Feasibility Study Working Group
Document 022 (completed)
Private Sector Inflow and Infiltration Source Reduction
by the
3RWW "Private Sector" / Lateral Subcommittee
Rev 8 - February 7, 2013
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1. Abstract/Objective

The intent of this document is to provide a resource with respect to programs, policies, techniques and potential effectiveness related to "private sector" (sewer lateral or building sewer) Infiltration/Inflow (I/I) flow source control for municipal entities considering initiating or expanding private lateral control programs as an element of a wet weather flow control program.

There is an increased awareness that significant I/I flow rate and volume originates in the "private sewer lateral" portion of separate sewer systems. Due in part to the cost of so-called "grey" alternatives, attention is or will be directed to this private lateral sources as a potential key factor in wet weather planning, implementation effectiveness and regional water quality objectives attainment.

2. Subcommittee Participants

- 3Rivers Wet Weather
- Butler Area Sewer Authority, Butler County Pennsylvania
- Fox Chapel Borough, Allegheny County Pennsylvania
- McCandless Township Sewer Authority, Allegheny County Pennsylvania
- Municipal Authority of the Township of South Fayette, Allegheny County Pennsylvania
- North Huntington Municipal Authority, Westmoreland County Pennsylvania
- Penn Township Sewer Authority, Westmoreland County Pennsylvania
- Peters Township Sanitary Authority, Washington County Pennsylvania
- Ross Township, Allegheny County Pennsylvania
- Unity Township Municipal Authority, Westmoreland County Pennsylvania
- Gateway Engineers
- Lennon, Smith Souleret Engineering Inc.

3. Document Outline

This document synopsizes existing programs being implemented by the Subcommittee participants and presents proposed measures recommended by them. For each of the existing programs, the following five broad categories are catalogued by this document and presented in Appendix A.

a. <u>Existing Program Description</u>
   i. What is the program?
   ii. Is it an area-wide program or real-estate transfer type program?

iii. How are improperly connected foundation drains identified/resolved?

b. Status of Existing Program
   i. What portion of the system has been completed?
c. Flow Reduction Effectiveness
   i. How effective has the program been in achieving its intent?
d. Resultant Considerations
   i. Have any unintended consequences/issues (i.e. street icing, backyard slides, wet basements) been identified?
e. Policies
   i. What Policies exist today?
   ii. What jurisdictional and/or legal issues were resolved or are outstanding?

4. Key Definitions

Certain key definitions, generalized testing program approaches and methodologies are necessary to be presented to facilitate understanding of the specific programs. These are presented as follows:

International Plumbing Code Definitions

- **Backwater Valve:** A device or valve installed in the Building Drain or sewer pipe where a sewer is subject to backflow, and which prevents drainage or waste from backing up into a low level or fixtures and causing a flooding condition (International Plumbing Code 2006)

- **Building Drain**: The lowest piping that collects the discharge from all other drainage piping inside the structure and extends 30 inches in developed length of pipe, beyond the exterior walls and conveys the drainage to the Building Sewer. (International Plumbing Code 2006)

- **Building Sewer:** That part of the drainage system that extends from the end of the Building Drain and conveys the discharge to a Public Sewer, private sewer, individual sewage disposal system or other point of disposal. (International Plumbing Code 2006)

- **Building Trap:** A device, fitting or assembly of fittings installed in the Building Drain to prevent circulation of air between the drainage system of the building and the Building Sewer. (International Plumbing Code 2006)

- **Cleanout:** An access opening in the drainage system utilized for the removal of obstructions. Types of cleanouts include a removable plug or cap, and a removable fixture or fixture trap. (International Plumbing Code 2006)

- **Public Main Line or Public Sewer:** A piping system used to collect sewage from the Building Sewers to transport sewage to treatment facilities, which is a common sewer directly controlled by a public authority. (International Plumbing Code 2006)

Miscellaneous Definitions

- **Building Sewer Lateral:** The pipe located between the Building Drain and the Building Sewer Tap Connection which shall be owned and maintained by the property owner. (pg 8, North Huntington Rules & Regulations)

- **Building Sewer Tap Connection:** The pipe, wyes, saddles, manholes & other appurtenances located between the Building Sewer Lateral and the Public Sewer and which shall be owned and maintained by the operating Public Sewer owner. (pg 8, North Huntington Rules & Regulations)

- **NASSCO:** National Association of Sewer Service Companies, setting industry standards for the assessment and rehabilitation of underground infrastructure.

- **Public Sewer:** A sewer owned and maintained by the Authority. (pg 8, North Huntington Rules & Regulations)

- **Parallel Sanitary Sewer System Approach:** An existing main line sanitary sewer, service laterals and manholes are converted into a neighborhood groundwater system to continue affirmative capture while a new secondary piping system is constructed in parallel to be utilized as a sanitary sewer. The new system consists of main line piping, service laterals and manholes. (3RWW, CEP User Guide)

5. Testing Programs

Testing programs fall under two headings: Existing Systems and Newly Constructed Systems. For the Existing systems there are two approaches, Area Wide Testing and Real-Estate Transfer Testing. For Newly constructed systems testing methodologies are the same however the distinction is in the timing of the testing.

Existing Systems

- Area Wide Testing Program

An Area Wide Testing Program is considered a proactive approach predicated on testing all laterals within a given geographic area, for instance sewershed or drainage area, of the municipality/authority service area. The Area Wide Testing program is considered proactive from the perspective that it is driven by the need to reduce I/I. The size and location of the area being tested is usually established by local knowledge of day to day operations, or specific testing aimed at identifying I/I "hotspots". For example target areas may be those that have exhibited basement backups, areas deemed excessively wet from flow isolation studies or, areas that have demonstrated significant peak flow response to precipitation events. It is generally understood that focused area-wide testing will likely have a greater impact on flow reduction that real-estate transfer testing which tends to be reactive (driven by home sales in lieu of targeted source flow reduction) and non-specific in nature. For an Area Wide program field testing may be implemented via third party vendors (i.e. engineering firms, Sewer Service companies etc.) or by Force Account (i.e. Operating Staff).

- Real-Estate Transfer Testing Program

A Real-Estate Transfer Testing Program is a longer term reactive program predicated on real-estate transfer/refinancing which triggers lateral testing. Under this approach local Ordinance requires at the time of a sale, refinancing, transfer or assignment of any interest in real estate property which is connected to public sewer systems, an inspection or testing of the lateral or potential sources of direct inflow. For Real-Estate testing programs field testing is usually completed by outside vendors (i.e. certified plumbers) or in some cases, by Force Account staff.

Newly Constructed Systems

All though the document is intended to be a document to be for testing of existing systems, the subcommittee thought it was prudent to include testing of new systems.

- Public Constructed Sanitary Sewer Line Extension – Building Sewer Testing Program

A Public Constructed Sanitary Sewer Line – Building Sewer Testing Program follows the construction of a new sanitary sewer main line by a public entity. Typically testing is done once the main line sewer is constructed. Usually the "public portion" of the service laterals has been installed and capped up to the public right-of-way line. The public service laterals are subject to the same field line acceptance tests as the public main line sewer which includes; Low pressure air testing, visual observation prior to backfilling, CCTV inspection, and dye testing. Typically testing of the main line must be completed and passed before a notice to connect is issued at which time then individual property owners can connect to the public system.

- Developer Constructed Sanitary Sewer Line Extension – Building Sewer Testing Program

A Developer Constructed Sanitary Sewer Line – Building Sewer Testing Program follows the construction of a new sanitary sewer main line by a private developer. Similar to the Public Constructed Sanitary Sewer Line Extension, testing is typically undertaken once the main line sewer is constructed and the public portion of the service laterals is installed. For the Developer constructed extensions, some portions of the Building Sewer and in some cases up to the Building Drain, have been constructed and are subjected to the low pressure air test during the main line testing. In other cases, the lateral is constructed when the specific lot is sold and the balance of the Building Sewer is constructed when lot-specific details are known. Testing of the Building Sewer is typically required prior to occupancy permitting. If any defects/failures were to be found, correction is typically required prior to issuance of the occupancy permit.

Follow up testing is recommended as part of long term system operations and maintenance.

6. Testing Methodologies

Public Relations, Public Safety and Notification

Irrespective of the testing methodologies to be implemented, it is acknowledged that respectful, positive public relations consisting of property owner education, working with the property owner to

extent appropriate and assisting with technical guidance associated with potential repairs and/or compliance is an overriding theme that serves as a fundamental element to successful "private sector" I/I source control. It is highly recommended that all technicians performing work on private property carry official photo identification. Uniforms with employee name, company name/logo are also strongly suggested as is introducing technicians to and notifying the local Police Department of testing dates/times/locations. It is recommended that technicians performing or reviewing this work be NASSCO certified.

Well in advance of any testing, a written notice should be provided to owners of the property that will be tested establishing the test date/time and advising of the test process/procedure and offering the property owner the option of observing the test. The notice should advise the property owner of the anticipated time scheduled for the observation and, if appropriate, follow up testing. One (1) week notice is suggested prior to testing. Where a fee is to be charged the property owner should be notified of the fee amount in writing. Where the property owners' water supply is used for testing municipality may want to consider a fee discount.

Visual Inspection

This work is often performed in-house by staff knowledgeable in collection system operation, maintenance and plumbing. It can be contracted out to engineering or sewer service companies. Visual inspection applies to all four of the lateral testing program applications identified above including the area-wide application and real-estate transfer application.

Purpose

The purposes of Visual Inspection are to; identify and record "existing conditions", to identify possible I/I sources on a property that may be connected to the sanitary sewer system, and to assess access points and conditions preparatory to follow up testing. Visual Inspection is a superficial level, initial reconnaissance documenting existing conditions for future reference.

Visual Inspection is usually the first step in any testing process intended to locate readily apparent sources of inflow/infiltration on a property that may be "illegally" connected to the sanitary sewer system. In certain cases the presence or absence of specific features are typically noted. Items to be identified include but are not limited to driveway/area drains, basement sump pumps, broken clean outs, broken inspection ports or site T's, floor drains, foundation drains, fresh air vents, and roof leaders, splash blocks etc.. Down sloping driveways with a driveway drain at the base with no known storm sewer point of connection is an observation that should be recorded.

A likely outcome from visual inspection is to identify the need for additional testing. Certain private "defects", (for example a low-lying broken inspection port) that are likely to drain surface water runoff are an obvious source that can be readily found through visual inspections. Certain other defects (e.g. a roof leader that extends into the ground) "may" be a potential source however; they cannot be confirmed "proof-positive" through simple visual inspection. Other methods identified herein will be required to confirm either an "illegal" or compliant connection.

Visual inspection differs from a lateral CCTV program in that this method can be considered a first step, superficial screening method.

Process / Procedure

Qualified technicians are deployed to a site with standard forms and preferably "custom" layout drawings of the lot/structure to be visually inspected. Where available it is recommended that a scale GIS plot or scaled sketch/copy of sewer permits that shows visible surface features (i.e. buildings, driveways, sidewalks, trees, etc.) on the lot be used to sketch and record pertinent observations. Use of standard title block and fill in forms is suggested to assure completeness and to record key information. Each inspection should include a signature block with time, date, and weather conditions noted.

Caution should be exercised by field staff as to not comment on findings/defects to the property owner. All communication should be made in writing after review of the test results.

Surface Drain and Roof Leader Dye Testing

Purpose

The purpose of this testing procedure is to affirmatively detect direct surface-storm water connections to the sanitary sewer from any surface area. Typical surface drains include floor drains, basement sump pumps, area drains, driveway drains, roof drains and yard/lawn drains all of which are intended to collect surface or storm water from an open area. Such connections are oftentimes considered "illegal", either by adopted Ordinance, Rules and Regulations, or Plumbing Code, and should not be connected to the sanitary sewer. Testing can be completed by properly trained and experienced technicians employed by a third party vendor hired by the municipality/sewer authority or by force account staff of the municipality/authority. This method applies to both the area-wide application and real-estate transfer application. Care should be exercised to perform dye testing in reasonable weather, acknowledging that frozen ground or snow pack could lead to misinterpretation.

Process / Procedure

Qualified technicians are deployed to a site with standard forms and "custom" layout drawings of the lot/structure to be inspected. Where available it is recommended that a scale GIS plot or scaled sketch/copy of sewer permits that shows visible surface features on the lot be used to sketch and record pertinent observations including dyed water injection points. Use of standard title block and fill in forms is suggested to assure completeness and to record key information. Each inspection should include a signature block with time, date, and weather conditions noted. Non-staining/ non-toxic fluorescent dye (tablet or liquid) is diluted with water of sufficient quantity to be clearly visible downstream is introduced in or on the floor drains, sump pump, driveway, yard and area drains, catch basins, and other suspected points of surface water inflow. Simultaneous to the introduction of the dyed water downstream manholes are monitored for the appearance of dye and recording the results. Depending on the distances involved travel times can be significant and should be calculated ahead of time. A team of technicians will be required to simultaneously introduce dye and monitor downstream manhole (e.g. at a minimum, one technician applies the dye to the suspected location,

second technician maintains a watch at the next downstream manhole). Provide additional personnel for safety/ traffic control where required.

During dye testing, information shall be recorded on standardized municipality/authority approved field forms. Written reports shall be completed for all structures tested regardless of findings. All reports shall be signed by the technician and technician's supervisor witnessing the tests. Copies of the municipality's/sewer authority's sanitary sewer base map showing building footprints accompany forms to provide supplemental annotation and documentation. The information recorded should include location, including name and address of property and property owner, date and time of testing, type of testing, time for dye to reach manhole and any other pertinent information regarding the test results which would impact a conclusion as to presence of lack of presence of an illegal connection. If discrepancy exists between the posted address and the address included on the base mapping, both addresses should be listed and documented appropriately. Dated color photographs for all buildings in which a source of direct inflow is found are suggested.

Caution should be exercised by field staff as to not comment on findings/defects to the property owner. All communication should be made in writing after review of the test results.

A sample standard operating procedure related to dye testing is appended, Appendix E.

Dyed Water Injection Testing

Purpose

The intent of this dye testing procedure is to attempt to detect direct and indirect storm water connections to the sanitary sewer from buried sources such as foundation drains. This method is also employed to assess the potential for I/I entrance along the Building Sewer (i.e. service lateral or building drain, the portion of sanitary sewer under structure).

A variation of this method, referred to as Dyed Water "Saturation" is similar to injection, however uses significantly more water. The accuracy of this method is very dependent on subsurface conditions including soil type, proximity of the injected dye to the pipes being tested, volume injected etc. Negative findings, i.e. lack of observation of dye at the main line / lateral connection or in site tee, is not truly dispositive. False negatives perhaps caused by an insufficient amount of water applied to the test are a distinct possibility. This method is used for both the area-wide application and real-estate transfer application. Care should be exercised to perform dye testing in reasonable weather, acknowledging that frozen ground or snow pack could lead to misinterpretation. Injection point(s) should be chosen to minimize damage to finished interiors; choose unfinished areas or garage areas, if possible.

Process / Procedure

Qualified technicians are deployed to a site with standard forms and "custom" layout drawings of the lot/structure to be inspected. Where available it is recommended that a scale GIS plot or scaled sketch/copy of sewer permits that shows visible surface features on the lot be used to sketch and record pertinent observations including dyed water injection points. Use of standard title block and

fill in forms is suggested to assure completeness and to record key information. Each inspection should include a signature block with time, date, and weather conditions noted. The testing crew should inject dyed water into the ground and allow ample time for the injected liquid to permeate the ground and reach the monitoring point at downstream locations. In order of preference the downstream monitoring/observation points are; site/observation tee, followed by CCTV either inserted in the site tee or "parked" at the point of connection to the main line, followed by next downstream manhole. The dye is typically injected by means of a 3/4 to 1 inch drive pipe with pointed end (discharge ports on side of pipes), worked into the ground such that dyed water will be introduced to the depth as required to be within 2 to 3 feet of the Building Sewer or footer. Care is required to avoid damage to the sewer piping and other underground utilities. The points of injection will be determined by the lot topography and position of the structure. A minimum of one injection point for each side of the structure is recommended; however two or more are required. One injection point should be as close to the building trap as possible. To check for I/I entrance along the Building Sewer, the dyed water is injected directly above the Building Sewer line, or above suspect joints/defects identified via CCTV.

A team of technicians will be required to simultaneously inject dye and monitor downstream (e.g. at a minimum, one technician applies the dye to the suspected location, second technician maintains a watch at the next downstream manhole). Provide additional personnel for safety/ traffic control where required.

During dye testing, information shall be recorded on standardized municipality approved field forms. Written reports shall be completed for all structures tested regardless of findings. All reports shall be signed by the operator and operator's supervisor witnessing the tests. Copies of the municipality's/sewer authority's sanitary sewer base map showing building footprints accompany forms to provide supplemental annotation and documentation. The information recorded should include location, including name and address of property and property owner, date and time of testing, type of testing, time for dye to reach manhole and any other pertinent information regarding the test results which would impact a conclusion as to presence of lack of presence of an illegal connection. If discrepancy exists between the posted address and the address included on the base mapping, both addresses should be listed and documented appropriately. Color and dated photographs for all buildings in which a source of direct inflow is found are suggested.

Caution should be exercised by field staff as to not comment on findings/defects to the property owner. All communication should be made in writing after review of the test results.

Smoke Testing

Purpose

The purpose of Smoke Testing is to preliminarily screen for potential direct surface connections to a sanitary sewer from a storm drain facility or, under proper groundwater conditions, identify indirect surface connections through the soil mantle to the sewer line. False positives and false negatives are a not un-common, and for this reason smoke testing has seen limited use in Western Pennsylvania. Smoke testing is not recommended for lateral testing. This method applies to both the area-wide application and real-estate transfer application. Typically a third-party vendor performs this work.

CCTV Testing

Purpose

The purpose of CCTV Testing is to visually inspect the physical characteristics/conditions of the Building Sewer and observe or document the entrance of I/I directly or indirectly as simulated via dyed water testing. The items that may be observed include but are not limited to physical (both structural and maintenance as defined by NASSCO) conditions of the lateral, the connection to the main line, active sources of extraneous flow, locations of bends and other fittings, and roots within the lateral. In-house authority staff knowledgeable in collection system maintenance and plumbing or third-party contractor and/or combination of the two typically perform this work. This method applies to both the area-wide application and real-estate transfer application.

Process / Procedure

CCTV Testing utilizes one of two methods. The first method is a push camera that can be inserted into the lateral from an access point located along the lateral. The second method is a lateral launch camera that enters the lateral from a parent unit located in the main sewer line. In either method a camera is inserted into the lateral line and a visual recording is taken of the lateral. A digital recording of the entire CCTV inspection should be made as well as a written report of the condition of each lateral should be prepared at the time of the inspection. The report should contain: identification, footage/stationing and locations of any pipe defects; locations and estimated quantity of inflow/infiltration and root intrusion; and the type and condition of the lateral connection. The formatting should be performed to NASSCO standards.

Caution should be exercised by field staff as to not comment on findings/defects to the property owner. All communication should be made in writing after review of the test results.

Low Pressure Air Testing

Purpose

The purpose of low-pressure air testing is generally for “acceptance” testing associated with Public or Developer Constructed Sanitary Sewer Line Extensions. In-house authority staff knowledgeable in collection system maintenance/plumbing or a third-party vendor typically performs this task. Water testing is more commonly used in Allegheny County.

Process / Procedure

Typically the Building Sewer from the structure served to the municipality’s/authority’s mainline are air tested for leakage and any section of sewer showing leakage in excess of the amount hereinafter set forth shall be rejected. Each section of Building Sewer being tested shall be temporarily sealed off by means of suitable plugs. All ends of lateral stubs must be sealed with suitable removable caps securely fastened to withstand internal test pressures. Gauge test pressures in the test shall be increased by the amount of groundwater pressure at the crown of the pipe. Plugs shall be properly

secured and care exercised in their removal. Plugs should be blocked and carefully braced to prevent sudden release of compressed air, slippage, or blowout due to internal pressure. Typically, pressurizing equipment shall have a safety gauge which shall limit the loading on the sewer line to 10 psi with calibrations on all pressure gauges being no greater than 0.10 psi. Air is slowly introduced into the pipe and the pressures be increased within the test section to 5.0 psi. The test section is usually required to sustain that 5.0 psi minimum without loss or drop in pressure for a time period of 5 minutes. In the event pressure loss does occur, appropriate repairs or reconstruction are made and the test procedure is repeated until the test criteria (5.0 psi for 5 minutes) are successfully accomplished.

