STATE OF MISSOURI Jeremiah W. (Jay) Nixon, Governor • Sara Parker Pauley, Director

DEPARTMENT OF NATURAL RESOURCES

www.dnr.mo.gov

MAY - 9 2012

The Honorable William Jenks III
Mayor of the City of Rolla
P.O. Box 979
Rolla, MO 65402

RE: Bypass Elimination Plan, City of Rolla, MO-0047031 and MO-0050652

Dear Mayor Jenks:

The Missouri Department of Natural Resources' Water Protection Program (Department) has received the Bypass Elimination Plan for Southeast and Vichy Road Wastewater Treatment Plants from Mr. Jeff Medows, P.E., CM Archer Group P.C., on May 3, 2012. This was required by the Peak Flow Voluntary Compliance Agreement (Agreement). Thank you for your submittal. There are no comments from the Department.

The Bypass Elimination Plan shall be fully implemented by the permitted Publicly Owned Treatment Works. The Bypass Elimination Plan, including the schedule and any deadlines contained therein, are enforceable terms of the Agreement pursuant to Paragraph 13 of the Agreement. If a discharge from the peak flow outfalls does occur, the City of Rolla shall report the bypass to the Southeast Regional Office pursuant to the requirement of Paragraph 9 of the Agreement.

If you have any questions in regard to this Agreement or other wet weather issues, please contact me by phone at (573) 526-4589, by e-mail at walter.fett@dnr.mo.gov, or by mail at the Missouri Department of Natural Resources, Water Protection Program, Engineering Section, P.O. Box 176, Jefferson City, MO 65102-0176. Thank you for working with the Department to protect our environment.

Sincerely,

WATER PROTECTION PROGRAM

Walter Fett

Walter Fett, Wet Weather Coordinator
Engineering Section

WF/pc

c: Mr. Jeff Meadows, P.E., CM Archer Group P.C.
Southeast Regional Office
File Copy

City of ROLLA

Rolla, Missouri

BYPASS ELIMINATION PLAN FOR SOUTHEAST AND VICHY ROAD WASTEWATER TREATMENT PLANTS

Prepared By:
HDR

HDR

In Association With:
CM | Archer

ARCHER
ENGINEERING - SURVEYING

APRIL 2012

HDR PROJECT NO. 174520

CONTENTS

SECTION

APPENDICES

1 EXECUTIVE SUMMARY AND BACKGROUND

1.1 EXECUTIVE SUMMARY

The purpose of this Bypass Elimination Plan (BEP) is to present the best course for elimination of bypasses at the Southeast and Vichy Road WWTPs in Rolla, MO. The Missouri Department of Natural Resources (MDNR) defines a bypass as "the diversion of wastewater from any portion of a wastewater treatment facility or sewer system to waters of the state." This report evaluates the operation of the Southeast and Vichy Road WWTPs and the collection system and develops recommendations to best eliminate bypasses in a cost effective manner. This bypass elimination plan has been prepared in response to a Voluntary Compliance Agreement (VCA) between MDNR and the City of Rolla, included in Appendix A. Figure 1-1 shows the location of the Southeast and Vichy Road WWTPs, as well as the City's other plant, the Southwest WWTP. The Southwest WWTP is not included in the VCA and the facility is not addressed in the BEP.

The Southeast WWTP consists of two facilities that will be referred to in this report as the West plant and the East plant. The Southeast WWTP is currently hydraulically capable of handling up to 10.0 mgd of total flow between the West and East plants. Based on data from recent years, the plant has seen a peak daily flow of 36.0 mgd, with the excess flow receiving primary treatment at two peak flow clarifiers before discharge to the receiving stream at Outfall 002 and Outfall 003 of the West and East plants, respectively. Discharges through the peak flow clarifiers (Outfalls 002 and 003) are considered bypasses and are no longer permitted.

The Vichy Road WWTP is currently hydraulically capable of handling up to 1.0 mgd of flow. Based on data from previous years, the plant has seen a peak daily flow of 4.0 mgd, with the excess flow receiving primary treatment at a peak flow clarifier before discharge to the receiving stream at Outfall 002. Discharges through the peak flow clarifier (Outfall 002) are considered bypasses and are no longer permitted.

In order to eliminate future bypasses at the Southeast and Vichy Road WWTPs this plan evaluates three possible alternatives. The alternatives are treatment plant expansion, flow equalization basins, and collection system improvements to reduce inflow and infiltration (I/I).

It is recommended that the City focus first on collection system improvements within the Southeast and Vichy Road WWTP service areas to eliminate sources of I/I into the system in order to reduce peak wet weather flows to the plants. The results of the I/I Reduction Program should be evaluated annually, and adjustments made to the program as necessary. The level of I/I removal achieved will be evaluated through flow monitoring.

The flow monitoring results will be further evaluated to determine the required size of the equalization basin facilities used to store peak wet weather flows beyond the treatment capacity of the WWTPs. If sufficient I/I reduction is achieved during the Voluntary Compliance Agreement period to eliminate the need for equalization basin facilities, the need for equalization basins will be reevaluated.

Table 1-1 shows the annual budget and resource allocation for the I/I Reduction Program. Tables 1-2 and 1-3 present the estimated costs for the equalization basin facilities at the Southeast and Vichy Road WWTPs, respectively.

Table 1-1 Annual Budget and Resource Allocation for I/I Reduction Program

Labor	$260,000
Equipment	$ 60,000
Materials	$ 50,000
Subtotal, City Performed Work	$370,000
Improvements by Contract	$250,000
Total Annual Costs	$620,000

Table 1-2 SE WWTP Equalization Basin Alternatives Cost Estimates

% I/I Removal	Alternative Description	Capital Cost	Annual O&M Cost
0	EQ Basin Volume = 36-mil gallons	$6,760,000	$14,000
25	EQ Basin Volume = 27-mil gallons	$5,640,000	$12,000

Note: Estimates based on best flow metering data available at time of analysis.

Table 1-3 Vichy Road WWTP Equalization Basin Alternatives Cost Estimates

% I/I Removal	Alternative Description	Capital Cost	Annual O&M Cost
0	EQ Basin Volume = 4.15-mil gallons	$1,380,000	$6,000
25	EQ Basin Volume = 3.0-mil gallons	$1,130,000	$6,000

Note: Estimates based on best flow metering data available at time of analysis.

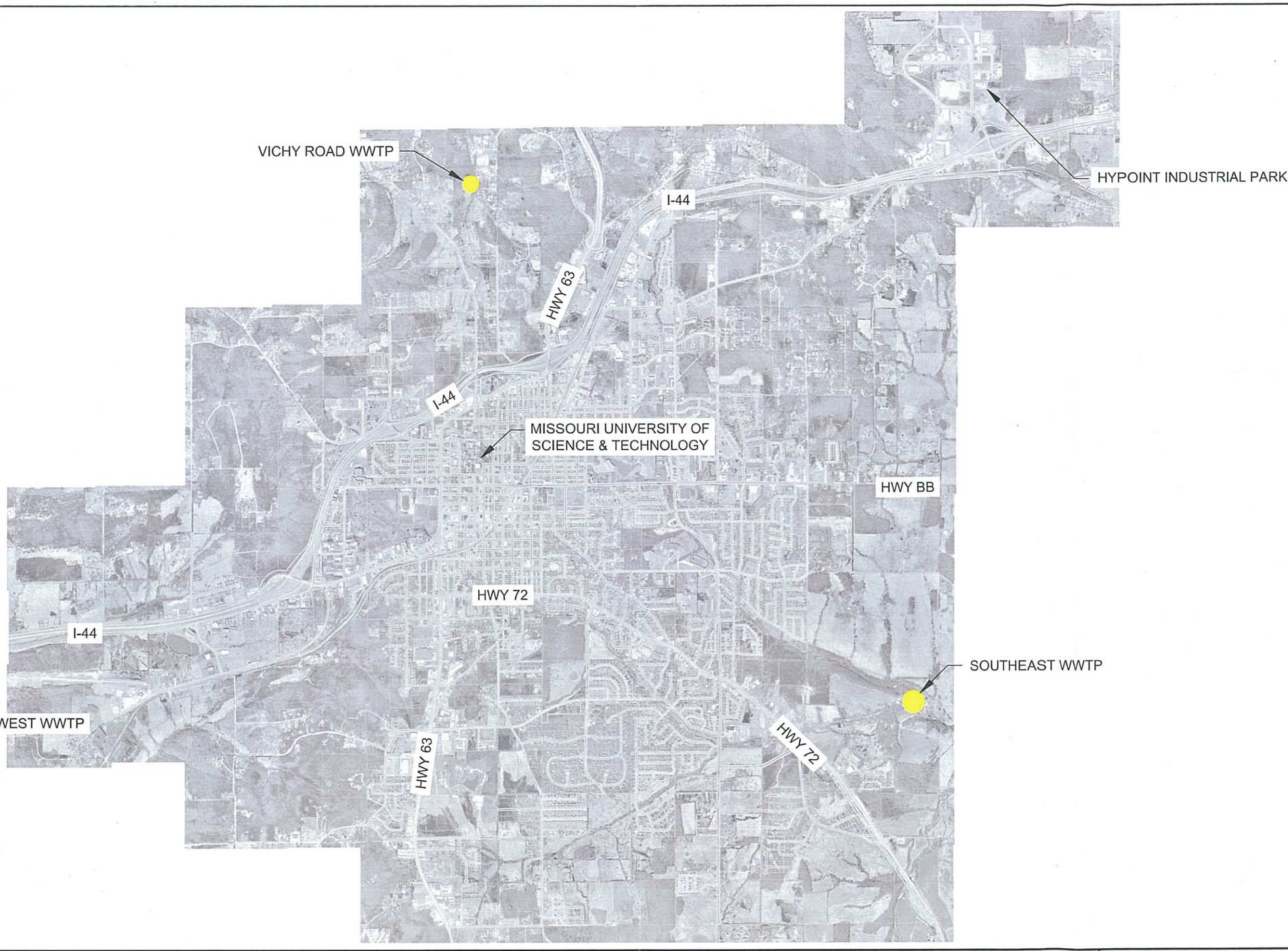
The implementation of the Bypass Elimination Plan (BEP) improvements should follow the schedule shown on the following page. Refer to Section 3.1.2 for a detailed schedule of the I/I Reduction Program. Refer to Section 4.4.3 for a detailed schedule of the equalization basin facilities.

Bypass Elimination Plan Schedule Summary:

1. May 5, 2012 – Submit BEP to MDNR for Approval (Start Date)

2. I/I Reduction and Collection System Rehabilitation Program:
   - Year 1 – 7 (2012 – 2018): I/I Reduction Pilot Study in Priority Basins
   - Year 2 – 8 (2013 – 2019): Ongoing I/I Removal and Collection System Rehabilitation
   - Year 1 – 9 (2012 – 2020): Ongoing Flow Monitoring
   - Ongoing Updates to BEP for Field Inspection and Flow Monitoring Data
   - Year 10 and Beyond: Continued I/I Inspections and Collection System Rehabilitation

3. Equalization Basin Facilities:
   - Year 1 (2012): Begin Land Acquisition Process
   - Year 8 (2019): Design
   - Year 9 (2020): Bid and Construction
   - Year 10 (2021): Complete Construction and Start Up Facilities



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HDR

HDR ENGINEERING, INC.
MO. STATE CERTIFICATE
OF AUTHORITY #000856
3741 NE TROON DRIVE
LEE'S SUMMIT, MO. 64064

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1100 North Outer Road
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City of ROLLA

CITY OF ROLLA, MO
BYPASS ELIMINATION PLAN

PROJECT NO. 11129910

FIGURE 1-1
ROLLA WWTP LOCATIONS

DRAWING NO. 1-1

1.2 PURPOSE AND BACKGROUND

Currently, the operating permits for the City of Rolla Southeast and Vichy Road WWTPs are being reviewed by the Missouri Department of Natural Resources (MDNR) for renewal. Within the new permits, discharges from the peak flow clarifiers located at both sites shall not be permitted. Therefore, any discharges from the peak flow clarifiers must be reported as bypasses to MDNR as they occur. The elimination of discharges from the peak flow clarifiers from the permit was the result of the Environmental Protection Agency's and the MDNR's interpretation of the Clean Water Act (40 CFR 122.41(m)). Currently it is interpreted that discharges from peak flow clarifiers represent a bypass of secondary treatment. Bypasses are not allowed under the Clean Water Act unless they are expressly permitted or are unavoidable to prevent loss of life, personal injury, or severe property damage. The MDNR requires that bypasses of secondary treatment be reported as required by the Clean Water Act, within 24-hours of their occurrence (40 CFR 122.41(l)(6).

The City has essentially eliminated sanitary sewer overflows (SSOS) from the collection system except potentially during abnormally extreme wet weather events. It should be noted that flow discharged through the peak flow clarifiers receives primary treatment before discharging, and thus differs from SSOS within the collection system.

To facilitate a phased elimination of peak flow clarifier discharges, the City of Rolla has entered into a Voluntary Compliance Agreement with the MDNR. The Voluntary Compliance Agreement (VCA) allows the City five years to implement improvements aimed at reducing or eliminating I/I within the collection system which results in bypasses of secondary treatment at the WWTF. The VCA requires the submission of a Bypass Elimination Plan (BEP) detailing the capital improvements necessary to eliminate discharges from peak flow clarifiers at both WWTPs. The BEP is mandated to include the following:

- An evaluation of the existing WWTF and the collection system
- A list of options evaluated to reduce peak flows and their associated costs
- A list and schedule for improvements to reduce peak flows to the WWTF such that bypasses are eliminated
- Information on costs, financial capability and financing schedule
- Public information and notification of bypass events
- Project implementation schedule, including annual milestones and deadlines to achieve Outfall No. 2 elimination as soon as practicable

After MDNR approves the BEP, annual progress reports must be submitted detailing the progress the City has made in implementing the BEP. If at the end of the five year period, discharges from the peak flow clarifier have not been eliminated but significant progress has been made toward its elimination, the City can petition MDNR for an additional five years during which additional efforts can be made to eliminate discharges from the peak flow clarifiers. MDNR will review all collected data from the City and extend the VCA term only if adequate evidence is available supporting the City's claims regarding progress made in reducing discharges.

It should be noted that the VCA will be rendered null and void should the City:

- Fail to provide public information and notification of bypass events;
- Fail to report bypass from the peak flow clarifiers;
- Fail to make mandated annual reports showing BEP progress;
- Fail to submit a BEP;

- Fail to make adequate progress toward the elimination of the outfall.

A copy of the VCA is located in Appendix A.

2 EXISTING WASTEWATER TREATMENT PLANTS AND COLLECTION SYSTEM

2.1 SERVICE AREA DESCRIPTIONS AND HISTORICAL WWTP FLOWS

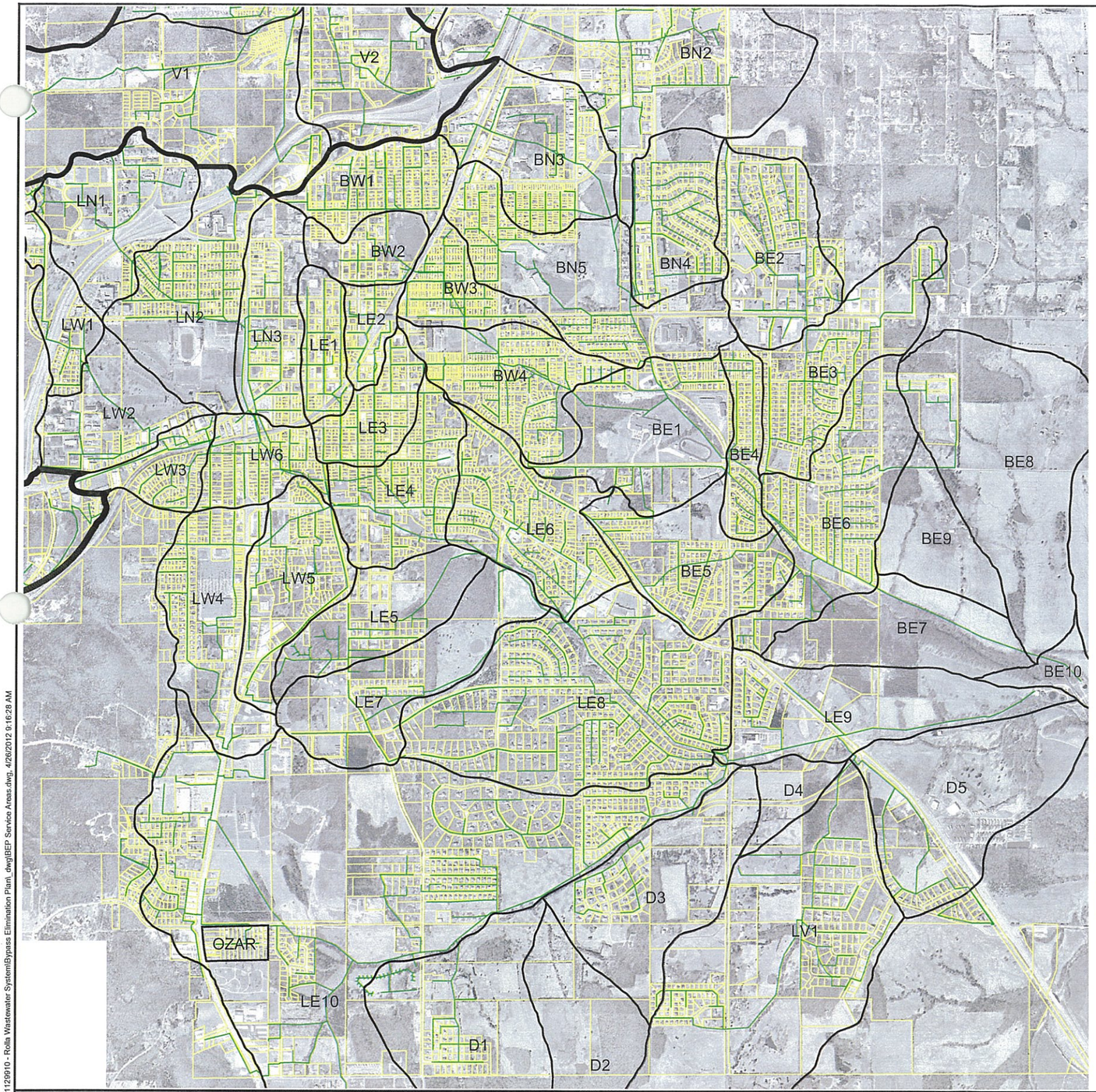
2.1.1 Southeast WWTP

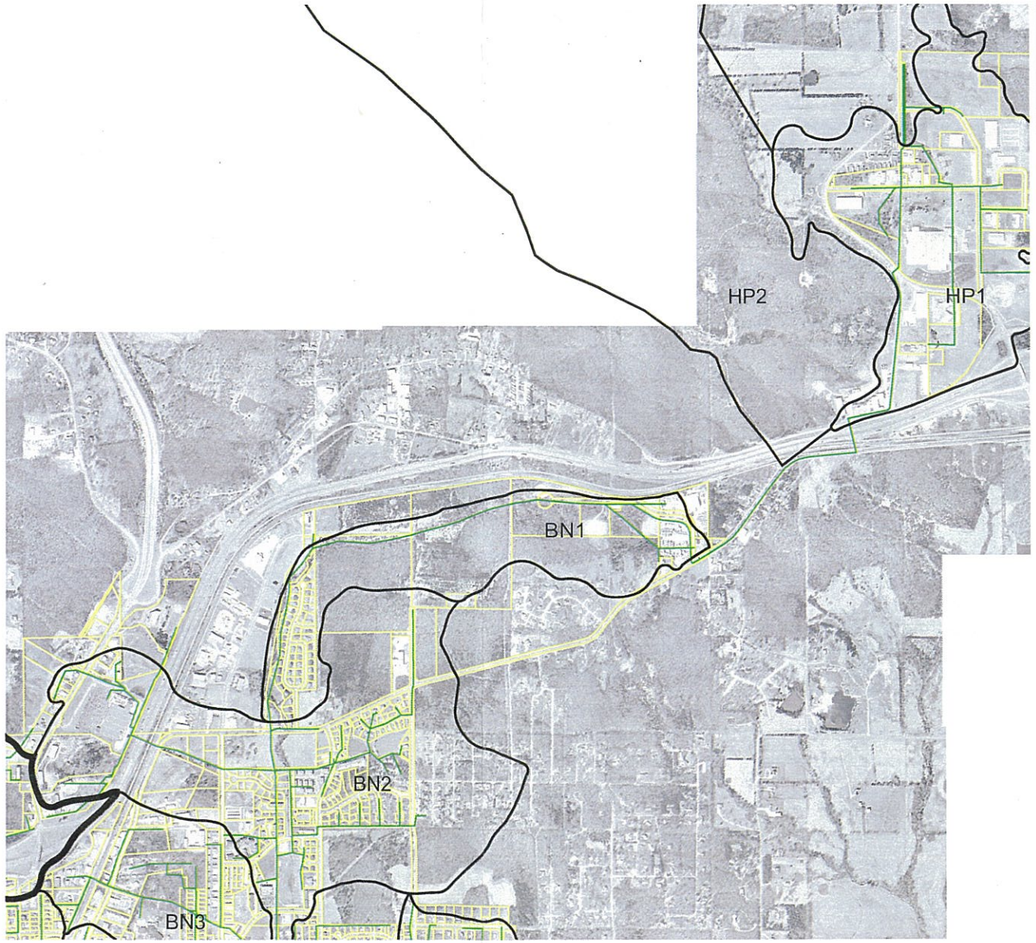
2.1.1.1 SOUTHEAST WWTP SERVICE AREA DESCRIPTION

The Southeast WWTP treats wastewater flows from an approximate 11 square mile area in the City of Rolla. The Southeast WWTP it the largest wastewater treatment facility in the City and its service area encompasses the majority of Rolla. The Southeast WWTP serves the majority of the City's residential areas, as well as the Missouri University of Science and Technology, the downtown commercial district, and industrial areas located in the north part of the City. The service area is divided into the four sub-basins listed in Table 2-1. Figure 2-1 shows the boundaries of the Southeast WWTP service area and its sub-basins.

Table 2-1 Southeast WWTP Sub-Basins

Sub-Basin	Area (ac)	Area (mi^2)
Burgher Branch	3,174	5.0
Dutro Carter Creek	2,096	3.3
Deible Branch	1,417	2.2
Love Branch	571	0.9
Total Service Area	7,258	11.3





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City of ROLLA

CITY OF ROLLA, MO
BYPASS ELMINATION PLAN

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FIGURE 2-1
SOUTHEAST WWTP
SERVICE AREA BOUNDARIES

DRAWING NO. 2-1

2.1.1.2 SOUTHEAST WWTP HISTORICAL FLOW RATES

Flow is transferred between the East and West plants at the direction of City personnel to optimize the facilities' treatment capabilities. Therefore, when analyzing average and peak flow records the total flow at the plant is analyzed, rather than just the individual flow through the plants. Table 2-2 summarizes the treatment capacity of the facilities and the current average dry weather, average daily, and peak wet weather flows received at the facilities, based on flow data from 2006 to 2010. The "Average Dry Weather Flow" refers to the average flow during dry weather periods, determined by calculating the average flow to the plant during dry weather periods only. The "Average Daily Flow" is the calculated average flow to the dry weather plants from 2006 to 2010.

Table 2-2 Southeast WWTP Flow Summary

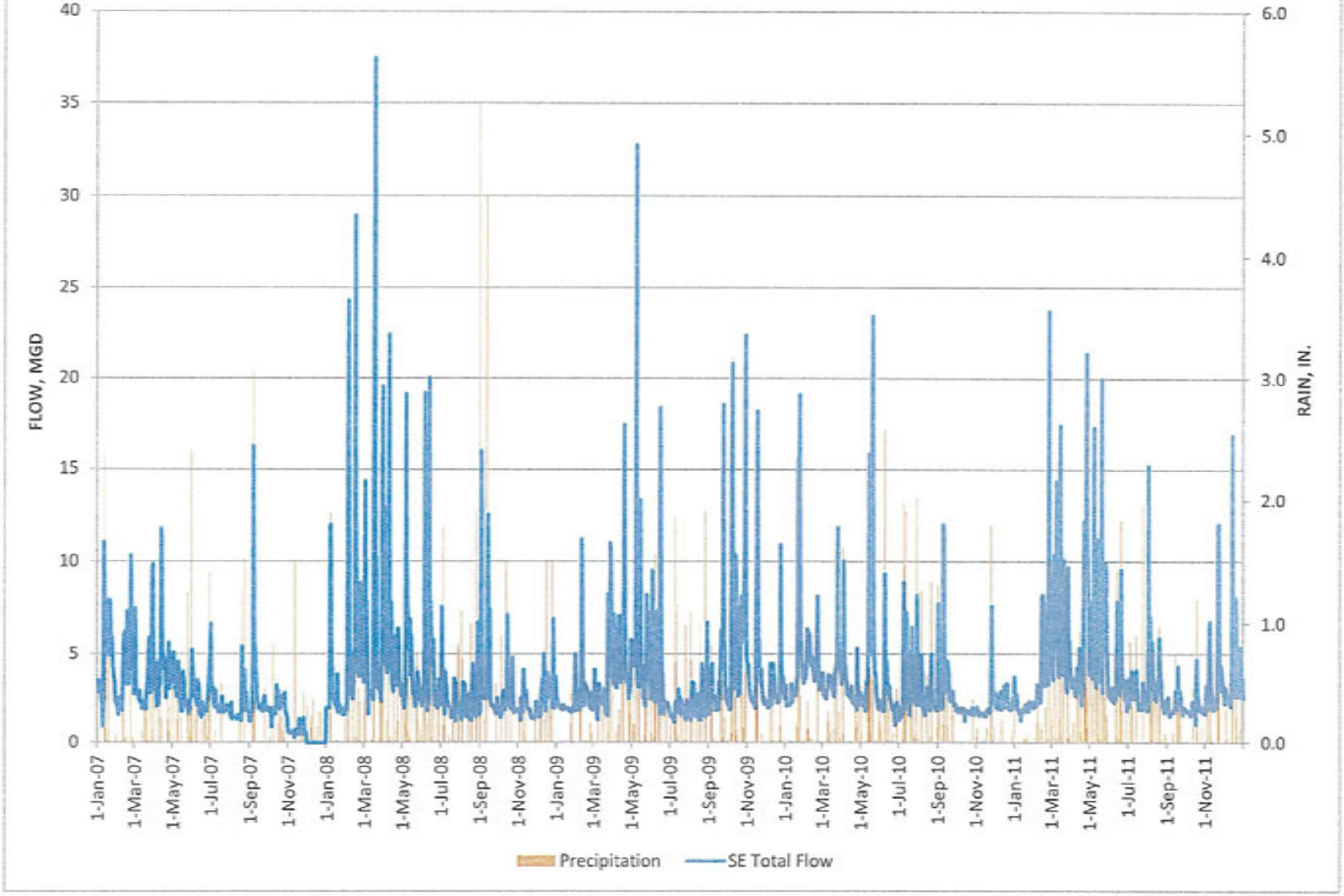
	Avg. Day Capacity (mgd)	Avg. Dry Weather Flow (mgd)	Avg. Daily Flow (mgd)	Peak Hydraulic Capacity (mgd)	Peak Daily Wet Weather Flow (mgd)
West Plant	2.6	-	-	5.2	-
East Plant	2.1	-	-	4.2	-
SE WWTP Total - Outfall 001	4.7	2.1	2.9	9.4	10.0
Peak Flow Clarifier (002)	N/A	N/A	N/A	13.0	13.0
Peak Flow Clarifier (003)	N/A	N/A	N/A	13.0	13.0
Total Flow	4.7	2.1	2.9	35.4	36.0

Although the Southeast WWTP has a rated peak hydraulic capacity of 9.4 mgd, records show that during periods of wet weather the plant throughput can reach a maximum of 10.0 mgd for short periods of time. Therefore, the peak wet weather flow of 10.0 mgd is defined as the peak flow that can currently be treated at the plant.

The ratio of peak flow to average dry weather flow at the plant is 17:1. The peak flows during wet weather periods are the result of stormwater entering the collection system through inflow and infiltration (I/I).

The total daily flow to the Southeast WWTP from 2007 to 2011, representing the total flow to the East and West plants and the peak flow clarifiers, is shown in Figure X. The flow data was compiled from daily flow data records from Discharge Monitoring Reports (DMR).

Figure 2-2 Rolla Southeast WWTP Historical Daily Flow and Rainfall



2.1.1.3 SOUTHEAST WWTP DESIGN STORM FLOW

A design storm event was selected and analyzed in the *Peak Flow Equalization Facilities for Southeast and Vichy Road WWTPs Preliminary Engineering Report* completed in December 2011, attached as Appendix B). A design storm event with an annual exceedance probability (AEP) of 10-percent (10-year return interval) was selected as the basis for the analysis. This design storm return interval has been used as a basis of design for other wastewater conveyance and equalization facilities in the state, and it is anticipated that storage to accommodate this design storm would be acceptable to the MDNR under the terms of the Voluntary Compliance Agreement. A 4-hour storm duration was used as the basis for the design hydrograph, based on flow and rainfall records that show the approximate time of concentration for the Southeast WWTP service area is 4 hours. A storm duration equivalent to the time of concentration of the service area produces the highest peak flow and is believed to be a reasonable basis to use for designing facilities to accommodate peak flows.

Flow data from 2006 to 2010 was analyzed in order to determine the peak flow rate to the facility, as well as the potential storage volume required to store wet weather flows in order to prevent bypasses. Minimal instantaneous flow data was available for the Southeast WWTP. Totalized daily flow data from Daily Monitoring Reports was analyzed in lieu of instantaneous data to construct a design hydrograph for use in determining peak flow rates and volumes. Because of the lack of instantaneous data and the difficulty of capturing a storm event equivalent to the design storm, some simplifying assumptions were used to determine peak flow rates and volumes. These assumptions are detailed in the *Peak Flow Equalization Facilities for Southeast and Vichy Road WWTPs Preliminary Engineering Report* located in Appendix B.

The peak hour flow and required equalization basin volume at the Southeast WWTP determined in this study for the design storm event are as follows:

- Peak Hour Flow = 54 mgd
- Equalization basin volume required = 36 mgal

It is recommended that instantaneous flow measurement equipment be installed at the Southeast WWTP. The additional flow data should be analyzed to construct more detailed design hydrographs to more accurately measure peak hour flows and determine required storage volumes before final design of improvements to the facility.

2.1.2 Vichy Road WWTP

2.1.2.1 VICHY ROAD WWTP SERVICE AREA DESCRIPTION.

The Vichy Road WWTP treats wastewater flows from an approximately 1.7 square mile (1,118 acre) area in the City of Rolla. The service area is referred to as the Spring Creek Sub-Basin and serves residential areas on the north part of the City, as well as Missouri S&T Thomas Jefferson Residence Hall and the Highway 63 commercial/industrial areas. Figure 2-3 shows the boundaries of the Vichy Road WWTP service area and its sub-basins.

SERVICE AREA BOUNDARY

SEWER MAIN

750 0 375 750

Scale: 1" = 750'

VICHY ROAD WWTP
SERVICE AREA BOUNDARY

V3

V2

V1

BW1

LN1

SOUTHWEST WWTP
SERVICE AREA BOUNDARY

LN1

LW1

L

SALL

M1

M2

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City of ROLLA

CITY OF ROLLA, MO
BYPASS ELIMINATION PLAN

PROJECT NO. 11129910

FIGURE 2-3 - SOUTHWEST WWTP
VICHY ROAD WWTP
SERVICE AREA BOUNDARIES

DRAWING NO. 2-3

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2.1.1.2 VICHY ROAD WWTP HISTORICAL FLOW RATES

Table 2-3 summarizes the treatment capacity of the Vichy Road WWTP and the current average dry weather, average daily, and peak wet weather flows received at the facilities, based on flow data from 2006 to 2010. The "Average Dry Weather Flow" refers to the average flow during dry weather periods, determined by calculating the average flow to the plant during dry weather periods only. The "Average Daily Flow" is the calculated average flow to the dry weather plant from 2006 to 2010.

Table 2-3 Vichy Road WWTP Flow Summary

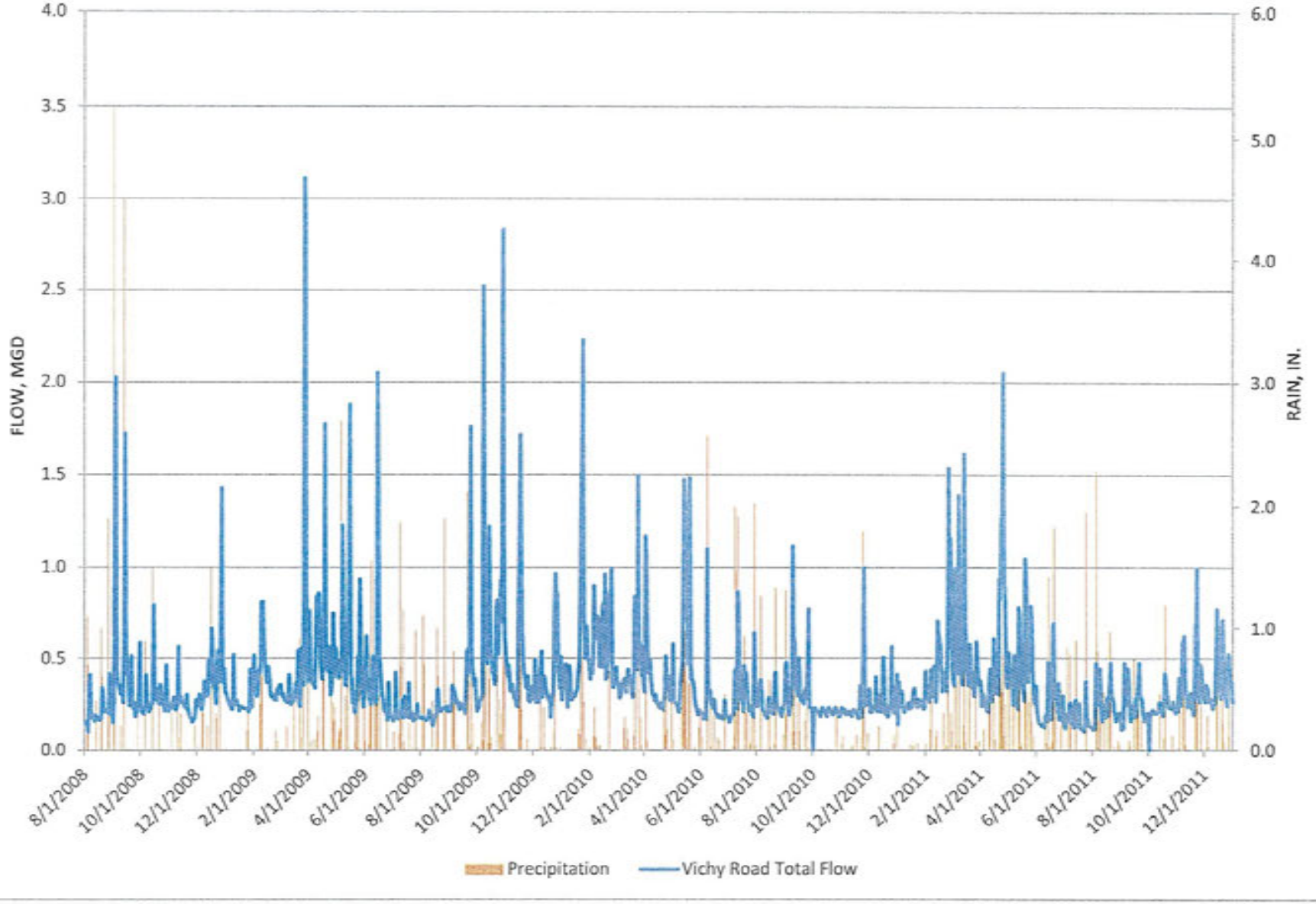
	Avg. Day Capacity (mgd)	Avg. Dry Weather Flow (mgd)	Avg. Daily Flow (mgd)	Peak Hydraulic Capacity (mgd)	Peak Daily Wet Weather Flow (mgd)
Vichy Rd. WWTP	0.40	0.21	0.27	0.80	1.00
Peak Flow Clarifier	N/A	N/A	N/A	3.00	3.00
Total Outfall 001	0.40	0.21	0.27	3.80	4.00

Although the Vichy Road WWTP has a rated peak hydraulic capacity of 0.8 mgd, records show that during periods of wet weather the plant throughput can reach a maximum of 1.0 mgd for short periods of time. Therefore, the peak wet weather flow of 1.0 mgd is defined as the peak flow that can currently be treated at the plant.

The ratio of peak flow to average dry weather flow at the plant is 19:1. The peak flows during wet weather periods are the result of stormwater entering the collection system through inflow and infiltration (I/I).

The total daily flow to the Vichy Road WWTP from 2008 to 2011 is shown in Figure X. The flow data was compiled from daily flow data records from Discharge Monitoring Reports (DMR).

Figure 2-4 Rolla Vichy Road WWTP Historical Daily Flow and Rainfall



2.1.1.3 VICHY ROAD WWTP DESIGN STORM FLOW

Design flows for the Vichy Road WWTP were determined based on the same 10-year, 4-hour duration storm event used for the Southeast WWTP. Flow data from 2006 to 2010 was analyzed in order to determine the peak flow rate to the facility, as well as the potential storage volume required to store wet weather flows in order to prevent bypasses. Instantaneous flow data was available for the Vichy Road WWTP for the largest storm event recorded during this period (the storm event occurred in March of 2008). Refer to the *Peak Flow Equalization Facilities for Southeast and Vichy Road WWTPs Preliminary Engineering Report* located in Appendix B for more details of this analysis.

The peak hour flow and required equalization basin volume at the Vichy Road WWTP determined in this study for the design storm event are as follows:

- Peak Hour Flow = 3.9 mgd
- Equalization basin volume required = 4.1 mgal

2.1.3 Southwest WWTP

2.1.2.1 SOUTHWEST WWTP SERVICE AREA DESCRIPTION

The Southwest WWTP treats wastewater flows from an approximately 0.66-square mile (424.5-acres) area in the City of Rolla. The service area is referred to as the Martin Springs Drive Sub-Basin and serves residential and commercial areas on the southwest extent the City. Figure 2-3 shows the boundaries of the Southwest WWTP service area and its sub-basins. The Southwest WWTP is not included in the VCA and therefore not further addressed in this report.

2.2 COLLECTION SYSTEM

2.2.1 Collection System Description and Inventory

The City's sanitary sewer collection system consists of approximately 692,000-ft of sewer lines and 3,300 manholes. Sewer lines range in size from 6-inch diameter to 42-inch diameter, with predominant materials of construction consisting of vitrified clay (VCP), polyvinyl chloride (PVC), and reinforced concrete (RCP). Table 2-4 on the following page presents the inventory of the collection system.

The City has been proactive in the establishment of accurate mapping of the collections system. Most active sanitary sewer manholes have been surveyed to ascertain their location. The survey data has been entered into a geographic information system (GIS) database, which has been made available to the collection system staff and operators. The GIS database has allowed the City to accurately inventory the collection system and develop important statistics regarding the system. For example, approximately 50-percent of the collection system is currently constructed with vitrified clay pipe. Furthermore, the GIS database has equipped the City to subdivide the collection system into smaller, discrete sewersheds to aid in the further inventory and inspection of the system. Figures 2-1and 2-3, previously presented in this report, show the discrete sewershed delineations currently utilized by the City.

TABLE 2-4 ROLLA COLLECTION SYSTEM INVENTORY AS OF NOVEMBER 2011

PIPE FOOTAGE BY MATERIAL

Sub-Basin	MHs	AVERAGE AGE OF SEWERLINE	6" VCP	6" PVC	8" VCP	8" UNKNOWN	8" TRUSS	8" PVC	8" CIP	10" PVC	10" VCP	12" VCP	12" DUCTILE	12" CLAY	12" PVC	15" VCP	15" PVC	18" VCP	18" RCP	18" PVC	21" VCP	21" PVC	24" VCP	24" RCP	24" PVC	30" VCP	30" RCP	30" PVC	36" RCP	36" PVC	42" RCP	42" PVC	TOTAL PIPE FOOTAGE
V1	93	27			5879			10135		126	291																						16431
V2	83	33	225		9476	60		4478		347	27																						14613
V3	88	33	1765		7790			4699										389				3086											17729
BN3	73	35	320		10942			3497			125				1109																		15993
BN4	93	34			14249			2070									150																16479
BN5	96	39	125		11673			2646			317			187	1464	413	327	729															17881
BW2	32	62	434		2009			54		199	645									1220													4561
LE1	53	69	6425		2273			217			128	1478																					10521
LN3	56	65	1349		6999			1540								118		201			1290					333							11830
LE2	42	70	579	465	2034			828				1418				142																	5466
BW3	60	65	1367	233	6706			460				3266			435																		12467
BW1	22	78	2785		9645			484																									12914
LW3	51	69	721		7009				449		627	697																					9503
LW6	76	60		271	7770			521						1611		2577		432			208			151		364	505	237	75	474			15196
LW4	71	71			9063			4098																									13161
LW5	77	50			14550																												14560
LE6	222	28		443	10353			31169																481			1027		1038				44521
LE4	80	50	1953	134	9420			1592										1174		399				292			571		1439	140	272	768	18164
LE3	45	70	6358		2432							2327						489															11606
LE6	107	58	413		15004			821										1876				297	587	2096									21094
BW4	84	54	1391		12277			602						546						1803					702								17321
LW1	28	57			5094			572																									5666
LW2	38	50	988		4722			1349			521	6																					7586
LV1	56	9						18323																									18323
LN1	37	41	160		6954	161					276																						7551
LE5	45	38			4611	89		4766																									9466
BE1	69	36			7153	467		4583							119	136	31		164	1512				390				1406					15961
LN2	94	42	3746		9454			1536		507		352			1307		970	396															18268
HP1	50	26						10504																									10504
BN1	34	34						9311																									9311

TABLE 2-4 ROLLA COLLECTION SYSTEM INVENTORY AS OF NOVEMBER 2011

			PIPE FOOTAGE BY MATERIAL																															
Sub-Basin	MHs	AVERAGE AGE OF SEWERLINE	6" VCP	6" PVC	8" VCP	8" UNKNOWN	8" TRUSS	8" PVC	8" CIP	10" PVC	10" VCP	12" VCP	12" DUCTILE	12" CLAY	12" PVC	15" VCP	15" PVC	18" VCP	18" RCP	18" PVC	21" VCP	21" PVC	24" VCP	24" RCP	24" PVC	30" VCP	30" RCP	30" PVC	36" RCP	36" PVC	42" RCP	42" PVC	TOTAL PIPE FOOTAGE
BE5	70	43	436		7389			4904		1059						182											543							14513
BN2	142	25		285	3006			23059		899	285																						27574
BE4	42	20			7551													658															8209
BE3	90	30			1713	760	3717	8339				512	57	2791																			17889
BE6	113	33			7824		693	10167		306	130									11		157			147		402		2708				22545
BE2	101	31			11195			7865						116																			19176
LE10	372	16		929	1716	1231		66394	154	243					2078	1075	4819																	78639
LE7	46	30		3925	6428																		5				715							11073
D1	25	9						5950																										5950
D2	0	0																																0
D3	0	0																																0
D4	0	0																																0
D5	37	10						7714																										7714
SALLY	45	23						7570		1264					993																			9827
M1	68	25			3940			8689									192																	12821
M2	41	32			4754			2138			400	3927					427																	11646
BE8	14	8						2710																										2710
BE9	0																																	0
BE10	0																																	0
LE9	45	24						5240																			961		328		4603			11132
OZARK	6	13						1161																										1161
BE7	11	25								899																	716		3365					4980
TOTAL	3333	-	31550	6685	271077	2768	4410	282795	603	5849	3772	13983	57	5251	7505	4643	6926	6344	164	4945	1498	3540	592	3410	849	697	5440	1643	8953	614	4875	768	692206

2.2.2 Flow Metering Results and Storm Analysis

The City purchased Isco 2150 portable area-velocity meters in the spring of 2011, with the expressed intent of investigating sanitary sewer flows within their collection system. Since the purchase of the meters, the City has performed extensive monitoring of the Vichy Road WWTP service area, with the goal of locating significant sources of I/I volume and eliminating them. Due to the size of the Vichy Road WWTP service area with respect to the other service areas, it was thought that it might be possible to find and eliminate enough I/I volume to eliminate wastewater bypasses at the WWTP.

Flow metering of the Vichy Road WWTP service area generally began in the downstream reaches of the service area and progressed upstream. Specific attention was paid to flows emanating from branch sewer lines connecting to the sewer trunk main. Flow meters were generally installed directly in sewer lines immediately upstream of manholes where the observed flow through the manhole was satisfactory to support accurate metering results. Flow meters were calibrated upon installation and checked regularly by City staff to assure that no accumulated systematic errors were observed in the acquisition of data. Meters were generally left in place for several weeks to allow for a determination of the average daily diurnal flow and I/I volumes generated during rainfall events.

Using the data that was obtained, an analysis of the observed wastewater flows was performed. First, a scattergraph of each flow meter installation was performed to verify that no significant system bias or adverse hydraulic conditions were present during the time that the meter was installed. Furthermore, the scattergraph was utilized to detect the presence of upstream and downstream sanitary sewer overflows (SSOs) within the collection system.

A determination of the average daily diurnal flow was then made to aid in the calculation of I/I volumes. The average daily diurnal flow was calculated utilizing a moving average of the sewer flows logged on days during which no rainfall events occurred. Based on the calculated average daily diurnal flow, I/I volumes were calculated for each rainfall event. The I/I volume was taken to be the sewer flow observed in excess of the average daily diurnal flow. Figure 2-6, shown below, presents a hydrograph with the average daily diurnal flow and I/I flows delineated, as well as the estimated I/I volume for one storm event. The graph shows the wastewater flows occurring over a 48-hour period, allowing the recession of flows to be observed. Flow charts and I/I analysis charts for each flow meter, as well as "flow meter journals" consisting of information documented by the City staff during the flow monitoring period are presented in Appendix C.

Table 2-5 shows the dates during which flow meters were installed within the collection system during 2011. Table 2-6 presents the observed average daily diurnal flow, peak flow and I/I volume determined during each flow meter installation.

Table 2-5: City of Rolla 2011 Flow Metering Installation

MH No.	Date Installed	Date Removed
V2-1	04-08-11	04-11-11
V1-3	04-08-11	04-22-11
V1-17	04-08-11	04-22-11
V3-36	04-07-11	04-22-11
V2-40	04-22-11	04-29-11
V2-2	04-22-11	05-23-11
V2-7	04-15-11	05-23-11
V2-10	04-22-11	05-24-11
V3-36.2	04-07-11	04-22-11

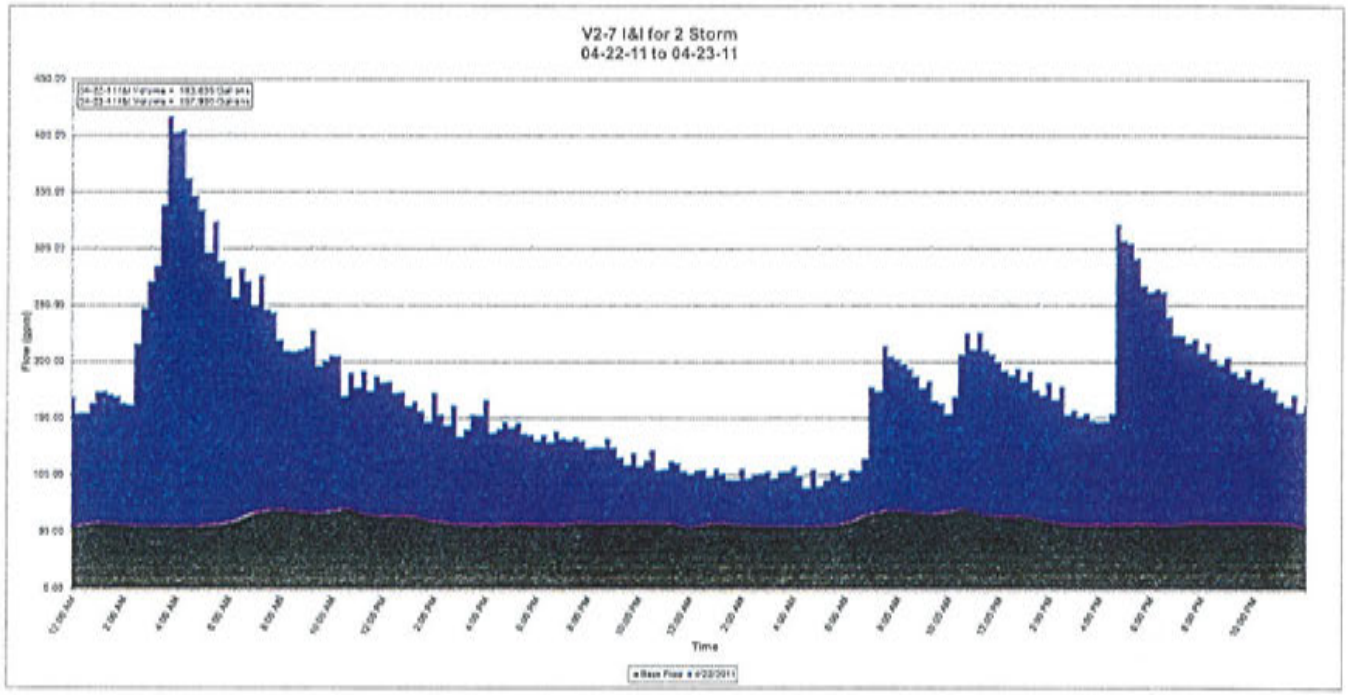
Table 2-5, Continued		
V2-14.15	05-24-11	06-20-11
V2-19.21	05-23-11	06-20-11
V2-44.67	05-22-11	06-20-11
V3-42.47	05-23-11	06-20-11
V2-21.22	07-12-11	09-02-11
V2-21.25	06-20-11	07-07-11
V2-27.28	07-12-11	09-01-11

Table 2-5: City of Rolla 2011 Flow Metering Summary

MH No.	Estimated ADDWF (gpd) (*)	Observed Peaking Factor	Observed Peak Flow (gpd)	Peak Flow Rain Event	P.F. Rain Event Rainfall Depth (in)	P.F. Rain Event I/I Volume (gallons) (‡)
V2-1	54,300	6.9	372,400	04-11-11	0.46	122,400
V1-3	17,600	19.4	341,300	04-22-11	1.36	63,900
V1-17	42,200	3.5	148,000	04-22-11	1.36	28,300
V3-36	3,700	104.2	385,500	04-22-11	1.36	70,100
V2-40	11,700	402.0	4,705,900	04-25-11	1.17	423,700
V2-2	5,200	79.5	410,900	05-19-11	1.52	55,200
V2-7	85,700	11.7	1,003,100	05-19-11	1.52	353,600
V2-10	49,300	17.2	846,600	05-19-11	1.52	167,500
V3-36.2	2,300	105.0	241,900	05-19-11	1.52	41,300
V2-14.15	4,000	192.1	758,000	06-19-11	1.81	76,200
V2-19.21	26,200	35.0	915,400	06-19-11	1.81	140,100
V2-44.67	1,700	16.2	28,300	06-19-11	1.81	13,500
V3-42.47	7,500	30.9	230,400	06-19-11	1.81	47,900
V2-21.25	12,000	25.0	301,300	07-06-11	--	76,500
V2-27.28	21,600	5.1	110,900	08-20-11	0.96	77,900

(*) Average Daily Dry Weather Flow
(‡) Flow volume in excess of ADDWF observed over 48-hour period after beginning of rainfall event

Figure No. 2-6: Sewer I/I for MH V2-7 during April 22, 2011 Rainfall Event



It is important to note that the data recorded for most locations was limited to 2-4 weeks of flow data each. Due to this limited data set and wet weather during the flow measurement period, the recorded dry weather flows may vary from the actual extended period dry weather flows. Peak wet weather flow readings can at times be caused by errors in flow meter readings caused by debris and other obstructions within the collection system; the limited data set makes it difficult to identify anomalous flow readings. It is recommended that the City leave flow meters in place longer at key locations within the collection system in order to capture more flow data during rain events. Recording flow data for longer periods of time can help establish dry weather flows to a greater level of accuracy and also help to identify and eliminate anomalous peak flow readings. This will also help to establish the peak wet weather flows within the collection system for different storm events. The pre-I/I removal program flow monitoring results will also be used to evaluate the results and effectiveness of the I/I removal program.

Each significant rainfall event during the flow monitoring period was analyzed to determine the storm frequency. This was completed in order to provide context to the flow monitoring results and peak wet weather flows recorded and shown in Table 2-6. The largest rainfall event recorded during this period was 2.28 inches of total rainfall over 4.3 hours, which equates to 96% of a 2-year return interval storm event. Table 2-7 shows the results of the storm frequency analysis.

Table 2-7 Storm Frequency Analysis				
Start Date	Total Monitored Rainfall (in)	Duration (hours)	Intensity (in/hr)	Storm Frequency
4/11/2011	0.46	6.5	0.071	21% of 1-year
4/15/2011	0.82	2.5	0.328	47% of 1-year
4/21/2011	1.36	10.0	0.136	57% of 1-year
4/23/2011	0.50	12.0	0.042	20% of 1-year
4/24/2011	0.57	10.0	0.057	24% of 1-year
4/25/2011	1.17	9.5	0.123	50% of 1-year
5/1/2011	0.68	8.5	0.080	26% of 1-year
5/7/2011	0.62	2.5	0.248	35% of 1-year
5/12/2011	1.41	3.0	0.470	80% of 1-year
5/19/2011	1.52	12.8	0.119	60% of 1-year
5/25/2011	0.92	16.0	0.058	35% of 1-year
6/10/2011	0.50	7.0	0.071	23% of 1-year
6/13/2011	1.42	6.0	0.237	68% of 1-year
6/18/2011	0.45	3.0	0.150	25% of 1-year
6/19/2011	1.81	4.5	0.402	94% of 1-year
6/27/2011	0.49	4.0	0.123	26% of 1-year
7/3/2011	0.85	1.5	0.567	54% of 1-year
7/6/2011	0.78	0.5	1.560	74% of 1-year
7/13/2011	0.90	5.5	0.164	44% of 1-year
7/24/2011	1.95	7.0	0.279	90% of 1-year
8/4/2011	2.28	4.3	0.536	96% of 2-year
8/5/2011	0.80	1.1	0.727	60% of 1-year
8/7/2011	0.66	0.8	0.795	54% of 1-year
8/12/2011	0.47	1.9	0.247	28% of 1-year
8/19/2011	0.96	1.6	0.600	59% of 1-year
9/14/2011	0.75	11.0	0.068	31% of 1-year
11/3/2011	0.77	19.0	0.041	28% of 1-year
11/7/2011	0.81	10.0	0.081	34% of 1-year
11/8/2011	0.62	10.0	0.062	26% of 1-year
11/20/2011	1.01	9.8	0.104	43% of 1-year
11/22/2011	1.28	10.8	0.119	53% of 1-year

Note: Rainfall data recorded at 8th Street Rain Gauge Station

2.2.3 Previous Collection System Evaluations and I/I Removal Efforts

The City of Rolla has been proactive in investigating, identifying and remediating sources of I/I within the collection system. The City has owned and operated closed circuit televised (CCTV) inspection equipment for some time, which historically has been utilized to identify structural issues associated with sewer lines within the collection system. In the recent past, the City has shifted its efforts to perform more comprehensive inspections in an effort to identify and eliminate I/I.

