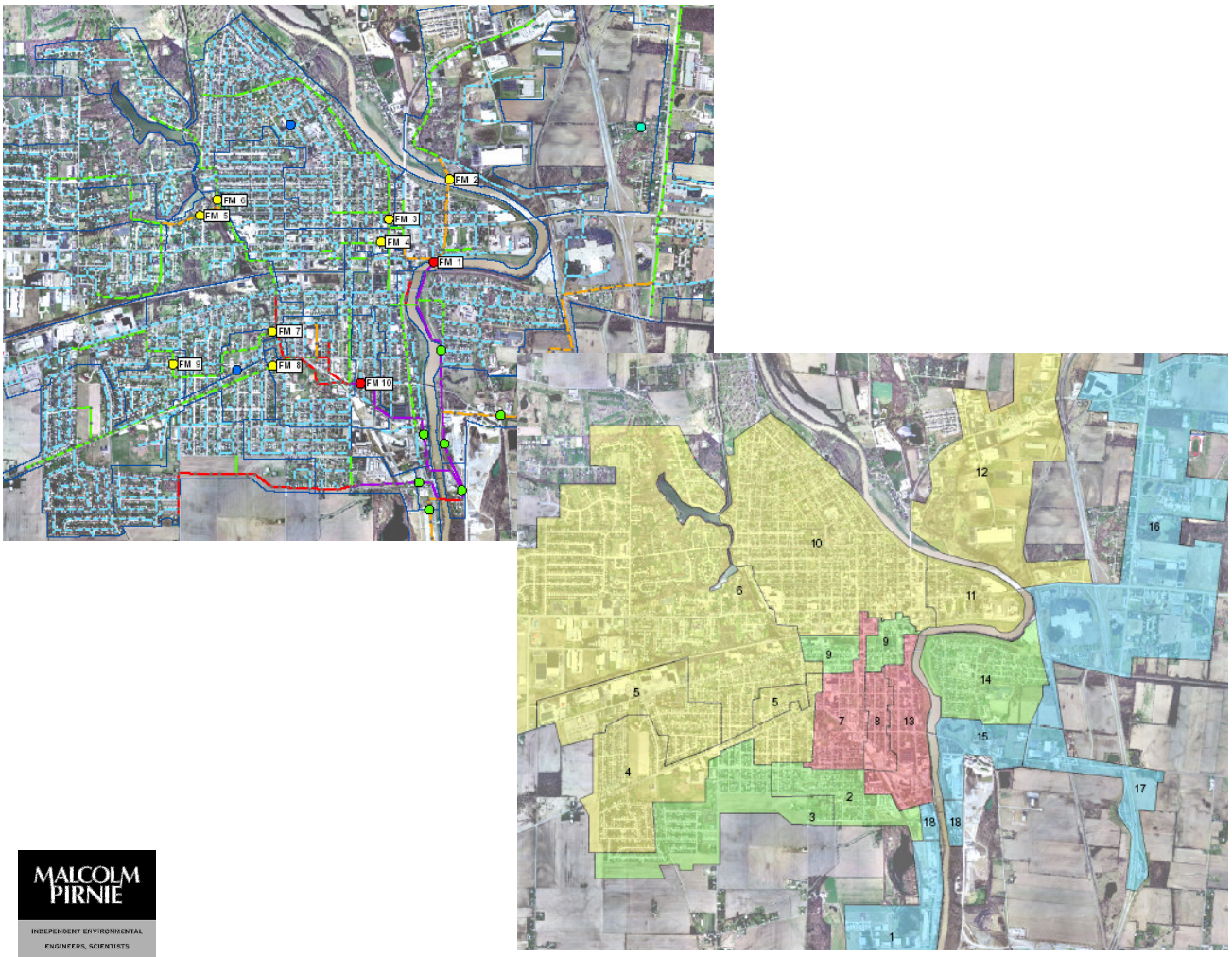
CITY OF PIQUA, OHIO

INFLOW AND INFILTRATION INVESTIGATION AND SEWER SYSTEM EVALUATION SURVEY PLAN

FINAL REPORT

OCTOBER 2006



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CITY OF PIQUA
INFLOW AND INFILTRATION INVESTIGATION AND SEWER SYSTEM EVALUATION SURVEY PLAN

FINAL REPORT

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INFLOW AND INFILTRATION INVESTIGATION AND SEWER SYSTEM EVALUATION SURVEY PLAN

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1.0 INTRODUCTION

1.1 PROJECT BACKGROUND

The City of Piqua (City) has experienced overflows within the sanitary sewer collection system because of rainfall dependent infiltration and inflow (RDI/I). The overflows occur upstream of the headworks facility of the Wastewater Treatment Plant (WWTP). The WWTP peak hydraulic design capacity is 8.3 mgd, controlled by the influent pumping firm capacity and the open channel capacity between WWTP processes. Once the flow rate exceeds 8 mgd, the plant operators throttle the flow to prevent flooding at the WWTP. This throttling creates a backwater condition in the interceptor sewers. If the wet weather event exceeds the interceptor storage capacity, then excess flows overtop a weir and discharge to the river upstream of the inverted siphon that crosses the Miami River.

In 2003, the Ohio Environmental Protection Agency (OEPA) directed the City to develop a plan to address this SSO. The City subsequently retained Malcolm Pirnie, Inc. to assist in developing this plan and to begin its implementation. An initial part of the plan, completed in 2006, was to develop a hydraulic model of the interceptor sewer system so that the City could begin to analyze solutions to control overflow events. The model was developed and calibrated based on a flow and rainfall monitoring program conducted in the spring of 2004. The data analysis and model results indicated that the interceptor sewer system has adequate capacity to transport both current and future wet weather flows to the WWTP, up to a 25-year, 24-hour design storm. The resulting peak flow for this design storm event is 20.3 mgd. The analysis also identified areas within the City's wastewater collection system that experience high amounts of RDI/I.

Figure 1-1 shows these areas shaded in red and yellow. The red area is the Power Plant meter basin and a portion of the Garnsey Street meter basin. The Power Plant meter basin was identified as high RDI/I locations from the previous flow meter data and model analysis. A portion of the Garnsey Street meter basin was included in the red area due to observations by City employees over the past few years.

The yellow areas represent two basins, the Water Street meter basin and the Garnsey Street meter basin. These areas experienced peaking factors greater than five but capture ratios less than nine percent during rainfall events. These values indicate that high amounts of RDI/I are entering the collection system and that this RDI/I could potentially be reduced with cost effective methods, such as sewer rehabilitation or replacement, illicit connection removal, and

N

Legend

- L-SEWR

Sanitary Sewers

- 6 - 10"
- 12 - 15"
- 16 - 21"
- 24 - 30"
- >33"

- Peaking Factor <5.0 and Capture Ratio <9.0%
- Capture Ratio >9.0%
- Peaking Factor >5.0
- Peaking Factor >5.0 and Capture Ratio >9.0%

NOTE
THIS IS FIGURE 5-3 FROM "SANITARY SEWER OVERFLOW EVALUATION" REPORT AUGUST 2006.

0 1,250 2,500 5,000
Feet

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DATE MAY 2006

Potential Inflow/Infiltration Problem Areas

INFLOW AND INFILTRATION INVESTIGATION AND SEWER SYSTEM EVALUATION SURVEY PLAN
CITY OF PIQUA, OHIO

FIGURE 1-1

storm to sanitary sewer cross-connection elimination. The blue and green areas were identified as portions of the collection system that are not likely to have RDI/I that can be reduced with cost effective methods, or have very little RDI/I. A more detailed presentation of the methods used to collect the 2004 data, and the results of the data analysis, can be found in the "Sanitary Sewer Overflow Evaluation" report prepared by Malcolm Pirnie, Inc. in August 2006.

1.2 PROJECT GOALS AND OBJECTIVES

The overall goal for the City is to eliminate sanitary sewer overflows (SSOs). Several alternatives to abate SSOs were evaluated during previous studies. Two solutions were identified as being potentially feasible for the City to eliminate SSO activity. The first alternative includes the construction of a 6 million gallon storage tank estimated to cost $14.8 million. The second potential alternative recommended was to determine the cost effectiveness of removing/reducing RDI/I through a sewer system evaluation survey (SSES) program. Because the City's SSO activates infrequently, (typically once or twice per year), the City made the decision to explore RDI/I reduction. RDI/I reduction is typically completed in two steps:

Step 1 – Flow and rainfall monitoring to identify areas for a SSES program.

Step 2 – Completion of a SSES program.

The objectives for this project (Step 1) are to establish a program that will:

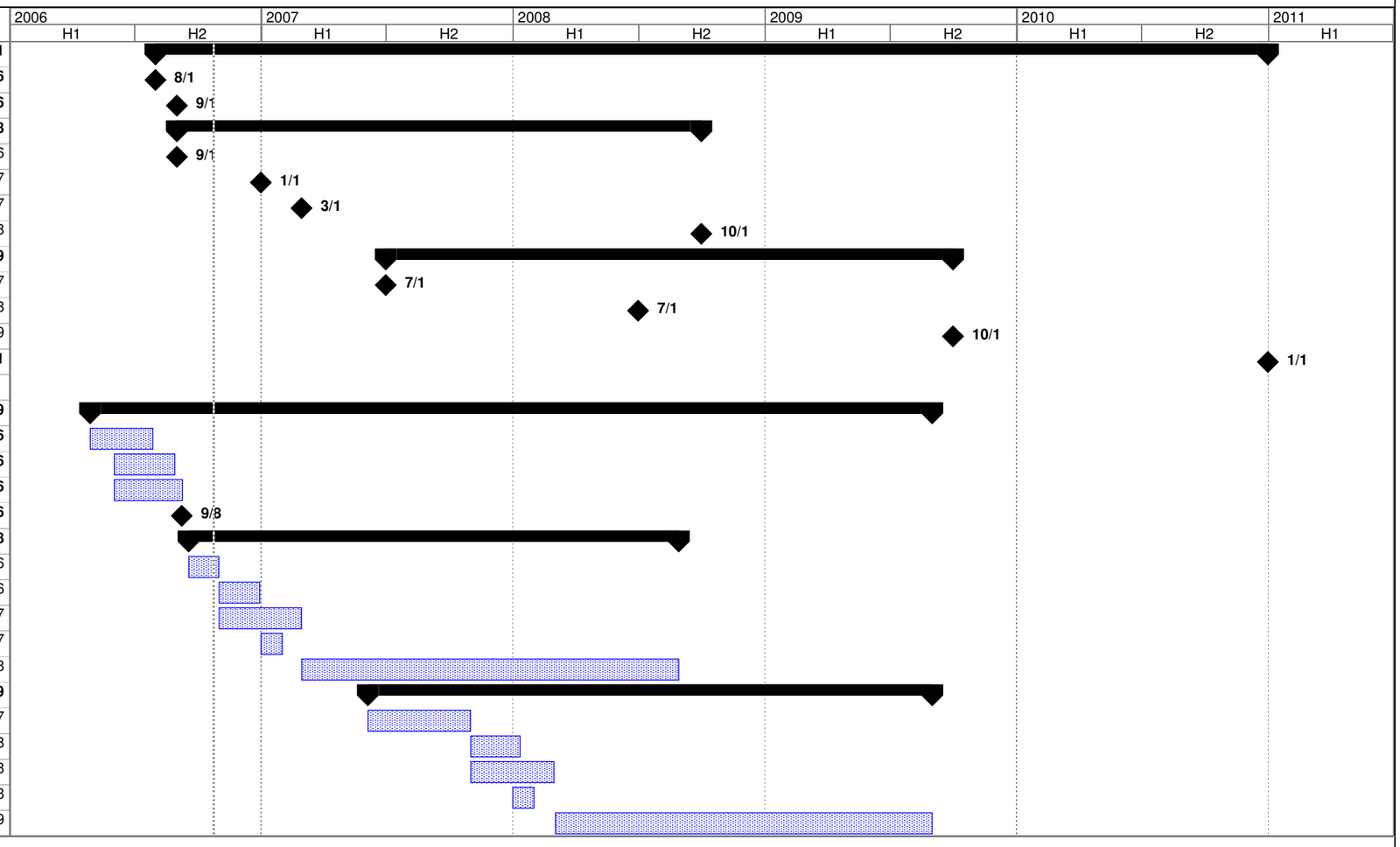
- Determine the extent of RDI/I in the Water Street and Garnsey Street basins.
- Develop a SSES plan for the targeted areas mentioned above.
- Satisfy OEPA requirements.

To achieve these objectives, additional information was required within the areas discussed above. Additional flow data was collected through flow monitoring (Step 1) of the yellow area to identify high RDI/I areas. The flow monitoring data was than used to develop a SSES program, which includes smoke testing, manhole inspection, closed-circuit television inspection, and dye testing. Based on the draft permit, all of the data must be collected and corresponding reports submitted to OEPA within a negotiated timeframe.

A preliminary schedule for the SSES was presented to the OEPA on March 29, 2006. OEPA informed the City by phone on April 18, 2006 that RDI/I removal was an acceptable alternative to storage, and that the proposed schedule would be incorporated into the next National Pollutant Discharge Elimination System (NPDES) permit. The draft NPDES permit was provided to the City on April 28, 2006, who responded with comments on June 5, 2006. The

SEWER SYSTEM EVALUATION SURVEY SCHEDULE

ID	Task Name	Duration	Start	Finish
1	**Ohio EPA Timeline**	**1155 days**	**Tue 8/1/06**	**Sat 1/1/11**
2	**NPDES Permit Sign Date**	**0 days**	**Tue 8/1/06**	**Tue 8/1/06**
3	**Begin Monitoring Program**	**0 days**	**Fri 9/1/06**	**Fri 9/1/06**
4	**Phase I**	**544 days**	**Fri 9/1/06**	**Wed 10/1/08**
5	Begin SSES Work	0 days	Fri 9/1/06	Fri 9/1/06
6	Submit SSES Report	0 days	Mon 1/1/07	Mon 1/1/07
7	Submit PIT to Ohio EPA	0 days	Thu 3/1/07	Thu 3/1/07
8	Complete Construction	0 days	Wed 10/1/08	Wed 10/1/08
9	**Phase II**	**589 days**	**Sun 7/1/07**	**Thu 10/1/09**
10	Begin SSES Work	0 days	Sun 7/1/07	Sun 7/1/07
11	Submit PIT to Ohio EPA	0 days	Tue 7/1/08	Tue 7/1/08
12	Complete Construction	0 days	Thu 10/1/09	Thu 10/1/09
13	**Submit SSO Elimination Plan**	**0 days**	**Sat 1/1/11**	**Sat 1/1/11**
14				
15	**Project Timeline**	**874 days?**	**Fri 4/28/06**	**Mon 8/31/09**
16	**Flow Monitoring**	**66 days**	**Fri 4/28/06**	**Thu 7/27/06**
17	**Flow Data Analysis**	**63 days**	**Fri 6/2/06**	**Mon 8/28/06**
18	**Develop SSES Program**	**72 days?**	**Fri 6/2/06**	**Fri 9/8/06**
19	**Submit SSES Program to City**	**0 days**	**Fri 9/8/06**	**Fri 9/8/06**
20	**Phase I**	**510 days**	**Mon 9/18/06**	**Thu 8/28/08**
21	SSES Investigation	32 days	Mon 9/18/06	Tue 10/31/06
22	SSES Report	43 days	Wed 11/1/06	Fri 12/29/06
23	Design	86 days	Wed 11/1/06	Wed 2/28/07
24	Permit to Install	1.15 mons	Mon 1/1/07	Wed 1/31/07
25	Construction	19.6 mons	Thu 3/1/07	Thu 8/28/08
26	**Phase II**	**586 days**	**Tue 6/5/07**	**Mon 8/31/09**
27	SSES Investigation	108 days	Tue 6/5/07	Wed 10/31/07
28	SSES Report	52 days	Thu 11/1/07	Fri 1/11/08
29	Design	87 days	Thu 11/1/07	Fri 2/29/08
30	Permit to Install	1.15 mons	Tue 1/1/08	Thu 1/31/08
31	Construction	391 days	Mon 3/3/08	Mon 8/31/09



Project: Piqua_Schedule-final.mpp
Date: Mon 10/23/06

Task | Progress | Summary | External Tasks | Deadline
Split | Milestone | Project Summary | External Milestone

INFLOW AND INFILTRATION INVESTIGATION AND
SEWER SYSTEM EVALUATION SURVEY PLAN
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FIGURE 1-2

NPDES permit was filed on August 1, 2006. The top portion of Figure 1.2 shows the schedule as defined by the NPDES permit.

2.0 INFLOW AND INFILTRATION INVESTIGATION

The first step of an RDI/I analysis is flow and rainfall monitoring to determine the extent of the RDI/I by separating larger areas into smaller service areas, or sub-basins. Similar to typical data collection needs for model development and calibration, this monitoring should occur during the high ground water and wet weather season. This section will discuss the flow and rainfall monitoring activities. Data collected during flow and rainfall monitoring is used to design the second step, a subsequent SSES program, as described in Section 3.0.

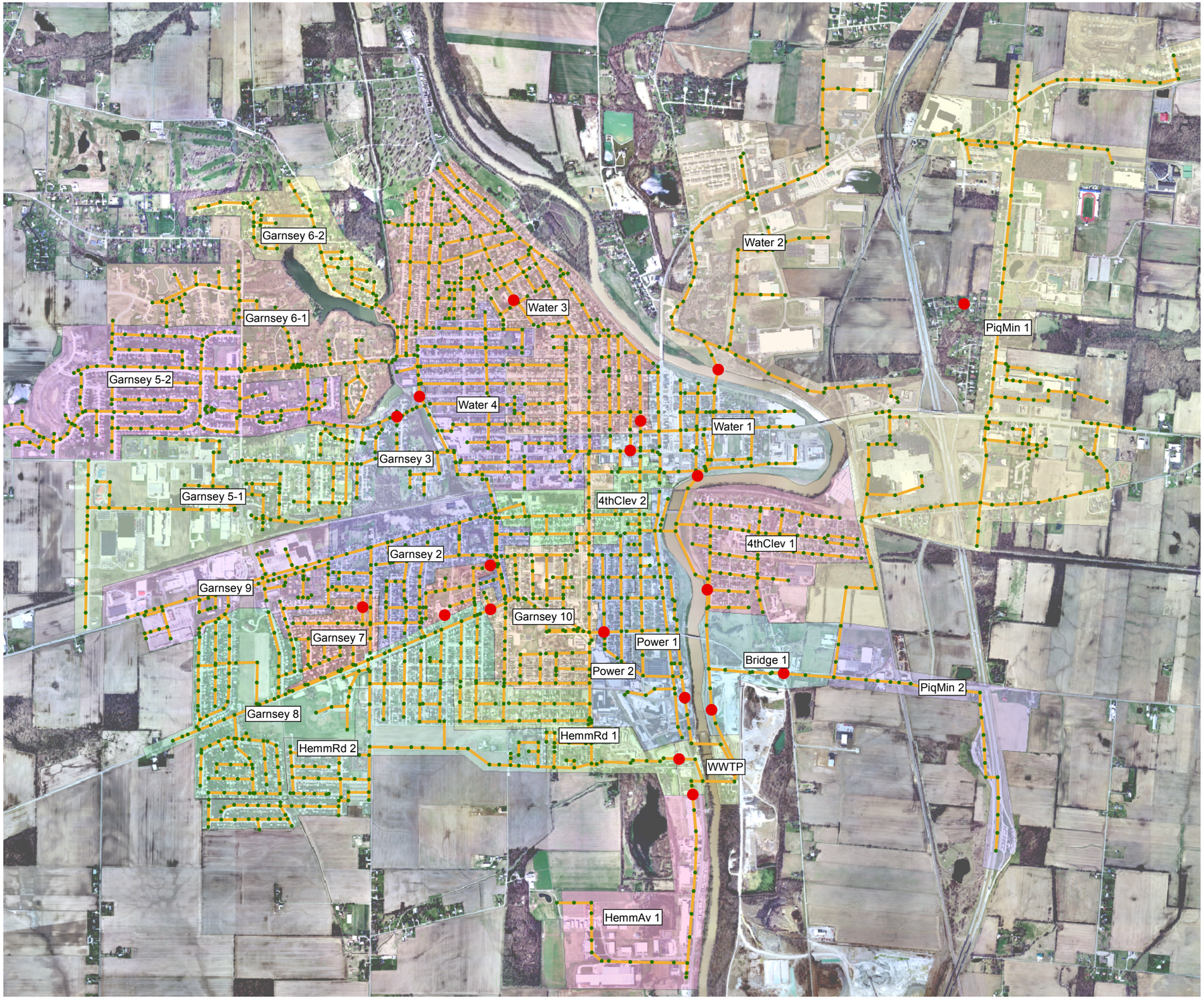
2.1 DATA COLLECTION

Data collected during previous studies identified two areas (yellow) requiring additional flow monitoring and one area (red) that has significant amounts of RDI/I during spring conditions and/or large rainfall events. These areas are shown in Figure 1-1. The basins were divided into sub-basins as shown in Figure 2-1.

The red area experiences both high peaking factors and high rainfall capture ratios. This means that the RDI/I in the red area is more excessive than levels Ten State's Standards specifies as acceptable. Because of this, and the fact that City employees identified known sources of RDI/I, additional flow monitoring was not required in this area. The SSES program will encompass all of the pipes and manholes within this area, as discussed in Section 3.2.

The yellow area can be further divided into the drainage area tributary to the Water Street meter and the drainage area tributary to the Garnsey Street meter. Figure 2-2 shows these meters, as well as the locations of all the meters used in the 2004 study, as well as the additional meters used in this project. Figure 2-3 shows a flow schematic of the collection system in relation to the flow meters.

The Water Street drainage area was further divided into four sub-drainage areas, represented by flow monitors: FM01, FM02, FM03, and FM04. The Garnsey Street drainage area was divided into six sub-drainage areas: FM05, FM06, FM07, FM08, FM09, and FM10.