Caution should be exercised by field staff as to not comment on findings/defects to the property owner. All communication should be made in writing after review of the test results.

7. Program Overviews

Pursuant to development of this document, local sanitary sewer authorities provided one page summaries of their programs related to private source reduction efforts. The following summaries are included in Appendix A:

A. Butler Area Sewer Authority, Butler County Pennsylvania
B. Fox Chapel Borough, Allegheny County Pennsylvania
C. McCandless Township Sewer Authority, Allegheny County Pennsylvania
D. Municipal Authority of the Township of South Fayette, Allegheny County Pennsylvania
E. North Huntingdon Municipal Authority, Westmoreland County Pennsylvania
F. Penn Township Sewer Authority, Westmoreland County Pennsylvania
G. Peters Township Sanitary Authority, Washington County Pennsylvania
H. Unity Township Municipal Authority, Westmoreland County Pennsylvania

8. Flow Data Based Case Histories – Private Sector I/I Source Reduction

The effectiveness of Private Source I/I reduction is best assessed via analysis of long term flow data that can document both “pre-” and “post-” program wet weather flow responses. However, very few entities have the resources to collect flow data specifically for this purpose. Of the entities participating in this effort only three either have or are proceeding with the collection of such information. The following paragraphs summarize those efforts to date.

Peters Township Sanitary Authority

Peters Township Sanitary Authority (PTSA) is currently in the process of an area-wide, multi-year pilot program utilizing a control basin / test basin approach to assess effectiveness of private source flow reduction. In the control basin, no repairs have been performed on any of the pipe segments or manhole structures. In the test basin, the sanitary sewers have received pipe lining and the manholes have been rehabilitated. Both basins have undergone simultaneous pre-repair flow monitoring to provide baseline data relative to effectiveness. Rainfall simulation was conducted via simultaneous dye injection and televising in the test basin to provide information relating to private source I/I contributions. This program is currently nearing the end of the repair phase which involves repairs to

the building sewers in the test basin. Upon completion of the repairs, PTSA will perform post-construction simultaneous flow monitoring of both the control basin and the test basin in an attempt to quantify effectiveness. This monitoring is scheduled in the first quarter of 2013.

Municipal Authority of the Township of South Fayette

The Municipal Authority of the Township of South Fayette (MATSF) provided long term flow data to 3RWW for the purpose of a long term flow analysis. The MATSF flow data was recorded by a magnetic flowmeter at their ALCOSAN point-of-connection force main located at the South Fayette/Bridgeville boundary lines. The flow data was provided as an average hourly flow and was reported to be "full capture". MATSF provided flow data from 2000 until 2011, with a data gap from the summer of 2007 through the summer of 2010. The information for a period of 2006 was not utilized due to monitor failure during the period. Other available flow data provided for MATSF was that gathered as part of the ALCOSAN Regional Flow Monitoring Plan from January 2008 until January 2009.

3RWW provided rain data from April 2000 until present that was part of the 3RWW radar calibrated rain gauge program.

Penn Township Sewage Authority

Penn Township Sewage Authority provided long term flow monitoring information that was generated by an area-velocity monitor located at the Penn Township/Monroeville boundary lines. The flow data was provided in one week intervals in 15-minute increments and ranged from 1998 until 2009. Flow data from 2004 was missing from April through December.

3RWW provided rain data from April 2000 until present that was part of the 3RWW radar calibrated rain gauge program.

Long Term Flow Analysis Approaches

The subcommittee applied the long term flow information provided by MATSF and Penn Township Sewage Authority to four different approaches for the purpose of analyzing flow monitoring data.

The first approach was to analyze yearly storm regression analyses that were created using the individual storm deconstruction hydrographs and their attendant response volumes. The intent of this effort was to assess whether decreased responses were apparent as the individual lateral programs were implemented over time. When applied, the regression analysis did not trend in any given pattern and therefore, no conclusive findings were determined from this analysis. The graphics displaying the regression analyses are provided in Appendix B for both authorities.

Some committee participants assess effectiveness by observing storm response volumes for certain "threshold" storm events such as a half inch storm. Following on this idea, the second approach was

to analyze a specific threshold precipitation event verse the overall storm response. Observed responses for the periods of record were grouped based on precipitation volume representing 0.5-inch, 1.0-inch, and 1.5-inch storm events (+/- 10%). Annual histograms, annotated by storm count, were plotted for each threshold storm. No pattern was evidenced for either data set and it was concluded that a threshold event does not predict the system storm response. The graphs with their yearly ranges provided in Appendix B for both authorities.

The third approach was to analyze the flow data on a yearly volumetric basis and unitize the inflow and infiltration into a gallon per inch-mile day (GPIMD) and GPIMD/Annual inches of precipitation. This analysis was deemed inconclusive due to the amount of missing or inconsistent data over the period of record, tables representing the months of missing data for each authority is included for review. The graphs displaying these findings are provided in Appendix B for both authorities.

The fourth approach utilized the Unit infiltration flow data basis from approach three, but only for typical wet weather months. Two groups of months were reviewed: October through December; March and April. This analysis, since it was based on the same flow data available for the third approach, contained several years of missing data periods. Review of the data available did not provide a conclusive outcome. Appendix B contains the graphs with the analyzed information.

In addition to program overviews, Appendix A also provides overview anecdotal reports prepared by committee participants with respect to individual "private sector" programs.

Results

The findings described above point to the fact that the success of a private service lateral program, as measured by impact on flow captured by the system, is not guaranteed simply because a program is implemented. Subsequent to the data analysis the discussion within the subcommittee focused on the fact that a broad spectrum program is not targeted in or on areas that contribute the most I/I cannot be expected to have significant measurable impact on flow reduction. Where I/I flow reduction is the primary objective it is of paramount importance to identify and focus on those areas within a system that serve as the principal source of the flow to be controlled, i.e. "Source Hot Spots".

Many of the programs that have been implemented are real-estate transfer programs and though these programs are effective in providing some level of inspection, they are geographically random in nature and do not allow for an overall rehabilitation to areas that may be causing significant I/I into the system. Two levels of identification were determined.

In terms of identifying the "Source Hot Spots" a high level review of the system could include:

- Historical Data
- Anecdotal Employee Field Observations
- Review of Soils in the Area

A more in-depth review would include:

- Night-time Flow Isolation Studies
- Closed-Circuit Televising
- Subsystem Flow Monitoring Data

3RWW Feasibility Study Working Group (FSWG) Document 009 and 009A identify how to utilize the night-time flow isolation studies as a means of determining where excessive I/I is entering a system. FSWG Document 012 explains step by step the procedure of performing a night-time flow study and how to analyze the field data received.

9. Defect Tracking

The subcommittee participants stressed the importance of tracking defects, why it should be done, and how it should be performed, if for nothing else than to provide as a resource for field and office staff in providing useful information to Board or Council members. These decision makers should require this type of data, at a minimum, to make informed decisions that will affect their customer base. Therefore it is essential to provide concise information that is gathered during the programs in a manner that can be reviewed quickly. These include summaries of the number of properties tested, failures found, and remedies implemented. Utilizing a database type format allows the support staff to prepare concise documents in a quick and ease accessible manner.

Establishing a database at the initiation of a program will help to provide the concise information needed. The database should contain information that the field crew can collect and, with minimum data entry skills, provide various information for the system. The tracking system should be electronic in nature. This would provide a more efficient method of data retrieval then sorting through years of paper field inspection sheets. This could be as simple as scanning the field documents into an electronic format, saving them by date and maintaining a continuous table of contents. A more complex and useful system would include a table of information that could be queried for the purposes of sorting out answers that the general public may want to know the answers. This table should include locations, types of defections, remedy methods and costs of remedies if available. The information on the field data collection sheets should correspond with the information on the table for the purpose of easy, concise collation of field data and the electronic recording method. A sample data collection form is included in Appendix C.

10. Synopsis of Resultant Considerations

Lessons have been learned through the subcommittee members experience in deploying "private source" reduction programs. These items are identified in the Resultant Considerations sections of the Program Overview Summaries located in Appendix A. A high level synopsis is as follows:

- **Program Visioning/Strategy Considerations**
    - Commitment: To promote effective "private source" flow reduction, a long-term municipal/authority commitment needs to be considered. Sustainable regulations whether it is municipal specific ordinances or authority specific sewer use regulations needs to be developed initially as part of the process. Following

regulation development continued diligent enforcement needs to also be considered. As an example, subcommittee experience suggests that a property determined to be in compliance during a time of sale test could modify existing drainage within perhaps several months or a year following the real-estate transfer necessitating continued time of sale testing and continued enforcement.

- Public Relations: One common theme that was reinforced within the subcommittee was the need for any potentially successful program to have a public relations element. Educating a property owner with respect to existing regulations and the background behind those regulations promotes cooperation and compliance. Subcommittee experience suggests that municipal or authority input with respect to repair also enhances compliance effectiveness.
- Documentation: Another common theme that was apparent from subcommittee participation, included the need for operating procedure development prior to program deployment detailing not only field activities related to testing but perhaps more importantly documentation of findings in a proactive, detailed and sustainable manner whether it be geospatially via Geographic Information System (GIS) or spreadsheet cataloging.
- Staffing: Coincidental to the commitment, public relations and documentation elements, sufficient staffing to conduct these activities as well as perhaps field activities is also a key strategic consideration associated with program effectiveness.

- **Scope of Work Considerations**
  - Area-Wide vs. Time of Sale: Subcommittee experience suggests that acknowledgment that there is a difference between these two types and the fact that each yields different effectiveness needs to be strongly considered. It was noted early on by the subcommittee that there is not a "one size fits all" approach to "private sector" source flow reduction and the type of program deployed should be municipal/authority specific.
  - Define Objectives/Identify Problem: As part of program development, reasonable objectives should be defined. This necessarily involves clear, concise problem identification whether it be I/I volume reduction associated with a system that pays for treatment on a "pay-to-play" basis (metered wastewater flow) or I/I peak flow rates associated with a system that has chronic SSO's during peak rain events. After identifying the problem, objectives can then be defined and municipal / authority specific program can be developed. Part of this program also involves the ability to measure or define effectiveness whether it be anecdotal (i.e. SSO X no longer bypasses during a 1" rain event) or actual monitored flow based utilizing a testing basin/control basin approach similar to the Peters Township Sanitary Authority or long-term averages per South Fayette Township Municipal Authority.
  - Area-Wide Program Field Testing Scope: Subcommittee experience suggests that an Area-Wide Testing program of less than 100 homes is reasonably manageable in terms of staffing commitments necessary for effective public relation and documentation elements.

- Physical Repair Scope of Work: After policy decisions are made pertaining to high level strategies and type of program to be deployed and objectives are identified, the physical scope of the repair associated with "private sector" source flow reduction must be considered. Subcommittee experience related to the physical scope of work was very broad including:
  - Building Sewer spot repairs of defects found to be contributing I/I during dyed water injection,
  - Building Sewer spot repairs of defects found during CCTV,
  - Removal of positive findings during dye testing,
  - Complete Building Sewer replacement during real-estate transfer for any structures determined to have storm water connection, surface water connections or infiltration found during CCTV.
  - Parallel Approach implementation in which the existing Building Sewer was converted to a neighborhood-type French Drain.

  Subcommittee member experience also suggests that the physical scope of work must be property specific and adaptable as often times when a Building Sewer spot repair was completed, additional Building Sewer deficiencies were then found, however not included in the original scope of work as CCTV documented a structurally sound internal pipe.

  Selection of the physical repair scope of work must consider the remaining, high level consideration.

- **Unintended Consequences Considerations**
  Subcommittee experience suggests that a successful program must consider "unintended consequences" which necessarily involve dealing with the fate of I/I removed from the Building Sewer. Observations reported by subcommittee members included:

  - Migration: Migration (i.e. I/I migrating from one defective joint that was repaired to another joint that was determined to be visually sound) back into the sanitary sewer system was found to be common, thereby limiting effectiveness.
  - Mini-Slides: In sloped yard areas to the rear of several properties that performed Building Sewer Repairs, mini-slides have been experienced perhaps caused by either by subsurface erosion of the removed I/I, surface erosion of surface discharged I/I or improper slope stabilization during repair.
  - Yard Wet Spots: In certain cases, wet spots developed in yard areas that were previously dry after completing Building Sewer repairs.
  - Wet Basements: Wet basements were also reported on properties (known to have pre-existing dry basements) that completed Building Sewer complete replacement or Building Sewer repair near the foundation.
  - Road Drainage Issues: Road drainage issues were reported on several cases in which foundation drains/sump pumps, previously connected the Building Sewer, and were re-routed with a roadway curb discharge. These cases were found to be particularly problematic during daytime snow melt events which trigger

foundation drainage and sump pump discharge followed by overnight freezing temperatures thereby causing icing conditions.

11. Synopsis of Anecdotal Reports

Butler Area Sewer Authority justifies their Private Sector Program by providing examples of large scale infiltration and inflow (I/I) problems found through the routine inspections. These include illegally connected sump pumps, natural springs directly connected to the sanitary sewer and cross-bored utilities.

Fox Chapel Sanitary Authority's program, which includes real-estate lateral camera inspections, has been anecdotally observed to reduce the frequency of manhole overflow during isolated significant winter wet weather events.

McCandless Township Sanitary Authority performs both Time of Sale and Random Dye Test Programs. They provide multiple examples of the amount of laterals that have been tested, the percentage of failures and specific items of interest identified by sewer shed. They feel that due to the Private Sector Programs, along with other mainline I/I programs, the system has seen reduction in wet weather flows and that the system can handle and absorb greater wet weather events than before the programs were undertaken.

The Municipal Authority of the Township of South Fayette (MATSF) has performed Time of Sale and new construction lateral testing since 2007. They believe the pre-occupancy, new construction testing identifies defects that normally would be missed, including "shoddy" installation. MATSF has a stringent agreement with ALCOSAN to limit their extraneous water within their system to 600 GPIMD measured quarterly. This has led them to seek multiple methods to control excess I/I. Their community has shown continued growth and yet their flow volumes have remained steady throughout their system. MATSF has concluded that their work in the I/I programs have continued to preserve system capacity. Their final observation has been that since the 2007 inception of the I/I programs, their yearly number of SSOs has decreased or been eliminated, along with the duration and volume of each event being reduced.

North Huntingdon Township Municipal Authority utilizes an area-wide program and a time-of-sale program. They have televised approximately 22% of their system to date. They describe their main reduction being shown in their electrical billing from their pump stations and from reduced peak flows at their Youghiogheny Treatment Plant.

Peters Township Sanitary Authority (PTSA) performs both area-wide and time-of-sale dye test programs. They are in the process of completing a comprehensive pilot program which involves the rehabilitation of both main line and private sector sewers, pre- and post-CCTV, and an un-rehabilitated control area for overall effectiveness of the source reductions pertaining to the pilot program. The findings of this pilot program will enable PTSA to formulate more cost-effective decisions regarding future source reduction projects.

12. Additional Information

Appendix D contains additional information with respect to "private sector" source flow reduction programs including municipal/authority contact information, web addresses and general statistics.

Appendix E contains an example of a standard operating procedure (SOP) of dye testing.

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- Sub Appendix C - McCandless Township Sewer Authority
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- Sub Appendix G - Peters Township Sanitary Authority
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Appendix B Long Term Flow Analysis

Appendix C Defect Tracking Sample Collection Form

Appendix D Additional Information

Appendix E Standard Operating Procedure for Dye Testing

APPENDIX A

Program Overviews and Anecdotal Reports

APPENDIX A

Sub-Appendix A:
Butler Area Sewer Authority

Feasibility Study Working Group
Document 022 (completed)
Private Sector Inflow and Infiltration Source Reduction
Program Overview
Butler Area Sewer Authority

Background:

The Butler Area Sewer Authority (BASA) currently owns, operates, and maintains a 10 million gallon per day (mgd) capacity wastewater treatment plant, over 230 miles of collector and interceptor sewers ranging in size from 6-inches to 48-inches in diameter, and 23 sewage pumping stations. Their service area covers approximately 32.5 square miles serving nearly 15,000 customers, of which 90% are residential. BASA primarily serves the City of Butler, Butler Township, Center Township, Summit Township, and East Butler Borough, as well as a limited number of customers in Connoquenessing and Oakland Townships, all located in central Butler County. BASA maintains the property service laterals from the main line up to the property right-of-way line. BASA bills their residential customers based on a flat rate and the commercial and industrial customers based on metered water usage. BASA has a five member Board of Directors serving staggered five-year terms. Three of the members are appointed by the City of Butler and the remaining two are appointed by Butler Township.

The existing sewage treatment plant is currently permitted to handle a peak flow of 25 mgd. Base sewage flows during dry weather periods currently average only about 5.0 mgd or about 50% of the plant's capacity. During extreme, wet weather events, the treatment plant is expected to receive an estimated peak flow rate of 69 mgd, almost three times the capacity of the existing treatment facilities. By the spring of 2013, and as a result of a Consent Order and Agreement (CO&A) with the Pennsylvania Department of Environmental Protection (DEP), BASA expects to complete construction and start-up four wet weather flow diversion pump stations and equalization storage tank facilities to regulate the peak, wet-weather flows to the treatment plant and prevent existing intermittent sanitary sewage overflows (SSOs) into the nearby waterways. Seven, above-ground concrete equalization storage tanks, located at three separate locations, with capacities ranging from 1.0 million gallons (MG) to 4.7 MG, will provide temporary storage for 22.1 MG of excess wet-weather flows. These diversion, pumping and equalization facilities will cost an estimated $30 million.

Program Description and Status:

In response to BASA's 2001 CO&A with the DEP, BASA's infiltration and inflow isolation and source identification programs were significantly expanded. Since 2001, BASA has implemented a:

i.) Voluntary, area-wide program in 2001,
ii.) Mandatory time-of-sale program, effective system-wide in 2004, and
iii.) Mandatory area-wide program in the Deshon sewer subsystem in 2008.

- The 2001 program generally involved placing door hangers ahead of time and making arrangements with willing landowners to dye test roof drains, yard drains, and sump pumps. The observation point for the testing was the nearest, downstream manhole, because most BASA customers do not have exterior vented traps, cleanouts or inspection tees. This program depended on voluntary cooperation of the property owner. When BASA began issuing Notice of Violations requiring the owners to correct illegal connections detected as a result of these tests, the voluntary cooperation of owners significantly decreased. As a result, this program was suspended in 2003.

- In 2004, all seven service area municipalities adopted a uniform ordinance establishing BASA's mandatory time-of-sale testing program that is still in effect today. BASA conducts

the inspection and testing for a nominal fee of $150 before any property is sold. BASA personnel conduct a television inspection of the sanitary sewer service lateral from the house to the sewer main, and perform dye testing of roof downspouts, driveway drains, yard drains, and sump pumps, to identify any pipe defects or illegal direct connections contributing extraneous storm water and groundwater to the sanitary sewers. Property owners are required to correct all violations at their own cost before the sale or money may be escrowed to complete repairs after the sale. A secondary benefit of this program is the knowledge that BASA gains about the sewer system in the older service areas, where accurate maps may not be available. This program has become an accepted step as part of any realty transfer, and has proven to be BASA's most effective method to identify and eliminate private sector sources of infiltration and inflow (I&I). This program requires a significant commitment of manpower and equipment and requires daily attention and follow-up monitoring.