Recently the City of Rolla purchased new portable flow meters to aid in their identification of I/I sources within the collection system. The ultrasonic area-velocity flow meters have been utilized by the City to monitor flow in numerous watersheds in an effort to quantify I/I volumes emanating from them. Since

the acquisition of the flow meters, the City has focused on the Vichy Road WWTP drainage basin as several areas of suspected high I/I sources are located there. Section 2.2.2 summarizes the finding of the flow metering performed by the City.

The City of Rolla is currently implementing a manhole inspection program, to be performed congruently with CCTV inspections of the collection systems. It is the City's intent to inspect every manhole at which CCTV inspection cameras are launched. The goal of the manhole inspections is aimed at identifying potential sources of I/I within the collection system, as well as structural and functional issues that required repair.

Because of the above mentioned programs that the City has developed and implemented, The City has been able to prioritize sewersheds based on the observed and anticipated I/I volumes. This will be discussed further in Section 3 of this report. Furthermore, in recent years the City has completed many collection system improvements to rehabilitate infrastructure and reduce I/I, as well as inspection and cleaning maintenance efforts within the collection system. Documentation of these efforts is presented in Appendix D. These efforts include:

- CCTV of sewer mains
- Manhole inspections
- Smoke testing
- Creek crossing inspection
- Dye testing
- Rerouting sewer mains to eliminate I/I sources
- Manhole and sewer main repairs
- Manhole and sewer main replacements
- Repair of private service taps to the city mains
- Flow monitoring
- Improvements to storm drainage to reduce I/I
- Line cleaning
- Grease trap inspections

3 I/I REDUCTION PROGRAM

3.1 I/I REDUCTION PROGRAM

3.1.1 Overview of City's I/I Reduction Program

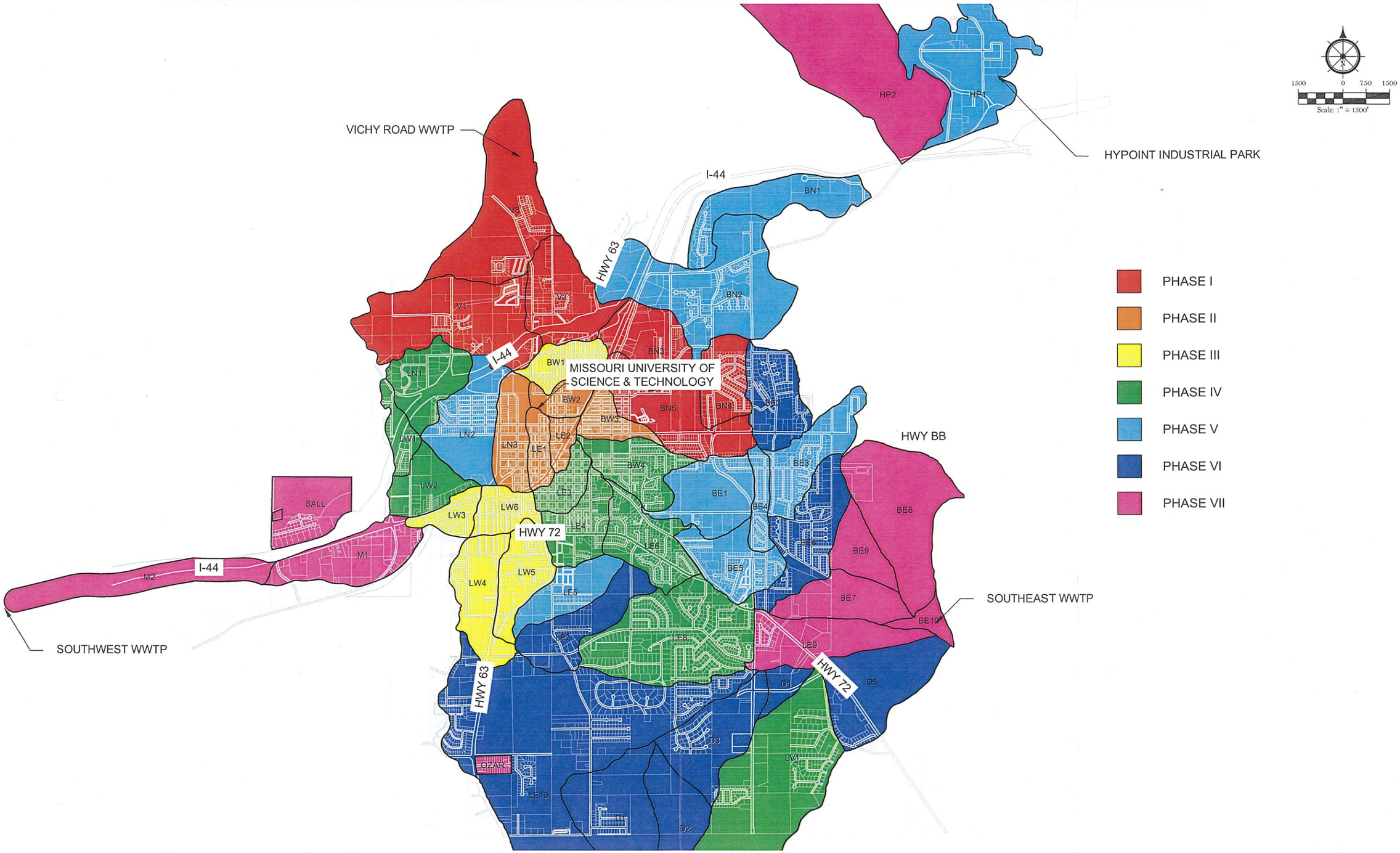
As described above, the City has been proactive in implementing an I/I Reduction Program aimed at locating and eliminating sources of inflow and infiltration into the sanitary sewer collection system so as to reduce the potential for sanitary sewer overflows within the collection system and bypasses at the WWTPs. The City's I/I Reduction Program centers around the implementation of comprehensive inspections of the collection system including, but not limited to:

- CCTV inspection of sewer mains – including the recent purchase of Granite XP software to track and document CCTV efforts
- Manhole inspections
- Smoke testing
- Dye testing
- Creek crossing inspections
- Investigation of private I/I sources, including the repair of uncapped cleanouts and disconnecting illicit connections
- Investigation of direct or indirect cross connections of storm drainage to the collection system

To aid in the implementation of the Bypass Elimination Plan, the City has worked to prioritize the inspection of the collection system. The City has placed higher priority on those areas having the highest average age and potential for the incidence of I/I (i.e. sewersheds having a high percentage of vitrified clay sewer pipe, brick manholes, etc). This prioritization was used as the basis for establishing a phased plan for inspection of the collection system as part of the BEP. The City will begin in Year 1 with inspections of the highest priority basins, i.e. the Year 1 Basins. A detailed schedule of the I/I reduction program is presented in Section 3.1.2. The City has prioritized the basins as follows:

- Year 1 Basins – V1, V2, V3, BN3, BN4, BN5
- Year 2 Basins – LE1, LE2, LN3, BW2, BW3
- Year 3 Basins – LW3, LW4, LW5, LW6, BW1
- Year 4 Basins – BW4, LE3, LE4, LE6, LE8, LW1, LW2, LV1
- Year 5 Basins – LN1, LN2, LE5, BE1, BE3, BE4, BE5, BN1, BN2, HP1
- Year 6 Basins – D1, D5, BE2, BE6, LE7, LE10
- Year 7 Basins – LE9, BE7, BE8, M1, M2, Ozark, Sally

Figure 3-1 presents a map detailing the BEP phasing plan for each of the basins. It is the City's intent to inspect all components of the public collection system located within one phase boundary each year. It is anticipated that a complete inspection of the entire collection system would be performed by the City during the next seven years. This phased implementation should allow the City to locate and eliminate potential sources of I/I within the scope of the full VCA term. The proposed phasing contained herein reflects further investigation within the worst sewersheds first, allowing greater time for the remediation of any problems located.



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FILES ATTACHED:	DESIGNED BY: KAC	DRAWN BY: DMS	CHECKED BY: JAM
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City of ROLLA

CITY OF ROLLA, MO
BYPASS ELIMINATION PLAN

PROJECT NO. 11129910

PHASE MAP

DRAWING NO. 3-1

To aid in the investigation of the collection system, the city has several tools which shall be utilized. First, the City currently owns and maintains a closed-circuit television (CCTV) inspection rover and data logger. The CCTV equipment can be utilized on all pipes with diameters exceeding 6-inches in diameter. The City also currently owns and operates 4 Isco 2150 portable area velocity flow meters. As illustrated in Section 2 of this report, the flow meters have been and continue to be utilized to quantify the volume of I/I present within the collection system after rainfall events.

The City has developed a database system that can be integrated directly with the City's GIS database for real-time tracking of inspections and inventory of system deficiencies requiring remediation. It is anticipated that the database will improve the City's ability to track and repair I/I sources within the system.

The annual budget and anticipated resource allocation for Year 1 of the I/I Reduction Program shown below in Table 3-1.

Table 3-1 Annual Budget and Resource Allocation for I/I Reduction Program

Labor	$260,000
Equipment	$ 60,000
Materials	$ 50,000
Subtotal, City Performed Work	$370,000
Improvements by Contract (e.g. cured-in-place-pipe, etc.)	$250,000
Total Annual Costs	$620,000

The rehabilitation of the priority basins within the collection system will first focus on repair of the most cost effective defects, as well as the aging infrastructure within the system to prevent further degradation. The City will complete pre and post I/I reduction flow monitoring to analyze the effectiveness and costs of I/I removal. The costs and results of the City's I/I removal program will be tracked and evaluated each year. The City will adjust its program as necessary and endeavor to complete the most cost effective I/I removal and collection system rehabilitation program within the annual budget.

3.1.2 I/I Reduction Program Schedule

The following is an annual schedule for the City's I/I Reduction Program. The resources detailed in Section 3.1.1 will be applied in order of priority beginning with the Year 1 Basins. At the end of each budget year, the City will evaluate the progress of the I/I Reduction Program and make adjustments to resource allocation as deemed appropriate. Note that Year 1 will begin after MDNR approval of the BEP. The approval date will be referred to as the Start Date. The schedule below assumes MDNR approval of the BEP in May of 2012. If approval comes at a later date the schedule will be adjusted accordingly based on the Start Date.

Year 1: May 2012 – May 2013

- Year 1 Basins Initial Flow and Rainfall Monitoring
- Year 1 Basins I/I Field Inspections
- Begin I/I Removal Repair/Rehabilitation Work in Year 1 Basins
- Ongoing Updates to BEP for Field Inspection and Flow Monitoring Data

Year 2: May 2013 – May 2014

- Year 2 Basins Initial Flow and Rainfall Monitoring
- Year 2 Basins I/I Field Inspections
- Complete I/I Removal Repair/Rehabilitation Work in Year 1 Basins
- Year 1 Basins Post I/I Reduction Flow Monitoring
- Begin I/I Removal Repair/Rehabilitation Work in Year 2 Basins
- Ongoing Updates to BEP for Field Inspection and Flow Monitoring Data

Year 3: May 2014 – May 2015

- Year 3 Basins Initial Flow and Rainfall Monitoring
- Year 3 Basins I/I Field Inspections
- Complete I/I Removal Repair/Rehabilitation Work in Year 2 Basins
- Year 2 Basins Post I/I Reduction Flow Monitoring
- Begin I/I Removal Repair/Rehabilitation Work in Year 3 Basins
- Ongoing Updates to BEP for Field Inspection and Flow Monitoring Data

Year 4: May 2015 – May 2016

- Year 4 Basins Initial Flow and Rainfall Monitoring
- Year 4 Basins I/I Field Inspections
- Complete I/I Removal Repair/Rehabilitation Work in Year 3 Basins
- Year 3 Basins Post I/I Reduction Flow Monitoring
- Begin I/I Removal Repair/Rehabilitation Work in Year 4 Basins
- Ongoing Updates to BEP for Field Inspection and Flow Monitoring Data

Year 5: May 2016 – May 2017

- Year 5 Basins Initial Flow and Rainfall Monitoring
- Year 5 Basins I/I Field Inspections
- Complete I/I Removal Repair/Rehabilitation Work in Year 4 Basins
- Year 4 Basins Post I/I Reduction Flow Monitoring
- Begin I/I Removal Repair/Rehabilitation Work in Year 5 Basins
- Ongoing Updates to BEP for Field Inspection and Flow Monitoring Data

Year 6: May 2017 – May 2018

- Year 6 Basins Initial Flow and Rainfall Monitoring
- Year 6 Basins I/I Field Inspections
- Complete I/I Removal Repair/Rehabilitation Work in Year 5 Basins
- Year 5 Basins Post I/I Reduction Flow Monitoring
- Begin I/I Removal Repair/Rehabilitation Work in Year 6 Basins
- Ongoing Updates to BEP for Field Inspection and Flow Monitoring Data

Year 7: May 2018 – May 2019

- Year 7 Basins Initial Flow and Rainfall Monitoring
- Year 7 Basins I/I Field Inspections
- Complete I/I Removal Repair/Rehabilitation Work in Year 6 Basins
- Year 6 Basins Post I/I Reduction Flow Monitoring
- Begin I/I Removal Repair/Rehabilitation Work in Year 7 Basins
- Ongoing Updates to BEP for Field Inspection and Flow Monitoring Data

Year 8: May 2019 – May 2020

- Complete I/I Removal Repair/Rehabilitation Work in Year 7 Basins
- Year 7 Basins Post I/I Reduction Flow Monitoring
- Ongoing Updates to BEP for Field Inspection and Flow Monitoring Data

Year 9: May 2020 – May 2021

- Ongoing Repair/Rehabilitation Work
- Ongoing Flow Monitoring

Year 10 and Beyond

- Continued Field Inspections and I/I Removal Repair/Rehabilitation Work

The City will evaluate the results of the inspection findings and I/I reduction efforts each year. As previously discussed, the basins were initially prioritized based on their anticipated level of I/I contribution. If the field inspection findings and cost-effective analysis determine that more of the rehabilitation budget should be spent on the higher priority basins (Year 1-4 Basins), the resource allocation and repair/rehabilitation schedule will be adjusted as needed

3.1.3 Estimated I/I Flows and Collection System Defects

The projected peak hour flows to the Southeast and Vichy Road WWTPs for the 10-year storm event were introduced in Section 2. Table 3-2 presents the projected total I/I, private sector I/I, and public sector I/I for the 10-year storm event. Typically 60-80% of the I/I flow within a collection system is attributable to private sector defects, i.e. I/I sources in private sewer laterals, sump pits and sump pumps, foundation drains, exterior area drains, and downspouts connected to the sanitary system. For the purposes of this report, it is assumed the private sector contributes 70% of the I/I within the City's collection system and the public sector contributed 30%.

Table 3-2 Projected Peak Hour I/I Flows to Southeast and Vichy Road WWTPs

Facility	Projected Peak Hour Flow For 10-Yr. Storm Event (MGD)	Base Flow (MGD)	Projected Peak Hour I/I Flow For 10-Yr. Storm Event (MGD)	Projected Private Sector Peak Hour I/I Flow - 70% (MGD)	Projected Public Sector Peak Hour I/I Flow - 30% (MGD)
Vichy Rd. WWTP	3.9	0.3	3.6	2.5	1.1
Southeast WWTP	54	3	51	36	15

The City is preparing to implement the I/I Reduction Pilot Study in the Year 1 basins. At this time, inspection data is not available as a basis for projecting I/I flows and repair costs for these sub-basins. The number of defects (I/I sources) was therefore conceptually projected based on the typical defect quantities identified during collection system inspections in similar aged systems throughout the state.

Table 3-3 presents the basis used for projecting conceptual public sector defect numbers and I/I flow per defect within the collection system. The numbers shown in the table are projections for the oldest sub-basins within the City. Defect projection numbers in newer sub-basins were reduced relative to the projected level of I/I contribution based on system age and the City's knowledge of the collection system.

Table 3-3 Basis for Public Sector Defect Projections			
Component	Public Sector Defect Projections for Oldest Sub-basins	1 Year Storm Unit I/I Flowrate	Flow Type
Upper MH	0.8 Defects/Per MH	0.70 - 0.80 gpm	Inflow
Lower MH	1.0 Defects/Per MH	0.35 - 0.40 gpm	Infiltration
VCP Pipe	0.05 Defects/Per LF	0.40 - 0.50 gpm	Infiltration
PVC/CIP Pipe	0.01 Defects/Per LF	0.40 - 0.50 gpm	Infiltration
Other Pipe	0.02 Defects/Per LF	0.40 - 0.50 gpm	Infiltration

Three categories of public sector defects were projected: upper manhole, lower manhole, and main line pipe defects. Upper manhole defects are those located on the manhole cover, frame, frame seal, grade adjustment ring, or chimney, while lower manhole defects are those located on the lower portions of the manhole. Upper manhole defects were projected separately from lower manholes defects because they are capable of allowing inflow into the manhole. Main line pipe defects were projected based on pipe material. Vitrified clay pipe (VCP) is commonly found in older portions of the collection system and usually contains relatively more I/I source defects than newer pipe materials such as polyvinyl chloride (PVC).

Table 3-4 summarizes the projected number of public sector defects and projected public sector I/I flows for each sub-basin. A detailed breakdown of these defect and flow projections is included in Appendix E.

Table 3-4 Projected Public Sector Defect and I/I Flow Summary						
Sub-Basin	Projected Upper MH Defects	Projected Lower MH Defects	Projected Main Line Pipe Defects	Total 1-Yr Storm Event I/I Flow (gpm)	Total 10-Yr Storm Event I/I Flow (gpm)	Total 10-Yr Storm Event I/I Flow (mgd)
V1	60	74	329	199	233	0.33
V2	53	66	430	232	262	0.38
V3	56	70	460	248	280	0.40
Basin Total	169	211	1219	680	774	1.12
Vichy Rd. WWTP Total	**169**	**211**	**1219**	**680**	**774**	**1.12**
BN1	19	24	65	58	71	0.10
BN2	80	99	285	246	297	0.43
BN3	47	58	492	307	337	0.48
BN4	60	74	588	371	409	0.59
BN5	61	77	573	367	406	0.58
Basin Total	266	333	2004	1349	1520	2.19
LE1	42	53	517	314	341	0.49
LE2	34	42	222	154	176	0.25
LE3	36	45	580	337	360	0.52
LE5	25	32	198	132	148	0.21
LE4	64	80	710	438	479	0.69
LE6	86	107	947	585	640	0.92
LE7	15	18	150	94	104	0.15
LE8	142	178	708	539	630	0.91

Table 3-4, Continued

Sub-Basin	Projected Upper MH Defects	Projected Lower MH Defects	Projected Main Line Pipe Defects	Total 1-Yr Storm Event I/I Flow (gpm)	Total 10-Yr Storm Event I/I Flow (gpm)	Total 10-Yr Storm Event I/I Flow (mgd)
LE9	7	9	34	26	31	0.04
LE10	119	149	379	344	420	0.61
Basin Total	570	712	4445	2963	3328	4.79
LN1	21	26	264	159	172	0.25
LN2	53	66	518	328	361	0.52
LN3	45	56	530	323	352	0.51
Basin Total	118	148	1313	810	886	1.28
BW1	18	22	626	336	347	0.50
BW2	26	32	169	118	134	0.19
BW3	48	60	578	352	382	0.55
BW4	67	84	742	458	501	0.72
Basin Total	158	198	2115	1264	1365	1.97
LW1	22	28	260	159	174	0.25
LW2	30	38	325	202	222	0.32
LW3	41	51	457	282	308	0.44
LW4	57	71	494	321	357	0.51
LW5	62	77	728	444	484	0.70
LW6	61	76	678	418	457	0.66
Basin Total	273	341	2943	1826	2001	2.88
LV1	11	13	37	32	39	0.06
Basin Total	11	13	37	32	39	0.06
BE1	39	48	333	217	241	0.35
BE2	32	40	258	171	192	0.28
BE3	50	63	313	222	254	0.37
BE4	24	29	287	174	189	0.27
BE5	39	49	330	216	241	0.35
BE6	36	45	233	163	186	0.27
BE7	2	2	18	11	12	0.02
BE8	2	3	5	6	7	0.01
Basin Total	224	280	1776	1180	1323	1.91
HP1	28	35	74	73	91	0.13
Basin Total	28	35	74	73	91	0.13
D1	4	5	12	11	14	0.02
D5	6	7	15	15	19	0.03

Table 3-4, Continued						
Sub-Basin	Projected Upper MH Defects	Projected Lower MH Defects	Projected Main Line Pipe Defects	Total 1-Yr Storm Event I/I Flow (gpm)	Total 10-Yr Storm Event I/I Flow (gpm)	Total 10-Yr Storm Event I/I Flow (mgd)
Basin Total	10	12	27	27	33	0.05
OZARK	1	1	2	2	3	0.00
Basin Total	1	1	2	2	3	0.00
SE WWTP Total	**1659**	**2074**	**14736**	**9526**	**10588**	**15.2**
M1	11	14	57	35	41	0.06
M2	7	8	96	46	50	0.07
Basin Total	17	22	153	81	91	0.13
SALLY	7	9	20	16	20	0.03
Basin Total	7	9	20	16	20	0.03
SW WWTP Total	**24**	**31**	**173**	**97**	**111**	**0.16**
Grand Total	**1853**	**2316**	**16127**	**10303**	**11474**	**16.52**

Table 3-5 presents the total projected I/I flows to the Southeast and Vichy Road WWTPs produced by the projected defects shown above. The projected flows match the projected public sector I/I flows to the plants, as previously presented in Table 3-5.

Table 3-5 Total Projected Public Sector Defect I/I Flows to WWTPs		
Facility	Projected Public Sector Peak Hour I/I Flow - 30% (MGD)	Total I/I Flow from Projected Public Sector Defects (MGD)
Vichy Rd. WWTP	1.1	1.1
Southeast WWTP	15	15

3.1.4 Defect Repair Unit Costs

Table 3-6 presents estimated unit costs for manhole rehabilitation, based on bid costs for previous projects. It is anticipated that by utilizing City staff and materials as planned, the City will be able to save money and complete some manhole rehabilitation activities at lower costs than shown in the following table, thereby allowing the City to complete more manhole rehabilitation within the I/I Reduction Program budget.

Table 3-6 Estimated Unit Costs for Manhole Rehabilitation		
Rehabilitation Activity	Unit	Cost
Cementitious MH Lining	VF	$120
Replace Cover	ea	$300
Frame Seal Rehab	ea	$500
Replace Frame	ea	$800
Replace Grade Adjustment Ring	ea	$800
Repair Wall/Bench Joint	ea	$600
Repair Pipe Seal	ea	$400
CIP Chimney Seals	ea	$400
CIP Pipe End Seal (4' into pipe)	ea	$400

Table 3-7 presents estimated unit costs for the rehabilitation of main line pipe, based on bid costs for previous projects. The City recently reached an agreement with a contractor for CIPP lining of approximately 3,800 linear feet of 8" pipe, at a cost of approximately $25/linear foot.

Table 3-8 Estimated Unit Costs for Main Line Rehabilitation		
Rehabilitation Activity	Unit	Cost
CIPP Lining (8" Pipe)	LF	$25
Open-Cut Pipe Replacement	LF	$50
Open-Cut Point Repair	ea	$2,000
Service Tap Repair	ea	$2,000
CIP Pipe End Seal (4' into pipe)	ea	$400

3.2 COST EFFECTIVE EVALUATION

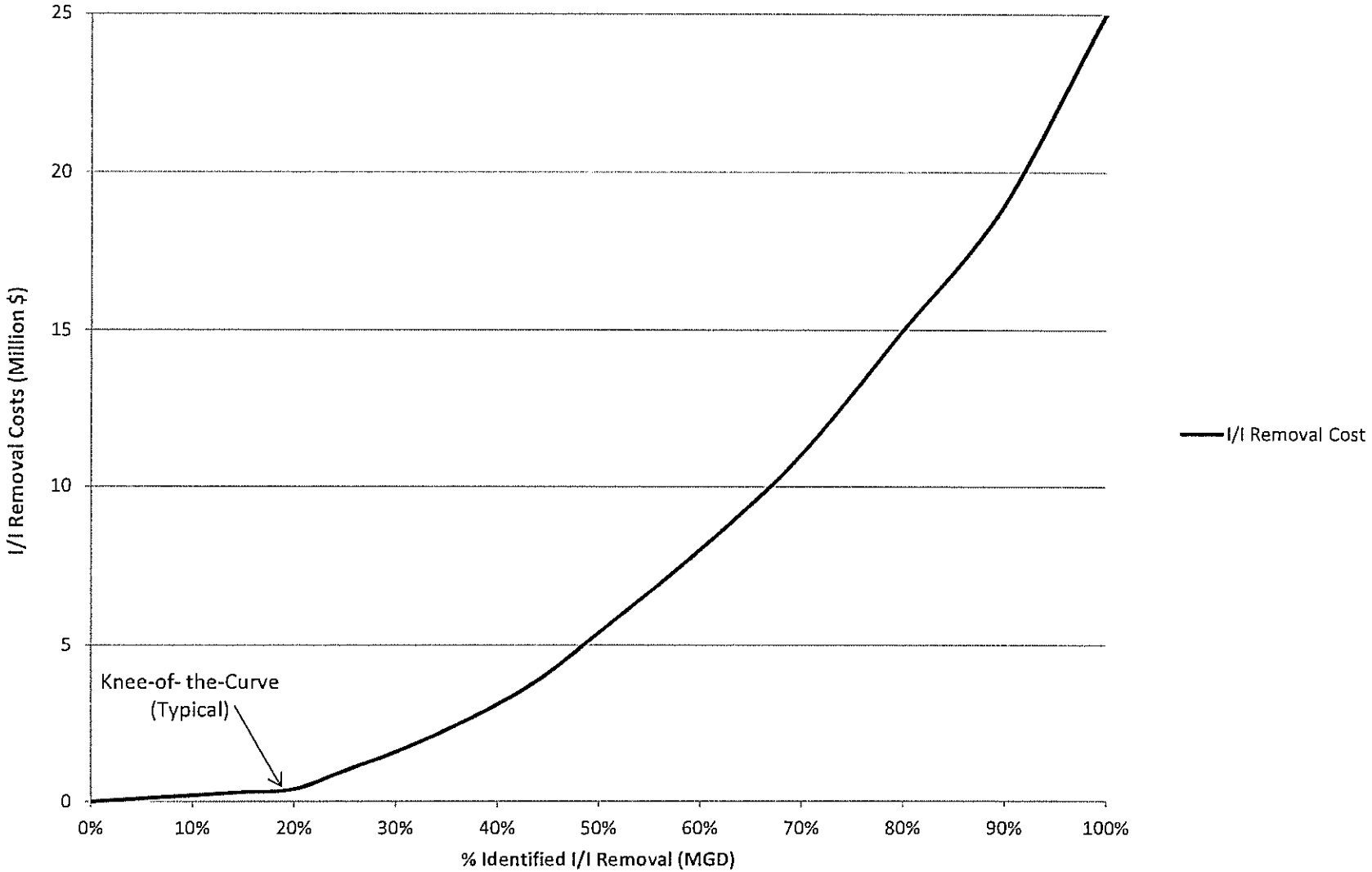
Rehabilitation costs and I/I flow quantities can vary significantly between the different I/I source defects and assets within the collection system. The rehabilitation of the priority basins within the collection system will first focus on repair of the most cost effective defects, as well as the aging infrastructure within the system to prevent further degradation. The costs and results of the City's I/I removal program will be tracked and evaluated each year. The City will adjust its program as necessary and endeavor to complete the most cost effective collection system rehabilitation and I/I removal program within the annual budget.

An I/I removal program typically includes a cost-effective analysis. Typically there is a point at which a diminishing marginal return for public sector I/I removal is realized, after which each unit of I/I removed becomes more expensive. When the point of diminishing marginal return is reached, it is typically more cost-effective to convey and treat the flow. Generally, the point of diminishing marginal return can be determined via a cost-effective curve that is constructed based on the estimated quantity of I/I and the associated repair costs for the I/I sources identified during field inspections. The defects identified by field inspections are prioritized on the basis of rehabilitation cost versus I/I flow removed ($/gpm of unit I/I flow). The resulting curve typically has a point where the cost to rehabilitate versus I/I flow removed increases dramatically. This point is called the "knee-of-the-curve", and it is recommended to focus rehabilitation efforts on the defects below the "knee-of-the-curve" in order to complete I/I removal and collection system rehabilitation in the most cost effective manner.

At this time, field inspection results are not yet available to use in constructing the cost-effective curve. Therefore, a representative cost-effective curve was created based on typical I/I removal cost-effective

curves. Figure 3-2 on the following page shows this representative cost curve for the Southeast WWTP (a similar curve shape would apply to the Vichy Road WWTP as well). As field inspections and collection system rehabilitation activities are completed, the cost-effective curve will be updated as the cost to remove I/I from the collection system is determined with a greater degree of accuracy.

Figure 3-2 Typical Cost-Effective Curve for I/I Reduction in Southeast WWTP Service Area



3.3 I/I REDUCTION PROGRAM GOALS

It is anticipated that approximately $440,000 of the City's annual $620,000 I/I removal program budget will be used for collection system rehabilitation, with the rest being spent on labor and equipment for field inspections and program administration. Table 3-9 presents a projection of the annual rehabilitation budgets for the Year 1-4 sub-basins. This projection is based off the projected defects within each sub-basin and will be adjusted as necessary based on the field inspection findings within each individual sub-basin. If the field inspection findings and cost-effective analysis determine that more of the rehabilitation budget should be spent on the basins from one particular year, the rehabilitation budgets will be adjusted as needed.

Table 3-9 Year 1-4 Priority Basins Projected Annual Rehabilitation Budget

		Manholes				Main Line Pipe			Total
	Sub-Basin	# of MHs in Sub-basin	Projected Upper MH Defects	Projected Lower MH Defects	Projected MH Rehab Costs	LF of VCP Pipe	Projected Main Line Pipe Defects	Projected Main Line Rehab Costs	Projected Total Annual Rehabilitation Budget
Year 1 Basins	V1	93	60	74	$35,000	6,170	329	$27,000	$62,000
	V2	83	53	66	$32,000	9,788	430	$36,000	$68,000
	V3	88	56	70	$34,000	9,944	460	$38,000	$72,000
	BN3	73	47	58	$28,000	11,387	492	$41,000	$69,000
	BN4	93	60	74	$35,000	14,249	588	$50,000	$85,000
	BN5	96	61	77	$36,000	13,444	573	$48,000	$84,000
	Year 1 Total	526	337	421	$200,000	64,982	2872	$240,000	$440,000
Year 2 Basins									
	LE1	53	42	53	$44,000	10,304	517	$62,000	$106,000
	LE2	42	34	42	$35,000	4,173	222	$26,000	$61,000
	LN3	56	45	56	$46,000	10,290	530	$63,000	$109,000
	BW2	32	26	32	$26,000	3,088	169	$20,000	$46,000
	BW3	60	48	60	$49,000	11,339	578	$69,000	$118,000
	Year 2 Total	243	194	243	$200,000	39,194	2016	$240,000	$440,000
Year 3 Basins									
	LW3	51	41	51	$34,000	9,054	457	$37,000	$71,000
	LW4	71	57	71	$47,000	9,063	494	$40,000	$87,000
	LW5	77	62	77	$52,000	14,560	728	$59,000	$111,000
	LW6	76	61	76	$52,000	12,962	678	$54,000	$106,000
	BW1	22	18	22	$15,000	12,430	626	$50,000	$65,000
	Year 3 Total	297	238	297	$200,000	58,069	2983	$240,000	$440,000

Table 3-9, continued

		Manholes				Main Line Pipe			Total
	Sub-Basin	# of MHs in Sub-basin	Projected Upper MH Defects	Projected Lower MH Defects	Projected MH Rehab Costs	LF of VCP Pipe	Projected Main Line Pipe Defects	Projected Main Line Rehab Costs	Projected Total Annual Rehabilitation Budget
Year 4 Basins	BW4	84	67	84	$29,000	14,214	742	$41,000	$70,000
	LE3	45	36	45	$16,000	11,606	580	$32,000	$48,000
	LE4	80	64	80	$28,000	12,557	710	$40,000	$68,000
	LE6	107	86	107	$37,000	17,880	947	$53,000	$90,000
	LE8	222	142	178	$62,000	10,363	708	$39,000	$101,000
	LW1	28	22	28	$10,000	5,094	260	$15,000	$25,000
	LW2	38	30	38	$13,000	6,237	325	$18,000	$31,000
	LV1	66	11	13	$5,000	0	37	$2,000	$7,000
	Year 4 Total	670	458	573	$200,000	77,951	4309	$240,000	$440,000

By focusing the I/I removal efforts on completing cost-effective I/I removal and rehabilitation of the aging infrastructure within the collection system, the City hopes to achieve the following goals:

- Reduce peak I/I flows to the Southeast and Vichy Road WWTPs by 15-25%
- Reduce the size of equalization facilities required to store peak wet weather flows at the plants, and if possible, eliminate the need for peak flow storage at the Vichy Road WWTP
- Reduce the pumping and/or conveyance capacity required to convey peak flows to the future equalization basin facilities
- Reduce the costs associated with conveyance and treatment of wet weather flows
- Rehabilitate aging infrastructure within the collection system to extend the life of assets within the collection system and limit future I/I sources from forming within the collection system

An evaluation of the impacts of I/I removal on equalization basin sizing and costs will be presented in Section 4.

4 ALTERNATIVES AND RECOMMENDATIONS

4.1 OVERVIEW

In order to eliminate bypasses from the system, three alternatives have been evaluated: treatment plant capacity expansion, I/I removal through collection system improvements, and construction of equalization basin facilities to store wet weather flows.

4.2 WWTP CAPACITY

4.2.1 Southeast WWTP

The Southeast WWTP has an average day capacity of 4.7 mgd. The current average daily, average dry weather, and peak daily wet weather flows to the plant were previously summarized in Table 2-2 in Section 2 of this report. The plant has a rated peak hydraulic capacity of 9.4 mgd, but records show the plant throughput can reach a maximum of 10.0 mgd during wet weather periods. The plant's average dry weather flow is 2.1 mgd, leaving the plant capable of treating up to 4.75 times the average dry weather flow during peak events.

The current average annual daily flow of 2.9 mgd is only 62% of the Southeast WWTP average day capacity of 4.7 mgd, and the average dry weather flow of 2.1 mgd is only 45% of the average day capacity. The plant has adequate capacity to treat average daily flows through the Year 2040, assuming an average annual growth rate of 1.5% within the service area.

In order to treat the peak daily flow of 36 mgd, the plant would need to add 13.3 mgd of capacity, resulting in an average day capacity of 18 mgd (a 382% capacity increase), assuming a 2:1 peak hydraulic treatment capacity. A plant with this level of treatment capacity would have a far greater treatment capacity than is necessary to treat current average daily flows (over 6 times greater than the current average of 2.9 mgd). Expansion of the WWTP is not a recommended alternative, due to the high cost of expansion and the fact that the plant is currently capable of treating significantly higher average daily flows than are currently being treated.

4.2.2 Vichy Road WWTP

The Vichy Road WWTP has an average day capacity of 0.40 mgd. The current average daily, average dry weather, and peak wet weather flows to the plant were previously summarized in Table 2-3 in Section 2 of this report. The plant has a rated peak hydraulic capacity of 0.80 mgd, but records show the plant throughput can reach a maximum of 1.0 mgd during wet weather periods. The plant's average dry weather flow is 0.21 mgd, leaving the plant capable of treating up to 4.75 times the average dry weather flow during peak events.

The current average annual daily flow of 0.27 mgd is only 67% of the plant's average day capacity of 0.40 mgd, and the average dry weather flow of 0.21 mgd is only 52% of the average day capacity. The plant has adequate capacity to treat average daily flows through the Year 2035, assuming an average annual growth rate of 1.5% within the service area.

In order to treat the peak daily flow of 4 mgd, the plant would need to add 1.60 mgd of capacity, resulting in an average day capacity of 2 mgd (a 500% capacity increase), assuming a 2:1 peak hydraulic treatment capacity. A plant with this level of treatment capacity would have a far greater treatment capacity than is necessary to treat current average daily flows (over 7 times greater than the current average of 0.27 mgd). Expansion of the WWTP is not a recommended alternative, due to the high cost of expansion and the fact

that the plant is currently capable of treating significantly higher average daily flows than are currently being treated.

4.3 I/I REDUCTION

A detailed breakdown of the City's I/I Reduction Program is presented in Section 3 of this report. It is recommended that the City first focus its BEP on I/I reduction. Repairs and rehabilitation of the collection system should be made based on the field inspection results. The repair and rehabilitation work should be prioritized based on cost effectiveness, i.e. the amount of I/I that can be eliminated versus the cost of the improvements. Improvements to the collection system are expected to include manhole and sewer line rehabilitation as well as repairs to eliminate I/I from the private sector from uncapped cleanouts, leaking abandoned laterals, and illicit connections.

4.4 EQUALIZATION BASINS

The feasibility of implementing equalization basins at both the Southeast WWTP and the Vichy Road WWTP as a means of eliminating bypasses of secondary treatment was investigated. Equalization basins were preliminarily sized assuming that all wet weather flows in excess of the capacities of the treatment facilities would be diverted to the equalization basins for storage until such a time as the peak flows had receded. For both the Southeast WWTP and the Vichy Road WWTP, equalization basins were sized for several design conditions. The first design condition assumed that no I/I reduction would be performed within the collection system. Subsequent design conditions were investigated for various levels of collection system I/I reduction. It is generally accepted that as I/I removal is performed, the size and associated cost of the equalization basins required decreases. Opinions of probable project cost for each design condition were generated to aid in the development of a cost curve for the project, which was utilized as tool to determine the most economical balance between I/I removal and equalization basin construction costs.

Several alternatives for the implementation of equalization basin facilities at both the Southeast and Vichy Road WWTPs are detailed in the *Peak Flow Equalization Facilities for the Southeast and Vichy Road Wastewater Treatment Plans,* December 2011, preliminary engineering report (PER) by HDR Engineering, Inc. and CM Archer Group, P.C, included in this report as Appendix B. The recommendations of the PER are summarized herein as they pertain to the elimination of bypasses at each facility.

4.4.1 Southeast WWTP

The primary alternative of interest for the implementation of equalization basin facilities at the Southeast WWTP involves the construction of the basins downstream of the existing plan. Flows in excess of the West Plant capacity are currently diverted to the existing Pump Station Flow Control Structure and Outfall No. 002. Flows in excess of the East Plant capacity are currently diverted to the existing Flow Measurement Structure and Outfall No. 003. Within the scope of the equalization basin improvements, the excess peak flows from both plant peak flow clarifiers would be diverted with new flow splitters placed upstream of Outfall No. 002 and No. 003, to a new gravity sewer conveyance. The gravity sewer would discharge directly to the equalization basin.

The equalization basin shall be divided into two discrete cells. The gravity sewer will discharge into the first cell, which has the highest water surface elevation. Cell No. 2 was terraced down the hillside in an effort to minimize excavation requirements and achieve balanced cut fill quantities. The system was designed to operate such that Cell No. 1 would fill first and once full, would overflow into Cell No. 2. A level sensing float switch would be installed in Cell No. 2 to provide a high water level indication which would be utilized to close normally open motorized sluice gates at both upstream flow splitters prior to the exceedances of the equalization basin volume. Flows would not be discharged directly from the

equalization basin during normal operation until the operator activates the equalization basin pump station to convey wastewater back to the WWTP for secondary treatment. When the peak flows have receded to a level that is permitting, wastewater in the equalization basin would be pumped back to the West Plant headworks.

Engineering opinions of probable project costs were compiled for several different levels of I/I removal within the collection system. The cost estimates for two of these scenarios are presented below in Table 4-1. All opinions of probable project costs include any anticipated capital costs, design fees, land acquisition costs, operations and maintenance cost, etc, associated with the proposed improvements. Refer to the *Peak Flow Equalization Facilities for Southeast and Vichy Road WWTPs Preliminary Engineering Report* located in Appendix B for detailed cost estimates and exhibits showing the proposed layout of the wet weather flow diversion structure, storm water pump station, force main and equalization basin facilities.

Table 4-1 SE WWTP Equalization Basin Alternatives Cost Estimates

% I/I Removal	Alternative Description	Capital Cost	Annual O&M Cost
0	EQ Basin Volume = 36-mil gallons	$6,760,000	$14,000
25	EQ Basin Volume = 27-mil gallons	$5,640,000	$12,000

Note: Estimates based on best flow metering data available at time of analysis.

4.4.2 Vichy Road WWTP

The primary alternative of interest for the implementation of equalization basin facilities at the Vichy Road WWTP involves the construction of a basin upstream of the existing plant. Wastewater flows in excess of the plant capacity are currently diverted to the peak flow clarifier for primary treatment and subsequently blended with treated effluent prior to discharge from the plant. Within the scope of equalization basin improvements at the facility, flows from the plant peak flow clarifier would be diverted via a new flow splitter placed prior to blending with treated effluent to a new storm water pump station.

The equalization basin shall have one cell. The force main shall discharge directly into the cell. A level sensing float switch would be installed in cell to provide a high water level indication which would be utilized to shut down the pump station prior to the exceedances of the equalization basin volume. Flows would not be discharged directly from the equalization basin during normal operation. When the peak flows have receded to a level that is permitting, wastewater in the equalization basin would be drained back to the plant headworks via gravity flow.

Engineering opinions of probable project costs were compiled for several different levels of I/I removal within the collection system. The cost estimates for two of these scenarios are presented below in Table 4-2. All opinions of probable project costs include any anticipated capital costs, design fees, land acquisition costs, operations and maintenance cost, etc, associated with the proposed improvements. Refer to the *Peak Flow Equalization Facilities for Southeast and Vichy Road WWTPs Preliminary Engineering Report* located in Appendix B for detailed cost estimates and exhibits showing the proposed layout of the wet weather flow diversion structure, storm water pump station, force main and equalization basin facilities.

Table 4-2 Vichy Road WWTP Equalization Basin Alternatives Cost Estimates

% I/I Removal	Alternative Description	Capital Cost	Annual O&M Cost
0	EQ Basin Volume = 4.15-mil gallons	$1,380,000	$6,000
25	EQ Basin Volume = 3.0-mil gallons	$1,130,000	$6,000

Note: Estimates based on best flow metering data available at time of analysis.

4.4.3 Equalization Basins Schedule

It is anticipated that the City will focus its efforts for 8-years (Years 1-8) on the reduction of I/I volumes within the collection system. During this time, the City will work steadily to inspect, locate and remediate potential sources of I/I within the publicly owned sanitary sewer collection system. At the same time, the City will monitor sanitary sewer flows within the collection system and at the WWTPs in an effort to track their progress in reducing I/I volumes.

With respect to the equalization basins, the City should move immediately to obtain the land area necessary at both the Southeast and Vichy Road WWTF to allow for their future construction. It is recommended that the City purchase enough land area to allow the construction of an equalization basin which would have the capacity to store excess flows assuming no I/I reduction within the collection system was achieved. During the eighth year of the BEP implementation, the City must pursue the construction of equalization basin alternatives detailed above. It is anticipated that final design of the equalization basin and conveyance systems would be performed during that year, with construction of the proposed facilities occurring during the ninth year of the BEP implementation. This would result in the completion of a fully functional equalization basin facility implemented at both WWTPs before the end of the 10-year term of the VCA. A proposed schedule for the implementation of the equalization basin alternatives is listed below.

Table 4-3: Equalization Basin Alternatives Implementation Summary

VCA/BEP Year	Task
Annually	– Inspection, location and remediation of I/I within the sanitary sewer collection system. – Monitoring of sanitary sewer flows within the collection system and at the WWTPs.
1	– Obtain land for construction of proposed equalization basin facilities.
8	– Begin final design of the proposed equalization basin and conveyance facilities.
9	– Bid and construct the proposed equalization basin and conveyance facilities per final design
10	– Perform start-up of proposed facilities in accordance with the VCA

4.5 RECOMMENDATIONS

It is recommended that the City focus first on collection system improvements within the Southeast and Vichy Road WWTP service areas to eliminate sources of I/I into the system in order to reduce peak wet weather flows to the plants. These improvements should be completed following the I/I Reduction Program schedule presented in Section 3.1.2. The anticipated annual costs for the I/I reduction efforts are presented in Section 3.1.1. The results of the I/I Reduction Program should be evaluated annually, and adjustments made to the program as necessary. The level of I/I removal achieved will be evaluated through flow monitoring.

The flow monitoring results will be further evaluated to determine the required size of the equalization basin facilities used to store peak wet weather flows beyond the treatment capacity of the WWTPs. The equalization basin facilities should then be constructed in accordance with the schedule presented in Section 4.4.3. The estimated costs for the equalization basin facilities are presented in Section 4.4.1 and Section 4.4.2. If sufficient I/I reduction is achieved during the Voluntary Compliance Agreement period to eliminate the need for equalization basin facilities at either plant, the need for equalization basins will be reevaluated.

4.6 BYPASS ELIMINATION PLAN IMPLEMENTATION SCHEDULE

The following presents a summary of the schedule for implementation of the BEP. Refer to Section 3.1.2 for a detailed schedule of the I/I Reduction Program. Refer to Section 4.4.3 for a schedule of the equalization basin facilities improvements.

Figure 4-1 Bypass Elimination Plan Schedule Summary

1. May 5, 2012 – Submit BEP to MDNR for Approval (Start Date)

2. I/I Reduction and Collection System Rehabilitation Program:
   - Year 1 – 7 (2012 – 2018): I/I Reduction Pilot Study in Priority Basins
   - Year 2 – 8 (2013 – 2019): Ongoing I/I Removal and Collection System Rehabilitation
   - Year 1 – 9 (2012 – 2020): Ongoing Flow Monitoring
   - Ongoing Updates to BEP for Field Inspection and Flow Monitoring Data
   - Year 10 and Beyond: Continued I/I Inspections and Collection System Rehabilitation
3. Equalization Basin Facilities:
   - Year 1 (2012): Begin Land Acquisition Process
   - Year 8 (2019): Design
   - Year 9 (2020): Bid and Construction
   - Year 10 (2021): Complete Construction and Start Up Facilities

4.7 PUBLIC NOTIFICATION OF BYPASS EVENTS

As part of the Bypass Elimination Plan, the City will continue to report all bypass events per the requirements of the Voluntary Compliance Agreement.

4.8 ONGOING BYPASS ELIMINATION PLAN UPDATES

The City will update the Bypass Elimination Plan as the following additional data becomes available:

- Collection system inspection results
- Repair costs for collection system rehabilitation

- Collection system flow monitoring results
- WWTP flow monitoring results

The projected I/I sources and defect repair costs presented in this report are based on typical industry data. These costs were used to help formulate the City's I/I Reduction Pilot Study and project the most cost effective level of I/I removal. As the City completes inspections to identify I/I sources with the priority basins of the collection system, this report will be updated to include these inspection results. As the City completes rehabilitation of I/I sources within the collection system, the repair costs will be tracked, and the report updated to reflect the costs.

The results of the pilot study will be evaluated each year, and the City will make adjustments to resource allocation within the I/I reduction program as deemed appropriate. The inspection results, repair costs, and flow monitoring results will be analyzed in an effort to determine the most effective allocation of the City's resources for I/I reduction and collection system rehabilitation.

The City will complete additional flow monitoring at the Southeast and Vichy Road WWTPs. The results of this flow monitoring will be used to assess the progress of the I/I reduction program and to aid in the final design of equalization basin facilities. The Bypass Elimination Plan will be updated to reflect the results of the flow monitoring, and the cost estimates for the equalization basin facilities will be updated as necessary.

5 COST ESTIMATES AND FINANCING

5.1 BEP PROGRAM COSTS

5.1.1 I/I Reduction Program Annual Costs

The annual budget and anticipated resource allocation for the I/I Reduction Program presented previously in Section 3 are shown below in Table 5-1.

Table 5-1 Annual Budget and Resource Allocation for I/I Reduction Program

Labor	$260,000
Equipment	$ 60,000
Materials	$ 50,000
Subtotal, City Performed Work	$370,000
Improvements by Contract	$250,000
Total Annual Costs	$620,000

5.1.2 Equalization Basin Facilities Cost Estimates

The estimated costs for the equalization basin facilities presented previously in Section 5 are shown below in Tables 5-2 and 5-3.

Table 5-2 SE WWTP Equalization Basin Alternatives Cost Estimates

% I/I Removal	Alternative Description	Capital Cost	Annual O&M Cost
0	EQ Basin Volume = 36-mil gallons	$6,760,000	$14,000
25	EQ Basin Volume = 27-mil gallons	$5,640,000	$12,000

Note: Estimates based on best flow metering data available at time of analysis.

Table 5-3 Vichy Road WWTP Equalization Basin Alternatives Cost Estimates

% I/I Removal	Alternative Description	Capital Cost	Annual O&M Cost
0	EQ Basin Volume = 4.15-mil gallons	$1,380,000	$6,000
25	EQ Basin Volume = 3.0-mil gallons	$1,130,000	$6,000

Note: Estimates based on best flow metering data available at time of analysis.

5.2 ANTICIPATED FINANCING PLAN AND IMPACT ON RATES

The City will finance the I/I Reduction Program with revenue generated by user rates. In 2011 the City increased sewer user rates from $3.50/1,000 gallons to $4.00/1,000 gallons in order to increase I/I reduction efforts. The City plans to continue implementing incremental rate increases from 2012 to 2014 to a total of $4.80/1,000 gallons to finance the additional costs of the BEP. The City anticipates applying for State Revolving Funds (SRF) to provide the capital required to complete the equalization basin facilities through a low interest loan.

In addition to the costs of the BEP, the City needs to finance an upcoming project to construct disinfection facilities at the Southeast WWTP. The City is also currently making bond payments for previously completed capital improvement projects to the collection system and WWTPs. The preliminary schedule of recent and anticipated future rate increases to finance the costs of the BEP and all other anticipated improvements is presented in Table 5-4. It is anticipated that the future rate increase to $4.80/1,000 gallons will be sufficient to finance all of the improvements identified in the BEP as well as the disinfection facilities. The user rate increases after Year 2014 are based on a projected 3% annual inflation rate.

Table 5-4 Rolla Anticipated Sewer User Rate Schedule

Fiscal Year	Sewer User Rate ($/1,000 gallons)
2010	$ 3.50
2011	$ 4.00
2012	$ 4.00
2013	$ 4.40
2014	$ 4.80
2015	$ 4.95*
2016	$ 5.10*
2017	$ 5.25*
2018	$ 5.40*
2019	$ 5.55*
2020	$ 5.70*
2021	$ 5.90*

* Projected rates assuming 3% annual inflation rate

APPENDIX A

VOLUNTARY COMPLIANCE AGREEMENT

CERTIFICATE OF TRUE COPY

STATE OF MISSOURI)
COUNTY OF PHELPS) ss.

I, Carol L. Daniels, City Clerk of the City of Rolla, Missouri, do hereby certify the above and foregoing to be a true copy of Resolution No. 1747, approved by the Rolla City Council during its meeting on April 18, 2011, and as the same appears in my office.

IN TESTIMONY WHEREOF, I have hereunto set my hand and affixed the seal of said City of Rolla, Missouri, this 24th day of April 2012.

Carol L. Daniels, Rolla City Clerk

RESOLUTION NO. 1747

A RESOLUTION AUTHORIZING THE MAYOR OF THE CITY OF ROLLA, MISSOURI TO EXECUTE ON BEHALF OF THE CITY OF ROLLA, MISSOURI A CERTAIN PEAK FLOW VOLUNTARY COMPLIANCE AGREEMENT BETWEEN THE CITY OF ROLLA, MISSOURI AND THE STATE OF MISSOURI DEPARTMENT OF NATURAL RESOURCES.

BE IT RESOLVED BY THE CITY COUNCIL OF THE CITY OF ROLLA, MISSOURI, AS FOLLOWS:

Section 1: That the Mayor of the City of Rolla, Missouri be and is hereby authorized and directed to execute on behalf of the City of Rolla, Missouri a certain Peak Flow Voluntary Compliance Agreement between the City of Rolla, Missouri and the State of Missouri Department of Natural Resources relating to Vichy Road Wastewater Treatment Plant, a copy of said agreement being attached hereto and marked Exhibit A.

Section2: That the Mayor of the City of Rolla, Missouri be and is hereby authorized and directed to execute on behalf of the City of Rolla, Missouri a certain Peak Flow Voluntary Compliance Agreement between the City of Rolla, Missouri and the State of Missouri Department of Natural Resources relating to Southeast Wastewater Treatment Plant, a copy of said agreement being attached hereto and marked Exhibit B.

Section 3: That this resolution shall be in full force and effect from and after the date of its passage and approval.

PASSED BY THE CITY COUNCIL OF THE CITY OF ROLLA, MISSOURI, AND APPROVED BY THE MAYOR THIS 18th DAY OF APRIL, 2011.

APPROVED:

MAYOR

ATTEST:

CITY CLERK

APPROVED AS TO FORM:

Digitally signed by J. Kent Robinson
DN: cn=J. Kent Robinson, o=Williams, Robinson, Ryler & Buschjost, P.C., ou=Williams, Robinson, Ryler & Buschjost, P.C., email=kent@missouriattorneys.com, c=US
Date: 2011.04.18 14:50:01 -05'00'

CITY COUNSELOR

1747

EXHIBIT B

PEAK FLOW

VOLUNTARY COMPLIANCE AGREEMENT

THIS COMPLIANCE AGREEMENT is made between the Missouri Department of Natural Resources and the City of Rolla, MO-0050652 (hereinafter "the Department" and "the City" or "the POTW"). The parties, the Department and the City, stipulate and agree as follows:

WHEREAS, the Department director or his designee, on behalf of the Missouri Clean Water Commission, administers the provisions of the Missouri Clean Water Law, Chapter 644 of the Revised Statutes of Missouri (as amended).

WHEREAS, the City owns and operates a wastewater treatment plant for the biological treatment of domestic wastewater.

WHEREAS, the City, in operation of this wastewater treatment plant discharges to "waters of the state," as defined in Section 644.016(26), RSMo.

WHEREAS, the City has obtained previous operating permits that include enforceable conditions on discharges. 10 CSR 20-7.015 *Effluent Regulations*, prior to its revision, established a basis for limiting the discharge from the peak flow clarifiers through Outfalls #002 and #003 to forty-five (45) milligrams per liter of Biochemical Oxygen Demand (BOD) and Total Suspended Solids (TSS), providing that the wastewater being discharged from these outfalls receives primary treatment and that the discharge is not continuous but occurs during wet-weather events.

WHEREAS, a revision to 10 CSR 20-7.015 *Effluent Regulations* became effective on June 30, 2010. This rule revision eliminated the provision that provided a mechanism to place forty-five (45) milligrams per liter of BOD and TSS limitations in National Pollutant Discharge Elimination System (NPDES) permits for discharges from Outfalls #002 and #003 because these discharges bypass secondary treatment, a requirement of the Clean Water Act. Federal regulations (40 CFR 122.41(m)(i)) define bypass as the "intentional diversion of waste streams from any portion of a treatment facility".

WHEREAS, to eliminate discharges from the peak flow clarifiers through Outfalls #002 and #003, the City will need to conduct an engineering evaluation followed by the construction of capital improvements. These efforts will require reasonable time and monetary investment.

WHEREAS, this Compliance Agreement only addresses bypasses made at the treatment works of wastewater that is routed through the peak flow clarifiers and discharged through Outfalls #002 and #003 without receiving secondary treatment. Bypasses upstream of the treatment plant, called sanitary sewer overflows, and other bypasses within the treatment plant are not covered in this Agreement.