N

Legend

- Sanitary Sewer System
- Manholes
- Meters

0 1,250 2,500 5,000

Feet

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DATE MAY 2006

SEWERSHED SUB-BASINS

INFLOW AND INFILTRATION INVESTIGATION AND SEWER SYSTEM EVALUATION SURVEY PLAN
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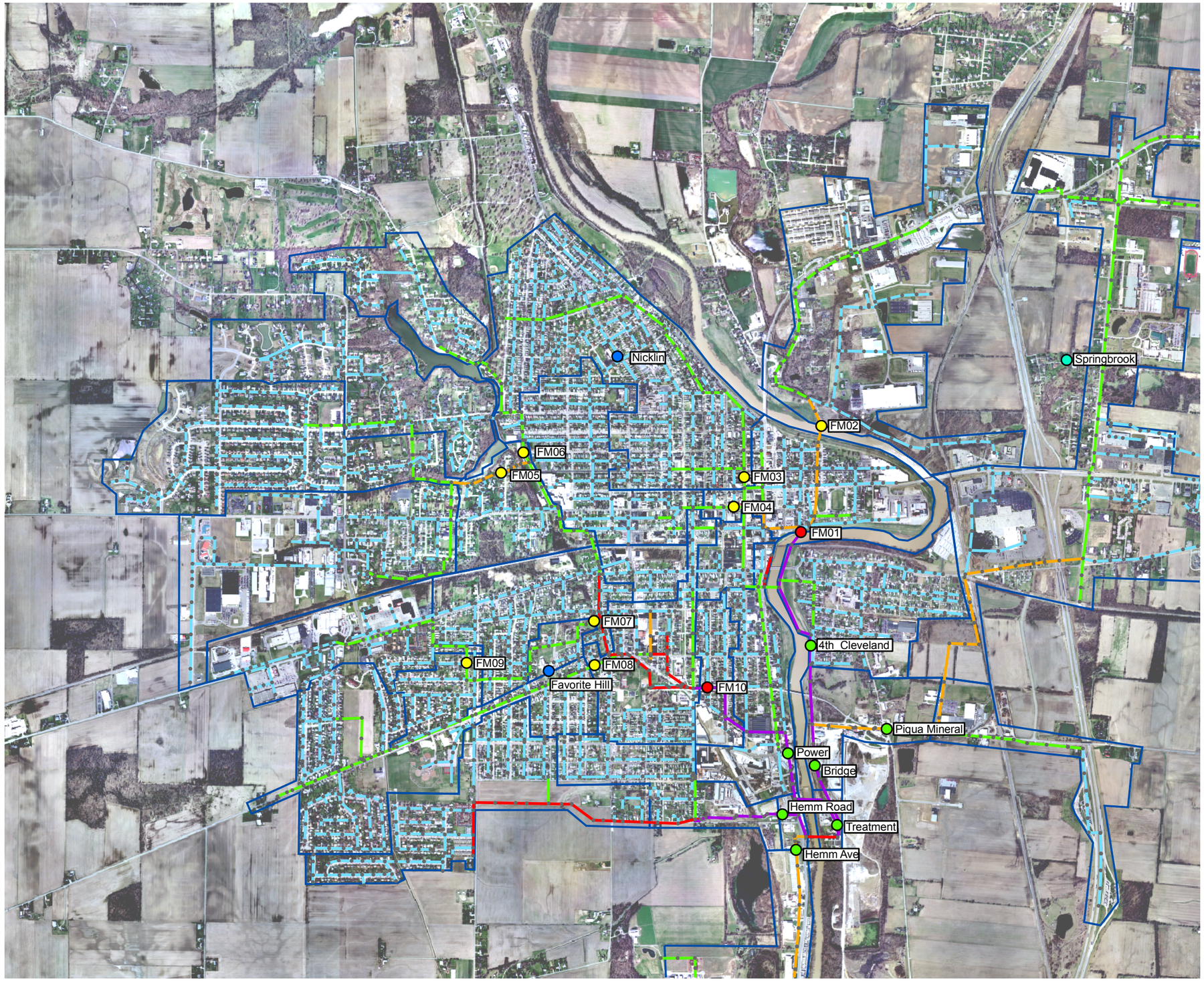
FIGURE 2-1



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Legend

Meters

- Meters 2004
- Meters 2004 and 2006
- Meters 2006
- Raingage 2004
- Raingage 2004 and 2006
- Manholes
- Subbasins

Sanitary Sewers

Diameter

- 6 - 10"
- 12 - 15"
- 16 - 21"
- 24 - 30"
- >33"

0 1,250 2,500 5,000

Feet

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DATE MAY 2006

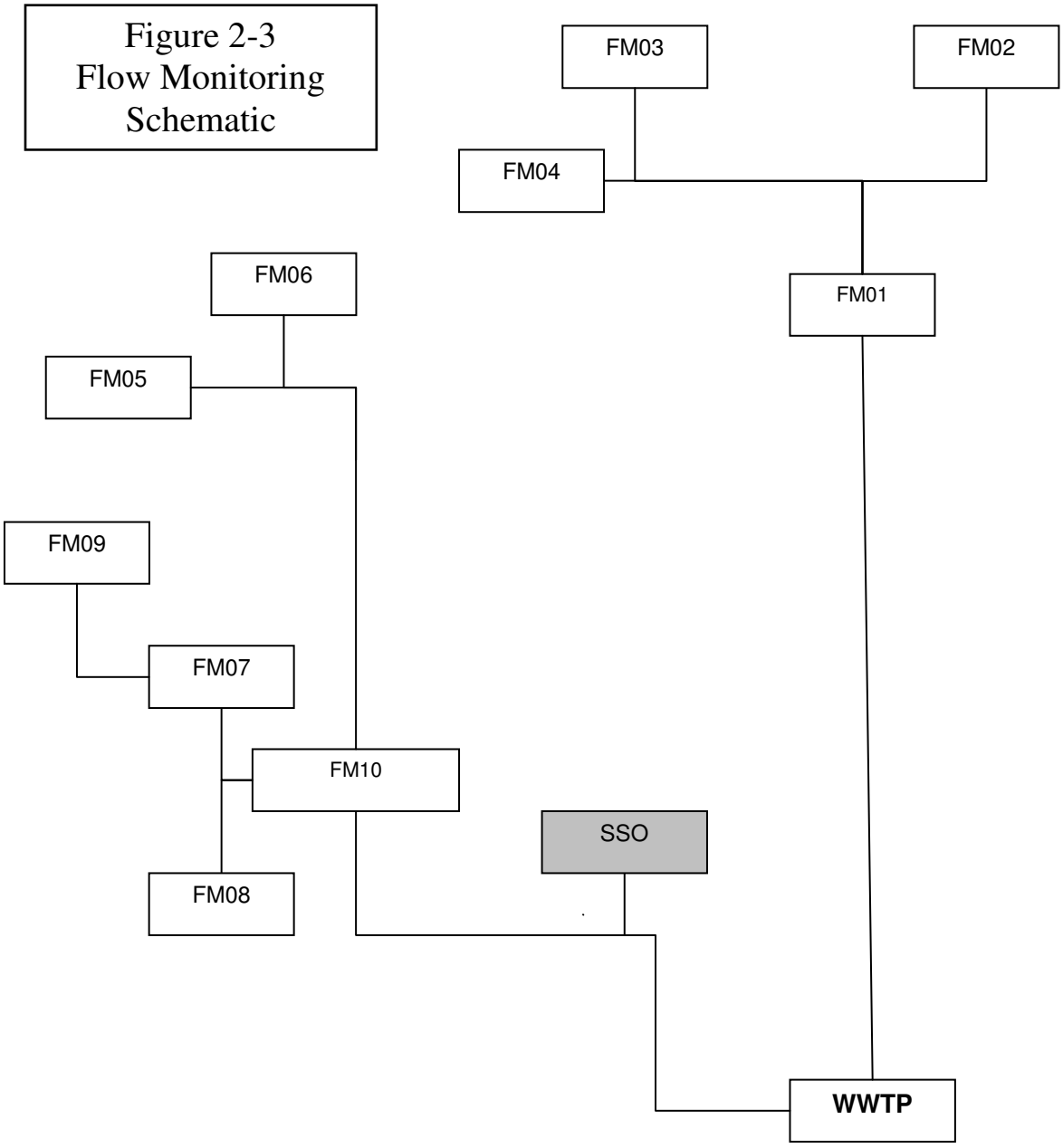
Flow Meter and Rain Gage Locations

INFLOW AND INFILTRATION INVESTIGATION AND SEWER SYSTEM EVALUATION SURVEY PLAN

CITY OF PIQUA, OHIO

FIGURE 2-2

Figure 2-3
Flow Monitoring
Schematic



All of the flow monitors were installed on April 28, 2006. They were programmed to collect depth and velocity readings every five minutes. Site visits occurred at least once a week where the data was downloaded and the precision of the meter measurements were checked and, if needed, adjusted. After the data was collected, it was reviewed for accuracy. The meters were removed on July 31, 2006.

In addition to flow data collected from the collection system, rainfall data was collected. Two rain gages were installed on the roofs of school buildings, away from structures that might interfere with data collection. Figure 2.1 shows the location of the rain gages, which were located at Favorite Hill School and Nicklin Learning Center. The rain gages used tipping bucket technology and recorded precipitation at 0.01 inch increments.

2.2 DATA ANALYSIS

Flow monitoring data is used to determine the magnitude of RDI/I entering the collection system and helps to determine if inflow and/or infiltration sources are present. When flows increase from the diurnal pattern soon after rainfall begins and returns to normal dry weather flows soon after the rainfall terminates (fast response) it suggests there are inflow sources from direct connections to the sanitary sewer system. These can be either cross-connections with the storm sewer system or illicit connections with roof or yard drains.

If the monitored flow begins to increase after the rainfall begins, or even after the event ends, and returns to normal flows within 12 hours (medium response) it suggests rapid infiltration sources are present within the collection system such as sump pumps, leaky service laterals, and foundation drains. If the monitored flow has a long recession limb after a rainfall event (slow response) it suggests there are infiltration sources due to cracks, misalignments, or root infiltration in the infrastructure. Hydrographs depicting the monitored flow for each meter are presented in Appendix A. Rain data is presented in Appendix B.

Table 2-1 provides the statistical analyses for each flow meter. There were four meter locations that experienced peaking factors greater than 5.0, FM06, FM07, FM08, and FM10. Peaking factors greater than 5.0 suggest that fast and medium responses to rainfall events are present in the collection system. Industry experience indicates that typical peaking factors for a sanitary sewer system are between 2.0 and 5.0. The four meters with peaking factors greater than 5.0 are located within the Garnsey Street meter drainage area.

Note two meters within the Water Street meter drainage area were influenced by back water conditions, as identified with a footnote in Table 2-1. The back water condition at these two meter locations was caused by restricting the peak flow at the WWTP headworks. Had the peak flow not been restricted, it is likely that the peaking factors would be greater than what was reported.

FM02 was located downstream from a commercial and industrial area. This resulted in the high calculated average dry weather flow (ADWF) per capita in gallons per capita per day

(gpcd) shown in Table 2-1. A high ADWF does not provide insight into the amount of RDI/I entering the system.

TABLE 2-1
SYSTEM STATISTICS AND PEAKING FACTORS

Flow Meter	Pipe Diameter (inches)	Population [1]	Minimum Dry Weather Flow (mgd) [2]	Average Dry Weather Flow (mgd) [3]	Average Dry Weather Flow per Capita (gpcd)	June 2, 2006 Peak Flow (mgd) [4]	Peaking Factor [5]
FM01	33	6,725	0.32	1.05	156	2.18[7]	2.1[7]
FM02[6]	21	253	0.02	0.20	791	0.43[7]	2.2[7]
FM03	15	3,751	0.01	0.25	67	0.94	3.7
FM04	12	1,889	0.02	0.11	58	0.43	3.9
FM05	15	2,204	0.18	0.55	272	1.77	3.2
FM06	18	645	0.02	0.14	211	0.68	5.0
FM07	12	1,175	0.07	0.32	272	2.37	7.4
FM08	12	1,840	0.06	0.25	136	2.31	9.3
FM09	12	669	0.02	0.21	314	0.72	3.4
FM10	36	8,129	0.49	1.23	151	7.52	6.1

(1) Population based on year 2000 U.S. Census Blocks
(2) Minimum Dry Weather Flow based on year 2006 flow monitoring data
(3) Average Dry Weather Flow based on year 2006 flow monitoring data
(4) Peak Wet Weather Flow during the 90 days of monitoring occurred on June 2, 2006
(5) Peaking Factor = June 2, 2006 Peak Flow / Average Dry Weather Flow
(6) Commercial/Industrial discharges contribute to the high gallons per capita per day flows
(7) Peak Wet Weather Flow influenced by WWTP gate operation, Peak Flows expected to be higher when unrestricted

Wet Weather Peaking Factor exceeds 5.0

Table 2-2 shows the percent capture ratio for each meter during five significant rain events. The capture ratio is the percentage of rain water that enters the collection system upstream of the measured location. Only FM07 for one event had a percent of rainfall captured greater than 9%. This indicates that there is a potential direct connection or cross-connection within the Garnsey 7 Sub-Basin that contributes rain water to the sanitary sewer system during large rain events. A capture ratio larger than 9% is an industry standard used to indicated when a SSES program should be conducted.

The italicized data is the average total rainfall depth recorded based on the two rain gauges during each storm event. There were several instances where meters showed a minimal response to the rainfall (less than 1%) as presented in Table 2-2. This indicates that there is very little, if any, RDI/I within the collection system upstream of the meter. There were two instances where FM02 recorded erroneous velocity measurements and no capture ratio could be calculated. Also, there were two instances when the computed RDI/I hydrograph looked unusual, resulting in a less accurate capture ratio.

A review of the hydrographs in Appendix A shows any discrepancies in recorded measurements for all of the meters. On June 2, 2006, the flow recorded by FM02 went to 0 cfs or below for a period greater than 24 hours. It is likely that the backwater condition caused debris to build up on the sensor preventing it from measuring a velocity, which is evident by the high depth measurements and low (sometimes negative) velocity measurements. This creates a ponding effect that utilizes any available storage capacity within the upstream collection system.

The flow depth at FM04 was less than 2 inches and even though a low flow probe was installed it was close to the measuring capabilities of the meter. Before the June 22, 2006 rain event, the depth measurements recorded seem inaccurate compared to previous measurements. Because of the steep slope of the pipes upstream of FM07's location, additional analysis of the data was conducted. The steep sloped pipe resulted in high velocity and low depth at FM07. These conditions were at the outer limits of the meter's ability to accurately measure both velocity and flow. Unfortunately, because of the characteristics of the collection system, this was the only feasible location for FM07.

TABLE 2-2

PERCENT CAPTURE RATIO

Flow Meter	Area (acres)	Rain Gage	5/18/2006	6/2/2006	6/22/2006	7/22/2006	7/29/2006
			Average Rainfall Depth (inch)				
			0.99	*2.65*	*1.23*	*1.84*	*1.81*
			Rainfall Capture Ratio (%)				
FM01	1,057	Nicklin	1.3	3.1	0.9	0.4	0.7
FM02	399	Nicklin	0.7	SE	0.3	0.4	0.5
FM03	341	Nicklin	1.7	2.9	0.2	0.5	0.6
FM04	162	Nicklin	**1.0**	3.2	**3.0**	2.6	3.0
FM05	573	Average	3.5	3.8	1.3	2.9	3.7
FM06	310	Nicklin	3.3	3.4	1.2	2.4	3.8
FM07	223	Favorite Hill	**4.5**	16.9	4.7	6.3	8.3
FM08	246	Favorite Hill	8.0	8.5	4.2	7.9	8.0
FM09	146	Favorite Hill	4.3	5.7	3.2	2.9	3.3
FM10	1,802	Favorite Hill	4.2	5.1	1.8	3.4	3.6
Bold Text	Suspect data and is discussed in Section 2.2						
	Capture Ratio greater than 9%						

Review of the monitoring data indicated that there was a flow balancing issue with the Garnsey meters, FM05, FM06, FM07, FM08, and FM 10. FM 10 receives flow from meters FM05, FM06, FM07, and FM08 as well as an incremental area which is 449 acres with a population of 2,445. The measured flow for FM10 should equal the measured flows from FM05, FM06, FM07, and FM08, plus the flow generated by the population within the incremental area of 449 acres. This incremental area is approximately 25% of the total drainage area tributary to meter 10 and 30% of the population. The additive flows from the upstream meters approximately equaled the flow recorded at FM 10 during dry weather conditions. However, flows at FM 10 were slightly higher than the additive flow during wet weather events.

The average dry weather flows (ADWF) from the upstream meters is 1.26 mgd and the ADWF for FM10 is 1.20 mgd. It appears that the measurements recorded at FM10 are more accurate than the upstream meters based on hydraulic conditions and scatter graphs, so it is likely that the upstream meters were reading between 25% and 30% too high. Industry standards indicate that acceptable error is +/- 10%. Mathematical calculations and field investigations were conducted in an attempt to identify the source of the error with no success.

Possible reasons for this discrepancy are velocity sensors reading local velocities instead of average velocities and inaccurate readings such as flow depths less than 2 inches and velocities greater than 5 fps which are close to the meters measuring capability. The accuracy of the meters was evaluated each week during routine maintenance visits. Independent depth and velocity

measurements were compared with the values recorded by the meter. As discussed above, the flows recorded by the meter at FM07 were compared with the theoretical values using the Manning's equation. This equation calculates the flow given the depth, pipe slope, and an assumed pipe roughness coefficient based on age and material.

Two assumptions can be made based on the data collected for the Garnsey meters. First, using this information in conjunction with Table 2-1, RDI/I is an issue that should be addressed in the incremental drainage area tributary to FM10. Second, because none of the upstream meters appear to be incorrectly measuring depths and velocities, we might assume that the error described above is distributed evenly between FM05, FM06, FM07, and FM08. Since capture ratios were computed by subtracting the wet weather flow from the dry weather diurnal pattern this would allow us to use the data collected from the upstream meters for comparison purposes and the development of a SSES program with adequate confidence.

For the Water Street meters, review of data from FM02, FM03, and FM04 indicate that there is no significant RDI/I within their respective drainage areas. The hydrograph for FM01 shows that the system has a quick response to rainfall, which indicates the possibility of direct connections. There were no data quality issues with flow balancing the meters installed in the Water Street meter drainage area. However, as noted on the graphs, there are short durations when the meter recorded depths and velocities inconsistent with surrounding measurements.

The rain data collected at both Favorite Hill School and Nicklin Learning Center, as well as the averaged data, are shown graphically in Appendix B. There were no issues with the rainfall data collected during the program.

Appendix C shows notes and photographs taken during the installation of each flow meter and rain gage. There is also a installation summary for each flow meter.

3.0 SEWER SYSTEM EVALUATION SURVEY PROGRAM

The second step of an RDI/I investigation is a SSES program. A SSES program includes smoke testing, manhole inspection, closed-circuit television inspection, dye testing, and public notification and education. The results obtained through a SSES program are then used to develop the recommendations for eliminating RDI/I sources identified during the SSES investigation in a study area and to develop planning cost estimates for recommended RDI/I source elimination alternatives in the study area.

The areas of the City in which the SSES program is recommended are divided into Phases I and II for implementation purposes. This section will discuss these activities.

3.1 SEWER SYSTEM EVALUATION SURVEY

A SSES program is the systematic physical and visual investigation of the infrastructure of a collection system. Each of the activities in an SSES program is described below.

3.1.1 SMOKE TESTING

Smoke testing is an efficient and cost-effective means to inspect the collection system infrastructure for sources of RDI/I. The smoke is introduced into the system by placing a non-exploding grenade into a centrally located manhole. A blower is than used to force the non-toxic smoke-filled air through the gravity sewer system. The smoke will escape the system through acceptable exits, such as manhole lids and vent stakes via laterals, and through unacceptable exits, such as storm system cross-connections, cracks in collection pipes and laterals, and roof drains, identifying sources of RDI/I. All locations where smoke escapes through unacceptable exits are recorded on a map for use in defining the limits of subsequent dye testing. Additionally, any acceptable exits that do not have smoke escaping are recorded on a map and are also used in defining the dye testing.

It is ideal to conduct smoke testing during the dry season, when the water table is low. Ground water can fill the voids in the soil around the pipes, restricting the smoke-filled air's ability to exit the pipe and travel to the ground surface. It is for this reason that RDI/I sources could be potentially missed, reducing the effectiveness of this form of investigation.

3.1.2 MANHOLE INSPECTION

Manholes are inspected visually from rim to invert. An entry is made by a qualified technician whom observes the structural integrity of the manhole. Items recorded in the field notes include cracks or chips in the concrete, water seeping through the chimney joints, and grout

missing from between the bricks. The ideal conditions for locating RDI/I through manhole inspection are during high ground water conditions and during a rain event. However, due to the inherent unsafe conditions that these situations create, entering manholes under these conditions is not normal procedure.

3.1.3 CLOSED-CIRCUIT TELEVISION INSPECTION

Closed-Circuit Television (CCTV) Inspection allows for the visual inspection of sewer pipes between manholes. A television camera, which is mounted to a robotic device, is lowered into the sewer through a manhole. The robotic device is connected to a monitor via a long cable. This allows an operator to control the device from a truck while viewing the live footage. Information from the camera is also recorded either on a video tape or digital video device (dvd).

The camera typically has panning and tilting capabilities, which allow for 360 degree observations and up-close inspection of potential RDI/I sources. Some devices are equipped such that they can inspect some or all of the laterals as well. Any location within the pipe that is suspected of experiencing RDI/I is documented based on the distance traveled from the manhole and should be scored following a standard protocol, e.g. the Pipeline Assessment Certification Program (PACP) protocols. The PACP method gives any defect observed during the inspection a value of 1 to 5, with 5 representing the most severe conditions.

The ideal conditions for locating RDI/I through CCTV inspection are to inspect the collection system during high ground water conditions and during a rain event. This will allow the observation of all RDI/I sources in the public right-of-way as well as in laterals.

3.1.4 DYE TESTING

Dye testing is used to identify specific cross-connections between the storm and sanitary sewers as well as illicit connections from roof drains or foundation drains to the sanitary collection system. A non-toxic dye is introduced into areas suspected of being an RDI/I source (based on the previous smoke testing), and the collection system is observed downstream. For cross-connections inspections, the storm structures are plugged and flooded with dye containing water. If dye is observed in the sanitary collection system downstream, then a cross-connection does exist. In regards to illicit connections, dye containing water is introduced into roof drains or around foundations near the foundation drain. Dye can also be introduced into sump pumps as part of the investigation.

Due to the potential of dye entering a building through cracks in the foundation, non-colored protein solutions are sometimes used instead of dye. The use of protein solutions for

inspection requires specialized equipment to identify if the solution has entered the building or the sanitary collection system. This increases the cost and difficulty of conducting the dye testing. Dye testing can sometimes be conducted in conjunction with CCTV inspection.

3.1.5 PUBLIC NOTIFICATION

The goal of the public notification and education program is two-fold – one for the residents in the specific study area and one that is more general in nature regarding the overall wastewater program:

1. Residents in the selected SSES area will be notified regarding scheduling and components of the RDI/I reduction and SSES program that will be specific to their area.
2. All residents of the City that receive wastewater service will be educated of the RDI/I reduction program, requirements of the OEPA NPDES permit, and how it may impact them.

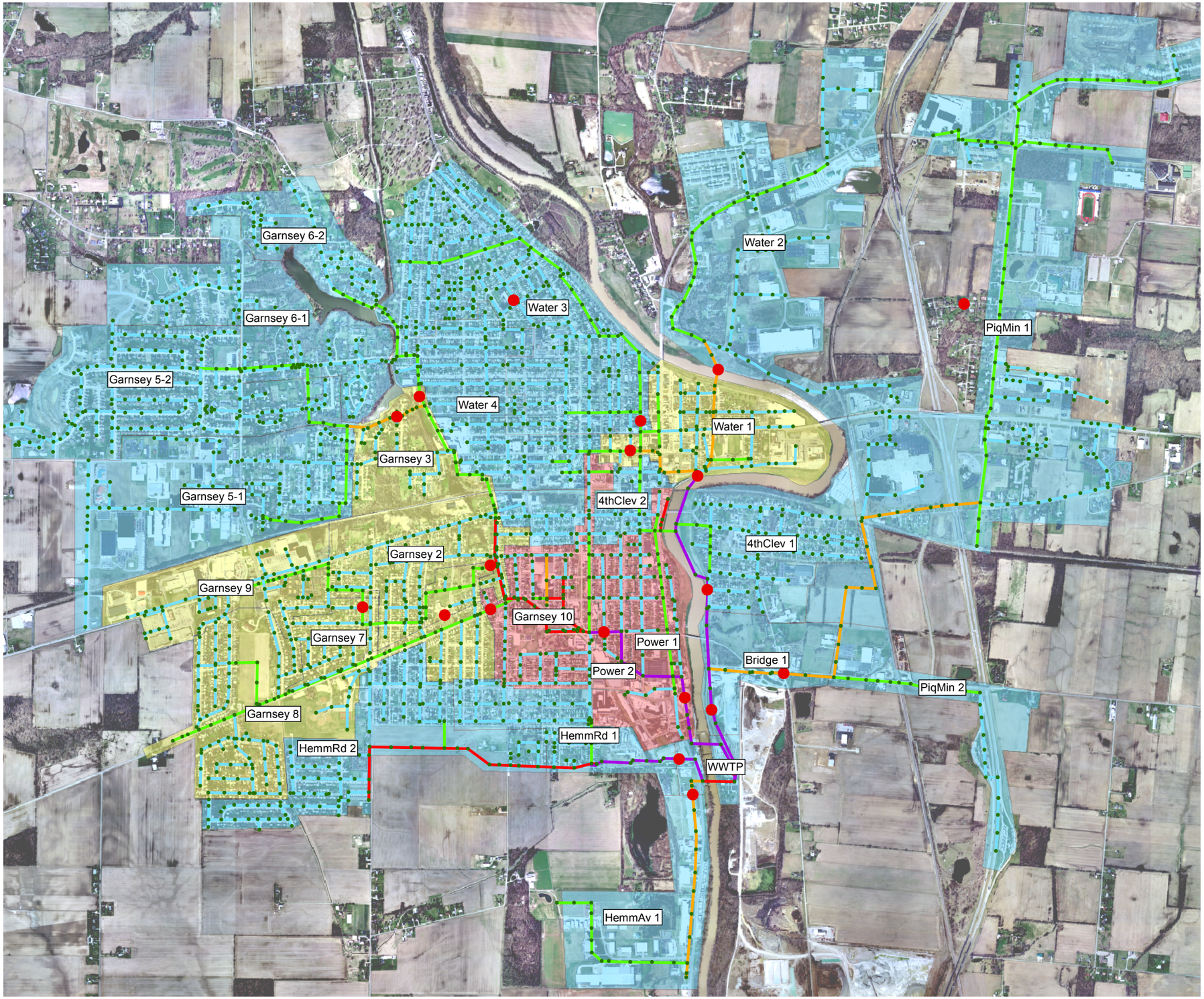
The resident notification will be performed in conjunction with the Phase I and Phase II of the proposed SSES program as described below. The larger scale public education program would be performed by the City as part of their on-going public program.