- In 2008, the BASA Board adopted a new policy and implemented a new pilot program requiring the mandatory testing and repair of defective private sewer service laterals in sewer subsystems, where BASA undertakes a complete rehabilitation and/or replacement project for the public portion of the sewer system, including the portion of the service laterals from the main to the public right-of-way and the installation of inspection tees on the laterals. The first part of the testing was a rainfall simulation test of all exterior roof and yard drains and over the service lateral itself to identify I&I sources. BASA contracted a third-party to conduct rainfall simulation testing within the recently rehabilitated Deshon service area. The second part of the program was a mandatory interior basement inspection to identify and dye test any sump pumps for illegal connections to the public sewers. BASA staff processed the rainfall simulation results, issued all follow-up notices to schedule the interior inspection, conducted all of the interior inspections, issued all follow-up notices of violation, and conducted follow-up testing and inspections to verify corrective actions. Private owners were required to correct all violations at their own cost. This pilot program has proven to be administratively difficult and BASA had to obtain administrative search warrants to access some properties. A total of 724 properties were affected the Deshon sewer subsystem, and as of August 2012, BASA is still working with 23 property owners that still must allow access and/or complete repairs. BASA has not yet completed an evaluation of the effectiveness of this pilot program.

Flow Reduction Effectiveness:

Where possible, BASA has monitored the effectiveness of these private source programs through the use of flow monitors within their system as well as draw down tests of sump pumps when they are identified. However, the flow reduction from most individual sources is very small relative to the total sewage flows in the sewer system and not measurable within the accuracy limits of the flow meters.

Resultant Considerations:

1. Continue the mandatory time-of-sale realty transfer inspection and testing program to identify private sources of I&I and wildcat private sewers, and continue enforcement of existing ordinances to eliminate these private sources of I&I.

2. BASA does not have any jurisdiction over the building drains and plumbing systems within new homes and buildings. BASA continues efforts to improve coordination of BASA and the local municipality UCC inspections and testing of new building sewers and building drains (e.g., combined test of interior and exterior sewer lines after the exterior trenches are backfilled and the concrete basement floors are poured) to prevent any illegal connections in new construction.

Feasibility Study Working Group
Document 022 (completed)
Private Sector Inflow and Infiltration Source Reduction
Anecdotal Points of Private Sector Program Benefits
Butler Area Sewer Authority

The Butler Area Sewer Authority (BASA) fully understands the benefits of having defensible data and justifiable costs when explaining the "value" of Private Sector Programs to community leaders, elected officials, realtors, and the general public. Unfortunately, due to a nearly infinite number of variables such as seasonal groundwater fluctuations, snow cover, basement construction, soil types, ever changing rainfall patterns, and flow metering limitations, it is improbable that one can reliably identify and quantify pre-repair and post-repair infiltration removal from individual private sector lateral upgrades, especially on a short term basis. Inflow rates are affected by the same variables cited above, but one's ability to approximate the amount of inflow removed from individual private sector lateral upgrades may be more reproducible and predictable on a short-term basis. The fact of the matter is that every private sector plumbing system may have some degree of intermittent or continuous infiltration and inflow that will vary over the short and long terms.

Regardless of how you carry out your testing program (rainfall simulation, televising, smoke testing, dye testing, etc.), the majority of the locations that you test and mandate property owners to repair, will likely result in little or no quantifiable infiltration or inflow reduction. Make no mistake, flow will likely be removed in some locations, but it will not likely be a quantifiable amount. On occasion however, you will identify significant sources and these are the ones that you need to spend effort on quantifying and showcasing to the public. This will go a long way in justifying your Private Sector Program to the individuals cited above. Without having some form of a testing program, one will never have the ability to identify and remove the significant sources of infiltration or inflow.

Though not the norm, BASA has multiple inflow scenarios which have resulted in significant and quantifiable flow removals since 2004 that would have otherwise gone unnoticed without having a Private Sector Program. These include locations where:

1.) Sump pumps were directly discharging to the sanitary sewer system. BASA monitored the pump rate and run time of a typical sump pump at one location for an entire year in 2007. BASA was able to compute that the sump pump discharged an average of 335 gallons of groundwater per day, every day, for an entire year. During wet weather periods, this sump pump inflow peaked by a factor of 25 to 8,395 gallons per day. Through our Private Sector Programs, we have been able determine that almost one in four homes have ground water sump pumps. Therefore, BASA has incentive to monitor where these sump pumps are discharging, especially in the wintertime.

2.) Springs were directly discharging inflow to the sanitary sewer system. BASA monitored the inflow of a spring into a floor drain at one residential location for a two-year period from 2005 to 2006. BASA was able to monitor and quantify this reliable spring which ran continuously year round to be discharging at least 1,440 gallons per day. During wet weather periods, this spring peaked by a factor of 45 to 64,800 gallons per day

3.) Local water utilities were "cross-bored" through laterals, subsequently developed leaks, and allowed a continuous stream of potable water inflow into the sanitary sewer system. Televising a private sector lateral at one location in 2007 identified a ¾-inch copper public water service line that was bored through a sanitary sewer. The copper line had a longitudinal split along it where it was exposed in the sewer that allowed a continuous inflow of 164,400 gallons per day.

These documented flow removals are just a few direct benefits of having a Private Sector Program. Some additional indirect benefits may include:

a.) Assisting your local water company with identifying and locating water leaks from their system. The water company has just as much incentive to keep treated water in their main lines as you do keeping any extra water out of your sanitary sewers.

b.) Assisting your local gas company with identifying dangerous cross bores of gas service lines into the sanitary sewer system. Though rare, there have been recent media reports at the national level of homes exploding as a result of a cross-bored gas service lines being damaged by an unsuspecting plumber running mechanical sewer cleaning equipment from the house to the main line.

c.) Increasing your knowledge of construction techniques and conditions of existing private service laterals that directly connect to your public sanitary sewer system. BASA has documented through television inspections during its Private Sector Program that portions of the private sewer service laterals from the edge of the public right-of-way towards the home and the older piping for the building drains under the basement floor have numerous pipe defects and problems, especially in the laterals constructed of thin-wall plastic drainage pipe and original clay pipe, that are actively contributing significant infiltration and inflow. BASA estimates that the total footage of sanitary sewers on private property (service laterals and building drains under basement floors) is almost equal to the total footage of public sanitary sewers (over 230 miles).

d.) Increasing customer service satisfaction with new owners moving into an existing home. Typically, the private piping under the floor and outside of the house is out-of-sight and out-of-mind which results in new owners taking a leap of faith about the condition or functionality of the plumbing network when purchasing a home. With a Private Sector Program, such as a time-of-sale testing program, you may prevent a buyer from inheriting the plumbing problems of the seller. Plumbing service problems could include flat lines, sags with standing water, or deformed pipe. Though not necessarily sources of infiltration and inflow, your customers could experience service problems, such as slow drains or costly basement backups, if these defects are present in their plumbing network.

APPENDIX A

Sub-Appendix B:
Fox Chapel Borough

Feasibility Study Working Group
Document 022 (completed)
Private Sector Inflow and Infiltration Source Reduction
Program Overview
Fox Chapel Sanitary Authority

Background:

The sanitary sewer system is owned by the Fox Chapel Sanitary Authority and is operated by Fox Chapel Borough. The Borough of Fox Chapel is located north of the Allegheny River in the north eastern corner of Allegheny County. It contains approximately 75 miles of interceptor and collection sewers and consists of four drainage areas. These include Guyasuta Run, Squaw Run, Aspinwall and Guys Run Drainage Areas. Guyasuta Run, Squaw Run and Aspinwall are tributary the ALCOSAN treatment facilities. The Guys Run Drainage Area flows down Campbells Run into the Harmar Township sewer system and is treated at the Allegheny Valley Joint Sewer Authority plant. The Authority serves approximately 1,895 customers and 100% are considered residential or institutional. There are no commercial customers. In the system, the building sewer lateral from the road right of way to the property structure is the responsibility of the property owner.

Program Description:

Fox Chapel has a real-estate transfer program that is mandated by Ordinance No. 510. It requires that any person selling real-estate to provide the purchaser with a Document of Certification prior to the sale. The Document of Certification is an official statement stating that there are no illegal storm sewers or surface water connections or infiltration into the sanitary sewer. The seller is required to hire a plumber registered with the Borough to perform the testing and the Borough's Sewer Department oversees the test by use of an inline camera. Results are valid for 12 months upon completion of the test.

Current Program Status:

Currently the program is active and 1,230 out of 1,895 homes have been tested at least once.

Flow Reduction Effectiveness:

Flow meter results at the point of connection illustrate that the peak flow after a rain event is of a shorter duration than it was prior to the program.

Resultant Considerations:

Items that have been realized throughout the program are that; Properties have to be continually retested at time of sale in as much as yard drains, downspouts and sump pumps are often connected to the system in the interim. Laterals have to be fixed in their entirety because sectional repairs often fail adjacent to the repaired section due to the construction activity. New lateral pipe with proper stone compaction often create French drains to the collector system and consideration should be given as to how to handle this water so that it does not transfer the infiltration problem.

Feasibility Study Working Group
Document 022 (completed)
Private Sector Inflow and Infiltration Source Reduction
Anecdotal Points of Private Sector Program Benefits
Fox Chapel Sanitary Authority

The Borough's dye test and point of sale lateral inspection program is in its 23rd year (2012) and has resulted in over 1230 homes being tested or re-tested. The initial program was adopted because of a tap ban, lack of a gravity connection to ALCOSAN and system wide wet weather overflows that occurred during any normal rain event.

The first step in the program was a dye test of all downspouts and outside drains of all 1850 homes and the subsequent requirement that the homeowner remove any downspouts and drains from the sanitary sewer system. The ongoing requirement is that all homes prior to sale must have a lateral camera inspection, which includes water infiltration testing as outlined in the Boroughs regulation governing sanitary sewer connections.

Antidotal evidence by the public works department is that the program has reduced overflows to isolated significant winter wet weather events.

APPENDIX A

Sub-Appendix C:
McCandless Township
Sewer Authority

Feasibility Study Working Group
Document 022 (completed)
Private Sector Inflow and Infiltration Source Reduction
Program Overview
McCandless Township Sanitary Authority

Background:

McCandless Township Sanitary Authority (MTSA) services all or parts of the municipalities of McCandless Township, Pine Township, Marshall Township, Bradford Woods Borough, Franklin Park, Ross Township and Hampton Township. Their service area covers approximately 44 square miles and maintains 18,000 customers. Approximately 85% of their customer base is residential. The collection system has approximately 250 miles of mainline sewer. MTSA maintains responsibility for only the mainline sewers and items associated with the service laterals are the responsibility of the property owners.

The overall system is broken down into five (5) watersheds. The majority of the watersheds are treated at one of the four MTSA treatment plants. The plants are Longvue No.1, Longvue No. 2, A & B, and Pine Creek. Longvue No. 1 treats the Little Pine Creek Watershed, and includes customers from the Township of McCandless, Hampton Township and Ross Township. Longvue No. 2 is a high rate trickling filter plant rated for 100,000 gpd capacity servicing the upper Girty's Run Watershed in the Town of McCandless and potions of Ross Township. A & B Treatment Plant is a conventional activated sludge treatment plant having a 400,000 gpd rated capacity. It services customers in the Town of McCandless and Hampton Township in the Pine Creek Watershed. The Pine Creek Sewage Treatment Plant is an activated sludge treatment plant with a 6.0 mgd rated capacity. This plant serves Bradford Woods Borough, the Fish Run Watershed in the Borough of Franklin Park, parts of Marshall Township, Pine Township, the Town of McCandless and the boundaries of Hampton Township. The reminder of the system is transported through Loweries Run System and is jointly owned and managed by Ross Township and MTSA. This portion is connected to the ALCOSAN system in Emsworth.

Program Description:

MTSA's dye testing program originated as a real-estate service lateral program in the 1990s and has since evolved into an area-wide dye testing program.

The program began in 1991 as dye testing that served the purpose of a real-estate transfer testing program that was maintained by McCandless Township. In 1992, the program was amended to include specific approval for certification that was for the life of the building and further defined the Temporary Document of Certification between seller and purchaser.

In May of 1997 a new ordinance, Ordinance No. 1183, was approved to amend and modify the original ordinance. This new ordinance designated MTSA as the Town's Agent for all activities associated with the dye testing program. It also allowed MTSA staff to enter private properties for the purpose of periodic testing, as well as establishing a 12 month limit on certification. This resulted in changes to the program from specifically for real-estate transfers into a more area-wide focused program.

Further revisions of the program in 1998, designated a dedicated staff for dye testing and the relating data processing requirements. In 2003, further revisions to Ordinance No. 1183, established 18 month certification limit and a computer based data system was created to better maintain the records of the testing and to integrate the data into the GIS system. In October 2006, the Borough of Franklin Park passed an ordinance designating MTSA as its agent for administration and program implementation for both time of sale and random dye testing. This helped to establish a greater regional program.

For the current state of the program, as of December 2011, MTSA was in negotiations with Marshall Township to develop their dye testing ordinance that would be administered by MTSA. This would broaden the regional program even further.

Current Program Status:

MTSA program status is divided by watershed. Each watershed has on-going dye testing. Below is a summary of each watershed's current effort.

Watershed	Structures Available	Structures Tested	Random/Area-Wide Testing	Real-Estate Program
A & B	573	573	511	44
Longvue No. 1	1,734	1,645	1,531	114
Longvue No. 2	236	224	217	7
Loweries Run	3,293	3,153	2,998	155
Pine Creek	9,660	3,361	2,908	453
Total	**15,496**	**8,956**	**8,165**	**773**

Flow Reduction Effectiveness:

Due to the size and complexity of the MTSA System it has been difficult to determine the flow reduction effectiveness through flow monitoring on a system wide basis. However, smaller basin studies have yielded some limited flow reduction success on the random/area-wide testing program.

Resultant Considerations:

Major findings from the on-going programs have found that direct flow connections can be resolved with cooperation from all parties involved. Another finding is the "down driveways" and stairwell drains are the hardest areas to resolve. Finally, pumping does not always solve the problem and the Authority must be able to offer several suggestions for rehabilitation to resolve the problem.

Ongoing Benefits of the Time of Sale and Random Dye Test Program

The McCandless Township Sanitary Authority has had a Time of Sale and Random Dye Test Program in effect since the early 1990's. This program first started for Time of Sale and was expanded to a Random Program shortly after its inception. The Authority's service area contains five separate sewer sheds each have been incorporated into the program over the years, with somewhat varying results.

The Lowries Run Sewer Shed has approximately 5000 EDUs and 99% have been tested under the Random Dye Test Program and/or the Time of Sale. This sewer shed was under a PA DEP Corrective Action Plan and this testing was a requirement of that Plan. Approximately 15% (750) of these structures failed the initial testing and required remediation. A large portion of these homes were constructed between 1950 and 1970 and the sewers were constructed using VCP pipe. The Authority was unable to accurately track the reduction of I&I in this sewer shed using flow monitors. Instead what the Authority did was to measure the areas of roofs, driveways and/or area drainage removed and made calculations based on the area with a 1 inch rainfall. These calculated removal rates were submitted to and accepted by PA DEP for compliance to the Authority's Corrective Action Plan.

At the completion of the Lowries Run Program the Authority's efforts moved to the Longvue #1 Service Area. This service area has approximately 3500 EDUs and 99% have been tested under the Random Dye Test program and/or the Time of Sale. The majority of these residences were constructed between the late 1940's and up to the mid 1960's. These homes had a failure rate of less than 10%. Although the "down driveway" connection scenario was more prevalent in this service area. During this testing program this sewer shed was undergoing major renovations to the collection system. The Authority replaced most of the collection system that ran in or near the streams, over flows were eliminated, many lining projects were undertaken, many leaking manholes were repaired and numerous pumping stations were renovated. With all this combined work the Authority saw an overall wet weather flow reduction of about 20%.

The Longvue #2 Service Area and the A&B Service Area were completed after the Longvue #1 Area. These two areas are somewhat smaller with EDU counts of 200 and 500 respectfully. The A&B area yielded results similar to the Longvue #1 Area with an added adverse feature of many springs entering the system, which were at times hard to detect with the testing methods the Authority was utilizing (identifying direct inflow only). The Longvue #2 service area however yielded some surprising results. These residences for the most part were built before 1955 and the collection system is nearing the end of its useful life. The results of the Random Dye Test Program were very good with around a 5% failure rate. With most of the remediation being minor in nature, raising fresh air vents, removing driveway area drains and things of that nature.

The Authority's final service area to be undertaken was the Pine Creek System. This is the Authority's largest area and newest area. There are approximately 12,000 EDUs connected to this system, including numerous commercial establishments. Around 80% of this system is plastic pipe of one form or another and most laterals are plastic as well. A vast majority had a

series of inspections during construction and for the most part things were installed according to code. To date the Authority is approximately 35% complete with this area and has seen failure rates of less that 4%. An oddity of this service area has been the number of stairwell drains found connected to the system. Being that the Authority has seen lower than expected failure rates in this system the emphasis on this sewer shed has moved from random testing to time of sale testing.

The ongoing benefits of the Authority's Time of Sale and Random Dye Test Program may not seem exceptionally clear from the surface. It has been difficult to quantify the exact I&I removed, for many reasons. Typically the Authority has had other I&I Programs going on at the same time, the service areas are somewhat large and it is difficult to measure flow reductions with limited monitoring of main trunk sewers. What is clear to me is that, as a system operator I have seen reductions in wet weather flows due to all the programs we have undertaken and the Authority's systems can handle and "absorb" a much greater wet weather event than before the programs were undertaken. I believe that dye testing of the laterals is a tool of an overall remediation program. That as this analysis points out; you must look at all aspects of the system from age, to terrain, to construction, building architecture, to reaction to wet weather events.As with most things in life, wet weather remediation is a puzzle and the pieces must be in place to see the clear picture.

Prepared by: Dennis J. Blakley

APPENDIX A

Sub-Appendix D:
Municipal Authority of the Township of South Fayette

Feasibility Study Working Group
Document 022 (completed)
Private Sector Inflow and Infiltration Source Reduction
Program Overview
Municipal Authority of the Township of South Fayette

Background:

The Municipal Authority of the Township of South Fayette (MATSF) services South Fayette Township and is located in southwestern Allegheny County, Pennsylvania. They own and operator approximately 126 miles of sanitary sewer ranging in size from 6" to 27", over 6,100 customers, of which approximately 96% are considered residential. The total service area covers approximately 20 square miles with continual growth each year. MATSF is made up of three sewer sheds, the largest being the Chartiers Creek, followed by Robinson Run and finally Thoms Run, which are all considered to be part of the ALCOSAN Chartiers Creek Basin. ALCOSAN treats all flows from MATSF. MATSF is responsible for the service laterals from the mainline sewer to the property line or edge of easement depending on the situation.

Program Description:

MATSF utilizes a real-estate transfer program which is in accordance with South Fayette Township's Ordinance No. 401. The Ordinance requires inspections to be done at the time of sale and are typically performed by Authority personnel. Dye testing is done in conjunction with video inspection of the laterals. Dye testing is not required for refinanced properties, unoccupied new homes or properties currently utilizing on lot systems. However the Authority does conduct a lateral Tap In inspection where the lateral is visually inspected, mapped and plotted with GPS Survey equipment for inclusion on a lateral map layer in the overall GIS mapping. Additionally a CCTV inspection of the new home lateral is conducted as part of the occupancy check list. Defects found during the Tap In and Occupancy inspections are forwarded to the home builder for correction. The Authority also has a lateral replacement rebate program that will issue rebates of $ 600.00 to $ 1,100.00 for a full replacement or rehabilitation of a defective lateral dependant on the length.

MATSF performed an area-wide dye testing program as mandated by an Administrative Consent Order (ACO) in May of 2007. They are in the process of possibly expanding the area wide inspection program that was started in 2007. By mid 2013, an area-wide lateral televising program is anticipated to be in place that will include inspection of laterals in portions of the system suspected of contributing excessive I/I, and will require property owners to repair lateral defects independent of property transfer.

Current Program Status:

Below is the summary of the efforts from 2007 through 2011.

	Number of Laterals	Number of Failures	Percentage of Failures
Real-Estates Tests	827	193	23.3%
Contract 2005-1 Area Wide	217	47[1]	21.66%
New Construction Inspections	530	64	12%
ACO Area Wide Tests[2]	2,491 properties	217[3]	8.71%

[1] Failures were PACP grade 4& 5
[2] Dye test only per ACO requirement, no lateral televising
[3] Failures include: unable to locate vent and low vents. Approximately 30 were direct inflow source failures.

The lateral rebate program has paid out $24,489.00 in rebates for the full replacement or rehabilitation of failed laterals. Spot repairs, where permitted, are not eligible for rebates. The total footage of laterals replaced during the time period was 1,997 feet.