NOW, THEREFORE, in consideration of the mutual promises contained herein and other good and valuable consideration, the Department and the City further stipulate and agree as follows:

1. The provisions of this Agreement shall apply to and be binding upon the parties executing this Agreement, as well as their successors in interest, and their successors in office. This Agreement shall not supersede any other orders or agreements made by the parties. Further, each party executing this Compliance Agreement shall be responsible for ensuring that their agents, subsidiaries, affiliates, lessees, officers, servants, or any person or entity acting pursuant to, through, or for the parties, adhere to the terms of this Compliance Agreement.

2. The signed copy of the Compliance Agreement shall be mailed to:

   Missouri Department of Natural Resources
   Permits and Engineering Section
   Attn: Wet Weather Coordinator
   P.O. Box 176
   Jefferson City, MO 65102

3. Receipt of the executed Compliance Agreement is acknowledged by the Department of Natural Resources (Department) signature affixed hereto.

4. All documents submitted to the Department pursuant to this Compliance Agreement shall be subject to review by the Department. If there are no comments from the Department within 60 calendar days after the date of submission of the document(s), then the document(s) shall be fully implemented by the permitted Publicly Owned Treatment Works (POTW). If the Department comments and/or requests modification of any documents submitted to the Department pursuant to this Agreement, the POTW agrees to make the modifications as directed by the Department and/or address the Department's comments and resubmit the document(s) within 60 calendar days of receipt of the Department's comment(s) or modification request.

5. Documents required by this Compliance Agreement, shall be submitted in duplicate to:

   Missouri Department of Natural Resources
   Permits and Engineering Section
   Attn: Wet Weather Coordinator
   P.O. Box 176
   Jefferson City, MO 65102

6. The Department will issue the draft permit in substantially the same form as contained in Attachment A. The POTW hereby waives its right to appeal or otherwise contest the provisions regarding the reporting of bypasses from Outfalls #002 and #003 in the draft permit and waives its right to petition for a variance of these provisions under 644.061 RSMo. However, nothing in this waiver or this Agreement shall be interpreted as a waiver by the POTW of its right to participate as a party, or otherwise, in any appeal of the permit by a third party or person.

7. The POTW agrees to commit the financial resources necessary and fully implement all of the requirements of this Compliance Agreement, in accordance with the timelines contained herein. If the POTW cannot continue to commit financial resources necessary to make adequate progress as defined in paragraph 15, the agreement may be rendered null and void. If POTW conducts a "no-feasible alternatives" analysis in accordance with 40 CFR 122.41 (m)(4)(i)(B) that is approved by the Department, the Consent Agreement may be modified or nullified.

8. The POTW agrees to operate the collection system and treatment facility in such a manner as to ensure that that the volume of effluent discharged through the main outfall is maximized, thereby minimizing bypass events through Outfalls #002 and #003. When the Outfalls #002 and #003 are activated, the POTW is required to achieve the maximum practicable treatment such that the bypassed effluent is of the highest quality achievable utilizing the POTW's existing facilities.

9. The POTW agrees to the reporting requirements of 40 CFR 122.41 (l) (6) and State bypass reporting requirements for any discharges of effluent from Outfalls #002 and #003. The written report shall include rainfall data (amount and duration) for the rainfall event that will identify the event as a wet weather discharge, in addition to the requirements of 40 CFR 122.41 (l) (6).

10. Within 365 days of execution of this Agreement, the POTW agrees to submit to the Department for review a Bypass Elimination Plan.

11. The Bypass Elimination Plan (Plan) shall include, but not be limited to:

    i. An evaluation of the existing plant and the collection system.
    ii. A list of options evaluated to reduce peak flows and the cost associated.
    iii. A list and schedule for improvements to reduce peak flows to the WWTF such that bypasses are eliminated.
    iv. Information on costs, financial capability, and financing schedule.
    v. Public information and notification of the bypass events.
    vi. Deadlines: The Plan shall include a schedule that includes at least annual milestones and a final date to achieve elimination as soon as practicable, but in no event later than ten years from the date this Compliance Agreement was executed.

    The POTW may utilize the guidance provided in the appropriate sections of the "Handbook: Sewer System Infrastructure Analysis and Rehabilitation" (EPA/625/6-91/030); "Existing Sewer Evaluation and Rehabilitation" (WEF MOP FD-6); "A Guide to Short Term Flow Surveys of Sewer Systems" (WRC Engineering, undated); and sound engineering practices.

    The "Combined Sewer Overflows – Guidance for Financial Capability Assessment and

Schedule Development" (EPA 832-B-97-004) provides a framework to assess the appropriateness of the schedule established by the Plan.

12. This Compliance Agreement shall be null and void if the Plan as submitted includes as an interim or final remedy any form of bypass, including blending. Any other form of bypassing requires a "no feasible alternative" analysis as defined in 40 CFR 122.41 (m)(4)(i)(B). As U.S Environmental Protection Agency issues any new federal law, regulation, or national policy governing bypassing, the POTW may request modification to the Plan to conform to such new federal law, regulation, or national policy.

13. After the review and comment periods of the Bypass Elimination Plan described in item 4 have ended, the Bypass Elimination Plan, including the schedule and any deadlines contained therein, shall become enforceable terms of this Agreement.

14. Once a Bypass Elimination Plan has been submitted to the department, the POTW agrees to make annual reports to the Department of all progress during the previous year. The reports are due June 30 of each year and the information provided will be considered for purposes of paragraph 17. The reports shall include:

    i. The status of implementation of all plans required by this Agreement, including a statement as to whether specific schedule milestone dates in the schedules included in each plan were met and a summary of project expenditures. The POTW shall also submit a certification that the specified work has been completed, including the following documentation:

        a) For work performed by a private contractor, the POTW shall submit a certification by the POTW's Engineer that the specified work has been completed.

        b) For work performed by the POTW personnel, a copy of the work order (or similar documentation) for the project. A cover letter certifying that the work is completed shall accompany the work orders compiled and submitted during the publication of each annual report. The cover letter may be signed by the POTW's Engineer or the City's Engineer.

    ii. The POTW shall maintain copies of all written submissions prepared pursuant to the Compliance Agreement and this Appendix for at least thirty-six (36) months after termination of the Compliance Agreement.

    iii. Modifications to the Bypass Elimination Plan with supporting documentation for the changes.

15. The POTW agrees that the Department may render this Agreement null and void based on failure to report any bypass from Outfalls #002 and #003, failure to make annual reports required in item 14, failure to submit a Bypass Elimination Plan as required in item 10, or failure to make adequate progress. Adequate progress is defined as meeting interim dates set in the Bypass Elimination Plan, a decrease in the number of bypasses, and a decrease in duration and amount of effluent discharged while considering hydrogeologic factors.

16. If at the end of the first permit cycle the POTW determines it can not be in full compliance with Missouri Clean Water Law and the federal Clean Water Act regarding bypass discharges through the Outfalls #002 and #003, the POTW shall submit a request to extend or revise this Compliance Agreement with their permit renewal to the Department 180 days before the expiration of the operating permit.

17. When the Department receives the request to extend or revise this Agreement at permit renewal, the Department may review any relevant information to determine if adequate progress has been completed. If adequate progress has been made, the Compliance Agreement may be extended for one additional permit cycle. Compliance Agreements cannot, and will not be extended in excess of ten years.

18. If after extension, bypasses are still occurring at the end of Compliance Agreement, the POTW may choose to submit a "no feasible alternatives" analysis ninety (90) days prior to the expiration date to seek approval of future bypasses within its reissued NPDES permit.

19. The POTW is expected to be in full compliance with permit conditions concerning bypasses by the end of the upcoming permit cycle in five (5) years, or with an extension, by the end of the subsequent permit cycle in ten (10) years. The POTW agrees to comply with this Compliance Agreement for the term of the Agreement. Nothing herein prevents the Department from taking enforcement action based on non-compliance with the Missouri Clean Water Law or the federal Clean Water Act and implementing regulations except for bypasses from Outfalls #002 and #003 which are addressed under this Agreement.

20. Each signatory to this Compliance Agreement avers that he or she has the authority to bind his or her respective party to this Compliance Agreement as evidenced by his or her signature on this Compliance Agreement. Execution of this Compliance Agreement shall be completed when the Department has signed and dated the Compliance Agreement. As the last party signing the Compliance Agreement, the Department shall promptly distribute copies of the executed Compliance Agreement to the other signatories.

21. The terms of this Agreement supersede all previous memoranda of understanding, notes, conversations, and agreements expressed or implied, with respect to the subject matter

addressed herein. This Agreement may not be modified orally.

In Witness Whereof, the parties have executed this Agreement as follows:

City of Rolla

By: _____ Date: 18 APR 2011
The Honorable William Jenks, III, Mayor

MISSOURI DEPARTMENT OF NATURAL RESOURCES

By: John Madras Date: 5/3/11
John Madras, Director
Water Protection Program

EXHIBIT A

PEAK FLOW

VOLUNTARY COMPLIANCE AGREEMENT

THIS COMPLIANCE AGREEMENT is made between the Missouri Department of Natural Resources and the City of Rolla, MO-0047031 (hereinafter "the Department" and "the City" or "the POTW"). The parties, the Department and the City, stipulate and agree as follows:

WHEREAS, the Department director or his designee, on behalf of the Missouri Clean Water Commission, administers the provisions of the Missouri Clean Water Law, Chapter 644 of the Revised Statutes of Missouri (as amended).

WHEREAS, the City owns and operates a wastewater treatment plant for the biological treatment of domestic wastewater.

WHEREAS, the City, in operation of this wastewater treatment plant discharges to "waters of the state," as defined in Section 644.016(26), RSMo.

WHEREAS, the City has obtained previous operating permits that include enforceable conditions on discharges. 10 CSR 20-7.015 *Effluent Regulations*, prior to its revision, established a basis for limiting the discharge from the peak flow clarifier through Outfall #002 to forty-five (45) milligrams per liter of Biochemical Oxygen Demand (BOD) and Total Suspended Solids (TSS), providing that the wastewater being discharged from this outfall receives primary treatment and that the discharge is not continuous but occurs during wet-weather events.

WHEREAS, a revision to 10 CSR 20-7.015 *Effluent Regulations* became effective on June 30, 2010. This rule revision eliminated the provision that provided a mechanism to place forty-five (45) milligrams per liter of BOD and TSS limitations in National Pollutant Discharge Elimination System (NPDES) permits for discharges from Outfall #002 because these discharges bypass secondary treatment, a requirement of the Clean Water Act. Federal regulations (40 CFR 122.41(m)(i)) define bypass as the "intentional diversion of waste streams from any portion of a treatment facility".

WHEREAS, to eliminate discharges from the peak flow clarifier through Outfall #002, the City will need to conduct an engineering evaluation followed by the construction of capital improvements. These efforts will require reasonable time and monetary investment.

WHEREAS, this Compliance Agreement only addresses bypasses made at the treatment works of wastewater that is routed through the peak flow clarifier and discharged through Outfall #002 without receiving secondary treatment. Bypasses upstream of the treatment plant, called sanitary sewer overflows, and other bypasses within the treatment plant are not covered in this Agreement.

NOW, THEREFORE, in consideration of the mutual promises contained herein and other good and valuable consideration, the Department and the City further stipulate and agree as follows:

1. The provisions of this Agreement shall apply to and be binding upon the parties executing this Agreement, as well as their successors in interest, and their successors in office. This Agreement shall not supersede any other orders or agreements made by the parties. Further, each party executing this Compliance Agreement shall be responsible for ensuring that their agents, subsidiaries, affiliates, lessees, officers, servants, or any person or entity acting pursuant to, through, or for the parties, adhere to the terms of this Compliance Agreement.

2. The signed copy of the Compliance Agreement shall be mailed to:

   Missouri Department of Natural Resources
   Permits and Engineering Section
   Attn: Wet Weather Coordinator
   P.O. Box 176
   Jefferson City, MO 65102

3. Receipt of the executed Compliance Agreement is acknowledged by the Department of Natural Resources (Department) signature affixed hereto.

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5. Documents required by this Compliance Agreement, shall be submitted in duplicate to:

   Missouri Department of Natural Resources
   Permits and Engineering Section
   Attn: Wet Weather Coordinator
   P.O. Box 176
   Jefferson City, MO 65102

6. The Department will issue the draft permit in substantially the same form as contained in Attachment A. The POTW hereby waives its right to appeal or otherwise contest the provisions regarding the reporting of bypasses from Outfall #002 in the draft permit and waives its right to petition for a variance of these provisions under 644.061 RSMo. However, nothing in this waiver or this Agreement shall be interpreted as a waiver by the POTW of its right to participate as a party, or otherwise, in any appeal of the permit by a third party or person.

7. The POTW agrees to commit the financial resources necessary and fully implement all of the requirements of this Compliance Agreement, in accordance with the timelines contained herein. If the POTW cannot continue to commit financial resources necessary to make adequate progress as defined in paragraph 15, the agreement may be rendered null and void. If POTW conducts a "no-feasible alternatives" analysis in accordance with 40 CFR 122.41 (m)(4)(i)(B) that is approved by the Department, the Consent Agreement may be modified or nullified.

8. The POTW agrees to operate the collection system and treatment facility in such a manner as to ensure that that the volume of effluent discharged through the main outfall is maximized, thereby minimizing bypass events through Outfall #002. When the Outfall #002 is activated, the POTW is required to achieve the maximum practicable treatment such that the bypassed effluent is of the highest quality achievable utilizing the POTW's existing facilities.

9. The POTW agrees to the reporting requirements of 40 CFR 122.41 (l) (6) and State bypass reporting requirements for any discharges of effluent from Outfall #002. The written report shall include rainfall data (amount and duration) for the rainfall event that will identify the event as a wet weather discharge, in addition to the requirements of 40 CFR 122.41 (l) (6).

10. Within 365 days of execution of this Agreement, the POTW agrees to submit to the Department for review a Bypass Elimination Plan.

11. The Bypass Elimination Plan (Plan) shall include, but not be limited to:

    i. An evaluation of the existing plant and the collection system.
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The "Combined Sewer Overflows – Guidance for Financial Capability Assessment and Schedule Development" (EPA 832-B-97-004) provides a framework to assess the appropriateness of the schedule established by the Plan.

12. This Compliance Agreement shall be null and void if the Plan as submitted includes as an interim or final remedy any form of bypass, including blending. Any other form of bypassing requires a "no feasible alternative" analysis as defined in 40 CFR 122.41 (m)(4)(i)(B). As U.S Environmental Protection Agency issues any new federal law, regulation, or national policy governing bypassing, the POTW may request modification to the Plan to conform to such new federal law, regulation, or national policy.

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14. Once a Bypass Elimination Plan has been submitted to the department, the POTW agrees to make annual reports to the Department of all progress during the previous year. The reports are due June 30 of each year and the information provided will be considered for purposes of paragraph 17. The reports shall include:

    i. The status of implementation of all plans required by this Agreement, including a statement as to whether specific schedule milestone dates in the schedules included in each plan were met and a summary of project expenditures. The POTW shall also submit a certification that the specified work has been completed, including the following documentation:

        a) For work performed by a private contractor, the POTW shall submit a certification by the POTW's Engineer that the specified work has been completed.

        b) For work performed by the POTW personnel, a copy of the work order (or similar documentation) for the project. A cover letter certifying that the work is completed shall accompany the work orders compiled and submitted during the publication of each annual report. The cover letter may be signed by the POTW's Engineer or the City's Engineer.

    ii. The POTW shall maintain copies of all written submissions prepared pursuant to the Compliance Agreement and this Appendix for at least thirty-six (36) months after termination of the Compliance Agreement.

    iii. Modifications to the Bypass Elimination Plan with supporting documentation for the changes.

15. The POTW agrees that the Department may render this Agreement null and void based on failure to report any bypass from Outfall #002, failure to make annual reports required in item 14, failure to submit a Bypass Elimination Plan as required in item 10, or failure to make adequate progress. Adequate progress is defined as meeting interim dates set in the Bypass Elimination Plan, a decrease in the number of bypasses, and a decrease in duration and amount of effluent discharged while considering hydrogeologic factors.

16. If at the end of the first permit cycle the POTW determines it can not be in full compliance with Missouri Clean Water Law and the federal Clean Water Act regarding bypass discharges through the Outfall #002, the POTW shall submit a request to extend or revise this Compliance Agreement with their permit renewal to the Department 180 days before the expiration of the operating permit.

17. When the Department receives the request to extend or revise this Agreement at permit renewal, the Department may review any relevant information to determine if adequate progress has been completed. If adequate progress has been made, the Compliance Agreement may be extended for one additional permit cycle. Compliance Agreements cannot, and will not be extended in excess of ten years.

18. If after extension, bypasses are still occurring at the end of Compliance Agreement, the POTW may choose to submit a "no feasible alternatives" analysis ninety (90) days prior to the expiration date to seek approval of future bypasses within its reissued NPDES permit.

19. The POTW is expected to be in full compliance with permit conditions concerning bypasses by the end of the upcoming permit cycle in five (5) years, or with an extension, by the end of the subsequent permit cycle in ten (10) years. The POTW agrees to comply with this Compliance Agreement for the term of the Agreement. Nothing herein prevents the Department from taking enforcement action based on non-compliance with the Missouri Clean Water Law or the federal Clean Water Act and implementing regulations except for bypasses from Outfall #002 which are addressed under this Agreement.

20. Each signatory to this Compliance Agreement avers that he or she has the authority to bind his or her respective party to this Compliance Agreement as evidenced by his or her signature on this Compliance Agreement. Execution of this Compliance Agreement shall be completed when the Department has signed and dated the Compliance Agreement. As the last party signing the Compliance Agreement, the Department shall promptly distribute copies of the executed Compliance Agreement to the other signatories.

21. The terms of this Agreement supersede all previous memoranda of understanding, notes, conversations, and agreements expressed or implied, with respect to the subject matter addressed herein. This Agreement may not be modified orally.

In Witness Whereof, the parties have executed this Agreement as follows:

City of Rolla

By: _____ Date: 18 APR 2011
The Honorable William Jenks, III, Mayor

MISSOURI DEPARTMENT OF NATURAL RESOURCES

By: _____ Date: 5/3/11
John Madras, Director
Water Protection Program

APPENDIX B

PEAK FLOW EQUALIZATION FACILITIES FOR SOUTHEAST AND VICHY ROAD WWTPS PRELIMINARY ENGINEERING REPORT

City of ROLLA

Rolla, Missouri
Preliminary Engineering Report

PEAK FLOW EQUALIZATION FACILITIES FOR SOUTHEAST AND VICHY ROAD WASTEWATER TREATMENT PLANTS

Prepared By:
CM | Archer

ARCHER
ENGINEERING · SURVEYING

In Association With:
HDR | Archer

HDR | Archer

DECEMBER 2011

CM ARCHER PROJECT NO. 11129910

CONTENTS

SECTION

1 DESCRIPTION OF NEED

1.1 OVERVIEW OF ROLLA WASTEWATER SYSTEM

The City of Rolla is located in Phelps County in central Missouri. The City had a reported population of 19,559 during the 2010 U.S. Census. The Missouri University of Science and Technology (formerly called the University of Missouri-Rolla) is located in the City and has an annual enrollment of approximately 7,000 students. The City's wastewater is treated at three wastewater treatment plants (WWTPs): the Southeast WWTP, Vichy Road WWTP, and the Southwest WWTP. Figure 1-1 shows the location of the three wastewater treatment plants serving the City of Rolla.

1.2 BACKGROUND

The City of Rolla has formally stated a desire to preserve the area as a spot of great natural beauty for the enjoyment of the people as development and growth occurs within the city. Given the emphasis place on environmental quality within the City and its surroundings, the City strongly desires to take a proactive role in protecting and enhancing the area's natural resources. This desire along with mandates from the Missouri Department of Natural Resources (MDNR) and impending changes to the operating permits for the City's wastewater treatment facilities have prompted the City to work towards the elimination of inflow and infiltration (I/I) within their sanitary sewer collection system.

It is anticipated that the City's Southeast WWTP operating permit will be released in September 2011 for public comment, prior to its being finalized and implemented. Based on previous discussions with the MDNR, it is further anticipated that within the permit, discharges from the City's peak flow clarifiers, previously regulated as Outfalls No. 002 and No. 003, will not allowed. The City will be required to report discharges from these outfalls when they occur as the discharges will be considered to be bypasses of secondary treatment.

The City's Vichy Road WWTP operating permit was released in June 17, 2011 for public comment, prior to its being finalized and implemented. Within the draft permit, the discharges from the facility's peak flow clarifier, previously regulated as Outfall No. 002, were not permitted. The City will be required to report discharges from this outfall when they occur as they are considered to be bypasses of secondary treatment. It should be noted that Outfall No. 002 at the Vichy Road WWTP does not physically exist; flows from the peak flow clarifier are blended with treated plant effluent prior to discharge from the plant through Outfall No. 1.

To facilitate a phased elimination of discharges from the peak flow clarifiers at both facilities, the City has been given the option to enter into voluntary compliance agreements with MDNR. The voluntary compliance agreements (VCAs) will allow the City five years to implement improvements aimed at reducing or eliminating bypasses at the treatment facility. The VCAs will require the submission of a Bypass Elimination Plan (BEP) detailing the capitol improvements necessary to eliminate bypasses of secondary treatment. The BEP is mandated to include the following:

- An evaluation of the existing WWTF and the collection system.
- A list of options evaluated to reduce peak flows and their associated costs.

- A list and schedule for improvements to reduce peak flows to the WWTF such that bypasses are eliminated.
- Information on costs, financial capability and financing schedule
- Public information and notification of bypass events.
- Project implementation schedule, including annual milestones and deadlines to achieve Outfall No. 2 and No. 3 elimination as soon as practicable.

After MDNR approves the BEP, annual progress reports must be submitted detailing the progress the City has made in implementing the BEP. If at the end of the five year period, discharges from the peak flow clarifiers have not been eliminated, but significant progress has been made toward its elimination, the City can petition MDNR for an additional five year to eliminate the discharges. MDNR will review all collected data from the City and extend the VCA only if adequate evidence is available supporting the City's claims.

It should be noted that the VCA will be rendered null and void should the City:

- Fail to report bypasses from Outfall No. 2 and No. 3
- Fail to make mandated annual reports showing BEP progress
- Fail to submit a BEP
- Fail to make adequate progress toward the elimination of the outfall.

1.3 PURPOSE

In preparation of the development of a comprehensive BEP, the City of Rolla authorized HDR Engineering, Inc, and CM Archer Group, P.C., to investigate the feasibility of implementing equalization storage facilities at both the Southeast and Vichy Road WWTPs. The investigation was to serve as a planning tool for the City, detailing capital improvements necessary to reduce bypasses of secondary treatment at both treatment plants. This document shall specifically provide:

- A review of existing WWTP hydraulics based on the best available data at the time of the analysis.
- A determination of the design storm return period and duration
- A determination of the anticipated peak flow rates and equalization storage volumes based on analysis utilizing the selected design storm event.
- A preliminary design of equalization storage basins and pump station facilities necessary to detain peak flows in excess of the plant capacities.
- A development of opinions of probable project costs associated with the implementation of each equalization basin alternative
- A comparison of equalization basin alternatives assuming various degrees of Inflow & Infiltration (I/I) reduction within the collection system.
- A recommendation of the selected alternative for each facility

DRAWING FILE NAME: Figure 1-1.dwg		PROJECT NO.:	
DATE LAST SAVED: 08/15/11	PLOT SCALE: 1:1	DATE/TIME PLOTTED:	
FILES ATTACHED:	DESIGNED BY: KAC	DRAWN BY: JSM	CHECKED BY: JAM
ATTACHED FILE NAMES:			

HDR

HDR ENGINEERING, INC.
MO. STATE CERTIFICATE OF AUTHORITY #000856
3741 NE TROON DRIVE

ARCHER
1100 North Outer Road
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City of ROLLA

CITY OF ROLLA, MO
WET WEATHER FLOW EVALUATION

PROJECT NO. 11129910

FIGURE 1-1
ROLLA WWTP LOCATIONS

DRAWING NO. 1-1

2 SERVICE AREA DESCRIPTION

2.1 SOUTHEAST WWTP SERVICE AREA DESCRIPTION

The Southeast WWTP treats wastewater flows from an approximate 11 square mile area in the City of Rolla. The Southeast WWTP it the largest wastewater treatment facility in the City and its service area encompasses the majority of Rolla. The Southeast WWTP serves the majority of the City's residential areas, as well as the Missouri University of Science and Technology, the downtown commercial district, and industrial areas located in the north part of the City. The service area is divided into the four sub-basins listed in Table 2-1. Figure 2-1 shows the boundaries of the Southeast WWTP service area and its sub-basins.

Table 2-1 Southeast WWTP Sub-Basins

Sub-Basin	Area (ac)	Area (mi^2)
Burgher Branch	3,174	5.0
Dutro Carter Creek	2,096	3.3
Deible Branch	1,417	2.2
Love Branch	571	0.9
Total Service Area	7,258	11.3

The Southeast WWTP consists of two facilities that will be referred to in this report as the West plant and the East plant. Flow from the Burgher Branch sub-basin is conveyed to the East plant, while flows from the Dutro Carter Creek, Deible Branch, and Love Branch sub-basins are conveyed to the West plant. Dry weather flows treated by each facility combine and discharge together at Outfall 001. The West and East plants each include a peak flow clarifier (Outfall 002 and 003, respectively) which currently receive and discharge wet weather flows greater than the treatment capacity of the facility. A Bypass Elimination Plan (BEP) is currently being formulated to eliminate wet weather bypasses through Outfalls 002 and 003.

Dry weather flow is transferred between the East and West plants (the "dry weather plants") at the direction of City personnel to optimize the facilities' treatment capabilities. Therefore, when analyzing average and peak flow records the total flow at the plant is analyzed, rather than just the individual flow through the dry weather plants. Table 2-2 summarizes the treatment capacity of the facilities and the current average dry weather, average daily, and peak wet weather flows received at the facilities, based on flow data from 2006 to 2010. The "Average Dry Weather Flow" refers to the average flow during dry weather periods, determined by calculating the average flow to the plant during dry weather periods only. The "Average Daily Flow" is the calculated average flow to the dry weather plants from 2006 to 2010. This does not include flow diverted to the peak flow clarifiers.

Table 2-2 Southeast WWTP Flow Summary

	Avg. Day Capacity (mgd)	Avg. Dry Weather Flow (mgd)	Avg. Daily Flow* (mgd)	Peak Hydraulic Capacity (mgd)	Peak Wet Weather Flow (mgd)
West Plant	2.6	-	-	5.2	-
East Plant	2.1	-	-	4.2	-
SE WWTP Total - Outfall 001	4.7	2.1	2.9	9.4	10.0
Peak Flow Clarifier (002)	N/A	N/A	N/A	13.0	13.0
Peak Flow Clarifier (003)	N/A	N/A	N/A	13.0	13.0
Total Flow	4.7	2.1	2.9	35.4	36.0

* Average daily flow treated at plant. Does not include flow diverted to peak flow clarifiers.

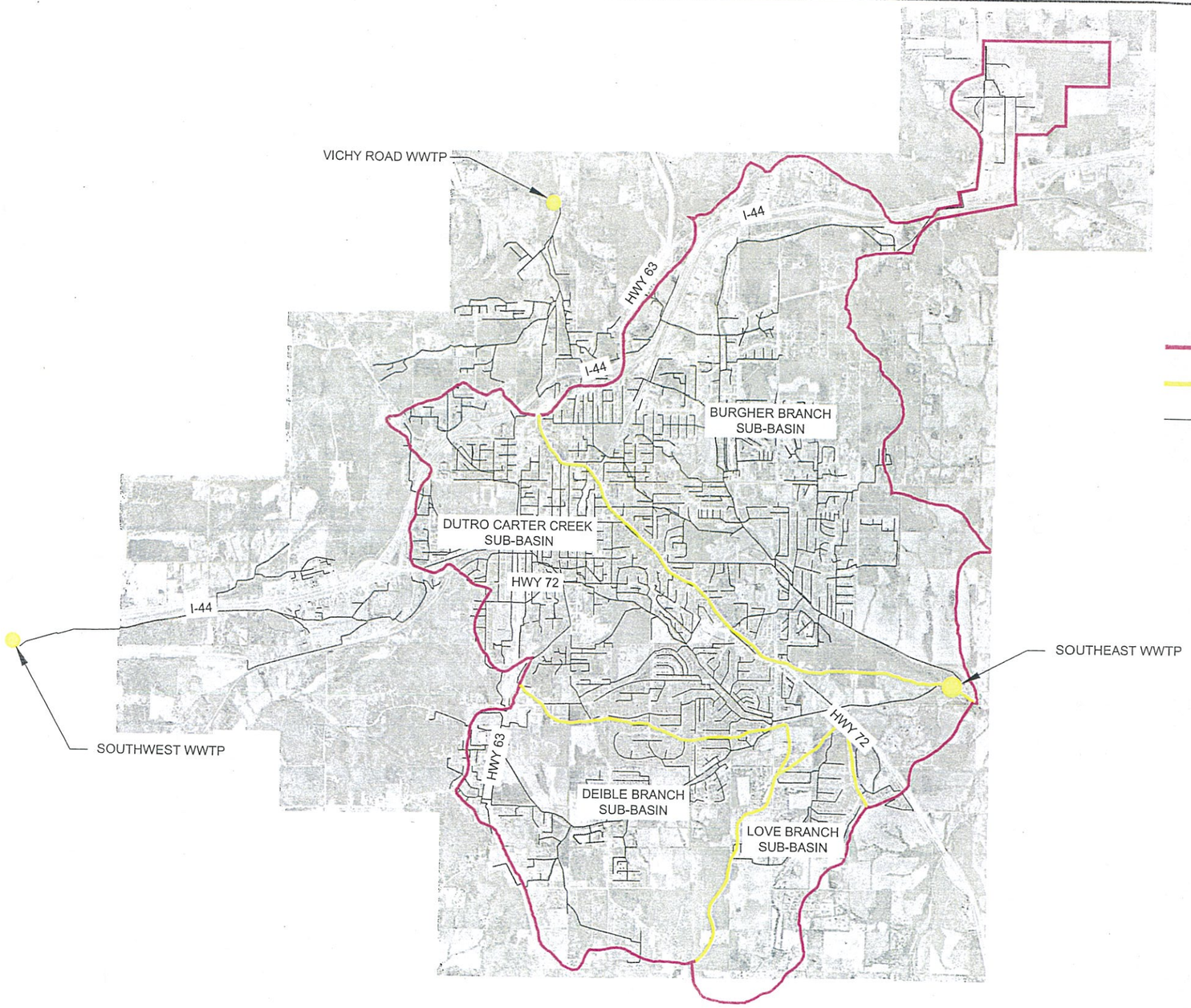
Although the Southeast WWTP has a rated peak hydraulic capacity of 9.4-mgd, records show that during periods of extreme wet weather the plant throughput can reach a maximum of 10.0-mgd for short periods of time without causing adverse affects on the treatment facility's treatment performance. Therefore, the peak treatment capacity of both plants, for the purposes of this analysis, shall be taken to be 10.0-mgd.

The current average daily flow of 2.9-mgd is only 62% of the Southeast WWTP average day capacity of 4.7-mgd. This confirms there is room for significant growth within the service area. Wet weather flows are high in comparison to dry weather flows and have been observed as high as the system's peak hydraulic capacity. The City has implemented an Infiltration/Inflow (I/I) removal program that is expected to decrease current peak wet weather flows and prevent future peak wet weather flows from increasing beyond current levels, regardless of future projected growth within the service area.

The City's population increased from 16,367 in 2000 to 18,351 in 2009, an annual growth rate of 1.28%. The City is expected to continue to grow at a moderate, stable rate. Table 2-3 summarizes the projected future City population and average daily flows to the Southeast WWTP over a 20-year period, assuming that flow increases relative to population growth at an annual increase of 1.5%. As detailed in Table 2-3, it is anticipated that the current WWTP sizing should adequate to meet project population increase over the next 20-years. As previously discussed in this section, the peak treatment capacity of both plants is 10.0-mgd

Table 2-3 SE WWTP Projected Future Flows

Year	Rolla Population	Annual Growth Rate (%)	SE WWTP Avg. Daily Flow
2009	18,351	-	2.9
2015	20,066	1.5	3.2
2020	21,617	1.5	3.4
2025	23,287	1.5	3.7
2030	25,087	1.5	4.0
2035	27,026	1.5	4.3



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City of ROLLA

CITY OF ROLLA, MO
WET WEATHER FLOW EVALUATION

PROJECT NO. 11129910

FIGURE 2-1
SOUTHEAST WWTP
SERVICE AREA BOUNDARIES

DRAWING NO. 2-1

2.2 VICHY ROAD WWTP SERVICE AREA DESCRIPTION

The Vichy Road WWTP treats wastewater flows from an approximately 1.7 square mile (1,118 acre) area in the City of Rolla. The service area is referred to as the Spring Creek Sub-Basin and serves residential areas on the north part of the City, as well as Missouri S&T Thomas Jefferson Residence Hall and the Highway 63 commercial/industrial areas.

Flow from the Spring Creek sub-basin is conveyed to the Vichy Road WWTP. The flow passes through a single treatment train (the "dry weather plant") before discharging to Outfall 001. The Vichy Road WWTP includes a peak flow clarifier which currently receives and discharges wet weather flows greater than the treatment capacity of the facility. During wet weather periods, the flow from the peak flow clarifier is combined with the dry weather flow treated at the plant and discharged together at the combined outfall pipe located at Outfall 001. Although there is a single physical outfall pipe, the dry weather and wet weather flows are treated as two separate outfalls in the permit. Flow from the peak flow clarifier is monitored and recorded separately from the dry weather plant, and is listed in the permit as Outfall 002. A Bypass Elimination Plan (BEP) is currently being formulated to eliminate wet weather bypasses through the peak flow clarifier.

Table 2-4 summarizes the treatment capacity of the Vichy Road WWTP and the current average dry weather, average daily, and peak wet weather flows received at the facilities, based on flow data from 2006 to 2010. The "Average Dry Weather Flow" refers to the average flow during dry weather periods, determined by calculating the average flow to the plant during dry weather periods only. The "Average Daily Flow" is the calculated average flow to the dry weather plant from 2006 to 2010. This does not include flow diverted to the peak flow clarifiers.

Table 2-4 Vichy Road WWTP Flow Summary

	Avg. Day Capacity (mgd)	Avg. Dry Weather Flow (mgd)	Avg. Daily Flow (mgd)*	Peak Hydraulic Capacity (mgd)	Peak Wet Weather Flow (mgd)
Vichy Rd. WWTP	0.40	0.21	0.27	0.80	1.00
Peak Flow Clarifier	N/A	N/A	N/A	3.00	3.00
Total Outfall 001	0.40	0.21	0.27	3.80	4.00

* Average daily flow treated at plant. Does not include flow diverted to peak flow clarifier.

Although the Vichy Road WWTP has a rated peak hydraulic capacity of 0.8-mgd, records show that during periods of extreme wet weather the plant throughput can reach a maximum of 1.0-mgd for short periods of time without having adverse affects on the facility's performance. Therefore, the peak treatment capacity of the plant, for the purposes of this analysis, shall be taken to be 1.0-mgd.

The current average daily flow of 0.27-mgd is 68% of the Vichy Road WWTP average day capacity of 0.40-mgd. This confirms there is room for significant growth within the service area. Wet weather flows are high in comparison to dry weather flows and have been observed as high as the system's peak hydraulic capacity. The City has implemented an Infiltration/Inflow (I/I) removal program that is expected to decrease current peak wet weather flows and prevent future peak wet weather flows from increasing beyond current levels, regardless of future projected growth within the service area.

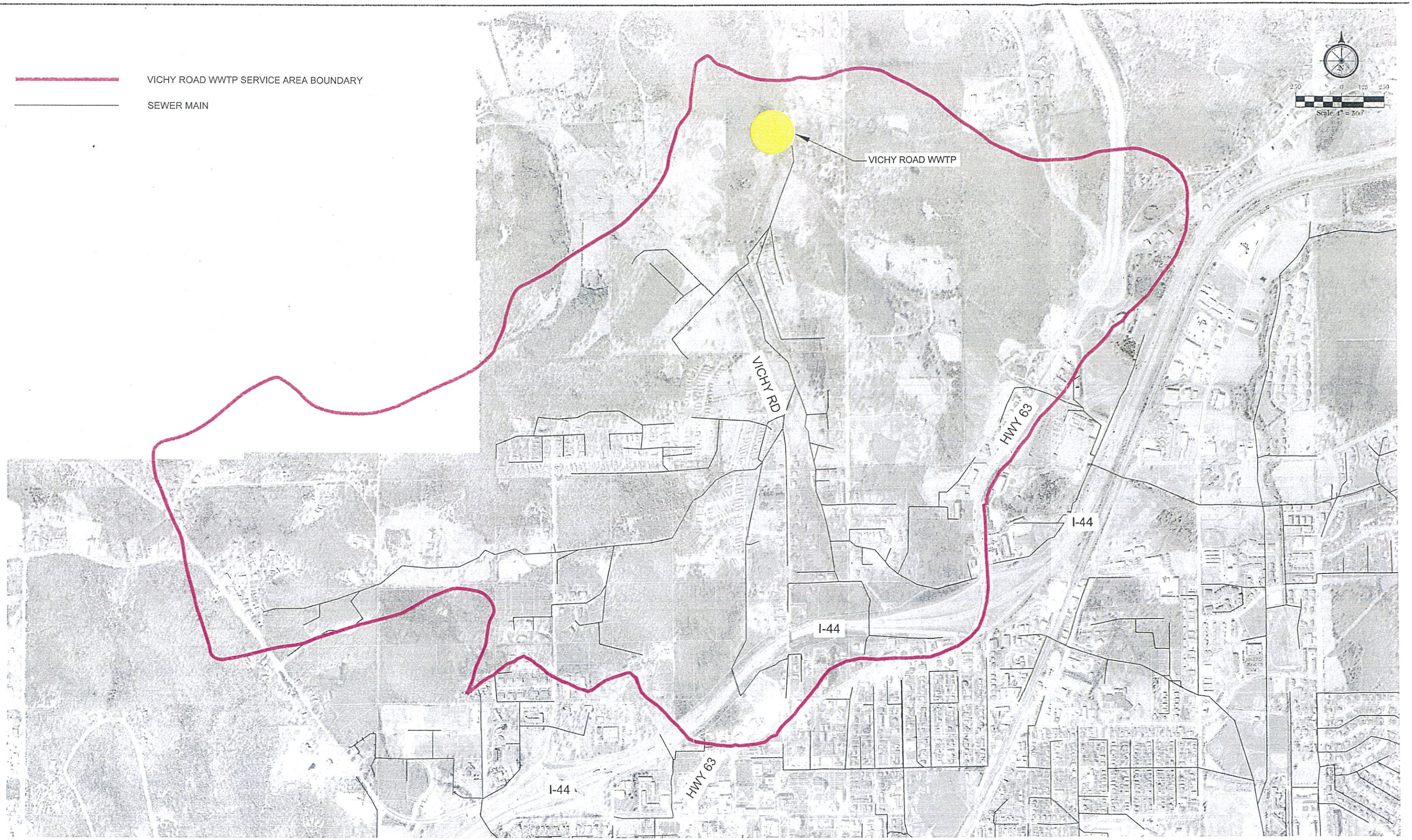
The City's population increased from 16,367 in 2000 to 18,351 in 2009, an annual growth rate of 1.28%. The City is expected to continue to grow at a moderate, stable rate. Table 2-5 summarizes the projected future City population and average daily flows to the Vichy Road WWTP, assuming that flow increases relative to population growth at an annual rate of 1.5%. As detailed in Table 2-5, it is anticipated that the current WWTP sizing should adequate to meet the projected population increase over the next 20-years. As previously discussed in this section, the peak treatment capacity of the plant is 1.0-mgd

Table 2-5 Vichy Road WWTP Projected Future Flows

Year	Rolla Population	Annual Growth Rate (%)	Vichy Rd. WWTP Avg. Daily Flow
2009	18,351	-	0.27
2015	20,066	1.5	0.30
2020	21,617	1.5	0.32
2025	23,287	1.5	0.34
2030	25,087	1.5	0.37
2035	27,026	1.5	0.40

VICHY ROAD WWTP SERVICE AREA BOUNDARY

SEWER MAIN



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City of ROLLA

CITY OF ROLLA, MO
WET WEATHER FLOW EVALUATION

PROJECT NO. 11129910

FIGURE 2-2
VICHY ROAD WWTP
SERVICE AREA BOUNDARIES

DRAWING NO. 2-2

3 EXISTING WASTEWATER TREATMENT PLANTS

3.1 SOUTHEAST WWTP

The Southeast WWTP is located in the southeast part of the City, approximately 2/3 of a mile east of Hwy 72, and is the largest of the City's wastewater treatment facilities. Figure 3-1, located on the following page, shows the existing layout of the treatment plant. The Southeast WWTP consists of two facilities, referred to in this report as the West plant and the East plant. Dry weather flows from each facility combine and discharge at Outfall No. 001, to Burgher Branch Creek. The West and East Plant treatment trains each include a peak flow clarifier (Outfall No. 002 and No. 003, respectively) which currently receive and discharge wet weather flows greater than the treatment capacity of the plants. Outfall No. 002 discharges to Dutro Carter Creek while Outfall No. 003 discharges to Burger Branch Creek. A preliminary floodplain study dated April 14, 2011 by Allgeier, Martin, and Associates, Inc. determined that 100-yr flood elevations at the Southeast WWTP site range from 943.01 (at the primary clarifier of the West Plant) to 937.25 (at Outfall No. 001).

The West Plant has two parallel treatment trains: the first consisting of an activated sludge treatment unit; the other a primary clarifier, trickling filter, and secondary clarifier. The two treatment trains combine and are pumped to a trickling filter tower. The flow then discharges to sand filters, travels through a Parshall flume which measures the flow, and then to a junction manhole where it combines with flow from the East Plant before discharging to Outfall No. 001.

Peak flows in excess of the West Plant capacity are split at the headworks prior to the pretreatment process. The excess flows are directed through a wet weather fine screen for the removal of coarse solids. From the screen, the excess influent flows to a peak flow clarifier (PFC No. 2) where primary treatment of the influent occurs. Sludge captured in PFC No. 2 is returned to the activated sludge treatment process to aide in biological treatment of the influent wastewater. Once excess influent flows receive primary treatment at the PFC No. 2, they are routed to a pump station flow control structure and are subsequently discharged from Outfall No. 002.

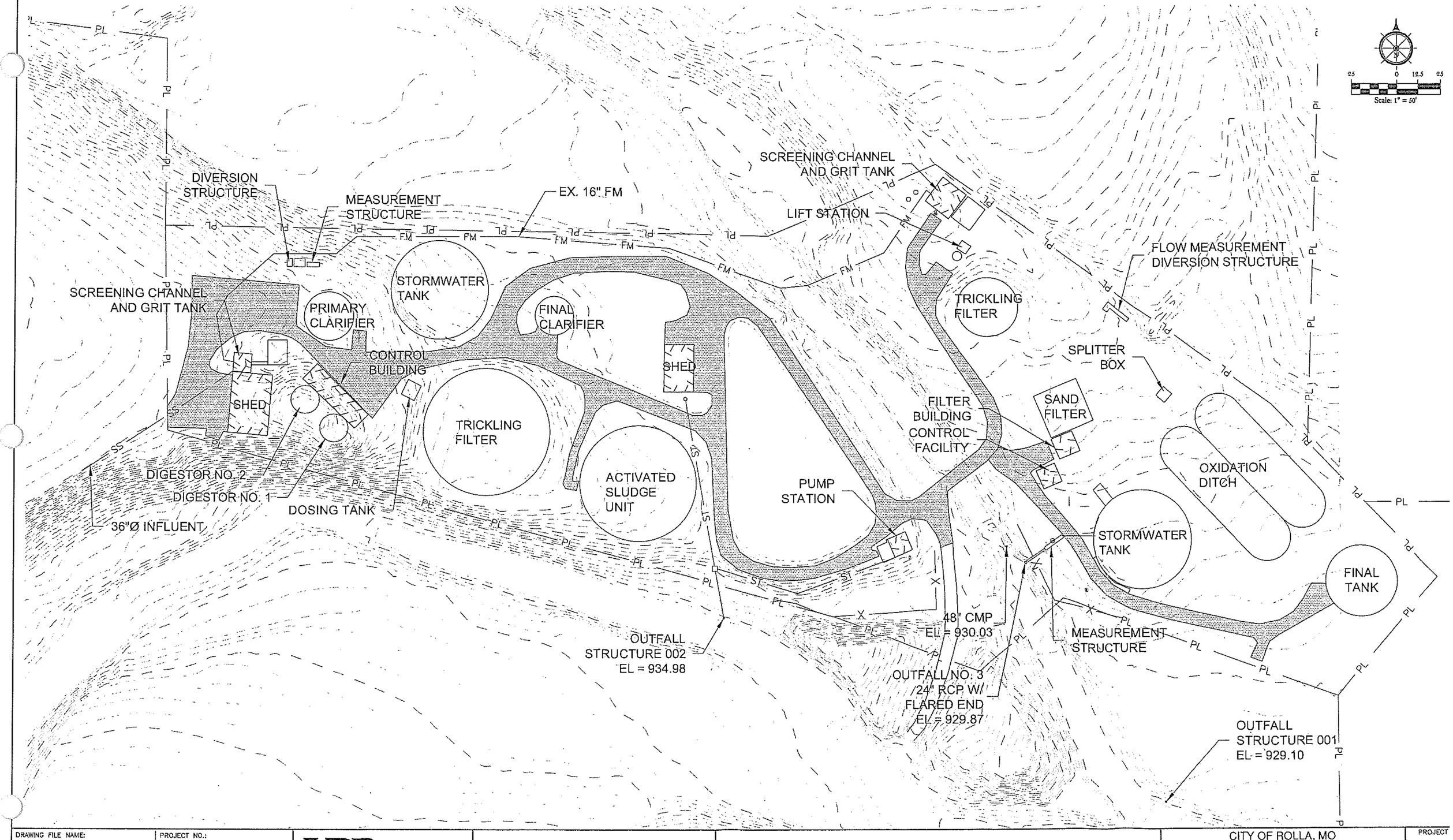
Excess flows sent to PFC No. 2 are measured downstream of the wet weather fine screen, prior to primary treatment. The flow measurement device consists of a downward looking ultrasonic transducer/transmitter mounted above an 18-inch Parshall flume. The maximum flowrate measurement that can be captured by the flow meter is approximately 15.78-mgd. The transmitter for the flow meter is located in the existing control building and provides instantaneous flow indication as well as flow totalization, however does not provide for logging of flow data in real time.

Flow enters the East Plant at the headworks and is sent through a pretreatment process consisting of fine screening and grit removal. Once through the pretreatment process, flow passes through a flow measurement and diversion structure, then through the oxidation ditch and the final clarifier before combining with the flow from the West plant and discharging.

Peak flows received at the East Plant are sent through a pretreatment process consisting of a fine screen and grit chamber. All flows pass through the pretreatment process to a flow measurement structure, where flows in excess of the treatment facility capacity are split and sent to a peak flow clarifier (PFC No. 3) for primary treatment. Sludge retained in the PFC No. 3 is recycled to the oxidation ditch to aid in the biological treatment of the wastewater. Once the influent receives primary treatment, flows are directed to a flow measurement structure consisting of an 18-inch Parshall flume, prior to being discharged at Outfall No. 003.

The flow measurement device for the East Plant consists of an 18-inch Parshall flume with a downward looking Hach Sigma 980 Ultrasonic transducer/transmitter mounted above the flume. The transmitter is mounted on a local equipment rack. The ultrasonic transmitter has the capability to log flow data real-time at preset time intervals. For the purposes of this analysis, data from the unit was obtained and utilized to determine the response of the sanitary sewer collection system to specific rain events.

Dry weather flow can be transferred between the East and West plants at the direction of City personnel to optimize the facilities treatment capabilities. Flow is transferred from the West to the East plant by gravity, and can be pumped from the East to the West plant via force main. Figure 3-2 shows a flow schematic of the Southeast WWTP.



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City of ROLLA

CITY OF ROLLA, MO
WET WEATHER FLOW EVALUATION

SOUTHEAST WWTP
EXISTING SITE PLAN

PROJECT 11129

DRAWING 3-1

3.2 VICHY ROAD WASTEWATER TREATMENT PLANT

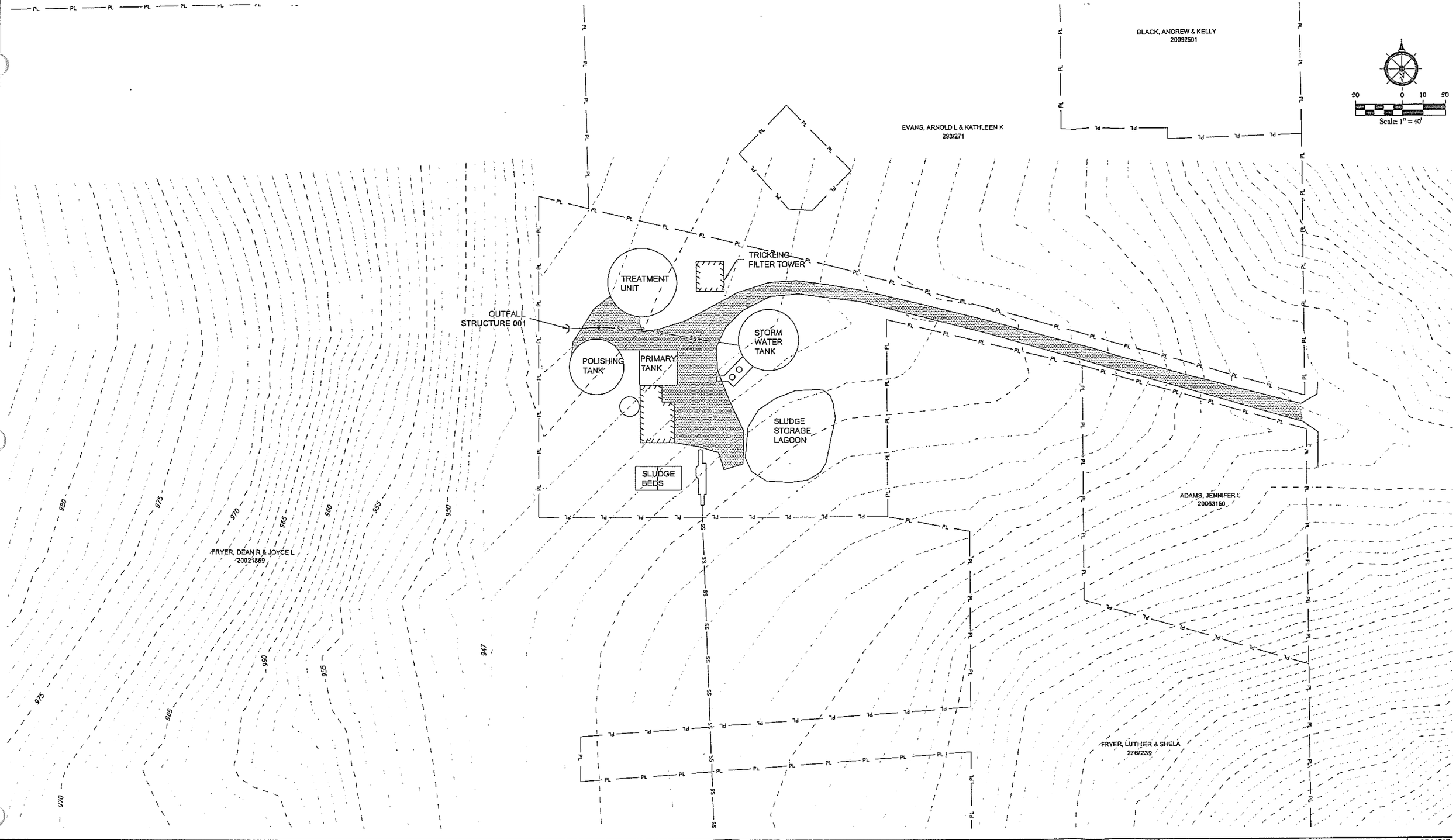
The Vichy Road WWTP is located in the northwest part of the City, approximately 500 feet west of Vienna Road. Figure 3-3, located on the following page, details the existing layout of the treatment plant. The Vichy Road WWTP includes a peak flow clarifier which currently receives and discharges wet weather flows greater than the treatment capacity of the plant. During wet weather periods, the flow from the peak flow clarifier is combined with the dry weather flow treated at the plant and discharged together at Outfall 001 to an unnamed tributary of Spring Creek.

The Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map (FIRM) No. 29161C0232D, effective February 20, 2008, defines the flood plain in the vicinity of the WWTP as an approximate Zone A. Based on the FIRM data and USGS Topographic Quadrangle Contours, it is estimated that the approximate 100-year flood plain elevation is 953.00-ft. Based on discussions with City personnel, the maximum observed flood elevation was determined to be 945.05-ft. Prior to proceeding with the final design of proposed improvements at the site, a hydrologic and hydraulic analysis should be performed to determine the actual anticipated base flood elevations on and around the WWTP site. Until a more refined base flood elevation at Outfall No. 001 can be determined, the 100-year flood elevation for the purposes of design will be taken to be 945.05-ft.

Flow at the Vichy Road WWTP plant passes through a screening channel and grit chamber, and then to the primary clarifier. From there it enters the activated sludge treatment unit, and is then pumped to a trickling filter tower before draining into the final clarifier. After the final clarifier, flow travels to a junction manhole, where it is combined with flow from the peak flow clarifier during wet weather periods. See Figure 3-4 for an existing flow schematic of the Vichy Road WWTP.

Peak flows, in excess of the facility's capacity, are received at the headworks, where coarse solids are removed via a fine screen. Immediately downstream of the fine screen, excess flows are split and sent to the peak flow clarifier (PFC) where primary treatment of the excess flow occurs. Sludge accumulated in the PFC is recycled for use in the activated sludge treatment unit. Once primary treatment occurs, flow from the PFC is blended with the flow from the secondary clarifier prior to its discharge from the facility at Outfall No. 001. Note that for the purposes of permitting, Outfall No. 002 is located at the discharge of the peak flow clarifier.

Measurement of excess flows occurs after the flows are split, downstream of the fine screen. The flow meter consists of a 12-inch Parshall flume with a downward looking ultrasonic transducer/transmitter. The ultrasonic transmitter is configured to provide instantaneous as well as totalized flow values. Furthermore, the transmitter is capable of logging flow data realtime at a preselected time interval. For the purposes of analysis, realtime flow data from the meter was utilized.



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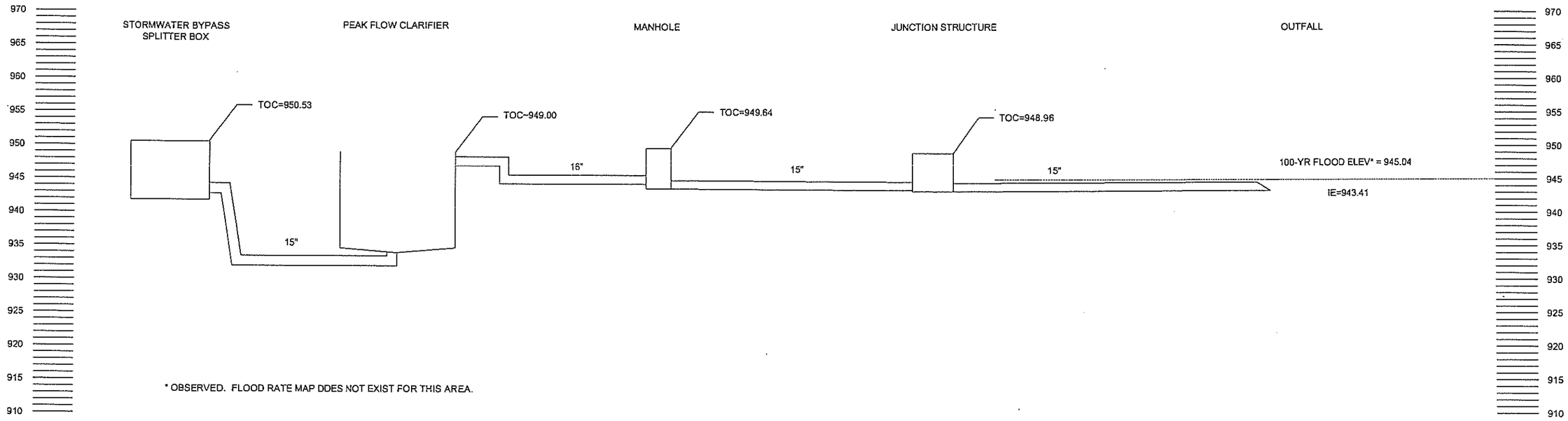
WET WEATHER FLOW EVALUATION

PROJECT 111299

VICHY ROAD WWTP
EXISTING SITE PLAN

DRAWING 3-3

VICHY ROAD WWTP



* OBSERVED. FLOOD RATE MAP DOES NOT EXIST FOR THIS AREA.