3.2 PROPOSED SSES PHASE I

Phase I of the proposed SSES is the red area of Figure 3-1. This area was identified as having high RDI/I during the flow monitoring and model development that occurred between 2004 and 2006 as well as by field observations by City employees. Table 3-1 summarizes the infrastructure to be inspected during Phase I. The bottom portion of Figure 1-2 shows a proposed schedule for Phase I.

TABLE 3-1
PHASE I SSES PROGRAM

Approximate linear feet of pipe to be smoke tested	43,900
Approximate linear feet of pipe to be CCTV	43,900
Approximate number of manholes to be visually inspected	180
Estimated number of structures to be dye tested	275



N

Legend

- Meters
- Manholes

Sanitary Sewers

Diameter

- 6 - 10"
- 12 - 15"
- 16 - 21"
- 24 - 30"
- >33"

Proposed SSES Program

- PHASE 1
- PHASE II
- No SSES Proposed

0 1,250 2,500 5,000

Feet

MALCOLM PIRNIE

MALCOLM PIRNIE, INC.
EAST LANSING, MICHIGAN

DATE MAY 2006

Recommended SSES Program

INFLOW AND INFILTRATION INVESTIGATION AND
SEWER SYSTEM EVALUATION SURVEY PLAN
CITY OF PIQUA, OHIO

FIGURE 3-1

3.3 PROPOSED SSES PHASE II

Phase II of the proposed SSES is the yellow area as shown in Figure 3-1 and comprises of sub-basins within the Water Street meter basin and the Garnsey Street meter basin. These areas were identified as having potentially high RDI/I areas during the flow monitoring and model development that occurred between 2004 and 2006. Table 3-2 summarizes the infrastructure to be inspected during Phase II. The bottom portion of Figure 1-2 shows a proposed schedule for Phase II.

TABLE 3-2
PHASE II SSES PROGRAM

Approximate linear feet of pipe to be smoke tested	114,300
Approximate linear feet of pipe to be CCTV	114,300
Approximate number of manholes to be visually inspected	500
Estimated number of structures to be dye tested	650

4.0 CONCLUSIONS & RECOMMENDATIONS

The conclusions and recommendations from the first step of an RDI/I investigation, flow and rainfall monitoring, are summarized in this section. The recommendations for the second step, a SSES program, are also included. This includes a proposed scope (linear feet of pipe and number of manholes to be inspected) and timeframe (Phase I and Phase II) for completing the investigation.

4.1 CONCLUSIONS

RDI/I is an issue in isolated areas within the City of Piqua. This was identified in the "Sanitary Sewer Overflow Evaluation" report prepared by Malcolm Pirnie, Inc. in August 2006 (Malcolm Pirnie, 2006) and confirmed during this program. The extent of the RDI/I that is typically cost effective to remove, those attributed to fast response, was narrowed to specific sub-basins as a part of this study, and not as wide spread as previous work indicated. Figure 3-1 shows the sub-basins that were recommended for a future SSES program. The red areas represent the work that would occur under Phase I and the yellow areas represent the work that would occur under Phase II.

The overall quality of the data collected from the ten meters is acceptable. Various issues were identified but were determined to not grossly impact the ability to use the data in this study. The issues identified in FM01 and FM02 can be attributed to the restriction of flow at the WWTP. Data at FM04 is likely due to the stream depth being lower than the sensor's ability to accurately measure. Errors in FM05, FM06, FM07, FM08, and FM10 could not be corrected during the program. However, if it is assumed that the error is equally divided between FM05, FM06, FM07, and FM08, the flow data collected can still be used for comparative purposes and for the development of the SSES program. The data collected by the two rain gages were determined to be free of error or other issues.

This study meets the OEPA requirement of Part I, C – Schedule of Compliance, I. Municipal SSO Schedule, a.: Event Code 9099 in the draft NPDES permit – "The permittee shall begin monitoring sanitary sewer sub-basins that have been identified as high contributor of infiltration and inflow as soon as possible, but not later than two months from the effective date of the permit." Since the permit has not been signed and made effective, the City has met and exceeded the permit requirements.

4.2 RECOMMENDATIONS

Each Phase should begin with smoke testing and manhole inspections, followed by CCTV inspection and dye testing. As presented in Table 3-1, 43,900 LF of pipe and 180 manholes should be inspected in Phase I. Similarly, Table 3-2 shows that 114,300 LF of pipe and 500 manholes should be inspected in Phase II. The scope of the dye testing for each Phase will be established during the smoke testing portion of the program, and is only estimated in this report. These activities will identify the locations of the sources of RDI/I within the collection system, both publicly and privately owned. As part of the SSES program, a summary report will be submitted to OEPA following the conclusion of the SSES field activities for each Phase outlining the anticipated system improvements and modifications.

The SSES program has been separated into Phase I and Phase II. Phase I should begin in mid-September of 2006. This is to comply with the NPDES permit which was filed by the OEPA on August 1, 2006 and to allow the first step of the program, smoke testing, to be conducted during dry weather and low water table conditions. This will allow for the satisfaction of Part I, C – Schedule of Compliance, I. Municipal SSO Schedule, b.: Event Code 21599 – "The permittee shall begin phase one of a Sanitary Sewer Evaluation Survey as soon as possible, but not later than 2 months from the effective date of the permit." A four month duration for Phase I will satisfy Part I, C – Schedule of Compliance, I. Municipal SSO Schedule, c.: Event Code 21599 – "The permittee shall complete and submit a copy of the phase one Sanitary Sewer Evaluation Survey as soon as possible, but not later than 6 months from the effective date of the permit to the Ohio EPA Southwest District Office." Phase II should begin in June 2007 to comply with the filed NPDES permit.

Additional work is required to begin at the completion of Phase I and Phase II. The SSES program will identify the location of RDI/I sources within the collection system that require repair or replacement. This additional work includes the design of these improvements, submittal of complete Permit to Install applications, and construction of the system improvements. For Phase I, these activities will satisfy:

Part I, C – Schedule of Compliance, I. Municipal SSO Schedule, d.: Event Code 1299 – "The permit shall submit to the Ohio EPA Southwest District Office a complete Permit to Install application and detailed plans (as necessary) for collection system improvements identified in the phase one SSES as soon as possible, but not later than 8 months from the effective date of the permit."

Part I, C – Schedule of Compliance, I. Municipal SSO Schedule, e.: Event Code 4599 – "The permittee shall complete construction of all phase one sanitary sewer improvement as identified in the SSES as soon as possible, but not later than 27 months from the effective date of the permit."

For Phase II, these activities will satisfy:

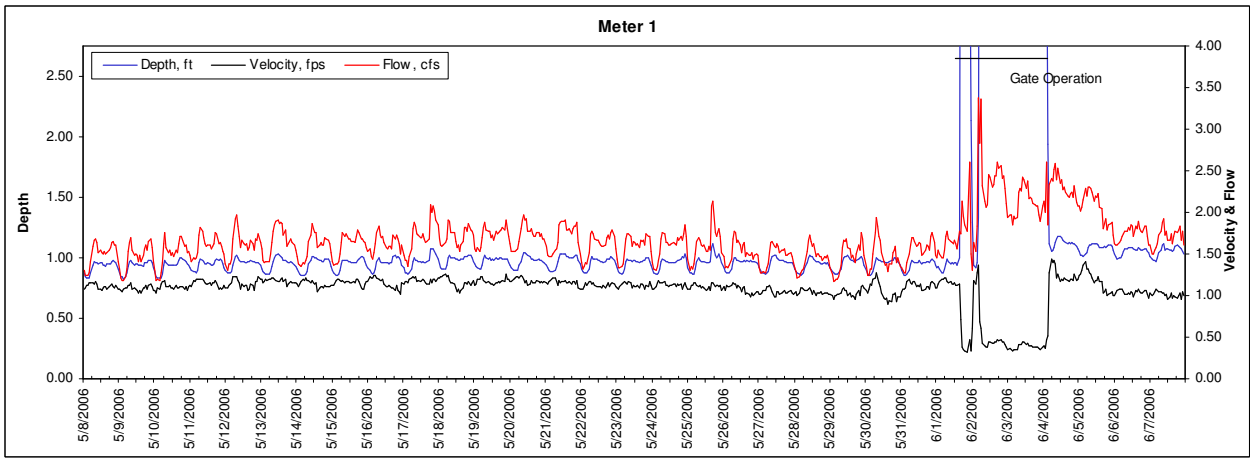
Part I, C – Schedule of Compliance, I. Municipal SSO Schedule, g.: Event Code 1299 – "The permit shall submit to the Ohio EPA Southwest District Office a complete Permit to Install application and detailed plans (as necessary) for collection system improvements identified in the phase two SSES as soon as possible, but not later than 24 months from the effective date of the permit."

Part I, C – Schedule of Compliance, I. Municipal SSO Schedule, h.: Event Code 4599 – "The permittee shall complete construction of all phase two sanitary sewer improvement as identified in the SSES as soon as possible, but not later than 39 months from the effective date of the permit."

A new flow monitoring study will need to be conducted post construction of the Phase II improvements the satisfy Part I, C – Schedule of Compliance, I. Municipal SSO Schedule, i.: Event Code 9099 – "The permittee shall begin monitoring the major sanitary sewer interceptors as soon as possible, but not later than 48 months from the effective date of the permit. Data collected as part of the study shall be used to determine the effect of the infiltration and inflow reduction program. Computerized modeling shall be used to interpret the date." After this study, a new SSO elimination plan will need to be submitted as part of the NPDES permit requirements. Part I, C – Schedule of Compliance, I. Municipal SSO Schedule, j.: Event Code 8599 – "The permittee shall submit a plan of action and implementation schedule for elimination of sanitary sewer overflows as soon as possible, but not later than 54 months from the effective date of the permit.