Flow Reduction Effectiveness:

MATSF with the assistance of 3RWW is analyzing 10 years worth of historical flow data at their master meter location to determine the overall effectiveness of flow reduction within their system.

Resultant Considerations:

The 3RWW study utilized three different approaches to analyzing the hourly flow monitoring data. The first approach was to analyze a specific precipitation event verse the overall storm response. It was concluded that a specification precipitation event does not predict the system storm response. Each storm response is unique since it is affected by specific system characteristics at the time of the event. The second approach was to analyze yearly storm regression analyses that were created using the trending of individual storm deconstruction hydrographs and their responses. The general theory was that as a system reduced private inflow and inflations, the regression analyses would trend in favor of decreased response. When applied, the regressions did not trend according to this theory and again can be related to each individual storm event being effected by the overall system characteristics at the time of the event. The final approach was to analyze the flow data on a yearly basis and unitize the inflow and infiltration into a gallon per inch-mile day (GPIMD) based on the inch-miles of sewer for the entire sewer shed. These analysis was inconclusive due to the missing digital data over the period of record. However, a significant amount of additional flow data existed for evaluation period, but not in an hourly digital format (which apparently was not properly backed-up or archived). Trends were more defined when all historic flow information was plotted. (SEE ANECDOTAL SUMMARY)

Municipal Authority of the Township of South Fayette

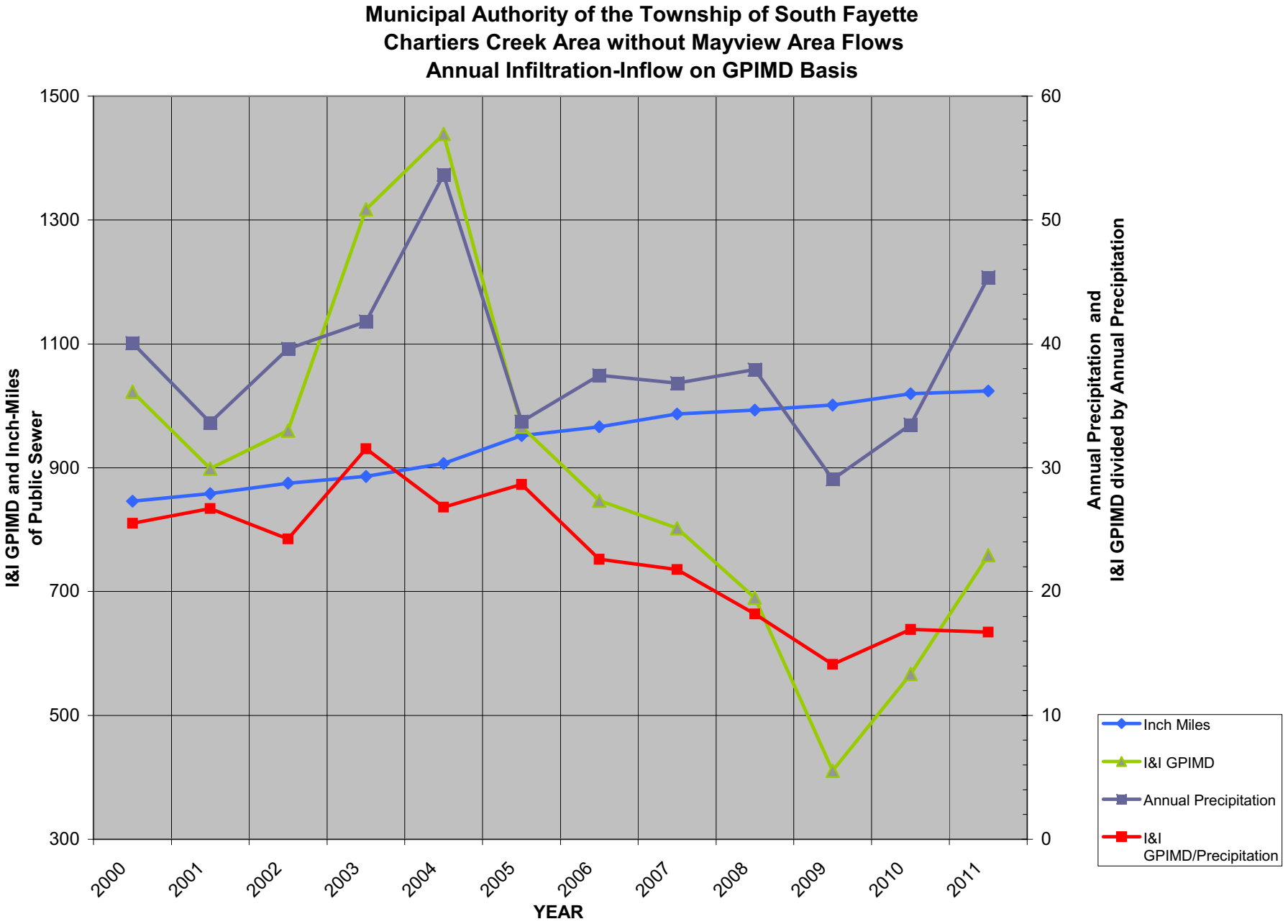
Detailed analysis of impact of MATSF's private sector program with respect to peak flow rate reduction (on a system-wide basis) did not yield evidence that the program implemented in June 2007 has yet had discernible results. From an annual volume perspective, when accounting for variations in system length and annual precipitation, trends, while not as uniform as one would hope, do indicate that I&I reduction efforts incorporating the private sector work seem to be heading in the desired direction, when taking into account all available flow information (See attached graph).

Relatively speaking, the MATSF private sector program is still relatively new. Currently it has been primarily focused on inspection of laterals during new construction (at time of occupancy) and property transfer. One would think that no problems should be found in laterals associated with new construction, but numerous significant defects have been identified as a result of the pre-occupancy televising that would have otherwise gone undetected. While not all of those defects would necessarily correlate to extraneous water entry into the sewer, there is no doubt that the builders in the municipality are now clearly aware that this inspection will be done and there is no tolerance for shoddy work. On average, nearly 100 new buildings are added to the MATSF system annually. With respect to the time of sale situation, the inspection, while an additional burden to the property owner, has clearly been successful for identifying serious defects in the private lateral that would not be addressed without the program. Once again, repairing these defects does not insinuate that there is measurable I/I reduction benefit for each situation. However, since MATSF is obligated (and desires) to have an aggressive O&M program for the public sewer system, it follows that any piping connected to the public system also be subject to scrutiny and that significant defects be addressed by the property owner. Expecting any significant type of system wide I/I reduction by only concentrating on maintaining the public portion of the sanitary sewer system is clearly wishful thinking. Numerous studies done on the national level have clearly indicated a far greater rate of success for I/I reduction when rehabilitation projects encompass both the public and private portion of the system. Further, no other utility (gas/water) would allow for known problems within the private portion of those systems to go unaddressed by the property owner. MATSF feels that the same should apply to sanitary sewer systems and will continue to inspect the private portion of the sanitary sewer system, including expansion of the program for area wide inspections not related to time of sale, independent of direct I/I reduction measurement.

Finally, a few other items that influence MATSF's aggressive stance on the private sector program are as follows:

- ALCOSAN's Agreement with MATSF clearly requires that the Authority take steps to reduce extraneous water entry into the system in excess of 600 GPIMD (on a quarterly average). This extremely stringent requirement forces MATSF to look outside the scope of conventional techniques utilized to control excess I/I.

- Since MATSF generally defines public ownership of a lateral to be within any sewer easement or road right-of-way, assessing only the condition of the public portion of the lateral is not desired, and is sometime impractical. Inspection of the entire lateral, including both the public and private portion, under a defined program, is considered to be essential.
- South Fayette Township continues to grow at a relatively rapid pace. It is essential that MATSF take all reasonable steps to preserve system capacity to the degree possible. At a minimum, MATSF's efforts at I/I reduction on both the public and private portions of the system have kept flow volumes from increasing, even with the continued growth. It is highly unlikely this would be the case without an aggressive I/I program that includes the private sector.
- While the results of the recent system wide flow analysis was inconclusive as to the impact of the program with respect to peak flow rates, one thing that can't be disputed is a known reduction to the number of hydraulic related SSO' events over the past several years. Prior to 2007, hydraulic related SSO's were as high as 4 per year. Over the past few years, there has been no more than 2 events per year, with most years having 0 events. The duration and volume of the recent SSO events are noticeably less than in the past.


Municipal Authority of the Township of South Fayette
Chartiers Creek Area without Mayview Area Flows
Annual Infiltration-Inflow on GPIMD Basis
I&I GPIMD and Inch-Miles of Public Sewer
Annual Precipitation and I&I GPIMD divided by Annual Precipitation
1500
1300
1100
900
700
500
300
60
50
40
30
20
10
0
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
YEAR
Inch Miles
I&I GPIMD
Annual Precipitation
I&I GPIMD/Precipitation

APPENDIX A

Sub-Appendix E:
North Huntingdon Township Municipal Authority

Feasibility Study Working Group
Document 022 (completed)
Private Sector Inflow and Infiltration Source Reduction
Program Overview
North Huntingdon Township Municipal Authority

Background:

North Huntingdon Township Municipal Authority (NHTMA) services North Huntingdon and portions of Irwin, Manor, Hempfield, Sewickley, White Oak and South Versailles. They are located in the western edge of Westmoreland County. Their service area covers 26 square miles and services approximately 12,600 customers, 80% of which are residential. NHTMA owns and operates the Youghiogheny Treatment Plant which treats approximately half of the customer base. The remaining customers are treated by the Brush Creek Water Pollution Control Plant which is owned and operated by the Western Westmoreland Municipal Authority (WWMA). NHTMA operates 255 miles of mainline sewer. They also own and maintain a portion of the service lateral only if they cross underneath a road. NHTMA bills residential customers on flat rate basis; commercial customers are billed based on water consumption.

Program Description:

NHTMA utilizes several methods for service lateral inspection. The first method is an area-wide program. The area-wide program is in response to overflows continuing to take place even after installation of two storage basins. The areas that were focused on were areas that contained terracotta mainlines and laterals. The second method of inspection is a real-estate service program. This program is required for property transfers and property refinancing within the service area and administered by NHTMA.

Current Program Status:

From May 2008 through March, 2012, NHTMA has tracked the amount of inspections that have been performed. Relating to the real-estate service inspections, 1,877 properties were inspected and 625 failed, resulting in a 33% failure rate. The area-wide program is done a project by project basis. During the above mentioned time frame they tested 424 laterals and 288 resulted in failures. This resulted in a 68% failure rate. Overall, these two programs have tested approximately 18% of the homes within the system.

Flow Reduction Effectiveness:

We have televised 22% of the laterals in our System. It is hard to tell the affect of the program, but we have noticed lower electric bills at some of the pump stations, and that the peaks at the Yough Plant have changed during rain events. But every rain event is different, and it is hard to be sure of what affect we are having.

We are working on replacing the main line and laterals in the Country Hills /Brush Creek drainage area.. There will be three phases, and we are currently on Phase 2. We are hoping to have results when we complete the last phase of this project. We also have a building lateral replacement program grant from the County. We are putting Phase 5 out to bid now. But this is Township wide.

I feel we are making a difference one lateral at a time. It will take years to see the final outcome. When we televise a lateral on a sale or refinance of a home, we are giving the homeowner peace of mind that their lateral is not adding to the problem of infiltration.

Resultant Considerations:

NHTMA has realized throughout the lateral inspection that maintaining the necessary amount of staff is important in keeping up with demand in order to find effectiveness of the programs.

NHTMA learned that during an area-wide program which includes replacement of mainline sewers along with laterals it is not in the best interest of the Authority to issue permits for lateral replacements while the mainline sewer is being replaced.

APPENDIX A

Sub-Appendix F:
Penn Township
Sewer Authority

Feasibility Study Working Group
Document 022 (completed)
Private Sector Inflow and Infiltration Source Reduction
Program Overview
Penn Township Sewage Authority

Background:

Penn Township Sewage Authority (Authority) serves Penn Township over approximately 30.5 square miles. Their service base consists of 5,819 customers equaling 6,397 EDUs with 5,900 connections. Their current customer base is 88.6% residential. The sewage collected within the system is treated at three different treatment plants, depending on location within the township, these are: Western Westmoreland Municipal Authority (WWMA), ALCOSAN, and Jeannette Municipal Authority (JMA). Penn Township Sewage Authority owns the service lateral from the mainline to the right-of-way line.

Program Description:

The Authority utilizes a real-estate service lateral program as their method for existing service lateral inspections. The Township of Penn approved Ordinance No. 607 on August 16, 1993. This ordinance established a codified procedure for construction of sewer lines with the Township of Penn. The Township of Penn built upon the approved Ordinance No. 607, by establishing Ordinance No. 630 November 21, 1994. The ordinance covers the initial guidelines of how the perform House Sale Inspections. The inspection is to be completed prior to a Municipal No-Lien Certificate being issues. It established that the Authority had within ten (10) days of receipt of request to perform the inspection. Once the inspection was completed, the Authority had five (5) days to notify the owner of any violations and the necessary repair work to correct the violation. The Authority had 48 hours to inspect the repair and issue a Certificate of Compliance to the owner. The Authority issues a Municipal No-Lien Certificate for use for the real-estate transaction. The inspection results were valid for three (3) years presuming no modifications had taken place on the property. An additional ordinance is related to the real-estate lateral program, Ordinance No. 809, established May 16, 2005. It allows the Authority to mandate its fees associated with enforcement of Ordinance 630.

The Authority requires all new connections to follow the Penn Township Sewage Authority Rules and Regulations for Sanitary Sewer Installation. These include guidelines for type and size service pipe, along with details related to connecting to the mainline. They also explain that a final camera inspection is required prior to the Occupancy Permit.

Current Program Status:

Since 2007, the Authority has maintained a record of the real-estate transfer service lateral inspections. In total 883 laterals have been inspected and of those 193 failed their inspections, requiring correction.

Flow Reduction Effectiveness:

The Authority bases their reduction efforts on system wide analysis, not on a separate sewer shed analysis.

Resultant Considerations:

The Authority has found that the key to having a successful program is working directly with the homeowners to solve the I & I issues.

APPENDIX A

Sub-Appendix G:
Peters Township
Sanitary Authority

Feasibility Study Working Group
Document 022 (completed)
Private Sector Inflow and Infiltration Source Reduction
Program Overview
Peters Township Sanitary Authority

Background:

Peters Township Sanitary Authority (Authority) services the western portion of Peters Township located in northeastern Washington County, Pennsylvania. They also service 82 customers in the Marella Manor area of Upper St. Clair located in southwestern Allegheny County. Sewage for this area is conveyed through Upper St. Clair Township with treatment provided by the Allegheny County Sanitary Authority (ALCOSAN).

The Authority service area covers 13 square miles and serves 6,000 customers, of which approximately 95% are residential. The Authority owns and operates two treatment plants; Brush Run Water Pollution Control Plant (WPCP) and Donaldson's Crossroads WPCP, maintains eight pump stations and 126 miles of public sewer.

The Authority owns and operations the collection system tributary to the plants. The property owners own and maintain the building sewer from the house to the connection of the main line sewer. Customers are billed on a water consumption basis.

Program Description:

PTSA utilizes several methods for building sewer inspection. The main method of inspection is a time of sale dye test program. This inspection is required for property transfers within the service area and is administered by the Authority. Authority staff conducts the testing using dyed water and visual inspection of key areas around the home and property. CCTV inspection is not done as a rule but is done to locate infiltration that presents itself via dyed water injection. The test is valid for one year from the date of testing.

The second method is area-wide dye testing. This is done in specific sewersheds where flow is high and/or in sewersheds that discharge into lift stations to reduce electric demands and when pump replacement is warranted.

The third program, which is currently in a pilot program phase, is the The Friar Lane Pilot Program. The Authority offered inspections and to repair defects contributing I/I to homeowners in a specific sewershed, at no cost, in order to study the effects of an area-wide program. PTSA has identified a sewershed that has not had any repairs to the public or private sewers adjacent to Friar Lane to use as a control basin for the study. Pre and post-repair flow studies will also be used to quantify results.

PTSA requires building sewer inspections during new development within their service area. These are included in the standard construction specifications for the Authority. During wet weather, the Authority also conducts main line and building sewer inspections in areas that have been identified as contributing high amounts of RDII through engineering studies.

Current Program Status:

The Authority is in the process of repairing defects identified in the testing of the Friar Lane pilot program using in-house personnel. At this time they have estimated extraneous RDII observed from testing but will have data on removal amounts after repairs are made and flow monitoring is conducted.

Flow Reduction Effectiveness:

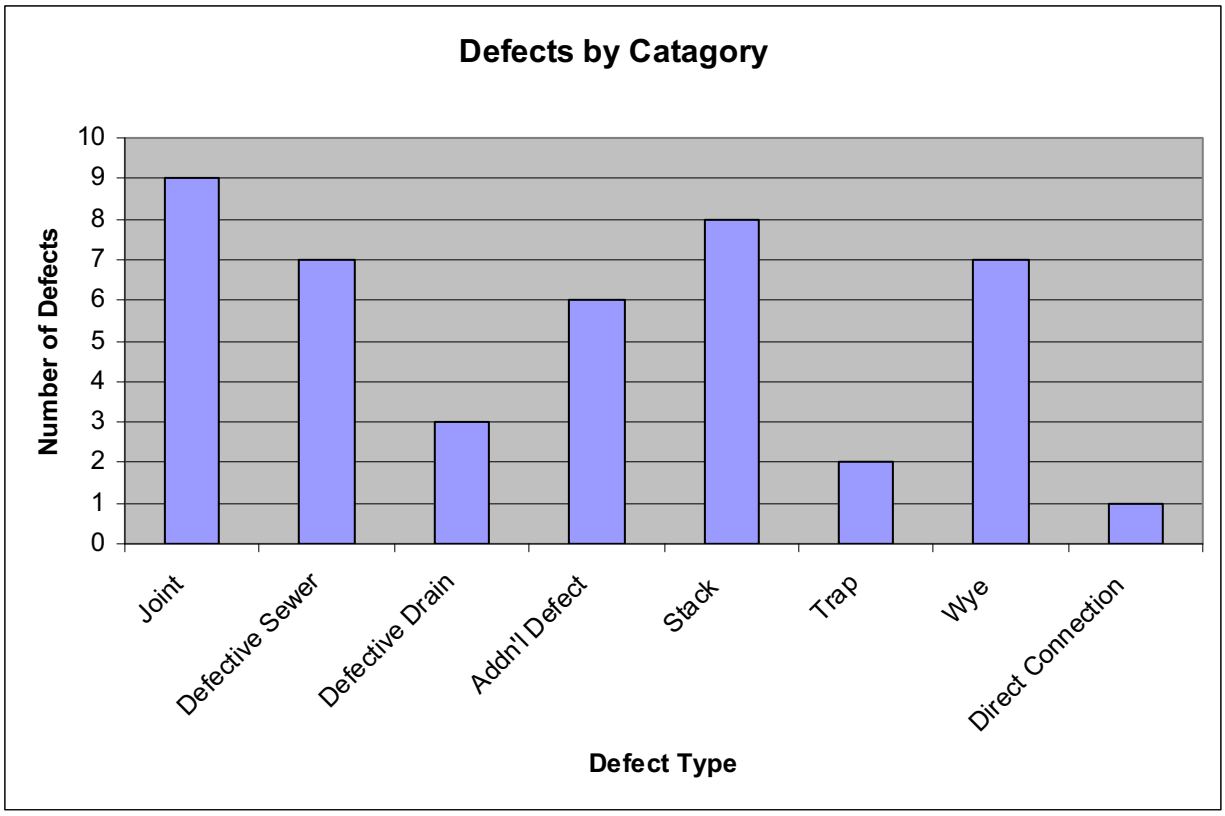
The time of sale dye test program has identified defects that lead to I&I and the defects have been corrected prior to issuance of a Document of Certification for closing.

The Friar Lane area-wide pilot program will determine if an area-wide building sewer inspection program is a cost-effective method of RDII flow reduction. If it is found to cost-effectively reduce peak flows during rain events, the program may be administered in other sewersheds identified as contributing high levels of RDII.