TOC = TOP OF CONCRETE
IE = INVERT ELEVATION

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CITY OF ROLLA, MO
WET WEATHER FLOW EVALUATION

VICHY ROAD WWTP
FLOW DIAGRAM

PROJECT N 111299

DRAWING N 3-4

4 TIMING OF IMPROVEMENTS AND OTHER REGULATORY CONSIDERATIONS

Since the mid-1990s, the Environmental Protection Agency (EPA) has been working to draft regulations aimed at eliminating bypasses of secondary treatment at wastewater treatment facilities that are a result of storm water inflow and infiltration into the sanitary sewer systems draining to the facilities. In 2001, the EPA released for public comment a draft rule for the elimination of storm water bypasses. Since release of the draft "Storm Water Rule" consensus among key stakeholders has been difficult to achieve. To date, a finalized rule has not been developed.

In the meantime, the EPA has been working within its mandate to enforce the Clean Water Act of 1972, placing pressures on states and large metropolitan entities to eliminate storm water bypasses via the implementation of capacity, management, operations and maintenance (CMOM) programs. Numerous consent decrees have been implemented by the EPA throughout the State of Missouri, in cities such as Lebanon, Kansas City and St. Louis. The EPA has also placed pressure on the Missouri Department of Natural Resources (MDNR) to eliminate bypasses of secondary treatment, which had previously been permitted as peak flow clarifiers providing primary treatment with effluent limits of 45-mg/l BOD and 45-mg/l TSS.

In an effort to comply with the EPA, the MDNR has recently begun eliminating previously permitted outfalls from peak flow primary clarifiers. Because these outfalls are eliminated from the treatment facility operating permit, it becomes illegal to discharge from the facility at these locations.

The MDNR, realizing that discharges from peak flow clarifiers is a direct result of storm water inflow and infiltration (I/I) and that I/I is a very complex and costly problem to remediate, developed a voluntary compliance agreement (VCA) to allow for the phased elimination of discharges from storm water bypass outfalls. The VCA allows the permittee to study their collections system and implement a phased plan for the elimination of storm water bypasses. Once approved by the MDNR, the permittee is required to implement the plan, providing annual progress reports detailing capital expenditures and progress in I/I reduction. At the end of a 5-year term, if bypasses are not eliminated, the permittee can apply for an additional 5-year term to implement I/I improvements further aimed at eliminating bypasses. The MDNR will allow the extension of the VCA only if it is deemed that adequate progress has been made during the first VCA term.

If at the end of the second 5-year VCA term, bypasses cannot be completely eliminated, an equalization storage facility must be provided to capture excess flows for storage and subsequent treatment. However, if storage facilities are not feasible, a "No Feasible Alternatives" analysis must be performed and submitted to the MDNR for approval.

If the decision is made to implement equalization storage facilities, it is anticipated that the design of the facility should occur approximately 2-years prior to the expiration of the VCA term, so as to provide adequate time for the construction of the facilities. If adequate progress is achieved during the first VCA term and a second VCA term is granted, the design of the equalization basin facilities should occur during the eighth year of the VCA. This delay in the facilities design should allow for the maximization of I/I reduction expenditures aimed at minimizing expenditures on the equalization basin facilities.

Within the scope of this project, it is recommended that design of the equalization facilities begin no later than January 1, 2019. Construction of the facilities should occur during the following year with successful project completion being achieved by the spring of 2021.

5 EQUALIZATION FACILITIES REQUIREMENTS

5.1 GENERAL DESIGN CONSIDERATIONS

The design of equalization basin facilities should meet several key criteria to function as necessary to meet current and future state regulations. Furthermore, the criteria listed below are critical for assuring proper operation of the facilities with minimal maintenance expenditures.

- Equalization basins should be located downstream of pretreatment processes, such as screening, grit removal, comminuters, etc. This helps to reduce the quantity of coarse solids, grit and other debris that could potentially be deposited within the basins.
- The equalization basins should be located on one contiguous parcel of land with adequate access to the facility to allow for debris removal from the basin and maintenance of the slopes. It is typically preferable to provide for access of the facility during design storm events (i.e. 100-year storm).
- The bottom of the equalization basin should be located at or above the top of bank and/or the normal water surface elevation of the receiving watercourse. This should facilitate the discharge of a basin underdrain system via gravity flow to the watercourse.
- The top of the basin berm should be a minimum of 1-ft higher than the anticipated 100-year flood plain. This limits the potential for inundation of the basin during storm events.
- Piping and other facilities designed to convey flows to and from the basin must be designed to achieve minimum scour velocities so as to limit deposition of solids within the piping.
- Basins should have adequate volume to capture flows in excess of the WWTP capacity for the selected design storm.

5.2 HYDROLOGIC AND HYDRAULIC DESIGN CONSIDERATIONS

Flow data from 2006 to 2010 was analyzed in order to determine the required equalization basin storage volume and the anticipated peak flow rate into each facility. Totalized daily flow data was available for the Southeast WWTP. However, only minimal instantaneous flow data was available for analysis. Instantaneous flow data was available for the Vichy Road WWTP for some select periods of time and was utilized in this analysis along with the recorded totalized daily flow data for the plant.

There is no exact design criteria mandated by the MDNR for use in designing equalization basin storage facilities. A design storm event with an annual exceedance probability (AEP) of 10-percent (10-year return interval) was selected. This design storm return interval has been used as a basis of design for other wastewater treatment facilities. It is anticipated that storage to accommodate this design storm event would be economically feasible to the City while meeting the necessary MDNR regulations.

5.2.1 SE WWTP Equalization Basin

5.2.1.1 DETERMINATION OF RECOMMENDED STORAGE VOLUME

Minimal instantaneous flow data for the East plant peak flow clarifier (Outfall 003) was available, and there was no instantaneous data available for the West plant peak flow clarifier (Outfall 002). Totalized daily flow data records from Discharge Monitoring Reports (DMR) were analyzed in lieu of instantaneous data in order to construct a design hydrograph for use in determining storage requirements. Because of

the lack of instantaneous data and the difficulty of capturing a storm event equivalent to the design storm, some simplifying assumptions were used to determine the required storage volume and peak flow pumping capacity. It is recommended that instantaneous flow measurement equipment be installed at the Southeast WWTP and the additional flow data analyzed before final design of the equalization basin facilities. This will enable the City to construct more detailed design hydrographs for determining required equalization basin storage, and to accurately measure peak hourly flows to the facility.

After reviewing flow and precipitation records for several storm events, the largest recorded storm event was selected to use as a basis of design. The storm, which occurred on March 18th and 19th of 2008, resulted in a total rainfall of 6.69 inches over 48 hours, with a maximum 24-hour rainfall of 5.6 inches. This equates to an approximate 17-year return interval storm. The peak daily flow to the Southeast WWTP produced by this storm event was 37.44 mgd. Figure 5-1 on the following page is a hydrograph showing the flow though Outfall 001, Outfalls 002 and 003 (peak flow clarifiers), and the total plant flow during this storm event.

This hydrograph was "scaled down" to a 10-year, 4-hr storm event. A 4-hour storm duration was used to construct the "design" hydrograph based on flow and rainfall records that show the approximate time of concentration for the Southeast WWTP service area is 4 hours. A storm duration equivalent to the time of concentration of the service area produces the highest peak flow and is believed to be a reasonable basis to use for designing equalization basin facilities. For the purposes of this study, it was assumed that any flow above the facility's average day capacity of 4.7 mgd will be diverted to the equalization basin for storage. This analysis determined that the required equalization basin volume at the Southeast WWTP to store a 10-year, 4-hour storm event is 36 million gallons.

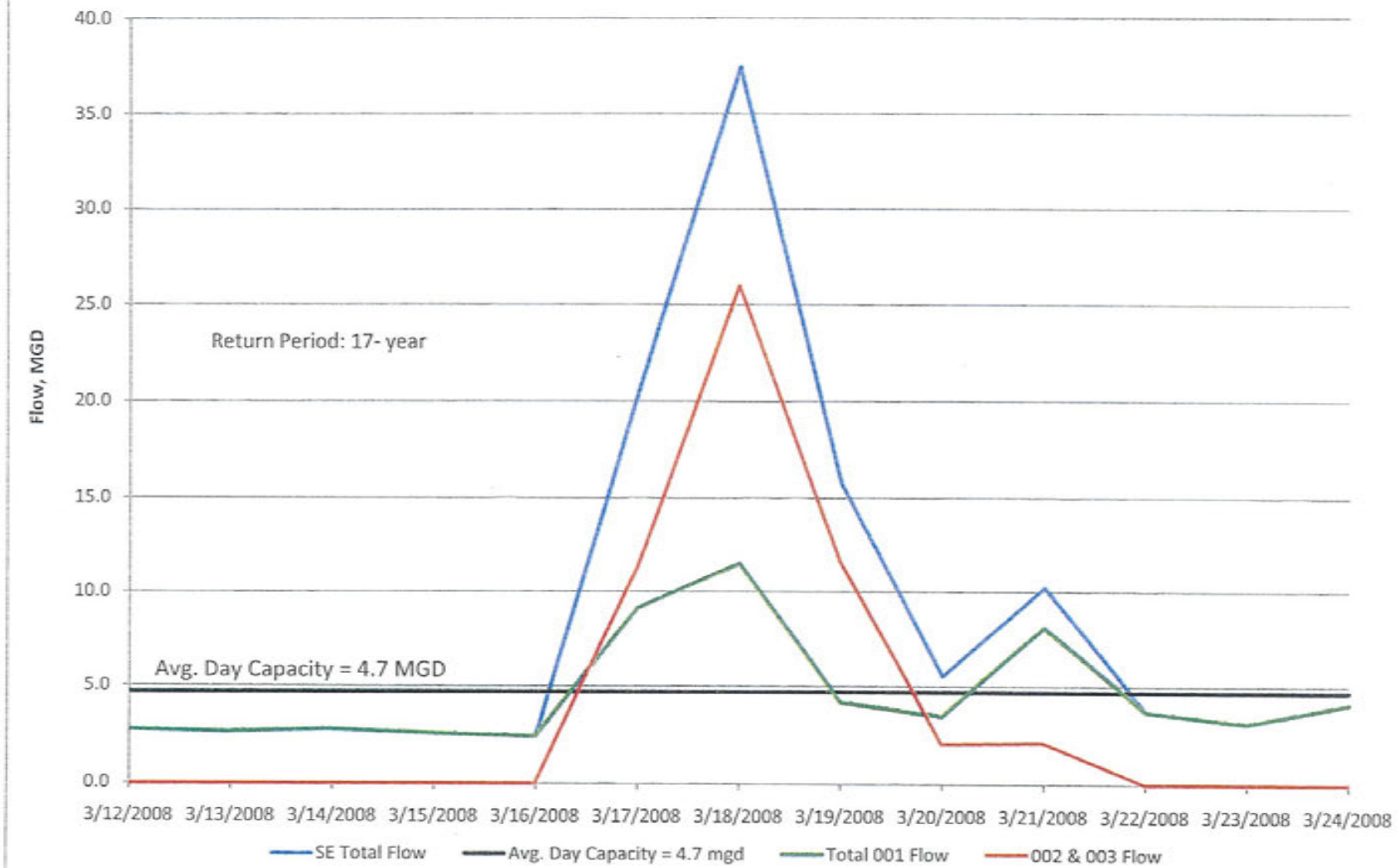
5.2.1.2 DETERMINATION OF PEAK FLOW RATE

As previously discussed, the lack of instantaneous recorded flow data makes it impossible to determine the peak hour flow to the Southeast WWTP from flow records. A limited amount of metered flow data recorded at 15-minute intervals was acquired for the East plant peak flow clarifier (Outfall 003) only. This data was analyzed to determine an approximate peak flow rate based on the following data and assumptions:

- The largest storm event with instantaneous flow data recorded occurred was a 2-year, 17-hour duration storm on October 29, 2009.
- The peak hourly flow recorded during this storm event was 10.32 mgd.
- The peak 24-hour flow produced by this storm event was 7.11 mgd.
- The ratio of peak hour flow to peak 24-hour flow = 1.45. To be conservative this ratio was rounded up to 1.5. This ratio is reasonable and consistent with prior project experience at other similar facilities.
- Design storm peak hour flow = 36 mgd (peak daily flow to the Southeast WWTP) x 1.5 = 54 mgd.
- Maximum plant throughput = 10.0 mgd.
- Peak hour flow conveyance capacity required = 54 mgd – 10 mgd = 44 mgd.

The anticipated peak hourly flow at the Southeast WWTP is 54 mgd, with a maximum conveyance capacity of 44 mgd required to convey the flow to the equalization basin facilities.

Figure 5-1 - Southeast WWTP Flow for March 2008 Storm Event
Unadjusted Flow Data



5.2.1.3 I/I REDUCTION AND IMPACT ON BASIN VOLUME

The City is working towards the elimination of inflow and infiltration (I/I) within its sanitary sewer collection system. This effort will help to reduce peak wet weather flows and the total volume of wet weather flow conveyed to the treatment plant, thus reducing the required equalization basin storage volume and peak hour flows to the facility. Table 5-1 on the following page gives the required equalization basin sizing and peak hour flows for the following three scenarios:

- No I/I Reduction
- 25% I/I Reduction
- 50% I/I Reduction

Table 5-1 Southeast WWTP - Impact of I/I Reduction on EQ Basin Sizing and Peak Hour Flows

Scenario	EQ Basin Size (mg)	Peak Hour Flow (mgd)
No I/I Reduction	36	54
25% I/I Reduction	27	41
50% I/I Reduction	18	27

5.2.2 Vichy Road WWTP Design

5.2.2.1 DETERMINATION OF RECOMMENDED STORAGE VOLUME

The storm event from March 2008 used to analyze the required equalization basin storage volume for the Southeast WWTP was also used for the Vichy Road WWTP. Instantaneous flow data records were available for the Vichy Road WWTP for only February through July of 2008. Totalized daily flow data records from Discharge Monitoring Reports (DMR) were used to analyze the rest of the time period covered in this analysis. Instantaneous data was available for the March 2008 storm event and was used to construct the hydrographs used in this analysis.

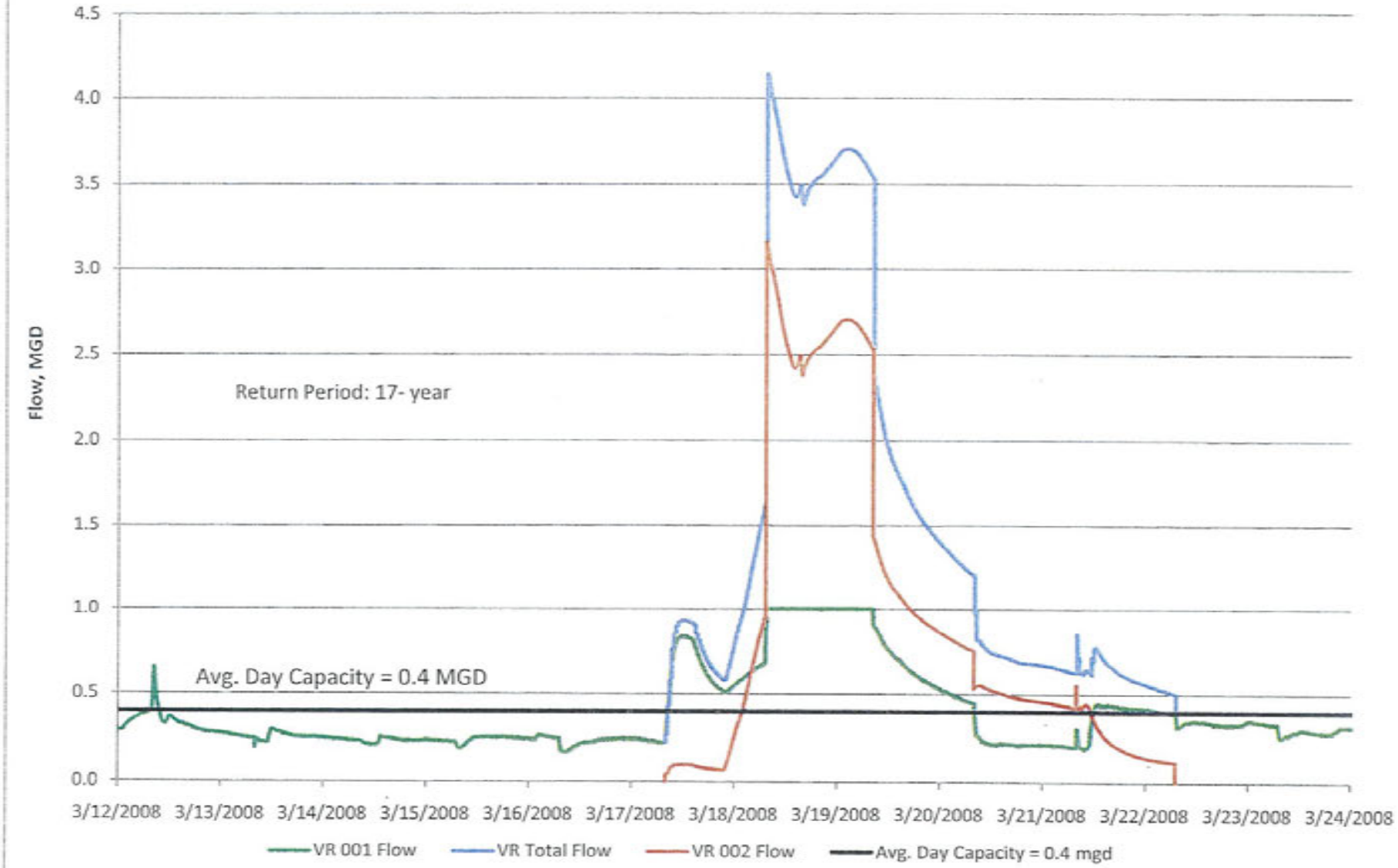
The peak hourly flow to the Vichy Road WWTP produced by this storm event was 4.12 mgd. Figure 5-2 on the following page is a hydrograph showing the flow though Outfall 001, Outfall 002, and the total flow during this storm event.

This hydrograph was "scaled down" to a 10-year design storm using similar methods as for the Southeast WWTP, described in Section 5.2.1. This analysis determined that the required equalization basin volume at the Vichy Road WWTP to store a 10-year, 4-hour storm event is 2.8 million gallons.

5.2.2.2 DETERMINATION OF PEAK FLOW RATE

Peak hourly flows were determined from the instantaneous flow records during the March 2008 storm event. The peak hourly flow for the 10-year design storm is 3.9 mgd.

Figure 5-2 - Vichy Road WWTP Metered Flow for March 2008 Storm Event - Unadjusted Flow Data



5.2.2.3 I/I REDUCTION AND IMPACT ON BASIN VOLUME

The City is working towards the elimination of inflow and infiltration (I/I) within its sanitary sewer collection system. This effort will help to reduce peak wet weather flows and the total volume of wet weather flow conveyed to the treatment plant, thus reducing the required equalization basin storage volume and peak hour flows to the facility. Table 5-2 gives the required equalization basin sizing and peak hour flows for the following three scenarios:

- No I/I Reduction
- 25% I/I Reduction
- 50% I/I Reduction

Table 5-2 Vichy Road WWTP - Impact of I/I Reduction on EQ Basin Sizing and Peak Hour Flows

Scenario	EQ Basin Size (mg)	Peak Hour Flow (mgd)
No I/I Reduction	4.1	3.9
25% I/I Reduction	3.0	2.9
50% I/I Reduction	2.1	2.0

6 IMPROVEMENT ALTERNATIVES

6.1 SOUTHEAST WWTP

Multiple improvement alternatives for the implementation of equalization facilities at the SE WWTP were investigated. The primary difference between the alternatives was the location of the basins with respect to the WWTP. One further difference was the percentage of total I/I reduction achieved by the City prior to the construction of the facilities. Opinions of probable project costs were developed for each alternative. Included within the opinions of project cost were estimates of operations and maintenance costs. Present worth values of each alternative were calculated in an effort to facilitate a direct comparison of each alternative.

6.1.1 Alternative 1A – West Basin, No I/I Reduction

This alternative assumes that an equalization basin will be constructed due west of the SE WWTP. The total basin volume shall be 36-million gallons, which will be sufficient to store flows from a 10-year (AEP = 10-percent), 4-hour design storm, assuming that no I/I reduction is achieved within the sanitary sewer collection system.

As detailed in Section 3.1, flows in excess of the West Plant capacity are ultimately diverted to the Pump Station Flow Control Structure and Outfall No. 002. Flows in excess of the East Plant capacity are ultimately diverted to the Flow Measurement Structure and Outfall No. 003. Within the scope of Alternative 1A, flows from both plant peak flow clarifiers would be diverted with flow splitters placed prior to the Outfall No. 002 and 003, to a new storm water pump station. The flow splitters would be designed to limit the flowrates to the storm water pump station to 31,000-gpm; flows in excess of 31,000-gpm would be discharged from the Outfall No. 002 and No. 003 so as to protect pumping and control equipment from inundation related damage.

The storm water pump station would be a quadraplex station with submersible non-clog centrifugal pumps. The pumps would be mounted in a wetwell configuration and would be operated such that the anticipated peak flowrate would be achieved with three firm pumps operating in parallel. One pump would be provided as a standby unit, providing system redundancy should one firm pump fail. Based on a hydraulic analysis of the pump station and force main system, it is anticipated that the pumps would be driven by 385-Hp, 3-phase, 480V, 60-Hz motors. The anticipated operating duty point for each pump is 10,956-gpm at 105.0-ft total dynamic head (TDH).

The pump station would discharge to a force main which would convey flows along the south WWTP property line, west to the proposed equalization basin. The force main was preliminarily design as 42-inch diameter restrained joint ductile iron pipe.

The equalization basin was divided into three discrete cells. The force main will discharge into the first cell, which has the highest water surface elevation. Cells No. 2 and 3 were terraced down the hillside in an effort to minimize excavation requirements and achieve balanced cut fill quantities. The system was designed to operate such that Cell No. 1 would fill first and once full, would overflow into Cell No. 2. Similarly, Cell No. 2 would fill and overflow into Cell No. 3. A level sensing float switch would be installed in Cell No. 3 to provide a high water level indication which would be utilized to shut down the pump station, prior to the exceedances of the equalization basin total volume. Wastewater would not discharge directly from the equalization basin during normal operation until the operator opens a manual valve on outlet structure to drain stored wastewater back to the WWTP for secondary treatment.

When the peak flows have receded to a level that is permitting, stored wastewater in the equalization basin would be drained back to the West Plant headworks via gravity flow. The flows would be split at that time between the East and West Plants to optimize the treatment of the wastewater. It should be noted that flows are conveyed from the West Plant to the East plant via a 16-inch gravity line with an inverted siphon beneath the creek (Burgher Branch).

The anticipated present worth cost of Alternative 1A is $8,412,000. This cost includes all capital costs, design fees, land acquisition cost, operations and maintenance cost, etc, associated with the proposed improvements. Figure 6-1 provides a detail of the proposed storm water pump station. Figure 6-2 details the proposed layout of the wet weather flow diversion, storm water pump station, force main and equalization basins associated with Alternative 1A. Figure 6-6 shows the hydraulic profile for the improvements.

6.1.2 Alternative 1B – North Basin, No I/I Reduction

This alternative is identical to Alternate 1A, except that the equalization basin is located due north of the SE WWTP. The total basin volume shall be 36-million gallons, which will be sufficient to store flows from a 10-year (AEP = 10-percent), 4-hour design storm, assuming that no I/I reduction was achieved within the sanitary sewer collection system.

Because of differences in the location of the equalization basin and associated differences in water surface elevations, the submersible non-clog centrifugal pumps for Alternative No. 1B will driven by 385-Hp, 3-phase, 480V, 60-Hz motors. The anticipated operating duty point for each pump is 10,946-gpm at 84.8-ft total dynamic head (TDH).

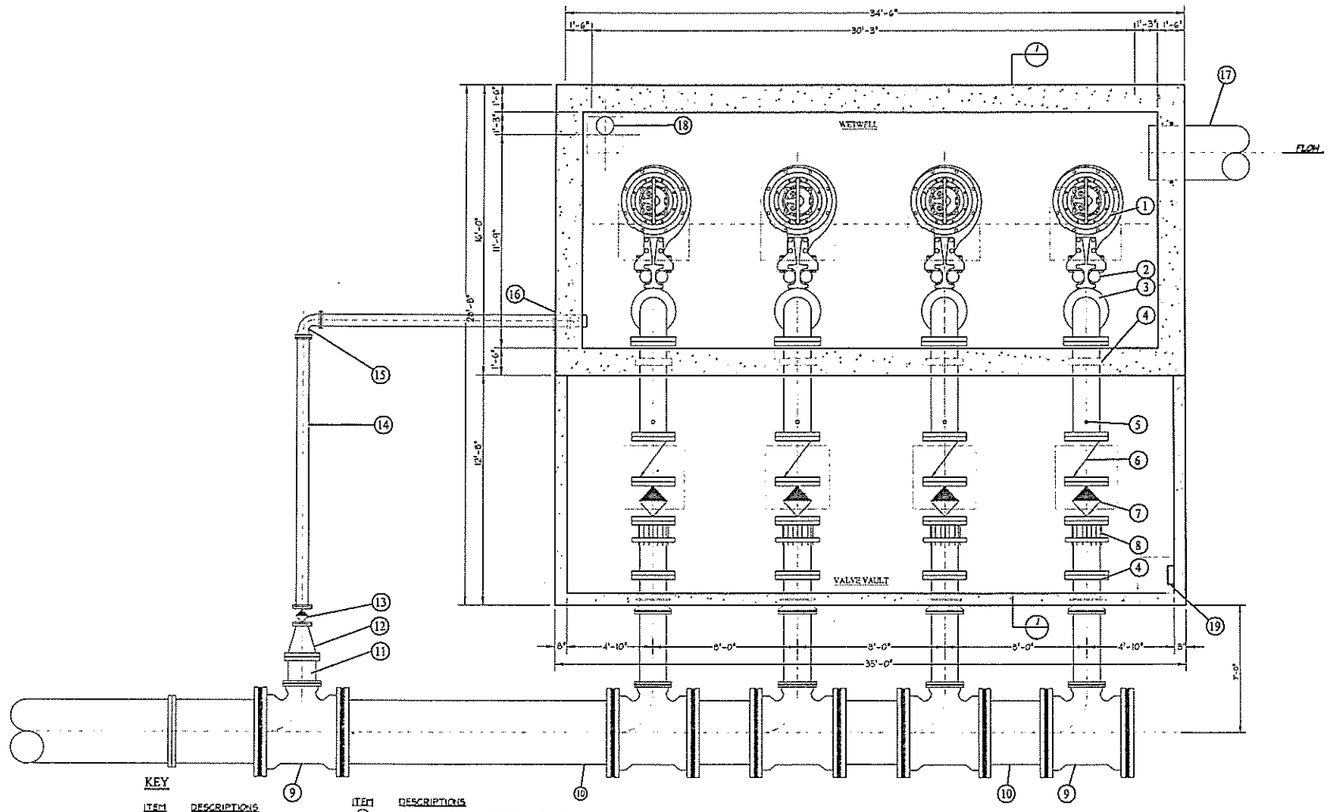
When the peak flows have receded to a level that is permitting, stored wastewater in the equalization basin would be drained back to the East Plant headworks via gravity flow. The flows would be split at that time between the East and West plant to optimize the treatment of the wastewater. Flows would be conveyed from the East Plant to the West Plant via an existing storm water pump station rated at 3.8-mgd. The existing storm water pump station discharges to an existing 14-inch diameter force main which conveys flows beneath the creek (Burgher Branch) back to the headworks of the West Plant for treatment.

The anticipated present worth cost of Alternative 1B is $8,552,000. This cost includes all capital costs, design fees, land acquisition cost, operations and maintenance cost, etc, associated with the proposed improvements. Figure 6-3 details the proposed layout of the wet weather flow diversion, storm water pump station, force main and equalization basins associated with Alternative 1B. Figure 6-6 shows the hydraulic profile for the improvements.

6.1.3 Alternative 2A – West Basin, 25-percent I/I Reduction

This alternative assumes that an equalization basin will be constructed due west of the SE WWTP. The total basin volume shall be 27-million gallons, which will be sufficient to store flows from a 10-year (AEP = 10-percent), 4-hour design storm, assuming that I/I into the sanitary sewer collection system is reduced by 25-percent.

As detailed in Section 3.1, flows in excess of the West Plant capacity are ultimately diverted to the Pump Station Flow Control Structure and Outfall No. 002. Flows in excess of the East Plant capacity are ultimately diverted to the Flow Measurement Structure and Outfall No. 003. Within the scope of Alternative 2A, flows from both plant peak flow clarifiers would be diverted with flow splitters placed prior to the Outfall No. 002 and No. 003, to a new storm water pump station. The flow splitters would be designed to limit flowrates to the storm water pump station to 24,000-gpm; flowrates in excess of



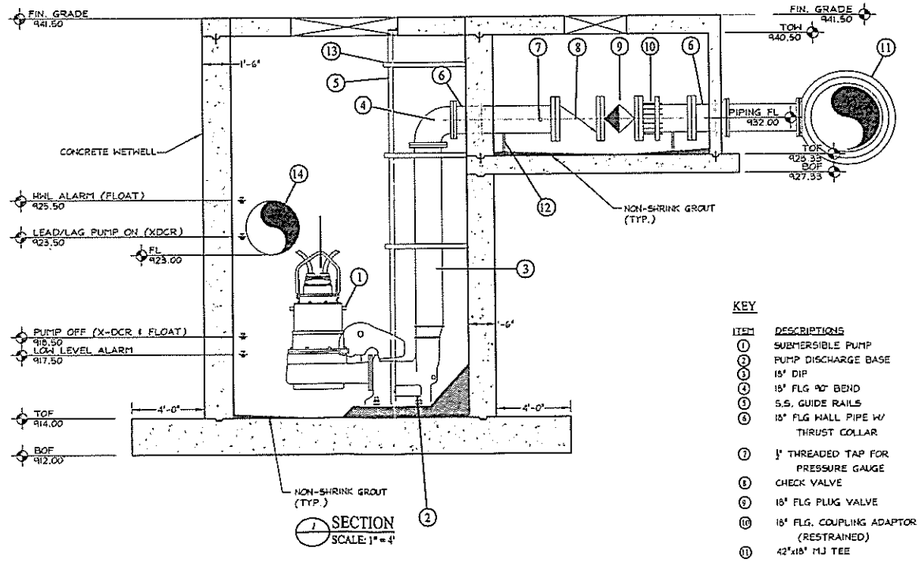
PLAN VIEW @ ELEV. 934.00
SCALE: 1" = 4'

KEY

ITEM	DESCRIPTION
1	SUBMERSIBLE PUMP
2	S.S. GUIDERAILS
3	18" FLG. 90° BEND
4	18" FLG WALL PIPE W/ THRUST COLLAR
5	¾" THREADED TAP FOR PRESSURE GAUGE
6	18" FLG CHECK VALVE
7	18" FLG PLUG VALVE
8	18" FLG. COUPLING ADAPTOR (RESTRAINED)
9	42"x18" FLG TEE
10	42" DIP
11	18" DIP
12	18"x8" MJ REDUCER
13	8" MJ BURRIED SERVICE PLUG VALVE
14	8" DIP
15	8" MJ 90° BEND
16	8" WALL PIPE W/ THRUST COLLAR
17	36" DIP INFLUENT
18	STILLING WELL FOR PRESSURE X-DCR
19	MANHOLE STEPS

NOTES

1. DISCHARGE PIPING, BETWEEN THE PUMP BASE AND DISCHARGE HEADER, INCLUDING ALL VALVES AND ACCESSORIES SHALL BE IDENTICAL FOR EACH PUMP.
2. CONCRETE REINFORCEMENT NOT SHOWN FOR CLARITY.
3. PRESSURE GAUGE SHALL BE OMEGA PGH-45L-160PSI/-100-SS-KCG STAINLESS STEEL, LIQUID FILLALBE INDUSTRIAL PRESSURE GAUGE, DIAPHRAGM PRESSURE SEAL, ¾" NPT STAINLESS STEEL BALL VALVE AND STAINLESS STEEL THREADED NIPPLE.



SECTION
SCALE: 1" = 4'

KEY

ITEM	DESCRIPTION
1	SUBMERSIBLE PUMP
2	PUMP DISCHARGE BASE
3	18" DIP
4	18" FLG 90° BEND
5	S.S. GUIDE RAILS
6	18" FLG WALL PIPE W/ THRUST COLLAR
7	¾" THREADED TAP FOR PRESSURE GAUGE
8	CHECK VALVE
9	18" FLG PLUG VALVE
10	18" FLG. COUPLING ADAPTOR (RESTRAINED)
11	42"x18" MJ TEE
12	PIPE SUPPORTS
13	S.S PIPE AND GUIDE RAIL SUPPORT
14	36" DIP

NOTES

1. DISCHARGE PIPING, BETWEEN THE PUMP BASE AND DISCHARGE HEADER, INCLUDING ALL VALVES AND ACCESSORIES SHALL BE IDENTICAL FOR EACH PUMP.
2. PRESSURE GAUGE SHALL BE OMEGA PGH-45L-160PSI/-100-SS-KCG STAINLESS STEEL, LIQUID FILLALBE INDUSTRIAL PRESSURE GAUGE, DIAPHRAGM PRESSURE SEAL, ¾" NPT STAINLESS STEEL BALL VALVE AND STAINLESS STEEL THREADED NIPPLE.

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OF AUTHORITY #000856
3741 NE TROON DRIVE
LEE'S SUMMIT, MO 64064

ARCHER
1100 North Outer Road
St. James, Mo. 65559
573-265-0193 • Fax 573-265-0193

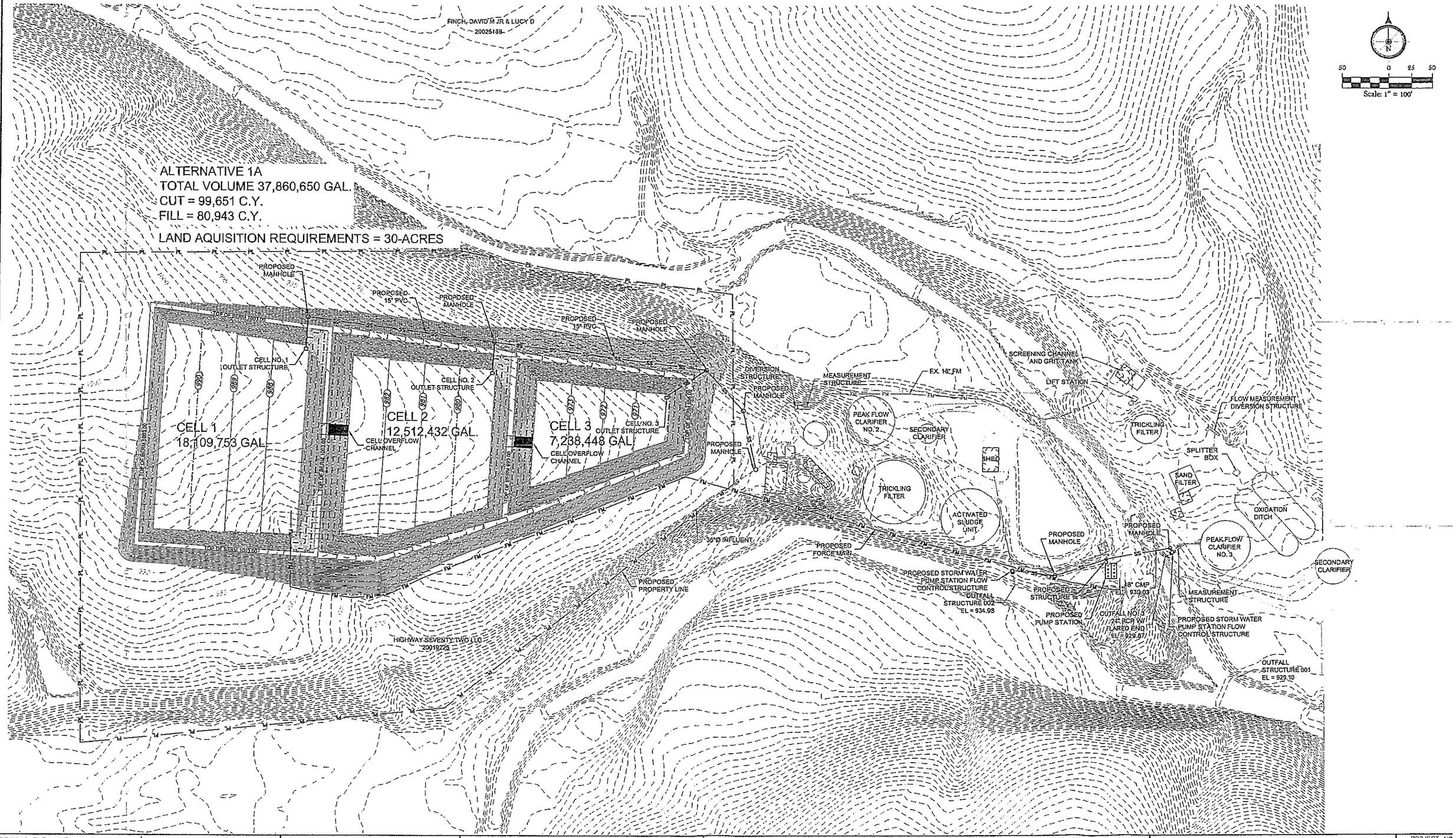
City of ROLLA

CITY OF ROLLA, MO
WET WEATHER FLOW EVALUATION

PROJECT NO. 11129910

SOUTHEAST WWTP EO FACILITIES
STORM WATER PUMP STATION
ALTERNATIVE 1A, 1B, 2A & 2B

DRAWING NO. 6-1



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City of ROLLA

CITY OF ROLLA, MO
WET WEATHER FLOW EVALUATION

PROJECT NO 1112991

SOUTHEAST WWTP EQ FACILITIES
WEST BASIN, NO I & I REDUCTION
ALTERNATIVE 1A PLAN

DRAWING NO 6-2

- ALTERNATIVE 1B
- TOTAL VOLUME 36,559,400 GAL.
- CUT = 163,080 C.Y.
- FILL = 79,403 C.Y.
- LAND AQUISITION REQUIREMENTS = 35-ACRES

CELL 1
19,179,131 GAL.

CELL 2
11,381,052 GAL.

CELL 3
5,999,222 GAL.

TOP OF BERM 989.00

TOP OF BERM 979.00

TOP OF BERM 969.00

CELL NO. 1 OUTLET STRUCTURE

CELL NO. 2 OUTLET STRUCTURE

CELL NO. 3 OUTLET STRUCTURE

CELL OVERFLOW CHANNEL

CELL OVERFLOW CHANNEL

FINCH, DAVID M JR & LUCY D
20025138

PROPOSED MANHOLE

PROPOSED MANHOLE

PROPOSED MANHOLE

PROPOSED MANHOLE

PROPOSED MANHOLE

EX. 16" FM

PEAK FLOW CLARIFIER NO. 2

SECONDARY CLARIFIER

CONTROL BUILDING

SHED

TRICKLING FILTER

ACTIVATED SLUDGE UNIT

HIGHWAY SEVENTY TWO LLC
20019225

36"Ø INFLUENT

PROPOSED STORM WATER PUMP STATION FLOW CONTROL STRUCTURE
OUTFALL STRUCTURE 002
EL = 934.98

PROPOSED PUMP STATION

PROPOSED STRUCTURE

48" CMP
EL = 930.03

OUTFALL NO. 3
24" RCP W/
FLARED END
EL = 929.87

TRICKLING FILTER

FLOW MEASUREMENT DIVERSION STRUCTURE

SPLITTER BOX

SAND FILTER

OXIDATION DITCH

PEAK FLOW CLARIFIER NO. 3

SECONDARY CLARIFIER

MEASUREMENT STRUCTURE

PROPOSED STORM WATER PUMP STATION FLOW CONTROL STRUCTURE

OUTFALL STRUCTURE 001
EL = 929.10

Scale: 1" = 100'

FOX, ROBERT A & MARILYN D
20082916

GUERRERN, DOUGLASS J & ALICE F
19983697

OUPES, RALPH W & CHERYL L
20033993

HARRISON, STEVEN D TRUST
20081893

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City of ROLLA

CITY OF ROLLA, MO
WET WEATHER FLOW EVALUATION

PROJECT NO. 1112991(

SOUTHEAST WWTP EQ FACILITIES
NORTH BASIN, NO 1 & I REDUCTION
ALTERNATIVE 1B PLAN

DRAWING NO. 6-3

24,000-gpm would be discharged from the Outfall No. 002 and 003 to protect pumping and control equipment from inundation related damage.

The storm water pump station would be a quadraplex station with submersible non-clog centrifugal pumps. The pumps would be mounted in a wetwell configuration and would be operated such that the anticipated peak flow rate would be achieved with three firm pumps operating in parallel. One pump would be provided as a standby unit, providing system redundancy should one firm pump fail. Based on a hydraulic analysis of the pump station and force main system, it is anticipated that the pumps would be driven by 280-Hp, 3-phase, 480V, 60-Hz motors. The anticipated operating duty point for each pump is 8,030-gpm at 97.1-ft total dynamic head (TDH).

The pump station will discharge to a force main which would convey flows along the south WWTP property line, west to the proposed equalization basin. The force main was preliminarily design as 42-inch diameter restrained joint ductile iron pipe.

The equalization basin was divided into three discrete cells. The force main will discharge into the first cell, which has the highest water surface elevation. Cells No. 2 and 3 were terraced down the hillside in an effort to minimize excavation requirements and achieve balanced cut fill quantities. The system was designed to operate such that Cell No. 1 would fill first and once full, would overflow into Cell No. 2. Similarly, Cell No. 2 would fill and overflow into Cell No. 3. A level sensing float switch would be installed in Cell No. 3 to provide a high water level indication which would be utilized to shut down the pump station, prior to the exceedance of the equalization basin volume. wastewater would not be discharge directly from the equalization basin during normal operation until the operator opens a manual valve on outlet structure to drain stored wastewater back to the WWTP for secondary treatment.

When the peak flows have receded to a level that is permitting, wastewater in the equalization basin would be drained back to the West Plant headworks via gravity flow. The flows would be split at that time between the East and West Plants to optimize the treatment of the wastewater. It should be noted that flows are conveyed from the West Plant to the East plant via a 16-inch gravity line with an inverted siphon beneath the creek (Burgher Branch).

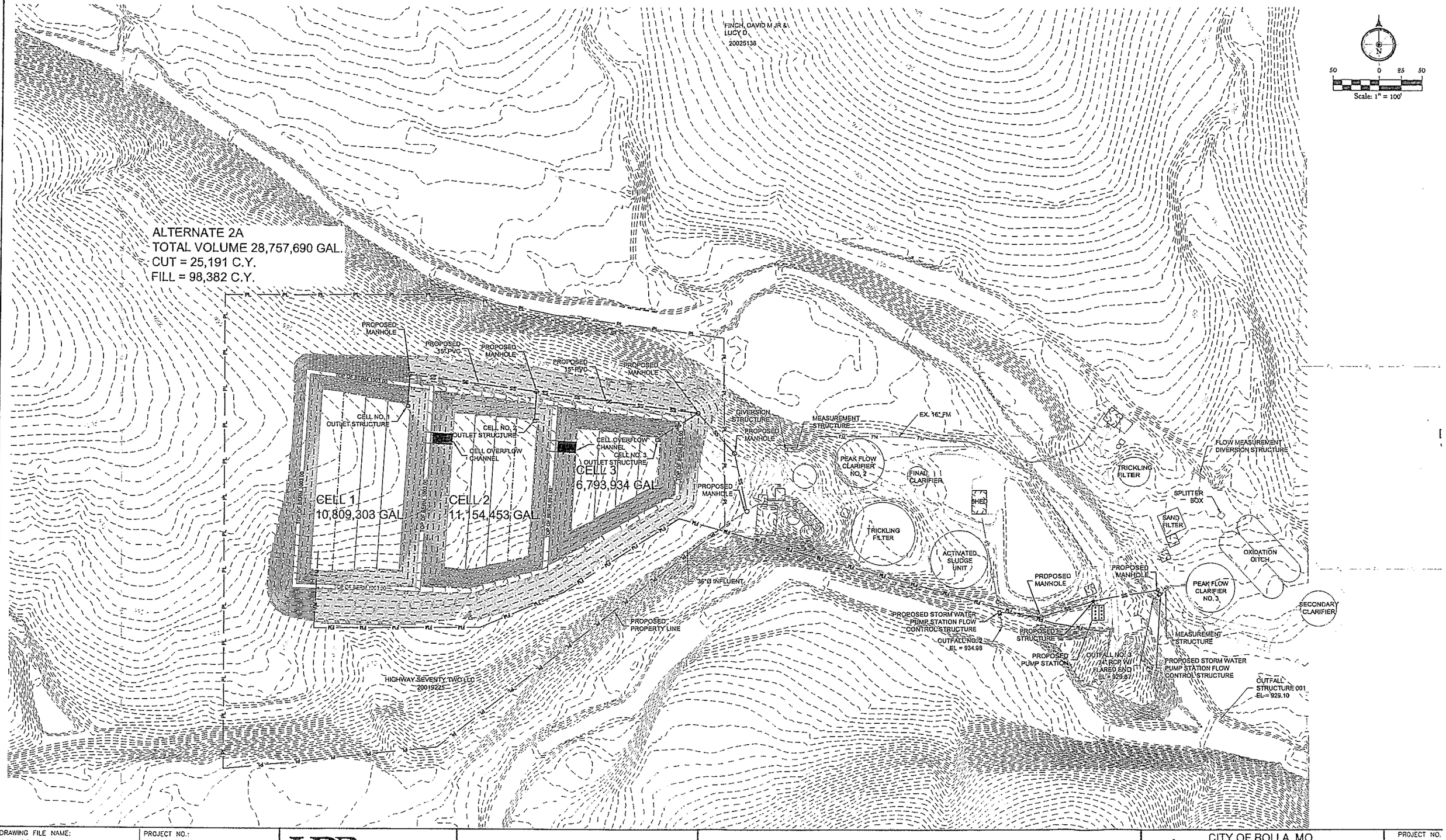
The anticipated present worth cost of Alternative 2A is $6,546,000. This cost includes all capital costs, design fees, land acquisition cost, operations and maintenance cost, etc, associated with the proposed improvements. Figure 6-4 details the proposed layout of the wet weather flow diversion, storm water pump station, force main and equalization basins associated with Alternative 2A. Figure 6-6 shows the hydraulic profile for the improvements.

6.1.4 Alternative 2B – North Basin, 25-percent I/I Reduction

This alternative is identical to Alternate 2A, except that the equalization basin is located due north of the SE WWTP. The total basin volume shall be 27-million gallons, which will be sufficient to store flows from a 10-year (AEP = 10-percent), 4-hour design storm, assuming that I/I into the sanitary sewer collection system is reduced by 25-percent.

Because of differences in the location of the equalization basin and associated differences in water surface elevations, the submersible non-clog centrifugal pumps for Alternative No. 2B will driven by 215-Hp, 3-phase, 480V, 60-Hz motors. The anticipated operating duty point for each pump is 8,161-gpm at 76.3-ft total dynamic head (TDH).

When the peak flows have receded to a level that is permitting, stored wastewater in the equalization basin would be drained back to the East Plant headworks via gravity flow. The flows would be split at



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CITY OF ROLLA, MO
WET WEATHER FLOW EVALUATION

PROJECT NO. 11129910

SOUTHEAST WWTP EQ FACILITIES
WEST BASIN, 25% I & I REDUCTION
ALTERNATIVE 2A PLAN

DRAWING NO. 6-4

that time between the East and West Plants to optimize the treatment of the wastewater. Flows would be conveyed from the East Plant to the West Plant via an existing storm water pumping station rated at 3.8-mgd. The existing storm water pump station discharges to an existing 14-inch diameter force main which conveys flows beneath the creek (Burgher Branch) back to the headworks of the West Plant for treatment.

The anticipated present worth cost of Alternative 2B is $6,242,000. This cost includes all capital costs, design fees, land acquisition cost, operations and maintenance cost, etc, associated with the proposed improvements. Figure 6-5 details the proposed layout of the wet weather flow diversion, storm water pump station, force main and equalization basins associated with Alternative 2B. Figure 6-6 shows the hydraulic profile for the improvements.

6.1.5 Alternative 3 – East Basin, No I/I Reduction

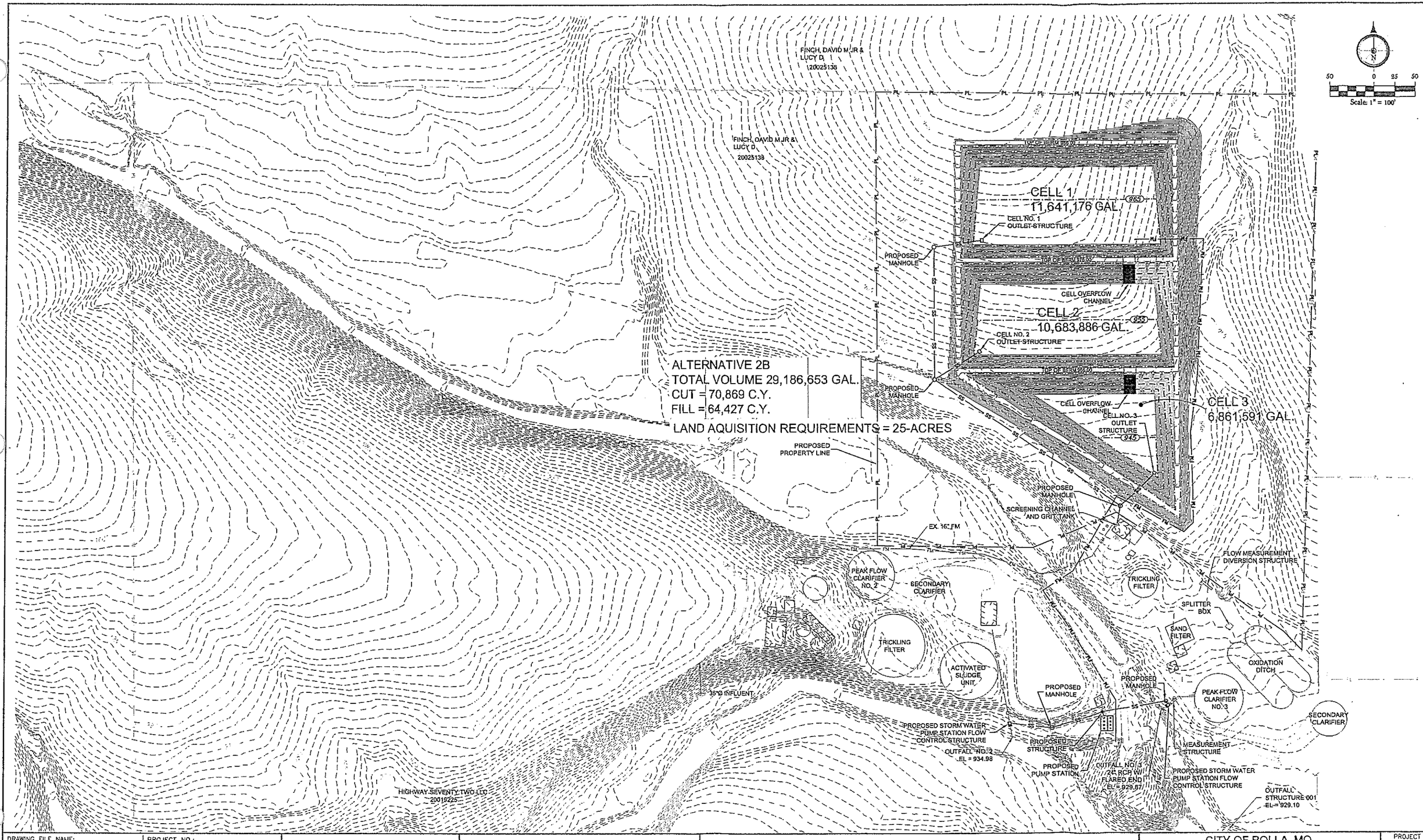
This alternative assumes that an equalization basin will be constructed due east of the SE WWTP. The total basin volume shall be 36-million gallons, which will be sufficient to store flows from a 10-year (AEP = 10-percent), 4-hour design storm, assuming that no I/I reduction is achieved within the sanitary sewer collection system.

As detailed in Section 3.1, flows in excess of the West Plant capacity are ultimately diverted to the Pump Station Flow Control Structure and Outfall No. 002. Flows in excess of the East Plant capacity are ultimately diverted to the Flow Measurement Structure and Outfall No. 003. Within the scope of Alternative 3, flows from both plant peak flow clarifiers would be diverted with flow splitters placed prior to the Outfall No. 002 and No. 003, to a new gravity sewer conveyance. The flow splitters would be designed to limit flowrates to the equalization basin to 31,000-gpm so as to limit the potentially adverse increases in the hydraulic grade line at higher flowrates.

Flows from PFC No. 2 would be diverted east toward PFC No. 3. The gravity sewer would consist of 36-inch diameter RCP pipe. The sewer line would have an inverted siphon at the creek crossing (Burgher Branch). Flows diverted from PFC No. 2 would be combined with flows from PFC No. 3 at a new flow splitter structure located immediately downstream of PFC No. 3. The combined flows would then travel 1,650-ft in a southeasterly direction toward the basin via a 42-inch diameter RCP gravity sewer. The gravity sewer would discharge directly to the equalization basin.

The equalization basin was divided into two discrete cells. The gravity sewer will discharge into the first cell, which has the highest water surface elevation. Cell No. 2 was terraced down the hillside in an effort to minimize excavation requirements and achieve balanced cut fill quantities. The system was designed to operate such that Cell No. 1 would fill first and once full, would overflow into Cell No. 2. A level sensing float switch would be installed in Cell No. 2 to provide a high water level indication which would be utilized to close normally open motorized sluice gates at both upstream flow splitters prior to the exceedances of the equalization basin volume. Flows would not be discharged directly from the equalization basin during normal operation until the operator activates the equalization basin pump station to convey wastewater back to the WWTP for secondary treatment.