APPENDIX A

Flow Data Hydrographs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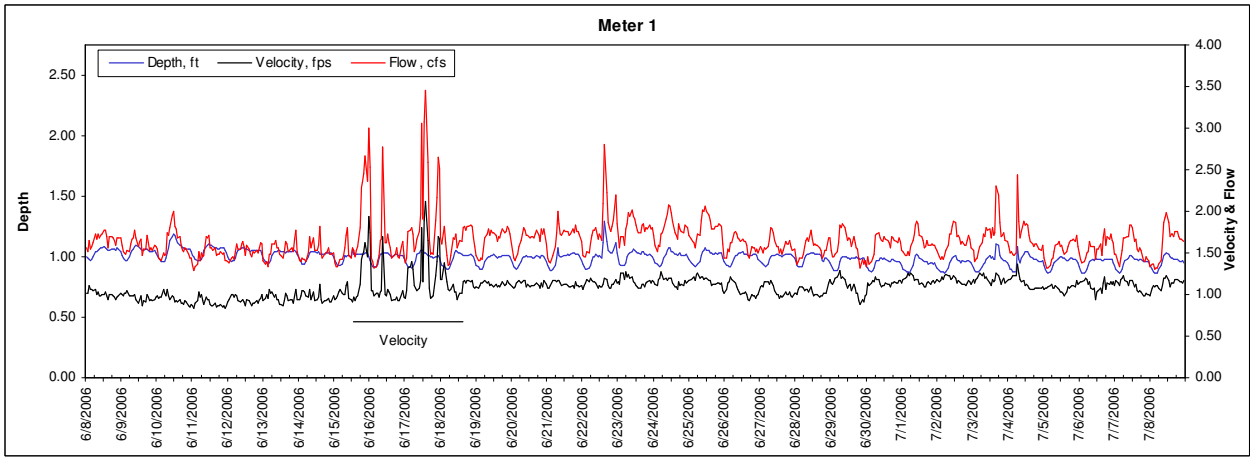
Velocity & Flow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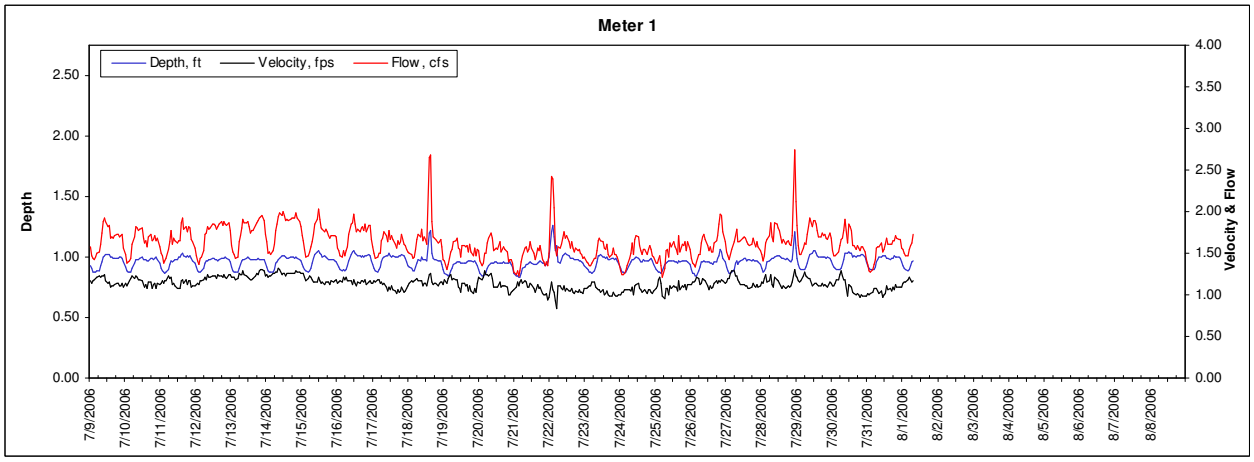
Velocity & Flow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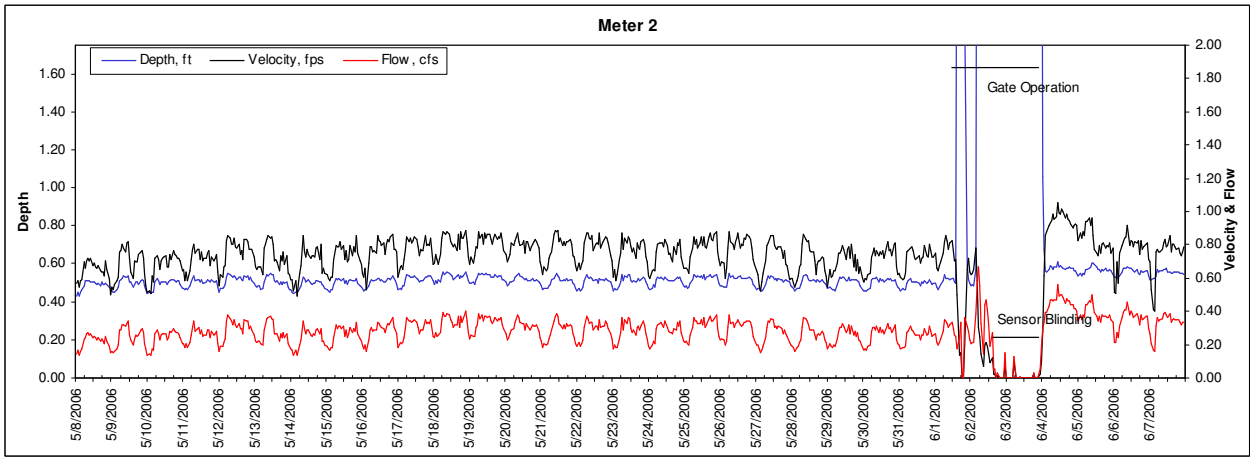
Velocity & Flow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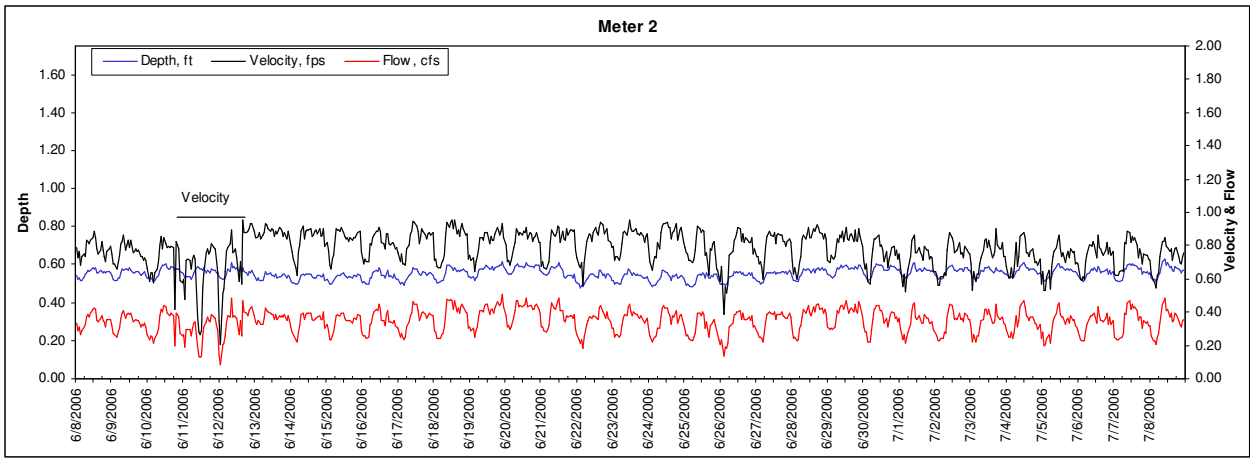
Sensor Blinding
Depth
Velocity & Flow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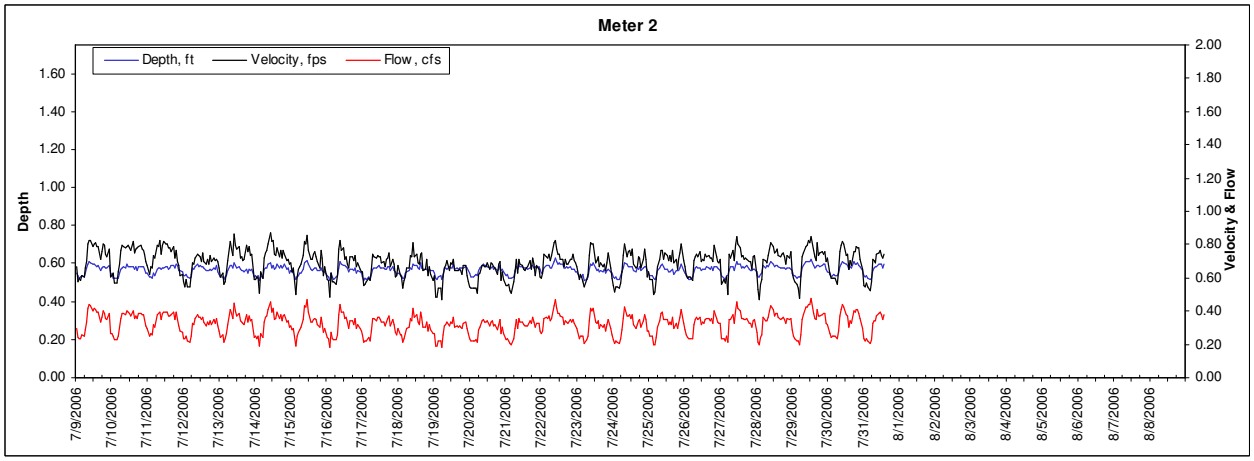
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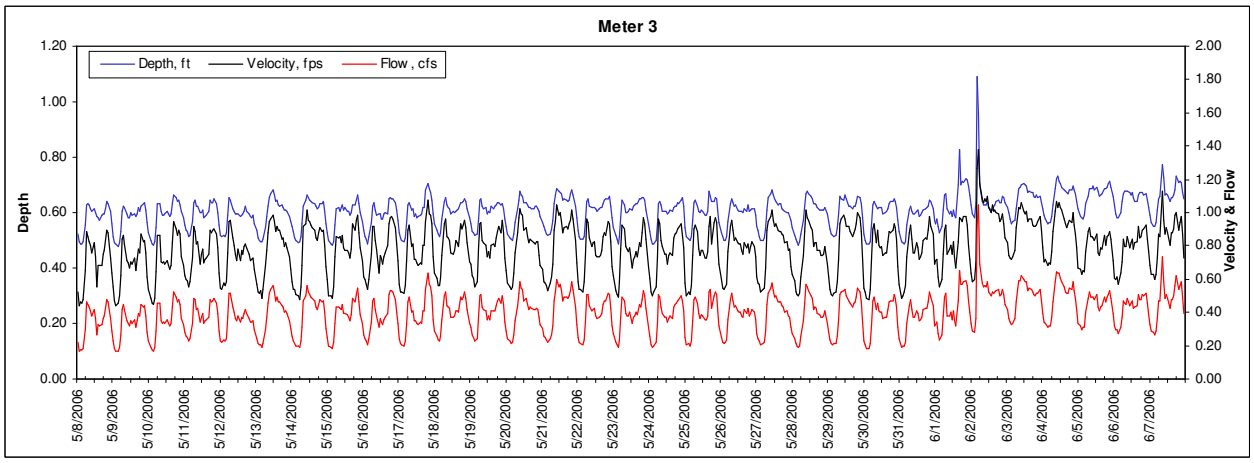
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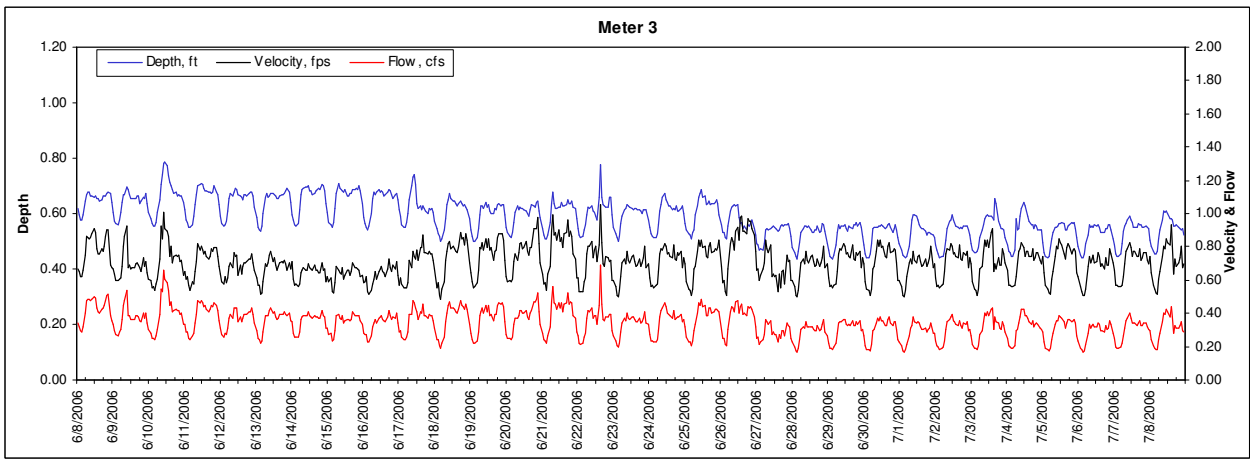
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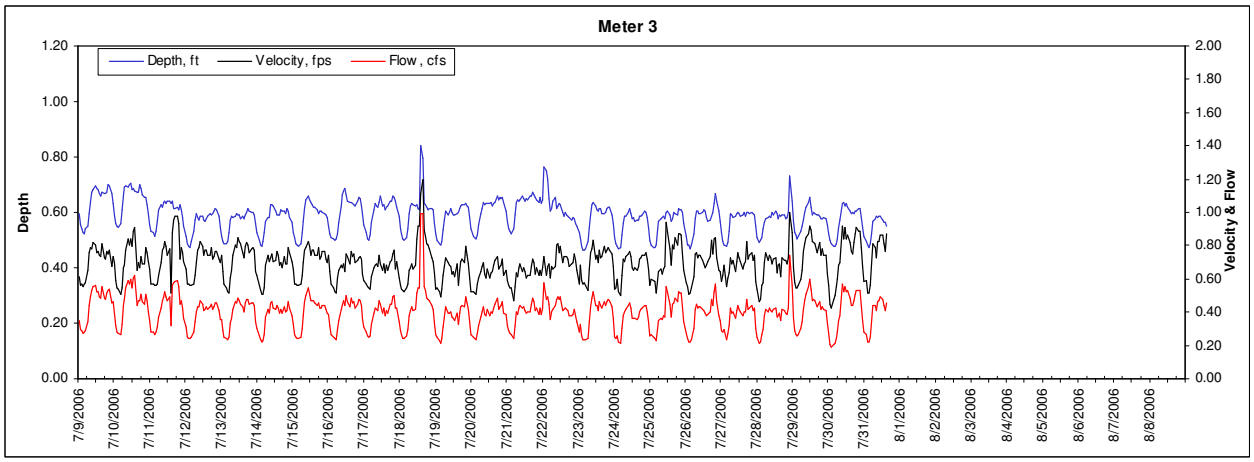
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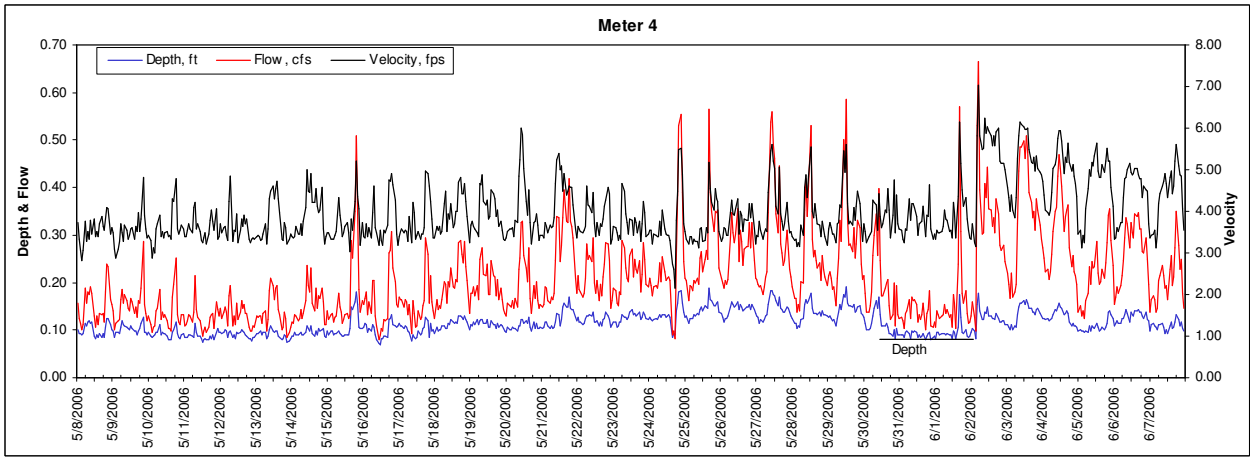
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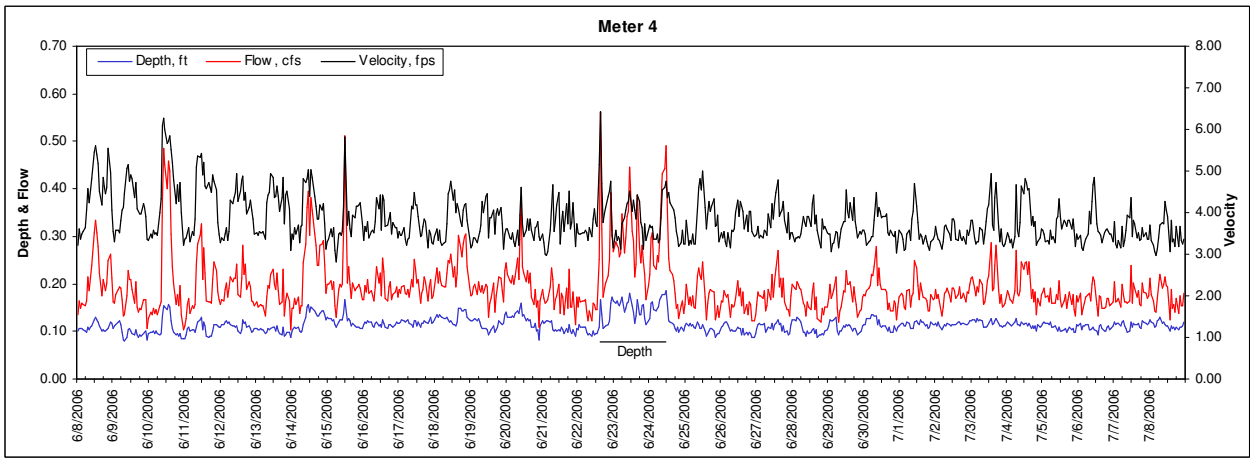
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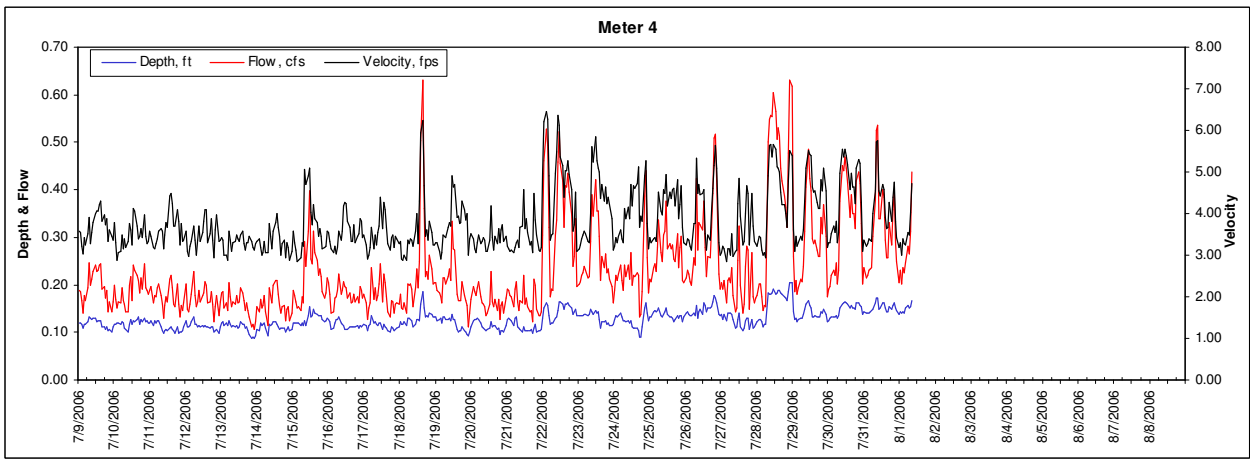
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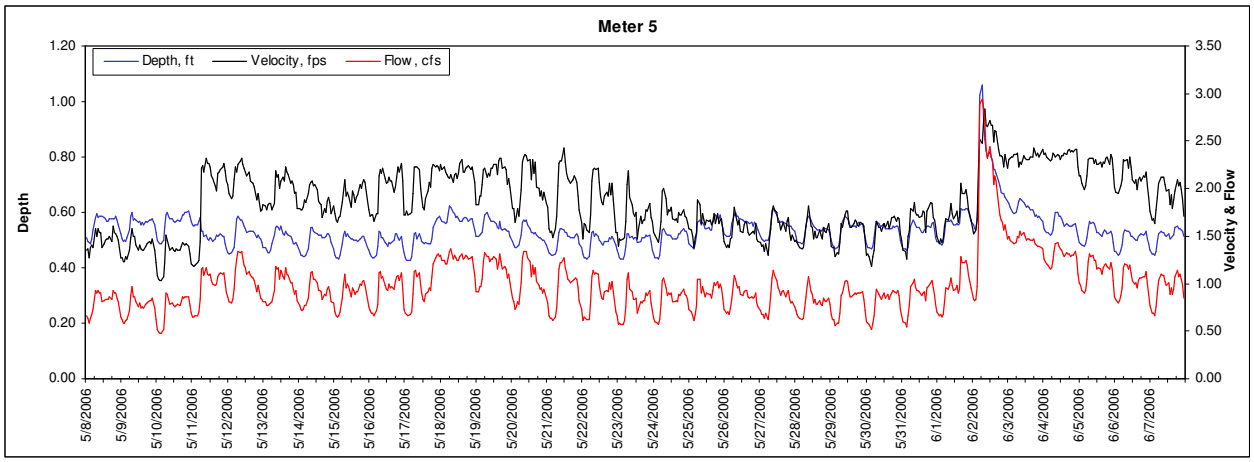
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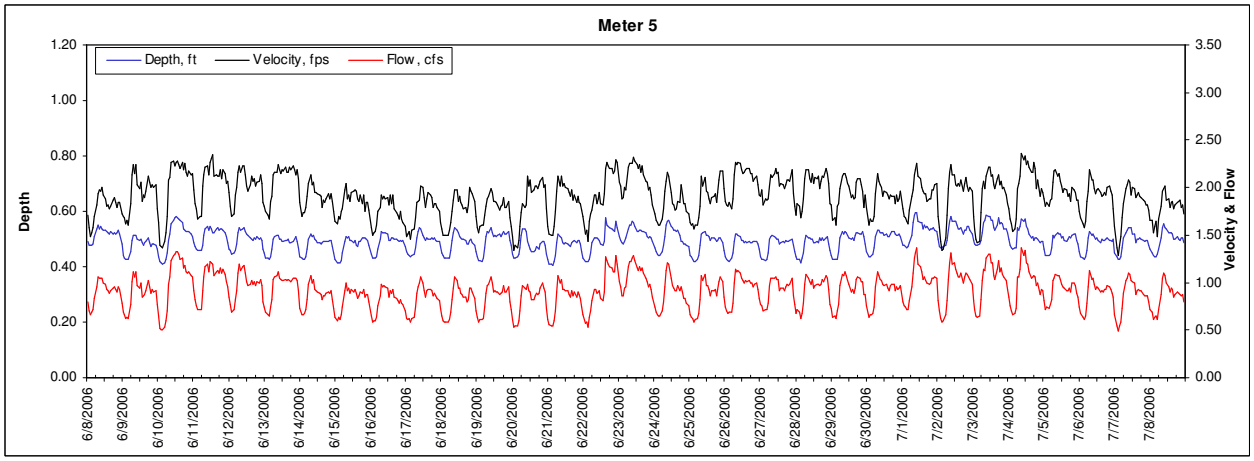
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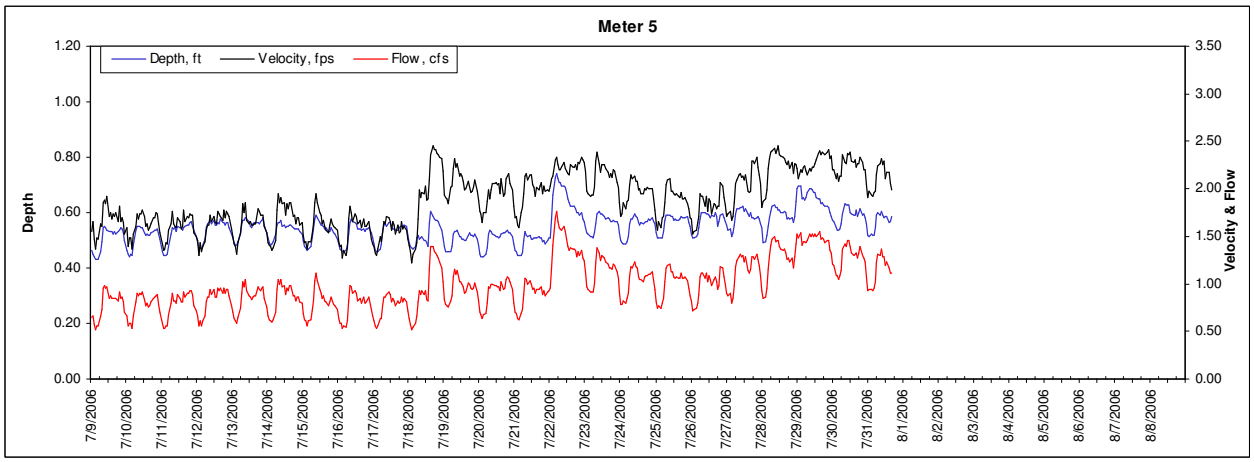
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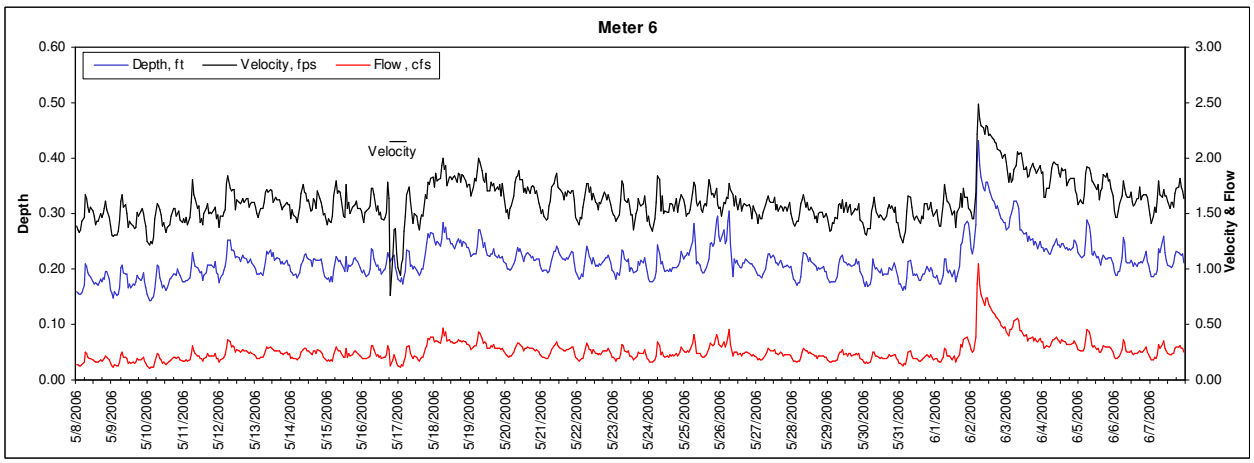
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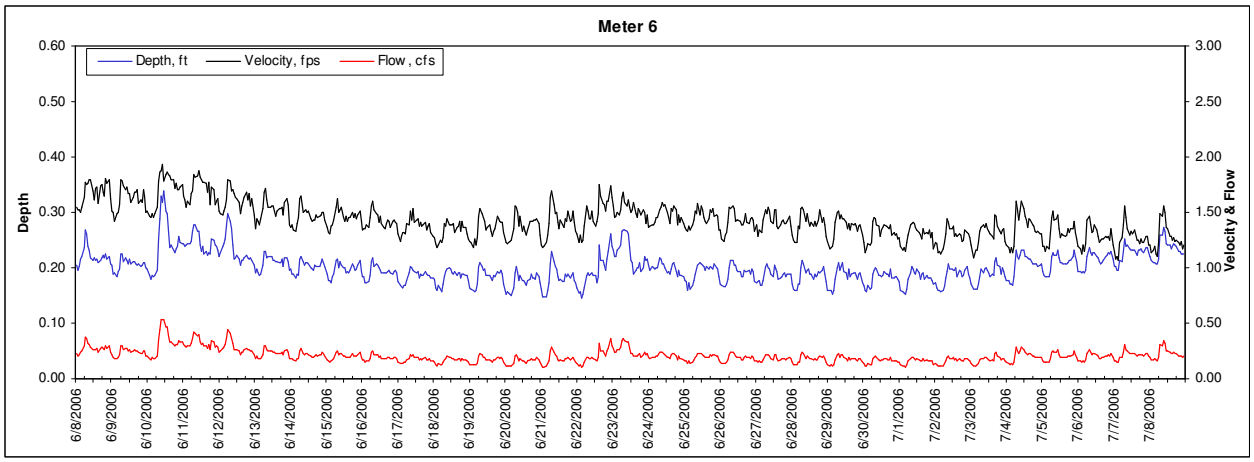
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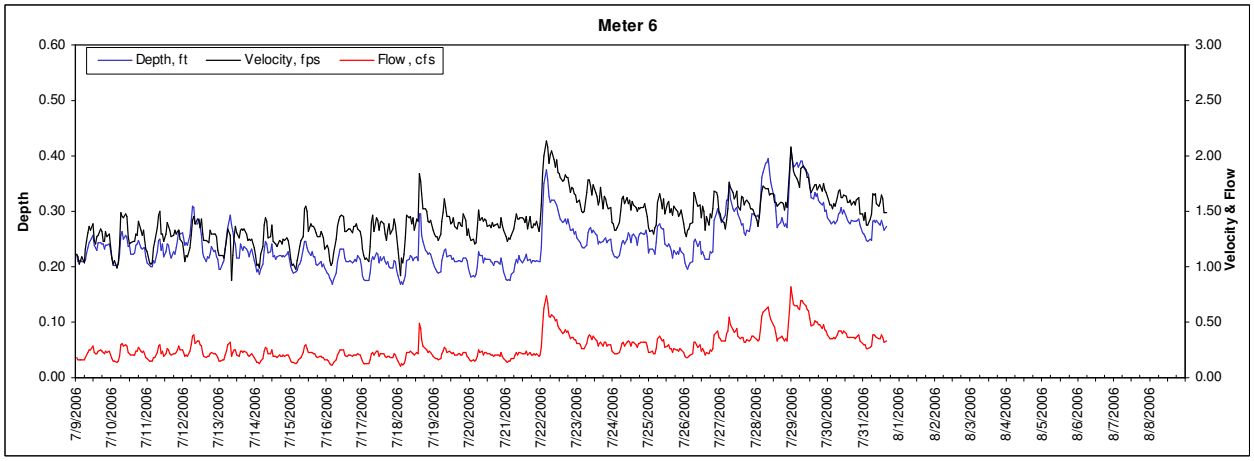
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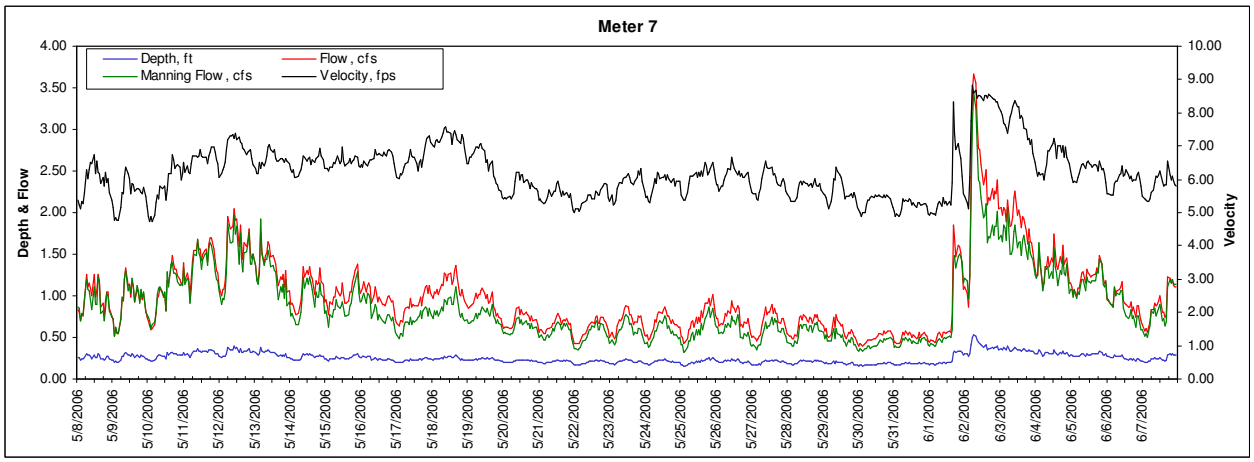
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Manning Flow , cfs
Velocity, fps
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8.00
9.00
10.00
5/8/2006
5/9/2006
5/10/2006
5/11/2006
5/12/2006
5/13/2006
5/14/2006
5/15/2006
5/16/2006
5/17/2006
5/18/2006
5/19/2006
5/20/2006
5/21/2006
5/22/2006
5/23/2006
5/24/2006
5/25/2006
5/26/2006
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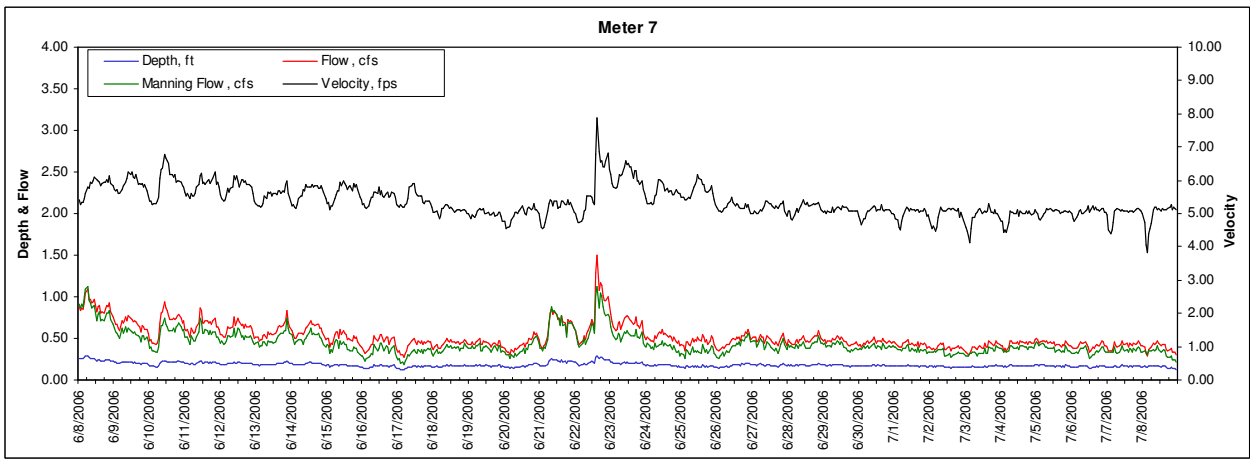
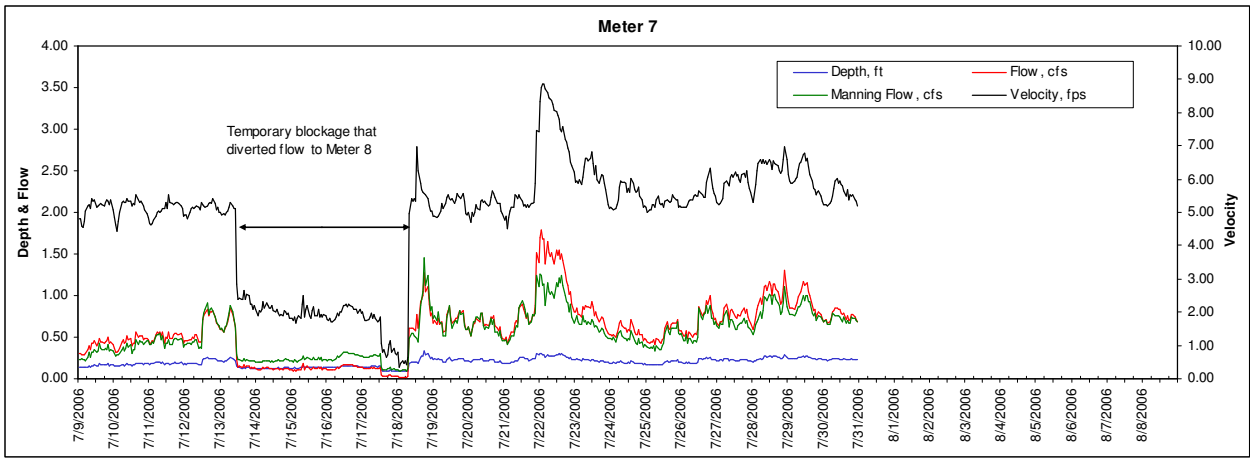
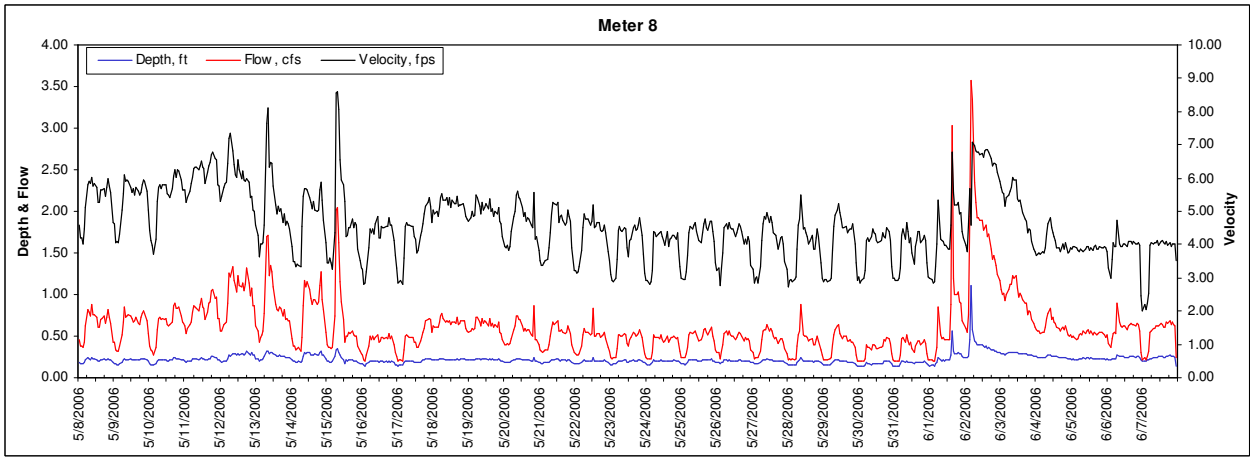
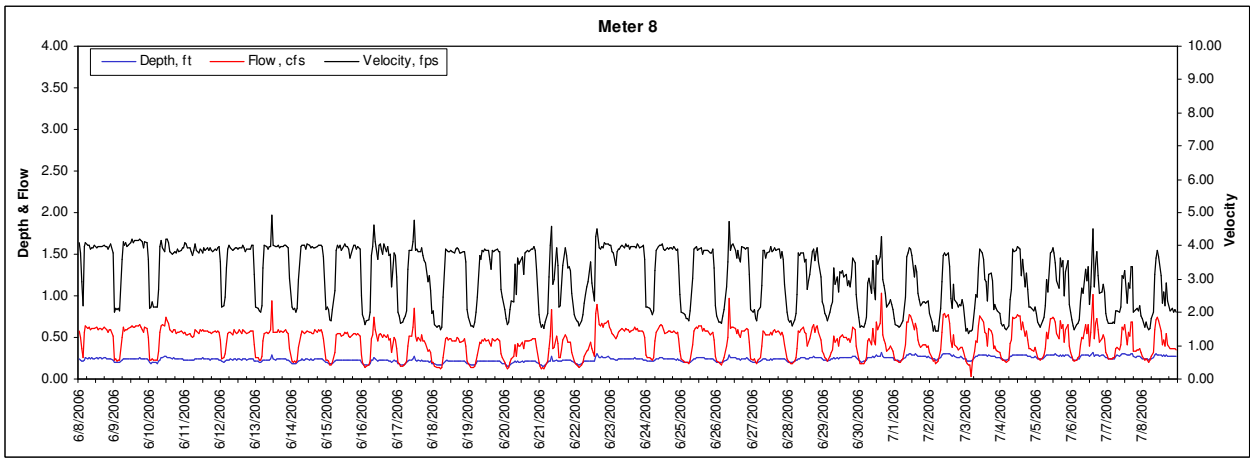
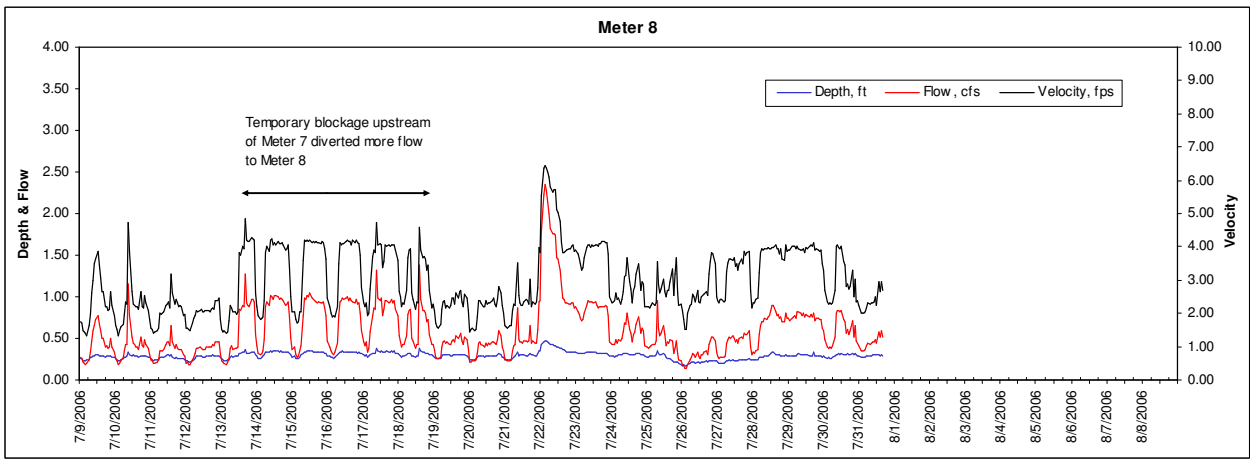
5/28/2006
5/29/2006
5/30/2006
5/31/2006
6/1/2006
6/2/2006
6/3/2006
6/4/2006
6/5/2006
6/6/2006
6/7/2006