Resultant Considerations:

In the Pilot Program, with repairs to16 of the 23 properties completed to date, the Authority has found additional defects in 50% of the properties during repair. These include: additional cracks in adjacent building sewer, defective joints and cracked traps that were not identified via CCTV.

The most prevalent category of defects leading to I/I was defective joints. Defective vent stacks were next followed by defective building sewers and wye connections.


Defects by Catagory
Number of Defects
10
9
8
7
6
5
4
3
2
1
0
Joint
Defective Sewer
Defective Drain
Addn'l Defect
Stack
Trap
Wye
Direct Connection
Defect Type

APPENDIX A

Sub-Appendix H:
Unity Township
Municipal Authority

Feasibility Study Working Group
Document 022 (completed)
Private Sector Inflow and Infiltration Source Reduction
Program Overview
Unity Township Municipal Authority

Background:

Unity Township Municipal Authority (UTMA) is located in Unity Township, Westmoreland County. UTMA services portions of Unity Township which include but are not limited to: the 14 Mile Run Sewershed, the Nine Mile Run Sewershed, the Monastery Sewershed, the Lloydsville Sewershed and the Mission and Horseshoe Points of Connections. Their service area covers approximate 69 square miles and they maintain 7,300 customers. They operate and maintain a system of 180 miles of collection and conveyance sewers. UTMA owns and operates the 14 Mile Run Water Pollution Control Plan (WPCP) and the Pleasant Unity WPCP. The sewage from Nine Mile Run, Monastery, and Llodysville Sewersheds along with the Mission and Horseshoe Points of Connections are transmitted by interceptor to the Latrobe Municipal Authority WCPC. UTMA is responsible for the building sewer lateral from main to the inspection tee which is located near the edge of mainline sewer right of way.

Program Description:

UTMA has a real-estate transfer program that was established by Resolution No. 92-2 and amended by Resolution No. 96-05 in April of 1996. The resolutions state that at the time of sale or in the event of a mortgage, a No Municipal Lien Certificate must be issued by the Authority. It requires that the property be in compliance with Section 96-20 of the Code of Ordinances of Unity Township. The section limits what can be discharged into the sanitary sewer system.

UTMA also has an area-wide program which is governed by Resolution No. 2000-03. This program works to further comply with Chapter 96 requirements and the Township Ordinances. The resolution establishes that the Operations Manager is to define the scope of work, that testing shall be performed by Authority field staff, that the Authority shall notify the necessary property owners of the inspections and that if found in violation the procedure for remedying the problems.

UTMA requires all new construction to have lateral inspections. They require a full time inspector when the pipe in being installed. All newly installed manholes must have inflow preventors. A final field inspection of all sewer extensions is to be performed by UTMA field staff, engineer, and contractor. They do not allow any lateral connections to be permitted until the letter of certification of completion is issued by UTMA's engineer and all new laterals have to be inspected prior to backfilling. A final television inspection of the lateral is required before an occupy permit is issued by the Township.

Current Program Status:

The current status of the real-estate transfer program is ongoing and continues to be valuable tool in managing removal of infiltration and inflow from building sewer laterals

The area-wide program was completed in most areas in 2009 and resulted in a substantial amount of I/I removal in areas identified with excessive infiltration and inflow by the use of flow monitoring and lateral televising in those problem areas.

Flow Reduction Effectiveness:

During the period from 1998 until 2006, 2,545 homes were tested and of those, 2,443 were found to be in good condition. These tests included both real-estate transfer and homes from the area-wide program. UTMA required 101 laterals to be replaced by the home owners. Overall that results in a 4% failure rate during the study period.

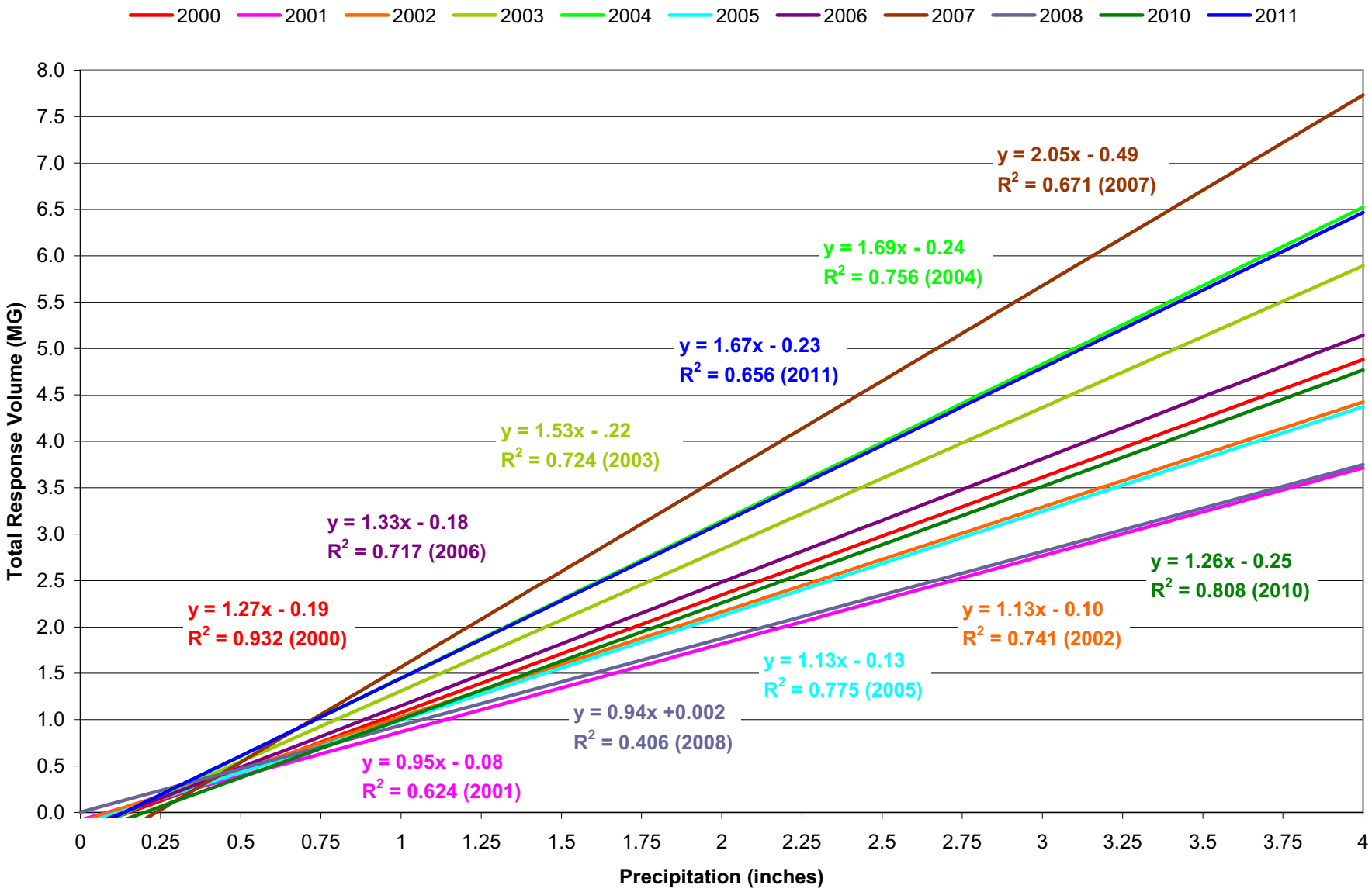
Resultant Considerations:

UTMA's experience in an area-wide program is that it is important to keep the number of homes in the program area to less than 100. In order for the program to be successful, it requires considerable amount of documentation and field work. Communications with the property owners is the key factor for the program's success.

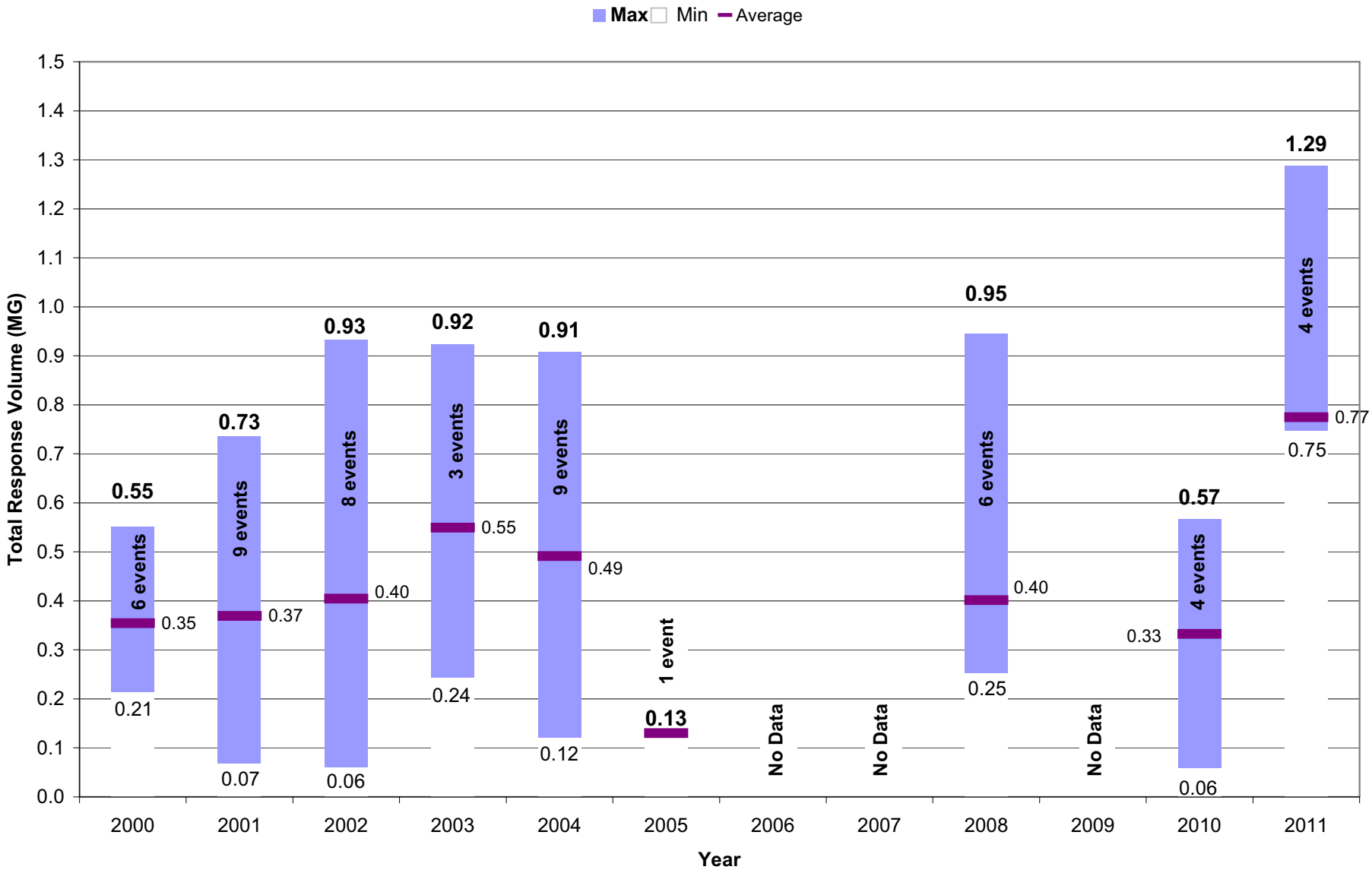
APPENDIX B

Long Term Flow Analysis

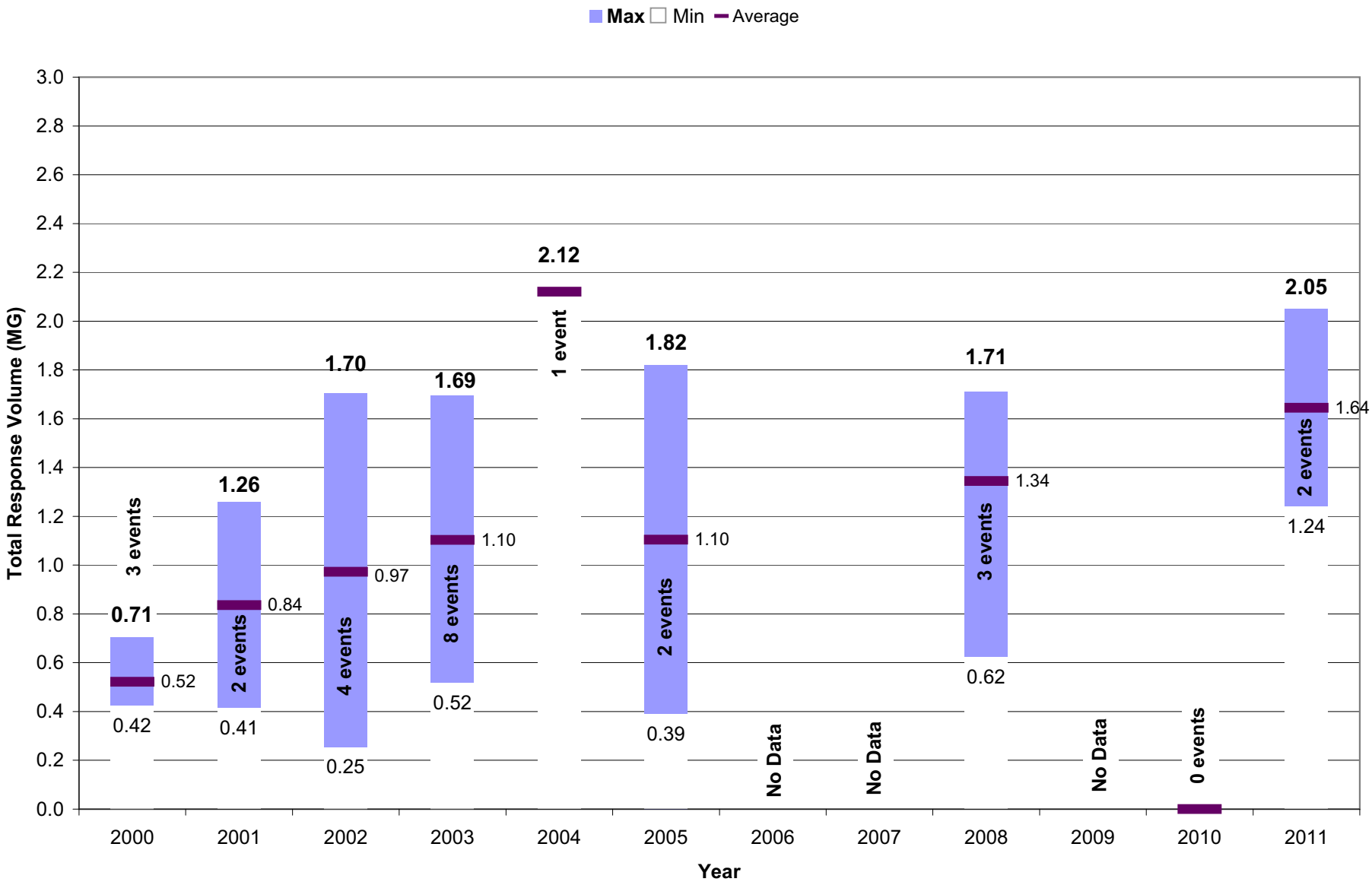
South Fayette Municipal Authority
Regression Plot Comparisons



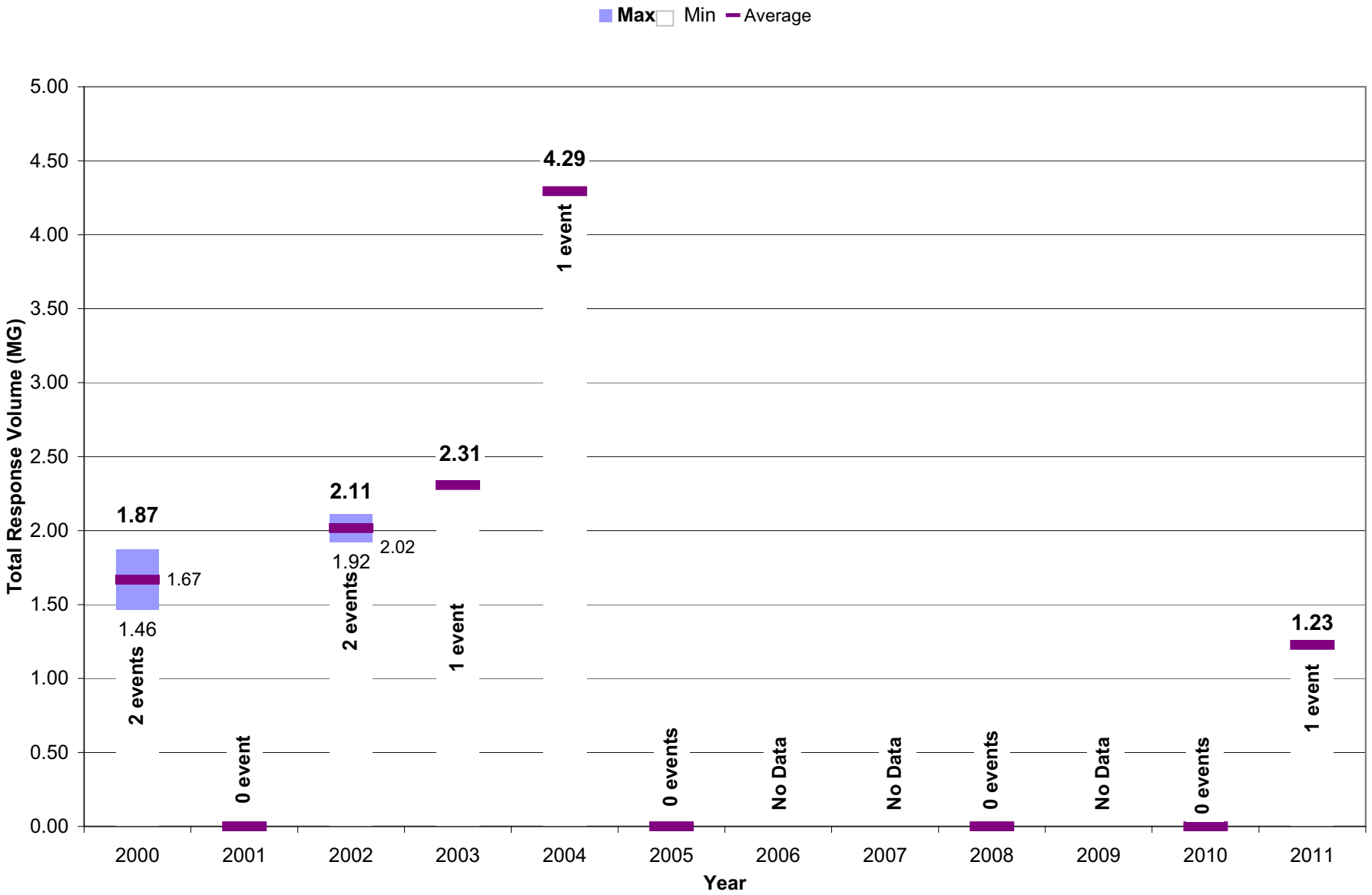
SOUTH FAYETTE MUNICIPAL AUTHORITY
TOTAL RESPONSE VOLUME DURING 0.5" STORM EVENT (+/- 10%)



SOUTH FAYETTE MUNICIPAL AUTHORITY
TOTAL RESPONSE VOLUME DURING 1.0" STORM EVENT (+/- 10%)