When the peak flows have receded to a level that is permitting, wastewater in the equalization basin would be pumped back to the West Plant headworks. The equalization basin pump station would consist of a triplex submersible non-clog centrifugal pump station designed to convey 3,500-gpm at 75-ft TDH. The pump would be driven by 60-Hp, 3-phase, 460-V, 60-Hz electric motors. The pump station would be configured such that two firm pumps would operate in parallel to achieve the desired design duty point, with the third pump being utilized as a standby unit. The pump station would discharge to a 14-inch diameter ductile iron pipe force main which would travel 2,990-ft west toward the West Plant



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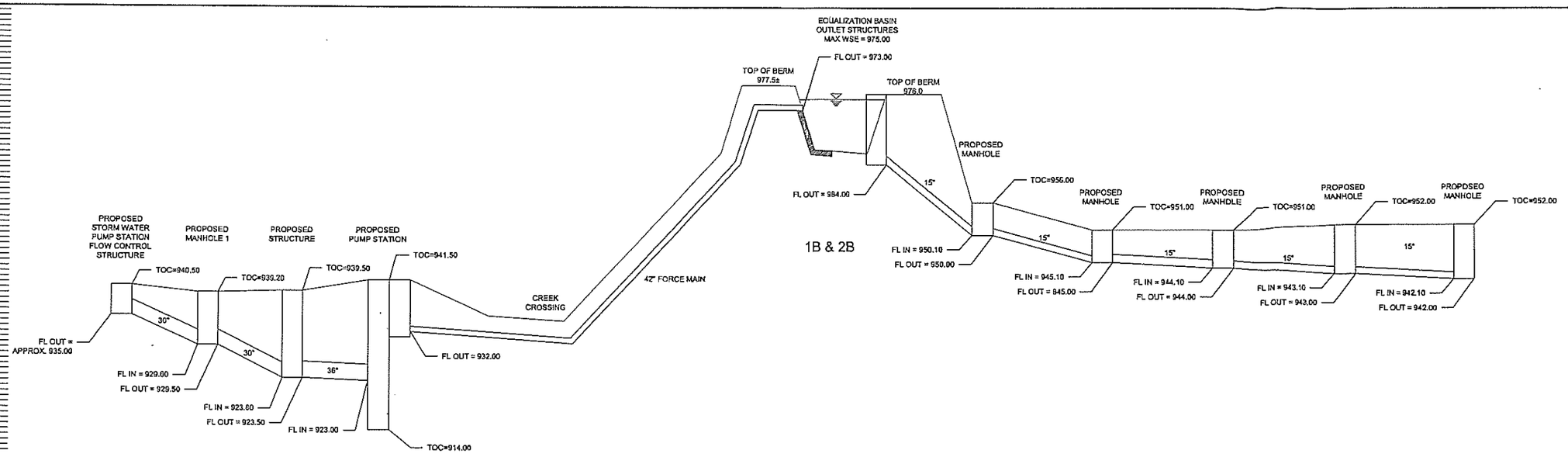
City of ROLLA

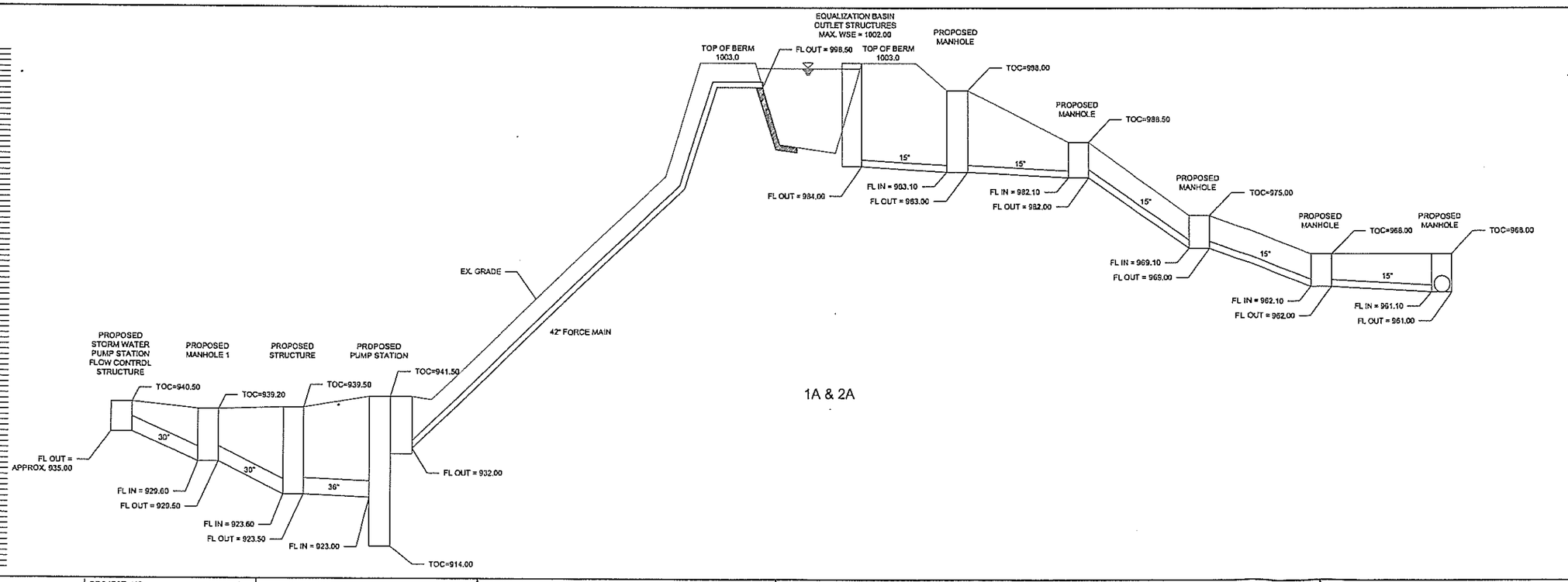
CITY OF ROLLA, MO
WET WEATHER FLOW EVALUATION

PROJECT NO. 11129910

SOUTHEAST WWTP EQ FACILITIES
NORTH BASIN, 25% I & I REDUCTION
ALTERNATIVE 2B PLAN

DRAWING NO. 6-5





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City of ROLLA

CITY OF ROLLA, MO
WET WEATHER FLOW EVALUATION

PROJECT NO. 11129910

SOUTHEAST WWTP EQ FACILITIES
ALTERNATIVES 1 & 2 HYDRAULIC PROFILE

DRAWING NO. 6-6

headworks. The force main would generally follow the proposed equalization gravity sewer conveyance and the SE WWTP south property line. The discharge location for the force main would be approximately 20-ft upstream of the West Plant headworks, where a doghouse manhole would be installed. As with Alternatives 1A and 2A, the flows would be split at that time between the East and West plant to optimize the treatment of the wastewater.

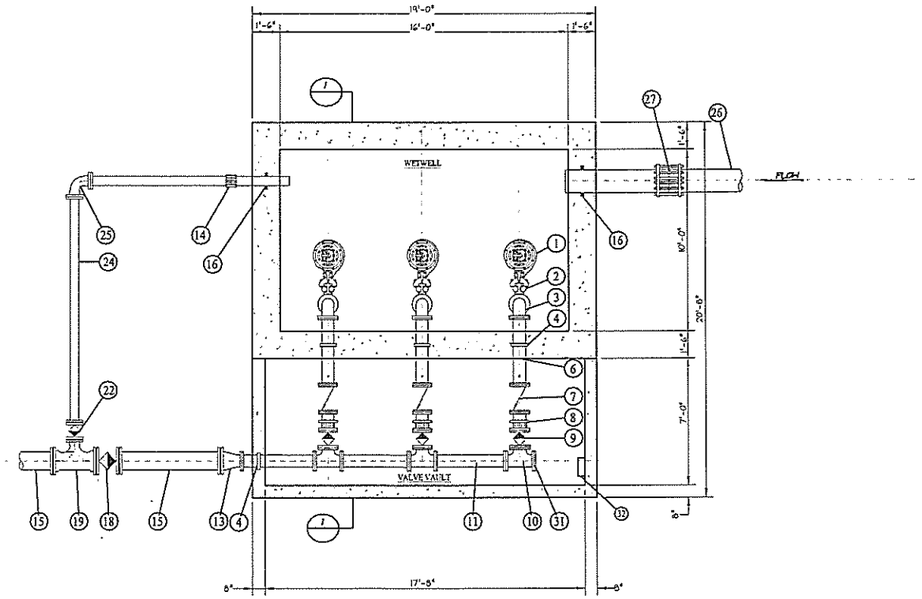
The anticipated present worth cost of Alternative 3 is $6,916,000. This cost includes all capital costs, design fees, land acquisition cost, operations and maintenance cost, etc, associated with the proposed improvements. Figure 6-7 provides a detail of the proposed storm water pump station. Figure 6-8 details the proposed layout of the wet weather flow diversion, storm water pump station, force main and equalization basins associated with Alternative 1A. Figure 6-10 shows the hydraulic profile for the improvements.

6.1.6 Alternative 4 – East Basin, 25-percent I/I Reduction

This alternative is identical to Alternate 3, except that the total basin volume shall be 27-million gallons, which will be sufficient to store flows from a 10-year (AEP = 10-percent), 4-hour design storm, assuming that I/I into the sanitary sewer collection system is reduced by 25-percent.

Because of the minimal differences between Alternative 3 and 4, the gravity sewer conveyance, the general equalization basin layout, the pump station design and force main size are the same. The primary difference between the two alternatives is the land area required for the basin and the grading quantities associated with the construction of the basins.

The anticipated present worth cost of Alternative 4 is $5,780,000. This cost includes all capitol costs, design fees, land acquisition cost, operations and maintenance cost, etc, associated with the proposed improvements. Figure 6-9 details the proposed layout of the wet weather flow diversion, storm water pump station, force main and equalization basins associated with Alternative 2B. Figure 6-10 shows the hydraulic profile for the improvements.



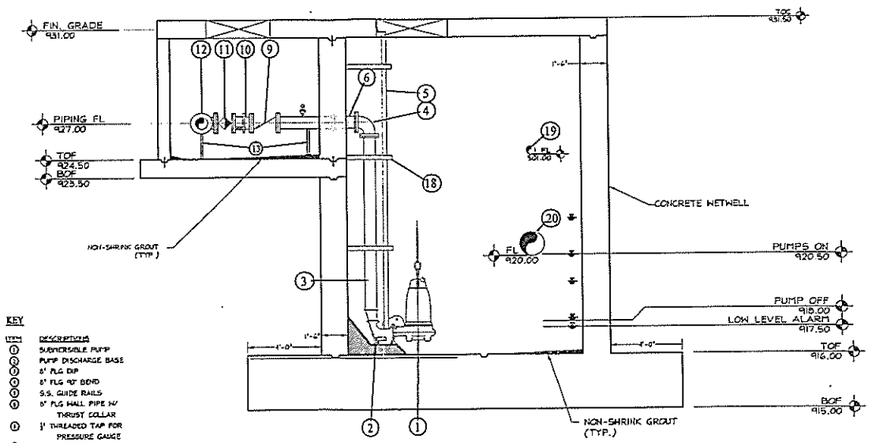
KEY

ITEM	DESCRIPTIONS
1	SUBMERSIBLE PUMP
2	S.S. GUIDERAILS
3	8" FLG. 90° BEND
4	8" FLG HALL PIPE W/ THRUST COLLAR
5	1" THREADED TAP FOR PRESSURE GAUGE
7	8" FLG CHECK VALVE
8	8" FLG. COUPLING ADAPTOR (RESTRAINED)
9	8" FLG PLUG VALVE
10	8" FLG TEE
11	8" DIP
13	14"x8" FLG REDUCER
15	14" DIP
16	HALL PIPE W/ THRUST COLLAR
18	14" MJ PLUG VALVE
19	14"x6" MJ TEE
22	6" FLG ECCENTRIC PLUG VALVE
24	6" DIP
25	6" MJ 90° BEND
26	15" PVC, SDR-35
27	FLEXIBLE JOINT
31	8" BLIND FLANGE
33	MANHOLE STEPS

PLAN VIEW
N.T.S.

NOTES

1. DISCHARGE PIPING, BETWEEN THE PUMP BASE AND DISCHARGE HEADER, INCLUDING ALL VALVES AND ACCESSORIES SHALL BE IDENTICAL FOR EACH PUMP.
2. CONCRETE REINFORCEMENT NOT SHOWN FOR CLARITY.
3. PRESSURE GAUGE SHALL BE OMEGA PGH-45L-160PSI/3-100-SS-3/8G STAINLESS STEEL, LIQUID FILLALBE INDUSTRIAL PRESSURE GAUGE, DIAPHRAGM PRESSURE SEAL, 3/8" NPT STAINLESS STEEL BALL VALVE AND STAINLESS STEEL THREADED NIPPLE.



KEY

ITEM	DESCRIPTIONS
1	SUBMERSIBLE PUMP
2	PUMP DISCHARGE BASE
3	8" FLG DIP
4	8" FLG 90° BEND
5	S.S. GUIDE RAILS
6	8" FLG HALL PIPE W/ THRUST COLLAR
9	1" THREADED TAP FOR PRESSURE GAUGE
10	8" FLG. COUPLING ADAPTOR (RESTRAINED)
11	8" FLG PLUG VALVE
12	8" FLG TEE
13	PIPE SUPPORTS
18	S.S. PIPE AND GUIDE RAIL SUPPORT
19	8" DIP
20	16" DIP

SECTION 1
N.T.S.

NOTES

1. DISCHARGE PIPING, BETWEEN THE PUMP BASE AND DISCHARGE HEADER, INCLUDING ALL VALVES AND ACCESSORIES SHALL BE IDENTICAL FOR EACH PUMP.
2. PRESSURE GAUGE SHALL BE OMEGA PGH-45L-160PSI/3-100-SS-3/8G STAINLESS STEEL, LIQUID FILLALBE INDUSTRIAL PRESSURE GAUGE, DIAPHRAGM PRESSURE SEAL, 3/8" NPT STAINLESS STEEL BALL VALVE AND STAINLESS STEEL THREADED NIPPLE.

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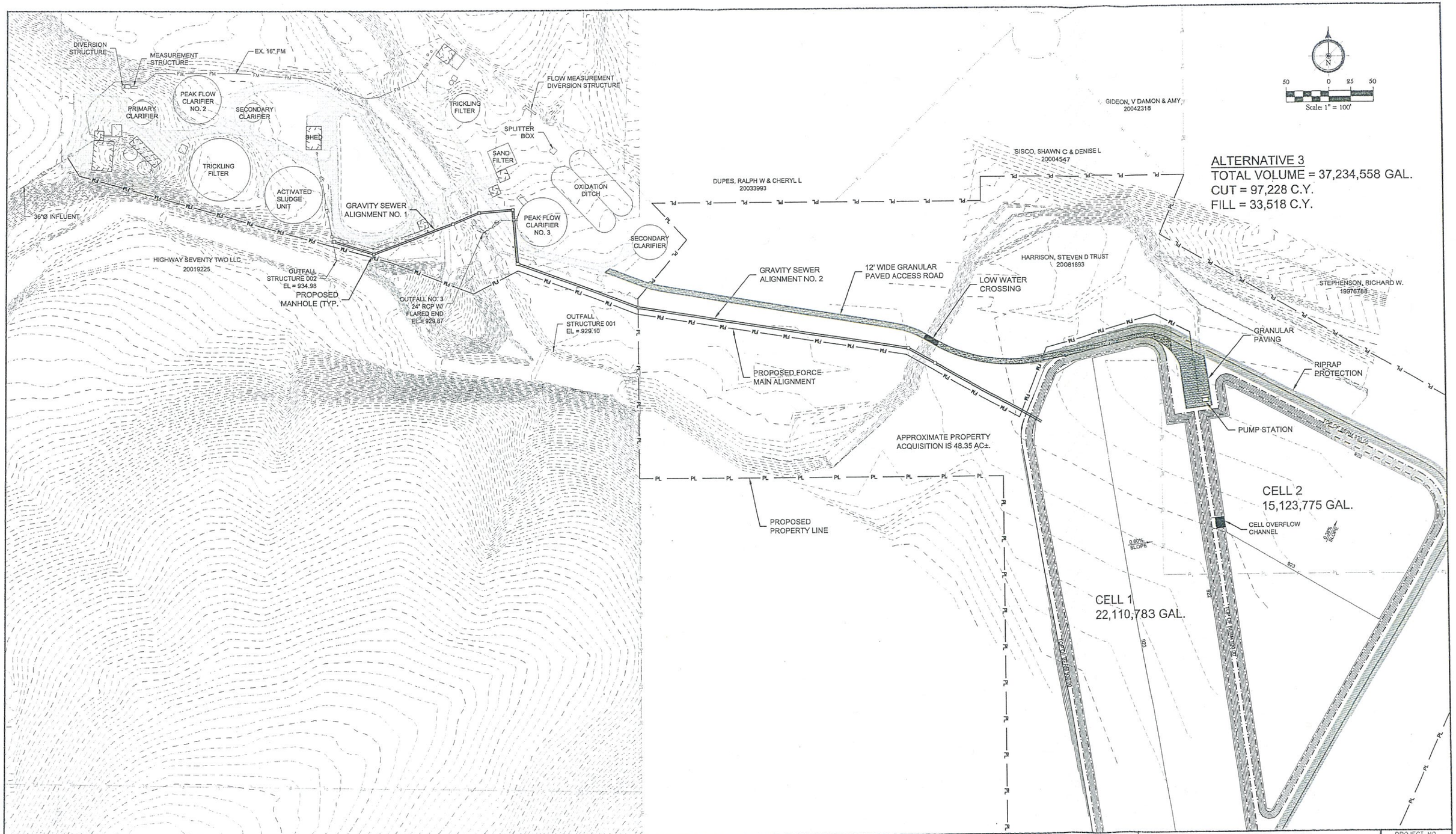
City of ROLLA

CITY OF ROLLA, MO
WET WEATHER FLOW EVALUATION

PROJECT NO. 11129910

SOUTHEAST WWTP EQ FACILITIES
STORM WATER PUMP STATION
ALTERNATIVE 3 & 4

DRAWING NO. 6-7



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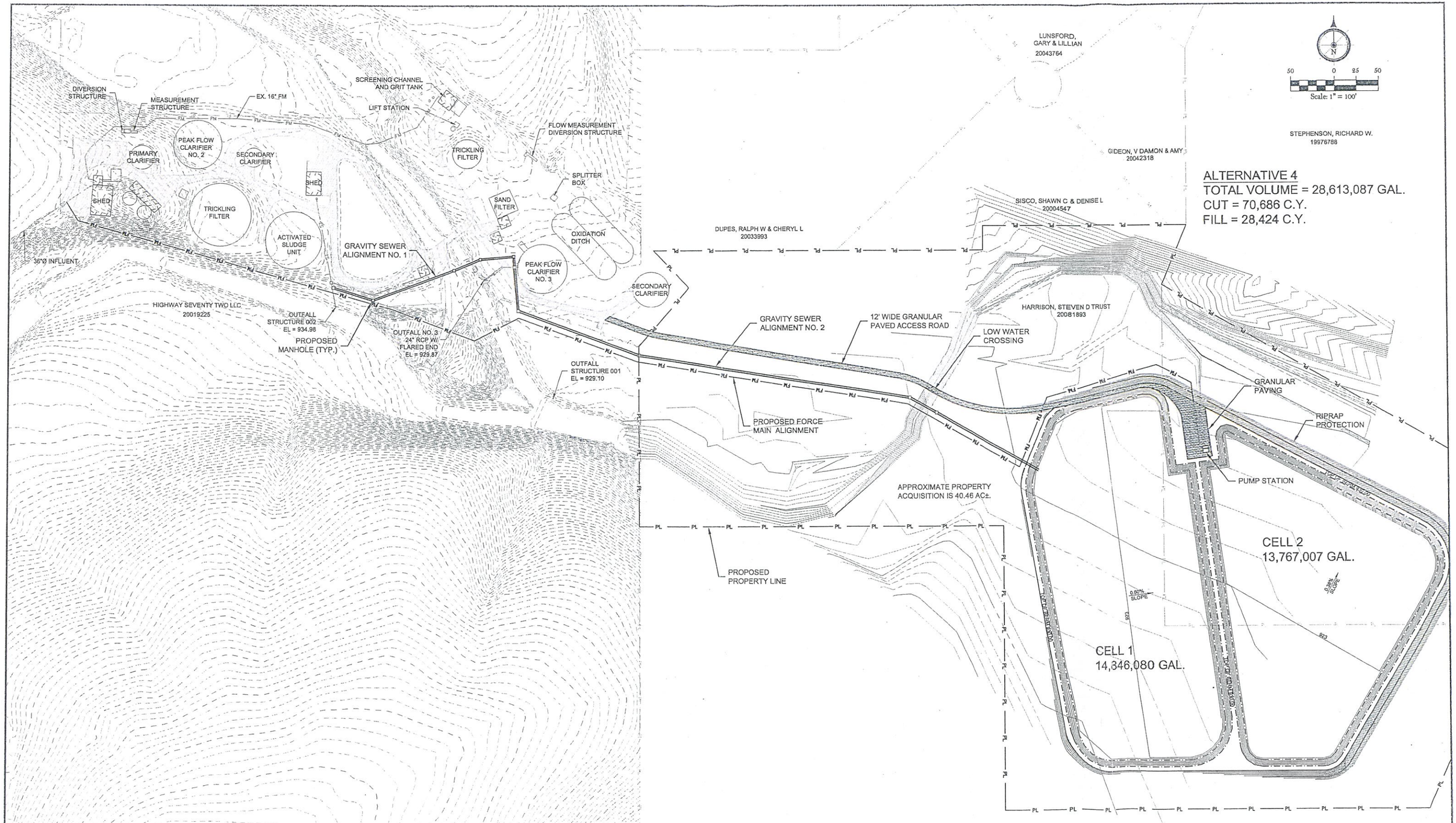
City of ROLLA

CITY OF ROLLA, MO
WET WEATHER FLOW EVALUATION

PROJECT NO. 11129910

SOUTHEAST WWTP EQ FACILITIES
EAST BASIN, NO I & I REDUCTION
ALTERNATIVE 3 PLAN

DRAWING NO. 6-8



ALTERNATIVE 4
TOTAL VOLUME = 28,613,087 GAL.
CUT = 70,686 C.Y.
FILL = 28,424 C.Y.

DRAWING FILE NAME: Rolla SSES Alt 4 27 mil gal		PROJECT NO.: 11129910	
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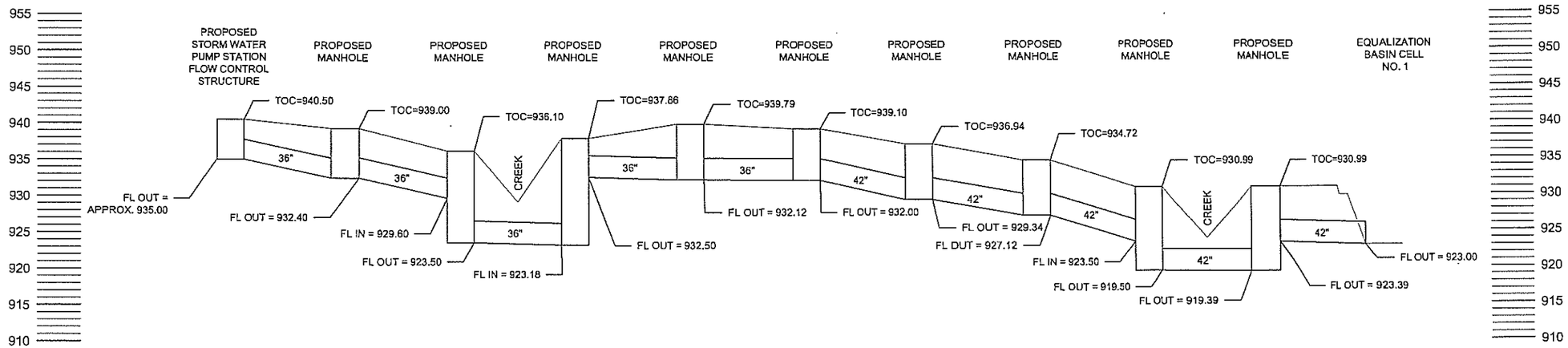
City of ROLLA

CITY OF ROLLA, MO
WET WEATHER FLOW EVALUATION

PROJECT NO. 11129910

SOUTHEAST WWTP EQ FACILITIES
EAST BASIN, 25% I & I REDUCTION
ALTERNATIVE 4 PLAN

DRAWING NO. 6-9



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City of ROLLA

CITY OF ROLLA, MO
WET WEATHER FLOW EVALUATION

PROJECT NO. 11129910

SOUTHEAST WWTP EQ FACILITIES
ALTERNATIVES 3 & 4
HYDRAULIC PROFILE

DRAWING NO. 6-10

6.2 VICHY ROAD WWTP

Multiple improvement alternatives for the implementation of equalization facilities at the Vichy Road WWTP were investigated. The primary difference between the alternatives was the location of the basins with respect to the WWTP. One further difference was the percentage of total I/I reduction achieved by the City prior to the construction of the facilities. Opinions of probable project costs were developed for each alternative. Included within the opinions of project cost were estimates of operations and maintenance costs. Present worth values of each alternative were calculated in an effort to facilitate a direct comparison of each alternative.

6.2.1 Alternative 5 – Southwest Basin, No I/I Reduction

This alternative assumes that an equalization basin would be constructed southwest of the Vichy Road WWTP. The total basin volume shall be 4.15-million gallons, which will be sufficient to store flows from a 10-year (AEP = 10-percent), 24-hour design storm, assuming that no I/I reduction is achieved within the sanitary sewer collection system.

As detailed in Section 3.2, flows in excess of the plant capacity are ultimately diverted the peak flow clarifier for primary treatment and subsequently blended with treated effluent prior to discharge from the plant. Within the scope of Alternative 5, flows from the plant peak flow clarifier would be diverted with flow splitters placed prior blending with treated effluent, to a new storm water pump station. The flow splitter would be designed to limit flows to the storm water pump station to 2,700-gpm; flows in excess of 2,700-gpm would be discharged from the Outfall No. 001 to protect pumping and control equipment from inundation related damage.

The storm water pump station would be a triplex station with submersible non-clog centrifugal pumps. The pumps would be mounted in a wetwell configuration and would be operated such that the anticipated peak flow rate would be achieved with two firm pumps operating in parallel. One pump would be provided as a standby unit, providing system redundancy should one firm pump fail. Based on a hydraulic analysis of the pump station and force main system, it is anticipated that the pumps would be driven by 25-Hp, 3-phase, 480V, 60-Hz motors. The anticipated operating duty point for each pump is 1,326-gpm at 41.8-ft total dynamic head (TDH).

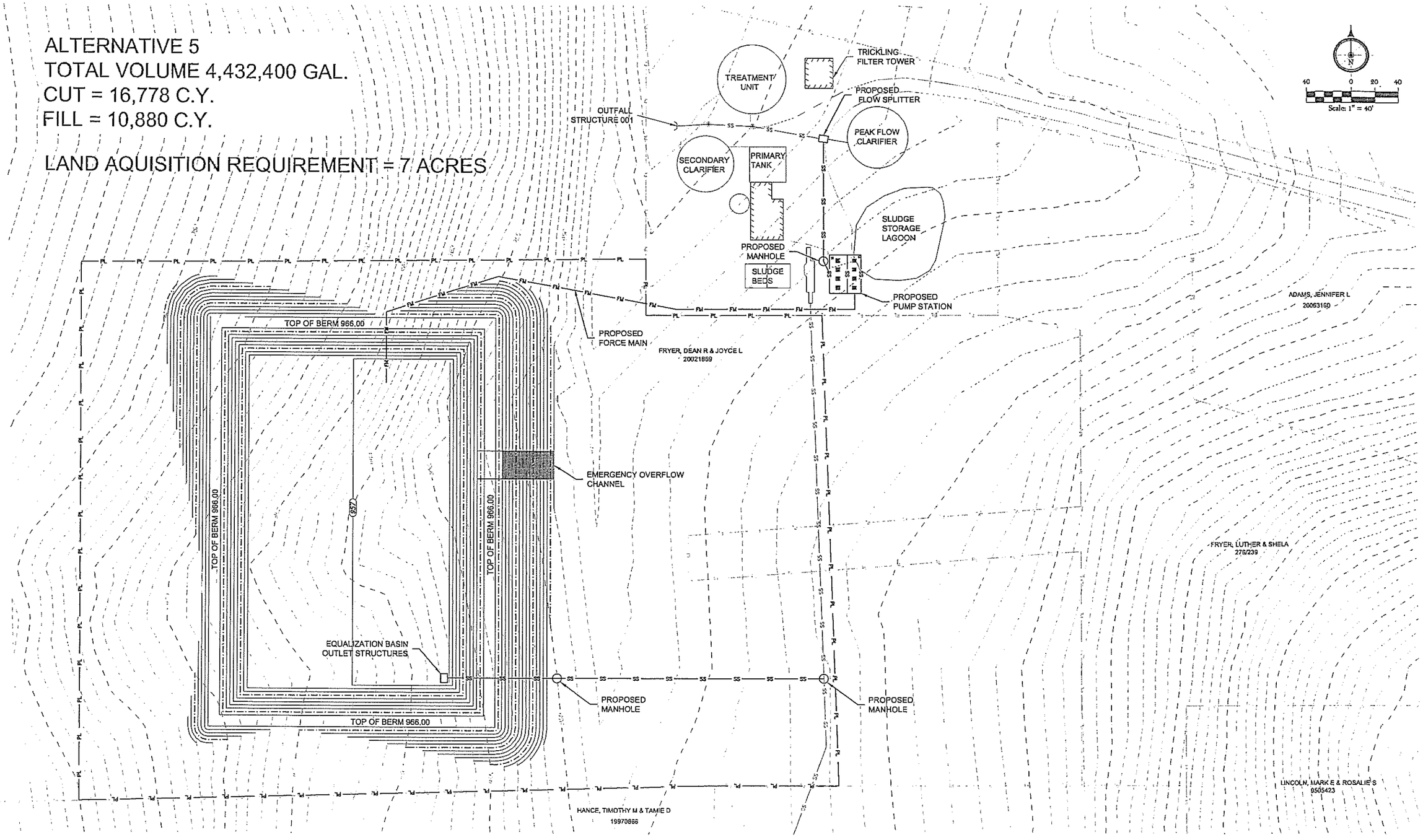
The pump station would discharge to a force main which would convey flows along the south WWTP property line, west toward the proposed equalization basin. The force main was preliminarily design as 14-inch diameter restrained joint ductile iron pipe.

The equalization basin will have one cell. The force main will discharge directly into the cell. A level sensing float switch would be installed in cell to provide a high water level indication which would be utilized to shut down the pump station prior to the exceedances of the equalization basin volume. Flows would not be discharged directly from the equalization basin during normal operation until the operator opens a manual valve on outlet structure to drain stored wastewater back to the WWTP for secondary treatment. When the peak flows have receded to a level that is permitting, wastewater in the equalization basin would be drained back to the plant headworks via gravity flow.

The anticipated present worth cost of Alternative 5 is $1,446,000. This cost includes all capitol costs, design fees, land acquisition cost, operations and maintenance cost, etc, associated with the proposed improvements. Figure 6-11 provides a detail of the proposed storm water pump station. Figure 6-12 details the proposed layout of the wet weather flow diversion, storm water pump station, force main and equalization basins associated with Alternative 5. Figure 6-14 shows the hydraulic profile for the improvements.

ALTERNATIVE 5
TOTAL VOLUME 4,432,400 GAL.
CUT = 16,778 C.Y.
FILL = 10,880 C.Y.

LAND AQUISITION REQUIREMENT = 7 ACRES



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City of ROLLA

CITY OF ROLLA, MO
WET WEATHER FLOW EVALUATION

PROJECT NO. 11129910

VICHY ROAD WWTP
SOUTHWEST BASIN, NO I & I REDUCTION
ALTERNATIVE 5 PLAN

DRAWING NO. 6-12

6.2.2 Alternative 6 – Southwest Basin, 25-percent I/I Reduction

This alternative is identical to Alternate 5, except that the total basin volume shall be taken to be 3-million gallons, which will be sufficient to store flows from a 10-year (AEP = 10-percent), 4-hour design storm, assuming that I/I into the sanitary sewer collection system is reduced by 25-percent.

The differences between Alternative 5 and 6 are minimal; the gravity sewer conveyance and the general equalization basin layout are the same. The primary difference between the two alternatives is the land area required for the basin, the grading quantities associated with the construction of the basins, the pump equipment size and the required force main diameter.

Because of differences in the planned water surface elevations of the basins and the lower anticipated peak flow rate into the facility, the submersible non-clog centrifugal pumps for Alternative No. 6 will driven by 20-Hp, 3-phase, 480V, 60-Hz motors. The anticipated operating duty point for each pump is 1,056-gpm at 41.4-ft total dynamic head (TDH). The force main diameter for this alternative shall be 12-inches.

The anticipated present worth cost of Alternative 6 is $1,196,000. This cost includes all capital costs, design fees, land acquisition cost, operations and maintenance cost, etc, associated with the proposed improvements. Figure 6-13 details the proposed layout of the wet weather flow diversion, storm water pump station, force main and equalization basins associated with Alternative 6. Figure 6-14 shows the hydraulic profile for the improvements.

6.2.3 Alternative 7 – North Basin, No I/I Reduction

This alternative assumes that an equalization basin will be constructed due north of the Vichy Road WWTP. The total basin volume shall be taken to be 4.15-million gallons, which will be sufficient to store flows from a 10-year (AEP = 10-percent), 4-hour design storm, assuming that no I/I reduction is achieved within the sanitary sewer collection system.

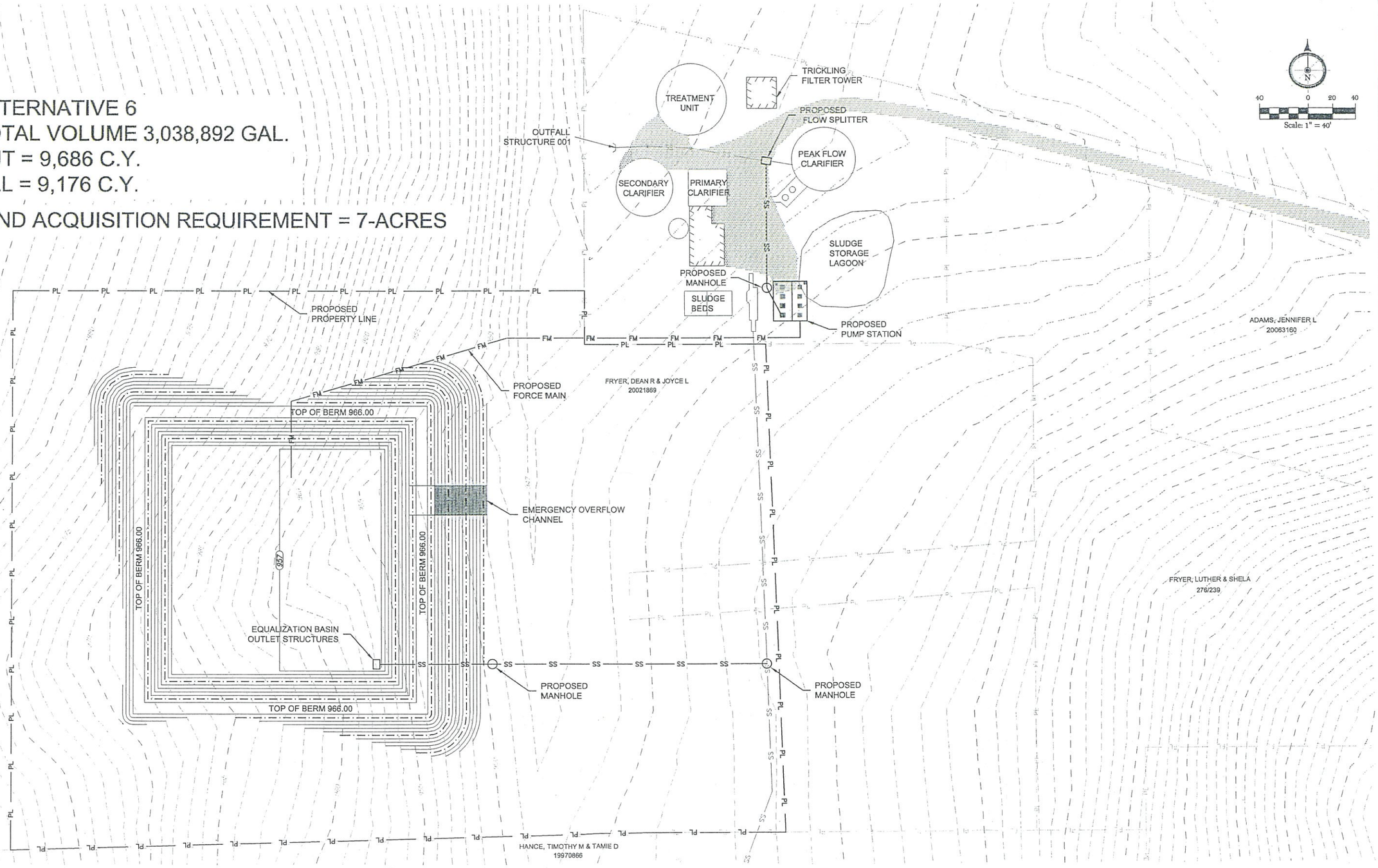
As detailed in Section 3.2, flows in excess of the plant capacity are ultimately diverted to the peak flow clarifier for primary treatment and blended with treated effluent prior to discharge from the facility. Within the scope of Alternative 7, flows from the peak flow clarifier would be diverted with a flow splitter placed prior to the Outfall No. 001, to a new gravity sewer conveyance. The flow splitter would be designed to limit flows to the storm water pump station to 2,778-gpm; flows in excess of 2,778-gpm would be discharged from the Outfall No. 001 limit the potentially adverse increases in the hydraulic profile at higher flowrates. The gravity sewer would consist of 18-inch diameter RCP pipe. The sewer line would have an inverted siphon immediately preceding its discharge to the equalization basin.

The equalization basin was design with one cells. The gravity sewer will discharge directly into the cell. A level sensing float switch would be installed in cell to provide a high water level indication which would be utilized to shut a motorized normally open sluice gate located at the flows splitter downstream of the peak flow clarifier. The closure of the gate would prevent discharges from occurring at the equalization basin. During normal operation of the facility, the only time that discharges form the basin would occur is when the operator opens a manual valve on outlet structure to drain stored wastewater back to the WWTP for secondary treatment.

When the peak flows have receded to a level that is permitting, stored wastewater in the equalization basin would be pumped back to the plant headworks. The equalization basin pump station would consist of a duplex submersible non-clog centrifugal pump station designed to convey 280-gpm at 25-ft TDH. The pump station would be configured such that one firm pump would operate to achieve the desired design duty point, with the second pump being utilized as a standby unit. The pump station

ALTERNATIVE 6
TOTAL VOLUME 3,038,892 GAL.
CUT = 9,686 C.Y.
FILL = 9,176 C.Y.

LAND ACQUISITION REQUIREMENT = 7-ACRES



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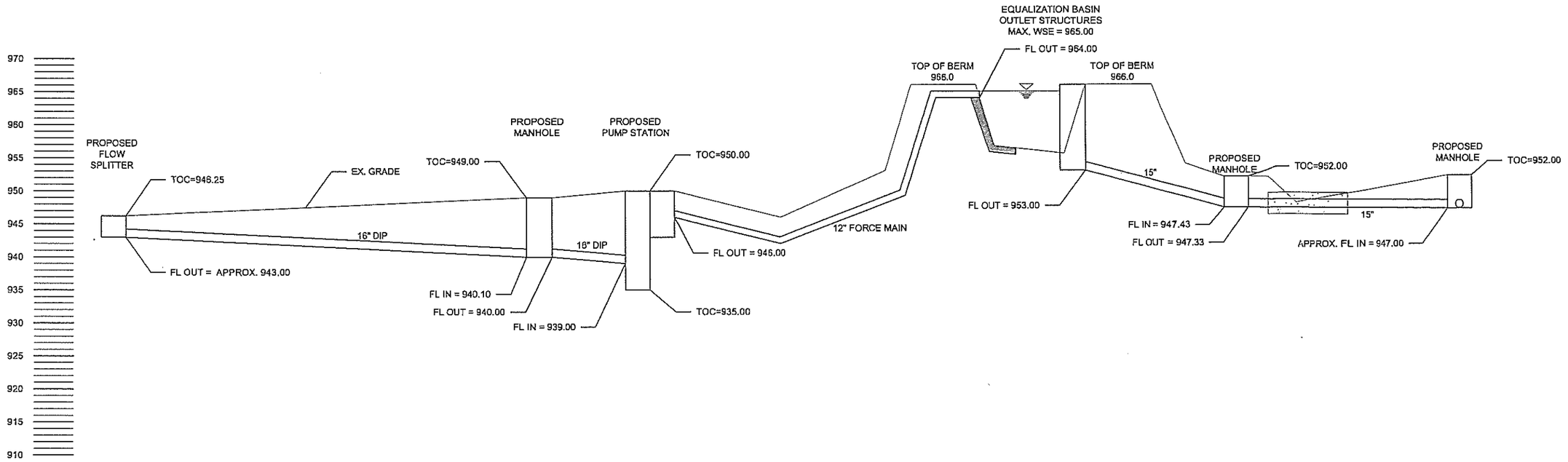
City of ROLLA

CITY OF ROLLA, MO
WET WEATHER FLOW EVALUATION

PROJECT NO. 11129910

VICHY ROAD WWTP
SOUTHWEST BASIN, 25% I & I REDUCTION
ALTERNATIVE 6 PLAN

DRAWING NO. 6-13



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WET WEATHER FLOW EVALUATION

PROJECT NO. 11129910

VICHY ROAD WWTP
ALTERNATIVES 5 & 6
HYDRAULIC PROFILES

DRAWING NO. 6-14

would discharge to a 6-inch diameter ductile iron pipe force main which would travel 1,800-ft south toward the plant headworks. The force main would generally follow the proposed equalization basin gravity sewer conveyance. The discharge location for the force main would be approximately 20-ft upstream of the plant headworks, where a doghouse manhole would be installed.

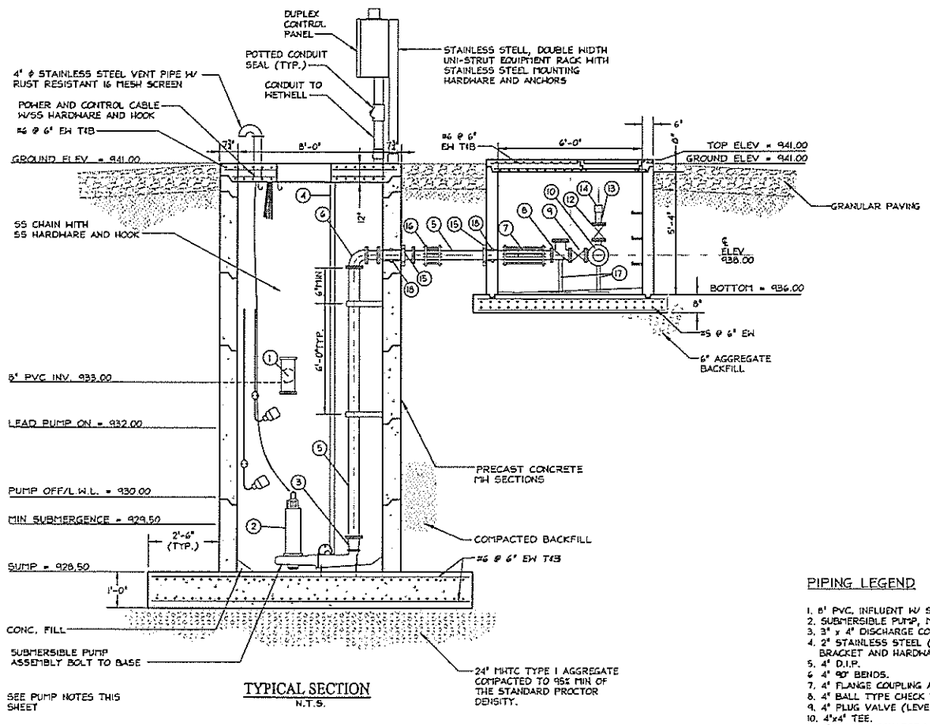
The anticipated present worth cost of Alternative 7 is $1,736,000. This cost includes all capitol costs, design fees, land acquisition cost, operations and maintenance cost, etc, associated with the proposed improvements. Figure 6-15 provides a detail of the proposed storm water pump station. Figure 6-16 details the proposed layout of the wet weather flow diversion, storm water pump station, force main and equalization basins associated with Alternative 7. Figure 6-18 shows the hydraulic profile for the improvements.

6.2.4 Alternative 8 – North Basin, 25-percent I/I Reduction

This alternative is identical to Alternate 7, except that the total basin volume shall be taken to be 3-million gallons, which will sufficient to store flows from a 10-year (AEP = 10-percent), 4-hour design storm, assuming that I/I into the sanitary sewer collection system is reduced by 25-percent.

The differences between Alternative 7 and 8 are minimal; the gravity sewer conveyance, the general equalization basin layout, the equalization basin pump station and force main are all the same. The primary difference would be that the flow splitter would be designed to limit the flowrate to the equalization basin to 2,020-gpm.

The anticipated present worth cost of Alternative 8 is $1,536,000. This cost includes all capital costs, design fees, land acquisition cost, operations and maintenance cost, etc, associated with the proposed improvements. Figure 6-17 details the proposed layout of the wet weather flow diversion, storm water pump station, force main and equalization basins associated with Alternative 6. Figure 6-18 shows the hydraulic profile for the improvements.



TYPICAL SECTION
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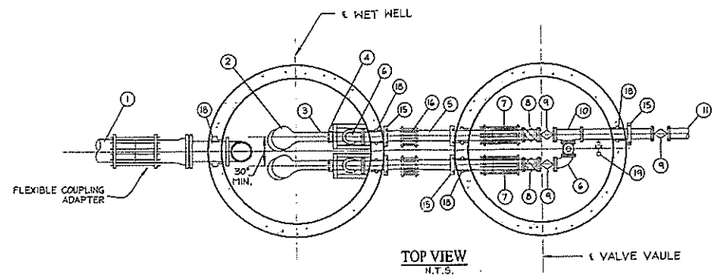
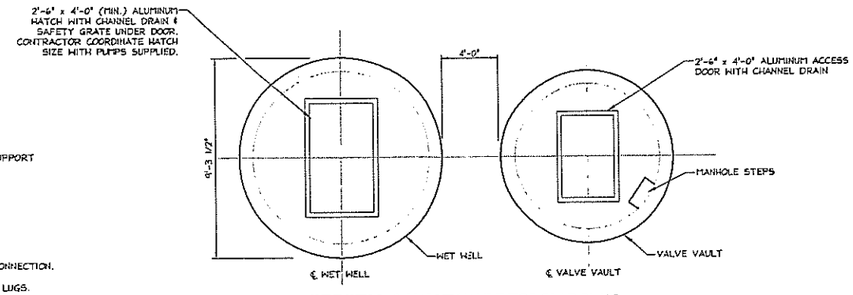


TOP VIEW
N.T.S.

PIPING LEGEND

1. 8" PVC. INFLUENT W/ SOLVENT WELDED VERTICAL TEE DEFLECTOR
2. SUBMERSIBLE PUMP, MOTOR AND PUMP BASE.
3. 3" x 4" DISCHARGE CONNECTION
4. 2" STAINLESS STEEL (SS) GUIDE BARS AND SS GUIDE RAIL AND PIPE SUPPORT BRACKET AND HARDWARE.
5. 4" D.I.P.
6. 4" 90° BENDS.
7. 4" FLANGE COUPLING ADAPTER (RESTRAINED)
8. 4" BALL TYPE CHECK VALVE.
9. 4" PLUG VALVE (LEVER OPERATED OR BURIED SERVICE).
10. 4"x4" TEE.
11. 4" D.I.P. DISCHARGE LINE.
12. 4" PLUG VALVE.
13. 4" D.I.P. SPOOL PIECE THREADED ON PLAIN END FOR PORTABLE PUMP CONNECTION.
14. 4" THREADED CAP.
15. GALVANIZED PIPE CLAMPS B-LINE OR APPROVED EQUAL W/WELDED PIPE LUGS.
16. 4" FLEXIBLE SLEEVE COUPLING. (RESTRAINED).
17. STAINLESS STEEL PIPE SUPPORTS.
18. LINK SEAL IN WALL SLEEVE (TYP.).
19. OMEGA PGH-45L-160PSI-1/4-100-SS-1/4G STAINLESS STEEL, LIQUID FILLABLE INDUSTRIAL PRESSURE GAUGE, DIAPHRAGM PRESSURE SEAL, 1/4" NPT STAINLESS STEEL BALL VALVE AND CLOSE NIPPLE.



WET WELL & VALVE VAULT TOP SLAB PLAN

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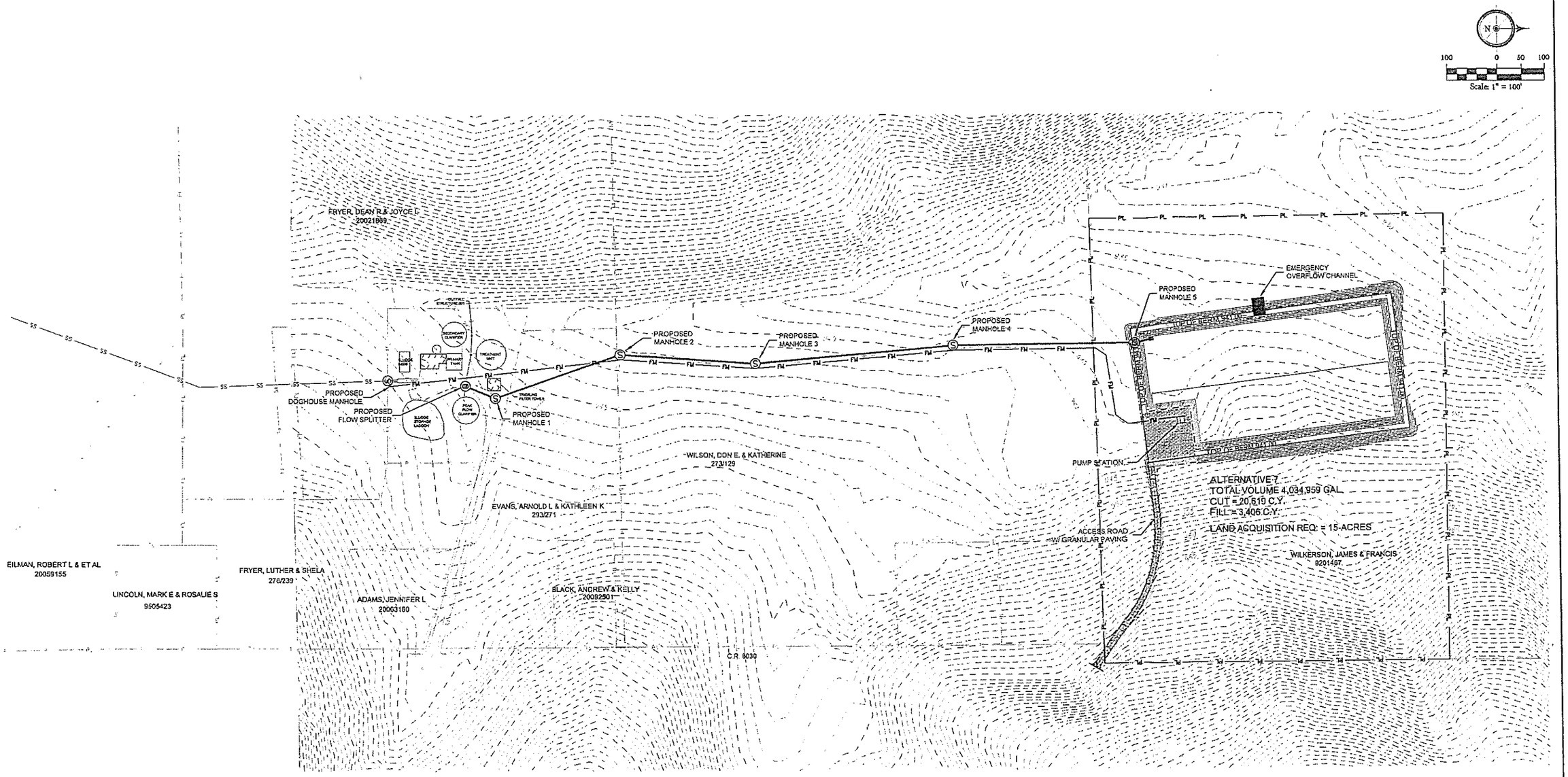
WET WEATHER FLOW EVALUATION

VICHY ROAD WWTP EQ FACILITIES
STORM WATER PUMP STATION
ALTERNATIVE 7 & 8

PROJECT NO. 11129910

DRAWING NO. 6-15



DRAWING FILE NAME: Rolla SSES opt 5 4 mil gal		PROJECT NO.: 11129910	
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FILES ATTACHED:	DESIGNED BY: KAC	DRAWN BY: JSM	CHECKED BY: JAM
ATTACHED FILE NAMES:			

HDR
HDR ENGINEERING, INC
MO. STATE CERTIFICATE
OF AUTHORITY #000856
3741 NE TROON DRIVE
LEE'S SUMMIT, MO 64064

ARCHER
1100 NORTH OUTER ROAD
ST. JAMES, MO 65559
573-265-9193 • FAX 573-265-9193

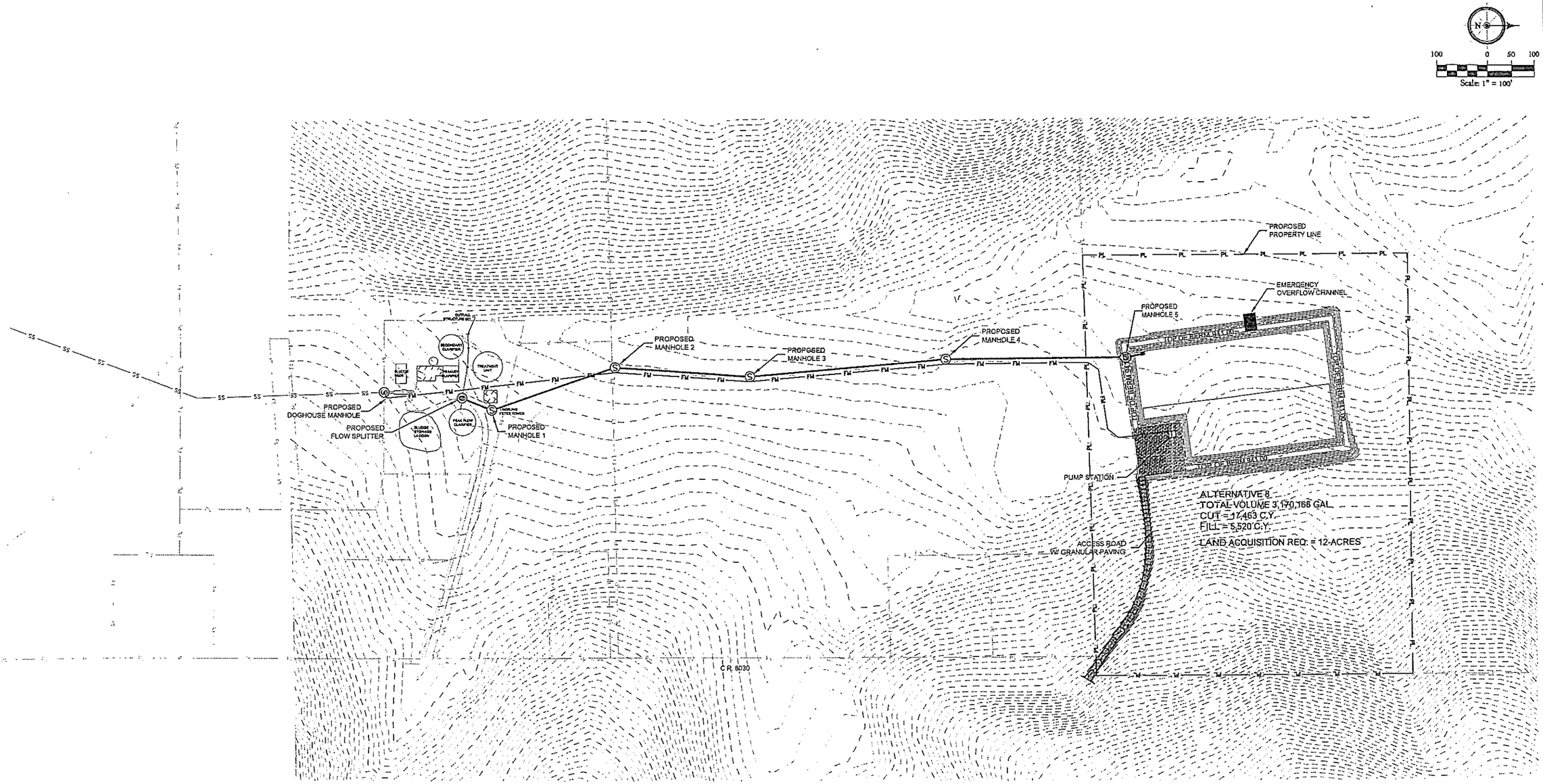
City of ROLLA

CITY OF ROLLA, MO
WET WEATHER FLOW EVALUATION

PROJECT NO. 11129910

VICHY ROAD WWTF
NORTH BASIN, NO I & I REDUCTION
ALTERNATIVE 7 PLAN

DRAWING NO. 6-16



DRAWING FILE NAME: Rolla SSES opt 5 4 mil gal		PROJECT NO.: 11129910	
DATE LAST SAVED: 06/15/11	PLOT SCALE: 1:1	DATE/TIME PLOTTED:	
FILES ATTACHED:	DESIGNED BY: KAC	DRAWN BY: JSM	CHECKED BY: JAM
ATTACHED FILE NAMES:			

HDR

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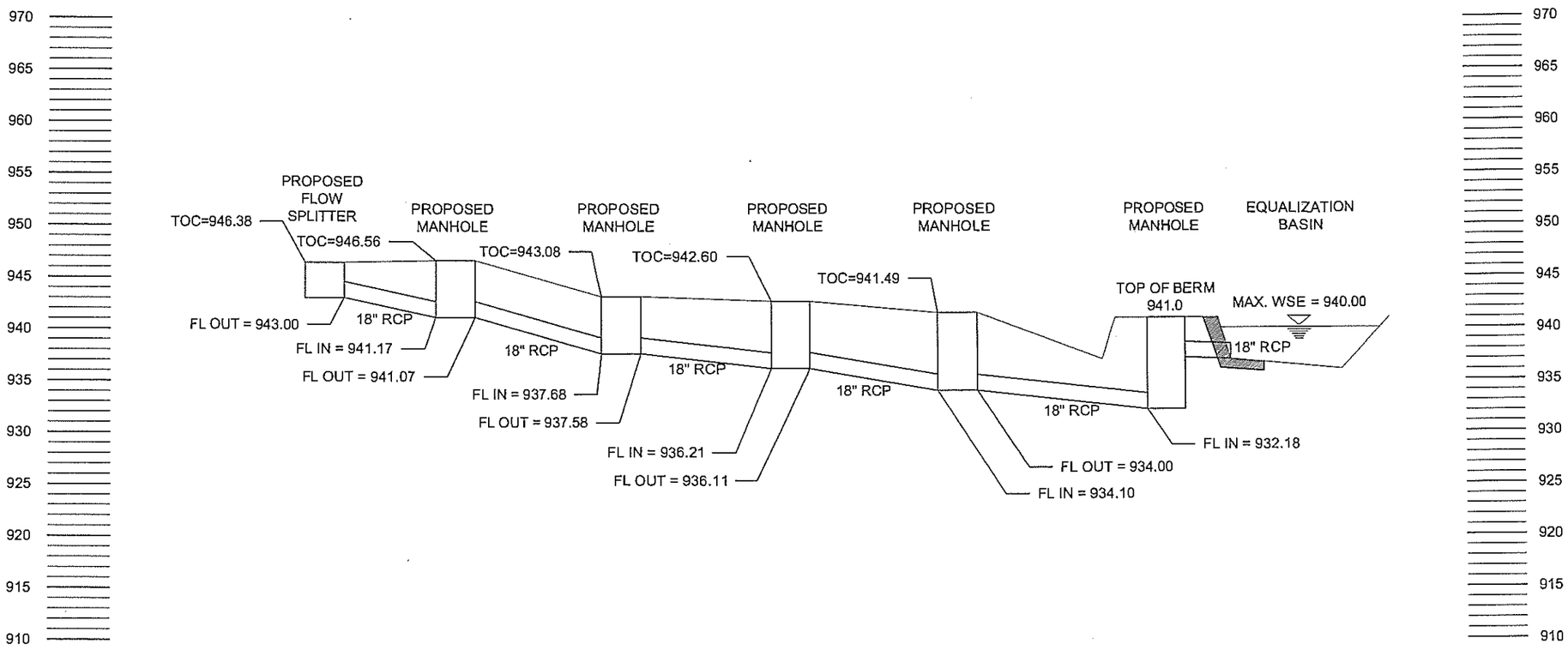
City of ROLLA

CITY OF ROLLA, MO
WET WEATHER FLOW EVALUATION

PROJECT NO. 11129910

VICHY ROAD WWTP
NORTH BASIN, 25% I & I REDUCTION
ALTERNATIVE 8 PLAN

DRAWING NO. 6-17



DRAWING FILE NAME: Rolla SSES opt 5 4 mil gal		PROJECT NO.: 11129910	
DATE LAST SAVED: 06/15/11	PLOT SCALE: 1:1	DATE/TIME PLOTTED:	
FILES ATTACHED:	DESIGNED BY: KAC	DRAWN BY: JSM	CHECKED BY: JAM
ATTACHED FILE NAMES:			

HDR
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City of ROLLA

CITY OF ROLLA, MO
WET WEATHER FLOW EVALUATION

PROJECT NO. 11129910

VICHY ROAD WWTP
ALTERNATIVE 7 & 8
HYDRAULIC PROFILE

DRAWING NO. 6-18

6.3 SUMMARY OF IMPROVEMENT ALTERNATIVES

As detailed above, multiple alternatives were investigated regarding the implementation of equalization basin facilities for both the SE WWTP and the Vichy Road WWTP. Table 6-1, located below provides a summary of anticipated project present worth costs for the SE WWTP alternatives. Table 6-2, also located below provides a summary of the project present worth costs for the Vichy Road WWTP alternatives. All opinions of project costs were compiled assuming that the City would pursue competitive bids for the implementation of the proposed improvements.