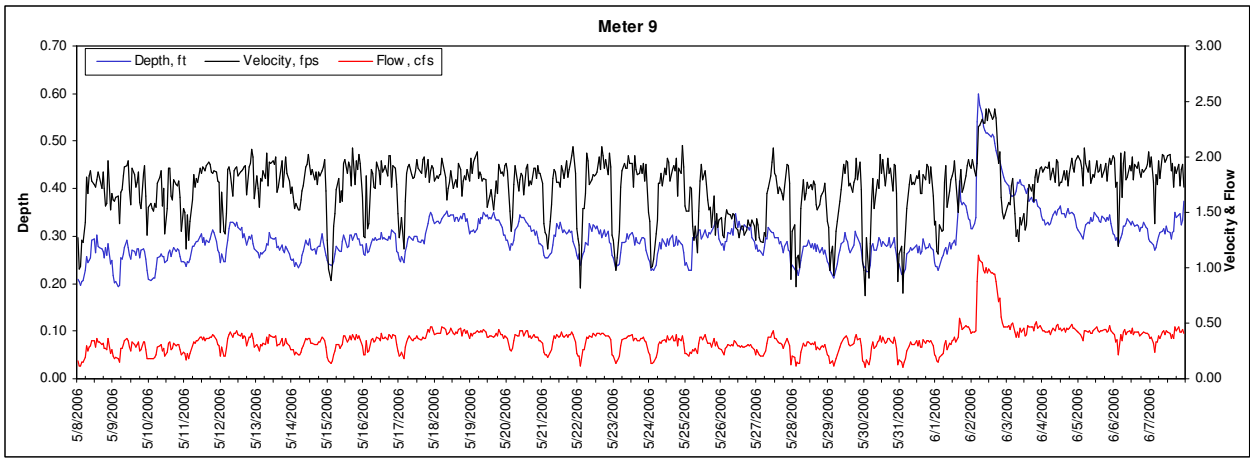

Meter 7
Depth, ft
Flow , cfs
Manning Flow , cfs
Velocity, fps
Depth & Flow
Velocity
0.00
0.50
1.00
1.50
2.00
2.50
3.00
3.50
4.00
0.00
1.00
2.00
3.00
4.00
5.00
6.00
7.00
8.00
9.00
10.00
6/8/2006
6/9/2006
6/10/2006
6/11/2006
6/12/2006
6/13/2006
6/14/2006
6/15/2006
6/16/2006
6/17/2006
6/18/2006
6/19/2006
6/20/2006
6/21/2006
6/22/2006
6/23/2006
6/24/2006
6/25/2006
6/26/2006
6/27/2006
6/28/2006
6/29/2006
6/30/2006
7/1/2006
7/2/2006
7/3/2006
7/4/2006
7/5/2006
7/6/2006
7/7/2006
7/8/2006

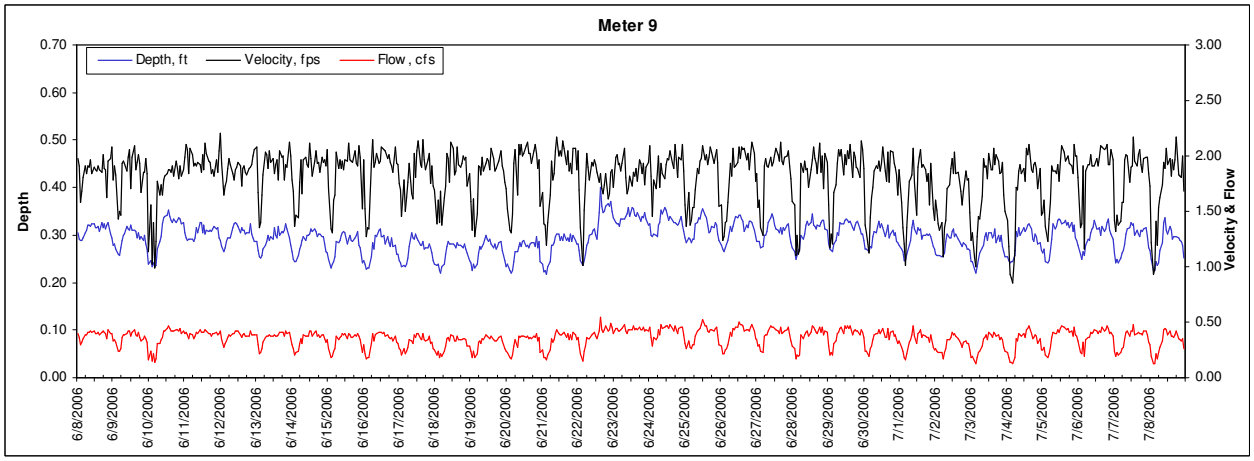

Meter 7
Depth, ft
Flow , cfs
Manning Flow , cfs
Velocity, fps
Temporary blockage that diverted flow to Meter 8
Depth & Flow
Velocity


Meter 8
Depth, ft
Flow , cfs
Velocity, fps
Depth & Flow
Velocity


Meter 8
Depth, ft
Flow , cfs
Velocity, fps
Depth & Flow
Velocity


Meter 8
Depth, ft
Flow , cfs
Velocity, fps
Temporary blockage upstream of Meter 7 diverted more flow to Meter 8
Depth & Flow
Velocity


Meter 9
Depth, ft
Velocity, fps
Flow, cfs
Depth
Velocity & Flow
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.00
3.00
2.50
2.00
1.50
1.00
0.50
0.00
5/8/2006
5/9/2006
5/10/2006
5/11/2006
5/12/2006
5/13/2006
5/14/2006
5/15/2006
5/16/2006
5/17/2006
5/18/2006
5/19/2006
5/20/2006
5/21/2006
5/22/2006
5/23/2006
5/24/2006
5/25/2006
5/26/2006
5/27/2006
5/28/2006
5/29/2006
5/30/2006
5/31/2006
6/1/2006
6/2/2006
6/3/2006
6/4/2006
6/5/2006
6/6/2006
6/7/2006


Meter 9
Depth, ft
Velocity, fps
Flow, cfs
Depth
Velocity & Flow
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.00
3.00
2.50
2.00
1.50
1.00
0.50
0.00
6/8/2006
6/9/2006
6/10/2006
6/11/2006
6/12/2006
6/13/2006
6/14/2006
6/15/2006
6/16/2006
6/17/2006
6/18/2006
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6/21/2006
6/22/2006
6/23/2006
6/24/2006
6/25/2006
6/26/2006
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6/30/2006
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7/2/2006
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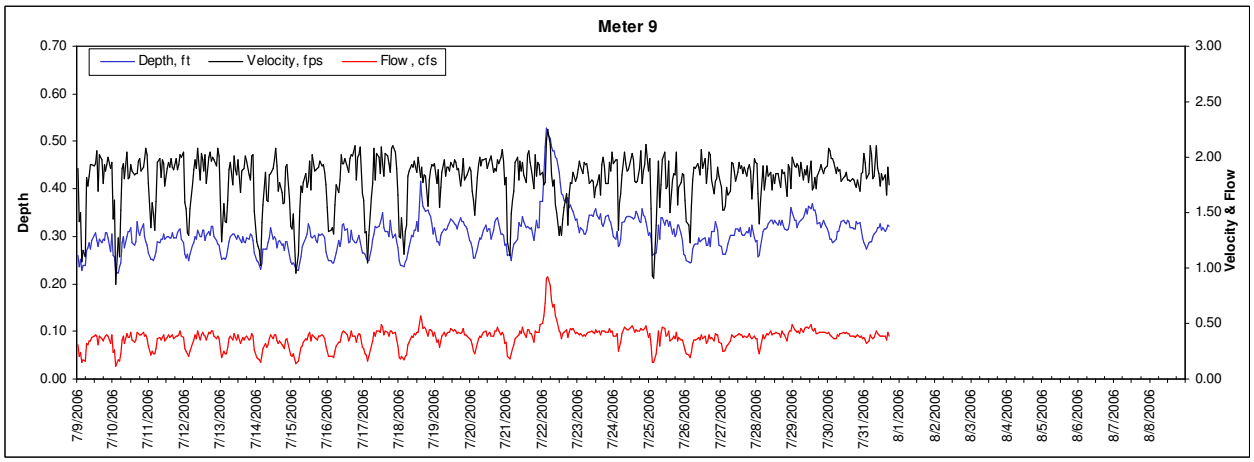
7/4/2006
7/5/2006
7/6/2006
7/7/2006
7/8/2006


Meter 9
Depth, ft
Velocity, fps
Flow, cfs
Depth
Velocity & Flow
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.00
3.00
2.50
2.00
1.50
1.00
0.50
0.00
7/9/2006
7/10/2006
7/11/2006
7/12/2006
7/13/2006
7/14/2006
7/15/2006
7/16/2006
7/17/2006
7/18/2006
7/19/2006
7/20/2006
7/21/2006
7/22/2006
7/23/2006
7/24/2006
7/25/2006
7/26/2006
7/27/2006
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7/29/2006
7/30/2006
7/31/2006
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8/2/2006
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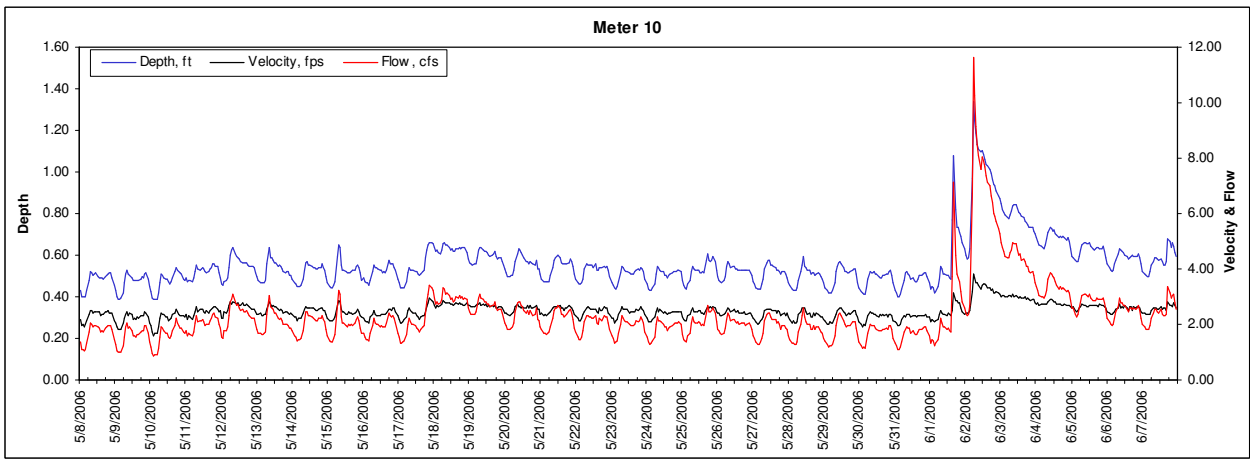
8/4/2006
8/5/2006
8/6/2006
8/7/2006
8/8/2006


Meter 10
Depth, ft
Velocity, fps
Flow, cfs
Depth
Velocity & Flow
1.60
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
12.00
10.00
8.00
6.00
4.00
2.00
0.00
5/8/2006
5/9/2006
5/10/2006
5/11/2006
5/12/2006
5/13/2006
5/14/2006
5/15/2006
5/16/2006
5/17/2006
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5/30/2006
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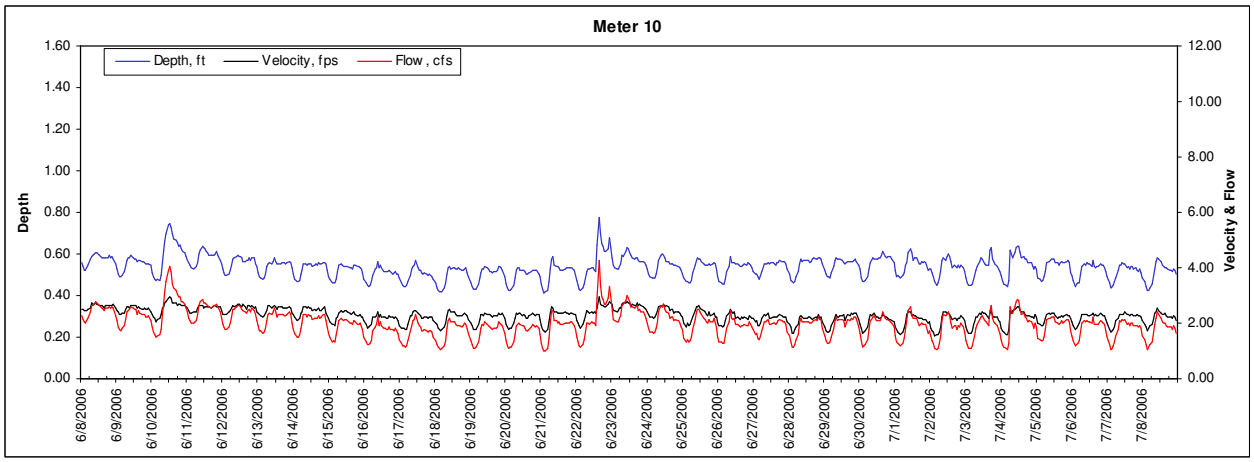
6/1/2006
6/2/2006
6/3/2006
6/4/2006
6/5/2006
6/6/2006
6/7/2006


Meter 10
Depth, ft
Velocity, fps
Flow , cfs
Depth
Velocity & Flow
1.60
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
12.00
10.00
8.00
6.00
4.00
2.00
0.00
6/8/2006
6/9/2006
6/10/2006
6/11/2006
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6/14/2006
6/15/2006
6/16/2006
6/17/2006
6/18/2006
6/19/2006
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6/22/2006
6/23/2006
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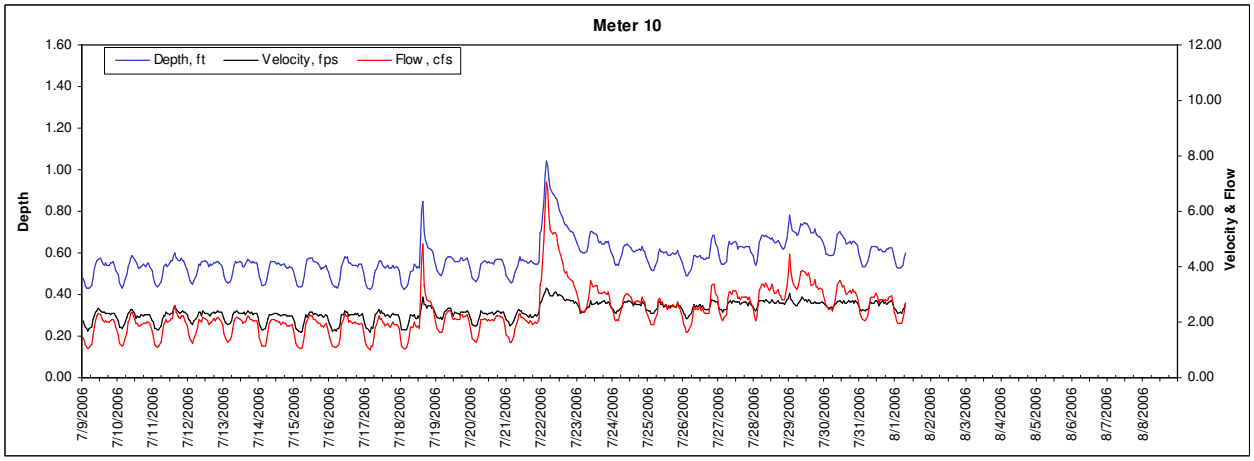
6/29/2006
6/30/2006
7/1/2006
7/2/2006
7/3/2006
7/4/2006
7/5/2006
7/6/2006
7/7/2006
7/8/2006