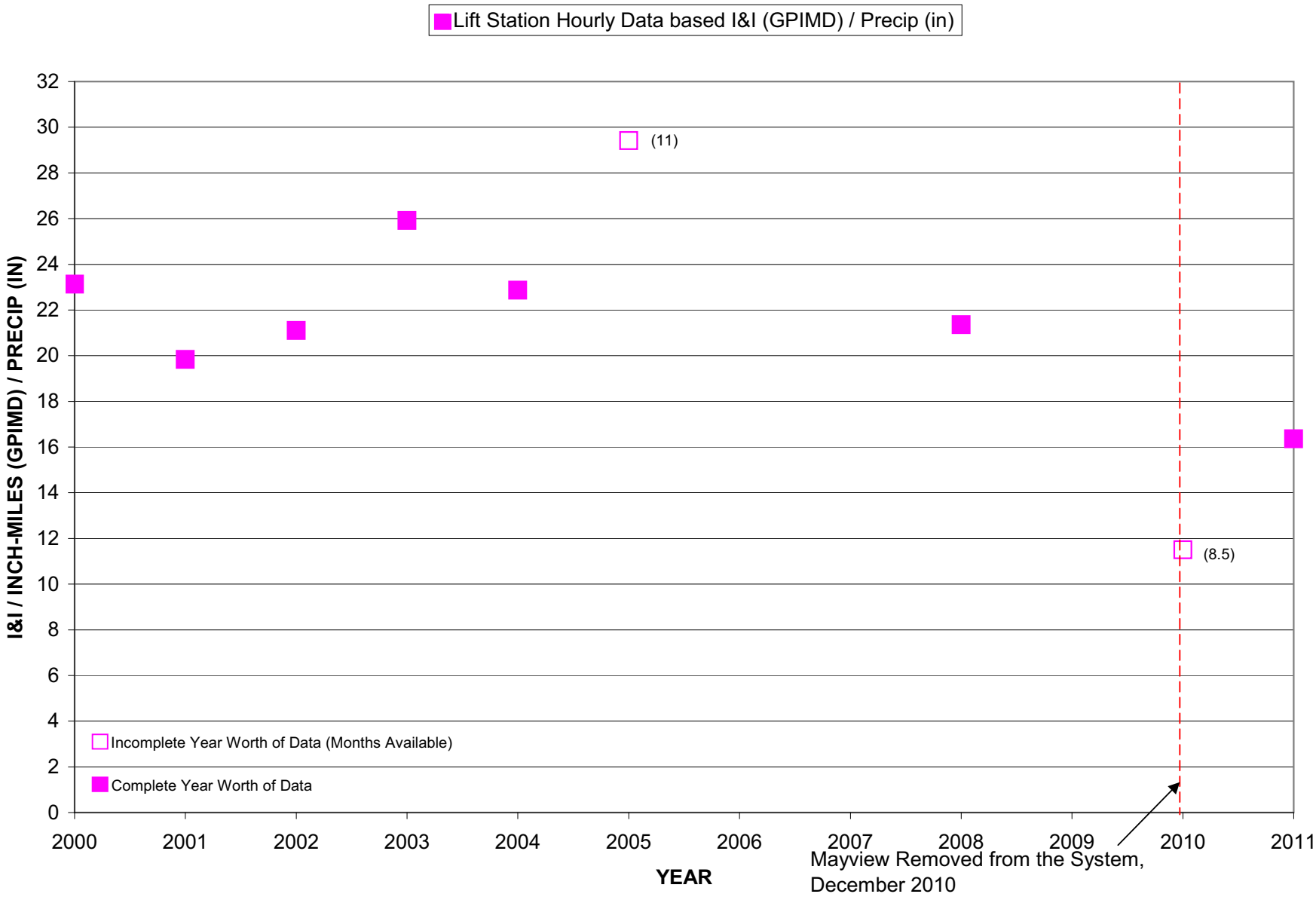


SOUTH FAYETTE MUNICIPAL AUTHORITY
TOTAL RESPONSE VOLUME DURING 1.5" STORM EVENT (+/- 10%)

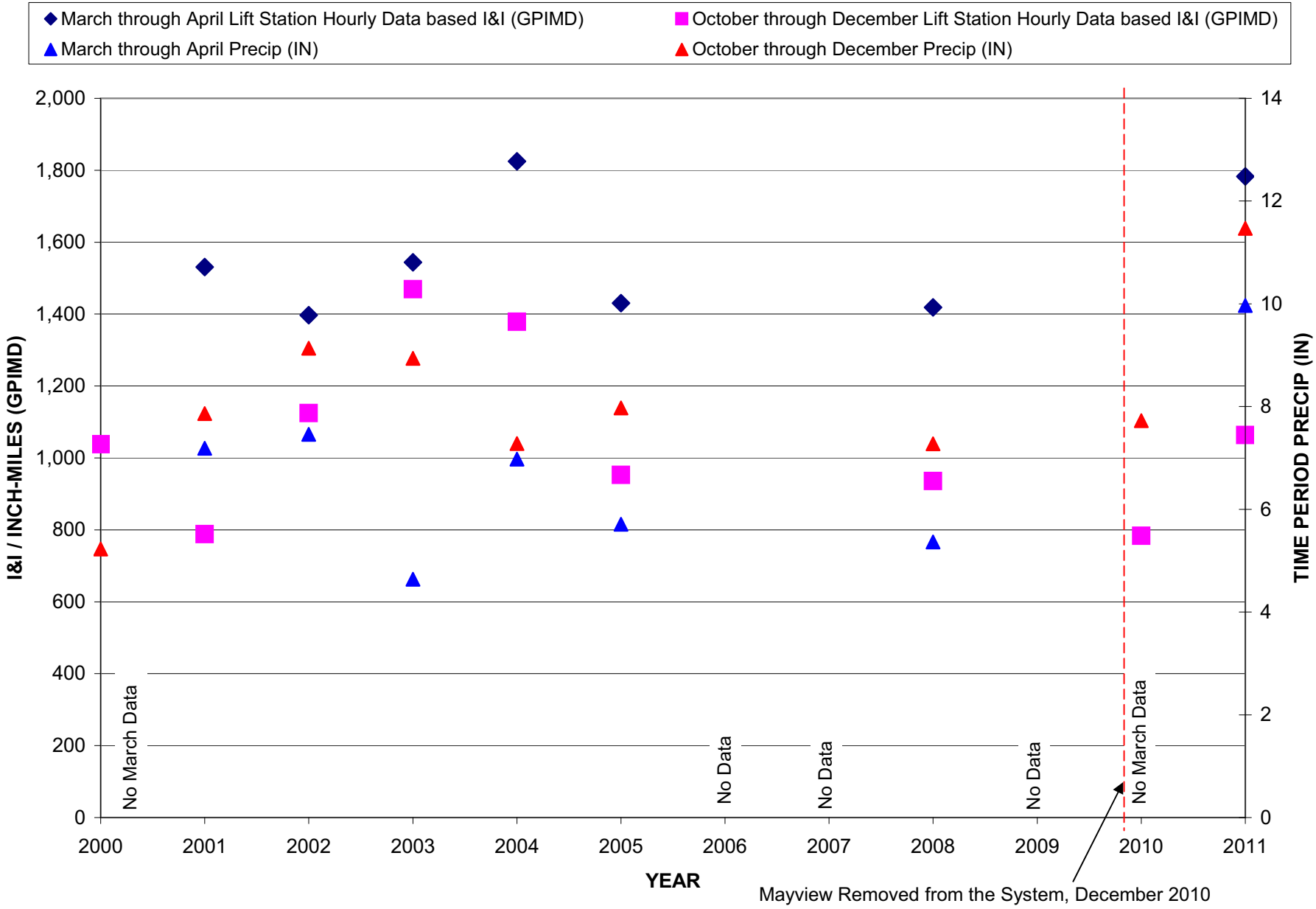


SOUTH FAYETTE MUNICIPAL AUTHORITY
DAILY I AND I GPIMD AND PRECIPITATION

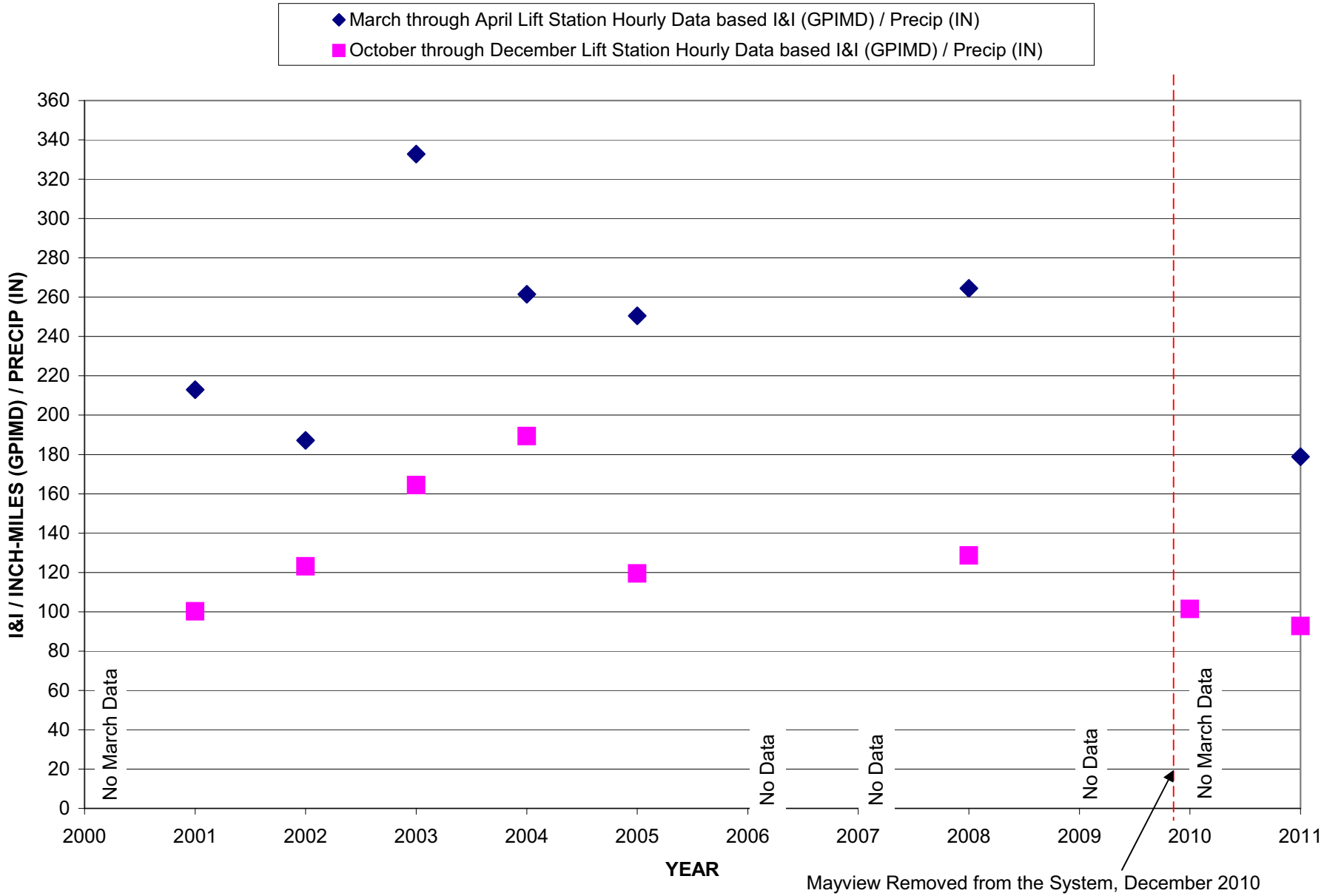
SOUTH FAYETTE MUNICIPAL AUTHORITY
DAILY I AND I GPIMD VERSE PRECIPITATION



SOUTH FAYETTE MUNICIPAL AUTHORITY
DAILY I AND I GPIMD AND PRECIPITATION
WET WEATHER



SOUTH FAYETTE MUNICIPAL AUTHORITY
DAILY I AND I GPIMD VERSE PRECIPITATION
WET WEATHER



South Fayette Municipal Authority
Flow Monitor Data
Missing/Unusable Data by Month in Weekly Increments[1]&[2]

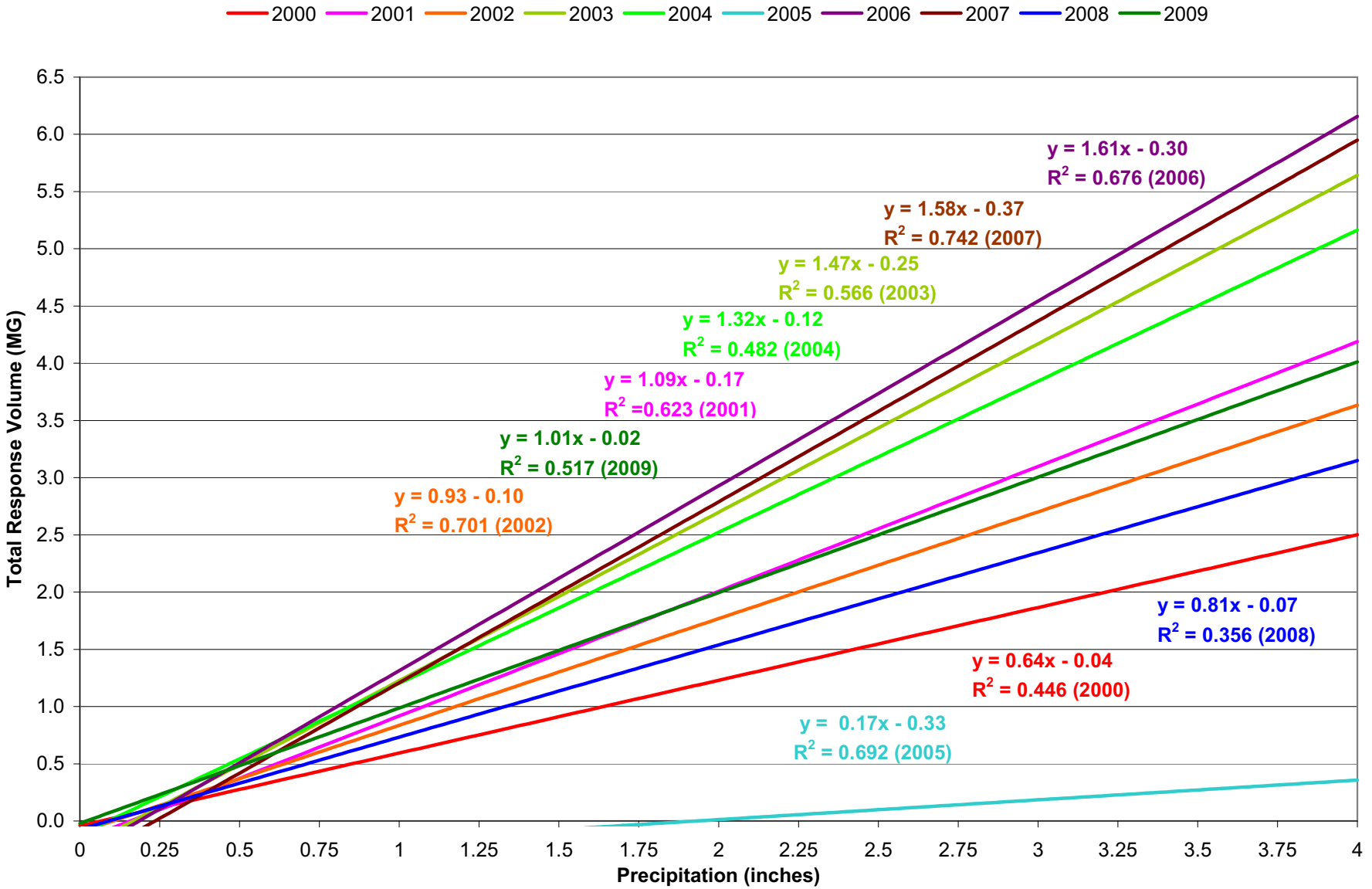
	MONTH											
YEAR	January	February	March	April	May	June	July	August	September	October	November	December
2000	0	0	0	0	0	0	0	0	0	0	0	0
2001	0	0	0	0	0	0	0	0	0	0	0	0
2002	0	0	0	0	0	0	0	0	0	0	0	0
2003	0	0	0	0	0	0	0	0	0	0	0	0
2004	0	0	0	0	0	0	0	0	0	0	0	0
2005	0	0	0	0	0	0	0	0	3.5	0	0	0
2006	0	0	4	4	4	4	4	0	0	0	0	0
2007	0	0	0	0	0	1	4	4	4	4	4	4
2008	SD	SD	SD	SD	SD	SD	SD	SD	SD	SD	SD	SD
2009	SD	4	4	4	4	4	4	4	4	4	4	4
2010	4	1	4	4	1	0	0	0	0	0	0	0
2011	0	0	0	0	0	0	0	0	0	0	0	0

[1] 0.5 weeks equals 4 days

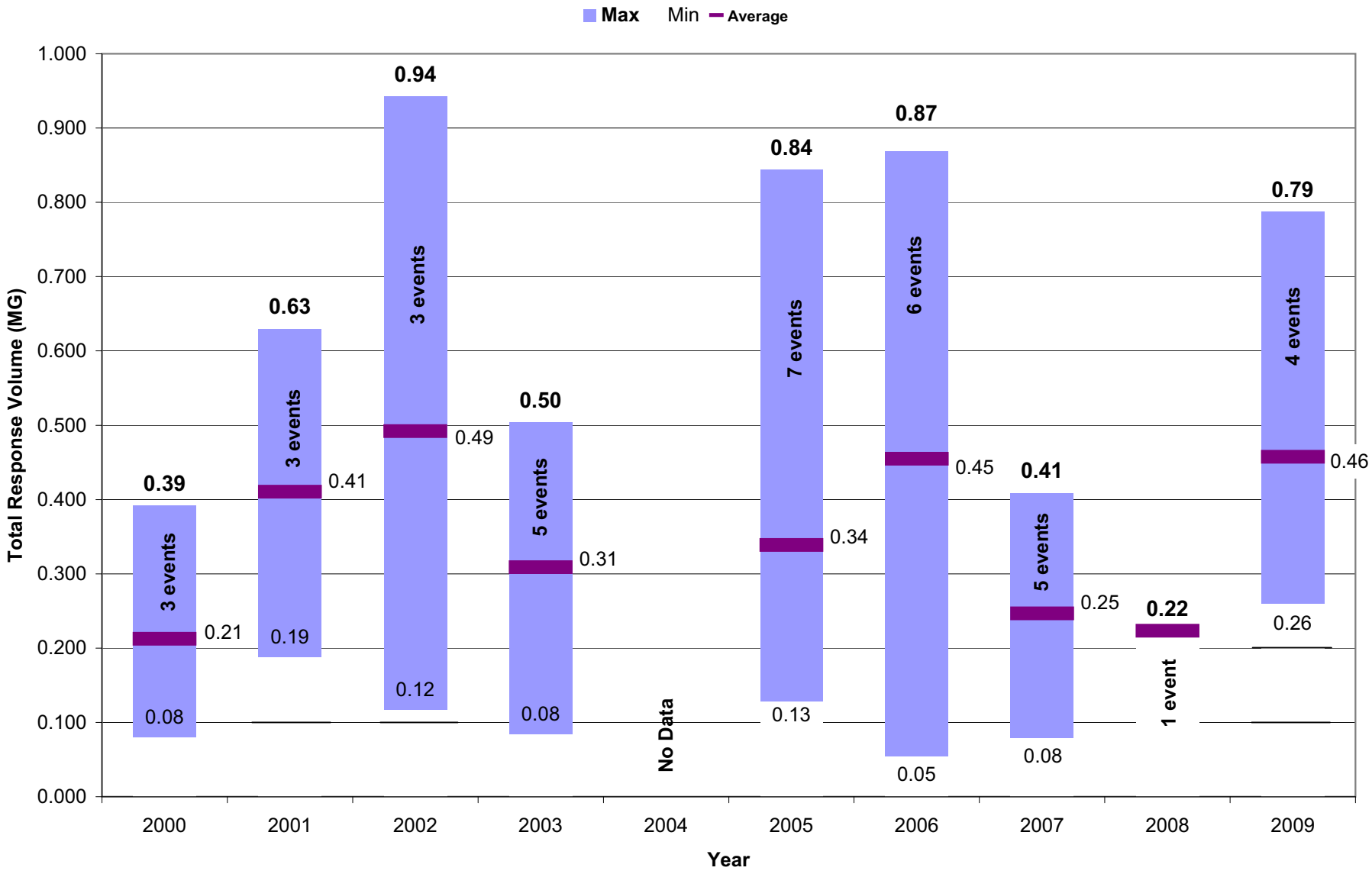
[2] SD equals Supplied Data: from ALCOSAN Study

