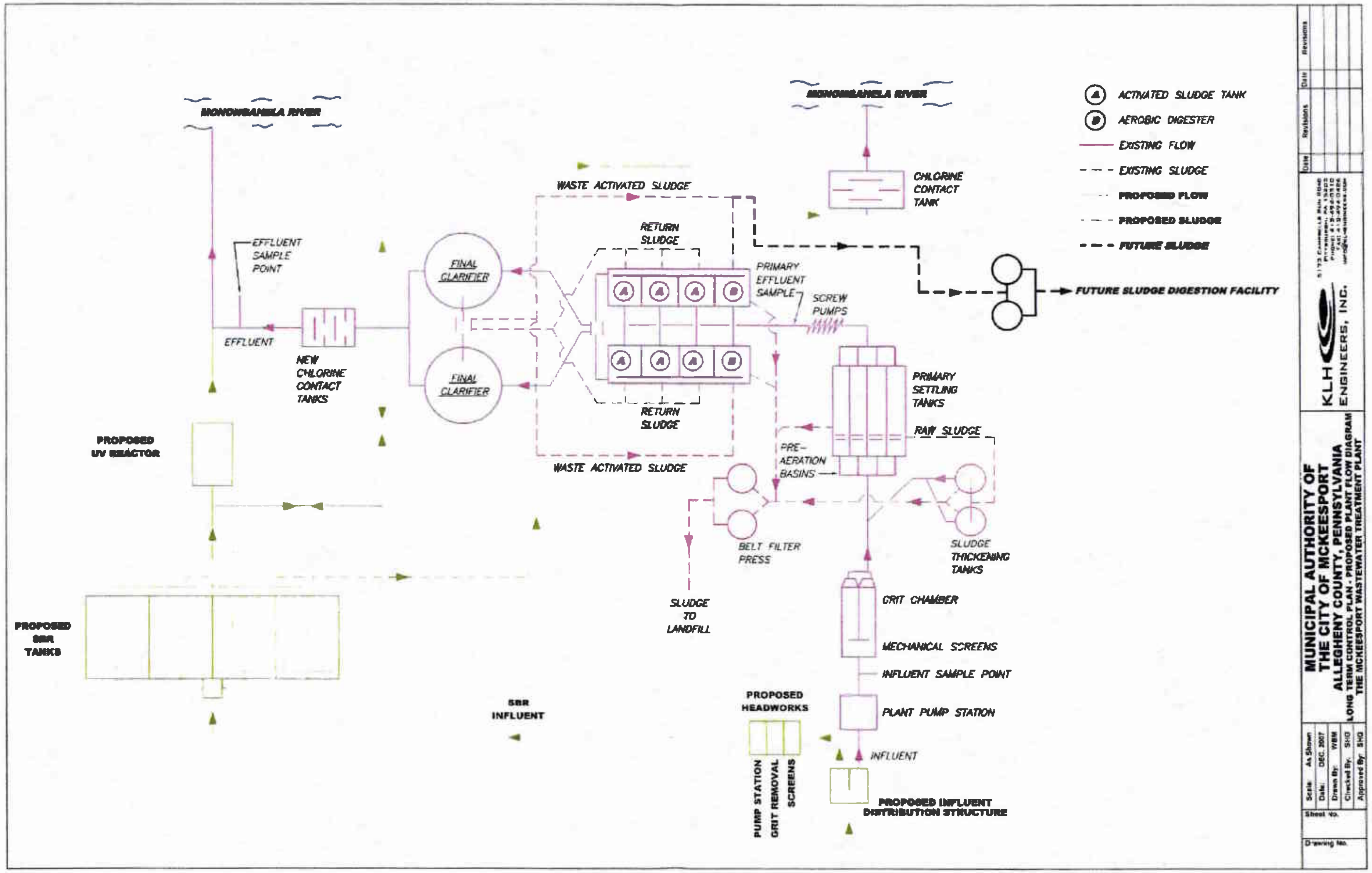
7.2.1 Sewer Separation

Since the original submittal of the LTCP in 2000, The Authority the Authority has completed separation of the storm sewer lines in the areas of the Upper Youghiogheny Interceptor and Long Run. This project has decreased total inflow from the Patterson Street Basin to the 28th street regulator and from the 36th Avenue Basin to the Eden Park Regulator.

7.2.2 MACM CSS Upgrade

The proposed CSS Upgrade concept proposes an expansion of the existing conveyance alignment and treatment facility. It involves the upgrade of the existing Long Run Pump Station with a new facility capable of delivering a maximum rate of 8.5 MGD through approximately 9,800 feet of a 24" new force main sewer that will be diverted under the Youghiogheny River to the newly constructed West Shore Pump Station which will also receive the flow from the West Shore communities (estimated peak 7.7 mgd). This flow, along with the combined flow from the Upper and Lower Monongahela interceptors, will be directed to a newly constructed headworks building at the WWTP where it would receive full treatment either through the existing process or new Sequential Batch Reactors (SBR's). The maximum expected peak flow at the WWTP would be approximately 42 mgd. The proposed WWTP flow diagram reflecting these upgrades is presented on the following pages.