Meter 10
Depth, ft
Velocity, fps
Flow , cfs
Depth
Velocity & Flow
1.60
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
12.00
10.00
8.00
6.00
4.00
2.00
0.00
7/9/2006
7/10/2006
7/11/2006
7/12/2006
7/13/2006
7/14/2006
7/15/2006
7/16/2006
7/17/2006
7/18/2006
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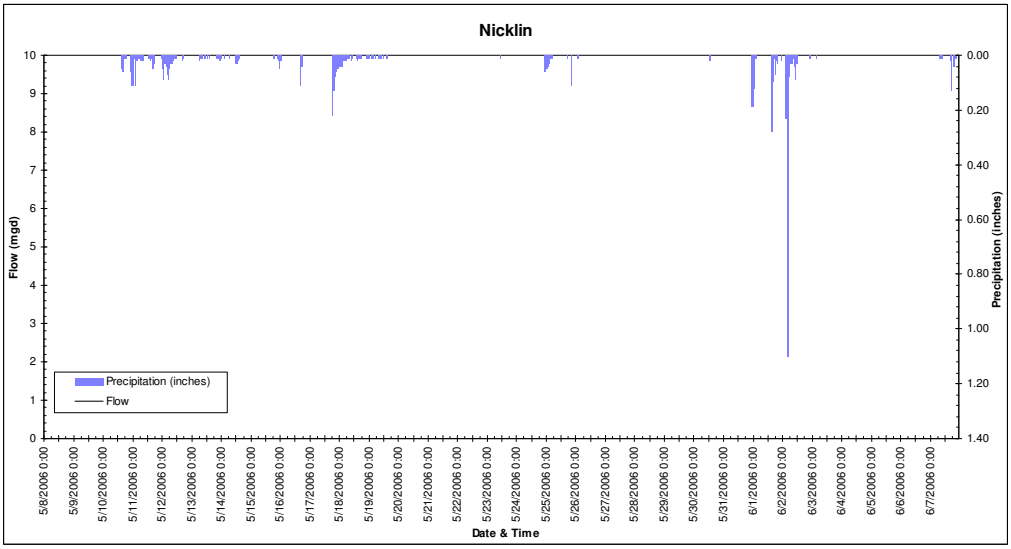
7/24/2006
7/25/2006
7/26/2006
7/27/2006
7/28/2006
7/29/2006
7/30/2006
7/31/2006
8/1/2006
8/2/2006
8/3/2006
8/4/2006
8/5/2006
8/6/2006
8/7/2006
8/8/2006

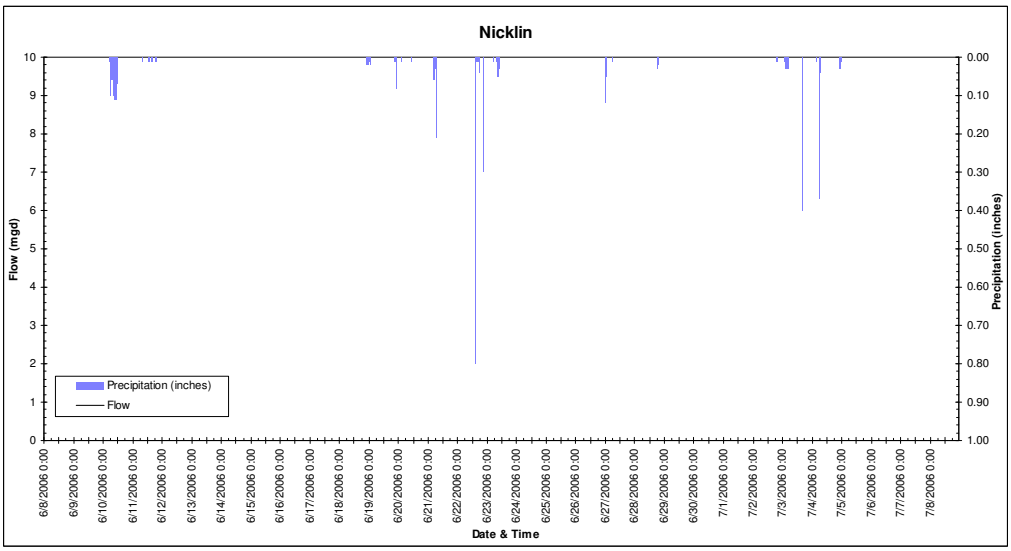
APPENDIX B

Rain Data

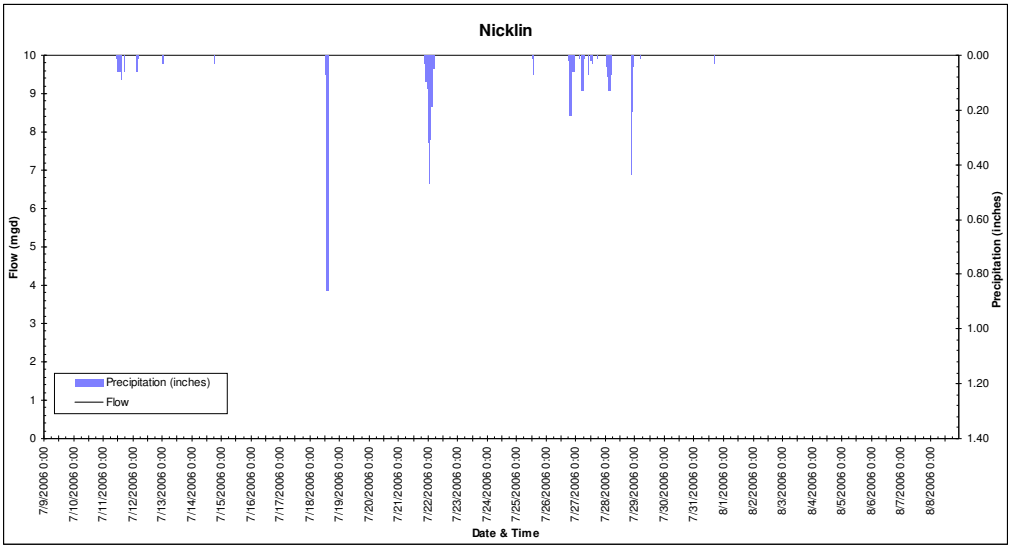
Date	Precipitation (inches)
5/8/2006 0:00	0.00
5/9/2006 0:00	0.00
5/10/2006 0:00	0.36
5/11/2006 0:00	0.41
5/12/2006 0:00	0.52
5/13/2006 0:00	0.13
5/14/2006 0:00	0.09
5/15/2006 0:00	0.10
5/16/2006 0:00	0.17
5/17/2006 0:00	0.59
5/18/2006 0:00	0.29
5/19/2006 0:00	0.08
5/20/2006 0:00	0.00
5/21/2006 0:00	0.00
5/22/2006 0:00	0.00
5/23/2006 0:00	0.01
5/24/2006 0:00	0.12
5/25/2006 0:00	0.26
5/26/2006 0:00	0.01
5/27/2006 0:00	0.00
5/28/2006 0:00	0.00
5/29/2006 0:00	0.00
5/30/2006 0:00	0.03
5/31/2006 0:00	0.19
6/1/2006 0:00	0.67
6/2/2006 0:00	1.72
6/3/2006 0:00	0.01
6/4/2006 0:00	0.00
6/5/2006 0:00	0.00
6/6/2006 0:00	0.00
6/7/2006 0:00	0.23
Total	5.99



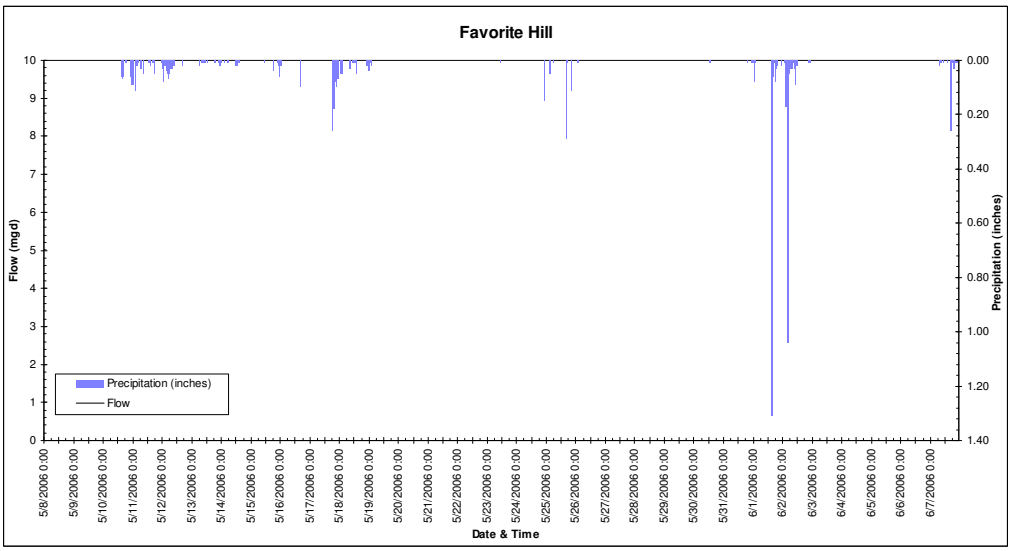
Date	Precipitation (inches)
6/8/2006 0:00	0.00
6/9/2006 0:00	0.00
6/10/2006 0:00	0.60
6/11/2006 0:00	0.05
6/12/2006 0:00	0.00
6/13/2006 0:00	0.00
6/14/2006 0:00	0.00
6/15/2006 0:00	0.00
6/16/2006 0:00	0.00
6/17/2006 0:00	0.00
6/18/2006 0:00	0.02
6/19/2006 0:00	0.12
6/20/2006 0:00	0.02
6/21/2006 0:00	0.30
6/22/2006 0:00	1.16
6/23/2006 0:00	0.10
6/24/2006 0:00	0.00
6/25/2006 0:00	0.00
6/26/2006 0:00	0.12
6/27/2006 0:00	0.10
6/28/2006 0:00	0.05
6/29/2006 0:00	0.00
6/30/2006 0:00	0.00
7/1/2006 0:00	0.00
7/2/2006 0:00	0.02
7/3/2006 0:00	0.49
7/4/2006 0:00	0.46
7/5/2006 0:00	0.00
7/6/2006 0:00	0.00
7/7/2006 0:00	0.00
7/8/2006 0:00	0.00
Total	3.61



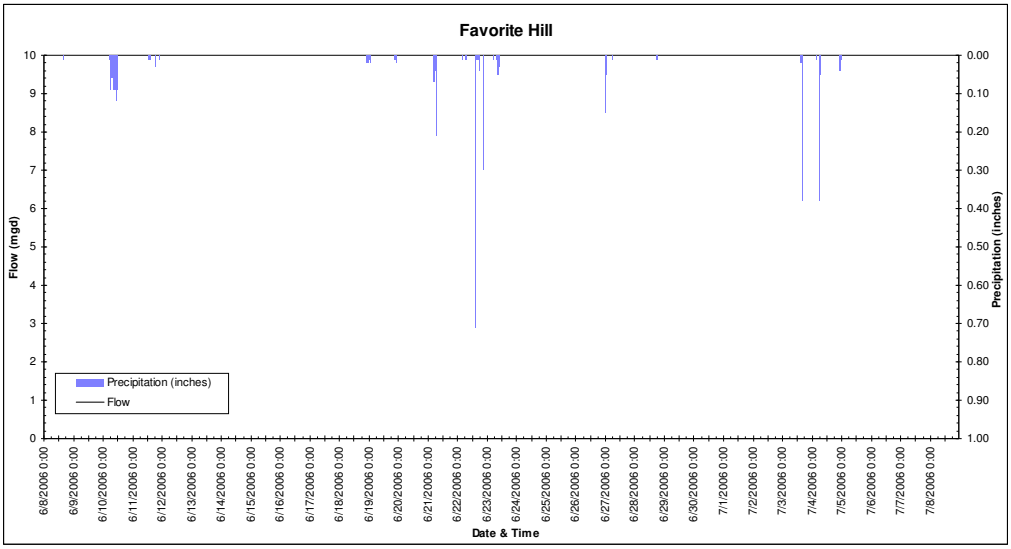
Date	Precipitation (inches)
7/9/2006 0:00	0.00
7/10/2006 0:00	0.00
7/11/2006 0:00	0.32
7/12/2006 0:00	0.07
7/13/2006 0:00	0.04
7/14/2006 0:00	0.03
7/15/2006 0:00	0.00
7/16/2006 0:00	0.00
7/17/2006 0:00	0.00
7/18/2006 0:00	0.93
7/19/2006 0:00	0.00
7/20/2006 0:00	0.00
7/21/2006 0:00	0.25
7/22/2006 0:00	1.34
7/23/2006 0:00	0.00
7/24/2006 0:00	0.00
7/25/2006 0:00	0.08
7/26/2006 0:00	0.52
7/27/2006 0:00	0.28
7/28/2006 0:00	1.01
7/29/2006 0:00	0.01
7/30/2006 0:00	0.00
7/31/2006 0:00	0.03
8/1/2006 0:00	
8/2/2006 0:00	
8/3/2006 0:00	
8/4/2006 0:00	
8/5/2006 0:00	
8/6/2006 0:00	
8/7/2006 0:00	
8/8/2006 0:00	
Total	4.91



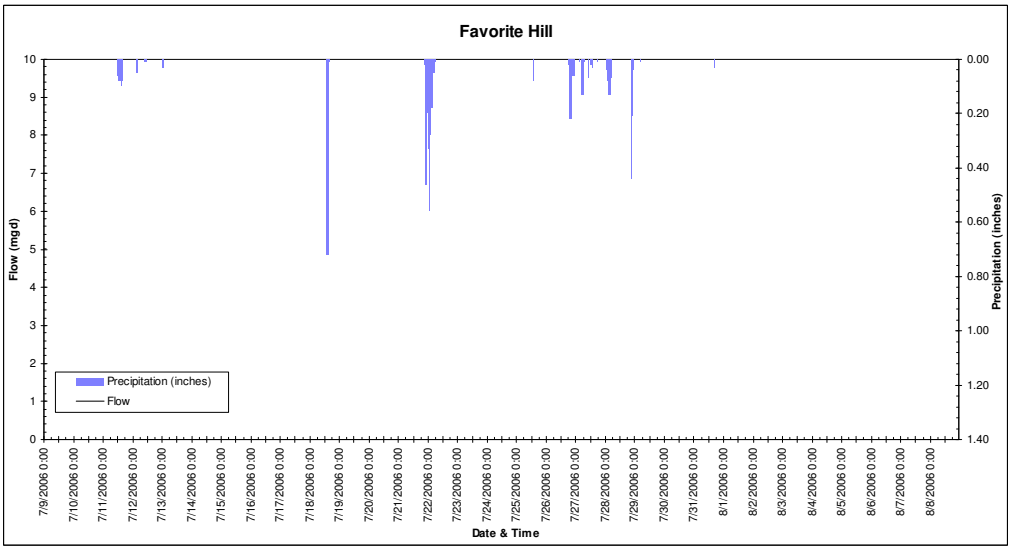
Date	Precipitation (inches)
5/8/2006 0:00	0.00
5/9/2006 0:00	0.00
5/10/2006 0:00	0.35
5/11/2006 0:00	0.38
5/12/2006 0:00	0.43
5/13/2006 0:00	0.11
5/14/2006 0:00	0.07
5/15/2006 0:00	0.14
5/16/2006 0:00	0.12
5/17/2006 0:00	0.72
5/18/2006 0:00	0.21
5/19/2006 0:00	0.07
5/20/2006 0:00	0.00
5/21/2006 0:00	0.00
5/22/2006 0:00	0.00
5/23/2006 0:00	0.01
5/24/2006 0:00	0.15
5/25/2006 0:00	0.48
5/26/2006 0:00	0.01
5/27/2006 0:00	0.00
5/28/2006 0:00	0.00
5/29/2006 0:00	0.00
5/30/2006 0:00	0.01
5/31/2006 0:00	0.02
6/1/2006 0:00	1.62
6/2/2006 0:00	1.55
6/3/2006 0:00	0.00
6/4/2006 0:00	0.00
6/5/2006 0:00	0.00
6/6/2006 0:00	0.00
6/7/2006 0:00	0.63
Total	7.08



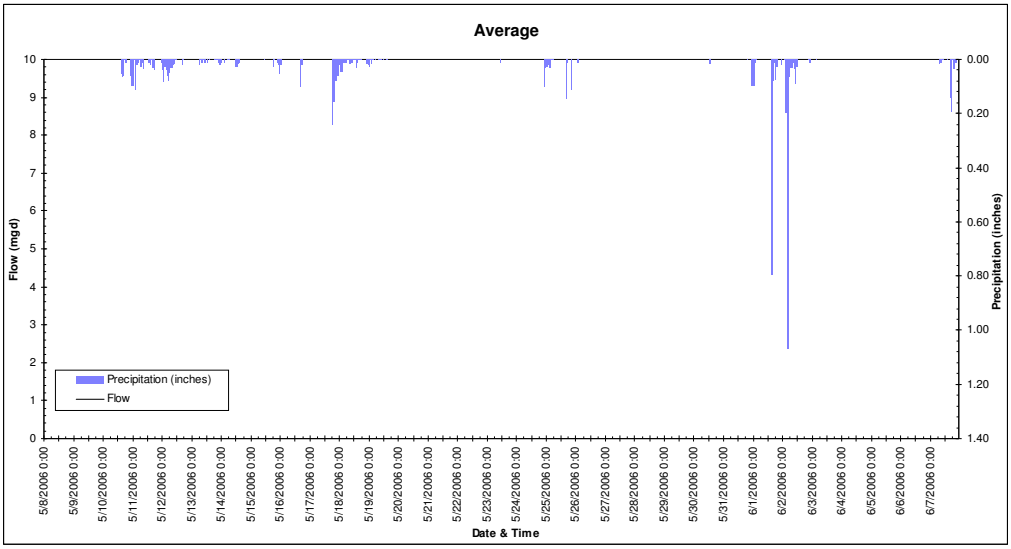
Date	Precipitation (inches)
6/8/2006 0:00	0.01
6/9/2006 0:00	0.00
6/10/2006 0:00	0.58
6/11/2006 0:00	0.06
6/12/2006 0:00	0.00
6/13/2006 0:00	0.00
6/14/2006 0:00	0.00
6/15/2006 0:00	0.00
6/16/2006 0:00	0.00
6/17/2006 0:00	0.00
6/18/2006 0:00	0.02
6/19/2006 0:00	0.06
6/20/2006 0:00	0.00
6/21/2006 0:00	0.32
6/22/2006 0:00	1.09
6/23/2006 0:00	0.10
6/24/2006 0:00	0.00
6/25/2006 0:00	0.00
6/26/2006 0:00	0.15
6/27/2006 0:00	0.10
6/28/2006 0:00	0.01
6/29/2006 0:00	0.00
6/30/2006 0:00	0.00
7/1/2006 0:00	0.00
7/2/2006 0:00	0.00
7/3/2006 0:00	0.40
7/4/2006 0:00	0.49
7/5/2006 0:00	0.00
7/6/2006 0:00	0.00
7/7/2006 0:00	0.00
7/8/2006 0:00	0.00
Total	3.39



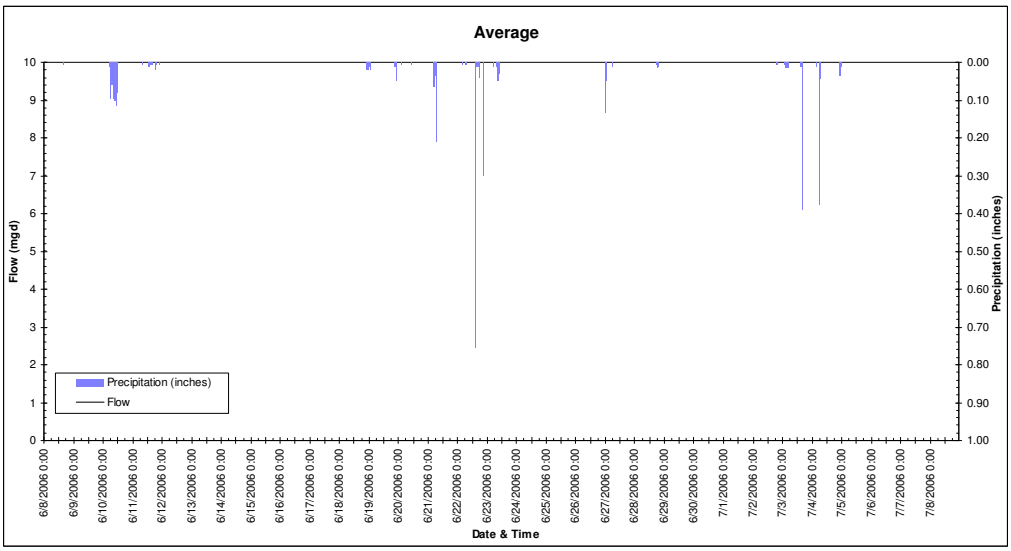
Date	Precipitation (inches)
7/9/2006 0:00	0.00
7/10/2006 0:00	0.00
7/11/2006 0:00	0.34
7/12/2006 0:00	0.06
7/13/2006 0:00	0.04
7/14/2006 0:00	0.00
7/15/2006 0:00	0.00
7/16/2006 0:00	0.00
7/17/2006 0:00	0.00
7/18/2006 0:00	0.80
7/19/2006 0:00	0.00
7/20/2006 0:00	0.00
7/21/2006 0:00	0.68
7/22/2006 0:00	1.41
7/23/2006 0:00	0.00
7/24/2006 0:00	0.00
7/25/2006 0:00	0.08
7/26/2006 0:00	0.52
7/27/2006 0:00	0.28
7/28/2006 0:00	1.01
7/29/2006 0:00	0.01
7/30/2006 0:00	0.00
7/31/2006 0:00	0.03
8/1/2006 0:00	
8/2/2006 0:00	
8/3/2006 0:00	
8/4/2006 0:00	
8/5/2006 0:00	
8/6/2006 0:00	
8/7/2006 0:00	
8/8/2006 0:00	
Total	5.26



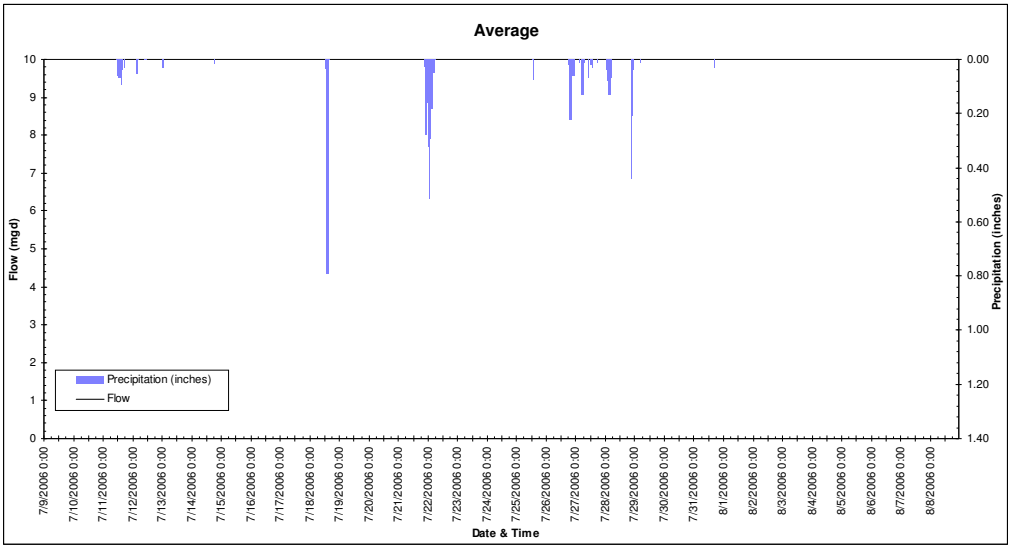
Date	Precipitation (inches)
5/8/2006 0:00	0.00
5/9/2006 0:00	0.00
5/10/2006 0:00	0.36
5/11/2006 0:00	0.40
5/12/2006 0:00	0.48
5/13/2006 0:00	0.12
5/14/2006 0:00	0.08
5/15/2006 0:00	0.12
5/16/2006 0:00	0.15
5/17/2006 0:00	0.66
5/18/2006 0:00	0.25
5/19/2006 0:00	0.08
5/20/2006 0:00	0.00
5/21/2006 0:00	0.00
5/22/2006 0:00	0.00
5/23/2006 0:00	0.01
5/24/2006 0:00	0.14
5/25/2006 0:00	0.37
5/26/2006 0:00	0.01
5/27/2006 0:00	0.00
5/28/2006 0:00	0.00
5/29/2006 0:00	0.00
5/30/2006 0:00	0.02
5/31/2006 0:00	0.11
6/1/2006 0:00	1.15
6/2/2006 0:00	1.64
6/3/2006 0:00	0.01
6/4/2006 0:00	0.00
6/5/2006 0:00	0.00
6/6/2006 0:00	0.00
6/7/2006 0:00	0.43
Total	6.54