Table 6-1: SE WWTP Alternatives Summary

Alternative No.	Alternative Description	Capital Cost	Annual O&M Cost	Present Worth Cost
1A	West Basin, 36-mil gallons P.F. = 31,000-gpm	$8,190,000	$19,000	$8,420,000
1B	North Basin, 36-mil gallons P.F. = 31,000-gpm	$8,330,000	$19,000	$8,560,000
2A	West Basin, 27-mil gallons P.F. = 24,000-gpm	$6,350,000	$17,000	$6,550,000
2B	North Basin, 27-mil gallons P.F. = 24,000-gpm	$6,060,000	$16,000	$6,250,000
3	East Basin, 36-mil gallons P.F. = 31,000-gpm	$6,760,000	$14,000	$6,920,000
4	East Basin, 27-mil gallons P.F. = 24,000-gpm	$5,640,000	$12,000	$5,780,000

Table 6-2: Vichy Road WWTP Alternatives Summary

Alternative No.	Alternative Description	Capital Cost	Annual O&M Cost	Present Worth Cost
5	Southwest Basin, 4.15-mil gallons P.F. = 2,700-gpm	$1,380,000	$6,000	$1,450,000
6	Southwest Basin, 3.0-mil gallons P.F. = 2,100-gpm	$1,130,000	$6,000	$1,200,000
7	North Basin, 4.5-mil gallons P.F. = 2,700-gpm	$1,680,000	$6,000	$1,740,000
8	North Basin, 3.0-mil gallons P.F. = 2,100-gpm	$1,480,000	$6,000	$1,540,000

6.4 DISCUSSION OF ALTERNATIVES

As can be seen in Table 6-1 above, the most cost effective equalization basin alternatives for the SE WWTP are those involving the placement of equalization basin facilities downstream of the treatment facilities. The placement of equalization basin facilities downstream of the facilities eliminates the need for a large pump station sized to meet anticipated peak flows. The elimination of the large pump station greatly reduces the overall project cost as well as the anticipated operation and maintenance associated with running the equipment.

The lower peak flow rate and required static head of Vichy Road WWTP resulted in similar pump station costs for the upstream and downstream alternatives. However, the shorter conveyance distance to the upstream basin made it more cost effective.

Present worth costs for the "No I/I Reduction" and "25-percent I/I Reduction" were determined by design as described above. Based on trends seen between costs for the "No I/I Reduction" and "25-percent I/I Reduction" alternatives, it is anticipated that if the "50-percent I/I Reduction" case could be achieved, an additional 20 to 30-percent savings would be seen for the SE WWTP equalization basin facility. An additional 10 to 20-percent savings would be realized for the Vichy Road WWTP equalization basin facility. It should be stressed that the currently proposed improvement alternatives are based on the best sanitary sewer flow data available at the time of the analysis. It is anticipated that as additional sanitary sewer flow data is obtained, that the design of the equalization basin can be refined.

Based on results from numerous I/I studies performed by HDR Engineering and CM Archer Group, several rules of thumb regarding I/I elimination have been developed for use within this analysis. Generally it has been observed that for every $250,000 spent on private source (buildings, direct connections, and service laterals) I/I reduction projects, a total of 1-million gallons of I/I can be eliminated at the WWTP during wet weather events. Furthermore, it has been observed that for every $1,000,000 spent on public sector I/I reduction projects, a total of 1-million gallons of I/I can be eliminated. These numbers may vary considerably based on the quantity and types of I/I sources found within a collection system and the degree to which I/I is present within the collection system. When a combination of private and public sector projects are implemented, the cost of I/I removal generally approaches $400,000 to $500,000 per million gallons of I/I removed.

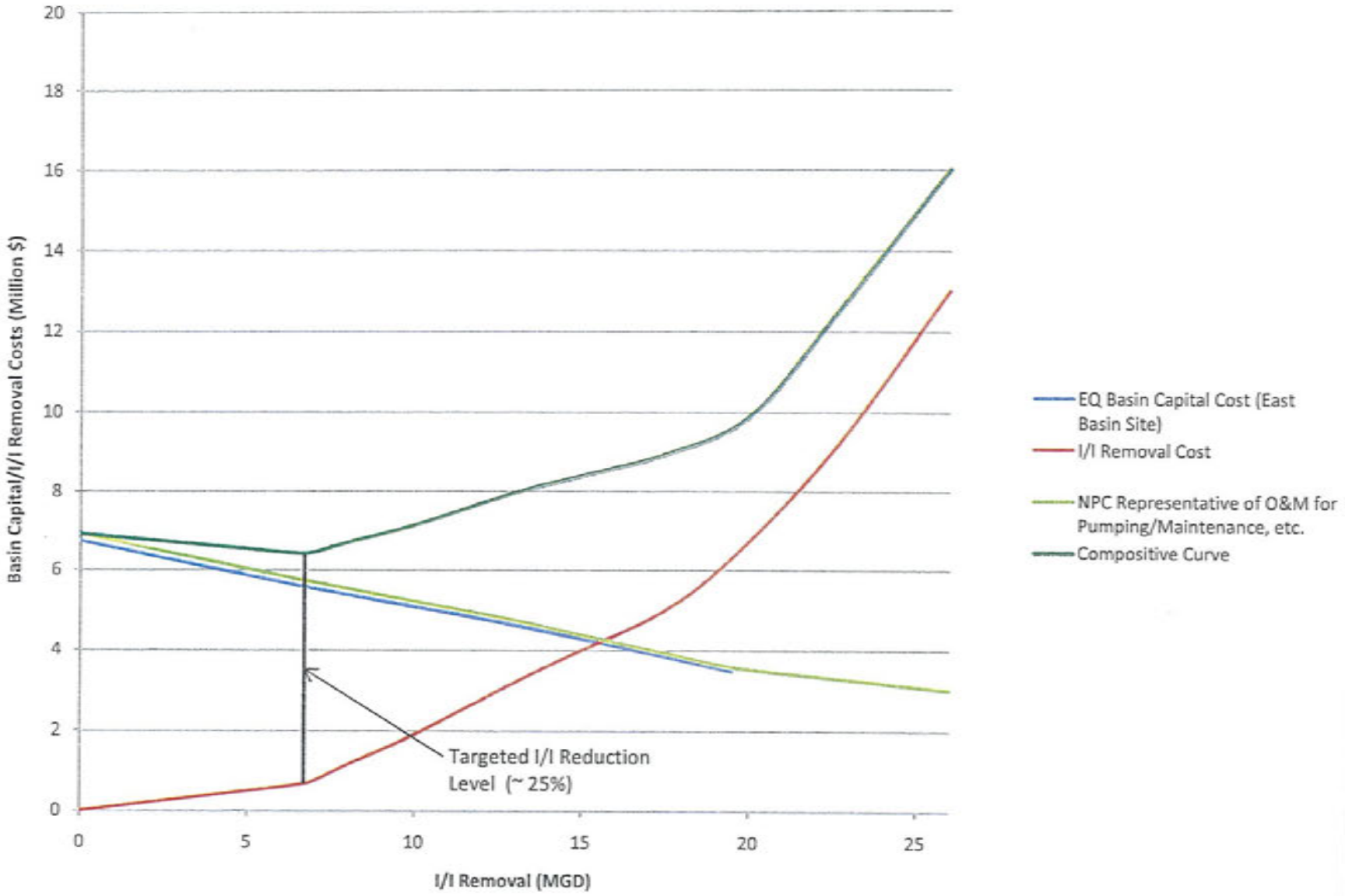
Because the City is intent on implementing an I/I inspection and removal program utilizing City personnel and equipment, it is anticipated that the costs of I/I removal will be lower for Rolla relative to I/I removal programs implemented for other communities. For the purposes of this study, a representative public sector improvements cost of approximately $500,000 per million gallons of I/I removal will be used. It should be noted that of each $500,000 spent, approximately 50-percent of that money would be utilized to reduce further age related degredation of the collection system. It should be stressed that the City's collection system is old, with an average age of 37-years. Furthermore, approximately 47-percent of the City's collection system is constructed with vitrified clay pipes, which are prone to structural failure and root intrusion. These factors combine to require that additional maintenance, repair and rehabilitation be performed to limit I/I into and further degredation of the collection system. The remaining 50-percent would be utilized for the elimination of existing I/I sources within the collection system.

Typically, there is a point at which a diminishing marginal return for public sector I/I removal is realized, after which each unit I/I removed becomes more expensive. When the point of diminishing marginal return is reached, it is typically more cost-effective to convey and treat the flow. Within the scope of this project, the point of diminishing marginal return was utilized to determine optimal size requirement

for the proposed equalization basin. Generally, the point of diminishing marginal return can be determined via a cost-effective curve that is constructed based on the estimated quantity of I/I and the associated repair costs for the I/I sources identified during field inspections.

At this time, field inspection results are not yet available to use in constructing the cost-effective curve. Therefore, a representative cost-effective curve was created based on typical I/I removal cost-effective curves. Figure 6-19 on the following page shows this representative curve for the Southeast WWTP (a similar curve shape would apply to the Vichy Road WWTP as well). As can be seen from the curve, it is expected the target I/I reduction level will be approximately 25%, and it is recommended that the equalization basin facilities be sized to accommodate the anticipated flows. Furthermore, it is recommended that a cost-effective curve be developed and continuously updated as field inspections are conducted, and the cost to remove I/I within the collection system can be determined more accurately.

Figure 6-19 Typical Cost-Effective Curve for Southeast WWTP



7 RECOMMENDED IMPLEMENTATION PLAN

7.1 IMPLEMENTATION PLAN

As detailed in Sections No. 1 and No. 4 of this report, the proposed improvements should be implemented within the scope of the Bypass Elimination Plan currently being developed by HDR Engineering and CM Archer Group for the City. It is anticipated that the City will have 8-years to work on the reduction of I/I volumes within the collection system. During this time, the City should work steadily to inspect, locate and remediate potential sources of I/I within the publicly owned sanitary sewer collection system. At the same time, the City must annually monitor sanitary sewer flows within the collection system and at the WWTFs in an effort to track their progress in reducing I/I volumes currently observed.

With respect to the equalization basins, the City should move immediately to obtain the land area necessary at both the Southeast and Vichy Road WWTF to allow for their future construction. It is recommended that the City purchase enough land area to allow the construction of an equalization basin which would have the capacity to detain excess flows assuming no I/I reduction within the collection system was achieved. During the eighth year of the BEP implementation, the City must pursue the construction of equalization basin alternatives detailed above. It is anticipated that final design of the equalization basin and conveyance systems would be performed during that year, with construction of the proposed facilities occurring during the ninth year of the BEP implementation. The ultimate goal would be to have a fully functional equalization basin facility implemented at both WWTPs at the end of the 10-year term for the VCA. A summary of the proposed schedule for the implementation of the equalization basin alternatives is listed below.

Table 7-1: Equalization Basin Alternatives Implementation Summary

VCA/BEP Year	Task
Annually	– Inspection, location and remediation of I/I within the sanitary sewer collection system. – Monitoring of sanitary sewer flows within the collection system and at the WWTPs.
1	– Obtain land for construction of proposed equalization basin facilities.
8	– Begin final design of the proposed equalization basin and conveyance facilities.
9	– Bid and construct the proposed equalization basin and conveyance facilities per final design
10	– Perform start-up of proposed facilities in accordance with the VCA

APPENDIX A – COST ESTIMATES

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1100 North Outer Road
St. James, Mo. 65559
573-265-0190 • Fax 573-265-0193

Project: HDR - Rolla Wastewater System
Client: City of Rolla, Missouri
By: KAC **Chk:**
Date: 8/13/2011 **Date:**

Opinion of Probable Project Cost

SE WWTF EQ Facilities - Alternative 1A

EQ Facilities - Alternative 1A: Shall involve the construction of a new quadraplex submersible non-clog pump station convey anticipated storm water flows in excess of the treatment facility capacity. Alternative 1A shall include, but not be limited to: flow splitters for the redirection of flows from Outfall No. 2 & 3 to the proposed pump station; a quadraplex pump station capable of conveying 31,000-gpm; force main for the conveyance of flows to the proposed equalization basin; a 36-million gallon equalization basin for the storage of excess flows; and a gravity sewer system to drain flows back to the WWTF for treatment after passing of storm event and recession of peak flows.

Item No.	Description	Qty	Unit	Unit Price	Total
Gravity Conveyance to Pump Station					
1	Flow Splitter	2	EA	$20,000.00	$40,000.00
2	30" RCP	380	LF	$60.00	$22,800.00
3	36" Ductile Iron Pipe	20	LS	$300.00	$6,000.00
4	60" Dia Manholes, 6 to 9-ft Deep	2	EA	$4,000.00	$8,000.00
5	6' x 6' Junction Box	1	EA	$5,000.00	$5,000.00
Pump Station					
6	Unclassified Excavation for Proposed PS	1	LS	$100,000.00	$100,000.00
7a	Electrical Power Supply (Primary)	1	LS	$125,000.00	$125,000.00
7b	Electrical Power Supply (Secondary)	1	LS	$125,000.00	$125,000.00
7c	Electrical Service Entry & Misc Equipment	1	LS	$250,000.00	$250,000.00
7d	Electrical - MCC w/ VFD	1	LS	$300,000.00	$300,000.00
7e	Prefabricated Concrete Electrical Building	1	LS	$100,000.00	$100,000.00
8a	Pump Equipment, Accessories & Controls	1	LS	$750,000.00	$750,000.00
8b	Pump Equipment, Accessories & Controls Installation	1	LS	$125,000.00	$125,000.00
9	Quadraplex Wetwell & Valve Vault Structure	1	LS	$200,000.00	$200,000.00
10	Miscellaneous Process Piping	1	LS	$110,000.00	$110,000.00
Force Main					
11	42" Ductile Iron Pipe, Restrained Joint	2,100	LF	$375.00	$787,500.00
12	Force Main Discharge Structure	1	LS	$15,000.00	$15,000.00
Equalization Basin					
13	EQ Basin Unclassified Excavation & Grading	1	LS	$1,096,161.00	$1,096,161.00
14	EQ Basin Liner System	1	LS	$870,764.00	$870,764.00
15	Underdrain System	7,000	LF	$30.00	$210,000.00
16	EQ Basin Outlet Structures	3	EA	$7,500.00	$22,500.00
17	15" ASTM D3034 SDR-35 PVC Sewer Line	1,410	LF	$55.00	$77,550.00
18	48" Dia Manholes, 6 to 12-ft Deep	5	EA	$2,500.00	$12,500.00

Subtotal =	$5,358,775
Contingency (20%) =	$1,071,755.0
Construction Subtotal =	**$6,430,530**
Engineering, Legal and Administration =	$1,607,700
Land Acquisition (30-Acres) =	$150,000
Opinion of Probable Project Cost =	**$8,188,300**

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Project: HDR - Rolla Wastewater System
Client: City of Rolla, Missouri
By: KAC **Chk:**
Date: 8/13/2011 **Date:**

Opinion of Probable Project Cost

SE WWTF EQ Facilities - Alternative 1B

EQ Facilities - Alternative 1B: Shall involve the construction of a new quadraplex submersible non-clog pump station convey anticipated storm water flows in excess of the treatment facility capacity. Alternative 1B shall include, but not be limited to: flow splitters for the redirection of flows from Outfall No. 2 & 3 to the proposed pump station; a quadraplex pump station capable of conveying 31,000-gpm; force main for the conveyance of flows to the proposed equalization basin; a 36-million gallon equalization basin for the storage of excess flows; and a gravity sewer system to drain flows back to the WWTF for treatment after passing of storm event and recession of peak flows.

Item No.	Description	Qty	Unit	Unit Price	Total
Gravity Conveyance to Pump Station					
1	Flow Splitter	2	EA	$20,000.00	$40,000.00
2	30" RCP	380	LF	$60.00	$22,800.00
3	36" Ductile Iron Pipe	20	LS	$300.00	$6,000.00
4	60" Dia Manholes, 6 to 9-ft Deep	2	EA	$4,000.00	$8,000.00
5	6' x 6' Junction Box	1	EA	$5,000.00	$5,000.00
Pump Station					
6	Unclassified Excavation for Proposed PS	1	LS	$100,000.00	$100,000.00
7a	Electrical Power Supply (Primary)	1	LS	$125,000.00	$125,000.00
7b	Electrical Power Supply (Secondary)	1	LS	$125,000.00	$125,000.00
7c	Electrical Service Entry & Misc Equipment	1	LS	$250,000.00	$250,000.00
7d	Electrical - MCC w/ VFD	1	LS	$300,000.00	$300,000.00
7e	Prefabricated Concrete Electrical Building	1	LS	$100,000.00	$100,000.00
8a	Pump Equipment, Accessories & Controls	1	LS	$750,000.00	$750,000.00
8b	Pump Equipment, Accessories & Controls Installation	1	LS	$125,000.00	$125,000.00
9	Quadraplex Wetwell & Valve Vault Structure	1	LS	$200,000.00	$200,000.00
10	Miscellaneous Process Piping	1	LS	$110,000.00	$110,000.00
Force Main					
11	42" Ductile Iron Pipe, Restrained Joint	1,700	LF	$375.00	$637,500.00
12	Force Main Discharge Structure	1	LS	$15,000.00	$15,000.00
Equalization Basin					
13	EQ Basin Unclassified Excavation & Grading	1	LS	$1,096,161.00	$1,096,161.00
14	EQ Basin Liner System	1	LS	$1,083,772.00	$1,083,772.00
15	Underdrain System	7,670	LF	$30.00	$230,100.00
16	EQ Basin Outlet Structures	3	EA	$7,500.00	$22,500.00
17	15" ASTM D3034 SDR-35 PVC Sewer Line	1,370	LF	$55.00	$75,350.00
18	48" Dia Manholes, 6 to 12-ft Deep	3	EA	$2,500.00	$7,500.00

Subtotal =	$5,434,683
Contingency (20%) =	$1,086,936.6
Construction Subtotal =	**$6,521,620**
Engineering, Legal and Administration =	$1,630,500
Land Acquisition (35-Acres) =	$175,000
Opinion of Probable Project Cost =	**$8,328,000**

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Client: City of Rolla, Missouri
By: KAC **Chk:**
Date: 8/13/2011 **Date:**

Opinion of Probable Project Cost

SE WWTF EQ Facilities - Alternative 2A

EQ Facilities - Alternative 2A: Shall involve the construction of a new quadraplex submersible non-clog pump station convey anticipated storm water flows in excess of the treatment facility capacity. Alternative 2A shall include, but not be limited to: flow splitters for the redirection of flows from Outfall No. 2 & 3 to the proposed pump station; a quadraplex pump station capable of conveying 24,000-gpm; force main for the conveyance of flows to the proposed equalization basin; a 27-million gallon equalization basin for the storage of excess flows; and a gravity sewer system to drain flows back to the WWTF for treatment after passing of storm event and recession of peak flows.

Item No.	Description	Qty	Unit	Unit Price	Total
Gravity Conveyance to Pump Station					
1	Flow Splitter	2	EA	$20,000.00	$40,000.00
2	30" RCP	380	LF	$60.00	$22,800.00
3	36" Ductile Iron Pipe	20	LS	$300.00	$6,000.00
4	60" Dia Manholes, 6 to 9-ft Deep	2	EA	$4,000.00	$8,000.00
5	6' x 6' Junction Box	1	EA	$5,000.00	$5,000.00
Pump Station					
6	Unclassified Excavation for Proposed PS	1	LS	$100,000.00	$100,000.00
7a	Electrical Power Supply (Primary)	1	LS	$100,000.00	$100,000.00
7b	Electrical Power Supply (Secondary)	1	LS	$100,000.00	$100,000.00
7c	Electrical Service Entry & Misc Equipment	1	LS	$200,000.00	$200,000.00
7d	Electrical - MCC w/ VFD	1	LS	$250,000.00	$250,000.00
7e	Prefabricated Concrete Electrical Building	1	LS	$100,000.00	$100,000.00
8a	Pump Equipment, Accessories & Controls	1	LS	$525,000.00	$525,000.00
8b	Pump Equipment, Accessories & Controls Installation	1	LS	$75,000.00	$75,000.00
9	Quadraplex Wetwell & Valve Vault Structure	1	LS	$200,000.00	$200,000.00
10	Miscellaneous Process Piping	1	LS	$110,000.00	$110,000.00
Force Main					
11	42" Ductile Iron Pipe, Restrained Joint	2,025	LF	$375.00	$759,375.00
12	Force Main Discharge Structure	1	LS	$15,000.00	$15,000.00
Equalization Basin					
13	EQ Basin Unclassified Excavation & Grading	1	LS	$679,651.00	$679,651.00
14	EQ Basin Liner System	1	LS	$582,414.00	$582,414.00
15	Underdrain System	5,600	LF	$30.00	$168,000.00
14	EQ Basin Outlet Structures	3	EA	$7,500.00	$22,500.00
15	15" ASTM D3034 SDR-35 PVC Sewer Line	1,155	LF	$55.00	$63,525.00
16	48" Dia Manholes, 6 to 12-ft Deep	5	EA	$2,500.00	$12,500.00

Subtotal =	$4,144,765
Contingency (20%) =	$828,953.0
Construction Subtotal =	**$4,973,718**
Engineering, Legal and Administration =	$1,243,500
Land Acquisition (25-Acres) =	$125,000
Opinion of Probable Project Cost =	**$6,342,300**

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Project: HDR - Rolla Wastewater System
Client: City of Rolla, Missouri
By: KAC **Chk:**
Date: 8/13/2011 **Date:**

Opinion of Probable Project Cost

SE WWTF EQ Facilities - Alternative 2B

EQ Facilities - Alternative 2B: Shall involve the construction of a new quadraplex submersible non-clog pump station convey anticipated storm water flows in excess of the treatment facility capacity. Alternative 2B shall include, but not be limited to: flow splitters for the redirection of flows from Outfall No. 2 & 3 to the proposed pump station; a quadraplex pump station capable of conveying 24,000-gpm; force main for the conveyance of flows to the proposed equalization basin; a 27-million gallon equalization basin for the storage of excess flows; and a gravity sewer system to drain flows back to the WWTF for treatment after passing of storm event and recession of peak flows.

Item No.	Description	Qty	Unit	Unit Price	Total
Gravity Conveyance to Pump Station					
1	Flow Splitter	2	EA	$20,000.00	$40,000.00
2	30" RCP	380	LF	$60.00	$22,800.00
3	36" Ductile Iron Pipe	20	LS	$300.00	$6,000.00
4	60" Dia Manholes, 6 to 9-ft Deep	2	EA	$4,000.00	$8,000.00
5	6' x 6' Junction Box	1	EA	$5,000.00	$5,000.00
Pump Station					
6	Unclassified Excavation for Proposed PS	1	LS	$100,000.00	$100,000.00
7a	Electrical Power Supply (Primary)	1	LS	$100,000.00	$100,000.00
7b	Electrical Power Supply (Secondary)	1	LS	$100,000.00	$100,000.00
7c	Electrical Service Entry & Misc Equipment	1	LS	$200,000.00	$200,000.00
7d	Electrical - MCC w/ VFD	1	LS	$250,000.00	$250,000.00
7e	Prefabricated Concrete Electrical Building	1	LS	$100,000.00	$100,000.00
8a	Pump Equipment, Accessories & Controls	1	LS	$475,000.00	$475,000.00
8b	Pump Equipment, Accessories & Controls Installation	1	LS	$70,000.00	$70,000.00
9	Quadraplex Wetwell & Valve Vault Structure	1	LS	$200,000.00	$200,000.00
10	Miscellaneous Process Piping	1	LS	$110,000.00	$110,000.00
Force Main					
11	42" Ductile Iron Pipe, Restrained Joint	1,550	LF	$375.00	$581,250.00
12	Force Main Discharge Structure	1	LS	$15,000.00	$15,000.00
Equalization Basin					
13	EQ Basin Unclassified Excavation & Grading	1	LS	$708,697.00	$708,697.00
14	EQ Basin Liner System	1	LS	$597,247.00	$597,247.00
15	Underdrain System	5,500	LF	$30.00	$165,000.00
14	EQ Basin Outlet Structures	3	EA	$7,500.00	$22,500.00
15	15" ASTM D3034 SDR-35 PVC Sewer Line	1,190	LF	$55.00	$65,450.00
16	48" Dia Manholes, 6 to 12-ft Deep	4	EA	$2,500.00	$10,000.00

Subtotal =	$3,951,944
Contingency (20%) =	$790,388.8
Construction Subtotal =	**$4,742,333**
Engineering, Legal and Administration =	$1,185,600
Land Acquisition (25-Acres) =	$125,000
Opinion of Probable Project Cost =	**$6,053,000**

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Project: HDR - Rolla Wastewater System
Client: City of Rolla, Missouri
By: KAC **Chk:**
Date: 7/25/2011 **Date:**

Opinion of Probable Project Cost

SE WWTF EQ Facilities - Alternative 3

EQ Facilities - Alternative 3: Shall involve the construction of a 36-inch and 42-inch diameter reinforced concrete gravity sewer system to convey peak flows from the West and East sides of the SE WWTF approximately 1,250-ft downstream of the facility to a new 36-million gallon equalization basin. The anticipated peak flow to be conveyed is 31,000-gpm. The EQ basin will detain excess peak flows generated via a 10-year, 4-hour storm event. A new triplex submersible non-clog pump station would be constructed which would convey detained flows back to the West side for the SE WWTF for treatment, after the recession of the peak flow event. The maximum capacity of the pump station would be 5-mgd.

Item No.	Description	Qty	Unit	Unit Price	Total
Gravity Conveyance to EQ Basin					
1	Flow Splitter	2	EA	$50,000.00	$100,000.00
2	42" RCP	1,485	LF	$90.00	$133,650.00
3	36" RCP	430	LF	$60.00	$25,800.00
4	72" Dia Manholes, 6 to 9-ft Deep	9	EA	$6,750.00	$60,750.00
EQ Basin Pump Station					
5a	Electrical Power Supply (Primary)	1	LS	$100,000.00	$100,000.00
5b	Electrical Power Supply (Secondary)	1	LS	$25,000.00	$25,000.00
5c	Electrical Service Entry & Misc Equipment	1	LS	$25,000.00	$25,000.00
5e	Prefabricated Concrete Electrical Building	1	LS	$50,000.00	$50,000.00
6a	Pump Equipment, Accessories & Controls	1	LS	$200,000.00	$200,000.00
6b	Pump Equipment, Accessories & Controls Installation	1	LS	$30,000.00	$30,000.00
7	Triplex Wetwell & Valve Vault Structure	1	LS	$200,000.00	$200,000.00
8	Miscellaneous Process Piping	1	LS	$47,500.00	$47,500.00
EQ Basin Pump Station Force Main					
9	14" Ductile Iron Pipe, Restrained Joint	3,000	LF	$160.00	$480,000.00
Equalization Basin					
11	EQ Basin Unclassified Excavation & Grading	1	LS	$1,069,508.00	$1,069,508.00
12	EQ Basin Liner System	1	LS	$1,236,727.00	$1,236,727.00
13	Underdrain System	8,000	LF	$30.00	$240,000.00
14	Riprap Revetment	6,000	SY	$35.00	$210,000.00
15	EQ Basin Outlet Structures	2	EA	$7,500.00	$15,000.00
16	15" ASTM D3034 SDR-35 PVC Sewer Line	300	LF	$55.00	$16,500.00
17	12-ft Wide Access Road	1,400	LF	$15.00	$21,000.00
18	Low Water Crossing	1	LS	$15,000.00	$15,000.00
18	Granular Paving	1,388	SY	$25.00	$34,700.00

Subtotal =	$4,336,135
Contingency (20%) =	$867,227.0
Construction Subtotal =	**$5,203,362**
Engineering, Legal and Administration =	$1,300,900
Land Acquisition (50-Acres) =	$250,000
Opinion of Probable Project Cost =	**$6,754,300**

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Project: HDR - Rolla Wastewater System
Client: City of Rolla, Missouri
By: KAC **Chk:**
Date: 7/25/2011 **Date:**

Opinion of Probable Project Cost

SE WWTF EQ Facilities - Alternative 4

EQ Facilities - Alternative 4: Shall involve the construction of a 36-inch and 42-inch diameter reinforced concrete gravity sewer system to convey peak flows from the West and East sides of the SE WWTF approximately 1,250-ft downstream of the facility to a new 27-million gallon equalization basin. The anticipated peak flow to be conveyed is 24,000-gpm. The EQ basin will detain excess peak flows generated via a 10-year, 4-hour storm event. A new triplex submersible non-clog pump station would be constructed which would convey detained flows back to the West side for the SE WWTF for treatment, after the recession of the peak flow event. The maximum capacity of the pump station would be 5-mgd.

Item No.	Description	Qty	Unit	Unit Price	Total
Gravity Conveyance to EQ Basin					
1	Flow Splitter	2	EA	$50,000.00	$100,000.00
2	42" RCP	1,485	LF	$90.00	$133,650.00
3	36" RCP	430	LF	$60.00	$25,800.00
4	72" Dia Manholes, 6 to 9-ft Deep	9	EA	$6,750.00	$60,750.00
EQ Basin Pump Station					
5a	Electrical Power Supply (Primary)	1	LS	$100,000.00	$100,000.00
5b	Electrical Power Supply (Secondary)	1	LS	$25,000.00	$25,000.00
5c	Electrical Service Entry & Misc Equipment	1	LS	$25,000.00	$25,000.00
5e	Prefabricated Concrete Electrical Building	1	LS	$50,000.00	$50,000.00
6a	Pump Equipment, Accessories & Controls	1	LS	$200,000.00	$200,000.00
6b	Pump Equipment, Accessories & Controls Installation	1	LS	$30,000.00	$30,000.00
7	Triplex Wetwell & Valve Vault Structure	1	LS	$200,000.00	$200,000.00
8	Miscellaneous Process Piping	1	LS	$47,500.00	$47,500.00
EQ Basin Pump Station Force Main					
9	14" Ductile Iron Pipe, Restrained Joint	3,000	LF	$160.00	$480,000.00
Equalization Basin					
11	EQ Basin Unclassified Excavation & Grading	1	LS	$777,546.00	$777,546.00
12	EQ Basin Liner System	1	LS	$941,414.00	$941,414.00
13	Underdrain System	5,600	LF	$30.00	$168,000.00
14	Riprap Revetment	4,525	SY	$35.00	$158,375.00
15	EQ Basin Outlet Structures	2	EA	$7,500.00	$15,000.00
16	15" ASTM D3034 SDR-35 PVC Sewer Line	300	LF	$55.00	$16,500.00
17	12-ft Wide Access Road	1,400	LF	$15.00	$21,000.00
18	Low Water Crossing	1	LS	$15,000.00	$15,000.00
18	Granular Paving	1,388	SY	$25.00	$34,700.00
				Subtotal =	$3,625,235
				Contingency (20%) =	$725,047.0
				Construction Subtotal =	**$4,350,282**
				Engineering, Legal and Administration =	$1,087,600
				Land Acquisition (40-Acres) =	$200,000
				Opinion of Probable Project Cost =	**$5,637,900**

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Project: HDR - Rolla Wastewater System
Client: City of Rolla, Missouri
By: KAC **Chk:**
Date: 7/25/2011 **Date:**

Opinion of Probable Project Cost

Vichy Road WWTF EQ Facilities - Alternative 5

EQ Facilities - Alternative 5: Shall involve the construction of a new triplex submersible non-clog pump station convey anticipated storm water flows in excess of the treatment facility capacity. Alternative 5 shall include, but not be limited to: flow splitter for the redirection of flows from Outfall No. 1 to the proposed pump station; a triplex pump station capable of conveying 2,700-gpm; force main for the conveyance of flows to the proposed equalization basin; a 4.15-million gallon equalization basin for the storage of excess flows; and a gravity sewer system to drain flows back to the WWTF for treatment after passing of storm event and recession of peak flows.

Item No.	Description	Qty	Unit	Unit Price	Total
Gravity Conveyance From EQ Basin					
1	Flow Splitter	1	EA	$20,000.00	$20,000.00
2	8" PVC	334	LF	$35.00	$11,690.00
3	48" Dia Manholes, 6 to 9-ft Deep	1	EA	$2,000.00	$2,000.00
4	48" Dia Doghouse Manholes, 6 to 9-ft Deep	1	EA	$2,250.00	$2,250.00
Storm Water Pump Station					
5a	Electrical Power Supply (Secondary)	1	LS	$25,000.00	$25,000.00
5b	Electrical Service Entry & Misc Equipment	1	LS	$15,000.00	$15,000.00
6a	Pump Equipment, Accessories & Controls	1	LS	$105,000.00	$105,000.00
6b	Pump Equipment, Accessories & Controls Installation	1	LS	$15,000.00	$15,000.00
7	Triplex Wetwell & Valve Vault Structure	1	LS	$60,000.00	$60,000.00
8	Miscellaneous Process Piping	1	LS	$22,050.00	$22,050.00
EQ Basin Pump Station Force Main					
9	14" Ductile Iron Pipe, Restrained Joint	500	LF	$160.00	$80,000.00
10	48" Dia Doghouse Manholes, 6 to 9-ft Deep	1	EA	$2,000.00	$2,000.00
Equalization Basin					
11	EQ Basin Unclassified Excavation & Grading	1	LS	$184,558.00	$184,558.00
12	EQ Basin Liner System	1	LS	$141,702.00	$141,702.00
13	Underdrain System	3,000	LF	$30.00	$90,000.00
14	Riprap Revetment	2,675	SY	$35.00	$93,625.00
15	EQ Basin Outlet Structures	1	EA	$7,500.00	$7,500.00
17	12-ft Wide Access Road	450	LF	$15.00	$6,750.00
18	Low Water Crossing	1	LS	$10,000.00	$10,000.00

Subtotal =	$894,125
Contingency (20%) =	$178,825
Construction Subtotal =	**$1,072,950**
Engineering, Legal and Administration =	$268,300
Land Acquisition (7-Acres) =	$35,000
Opinion of Probable Project Cost =	**$1,376,300**

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Project: HDR - Rolla Wastewater System
Client: City of Rolla, Missouri
By: KAC **Chk:**
Date: 7/25/2011 **Date:**

Opinion of Probable Project Cost

Vichy Road WWTF EQ Facilities - Alternative 6

EQ Facilities - Alternative 6: Shall involve the construction of a new triplex submersible non-clog pump station convey anticipated storm water flows in excess of the treatment facility capacity. Alternative 6 shall include, but not be limited to: flow splitter for the redirection of flows from Outfall No. 1 to the proposed pump station; a triplex pump station capable of conveying 2,020-gpm; force main for the conveyance of flows to the proposed equalization basin; a 3.00-million gallon equalization basin for the storage of excess flows; and a gravity sewer system to drain flows back to the WWTF for treatment after passing of storm event and recession of peak flows.

Item No.	Description	Qty	Unit	Unit Price	Total
Gravity Conveyance From EQ Basin					
1	Flow Splitter	1	EA	$20,000.00	$20,000.00
2	8" PVC	334	LF	$35.00	$11,690.00
3	48" Dia Manholes, 6 to 9-ft Deep	1	EA	$2,000.00	$2,000.00
4	48" Dia Doghouse Manholes, 6 to 9-ft Deep	1	EA	$2,250.00	$2,250.00
Storm Water Pump Station					
5a	Electrical Power Supply (Secondary)	1	LS	$25,000.00	$25,000.00
5b	Electrical Service Entry & Misc Equipment	1	LS	$15,000.00	$15,000.00
6a	Pump Equipment, Accessories & Controls	1	LS	$95,000.00	$95,000.00
6b	Pump Equipment, Accessories & Controls Installation	1	LS	$12,500.00	$12,500.00
7	Triplex Wetwell & Valve Vault Structure	1	LS	$50,000.00	$50,000.00
8	Miscellaneous Process Piping	1	LS	$22,050.00	$22,050.00
EQ Basin Pump Station Force Main					
9	14" Ductile Iron Pipe, Restrained Joint	500	LF	$160.00	$80,000.00
10	48" Dia Doghouse Manholes, 6 to 9-ft Deep	1	EA	$2,000.00	$2,000.00
Equalization Basin					
11	EQ Basin Unclassified Excavation & Grading	1	LS	$106,546.00	$106,546.00
12	EQ Basin Liner System	1	LS	$102,270.00	$102,270.00
13	Underdrain System	2,525	LF	$30.00	$75,750.00
14	Riprap Revetment	2,350	SY	$35.00	$82,250.00
15	EQ Basin Outlet Structures	1	EA	$7,500.00	$7,500.00
17	12-ft Wide Access Road	450	LF	$15.00	$6,750.00
18	Low Water Crossing	1	LS	$10,000.00	$10,000.00

Subtotal =	$728,556
Contingency (20%) =	$145,711
Construction Subtotal =	**$874,267**
Engineering, Legal and Administration =	$218,600
Land Acquisition (7-Acres) =	$35,000
Opinion of Probable Project Cost =	**$1,127,900**

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Project: HDR - Rolla Wastewater System
Client: City of Rolla, Missouri
By: KAC Chk:
Date: 7/25/2011 Date:

Opinion of Probable Project Cost
Vichy Road WWTF EQ Facilities - Alternative 7

EQ Facilities - Alternative 7: Shall involve the construction of an 18-inch diameter reinforced concrete gravity sewer system to convey peak flows from the Vichy Road WWTF approximately 1,250-ft downstream (north) of the facility to a 4.15-million gallon equalization basin. Flows in excess of the plant capacity would be detained in the equalization basin until the flows at the WWTF have receded, at which time the detained flows will be pumped back to the WWTF for treatment.

Item No.	Description	Qty	Unit	Unit Price	Total
Gravity Conveyance to EQ Basin					
1	Flow Splitter	1	EA	$50,000.00	$50,000.00
2	18" RCP	1,393	LF	$50.00	$69,650.00
3	48" Dia Manholes, 6 to 12-ft Deep	5	EA	$2,500.00	$12,500.00
EQ Basin Pump Station					
4a	Electrical Power Supply (Primary)	1	LS	$50,000.00	$50,000.00
4b	Electrical Power Supply (Secondary)	1	LS	$10,000.00	$10,000.00
4c	Electrical Service Entry & Misc Equipment	1	LS	$10,000.00	$10,000.00
5a	Pump Equipment, Accessories & Controls	1	LS	$40,000.00	$40,000.00
5b	Pump Equipment, Accessories & Controls Installation	1	LS	$5,000.00	$5,000.00
6	Duplex Wetwell & Valve Vault Structure	1	LS	$45,000.00	$45,000.00
7	Miscellaneous Process Piping	1	LS	$10,000.00	$10,000.00
EQ Basin Pump Station Force Main					
8	6" Ductile Iron Pipe, Restrained Joint	1,800	LF	$90.00	$162,000.00
9	48" Dia Doghouse Manholes, 6 to 9-ft Deep	1	EA	$2,000.00	$2,000.00
Equalization Basin					
10	EQ Basin Unclassified Excavation & Grading	1	LS	$226,809.00	$226,809.00
11	EQ Basin Liner System	1	LS	$178,008.00	$178,008.00
12	Underdrain System	3,000	LF	$30.00	$90,000.00
13	Riprap Revetment	1,500	SY	$35.00	$52,500.00
14	EQ Basin Outlet Structures	1	EA	$7,500.00	$7,500.00
15	8" ASTM D3034 SDR-35 PVC Sewer Line	100	LF	$35.00	$3,500.00
16	12-ft Wide Access Road	450	LF	$15.00	$6,750.00
17	Granular Paving	1,300	SY	$25.00	$32,500.00

Subtotal =	$1,063,717
Contingency (20%) =	$212,743
Construction Subtotal =	**$1,276,460**
Engineering, Legal and Administration =	$319,200
Land Acquisition (15-Acres) =	$75,000
Opinion of Probable Project Cost =	**$1,670,700**

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Project: HDR - Rolla Wastewater System
Client: City of Rolla, Missouri
By: KAC Chk:
Date: 7/25/2011 Date:

Opinion of Probable Project Cost

Vichy Road WWTF EQ Facilities - Alternative 8

EQ Facilities - Alternative 8: Shall involve the construction of an 18-inch diameter reinforced concrete gravity sewer system to convey peak flows from the Vichy Road WWTF approximately 1,250-ft downstream (north) of the facility to a 3.0-million gallon equalization basin. Flows in excess of the plant capacity would be detained in the equalization basin until the flows at the WWTF have receded, at which time the detained flows will be pumped back to the WWTF for treatment.

Item No.	Description	Qty	Unit	Unit Price	Total
Gravity Conveyance to EQ Basin					
1	Flow Splitter	1	EA	$50,000.00	$50,000.00
2	18" RCP	1,393	LF	$50.00	$69,650.00
3	48" Dia Manholes, 6 to 12-ft Deep	5	EA	$2,500.00	$12,500.00
EQ Basin Pump Station					
4a	Electrical Power Supply (Primary)	1	LS	$50,000.00	$50,000.00
4b	Electrical Power Supply (Secondary)	1	LS	$10,000.00	$10,000.00
4c	Electrical Service Entry & Misc Equipment	1	LS	$10,000.00	$10,000.00
5a	Pump Equipment, Accessories & Controls	1	LS	$40,000.00	$40,000.00
5b	Pump Equipment, Accessories & Controls Installation	1	LS	$5,000.00	$5,000.00
6	Duplex Wetwell & Valve Vault Structure	1	LS	$45,000.00	$45,000.00
7	Miscellaneous Process Piping	1	LS	$10,000.00	$10,000.00
EQ Basin Pump Station Force Main					
8	6" Ductile Iron Pipe, Restrained Joint	1,800	LF	$90.00	$162,000.00
9	48" Dia Doghouse Manholes, 6 to 9-ft Deep	1	EA	$2,000.00	$2,000.00
Equalization Basin					
10	EQ Basin Unclassified Excavation & Grading	1	LS	$131,373.00	$131,373.00
11	EQ Basin Liner System	1	LS	$177,067.00	$177,067.00
12	Underdrain System	3,000	LF	$30.00	$90,000.00
13	Riprap Revetment	750	SY	$35.00	$26,250.00
14	EQ Basin Outlet Structures	1	EA	$7,500.00	$7,500.00
15	8" ASTM D3034 SDR-35 PVC Sewer Line	100	LF	$35.00	$3,500.00
16	12-ft Wide Access Road	450	LF	$15.00	$6,750.00
17	Granular Paving	1,300	SY	$25.00	$32,500.00
				Subtotal =	$941,090
				Contingency (20%) =	$188,218
				Construction Subtotal =	**$1,129,308**
				Engineering, Legal and Administration =	$282,400
				Land Acquisition (12-Acres) =	$60,000
				Opinion of Probable Project Cost =	**$1,471,800**

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Project: HDR - Rolla Wastewater System
Client: City of Rolla, Missouri
By: KAC Chk:
Date: 8/13/2011 Date:

Opinion of Probable Project Cost

SE WWTF EQ Facilities - Alternative 1A

EQ Facilities - Alternative 1A: Shall involve the construction of a new quadraplex submersible non-clog pump station convey anticipated storm water flows in excess of the treatment facility capacity. Alternative 1A shall include, but not be limited to: flow splitters for the redirection of flows from Outfall No. 2 & 3 to the proposed pump station; a quadraplex pump station capable of conveying 31,000-gpm; force main for the conveyance of flows to the proposed equalization basin; a 36-million gallon equalization basin for the storage of excess flows; and a gravity sewer system to drain flows back to the WWTF for treatment after passing of storm event and recession of peak flows.

Item No.	Description	Qty	Unit	Unit Price	Total
Gravity Conveyance to Pump Station					
1	Flow Splitter	2	EA	$20,000.00	$40,000.00
2	30" RCP	380	LF	$60.00	$22,800.00
3	36" Ductile Iron Pipe	20	LS	$300.00	$6,000.00
4	60" Dia Manholes, 6 to 9-ft Deep	2	EA	$4,000.00	$8,000.00
5	6' x 6' Junction Box	1	EA	$5,000.00	$5,000.00
Pump Station					
6	Unclassified Excavation for Proposed PS	1	LS	$100,000.00	$100,000.00
7a	Electrical Power Supply (Primary)	1	LS	$125,000.00	$125,000.00
7b	Electrical Power Supply (Secondary)	1	LS	$125,000.00	$125,000.00
7c	Electrical Service Entry & Misc Equipment	1	LS	$250,000.00	$250,000.00
7d	Electrical - MCC w/ VFD	1	LS	$300,000.00	$300,000.00
7e	Prefabricated Concrete Electrical Building	1	LS	$100,000.00	$100,000.00
8a	Pump Equipment, Accessories & Controls	1	LS	$750,000.00	$750,000.00
8b	Pump Equipment, Accessories & Controls Installation	1	LS	$125,000.00	$125,000.00
9	Quadraplex Wetwell & Valve Vault Structure	1	LS	$200,000.00	$200,000.00
10	Miscellaneous Process Piping	1	LS	$110,000.00	$110,000.00
Force Main					
11	42" Ductile Iron Pipe, Restrained Joint	2,100	LF	$375.00	$787,500.00
12	Force Main Discharge Structure	1	LS	$15,000.00	$15,000.00
Equalization Basin					
13	EQ Basin Unclassified Excavation & Grading	1	LS	$1,096,161.00	$1,096,161.00
14	EQ Basin Liner System	1	LS	$870,764.00	$870,764.00
15	Underdrain System	7,000	LF	$30.00	$210,000.00
16	EQ Basin Outlet Structures	3	EA	$7,500.00	$22,500.00
17	15" ASTM D3034 SDR-35 PVC Sewer Line	1,410	LF	$55.00	$77,550.00
18	48" Dia Manholes, 6 to 12-ft Deep	5	EA	$2,500.00	$12,500.00

Subtotal =	$5,358,775
Contingency (20%) =	$1,071,755.0
Construction Subtotal =	**$6,430,530**
Engineering, Legal and Administration =	$1,607,700
Land Acquisition (30-Acres) =	$150,000
Opinion of Probable Project Cost =	**$8,188,300**

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Project: HDR - Rolla Wastewater System
Client: City of Rolla, Missouri
By: KAC **Chk:**
Date: 8/13/2011 **Date:**

Opinion of Probable Project Cost

SE WWTF EQ Facilities - Alternative 1B

EQ Facilities - Alternative 1B: Shall involve the construction of a new quadraplex submersible non-clog pump station convey anticipated storm water flows in excess of the treatment facility capacity. Alternative 1B shall include, but not be limited to: flow splitters for the redirection of flows from Outfall No. 2 & 3 to the proposed pump station; a quadraplex pump station capable of conveying 31,000-gpm; force main for the conveyance of flows to the proposed equalization basin; a 36-million gallon equalization basin for the storage of excess flows; and a gravity sewer system to drain flows back to the WWTF for treatment after passing of storm event and recession of peak flows.

Item No.	Description	Qty	Unit	Unit Price	Total
Gravity Conveyance to Pump Station					
1	Flow Splitter	2	EA	$20,000.00	$40,000.00
2	30" RCP	380	LF	$60.00	$22,800.00
3	36" Ductile Iron Pipe	20	LS	$300.00	$6,000.00
4	60" Dia Manholes, 6 to 9-ft Deep	2	EA	$4,000.00	$8,000.00
5	6' x 6' Junction Box	1	EA	$5,000.00	$5,000.00
Pump Station					
6	Unclassified Excavation for Proposed PS	1	LS	$100,000.00	$100,000.00
7a	Electrical Power Supply (Primary)	1	LS	$125,000.00	$125,000.00
7b	Electrical Power Supply (Secondary)	1	LS	$125,000.00	$125,000.00
7c	Electrical Service Entry & Misc Equipment	1	LS	$250,000.00	$250,000.00
7d	Electrical - MCC w/ VFD	1	LS	$300,000.00	$300,000.00
7e	Prefabricated Concrete Electrical Building	1	LS	$100,000.00	$100,000.00
8a	Pump Equipment, Accessories & Controls	1	LS	$750,000.00	$750,000.00
8b	Pump Equipment, Accessories & Controls Installation	1	LS	$125,000.00	$125,000.00
9	Quadraplex Wetwell & Valve Vault Structure	1	LS	$200,000.00	$200,000.00
10	Miscellaneous Process Piping	1	LS	$110,000.00	$110,000.00
Force Main					
11	42" Ductile Iron Pipe, Restrained Joint	1,700	LF	$375.00	$637,500.00
12	Force Main Discharge Structure	1	LS	$15,000.00	$15,000.00
Equalization Basin					
13	EQ Basin Unclassified Excavation & Grading	1	LS	$1,096,161.00	$1,096,161.00
14	EQ Basin Liner System	1	LS	$1,083,772.00	$1,083,772.00
15	Underdrain System	7,670	LF	$30.00	$230,100.00
16	EQ Basin Outlet Structures	3	EA	$7,500.00	$22,500.00
17	15" ASTM D3034 SDR-35 PVC Sewer Line	1,370	LF	$55.00	$75,350.00
18	48" Dia Manholes, 6 to 12-ft Deep	3	EA	$2,500.00	$7,500.00

Subtotal =	$5,434,683
Contingency (20%) =	$1,086,936.6
Construction Subtotal =	**$6,521,620**
Engineering, Legal and Administration =	$1,630,500
Land Acquisition (35-Acres) =	$175,000
Opinion of Probable Project Cost =	**$8,328,000**

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1300 North Outer Road
St. James, Mo. 65559
573-265-0190 • Fax 573-265-0193

Project: HDR - Rolla Wastewater System
Client: City of Rolla, Missouri
By: KAC Chk:
Date: 8/13/2011 Date:

Opinion of Probable Project Cost

SE WWTF EQ Facilities - Alternative 2A

EQ Facilities - Alternative 2A: Shall involve the construction of a new quadraplex submersible non-clog pump station convey anticipated storm water flows in excess of the treatment facility capacity. Alternative 2A shall include, but not be limited to: flow splitters for the redirection of flows from Outfall No. 2 & 3 to the proposed pump station; a quadraplex pump station capable of conveying 24,000-gpm; force main for the conveyance of flows to the proposed equalization basin; a 27-million gallon equalization basin for the storage of excess flows; and a gravity sewer system to drain flows back to the WWTF for treatment after passing of storm event and recession of peak flows.