Insert System Map of Upgrades


MONONGAHELA RIVER
MONONGAHELA RIVER
ACTIVATED SLUDGE TANK
AEROBIC DIGESTER
EXISTING FLOW
EXISTING SLUDGE
PROPOSED FLOW
PROPOSED SLUDGE
FUTURE SLUDGE
CHLORINE CONTACT TANK
WASTE ACTIVATED SLUDGE
RETURN SLUDGE
EFFLUENT SAMPLE POINT
FINAL CLARIFIER
FINAL CLARIFIER
PRIMARY EFFLUENT SAMPLE
SCREW PUMPS
FUTURE SLUDGE DIGESTION FACILITY
EFFLUENT
NEW CHLORINE CONTACT TANKS
RETURN SLUDGE
PRIMARY SETTLING TANKS
RAW SLUDGE
PROPOSED UV REACTOR
PRE-AERATION BASINS
WASTE ACTIVATED SLUDGE
BELT FILTER PRESS
SLUDGE THICKENING TANKS
SLUDGE TO LANDFILL
GRIT CHAMBER
PROPOSED SBR TANKS
MECHANICAL SCREENS
INFLUENT SAMPLE POINT
SBR INFLUENT
PROPOSED HEADWORKS
PLANT PUMP STATION
INFLUENT
PUMP STATION
GRIT REMOVAL
SCREENS
PROPOSED INFLUENT DISTRIBUTION STRUCTURE
Date
Revisions
Date
Revisions
KLH ENGINEERS, INC.
MUNICIPAL AUTHORITY OF THE CITY OF MCKEESPORT
ALLEGHENY COUNTY, PENNSYLVANIA
LONG TERM CONTROL PLAN - PROPOSED PLANT FLOW DIAGRAM
THE MCKEESPORT WASTEWATER TREATMENT PLANT
Scale: As Shown
Date: DEC. 2007
Drawn By: WBM
Checked By: SHG
Approved By: SHG
Sheet No.
Drawing No.

7.2.3 Infiltration/Inflow Control

Excessive infiltration and inflow can increase operation and maintenance costs and can consume a significant portion of the system's hydraulic capacity. The implementation of this control has been addressed through chemical grouting the Long Run Interceptor. Although exclusively a sanitary line, it contributes to the overload of the CSS and impairs downstream water quality of the receiving waters.

7.2.4 Regulating Devices

As a part of the anticipated Phase I of the Corp of Engineers (COE) project, the Authority has replaced regulators and outfall pipes to accommodate for a new pool elevation and adequate protection from river intrusion. This work included the installation of Tideflex type gates at the majority of the outfalls. Appendix N is comprised of as-constructed record drawings of the Phase I COE project.

In summary, the Phase I COE project included the following:

- All regulator structures have adjustable weirs in order to pass, at minimum, required 350% of an average dry weather flow.
- Prevent floatables from discharging to the river.
- Use of Tide-Flex backflow preventer valves either in the chamber or the outfall.
- User friendly for installation of samplers and flow meters

Phase II of this project consists of the replacement of the existing outfall pipes along the Lower Monongahela Interceptor. The design of Phase II is complete. Appendix O is comprised of construction drawings for the Phase II COE project. It is anticipated that this project will be constructed in 2007 – 2008.

8 IMPLEMENTATION SCHEDULE

Although the MACM has met the LTCP "presumption" approach, this Plan proposes implementation of the upgrades and improvements to the CSS and facilities. The Authority has submitted the proposed upgrade alternative for the system-wide improvements, including an implementation schedule to the DEP through the Act 537 process. The concepts and alternatives presented in this LTCP mirror those presented in the Act 537 Plan.

Since the MACM has met the LTCP "presumption" approach, no post construction monitoring plan and report are proposed.

The following table summarizes the proposed tasks and provides a general implementation schedule.

Activity	Target Date
MACM Authorizes KLH to begin Design of Facility Upgrades	March-07
Communities Begin System Assessments and I&I Reduction Program	March-07
KLH Completes Design Report for Facility Upgrades	June-07
KLH Submits Design of Facility Upgrades to DEP	June-08
New Service Agreements Adopted by Service Communities	July-08
DEP Issues Construction Permit for Facility Upgrades	September-08
MACM Advertises Facility Upgrade Projects for Receipt of Bids	October-08
MACM Awards Construction Contracts	December-08
Notice to Proceed Issued to Contractors	January-09
Construction of Facility Upgrades Complete and On-Line	December-10
Communities Complete System Assessments and I&I Reduction Program	August -12