Date	Precipitation (inches)
6/8/2006 0:00	0.01
6/9/2006 0:00	0.00
6/10/2006 0:00	0.59
6/11/2006 0:00	0.06
6/12/2006 0:00	0.00
6/13/2006 0:00	0.00
6/14/2006 0:00	0.00
6/15/2006 0:00	0.00
6/16/2006 0:00	0.00
6/17/2006 0:00	0.00
6/18/2006 0:00	0.02
6/19/2006 0:00	0.09
6/20/2006 0:00	0.01
6/21/2006 0:00	0.31
6/22/2006 0:00	1.13
6/23/2006 0:00	0.10
6/24/2006 0:00	0.00
6/25/2006 0:00	0.00
6/26/2006 0:00	0.14
6/27/2006 0:00	0.10
6/28/2006 0:00	0.03
6/29/2006 0:00	0.00
6/30/2006 0:00	0.00
7/1/2006 0:00	0.00
7/2/2006 0:00	0.01
7/3/2006 0:00	0.45
7/4/2006 0:00	0.48
7/5/2006 0:00	0.00
7/6/2006 0:00	0.00
7/7/2006 0:00	0.00
7/8/2006 0:00	0.00
Total	3.50



Date	Precipitation (inches)
7/9/2006 0:00	0.00
7/10/2006 0:00	0.00
7/11/2006 0:00	0.33
7/12/2006 0:00	0.07
7/13/2006 0:00	0.04
7/14/2006 0:00	0.02
7/15/2006 0:00	0.00
7/16/2006 0:00	0.00
7/17/2006 0:00	0.00
7/18/2006 0:00	0.87
7/19/2006 0:00	0.00
7/20/2006 0:00	0.00
7/21/2006 0:00	0.47
7/22/2006 0:00	1.38
7/23/2006 0:00	0.00
7/24/2006 0:00	0.00
7/25/2006 0:00	0.08
7/26/2006 0:00	0.52
7/27/2006 0:00	0.28
7/28/2006 0:00	1.01
7/29/2006 0:00	0.01
7/30/2006 0:00	0.00
7/31/2006 0:00	0.03
8/1/2006 0:00	
8/2/2006 0:00	
8/3/2006 0:00	
8/4/2006 0:00	
8/5/2006 0:00	
8/6/2006 0:00	
8/7/2006 0:00	
8/8/2006 0:00	
Total	5.09



APPENDIX C

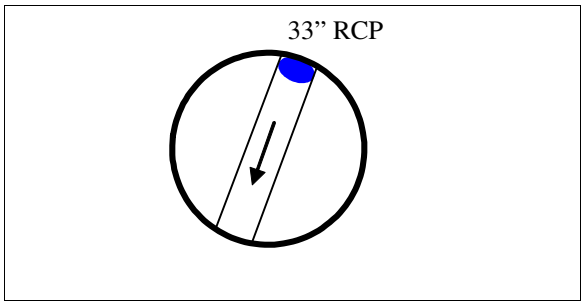
Field Data

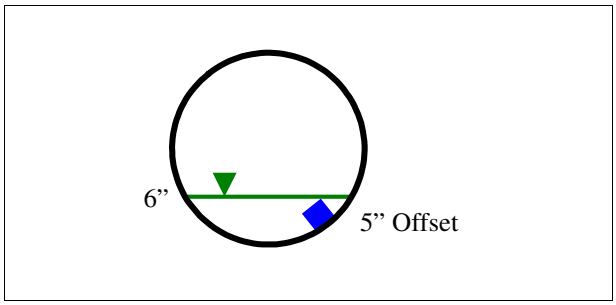
Hydromax USA

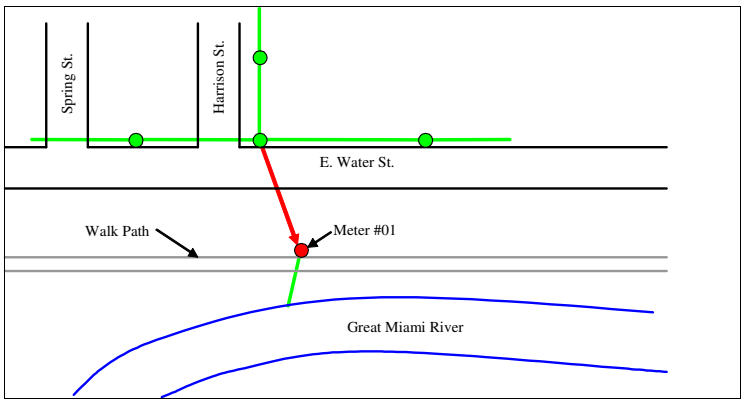
Advanced Pipeline Assessment

FLOW METER
OPENING SITE SHEET

Project #: 0614	City: Piqua, OH	Date: 4/28/2006	Installed By: RFDSJA
MH #:	Pipe Shape: Round	Pipe Mat: RCP	Pipe Size (in): 33
Site #/ Location Name:	**FM01 / Harrison St and E Water St**		MH Depth (ft): 22
Sensor #:	Meter Type: 910	Flow Meter Basin:	







Describe MH Location

(Roadway, Easement, Field, Sidewalk)

Find the cross section of Harrison St and E Water St. MH is over hill toward the river Road and MH painted green.

Site Hazards

Heavy Traffic? No

H2S? No

Sufficient O2? No

LEL Ok? No

Steps Ok? No

Describe any potential hazards

MH needs tri-pod

Meter Setup

Measure Depth (in):	11
Portable Vel. (fps):	1.25
Cycle (minutes):	

Real-time Readings

Level (in):	7
Velocity (fps):	1.19
Battery (volts):	6
Sensor Offset (in):	5
Meter Running?	Yes

Comments:

Used a side mount offset band that should work for this site.

Site Conditions

Surcharge Evidence? No

Depth of Surcharge (ft):

Depth of Silt (in): 4

Comments:

There is about 4" of silt in the bottom of this line.

Hydromax USA

Advanced Pipeline Assessment

FLOW METER
OPENING SITE SHEET

FM01 Area Photo

FM01 Manhole Photo

FM01 Pipe Photo

FM01 Pipe Photo

Hydromax USA
Advanced Pipeline Assessment

SITE SUMMARY

FM01: HARRISON STREET AND EAST WATER STREET

This flow meter was installed in a manhole at the intersection of Harrison St. and E. Water St. in a 33" circular pipe. This location is very close to the river. The sensor was installed with a 5" vertical offset due to 4" of silt in the invert of the pipe. The average dry weather flow depth ranged between 10.0"-13.0" with an average daily flow between 500-900 gpm. On 6/1/06, 2.87" of rain fell over a 15 hour period and the meter collected depth and velocity measurements that correlated to a peak wet weather flow of 2,455 gpm. The maximum recorded depth was approximately 140" indicating a surcharge level of approximately 12' above the invert.

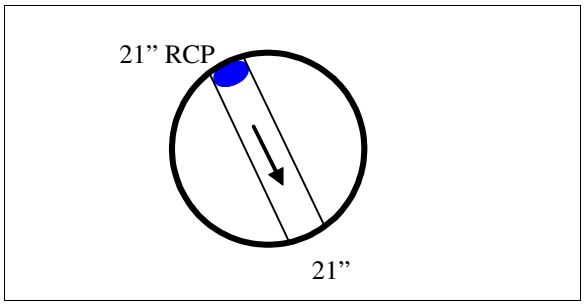
The scatter plot indicates that this site experienced normal open channel flow characteristics with backwater effects and surcharging during heavy rainfall events. The hydrograph shows a minor impact on the flow during rainfall events. The flows from sites 2, 3 and 4 are tributary to this location.

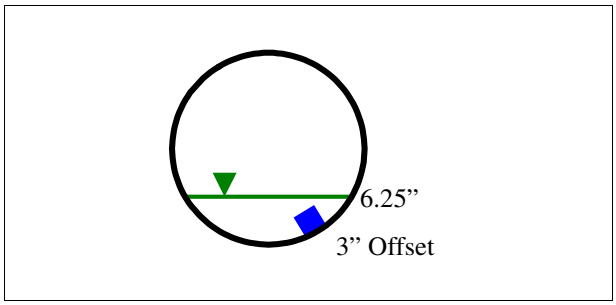
Hydromax USA

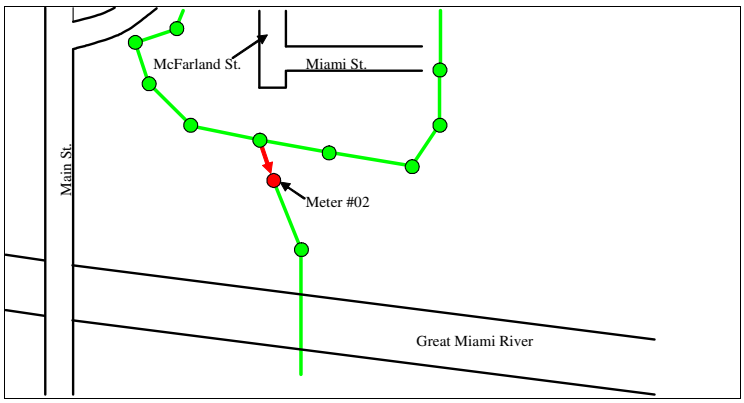
Advanced Pipeline Assessment

FLOW METER
OPENING SITE SHEET

Project #: 0614	City: Piqua, OH	Date: 4/28/2006 11:05:27 A	Installed By: RFDSJA
MH #:	Pipe Shape: Round	Pipe Mat: RCP	Pipe Size (in): 21
Site #/ Location Name:	**FM02 / Riverside off of Zimmerlin Rd and Dixie**		MH Depth (ft): 11
Sensor #:	Meter Type: 910	Flow Meter Basin:	







Describe MH Location

(Roadway, Easement, Field, Sidewalk)

Site Hazards

Heavy Traffic? No

H2S? No

Sufficient O2? No

LEL Ok? No

Steps Ok? No

Describe any potential hazards

good rungs in hole

Meter Setup

Measure Depth (in):	6.25
Portable Vel. (fps):	0.75
Cycle (minutes):	15

Real-time Readings

Level (in):	3.25
Velocity (fps):	0.8
Battery (volts):	6
Sensor Offset (in):	3
Meter Running?	Yes

Comments:

half and mounted offset.

Site Conditions

Surcharge Evidence? No

Depth of Surcharge (ft):

Depth of Silt (in): 2

Comments:

off Dixie Rd over the river bridge turn right on to Zimmermen Rd. Gravel access road on the right the leads to the hole painted green.

Hydromax USA

Advanced Pipeline Assessment

FLOW METER
OPENING SITE SHEET

FM02 Area Photo

FM02 Manhole Photo

FM02 Pipe Photo

FM02 Pipe Photo

Hydromax USA
Advanced Pipeline Assessment

SITE SUMMARY

FM02: RIVERSIDE OFF OF ZIMMERLIN ROAD AND DIXIE

This flow meter was installed in a manhole near the riverside off of Zimmerlin Rd. and Dixie Dr. in a 21" circular pipe. The sensor was installed with a 3" vertical offset due to 2" of silt in the invert of the pipe. The average dry weather flow depth ranges between 5.0"-7.5" with an average daily flow between 100-300 gpm. On 6/1/06, 2.87" of rain fell over a 15 hour period and the meter collected depth and velocity measurements that correlated to a peak wet weather flow of 586 gpm. The maximum recorded depth was approximately 90" indicating a surcharge level of approximately 6' above the invert.

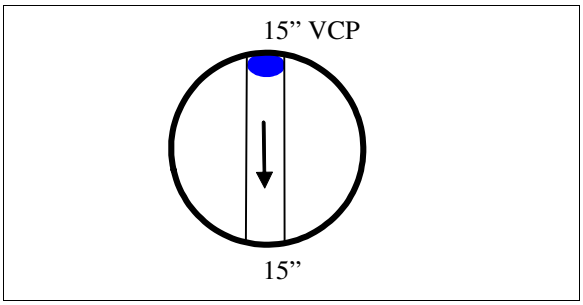
The scatter plot indicates that this site experienced normal open channel flow characteristics with backwater effects and surcharging during heavy rainfall events. The hydrograph does not show a significant impact during smaller rain events.

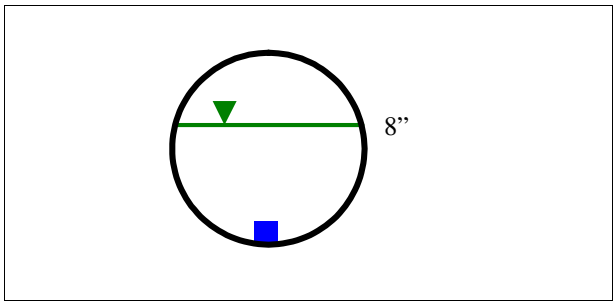
Hydromax USA

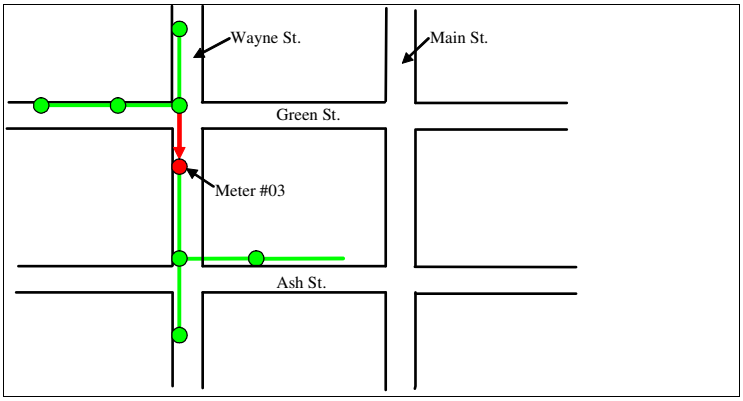
Advanced Pipeline Assessment

FLOW METER
OPENING SITE SHEET

Project #: 0614	City: Piqua, OH	Date: 4/28/2006 9:37:45 AM	Installed By: RFDSJA
MH #:	Pipe Shape: Round	Pipe Mat: VCP	Pipe Size (in): 15
Site #/ Location Name:	**FM03 / Wayne St and Ash St**		MH Depth (ft): 12
Sensor #:	Meter Type: 910	Flow Meter Basin:	







Describe MH Location

(Roadway, Easement, Field, Sidewalk)

At the corner of Wayne St and Ash St. in the middle of the road MH painted green

Site Hazards		Meter Setup		Site Conditions	
Heavy Traffic?	No	Measure Depth (in):	8	Surcharge Evidence?	No
H2S?	No	Portable Vel. (fps):	0.5	Depth of Surcharge (ft):	
Sufficient O2?	No	Cycle (minutes):	15	Depth of Silt (in):	
LEL Ok?	No	**Real-time Readings**		Comments:	
Steps Ok?	No	Level (in):	7.9		
Describe any potential hazards		Velocity (fps):	0.59		
no rungs, needs tri-pod		Battery (volts):	6		
		Sensor Offset (in):			
		Meter Running?	Yes		
		Comments:			

Hydromax USA

Advanced Pipeline Assessment

FLOW METER
OPENING SITE SHEET

FM03 Area Photo

FM03 Manhole Photo

FM03 Pipe Photo

FM03 Pipe Photo

Hydromax USA
Advanced Pipeline Assessment

SITE SUMMARY

FM03: WAYNE STREET AND ASH STREET

This flow meter was installed in a manhole near the intersection of Wayne St. and Ash St. in a 15" circular pipe. The average dry weather flow depth ranges between 5.0"-8.0" with an average daily flow between 100-300 gpm. On 6/1/06, 2.87" of rain fell over a 15 hour period and the meter collected depth and velocity measurements that correlated to a peak wet weather flow of 925 gpm. The maximum recorded depth was approximately 18.2" indicating a surcharged pipe.

Heavy debris consistently gathered around the sensor from mid-June through mid-July. This affected the level readings and office engineers manually adjusted the level readings 1" throughout this time period to more accurately represent flows at the site.

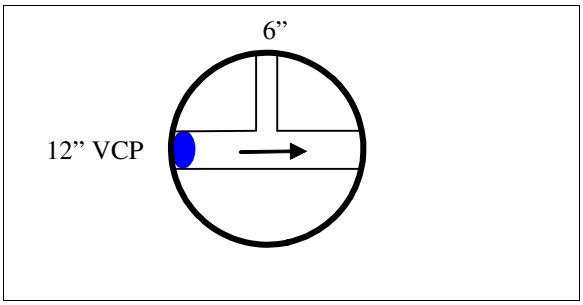
The scatter plot indicates that this site experienced normal open channel flow characteristics. The hydrograph does not show a significant impact during rainfall events.

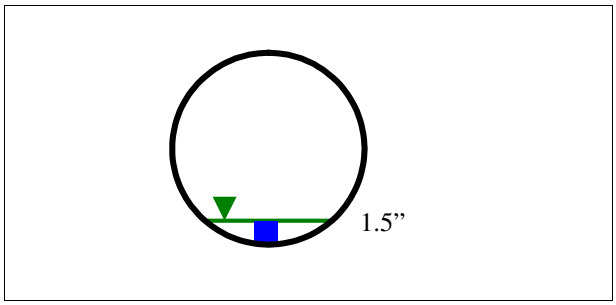
Hydromax USA

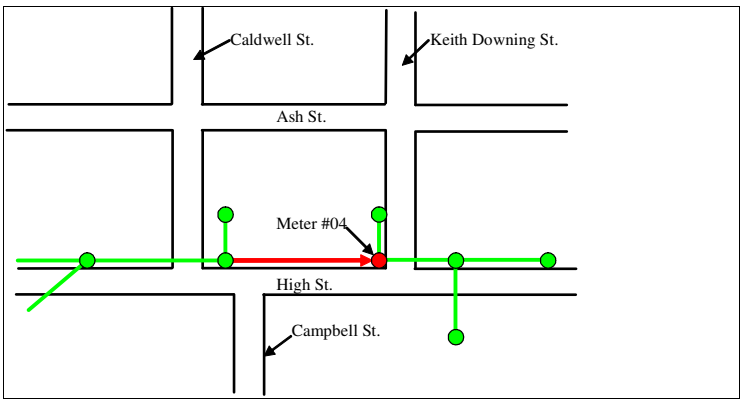
Advanced Pipeline Assessment

FLOW METER
OPENING SITE SHEET

Project #: 0614	City: Piqua, OH	Date: 4/28/2006 9:31:38 AM	Installed By: RFDSJA
MH #:	Pipe Shape: Round	Pipe Mat: VCP	Pipe Size (in): 12
Site #/ Location Name:	**FM04 / High St and Keith Downing St.**		MH Depth (ft): 15
Sensor #:	Meter Type: 910	Flow Meter Basin:	







Describe MH Location

(Roadway, Easement, Field, Sidewalk)

At the corner of Keith Downing and High St in the middle of the road, MH painted green.

Site Hazards

Heavy Traffic? No

H2S? No

Sufficient O2? No

LEL Ok? No

Steps Ok? No

Describe any potential hazards

rusty old rungs should use tri-pod

Meter Setup

Measure Depth (in):	1.5
Portable Vel. (fps):	4.15
Cycle (minutes):	15

Real-time Readings

Level (in):	1.755
Velocity (fps):	4.2
Battery (volts):	6
Sensor Offset (in):	
Meter Running?	Yes

Comments:

Site Conditions

Surcharge Evidence? No

Depth of Surcharge (ft):

Depth of Silt (in):

Comments:

high velocity, but line is in good shape.

Hydromax USA

Advanced Pipeline Assessment

FLOW METER
OPENING SITE SHEET

FM04 Area Photo

FM04 Pipe Photo

FM04 Pipe Photo

Hydromax USA
Advanced Pipeline Assessment

SITE SUMMARY

FM04: HIGH STREET AND KEITH DOWNING STREET

This flow meter was installed in a manhole near the intersection of High St. and Keith Downing St. in a 12" circular pipe. The average dry weather flow depth ranges between 0.75"-2.0" with an average daily flow between 50-200 gpm. On 6/1/06, 2.87" of rain fell over a 15 hour period and the meter collected depth and velocity measurements that correlated to a peak wet weather flow of 601 gpm. This location measured a higher flow on 5/24, however this may have been due to a short term blockage upstream. The maximum recorded depth was approximately 3".

This site exhibited high velocities for low levels making it a challenge for field crews to obtain consistent manual readings.

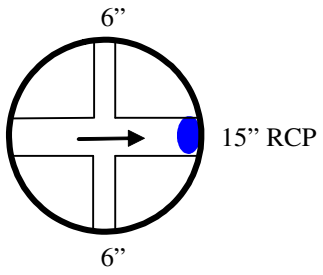
The scatter plot indicates that this site experienced normal open channel flow characteristics. The hydrograph does not show a significant impact during rainfall events.

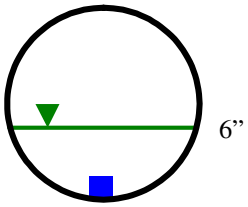
Hydromax USA

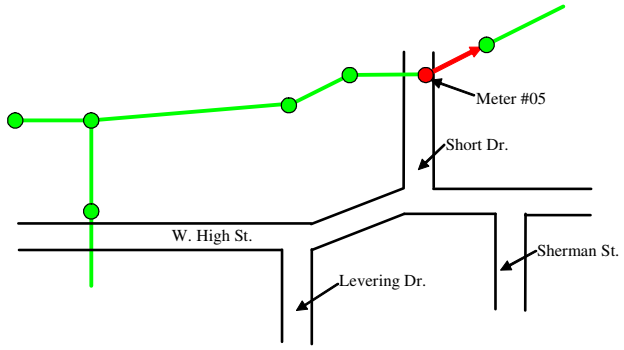
Advanced Pipeline Assessment

FLOW METER
OPENING SITE SHEET

Project #: 0614	City: Piqua, OH	Date: 4/28/2006 1:27:39 PM	Installed By: RFDSJA
MH #:	Pipe Shape: Round	Pipe Mat: RCP	Pipe Size (in): 15
Site #/ Location Name:	**FM05 / 315 Short Dr. Middle of Street**		MH Depth (ft): 11
Sensor #:	Meter Type: 910	Flow Meter Basin:	







Describe MH Location

(Roadway, Easement, Field, Sidewalk)

in street right in front of 315 Short Dr. painted orange.

Site Hazards

Heavy Traffic? No
H2S? No
Sufficient O2? No
LEL Ok? No
Steps Ok? No

Describe any potential hazards

no rungs tri-pod is a must

Meter Setup

Measure Depth (in):	6
Portable Vel. (fps):	1.6
Cycle (minutes):	15

Real-time Readings

Level (in):	6.15
Velocity (fps):	1.7
Battery (volts):	6
Sensor Offset (in):	
Meter Running?	Yes

Comments:

It was a badly shaped concrete line.