Item No.	Description	Qty	Unit	Unit Price	Total
Gravity Conveyance to Pump Station					
1	Flow Splitter	2	EA	$20,000.00	$40,000.00
2	30" RCP	380	LF	$60.00	$22,800.00
3	36" Ductile Iron Pipe	20	LS	$300.00	$6,000.00
4	60" Dia Manholes, 6 to 9-ft Deep	2	EA	$4,000.00	$8,000.00
5	6' x 6' Junction Box	1	EA	$5,000.00	$5,000.00
Pump Station					
6	Unclassified Excavation for Proposed PS	1	LS	$100,000.00	$100,000.00
7a	Electrical Power Supply (Primary)	1	LS	$100,000.00	$100,000.00
7b	Electrical Power Supply (Secondary)	1	LS	$100,000.00	$100,000.00
7c	Electrical Service Entry & Misc Equipment	1	LS	$200,000.00	$200,000.00
7d	Electrical - MCC w/ VFD	1	LS	$250,000.00	$250,000.00
7e	Prefabricated Concrete Electrical Building	1	LS	$100,000.00	$100,000.00
8a	Pump Equipment, Accessories & Controls	1	LS	$525,000.00	$525,000.00
8b	Pump Equipment, Accessories & Controls Installation	1	LS	$75,000.00	$75,000.00
9	Quadraplex Wetwell & Valve Vault Structure	1	LS	$200,000.00	$200,000.00
10	Miscellaneous Process Piping	1	LS	$110,000.00	$110,000.00
Force Main					
11	42" Ductile Iron Pipe, Restrained Joint	2,025	LF	$375.00	$759,375.00
12	Force Main Discharge Structure	1	LS	$15,000.00	$15,000.00
Equalization Basin					
13	EQ Basin Unclassified Excavation & Grading	1	LS	$679,651.00	$679,651.00
14	EQ Basin Liner System	1	LS	$582,414.00	$582,414.00
15	Underdrain System	5,600	LF	$30.00	$168,000.00
14	EQ Basin Outlet Structures	3	EA	$7,500.00	$22,500.00
15	15" ASTM D3034 SDR-35 PVC Sewer Line	1,155	LF	$55.00	$63,525.00
16	48" Dia Manholes, 6 to 12-ft Deep	5	EA	$2,500.00	$12,500.00

Subtotal =	$4,144,765
Contingency (20%) =	$828,953.0
Construction Subtotal =	**$4,973,718**
Engineering, Legal and Administration =	$1,243,500
Land Acquisition (25-Acres) =	$125,000
Opinion of Probable Project Cost =	**$6,342,300**

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Project: HDR - Rolla Wastewater System
Client: City of Rolla, Missouri
By: KAC **Chk:**
Date: 8/13/2011 **Date:**

Opinion of Probable Project Cost

SE WWTF EQ Facilities - Alternative 2B

EQ Facilities - Alternative 2B: Shall involve the construction of a new quadraplex submersible non-clog pump station convey anticipated storm water flows in excess of the treatment facility capacity. Alternative 2B shall include, but not be limited to: flow splitters for the redirection of flows from Outfall No. 2 & 3 to the proposed pump station; a quadraplex pump station capable of conveying 24,000-gpm; force main for the conveyance of flows to the proposed equalization basin; a 27-million gallon equalization basin for the storage of excess flows; and a gravity sewer system to drain flows back to the WWTF for treatment after passing of storm event and recession of peak flows.

Item No.	Description	Qty	Unit	Unit Price	Total
Gravity Conveyance to Pump Station					
1	Flow Splitter	2	EA	$20,000.00	$40,000.00
2	30" RCP	380	LF	$60.00	$22,800.00
3	36" Ductile Iron Pipe	20	LS	$300.00	$6,000.00
4	60" Dia Manholes, 6 to 9-ft Deep	2	EA	$4,000.00	$8,000.00
5	6' x 6' Junction Box	1	EA	$5,000.00	$5,000.00
Pump Station					
6	Unclassified Excavation for Proposed PS	1	LS	$100,000.00	$100,000.00
7a	Electrical Power Supply (Primary)	1	LS	$100,000.00	$100,000.00
7b	Electrical Power Supply (Secondary)	1	LS	$100,000.00	$100,000.00
7c	Electrical Service Entry & Misc Equipment	1	LS	$200,000.00	$200,000.00
7d	Electrical - MCC w/ VFD	1	LS	$250,000.00	$250,000.00
7e	Prefabricated Concrete Electrical Building	1	LS	$100,000.00	$100,000.00
8a	Pump Equipment, Accessories & Controls	1	LS	$475,000.00	$475,000.00
8b	Pump Equipment, Accessories & Controls Installation	1	LS	$70,000.00	$70,000.00
9	Quadraplex Wetwell & Valve Vault Structure	1	LS	$200,000.00	$200,000.00
10	Miscellaneous Process Piping	1	LS	$110,000.00	$110,000.00
Force Main					
11	42" Ductile Iron Pipe, Restrained Joint	1,550	LF	$375.00	$581,250.00
12	Force Main Discharge Structure	1	LS	$15,000.00	$15,000.00
Equalization Basin					
13	EQ Basin Unclassified Excavation & Grading	1	LS	$708,697.00	$708,697.00
14	EQ Basin Liner System	1	LS	$597,247.00	$597,247.00
15	Underdrain System	5,500	LF	$30.00	$165,000.00
14	EQ Basin Outlet Structures	3	EA	$7,500.00	$22,500.00
15	15" ASTM D3034 SDR-35 PVC Sewer Line	1,190	LF	$55.00	$65,450.00
16	48" Dia Manholes, 6 to 12-ft Deep	4	EA	$2,500.00	$10,000.00

Subtotal =	$3,951,944
Contingency (20%) =	$790,388.8
Construction Subtotal =	**$4,742,333**
Engineering, Legal and Administration =	$1,185,600
Land Acquisition (25-Acres) =	$125,000
Opinion of Probable Project Cost =	**$6,053,000**

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Project: HDR - Rolla Wastewater System
Client: City of Rolla, Missouri
By: KAC **Chk:**
Date: 7/25/2011 **Date:**

Opinion of Probable Project Cost

SE WWTF EQ Facilities - Alternative 3

EQ Facilities - Alternative 3: Shall involve the construction of a 36-inch and 42-inch diameter reinforced concrete gravity sewer system to convey peak flows from the West and East sides of the SE WWTF approximately 1,250-ft downstream of the facility to a new 36-million gallon equalization basin. The anticipated peak flow to be conveyed is 31,000-gpm. The EQ basin will detain excess peak flows generated via a 10-year, 4-hour storm event. A new triplex submersible non-clog pump station would be constructed which would convey detained flows back to the West side for the SE WWTF for treatment, after the recession of the peak flow event. The maximum capacity of the pump station would be 5-mgd.

Item No.	Description	Qty	Unit	Unit Price	Total
Gravity Conveyance to EQ Basin					
1	Flow Splitter	2	EA	$50,000.00	$100,000.00
2	42" RCP	1,485	LF	$90.00	$133,650.00
3	36" RCP	430	LF	$60.00	$25,800.00
4	72" Dia Manholes, 6 to 9-ft Deep	9	EA	$6,750.00	$60,750.00
EQ Basin Pump Station					
5a	Electrical Power Supply (Primary)	1	LS	$100,000.00	$100,000.00
5b	Electrical Power Supply (Secondary)	1	LS	$25,000.00	$25,000.00
5c	Electrical Service Entry & Misc Equipment	1	LS	$25,000.00	$25,000.00
5e	Prefabricated Concrete Electrical Building	1	LS	$50,000.00	$50,000.00
6a	Pump Equipment, Accessories & Controls	1	LS	$200,000.00	$200,000.00
6b	Pump Equipment, Accessories & Controls Installation	1	LS	$30,000.00	$30,000.00
7	Triplex Wetwell & Valve Vault Structure	1	LS	$200,000.00	$200,000.00
8	Miscellaneous Process Piping	1	LS	$47,500.00	$47,500.00
EQ Basin Pump Station Force Main					
9	14" Ductile Iron Pipe, Restrained Joint	3,000	LF	$160.00	$480,000.00
Equalization Basin					
11	EQ Basin Unclassified Excavation & Grading	1	LS	$1,069,508.00	$1,069,508.00
12	EQ Basin Liner System	1	LS	$1,236,727.00	$1,236,727.00
13	Underdrain System	8,000	LF	$30.00	$240,000.00
14	Riprap Revetment	6,000	SY	$35.00	$210,000.00
15	EQ Basin Outlet Structures	2	EA	$7,500.00	$15,000.00
16	15" ASTM D3034 SDR-35 PVC Sewer Line	300	LF	$55.00	$16,500.00
17	12-ft Wide Access Road	1,400	LF	$15.00	$21,000.00
18	Low Water Crossing	1	LS	$15,000.00	$15,000.00
18	Granular Paving	1,388	SY	$25.00	$34,700.00
				Subtotal =	$4,336,135
				Contingency (20%) =	$867,227.0
				Construction Subtotal =	**$5,203,362**
				Engineering, Legal and Administration =	$1,300,900
				Land Acquisition (50-Acres) =	$250,000
				Opinion of Probable Project Cost =	**$6,754,300**

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Project: HDR - Rolla Wastewater System
Client: City of Rolla, Missouri
By: KAC Chk:
Date: 7/25/2011 Date:

Opinion of Probable Project Cost

SE WWTF EQ Facilities - Alternative 4

EQ Facilities - Alternative 4: Shall involve the construction of a 36-inch and 42-inch diameter reinforced concrete gravity sewer system to convey peak flows from the West and East sides of the SE WWTF approximately 1,250-ft downstream of the facility to a new 27-million gallon equalization basin. The anticipated peak flow to be conveyed is 24,000-gpm. The EQ basin will detain excess peak flows generated via a 10-year, 4-hour storm event. A new triplex submersible non-clog pump station would be constructed which would convey detained flows back to the West side for the SE WWTF for treatment, after the recession of the peak flow event. The maximum capacity of the pump station would be 5-mgd.

Item No.	Description	Qty	Unit	Unit Price	Total
Gravity Conveyance to EQ Basin					
1	Flow Splitter	2	EA	$50,000.00	$100,000.00
2	42" RCP	1,485	LF	$90.00	$133,650.00
3	36" RCP	430	LF	$60.00	$25,800.00
4	72" Dia Manholes, 6 to 9-ft Deep	9	EA	$6,750.00	$60,750.00
EQ Basin Pump Station					
5a	Electrical Power Supply (Primary)	1	LS	$100,000.00	$100,000.00
5b	Electrical Power Supply (Secondary)	1	LS	$25,000.00	$25,000.00
5c	Electrical Service Entry & Misc Equipment	1	LS	$25,000.00	$25,000.00
5e	Prefabricated Concrete Electrical Building	1	LS	$50,000.00	$50,000.00
6a	Pump Equipment, Accessories & Controls	1	LS	$200,000.00	$200,000.00
6b	Pump Equipment, Accessories & Controls Installation	1	LS	$30,000.00	$30,000.00
7	Triplex Wetwell & Valve Vault Structure	1	LS	$200,000.00	$200,000.00
8	Miscellaneous Process Piping	1	LS	$47,500.00	$47,500.00
EQ Basin Pump Station Force Main					
9	14" Ductile Iron Pipe, Restrained Joint	3,000	LF	$160.00	$480,000.00
Equalization Basin					
11	EQ Basin Unclassified Excavation & Grading	1	LS	$777,546.00	$777,546.00
12	EQ Basin Liner System	1	LS	$941,414.00	$941,414.00
13	Underdrain System	5,600	LF	$30.00	$168,000.00
14	Riprap Revetment	4,525	SY	$35.00	$158,375.00
15	EQ Basin Outlet Structures	2	EA	$7,500.00	$15,000.00
16	15" ASTM D3034 SDR-35 PVC Sewer Line	300	LF	$55.00	$16,500.00
17	12-ft Wide Access Road	1,400	LF	$15.00	$21,000.00
18	Low Water Crossing	1	LS	$15,000.00	$15,000.00
18	Granular Paving	1,388	SY	$25.00	$34,700.00

Subtotal =	$3,625,235
Contingency (20%) =	$725,047.0
Construction Subtotal =	**$4,350,282**
Engineering, Legal and Administration =	$1,087,600
Land Acquisition (40-Acres) =	$200,000
Opinion of Probable Project Cost =	**$5,637,900**

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Project: HDR - Rolla Wastewater System
Client: City of Rolla, Missouri
By: KAC Chk:
Date: 7/25/2011 Date:

Opinion of Probable Project Cost

Vichy Road WWTF EQ Facilities - Alternative 5

EQ Facilities - Alternative 5: Shall involve the construction of a new triplex submersible non-clog pump station convey anticipated storm water flows in excess of the treatment facility capacity. Alternative 5 shall include, but not be limited to: flow splitter for the redirection of flows from Outfall No. 1 to the proposed pump station; a triplex pump station capable of conveying 2,700-gpm; force main for the conveyance of flows to the proposed equalization basin; a 4.15-million gallon equalization basin for the storage of excess flows; and a gravity sewer system to drain flows back to the WWTF for treatment after passing of storm event and recession of peak flows.

Item No.	Description	Qty	Unit	Unit Price	Total
Gravity Conveyance From EQ Basin					
1	Flow Splitter	1	EA	$20,000.00	$20,000.00
2	8" PVC	334	LF	$35.00	$11,690.00
3	48" Dia Manholes, 6 to 9-ft Deep	1	EA	$2,000.00	$2,000.00
4	48" Dia Doghouse Manholes, 6 to 9-ft Deep	1	EA	$2,250.00	$2,250.00
Storm Water Pump Station					
5a	Electrical Power Supply (Secondary)	1	LS	$25,000.00	$25,000.00
5b	Electrical Service Entry & Misc Equipment	1	LS	$15,000.00	$15,000.00
6a	Pump Equipment, Accessories & Controls	1	LS	$105,000.00	$105,000.00
6b	Pump Equipment, Accessories & Controls Installation	1	LS	$15,000.00	$15,000.00
7	Triplex Wetwell & Valve Vault Structure	1	LS	$60,000.00	$60,000.00
8	Miscellaneous Process Piping	1	LS	$22,050.00	$22,050.00
EQ Basin Pump Station Force Main					
9	14" Ductile Iron Pipe, Restrained Joint	500	LF	$160.00	$80,000.00
10	48" Dia Doghouse Manholes, 6 to 9-ft Deep	1	EA	$2,000.00	$2,000.00
Equalization Basin					
11	EQ Basin Unclassified Excavation & Grading	1	LS	$184,558.00	$184,558.00
12	EQ Basin Liner System	1	LS	$141,702.00	$141,702.00
13	Underdrain System	3,000	LF	$30.00	$90,000.00
14	Riprap Revetment	2,675	SY	$35.00	$93,625.00
15	EQ Basin Outlet Structures	1	EA	$7,500.00	$7,500.00
17	12-ft Wide Access Road	450	LF	$15.00	$6,750.00
18	Low Water Crossing	1	LS	$10,000.00	$10,000.00

Subtotal =	$894,125
Contingency (20%) =	$178,825
Construction Subtotal =	**$1,072,950**
Engineering, Legal and Administration =	$268,300
Land Acquisition (7-Acres) =	$35,000
Opinion of Probable Project Cost =	**$1,376,300**

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St. James, Mo. 65559
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Project: HDR - Rolla Wastewater System
Client: City of Rolla, Missouri
By: KAC **Chk:**
Date: 7/25/2011 **Date:**

Opinion of Probable Project Cost

Vichy Road WWTF EQ Facilities - Alternative 6

EQ Facilities - Alternative 6: Shall involve the construction of a new triplex submersible non-clog pump station convey anticipated storm water flows in excess of the treatment facility capacity. Alternative 6 shall include, but not be limited to: flow splitter for the redirection of flows from Outfall No. 1 to the proposed pump station; a triplex pump station capable of conveying 2,020-gpm; force main for the conveyance of flows to the proposed equalization basin; a 3.00-million gallon equalization basin for the storage of excess flows; and a gravity sewer system to drain flows back to the WWTF for treatment after passing of storm event and recession of peak flows.

Item No.	Description	Qty	Unit	Unit Price	Total
Gravity Conveyance From EQ Basin					
1	Flow Splitter	1	EA	$20,000.00	$20,000.00
2	8" PVC	334	LF	$35.00	$11,690.00
3	48" Dia Manholes, 6 to 9-ft Deep	1	EA	$2,000.00	$2,000.00
4	48" Dia Doghouse Manholes, 6 to 9-ft Deep	1	EA	$2,250.00	$2,250.00
Storm Water Pump Station					
5a	Electrical Power Supply (Secondary)	1	LS	$25,000.00	$25,000.00
5b	Electrical Service Entry & Misc Equipment	1	LS	$15,000.00	$15,000.00
6a	Pump Equipment, Accessories & Controls	1	LS	$95,000.00	$95,000.00
6b	Pump Equipment, Accessories & Controls Installation	1	LS	$12,500.00	$12,500.00
7	Triplex Wetwell & Valve Vault Structure	1	LS	$50,000.00	$50,000.00
8	Miscellaneous Process Piping	1	LS	$22,050.00	$22,050.00
EQ Basin Pump Station Force Main					
9	14" Ductile Iron Pipe, Restrained Joint	500	LF	$160.00	$80,000.00
10	48" Dia Doghouse Manholes, 6 to 9-ft Deep	1	EA	$2,000.00	$2,000.00
Equalization Basin					
11	EQ Basin Unclassified Excavation & Grading	1	LS	$106,546.00	$106,546.00
12	EQ Basin Liner System	1	LS	$102,270.00	$102,270.00
13	Underdrain System	2,525	LF	$30.00	$75,750.00
14	Riprap Revetment	2,350	SY	$35.00	$82,250.00
15	EQ Basin Outlet Structures	1	EA	$7,500.00	$7,500.00
17	12-ft Wide Access Road	450	LF	$15.00	$6,750.00
18	Low Water Crossing	1	LS	$10,000.00	$10,000.00

Subtotal =	$728,556
Contingency (20%) =	$145,711
Construction Subtotal =	**$874,267**
Engineering, Legal and Administration =	$218,600
Land Acquisition (7-Acres) =	$35,000
Opinion of Probable Project Cost =	**$1,127,900**

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Project: HDR - Rolla Wastewater System
Client: City of Rolla, Missouri
By: KAC **Chk:**
Date: 7/25/2011 **Date:**

Opinion of Probable Project Cost

Vichy Road WWTF EQ Facilities - Alternative 7

EQ Facilities - Alternative 7: Shall involve the construction of an 18-inch diameter reinforced concrete gravity sewer system to convey peak flows from the Vichy Road WWTF approximately 1,250-ft downstream (north) of the facility to a 4.15-million gallon equalization basin. Flows in excess of the plant capacity would be detained in the equalization basin until the flows at the WWTF have receded, at which time the detained flows will be pumped back to the WWTF for treatment.

Item No.	Description	Qty	Unit	Unit Price	Total
Gravity Conveyance to EQ Basin					
1	Flow Splitter	1	EA	$50,000.00	$50,000.00
2	18" RCP	1,393	LF	$50.00	$69,650.00
3	48" Dia Manholes, 6 to 12-ft Deep	5	EA	$2,500.00	$12,500.00
EQ Basin Pump Station					
4a	Electrical Power Supply (Primary)	1	LS	$50,000.00	$50,000.00
4b	Electrical Power Supply (Secondary)	1	LS	$10,000.00	$10,000.00
4c	Electrical Service Entry & Misc Equipment	1	LS	$10,000.00	$10,000.00
5a	Pump Equipment, Accessories & Controls	1	LS	$40,000.00	$40,000.00
5b	Pump Equipment, Accessories & Controls Installation	1	LS	$5,000.00	$5,000.00
6	Duplex Wetwell & Valve Vault Structure	1	LS	$45,000.00	$45,000.00
7	Miscellaneous Process Piping	1	LS	$10,000.00	$10,000.00
EQ Basin Pump Station Force Main					
8	6" Ductile Iron Pipe, Restrained Joint	1,800	LF	$90.00	$162,000.00
9	48" Dia Doghouse Manholes, 6 to 9-ft Deep	1	EA	$2,000.00	$2,000.00
Equalization Basin					
10	EQ Basin Unclassified Excavation & Grading	1	LS	$226,809.00	$226,809.00
11	EQ Basin Liner System	1	LS	$178,008.00	$178,008.00
12	Underdrain System	3,000	LF	$30.00	$90,000.00
13	Riprap Revetment	1,500	SY	$35.00	$52,500.00
14	EQ Basin Outlet Structures	1	EA	$7,500.00	$7,500.00
15	8" ASTM D3034 SDR-35 PVC Sewer Line	100	LF	$35.00	$3,500.00
16	12-ft Wide Access Road	450	LF	$15.00	$6,750.00
17	Granular Paving	1,300	SY	$25.00	$32,500.00

Subtotal =	$1,063,717
Contingency (20%) =	$212,743
Construction Subtotal =	**$1,276,460**
Engineering, Legal and Administration =	$319,200
Land Acquisition (15-Acres) =	$75,000
Opinion of Probable Project Cost =	**$1,670,700**

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Project: HDR - Rolla Wastewater System
Client: City of Rolla, Missouri
By: KAC Chk:
Date: 7/25/2011 Date:

Opinion of Probable Project Cost

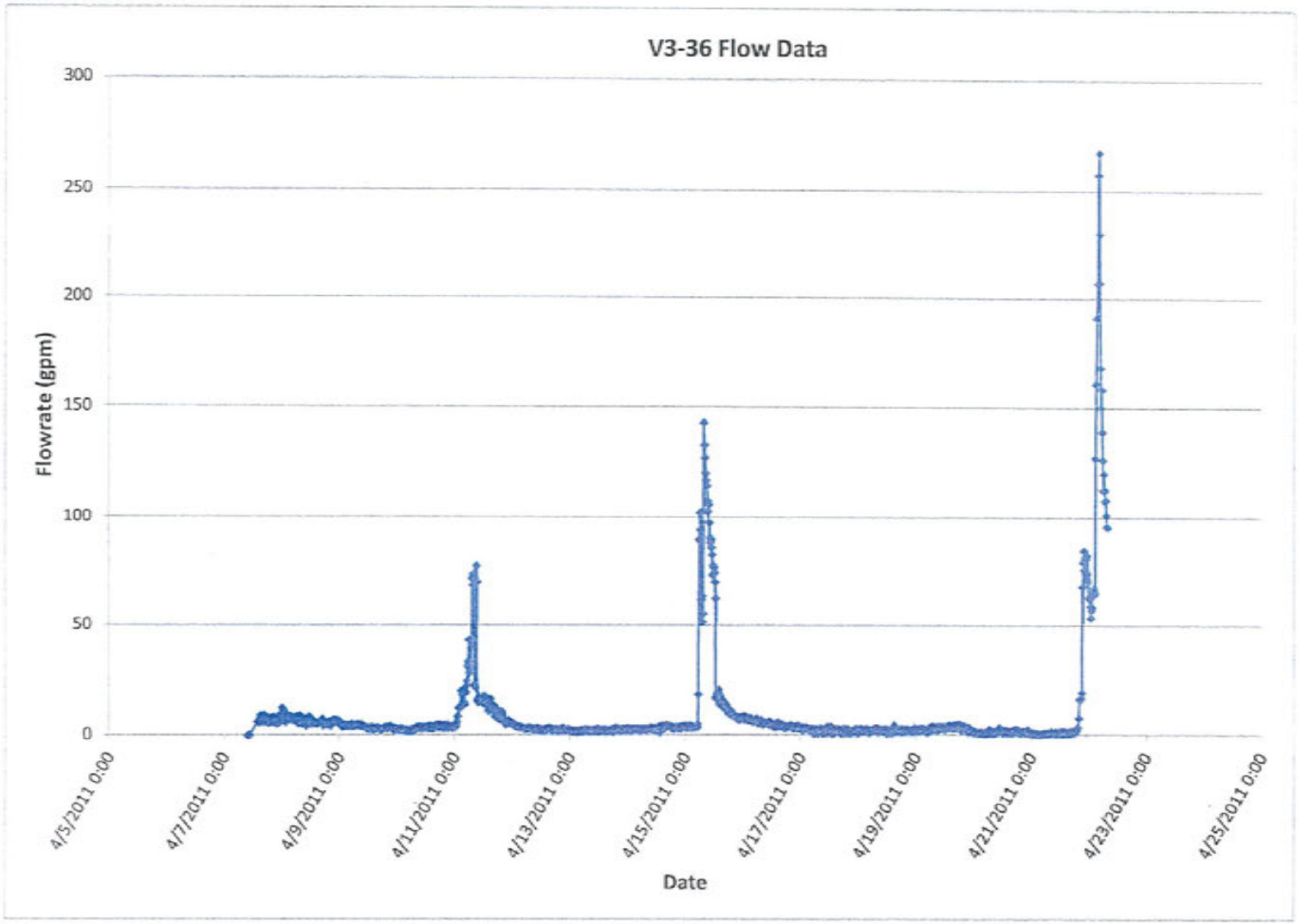
Vichy Road WWTF EQ Facilities - Alternative 8

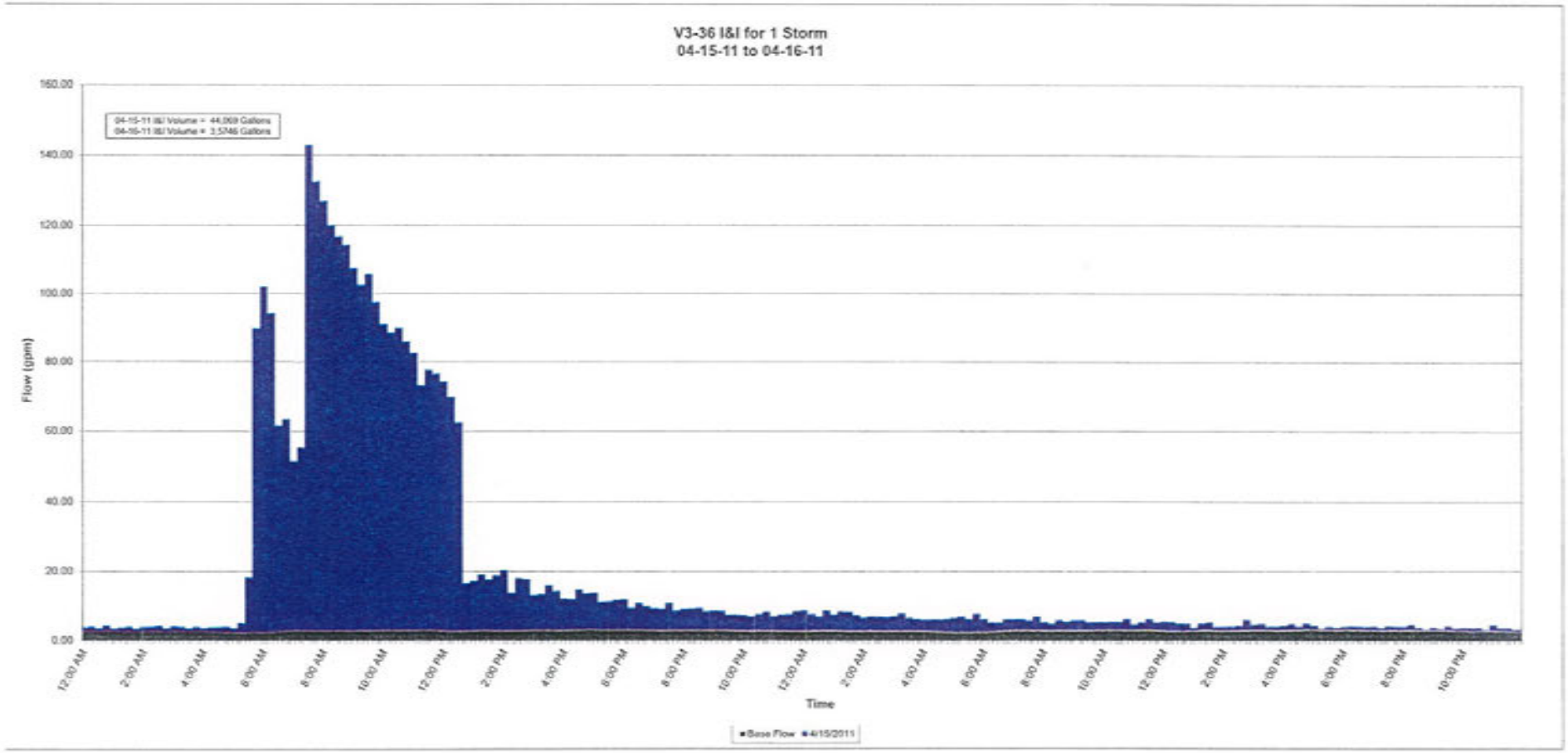
EQ Facilities - Alternative 8: Shall involve the construction of an 18-inch diameter reinforced concrete gravity sewer system to convey peak flows from the Vichy Road WWTF approximately 1,250-ft downstream (north) of the facility to a 3.0-million gallon equalization basin. Flows in excess of the plant capacity would be detained in the equalization basin until the flows at the WWTF have receded, at which time the detained flows will be pumped back to the WWTF for treatment.

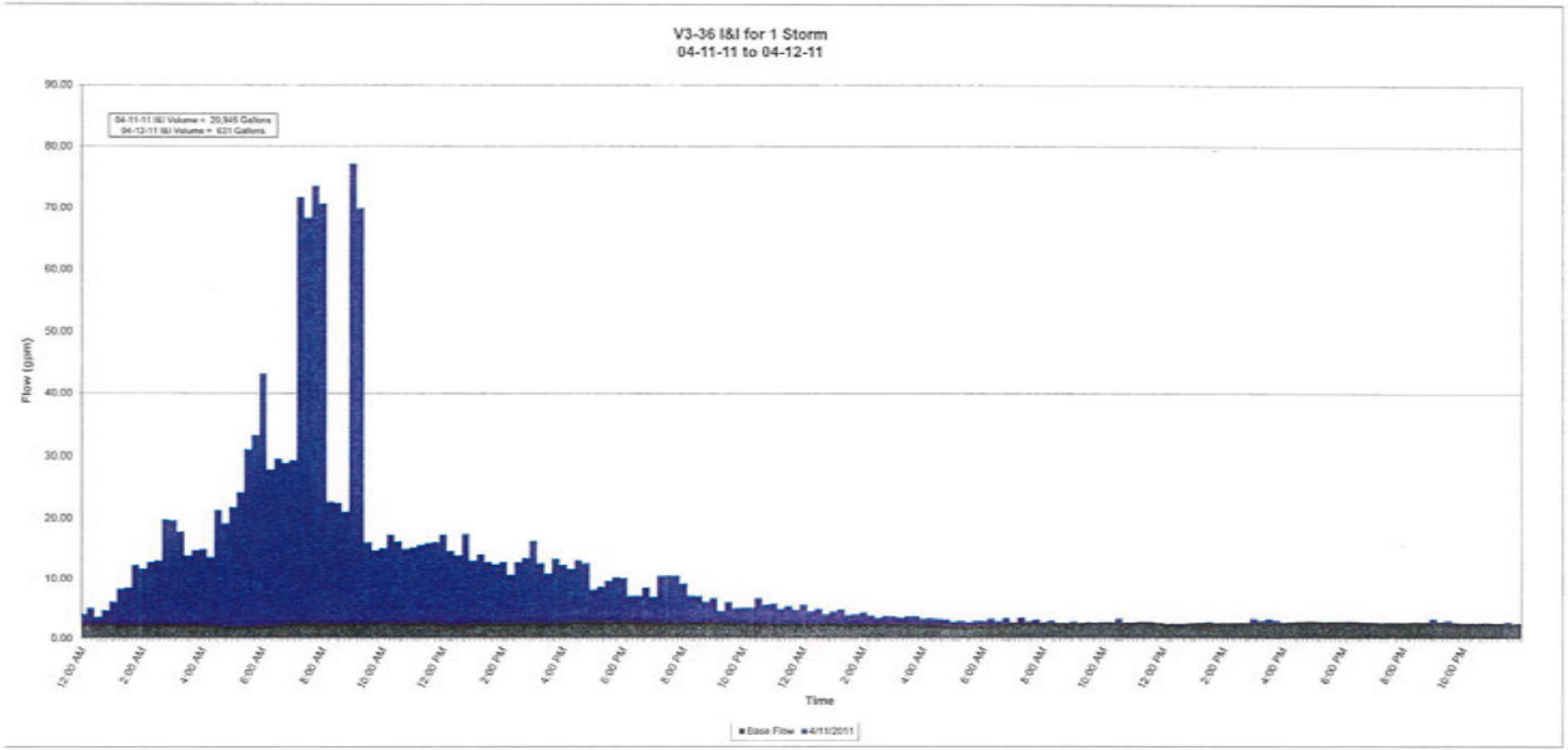
Item No.	Description	Qty	Unit	Unit Price	Total
Gravity Conveyance to EQ Basin					
1	Flow Splitter	1	EA	$50,000.00	$50,000.00
2	18" RCP	1,393	LF	$50.00	$69,650.00
3	48" Dia Manholes, 6 to 12-ft Deep	5	EA	$2,500.00	$12,500.00
EQ Basin Pump Station					
4a	Electrical Power Supply (Primary)	1	LS	$50,000.00	$50,000.00
4b	Electrical Power Supply (Secondary)	1	LS	$10,000.00	$10,000.00
4c	Electrical Service Entry & Misc Equipment	1	LS	$10,000.00	$10,000.00
5a	Pump Equipment, Accessories & Controls	1	LS	$40,000.00	$40,000.00
5b	Pump Equipment, Accessories & Controls Installation	1	LS	$5,000.00	$5,000.00
6	Duplex Wetwell & Valve Vault Structure	1	LS	$45,000.00	$45,000.00
7	Miscellaneous Process Piping	1	LS	$10,000.00	$10,000.00
EQ Basin Pump Station Force Main					
8	6" Ductile Iron Pipe, Restrained Joint	1,800	LF	$90.00	$162,000.00
9	48" Dia Doghouse Manholes, 6 to 9-ft Deep	1	EA	$2,000.00	$2,000.00
Equalization Basin					
10	EQ Basin Unclassified Excavation & Grading	1	LS	$131,373.00	$131,373.00
11	EQ Basin Liner System	1	LS	$177,067.00	$177,067.00
12	Underdrain System	3,000	LF	$30.00	$90,000.00
13	Riprap Revetment	750	SY	$35.00	$26,250.00
14	EQ Basin Outlet Structures	1	EA	$7,500.00	$7,500.00
15	8" ASTM D3034 SDR-35 PVC Sewer Line	100	LF	$35.00	$3,500.00
16	12-ft Wide Access Road	450	LF	$15.00	$6,750.00
17	Granular Paving	1,300	SY	$25.00	$32,500.00
				Subtotal =	$941,090
				Contingency (20%) =	$188,218
				Construction Subtotal =	**$1,129,308**
				Engineering, Legal and Administration =	$282,400
				Land Acquisition (12-Acres) =	$60,000
				Opinion of Probable Project Cost =	**$1,471,800**

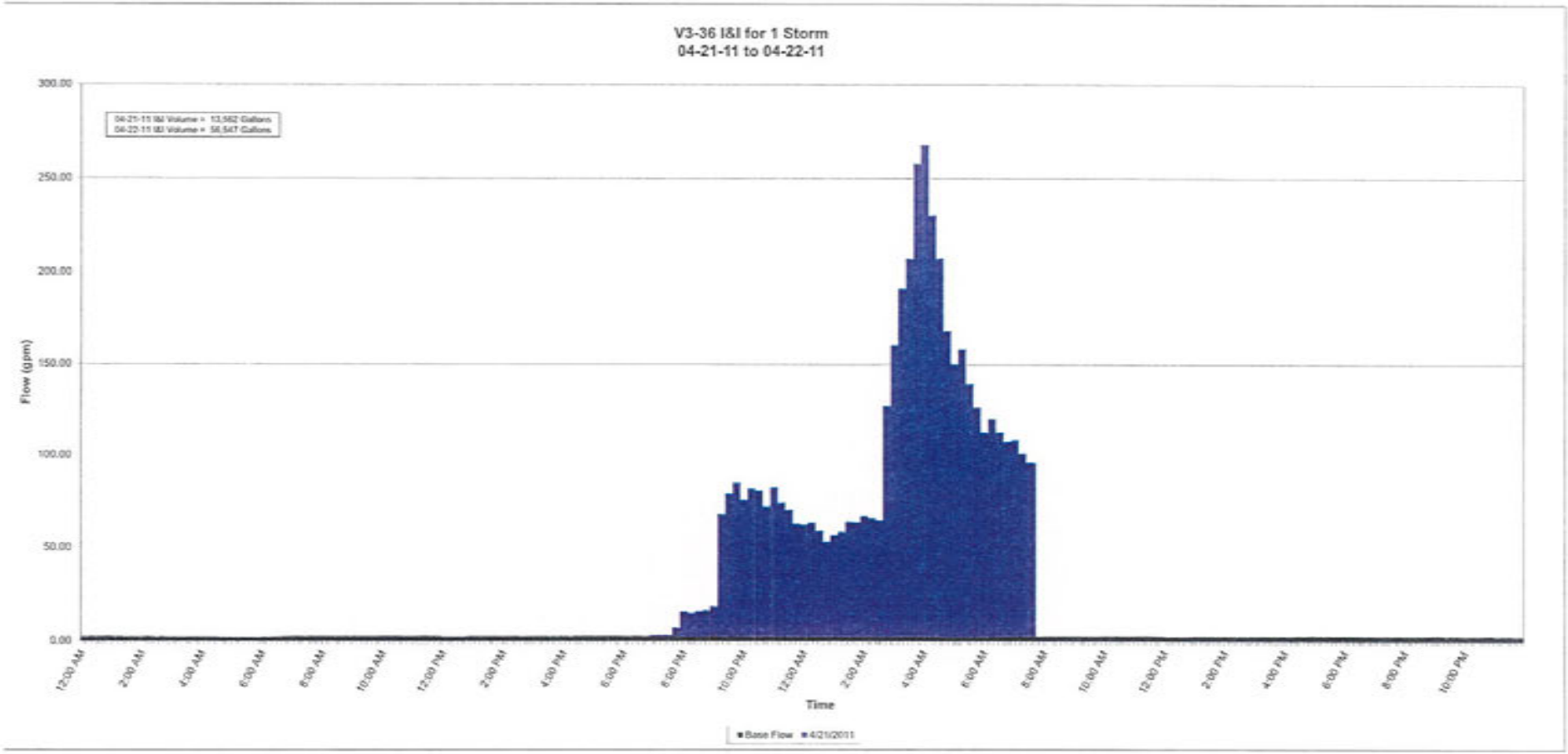
APPENDIX C

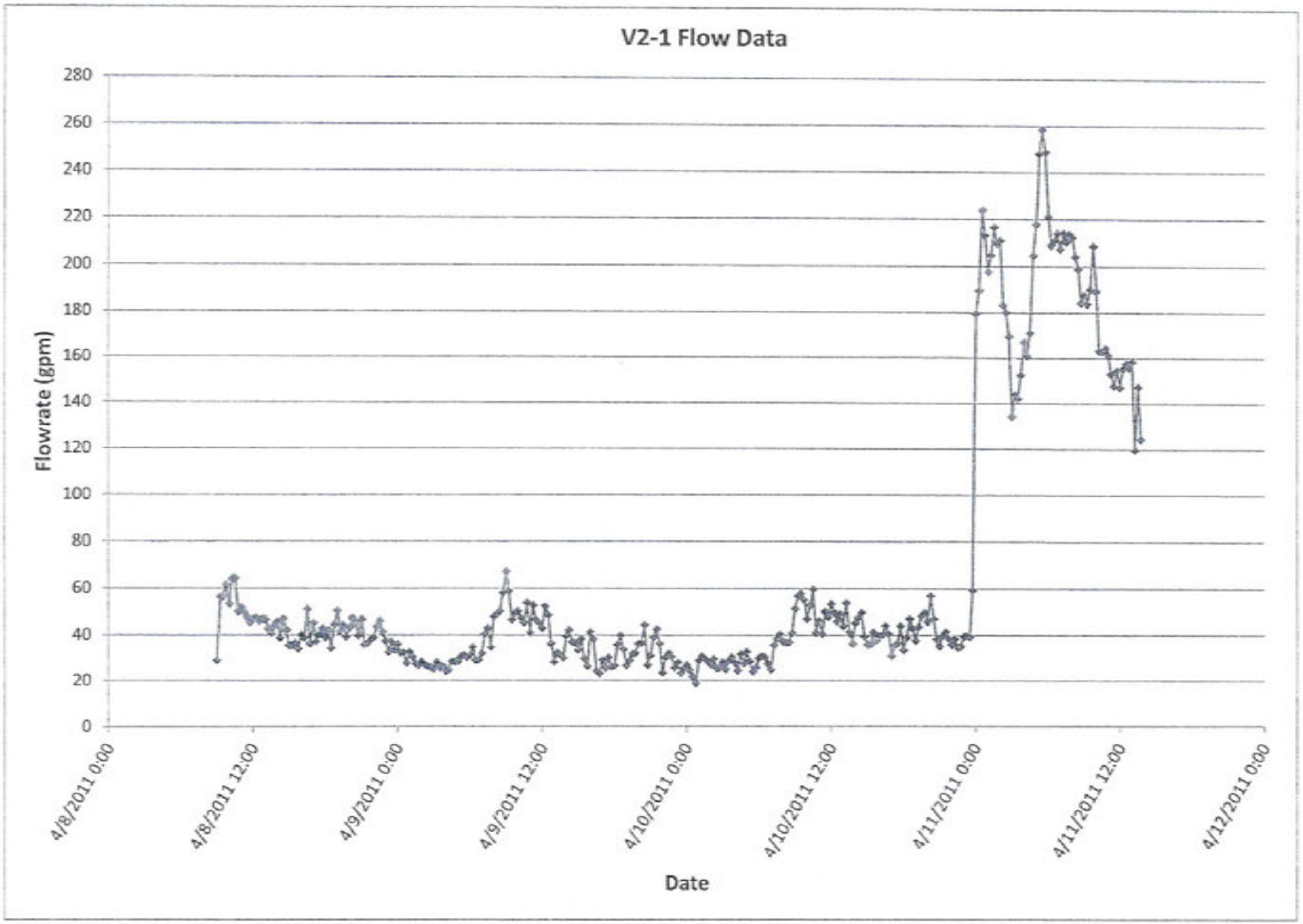
2011 COLLECTION SYSTEM FLOW MONITORING RESULTS AND ANALYSIS

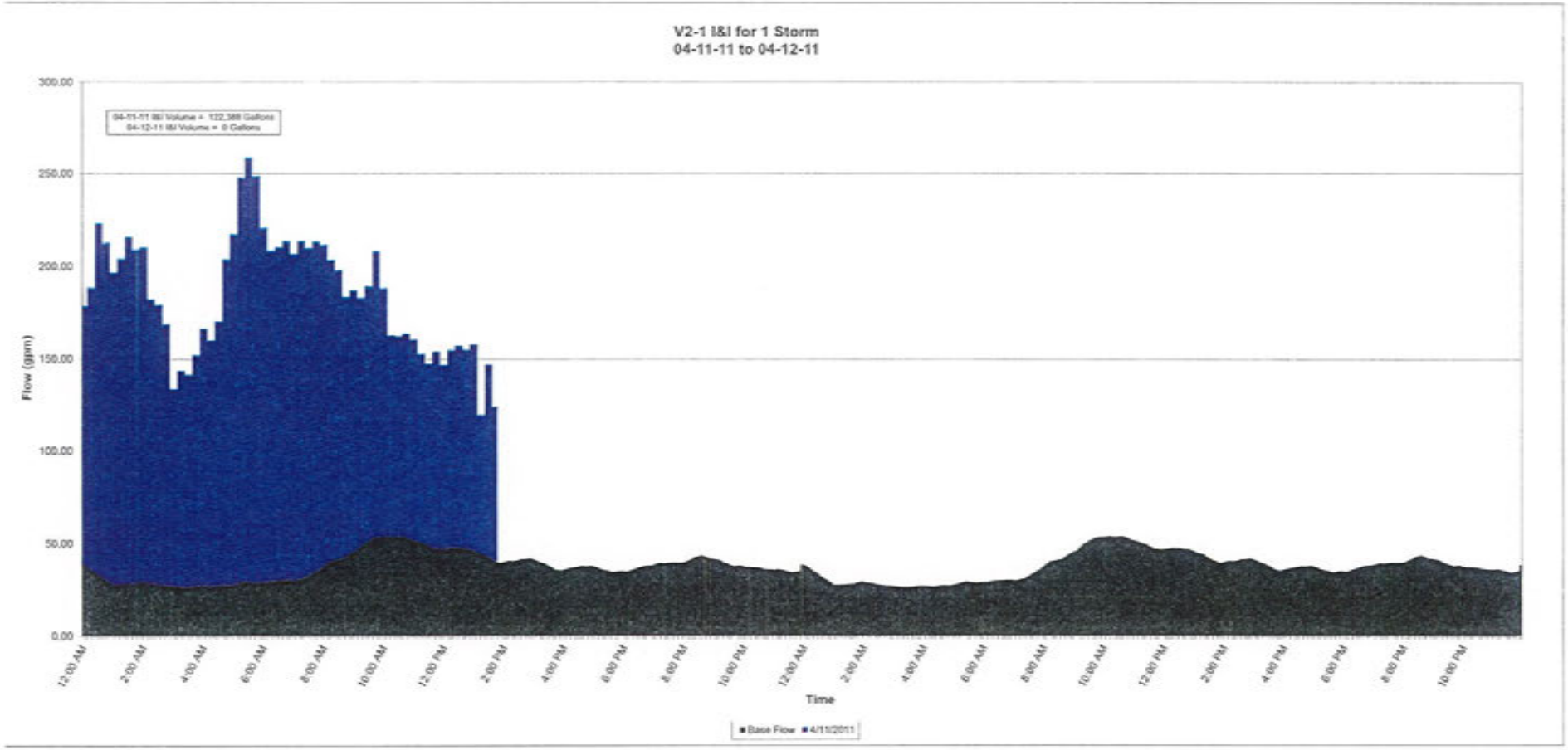

V3-36 Flow Data
300
250
200
150
100
50
0
Flowrate (gpm)
4/5/2011 0:00
4/7/2011 0:00
4/9/2011 0:00
4/11/2011 0:00
4/13/2011 0:00
4/15/2011 0:00
4/17/2011 0:00
4/19/2011 0:00
4/21/2011 0:00
4/23/2011 0:00
4/25/2011 0:00
Date

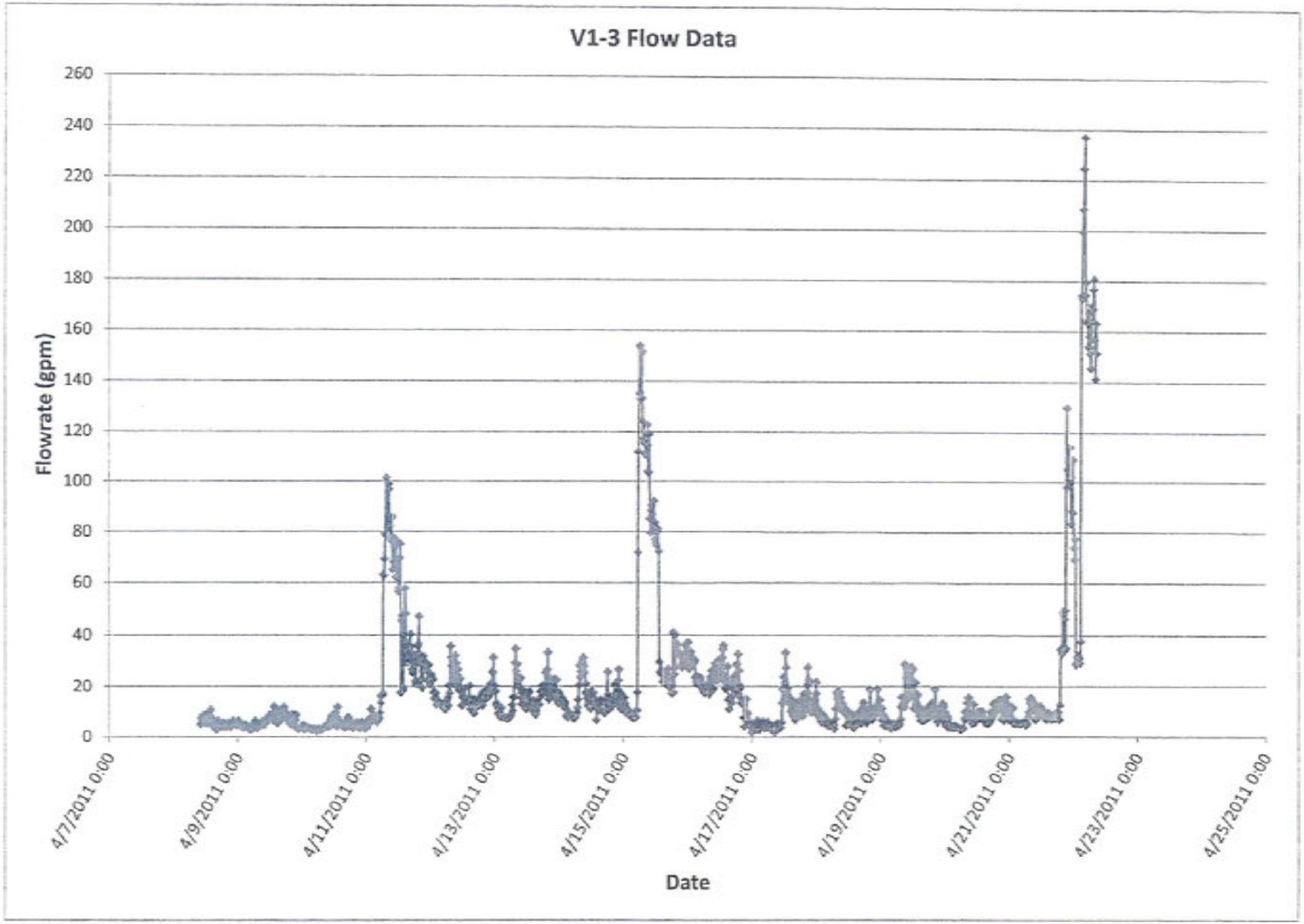

V3-36 I&I for 1 Storm
04-15-11 to 04-16-11
04-15-11 I&I Volume = 44,069 Gallons
04-16-11 I&I Volume = 3,5746 Gallons
160.00
140.00
120.00
100.00
80.00
60.00
40.00
20.00
0.00
Flow (gpm)
12:00 AM
2:00 AM
4:00 AM
6:00 AM
8:00 AM
10:00 AM
12:00 PM
2:00 PM
4:00 PM
6:00 PM
8:00 PM
10:00 PM
12:00 AM
2:00 AM
4:00 AM
6:00 AM
8:00 AM
10:00 AM
12:00 PM
2:00 PM
4:00 PM
6:00 PM
8:00 PM
10:00 PM
Time
Base Flow
4/15/2011

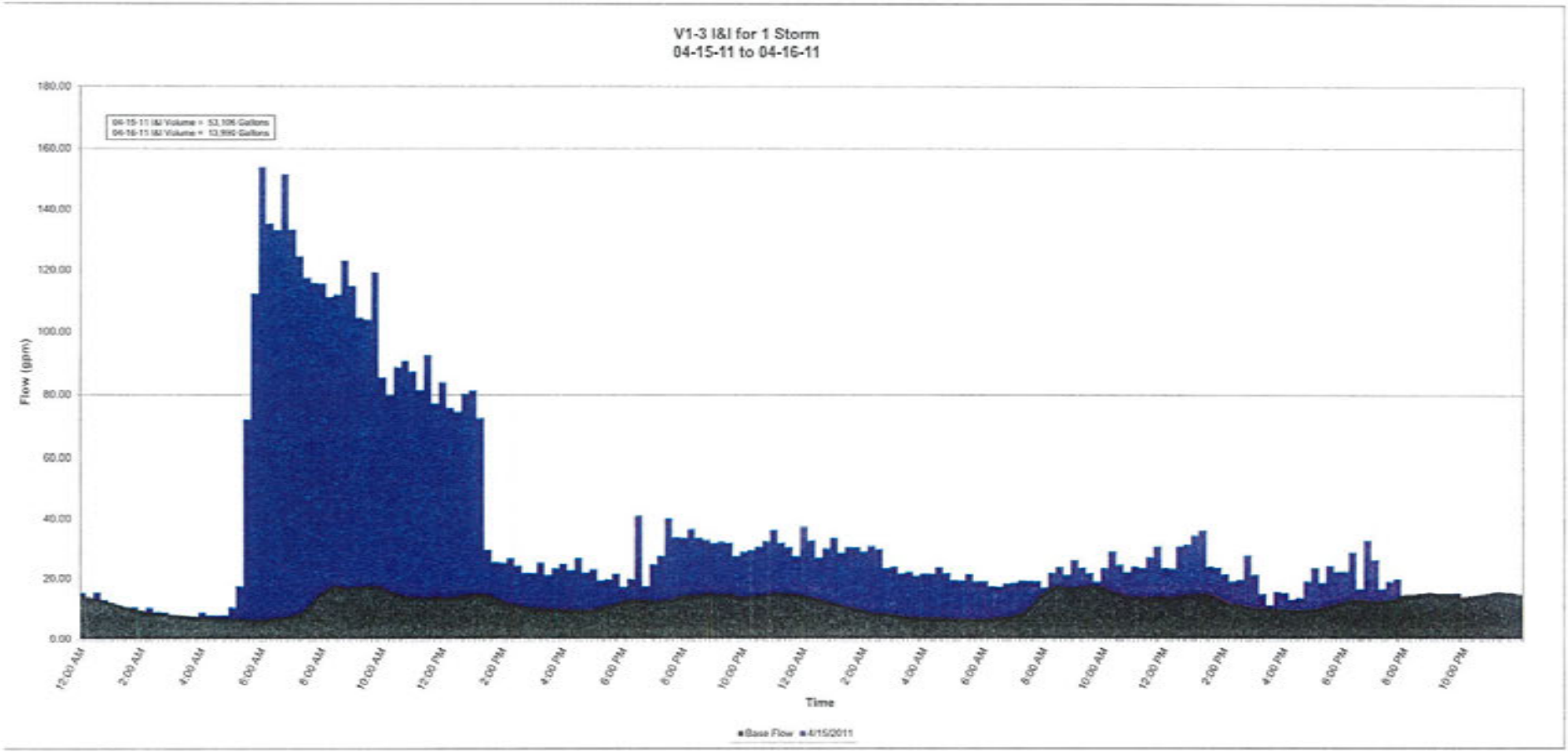

V3-36 I&I for 1 Storm
04-11-11 to 04-12-11
04-11-11 I&I Volume = 20,945 Gallons
04-12-11 I&I Volume = 631 Gallons
Flow (gpm)
90.00
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
12:00 AM
2:00 AM
4:00 AM
6:00 AM
8:00 AM
10:00 AM
12:00 PM
2:00 PM
4:00 PM
6:00 PM
8:00 PM
10:00 PM
12:00 AM
2:00 AM
4:00 AM
6:00 AM
8:00 AM
10:00 AM
12:00 PM
2:00 PM
4:00 PM
6:00 PM
8:00 PM
10:00 PM
Time
Base Flow
4/11/2011