YEAR	TOTAL WEEKS MISSING	TOTAL MONTHS MISSING
2000	0	0
2001	0	0
2002	0	0
2003	0	0
2004	0	0
2005	3.5	1
2006	20	5
2007	25	6.25
2008	0	0
2009	44	11
2010	14	3.5
2011	0	0

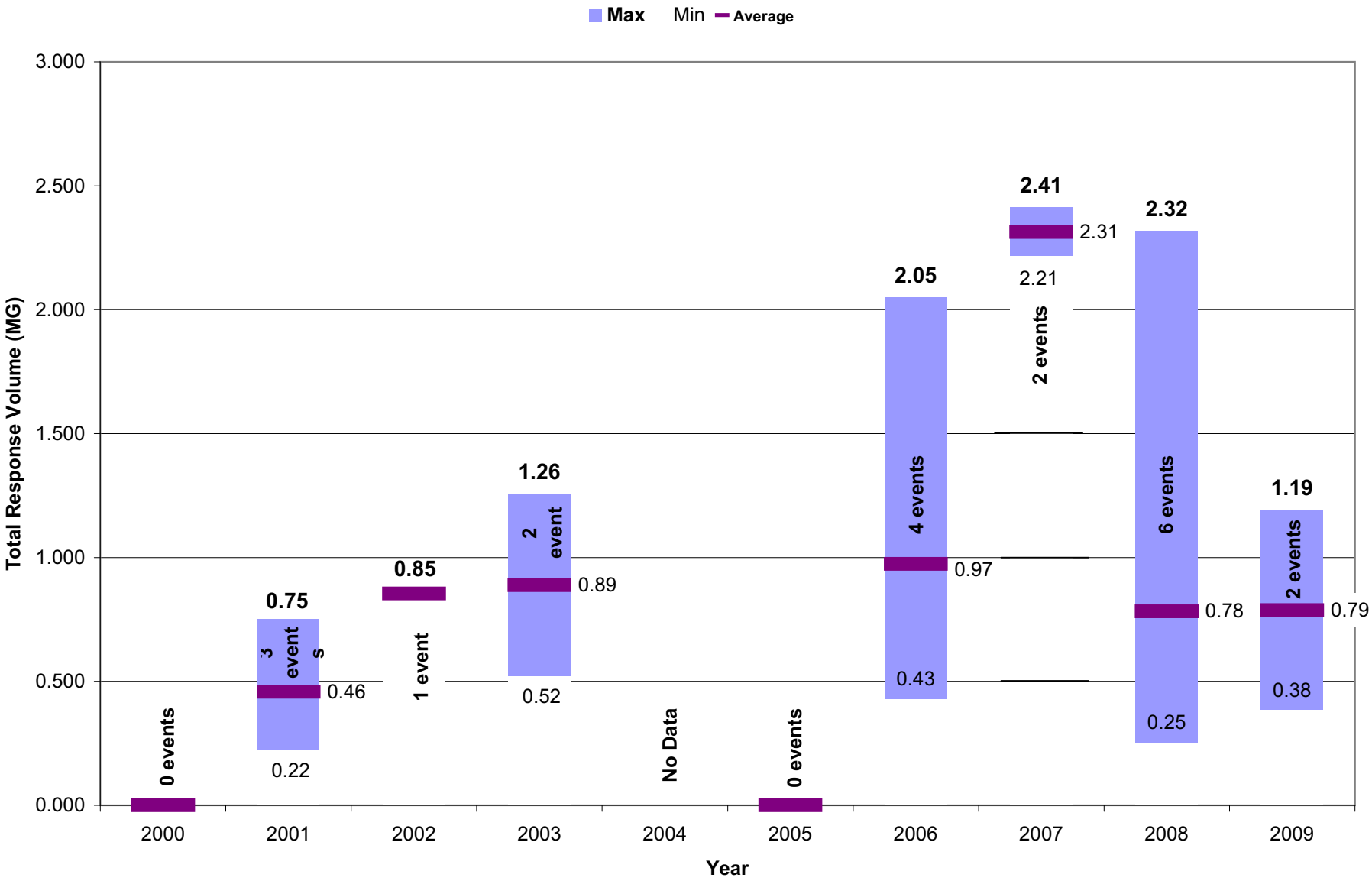
Penn Township Sewage Authority
Regression Plot Comparisons



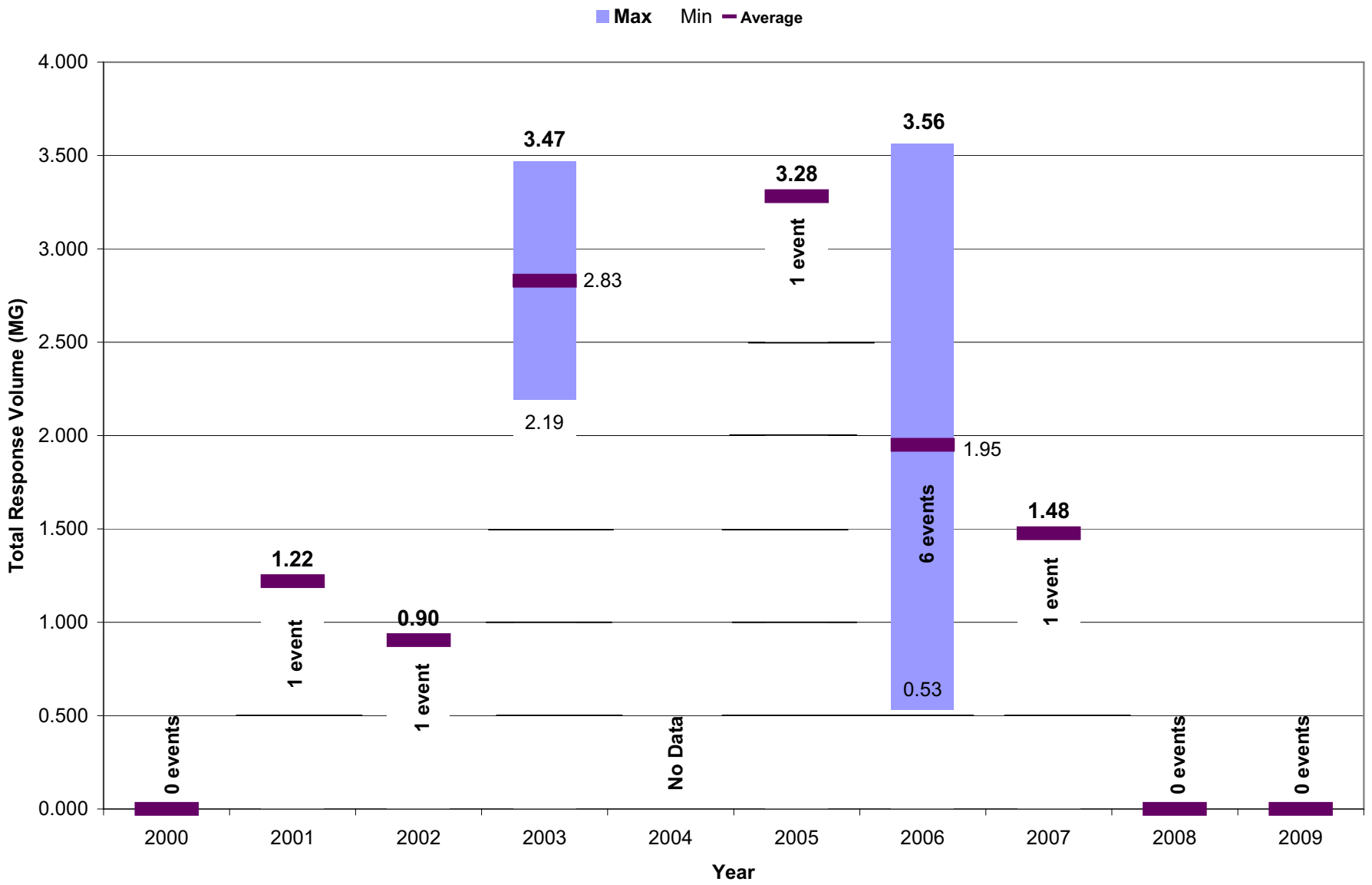
PENN TOWNSHIP SEWAGE AUTHORITY
TOTAL RESPONSE VOLUME DURING 0.5" STORM EVENT (+/- 10%)



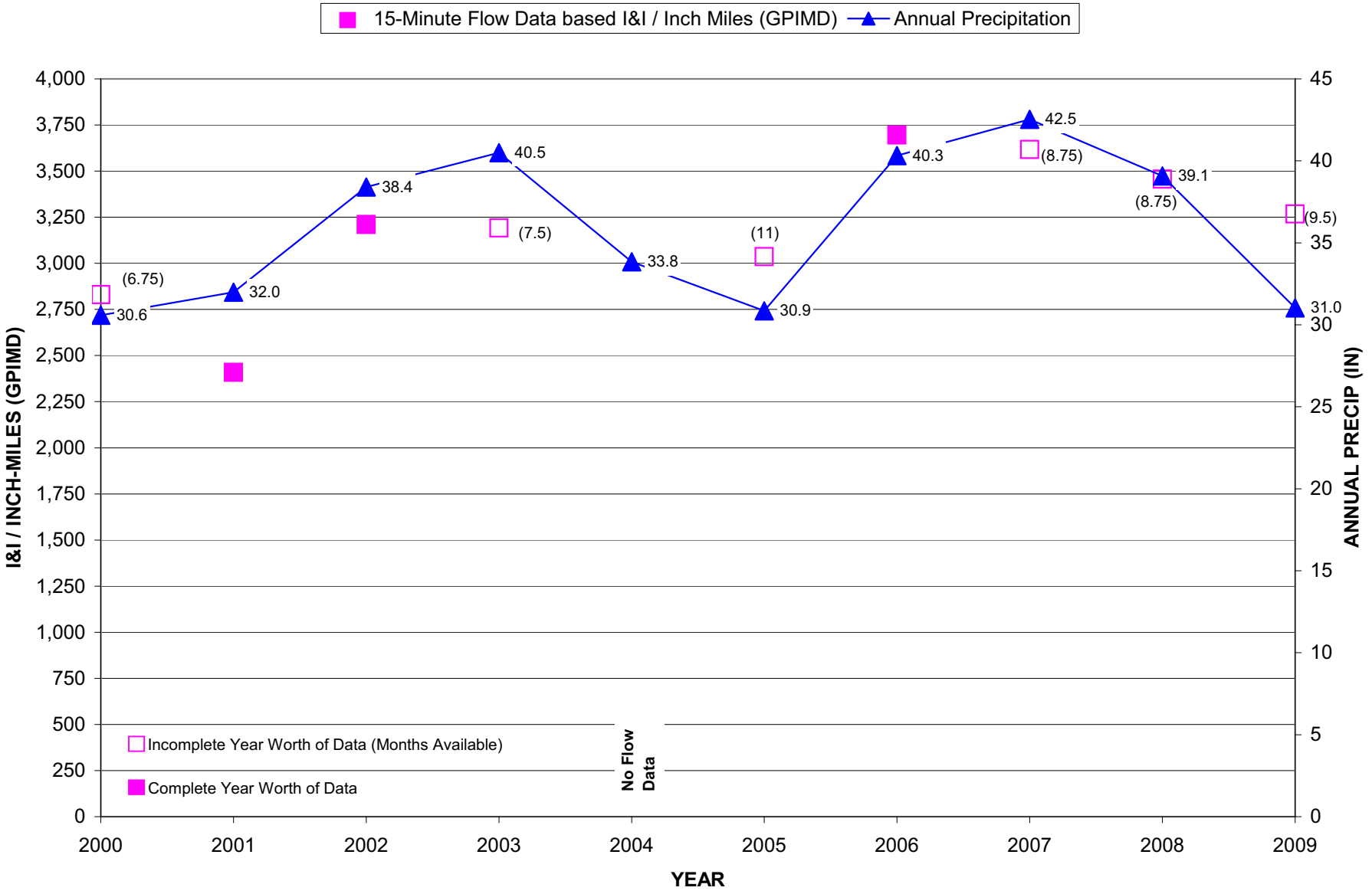
PENN TOWNSHIP SEWAGE AUTHORITY
TOTAL RESPONSE VOLUME DURING 1.0" STORM EVENT (+/- 10%)



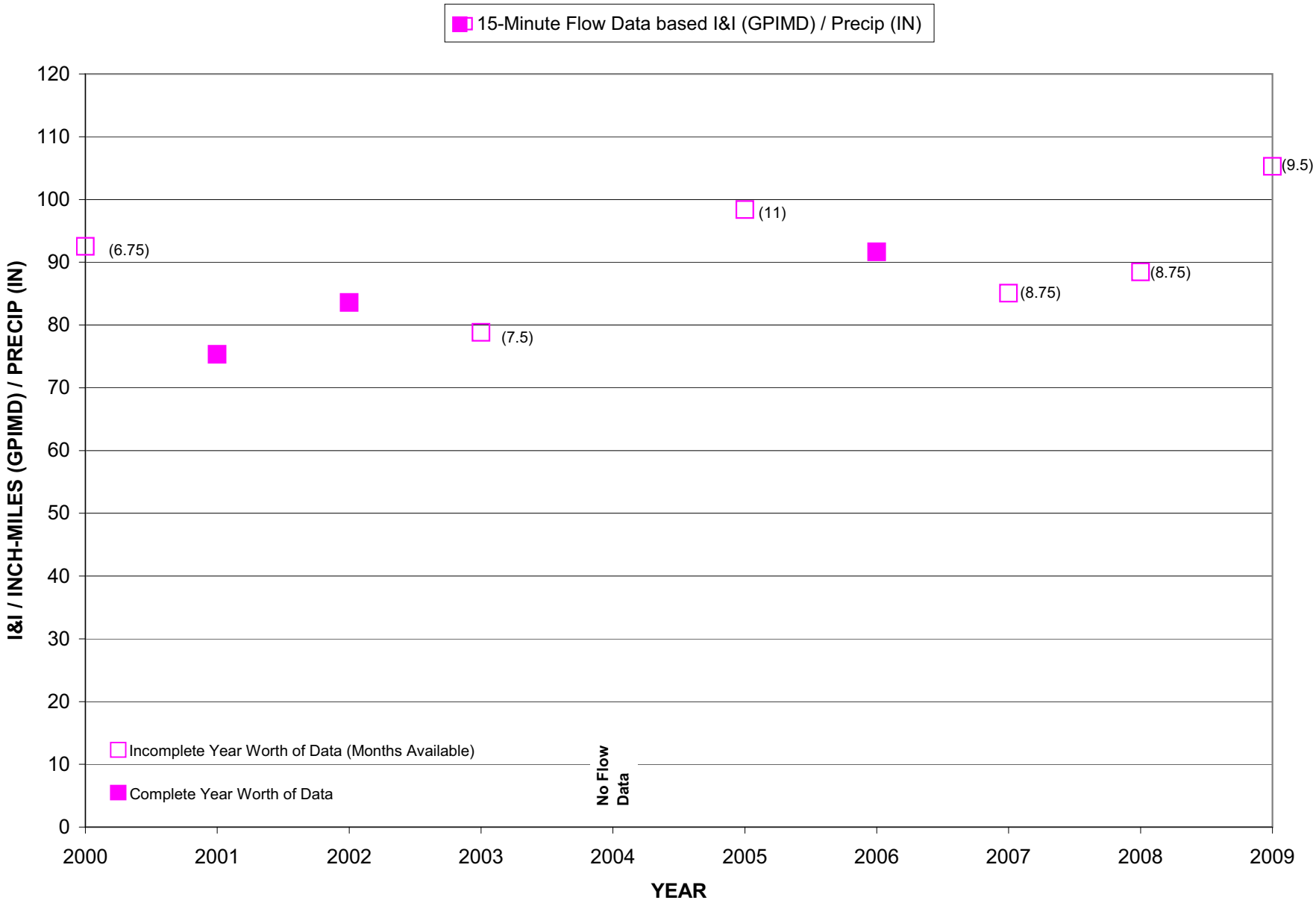
PENN TOWNSHIP SEWAGE AUTHORITY
TOTAL RESPONSE VOLUME DURING 1.5" STORM EVENT (+/- 10%)