Site Conditions

Surcharge Evidence? No
Depth of Surcharge (ft):
Depth of Silt (in):

Comments:

sensor is in the down stream line but is facing upstream. There will be no hydraulic problems here.

Hydromax USA

Advanced Pipeline Assessment

FLOW METER
OPENING SITE SHEET

FM05 Area Photo

FM05 Manhole Photo

FM05 Pipe Photo

FM05 Pipe Photo

Hydromax USA
Advanced Pipeline Assessment

SITE SUMMARY

FM05: 315 SHORT DRIVE MIDDLE OF STREET

This flow meter was installed in a manhole near 315 Short Dr. in a 15" circular pipe. The average dry weather flow depth ranges between 5.0"-7.5" with an average daily flow between 200-550 gpm. On 6/1/06, 2.87" of rain fell over a 15 hour period and the meter collected depth and velocity measurements that correlated to a peak wet weather flow of 1314 gpm. The maximum recorded depth was approximately 13".

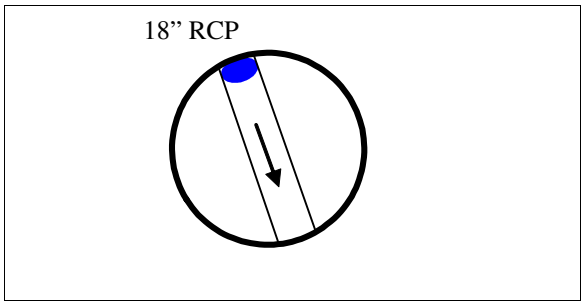
The scatter plot indicates that this site experienced normal open channel flow characteristics. The hydrograph shows a significant impact during rainfall events.

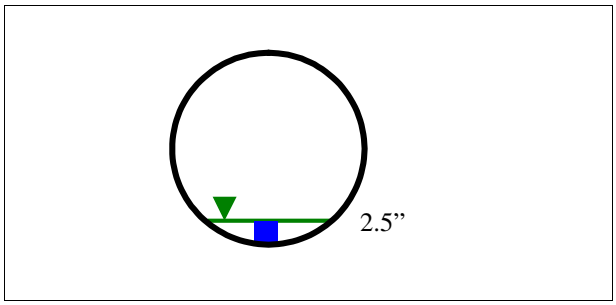
Hydromax USA

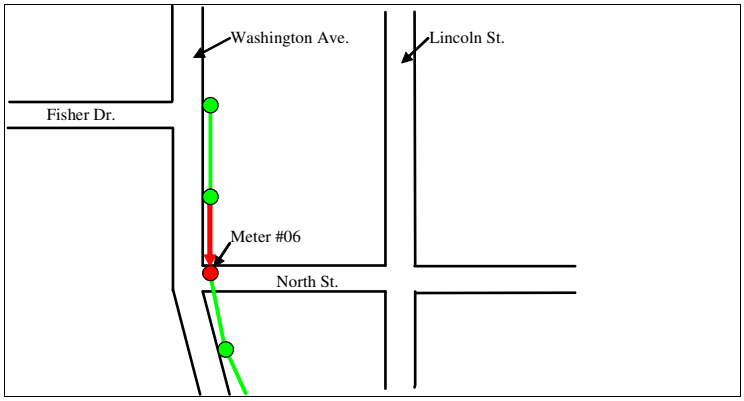
Advanced Pipeline Assessment

FLOW METER
OPENING SITE SHEET

Project #: 0614	City: Piqua, OH	Date: 4/28/2006 12:44:33 P	Installed By: RFDSJA
MH #:	Pipe Shape: Round	Pipe Mat: RCP	Pipe Size (in): 18
Site #/ Location Name:	**FM06 / North St and Washington Ave**		MH Depth (ft): 10
Sensor #:	Meter Type: 910	Flow Meter Basin:	







Describe MH Location

(Roadway, Easement, Field, Sidewalk)

right at the cross of Washington Ave and North St. Mh painted bright orange.

Site Hazards

Heavy Traffic? No

H2S? No

Sufficient O2? No

LEL Ok? No

Steps Ok? No

Describe any potential hazards

good hole, easy in easy out

Meter Setup

Measure Depth (in):	2.5
Portable Vel. (fps):	1.5
Cycle (minutes):	15

Real-time Readings

Level (in):	2.6
Velocity (fps):	1.65
Battery (volts):	6
Sensor Offset (in):	
Meter Running?	Yes

Comments:

Site Conditions

Surcharge Evidence? No

Depth of Surcharge (ft):

Depth of Silt (in):

Comments:

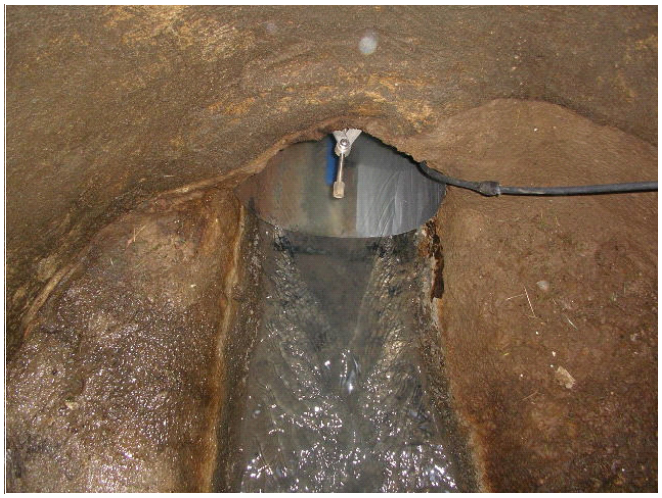
Hydromax USA

Advanced Pipeline Assessment

FLOW METER
OPENING SITE SHEET

FM06 Area Photo

FM06 Manhole Photo



FM06 Pipe Photo

FM06 Pipe Photo

Hydromax USA
Advanced Pipeline Assessment

SITE SUMMARY

FM06: NORTH STREET AND WASHINGTON AVENUE

This flow meter was installed in a manhole near the intersection of North St. and Washington Ave. in an 18" circular pipe. The average dry weather flow depth ranges between 1.75"-2.75" with an average daily flow between 50-150 gpm. On 6/1/06, 2.87" of rain fell over a 15 hour period and the meter collected depth and velocity measurements that correlated to a peak wet weather flow of 579 gpm. The maximum recorded depth was approximately 5.5".

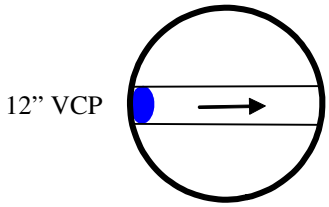
The scatter plot indicates that this site experienced normal open channel flow characteristics. The hydrograph shows an impact during rainfall events.

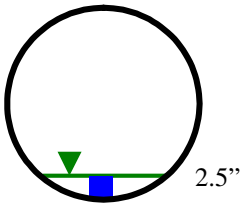
Hydromax USA

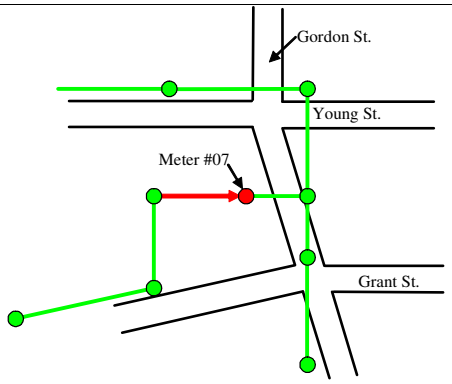
Advanced Pipeline Assessment

FLOW METER
OPENING SITE SHEET

Project #: 0614	City: Piqua, OH	Date: 4/28/2006 2:05:18 PM	Installed By: RFDSJA
MH #:	Pipe Shape: Round	Pipe Mat: VCP	Pipe Size (in): 12
Site #/ Location Name:	**FM07 / 428 Gordon St**		MH Depth (ft): 10
Sensor #:	Meter Type: 910	Flow Meter Basin:	







Describe MH Location

(Roadway, Easement, Field, Sidewalk)

directly in the middle of the driveway at 428 Gordon St. painted orange.

Site Hazards

Heavy Traffic? No
H2S? No
Sufficient O2? No
LEL Ok? No
Steps Ok? No

Describe any potential hazards

easy access

Meter Setup

Measure Depth (in): 2.5
Portable Vel. (fps): 6.5
Cycle (minutes):

Real-time Readings

Level (in): 2.76
Velocity (fps): 6.48
Battery (volts): 6
Sensor Offset (in):
Meter Running? Yes

Comments:

Site Conditions

Surcharge Evidence? No
Depth of Surcharge (ft):
Depth of Silt (in):

Comments:

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Advanced Pipeline Assessment

FLOW METER
OPENING SITE SHEET

FM07 Area Photo

FM07 Manhole Photo

FM07 Pipe Photo

FM07 Pipe Photo

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SITE SUMMARY

FM07: 428 GORDON STREET

This flow meter was installed in a manhole near 428 Gordon St. in a 12" circular pipe. The average dry weather flow depth ranges between 1.5"- 3.0" with an average daily flow between 150-400 gpm. On 6/1/06, 2.87" of rain fell over a 15 hour period and the meter collected depth and velocity measurements that correlated to a peak wet weather flow of 2,188 gpm. The maximum recorded depth was approximately 8".

This site exhibited high velocities with low levels making it a challenge for field crews to obtain consistent manual readings.
The scatter plot indicates that this site experienced normal open channel flow characteristics. The hydrograph shows a significant impact during rainfall events. The flow from site 9 is tributary to this location.

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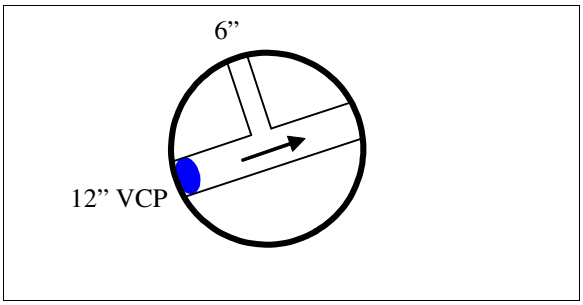
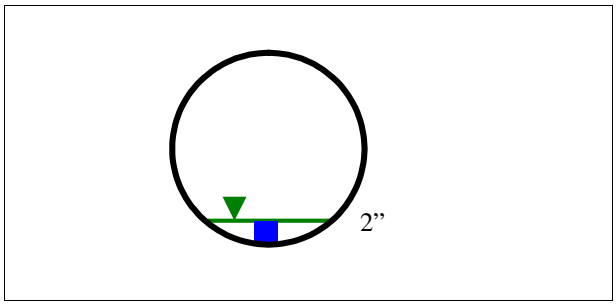
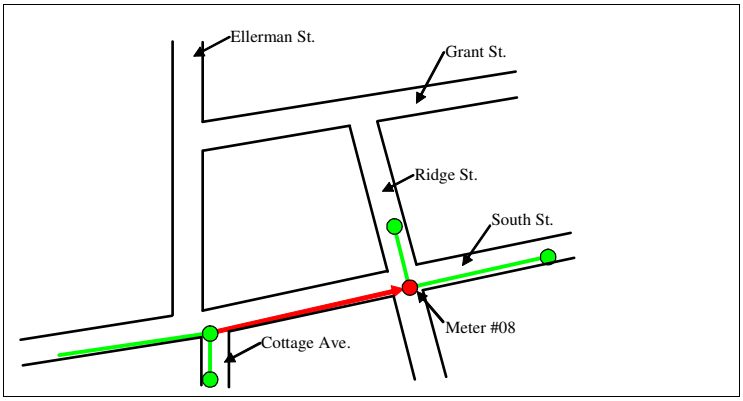
FLOW METER
OPENING SITE SHEET

Project #: 0614	City: Piqua, OH	Date: 4/28/2006 2:23:23 PM	Installed By: RFDSJA
MH #:	Pipe Shape: Round	Pipe Mat: VCP	Pipe Size (in): 12
Site #/ Location Name:	**FM08 / Ridge St and South St**		MH Depth (ft): 5
Sensor #:	Meter Type: 910	Flow Meter Basin:	







Describe MH Location

(Roadway, Easement, Field, Sidewalk)

at the cross of Ridge St and South St. in the middle of the street (Ridge) painted orange.

Site Hazards

Heavy Traffic? No

H2S? No

Sufficient O2? No

LEL Ok? No

Steps Ok? No

Describe any potential hazards

small hole

Meter Setup

Measure Depth (in):	2
Portable Vel. (fps):	3.75
Cycle (minutes):	15

Real-time Readings

Level (in):	1.984
Velocity (fps):	3.88
Battery (volts):	6
Sensor Offset (in):	
Meter Running?	Yes

Comments:

high velocity and low flow could cause some problems at night and in the summer but should be fine in the day time.

Site Conditions

Surcharge Evidence? No

Depth of Surcharge (ft):

Depth of Silt (in):

Comments:

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Advanced Pipeline Assessment

FLOW METER
OPENING SITE SHEET

FM08 Area Photo

FM08 Manhole Photo

FM08 Pipe Photo

FM08 Pipe Photo

Hydromax USA
Advanced Pipeline Assessment

SITE SUMMARY

FM08: RIDGE STREET AND SOUTH STREET

This flow meter was installed in a manhole near the intersection of Ridge St. and South St. in a 12" circular pipe. The average dry weather flow depth ranges between 2"-4" with an average daily flow between 50-500 gpm. On 6/1/06, 1.37" of rain fell over a 2 hour period. This corresponds to a 1-year, 2-hour event. The meter collected depth and velocity measurements that correlated to a peak wet weather flow of 2,267 gpm. This is the only site which showed a higher spike after the first 2 hours of the large rain event this day. The other meters exhibited greater flow toward the end of the longer 15-hour event. The maximum recorded depth was approximately 16.5" indicating a surcharged pipe.

The scatter plot indicates that this site experienced normal open channel flow characteristics. The hydrograph shows a significant impact during rainfall events. The hydrograph also shows evidence of flow spikes not associated with rain. These events usually last about 20 minutes but are not consistent in their frequency. It could possibly be an industrial discharge.

The meter was moved one manhole upstream on May 15, 2006 because of the high velocities and low levels causing difficult hydraulic conditions at the site.

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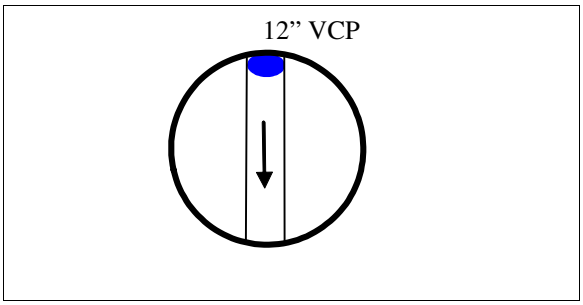
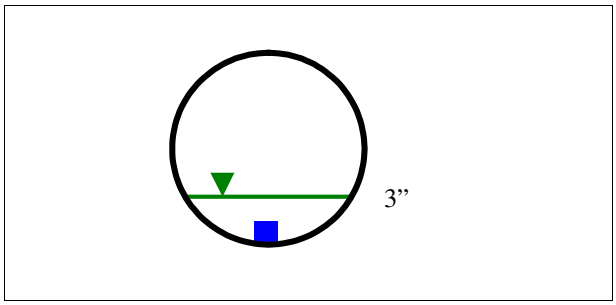
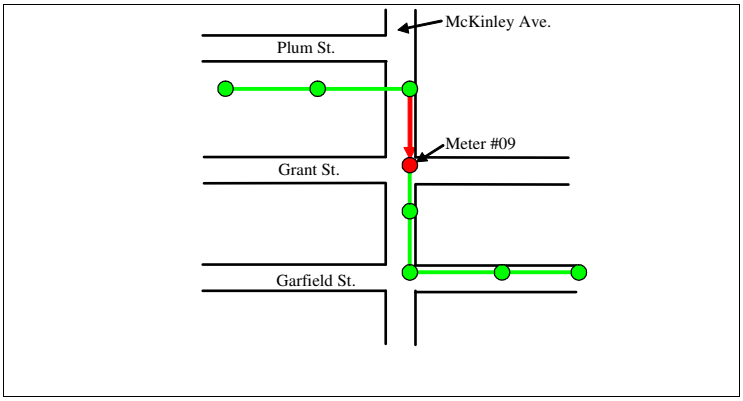
Advanced Pipeline Assessment

FLOW METER
OPENING SITE SHEET

Project #: 0614	City: Piqua, OH	Date: 4/28/2006 2:42:44 PM	Installed By: RFDSJA
MH #:	Pipe Shape: Round	Pipe Mat: VCP	Pipe Size (in): 12
Site #/ Location Name:	**FM09 / 1404 Grant St**		MH Depth (ft): 6
Sensor #:	Meter Type: 910	Flow Meter Basin:	







Describe MH Location

(Roadway, Easement, Field, Sidewalk)

Directly in front of 1404 Grant St. MH painted orange. In street

Site Hazards

Heavy Traffic? No

H2S? No

Sufficient O2? No

LEL Ok? No

Steps Ok? No

Describe any potential hazards

rungs bad and rusty

Meter Setup

Measure Depth (in):	3
Portable Vel. (fps):	1.65
Cycle (minutes):	15

Real-time Readings

Level (in):	2.991
Velocity (fps):	1.77
Battery (volts):	6
Sensor Offset (in):	
Meter Running?	Yes

Comments:

Site Conditions

Surcharge Evidence? No

Depth of Surcharge (ft):

Depth of Silt (in):

Comments:

Hydromax USA

Advanced Pipeline Assessment

FLOW METER
OPENING SITE SHEET

FM09 Area Photo

FM09 Manhole Photo

FM09 Pipe Photo

FM09 Pipe Photo

Hydromax USA
Advanced Pipeline Assessment

SITE SUMMARY

FM09: 1404 GRANT STREET

This flow meter was installed in a manhole near 1404 Grant St. in a 12" circular pipe. The average dry weather flow depth ranges between 2.0"-4.5" with an average daily flow between 25-250 gpm. On 6/1/06, 2.87" of rain fell over a 15 hour period and the meter collected depth and velocity measurements that correlated to a peak wet weather flow of 582 gpm. The maximum recorded depth was approximately 8".

The scatter plot indicates that this site experienced normal open channel flow characteristics. The hydrograph shows an impact during rainfall events.

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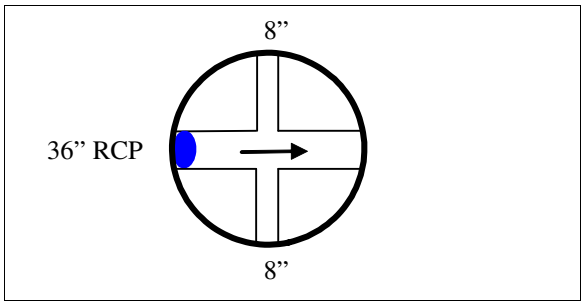
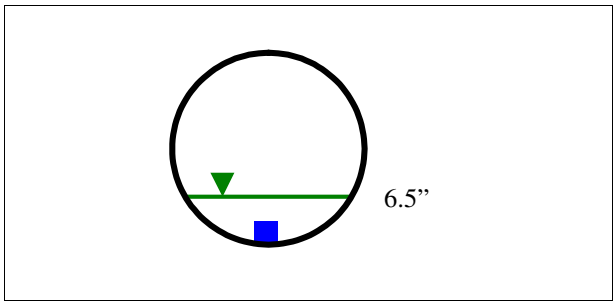
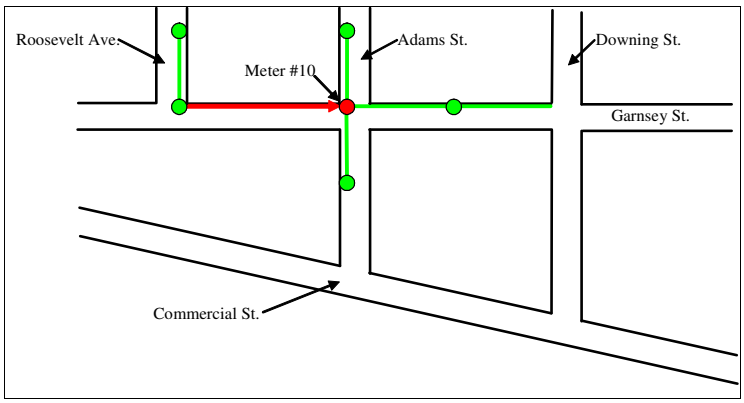
Advanced Pipeline Assessment

FLOW METER
OPENING SITE SHEET

Project #: 0614	City: Piqua, OH	Date: 4/28/2006 3:22:33 PM	Installed By: RFDSJA
MH #:	Pipe Shape: Round	Pipe Mat: RCP	Pipe Size (in): 36
Site #/ Location Name:	**FM10 / Garnsey St and Adams St**		MH Depth (ft): 10
Sensor #:	Meter Type: 910	Flow Meter Basin:	







Describe MH Location

(Roadway, Easement, Field, Sidewalk)

Directly in the middle of the intersection of Garnsey St and Adams St. MH painted green.

Site Hazards

Heavy Traffic? No

H2S? No

Sufficient O2? No

LEL Ok? No

Steps Ok? No

Describe any potential hazards

good steps but it is a big line so be careful.

Meter Setup

Measure Depth (in):	6.5
Portable Vel. (fps):	2.55
Cycle (minutes):	15

Real-time Readings

Level (in):	6.49
Velocity (fps):	2.45
Battery (volts):	6
Sensor Offset (in):	
Meter Running?	No

Comments:

Site Conditions

Surcharge Evidence? No

Depth of Surcharge (ft):

Depth of Silt (in):

Comments:

Hydromax USA

Advanced Pipeline Assessment

FLOW METER
OPENING SITE SHEET

FM10 Area Photo

FM10 Manhole Photo

FM10 Pipe Photo

FM10 Pipe Photo

Hydromax USA
Advanced Pipeline Assessment

SITE SUMMARY

FM10: GARNSEY STREET AND ADAMS STREET

This flow meter was installed in a manhole near the intersection of Garnsey St. and Adams St. in a 36" circular pipe. The average dry weather flow depth ranges between 4.5"-7.0" with an average daily flow between 400-1000 gpm. On 6/1/06, 2.78" of rain fell over a 15 hour period and the meter collected depth and velocity measurements that correlated to a peak wet weather flow of 5,795 gpm. The maximum recorded depth was approximately 17".

The scatter plot indicates that this site experienced normal open channel flow characteristics. The hydrograph shows an impact during rainfall events.

The flow from sites 5, 6, 7 and 8 are tributary to this site. The flow spikes that were seen at Site 8 are also seen on the hydrograph for Site 10. There appears to be a 10-20 minute lag in timing for the flow from site 8 to reach this location.

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Advanced Pipeline Assessment

RAIN GAUGE
OPENING SITE SHEET

Project #: 0614	City: Piqua, OH	Date: 4/28/2006 8:08:32 AM	Installed By: RFDSJA
Site # / Location Name: RG01 / Favorite Hill School, South St			
Basin:	Site Hazards:	Site Condition Comments:	
Site Description: the school janitor will guide anyone o the access point		Gauge on the roof of Favorite Hill Elementary School, must be accessed from inside the school. School is prepared for us and the name Hydromax USA.	

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Advanced Pipeline Assessment

RAIN GAUGE
OPENING SITE SHEET

Project #: 0614	City: Piqua, OH	Date: 4/28/2006 8:39:09 AM	Installed By: RFDSJA
Site # / Location Name: RG02 / Nicklin Learning Center			
Basin:	Site Hazards:	Site Condition Comments:	
Site Description:		Gauge inside Nickiln Learning Center. Main office will let you in and janitor will show the access ladder.