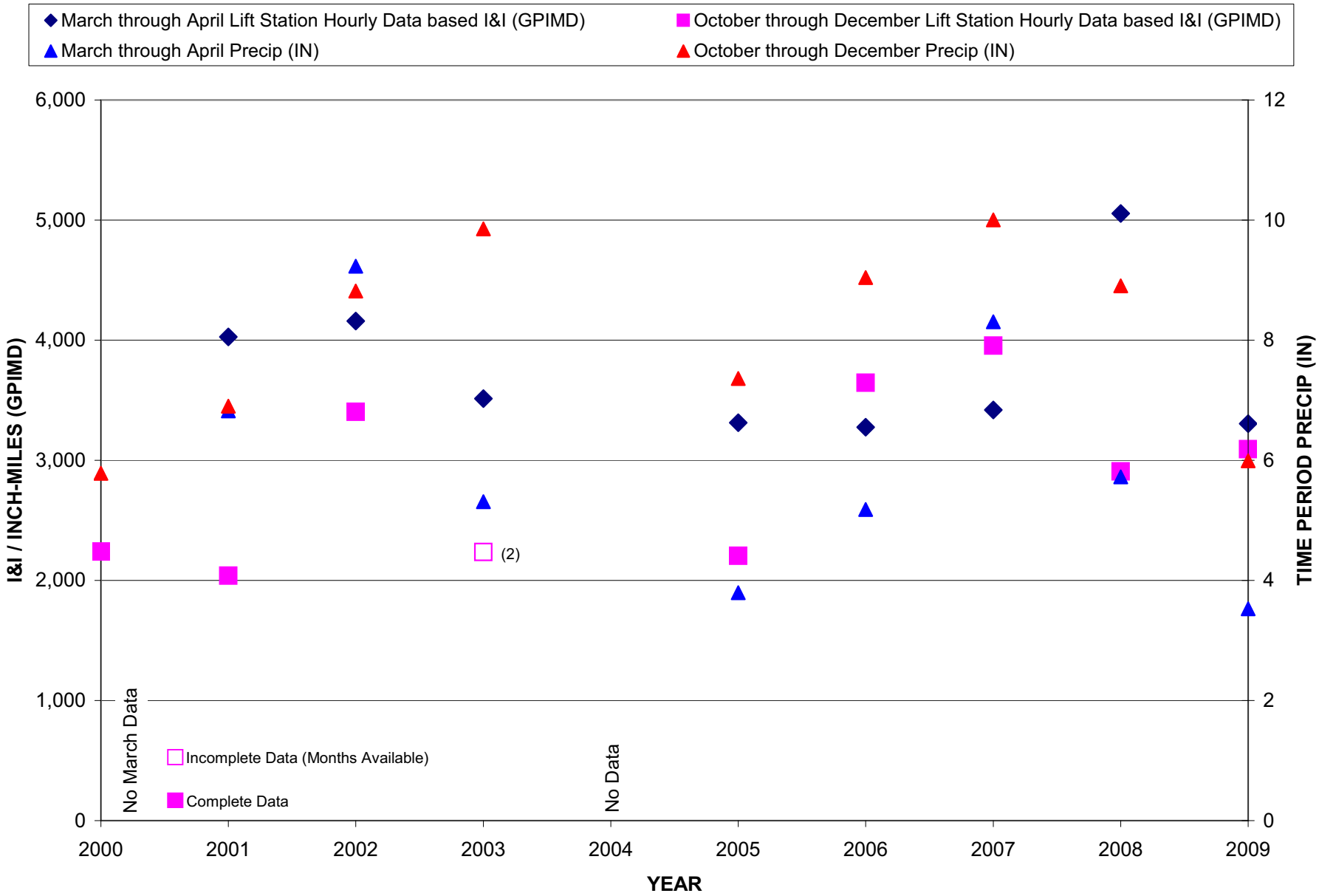
PENN TOWNSHIP SEWAGE AUTHORITY
DAILY I AND I GPIMD AND PRECIPITATION



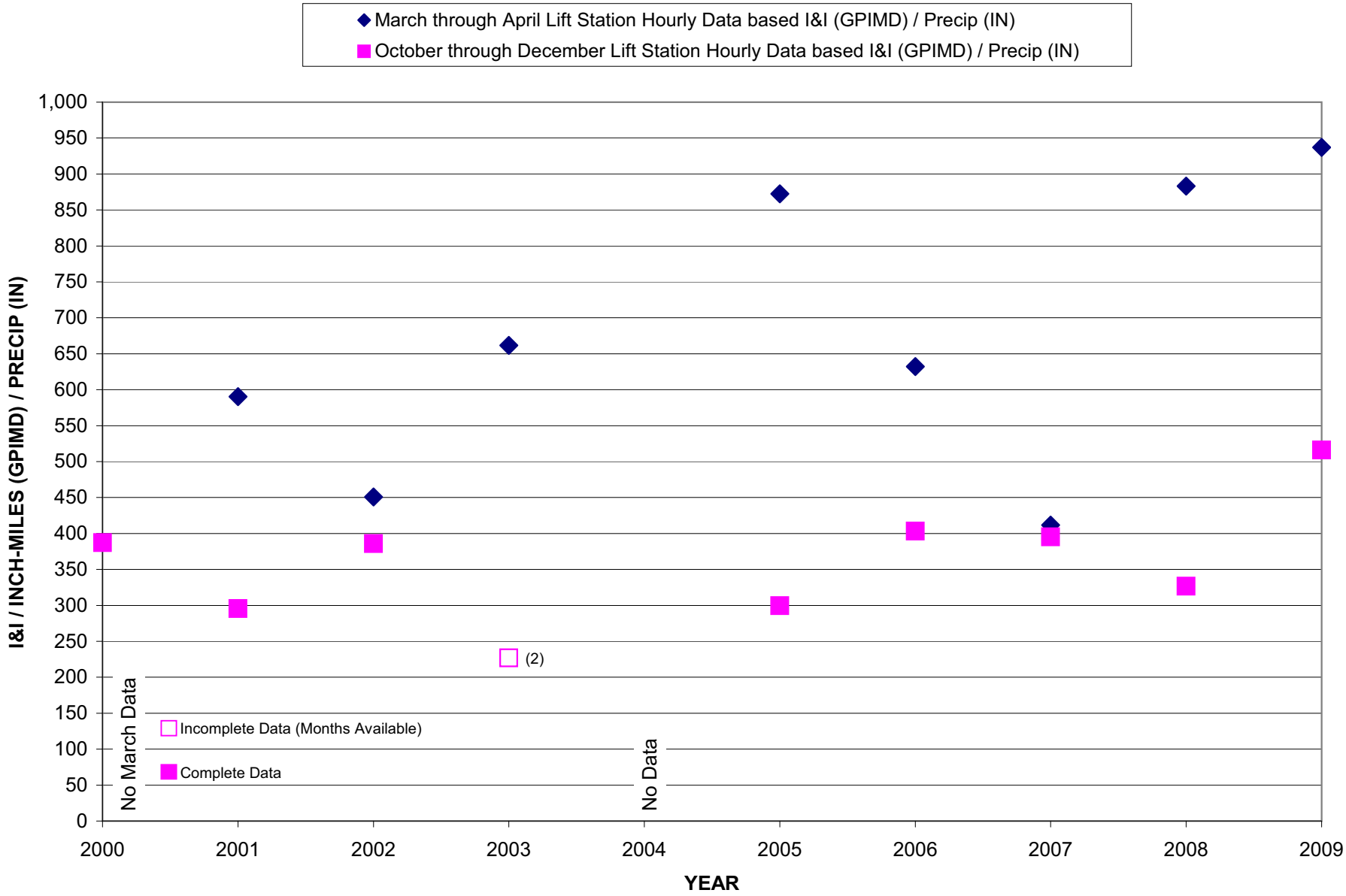
PENN TOWNSHIP SEWAGE AUTHORITY
DAILY I AND I GPIMD VERSE PRECIPITATION



PENN TOWNSHIP SEWAGE AUTHORITY
DAILY I AND I GPIMD AND PRECIPITATION
WET WEATHER



PENN TOWNSHIP SEWAGE AUTHORITY
DAILY I AND I GPIMD VERSE PRECIPITATION
WET WEATHER



Penn Township Sewage Authority
Flow Monitoring Data
Missing/Unusable Data by Month in Weekly Increments[1]

	MONTH											
YEAR	January	February	March	April	May	June	July	August	September	October	November	December
2000	2	1	0	3	4	4	4	3	0	0	0	0
2001	0	0	0	0	0	1	0	0	1	1	0	0
2002	0	0	1	0	0	0	0	0	0	0	0	0
2003	0	0	1	0	0	3	1	2	0	0	3.5	4
2004	1	3	0	4	4	4	4	4	4	4	4	4
2005	0	0	0	0	0	0	0.5	3.5	0	0	0	0
2006	0	0	0	1	0	0	0	0	0	0	1	0
2007	0	2	3.5	0	1	0	0.5	0	1	0	0	1.5
2008	4	3	0	0	0	1	1	1	0	0	0	0
2009	2	0	0	0	0	0.5	0	1	0	1	1	1

[1] 0.5 weeks equals 4 days

YEAR	TOTAL WEEKS MISSING	TOTAL MONTHS MISSING
2000	21	5.25
2001	3	0.75
2002	1	0.25
2003	14.5	4.5
2004	40	10
2005	4	1
2006	2	0.5
2007	9.5	3.25
2008	10	3.25
2009	6.5	2.5

APPENDIX C

Defect Tracking
Sample Collection Form

APPENDIX C
SAMPLE ELECTRONIC DATA COLLECTION FORM

Date	Building Sewer (Lateral) Location		Inspection																	
			Type				Defect									Repair				
					Retest		Major				Minor			Type						
	Street Number	Street	Pass	Fail	Pass	Fail	Broken Pipe	Hole in Pipe	Missing Pipe	Other	Broken Vent Cap	Missing Clean Out	Other	Spot (FT)	Full Replacement (FT)	Other	Date of Repair	Cost	Notes	

APPENDIX D

Additional Information

Community	Web Site	Customers	Public Sewer Length in Miles	Approximate Miles of Lateral	Year Lateral Televising Initiated	Current Inspection Fee	Private Ownership	Dyed Water Injection	Failure Criteria	Test Longevity	Enabling Legislation	Comments
Fox Chapel Borough	www.fox-chapel.pa.us	1,895	78	35	2001	$ 350 + cost of plumber	Home to main	YES	Any observed defect	Next Sale	Ord. 510	Plumber must be registered by Fox Chapel. Currently 44 listed
O'Hara Township	www.ohara.pa.us	3,300	69	37	2002	$100 res./$200 com. Plus cost of plumber	Home to main including wye	YES	Any observed defect	1 Year	Ord. 228	
Unity Township Municipal Authority (Westmoreland County)	www.utmapa.org	7,300	180		1998	$125	Home to main	NO	Any observed defect	3 Years	Res. 92-2 and 96-05	Unity has also performed 2 area wide lateral programs in defined problem areas.
Butler Area Sewer Authority (Butler County)	www.basapa.org	15,000	230		2003	$150	Home to right-of-way	YES	Any observed defect	3 Years	Various Ord by 7 Municipalities	Main portion of lateral under basement floor also televised at time of sale. Must be leaking significantly to fail test.
Plum Borough Municipal Authority	www.plumboroughma.com	10,000	100 (Only 8.5 miles to ALCOSAN)	5 (ALCOSAN Portion only)	2004	$230	Home to main	NO	Any observed defect	1 Year		Web Site appears to be under development
Penn Township Sewage Authority (Westmoreland County)		5,819	83(Only 24 miles to ALCOSAN)	25 (ALCOSAN Portion only)	1998	$125	Home to right-of-way	NO	Any observed defect	3 Years	Penn Twp. Ord 630 plus Authority Rules/Regs	
South Fayette Township Municipal Authority	www.matsf.net	5,900	126	45	2007	$175 if 7 day notice is given. $275 for short notice/weekends (+ $1/ft if lateral exceeds 100ft -negotiable)	Home to right-of-way	YES	Level 3 or greater NASSCO structural defect (or multi level 2 defects) or Level 2 or greater leak defect	3 Years	Res. # 150	$1,000 Incentive paid for complete lateral replacement or relining from house to right-of-way plus $5/ft in excess of 100' replaced. No incentive paid for authorized spot repairs.
North Fayette Township	www.north-fayette.com	4395 (ALCOSAN portion only)	34 (ALCOSAN portion only)	22	2010	$30 + cost of plumber	Home to main	NO	Level 3 or greater NASSCO structural defect (or multi level 2 defects) or Level 2 or greater leak defect	3 Years	Ord. 359 and 401	
North Huntingdon Township Muncipal Authority (Westmoreland County)	www.nhtma.org	12,600	265 (Only 5 Miles to ALCOSAN	4 (ALCOSAN Portion only)	2008	$230	Home to main unless lateral cross public road, then to R/W	?	Level 3 or greater NASSCO structural defect (or multi level 1/2 defects) or any observed leak	2 Years	Rules & Regulations adopted 5-1-08	NHTMA also has a area wide lateral inspection program in portions of their system where mains are replaced/relined. Generally, same failure criteria is use but up to 5 years is allowed for repairs of level 3 defects, and 12 months for level 4/5 defects. Also, under the area wide program, low/moderate income property owners may apply for CDBG funds for lateral repairs.
Peters Township Sanitary Authority (Washington County)	www.ptsaonline.org	6,000	138 (Only 1.5 Miles to ALCOSAN	1 (ALCOSAN portion only)	2008 (no time of sale televising of lateral is performed unless leak is found via rainfall simulation)	Dye test: $150 + $50 if PTSA supplies water; $50 no-show fee	Home to main	YES	PTSA performs rainfall simulation at time of sale for both inflow sources and injection of water along foundation to look for subsurface building sewer leaks.	1 Year	Twp. Ord. #507 and Authority Resolutions 98-7-1; 04-05-08; and 06-08-09	PTSA has conducted area-wide lateral inspection programs in portions of the system when mains are repaired/relined. In particular, a pilot area wide program is currently underway in the Friar Lane area.
Baldwin Borough	www.baldwinborough.org	Approx. 5,900 (ALCOSAN portion only)	71 Miles to ALCOSAN	45 (ALCOSAN portion only)	2012	$25 + cost of plumber	Home to main	YES	Level 3 or greater NASSCO structural defect (or more than two NASSCO level 2 defects in 50') or any leak with a NASSCO Level 2 or higher rank	5 Years	Ord. 844 effective 4-23-12	
Franklin Township Municipal Sanitary Authority (Westmoreland County)	www.ftmsa.org	Approx. 12,100 EDU's	327.5		2010	$350 (Include initial inspection and any re-testing)	Home to right-of-way	NO	Any observed defect	5 Years	Authority Resolution 10-08 and Murrysville Ordinance 804-10	Murrysville Ordinance also written to address inspection of laterals other than time of sale. Lateral televising currently only performed at time of sale and refinancing for the Murrysville customers tributary to FTMSA. Other tributary communities doing basic dye test only.

Approximate Lateral Length in Miles is an estimate from the 3RWW WebMap and applies to ALCOSAN service area only. These values are likely less than the actual since the shortest path from building to main is presumed without bends and since multi-family buildings such as townhomes are represented in WebMap as a single lateral where oftentimes there are several. This may also apply to certain commercial buildings.

Updated 8/29/2013

APPENDIX E

Standard Operating Procedure for Dye Testing

APPENDIX E

Procedures for Performing Dye Testing
Field Personnel

Areas to be tested: Manholes (if present)
Downspouts & Roof Leaders
Foundation Drains
All Area Drains: Stairwell, Driveway, Open Drains
Vented House Trap

Begin with a visual observation of the property; locate any and all surface drains, roof leaders and any possible points of discharge for verification. Dye test vent trap, or connected fixture, to confirm sanitary point of discharge. Observations for dye will be made in the nearest manhole downstream of the building sewer, verify that you are viewing the correct manhole.

Manholes:

- If property contains a manhole, verify it is not buried and is free and clear for access.
- If buried less than four inches: clear the debris, excavate and raise to grade.
- If buried more than four inches: indicate on the form the physical description of the location, such as planter, mulch bed, lawn, etc.

Downspouts and Roof Leaders:

- **ALL** roof drain leaders that do not discharge directly onto the surface shall be tested by introducing dyed water into each conductor. The discharge must not enter the sanitary sewer either directly or indirectly.

Foundation Drains:

- Inspect the basement for sump pumps, inside foundation drains and obvious concrete work leading to the floor drains. If present, open drain and perform a visual inspection for prohibited connections and note same on form if found.
- Any and all sump pumps serving the residence shall be tested by filling the sump pit with dyed water and operating the pump. Verify dyed water does not enter the sanitary sewer main.
- The outside perimeter of the house shall be checked for the presence of prohibited foundation drain connects. This will require the injection of dyed water into the ground and allowing ample time for the said dye to permeate the ground and reach the discharge point. The dye shall be injected by means of a 3/4 to 1 inch pipe worked into the ground with water flowing to depth of approximately 2 to 3 feet (see attachment for diagram of apparatus). The points of injection will be determined by the lay of the land and position of the structure. A minimum of one injection point for each side of the dwelling will be required. One injection point will be as close to the vent trap as possible. If the ground is frozen and the test is not able to be performed, contact management.
- When the inspection port has been provided at the property line it may be used for the purpose of observing the dye. Under no circumstances will the use of the vent trap be permitted for observation of dye to determine a violation because prohibited connections may be downstream of the vent trap. Ample time must be allowed to elapse before making

determination of pass or fail. It must be recognized that dyed water may go into a drywell, an old septic tank, leach field, water buffalo, storm sewer, or simply on the ground. If dye is not located in the sanitary sewer main within a reasonable amount of time, typically 10 minutes, depending on circumstances (extended building sewers or extremely dry conditions would require longer times), assume test location not to be a violation.

Area Drains:

- **ALL** surface or areaway drains, including but not limited to, stairwell, driveway drains, and the like, shall be tested. Each shall be tested individually, and independently of each other by introducing dyed water into each.

Inspection Ports, Vents and Cleanouts:

- Locate vent trap and make note of height above ground level and ensure vent does not serve as an area drain.
- If there is an inspection port installed, verify integrity: cap height, casting, etc
- Verify the clean out complies with Rules and Regulations as of the date of installation or rehabilitation. Locate all cleanouts shown on permit, verify they are not compromised and are in compliance with the Rules and Regulations.

New Construction:

- A Dye Test is not required if the following two criteria are met:
  1. The property has been connected to the sanitary sewer within the previous 12 months;
  2. The building inspector has performed the final plumbing inspection within the preceding 12 months.

Other Tests:

- Running water observed in the tap, with no fixtures being used, will constitute a violation.
- When running water is observed in the tap, with no fixtures being used, the CCTV camera will be employed, if possible to assist in determining the source o f the infiltration.
- Smoke testing may also be used to identify deficiencies on the property.

Notes:

- **Appointment Time**:
  1. Inspection has been scheduled. Show up on time.
  2. Homeowner or homeowner's representative has a 15 minute grace period to show for a scheduled appointment. A fee will be charged to the homeowner if late.
  3. If homeowner does not show, contact office to confirm homeowner did not call and is running late.
- **Location of facilities:** A copy of the permit drawing for the service connection and a copy of the sewer line drawings for the area identifying the manhole to view will be provided.
- **Reports:** Results of the inspection will be entered on the Work Order for Dye Test and Inspection. The form will be completed in it entirety.
- **Violations:** Once a violation is encountered, the color of the dye solution must be changed before proceeding to avoid the possibility of a false positive result. Allow ample time and

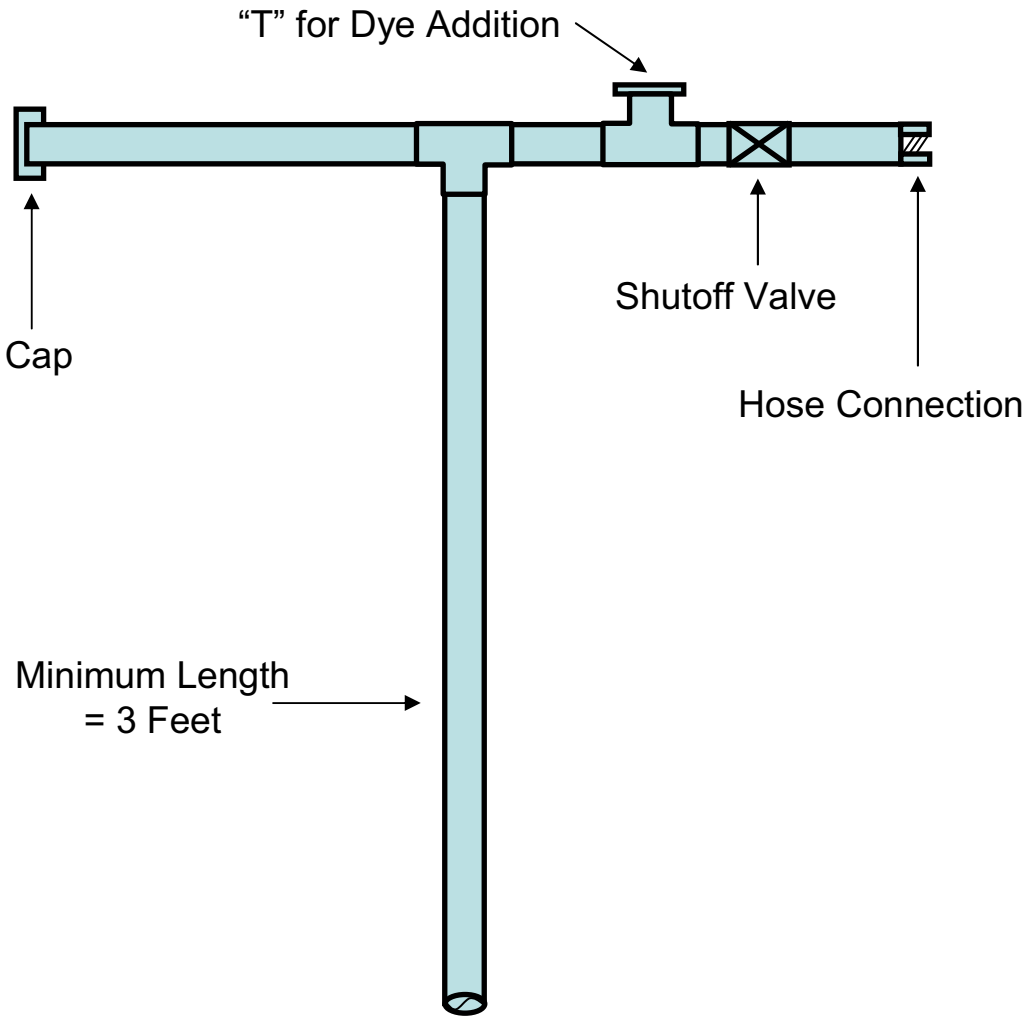
flow to flush the trap of existing dye. Violations will be noted on the Work Order for Dye Test and Inspection.

- **Violation Correction**: If a prohibited discharge is disconnected, it shall conform to applicable Township ordinances and Authority Rules and Regulations.
- **Completed Report:** A completed Report of Dye Test and Inspection shall be returned to the Authority office for processing upon completion of the test. The report shall be completed in its entirety, and notation made when test locations are non existent.
- **Results of Test:** Field personnel will not comment as to the findings or result of testing to the homeowner or homeowner's representative during or after the test. All results or comments will be provided in writing by management.

Procedure for Performing a Dye Test
Violation Correction Inspection

- Refer to original Work Order and locate the section noting the location and circumstances of violation(s) encountered.
- Inspect violations to determine proper corrective actions have been taken. Note on the Violation Correction Inspection form the corrections made to bring into compliance.
- List any violations that have not been corrected or corrected properly.
- The above "Notes" will be followed where applicable.
- The complete Violation Correction Inspection form shall be returned to the Authority office for processing upon completion of the test.

FOUNDATION DRAIN TESTING APPARATUS



To be constructed of 3/4 or 1 inch rigid steel pipe