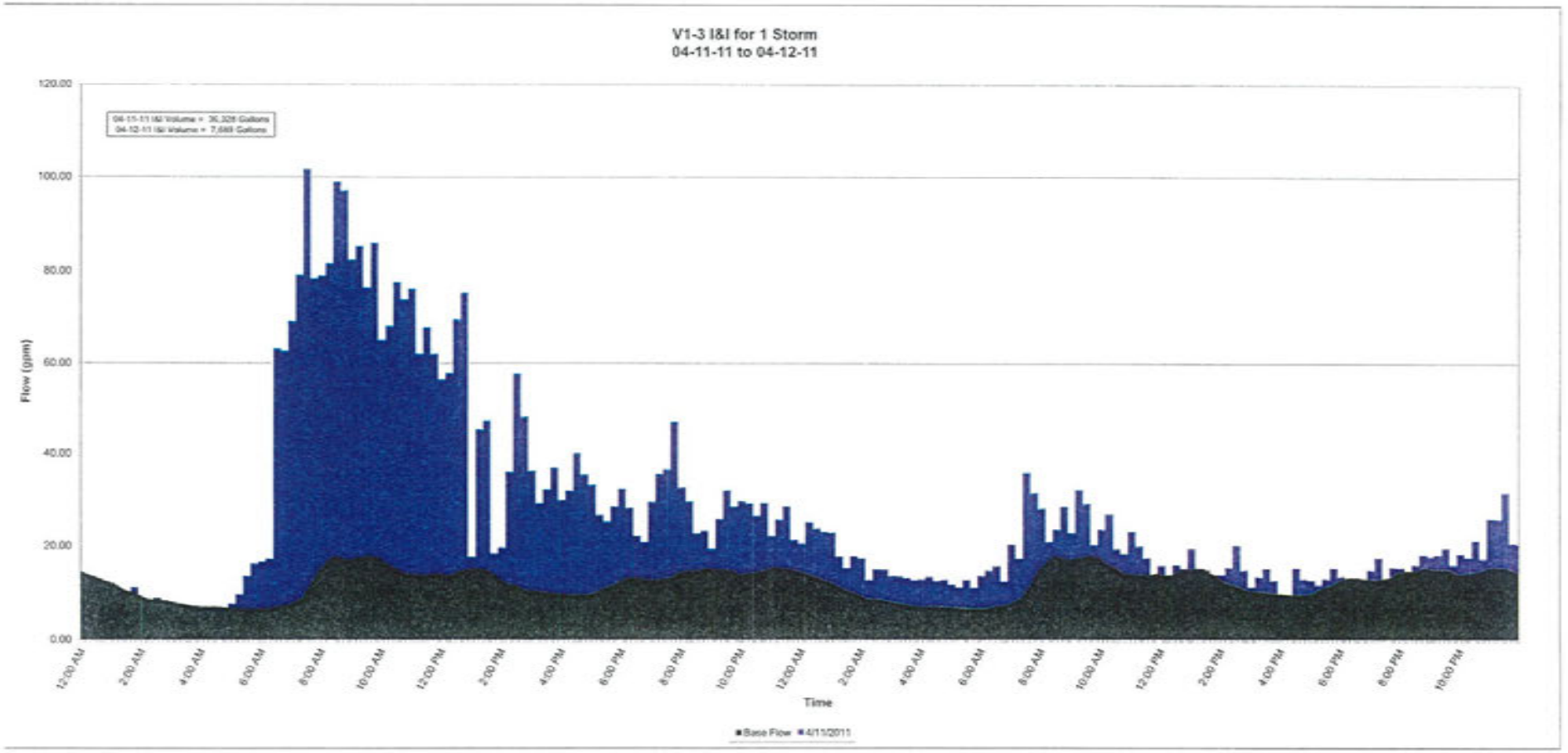

V3-36 I&I for 1 Storm
04-21-11 to 04-22-11
04-21-11 I&I Volume = 13,562 Gallons
04-22-11 I&I Volume = 56,547 Gallons
Flow (gpm)
300.00
250.00
200.00
150.00
100.00
50.00
0.00
12:00 AM
2:00 AM
4:00 AM
6:00 AM
8:00 AM
10:00 AM
12:00 PM
2:00 PM
4:00 PM
6:00 PM
8:00 PM
10:00 PM
Time
Base Flow
4/21/2011

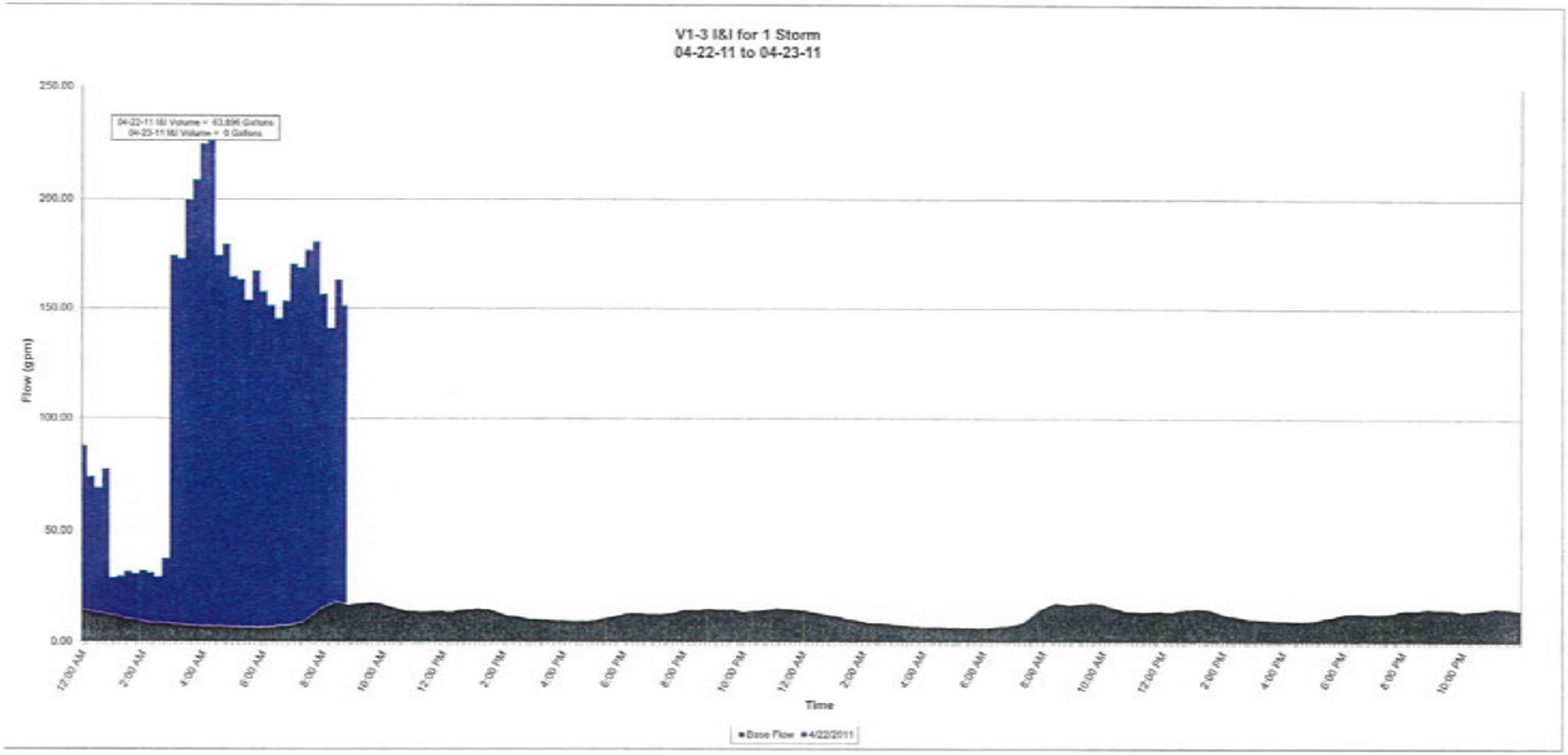

V2-1 Flow Data
Flowrate (gpm)
280
260
240
220
200
180
160
140
120
100
80
60
40
20
0
4/8/2011 0:00
4/8/2011 12:00
4/9/2011 0:00
4/9/2011 12:00
4/10/2011 0:00
4/10/2011 12:00
4/11/2011 0:00
4/11/2011 12:00
4/12/2011 0:00
Date

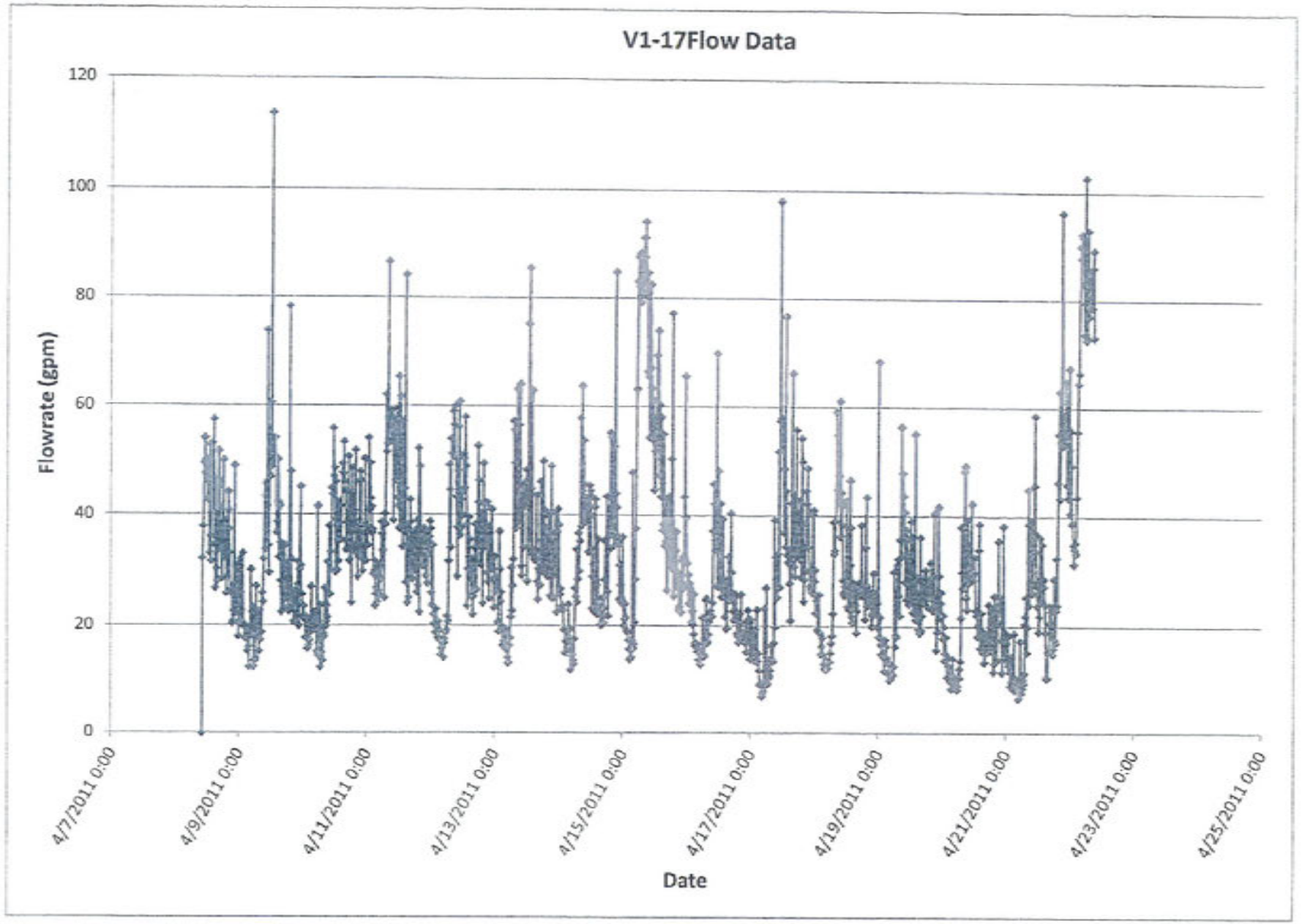

V2-1 I&I for 1 Storm
04-11-11 to 04-12-11
04-11-11 I&I Volume = 122,388 Gallons
04-12-11 I&I Volume = 0 Gallons
300.00
250.00
200.00
150.00
100.00
50.00
0.00
Flow (gpm)
12:00 AM
2:00 AM
4:00 AM
6:00 AM
8:00 AM
10:00 AM
12:00 PM
2:00 PM
4:00 PM
6:00 PM
8:00 PM
10:00 PM
12:00 AM
2:00 AM
4:00 AM
6:00 AM
8:00 AM
10:00 AM
12:00 PM
2:00 PM
4:00 PM
6:00 PM
8:00 PM
10:00 PM
Time
Base Flow
4/11/2011

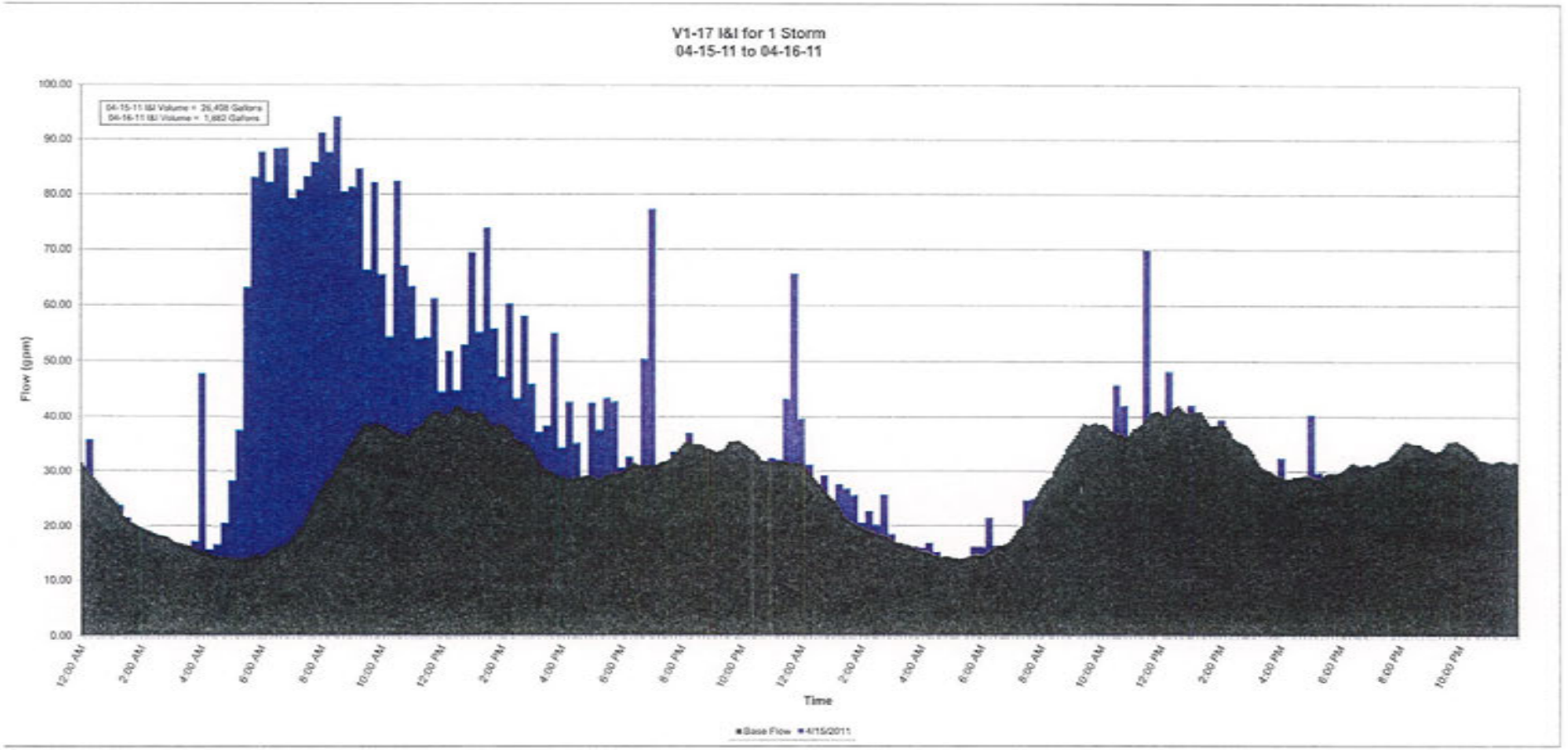

V1-3 Flow Data
Flowrate (gpm)
260
240
220
200
180
160
140
120
100
80
60
40
20
0
4/7/2011 0:00
4/9/2011 0:00
4/11/2011 0:00
4/13/2011 0:00
4/15/2011 0:00
4/17/2011 0:00
4/19/2011 0:00
4/21/2011 0:00
4/23/2011 0:00
4/25/2011 0:00
Date

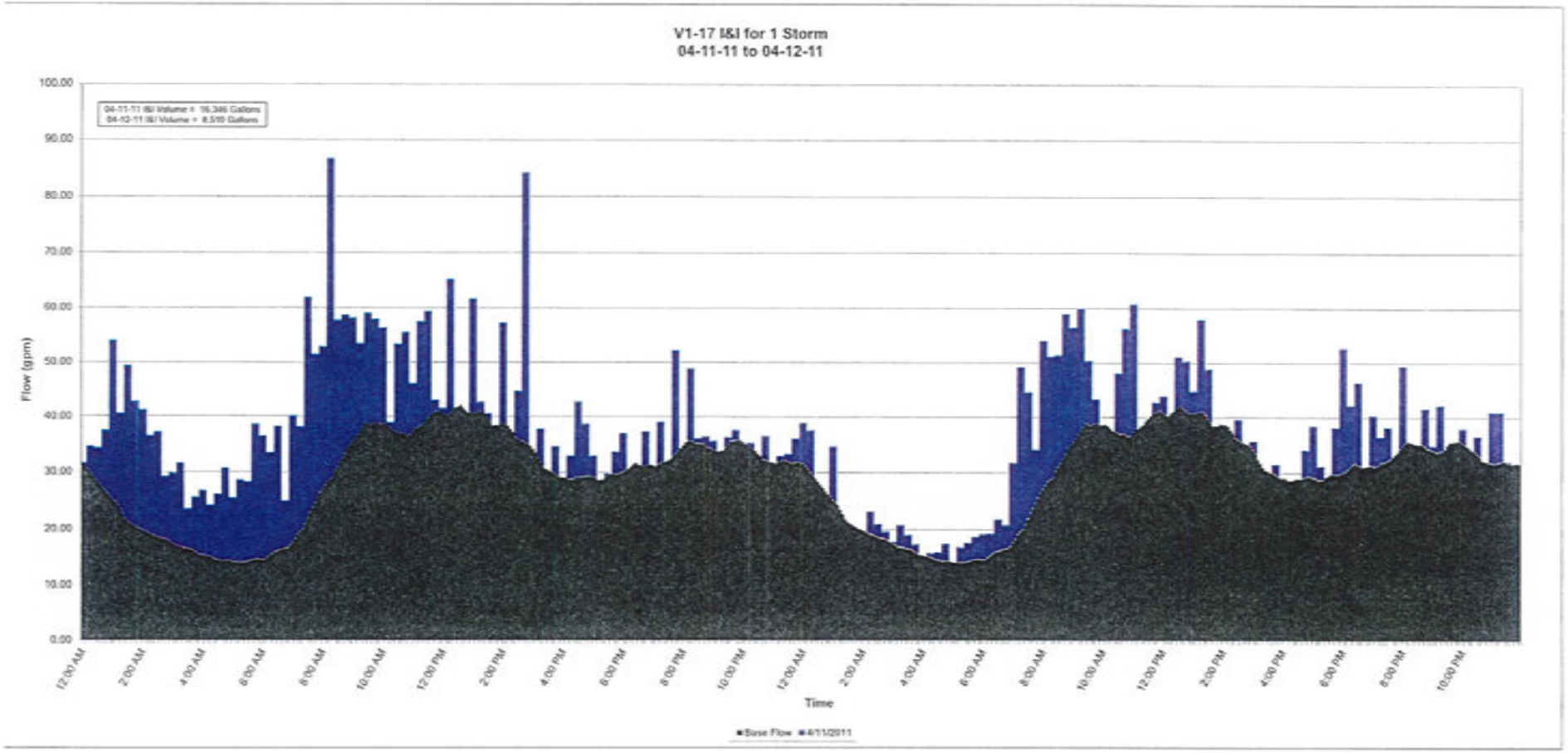

V1-3 I&I for 1 Storm
04-15-11 to 04-16-11
04-15-11 I&I Volume = 53,106 Gallons
04-16-11 I&I Volume = 13,990 Gallons
Flow (gpm)
180.00
160.00
140.00
120.00
100.00
80.00
60.00
40.00
20.00
0.00
12:00 AM
2:00 AM
4:00 AM
6:00 AM
8:00 AM
10:00 AM
12:00 PM
2:00 PM
4:00 PM
6:00 PM
8:00 PM
10:00 PM
12:00 AM
2:00 AM
4:00 AM
6:00 AM
8:00 AM
10:00 AM
12:00 PM
2:00 PM
4:00 PM
6:00 PM
8:00 PM
10:00 PM
Time
Base Flow
4/15/2011

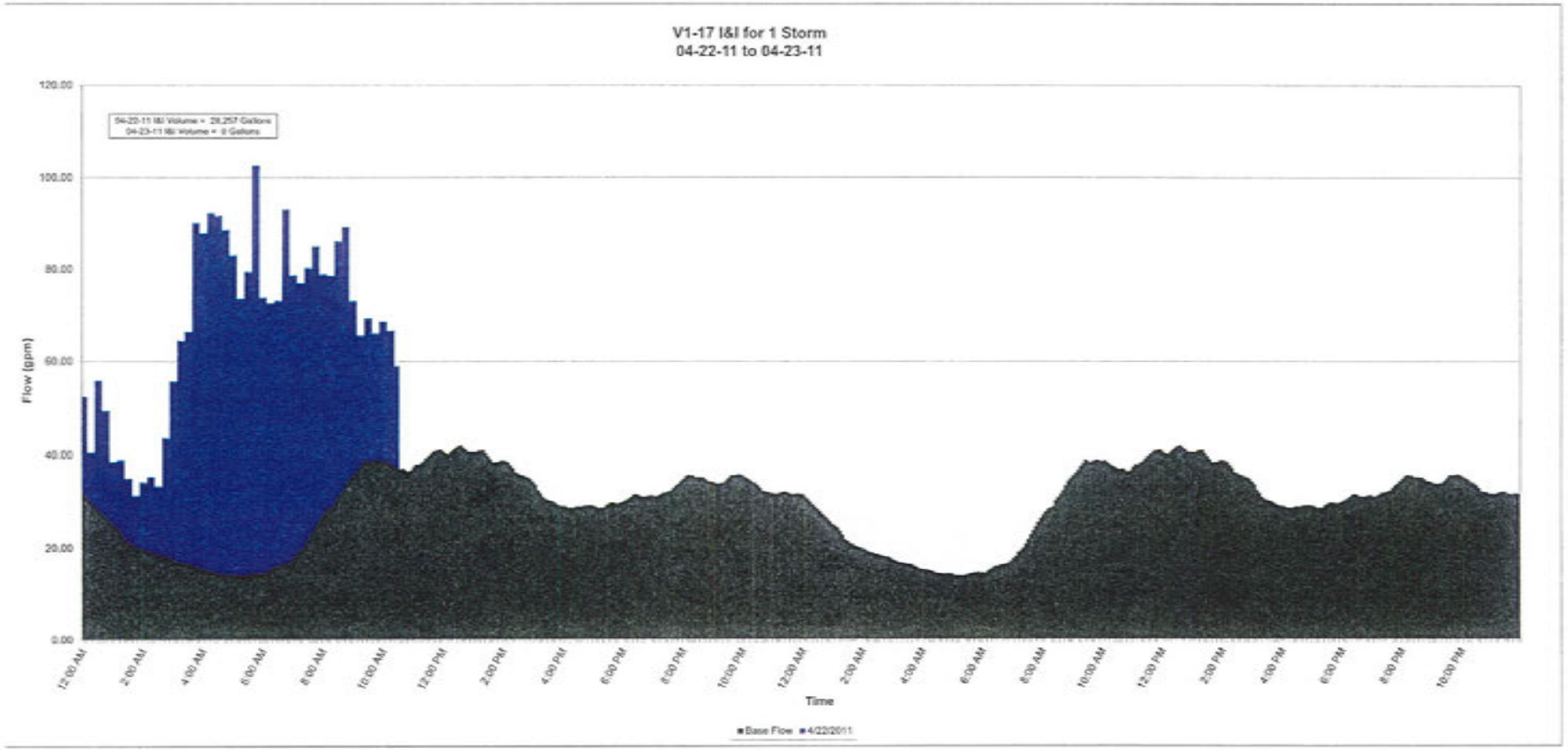

V1-3 I&I for 1 Storm
04-11-11 to 04-12-11
04-11-11 I&I Volume = 36,328 Gallons
04-12-11 I&I Volume = 7,649 Gallons
Flow (gpm)
120.00
100.00
80.00
60.00
40.00
20.00
0.00
12:00 AM
2:00 AM
4:00 AM
6:00 AM
8:00 AM
10:00 AM
12:00 PM
2:00 PM
4:00 PM
6:00 PM
8:00 PM
10:00 PM
12:00 AM
2:00 AM
4:00 AM
6:00 AM
8:00 AM
10:00 AM
12:00 PM
2:00 PM
4:00 PM
6:00 PM
8:00 PM
10:00 PM
Time
Base Flow
4/11/2011

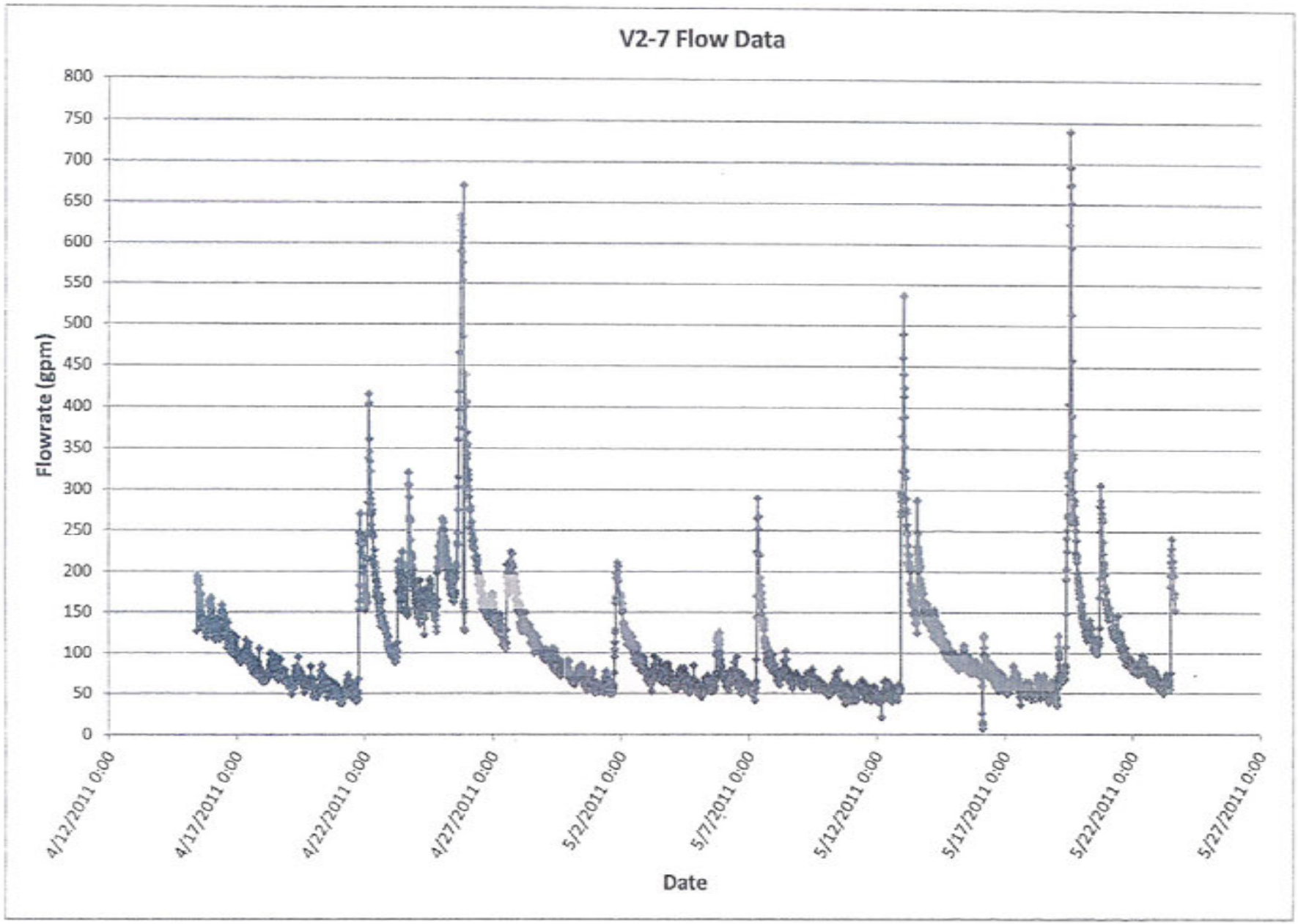

V1-3 I&I for 1 Storm
04-22-11 to 04-23-11
04-22-11 I&I Volume = 63,896 Gallons
04-23-11 I&I Volume = 0 Gallons
250.00
200.00
150.00
100.00
50.00
0.00
Flow (gpm)
12:00 AM
2:00 AM
4:00 AM
6:00 AM
8:00 AM
10:00 AM
12:00 PM
2:00 PM
4:00 PM
6:00 PM
8:00 PM
10:00 PM
12:00 AM
2:00 AM
4:00 AM
6:00 AM
8:00 AM
10:00 AM
12:00 PM
2:00 PM
4:00 PM
6:00 PM
8:00 PM
10:00 PM
Time
Base Flow
4/22/2011

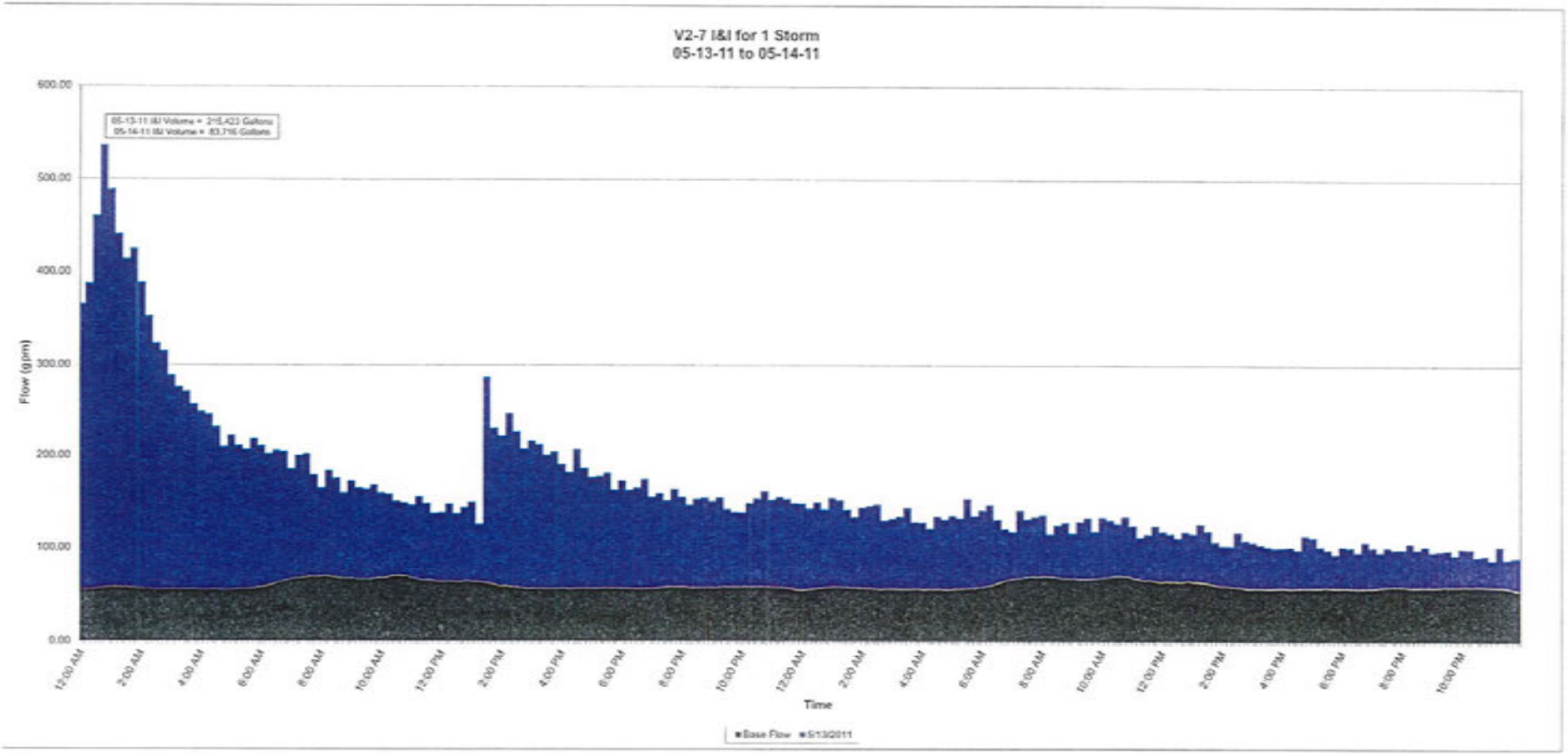

V1-17Flow Data
120
100
80
60
40
20
0
Flowrate (gpm)
4/7/2011 0:00
4/9/2011 0:00
4/11/2011 0:00
4/13/2011 0:00
4/15/2011 0:00
4/17/2011 0:00
4/19/2011 0:00
4/21/2011 0:00
4/23/2011 0:00
4/25/2011 0:00
Date

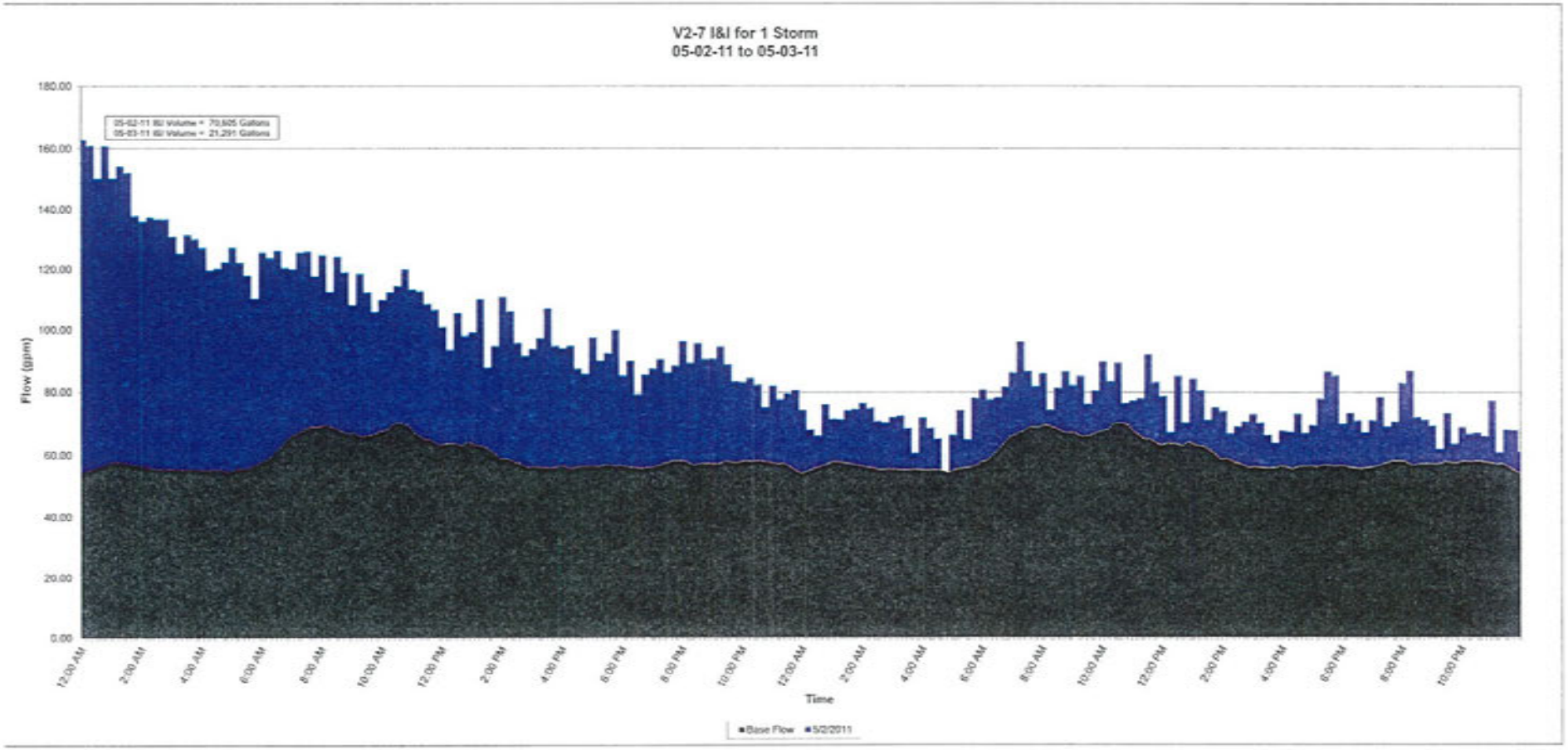

V1-17 I&I for 1 Storm
04-15-11 to 04-16-11
04-15-11 I&I Volume = 29,408 Gallons
04-16-11 I&I Volume = 1,682 Gallons
Flow (gpm)
100.00
90.00
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
12:00 AM
2:00 AM
4:00 AM
6:00 AM
8:00 AM
10:00 AM
12:00 PM
2:00 PM
4:00 PM
6:00 PM
8:00 PM
10:00 PM
Time
Base Flow
4/15/2011

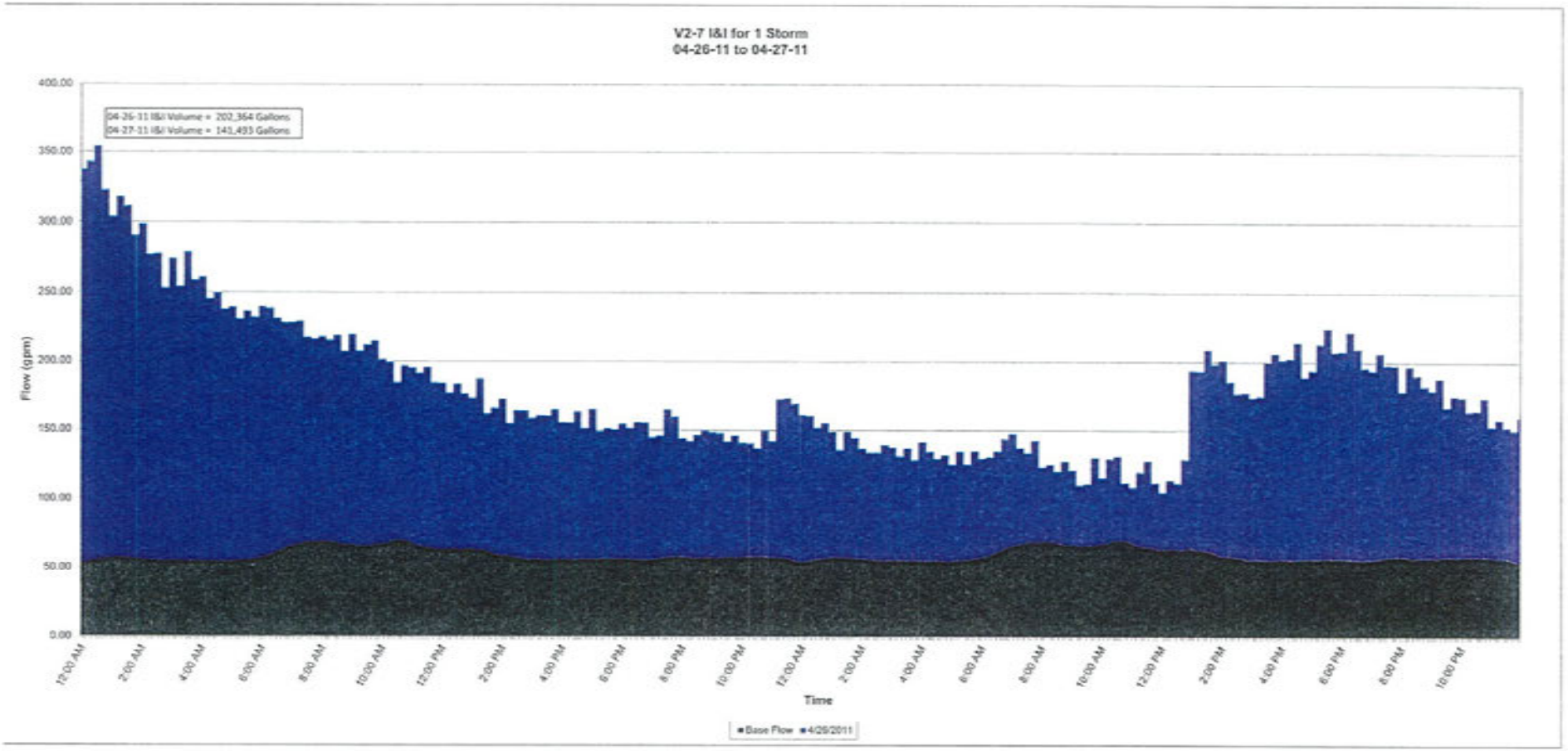

V1-17 I&I for 1 Storm
04-11-11 to 04-12-11
04-11-11 I&I Volume = 16,346 Gallons
04-12-11 I&I Volume = 8,510 Gallons
Flow (gpm)
100.00
90.00
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
12:00 AM
2:00 AM
4:00 AM
6:00 AM
8:00 AM
10:00 AM
12:00 PM
2:00 PM
4:00 PM
6:00 PM
8:00 PM
10:00 PM
12:00 AM
2:00 AM
4:00 AM
6:00 AM
8:00 AM
10:00 AM
12:00 PM
2:00 PM
4:00 PM
6:00 PM
8:00 PM
10:00 PM
Time
Base Flow
4/11/2011

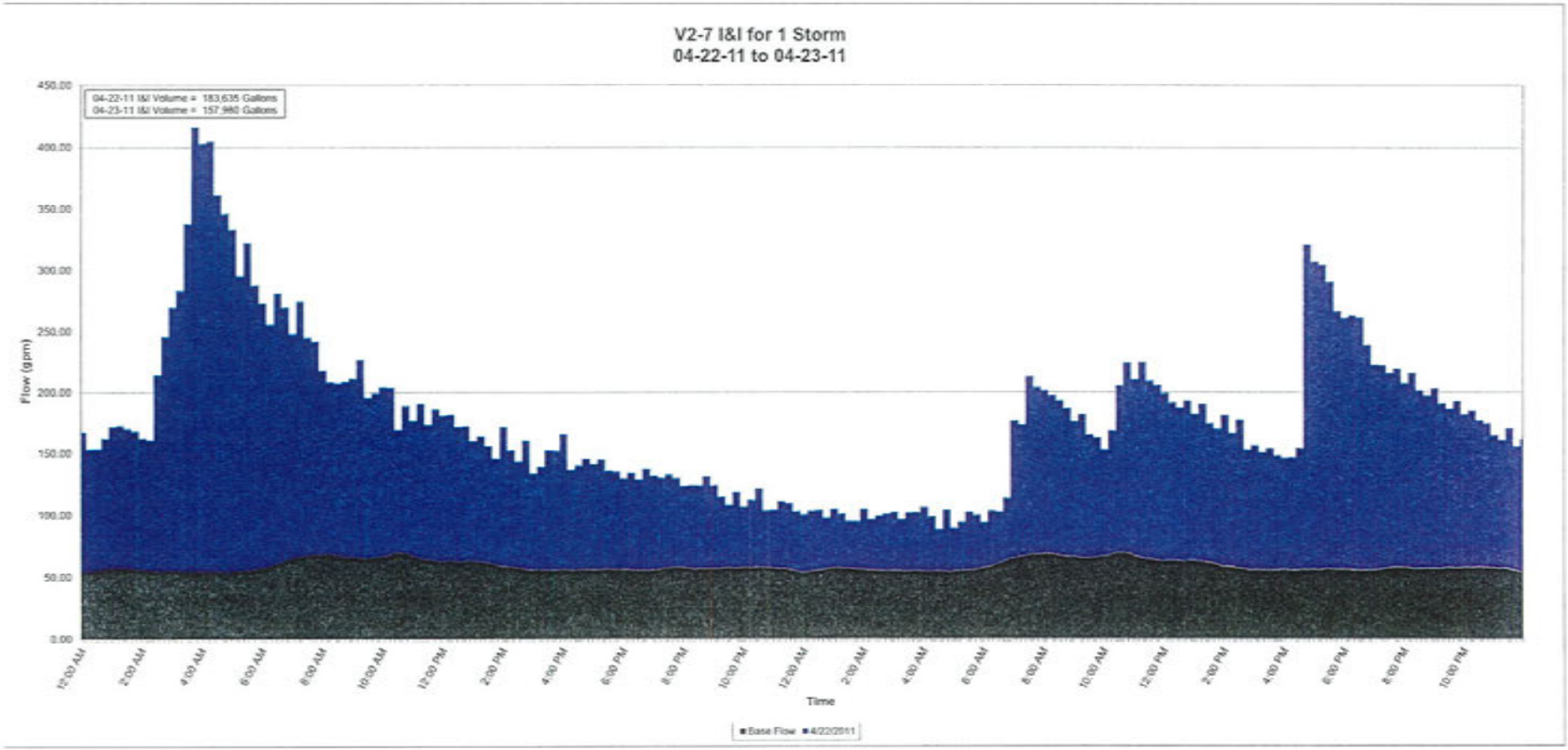

V1-17 I&I for 1 Storm
04-22-11 to 04-23-11
04-22-11 I&I Volume = 28,257 Gallons
04-23-11 I&I Volume = 0 Gallons
120.00
100.00
80.00
60.00
40.00
20.00
0.00
Flow (gpm)
12:00 AM
2:00 AM
4:00 AM
6:00 AM
8:00 AM
10:00 AM
12:00 PM
2:00 PM
4:00 PM
6:00 PM
8:00 PM
10:00 PM
12:00 AM
2:00 AM
4:00 AM
6:00 AM
8:00 AM
10:00 AM
12:00 PM
2:00 PM
4:00 PM
6:00 PM
8:00 PM
10:00 PM
Time
Base Flow
4/22/2011

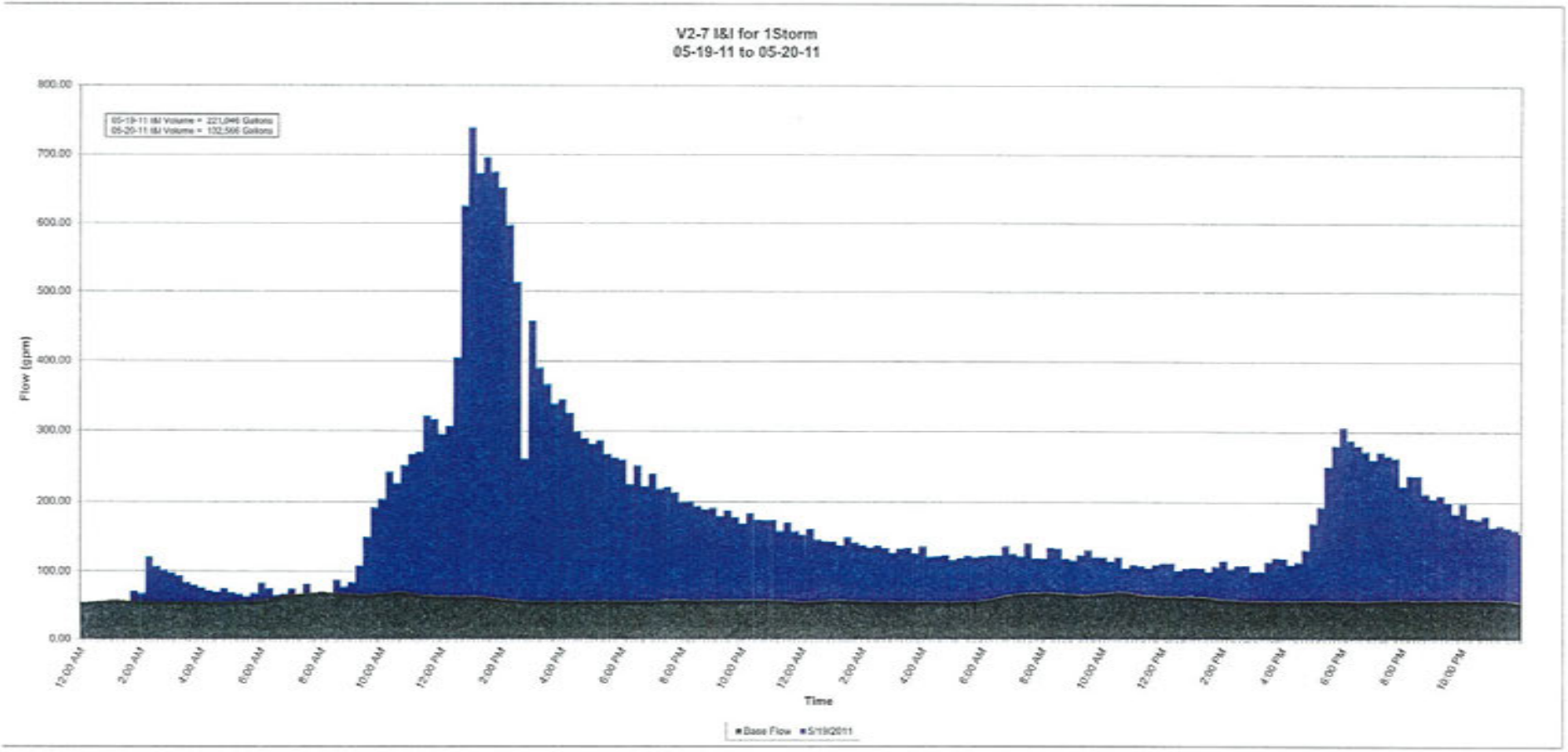

V2-7 Flow Data
Flowrate (gpm)
800
750
700
650
600
550
500
450
400
350
300
250
200
150
100
50
0
4/12/2011 0:00
4/17/2011 0:00
4/22/2011 0:00
4/27/2011 0:00
5/2/2011 0:00
5/7/2011 0:00
5/12/2011 0:00
5/17/2011 0:00
5/22/2011 0:00
5/27/2011 0:00
Date


V2-7 I&I for 1 Storm
05-13-11 to 05-14-11
05-13-11 I&I Volume = 215,423 Gallons
05-14-11 I&I Volume = 83,716 Gallons
600.00
500.00
400.00
300.00
200.00
100.00
0.00
Flow (gpm)
12:00 AM
2:00 AM
4:00 AM
6:00 AM
8:00 AM
10:00 AM
12:00 PM
2:00 PM
4:00 PM
6:00 PM
8:00 PM
10:00 PM
Time
Base Flow
5/13/2011


V2-7 I&I for 1 Storm
05-02-11 to 05-03-11
05-02-11 I&I Volume = 70,605 Gallons
05-03-11 I&I Volume = 21,291 Gallons
Flow (gpm)
180.00
160.00
140.00
120.00
100.00
80.00
60.00
40.00
20.00
0.00
12:00 AM
2:00 AM
4:00 AM
6:00 AM
8:00 AM
10:00 AM
12:00 PM
2:00 PM
4:00 PM
6:00 PM
8:00 PM
10:00 PM
12:00 AM
2:00 AM
4:00 AM
6:00 AM
8:00 AM
10:00 AM
12:00 PM
2:00 PM
4:00 PM
6:00 PM
8:00 PM
10:00 PM
Time
Base Flow
5/2/2011


V2-7 I&I for 1 Storm
04-26-11 to 04-27-11
04-26-11 I&I Volume = 202,364 Gallons
04-27-11 I&I Volume = 143,493 Gallons
Flow (gpm)
400.00
350.00
300.00
250.00
200.00
150.00
100.00
50.00
0.00
12:00 AM
2:00 AM
4:00 AM
6:00 AM
8:00 AM
10:00 AM
12:00 PM
2:00 PM
4:00 PM
6:00 PM
8:00 PM
10:00 PM
12:00 AM
2:00 AM
4:00 AM
6:00 AM
8:00 AM
10:00 AM
12:00 PM
2:00 PM
4:00 PM
6:00 PM
8:00 PM
10:00 PM
Time
Base Flow
4/26/2011


V2-7 I&I for 1 Storm
04-22-11 to 04-23-11
04-22-11 I&I Volume = 183,635 Gallons
04-23-11 I&I Volume = 157,980 Gallons
Flow (gpm)
450.00
400.00
350.00
300.00
250.00
200.00
150.00
100.00
50.00
0.00
12:00 AM
2:00 AM
4:00 AM
6:00 AM
8:00 AM
10:00 AM
12:00 PM
2:00 PM
4:00 PM
6:00 PM
8:00 PM
10:00 PM
12:00 AM
2:00 AM
4:00 AM
6:00 AM
8:00 AM
10:00 AM
12:00 PM
2:00 PM
4:00 PM
6:00 PM
8:00 PM
10:00 PM
Time
Base Flow
4/22/2011


V2-7 I&I for 1Storm
05-19-11 to 05-20-11
05-19-11 I&I Volume = 227,046 Gallons
05-20-11 I&I Volume = 132,566 Gallons
800.00
700.00
600.00
500.00
400.00
300.00
200.00
100.00
0.00
Flow (gpm)
12:00 AM
2:00 AM
4:00 AM
6:00 AM
8:00 AM
10:00 AM
12:00 PM
2:00 PM
4:00 PM
6:00 PM
8:00 PM
10:00 PM
12:00 AM
2:00 AM
4:00 AM
6:00 AM
8:00 AM
10:00 AM
12:00 PM
2:00 PM
4:00 PM
6:00 PM
8:00 PM
10:00 PM
Time
Base Flow
5/19/2011

Flow Meter Journal

Site: V2-7

Date: 5/9/11

Time: 1600

Crew Members: Brian and Brandon

-Site V2-7 again shows major I & I spiking at almost 300 gpm. Also total flow indicates this with almost 4 million gallons flowed in 3-4 week span.

-Conclusion drawn at site V2-7: Given readings at V2-10 site there is heavy flow coming from Sooter inn string and from Vichy road string. Recommend moving meters from V2-7 and V2-10 to V2-9 to track Vichy road string and V2-83 to track Sooter inn string.

Date: 5/16/11

Time: 1200

Crew members: Dane, Scott, Brian

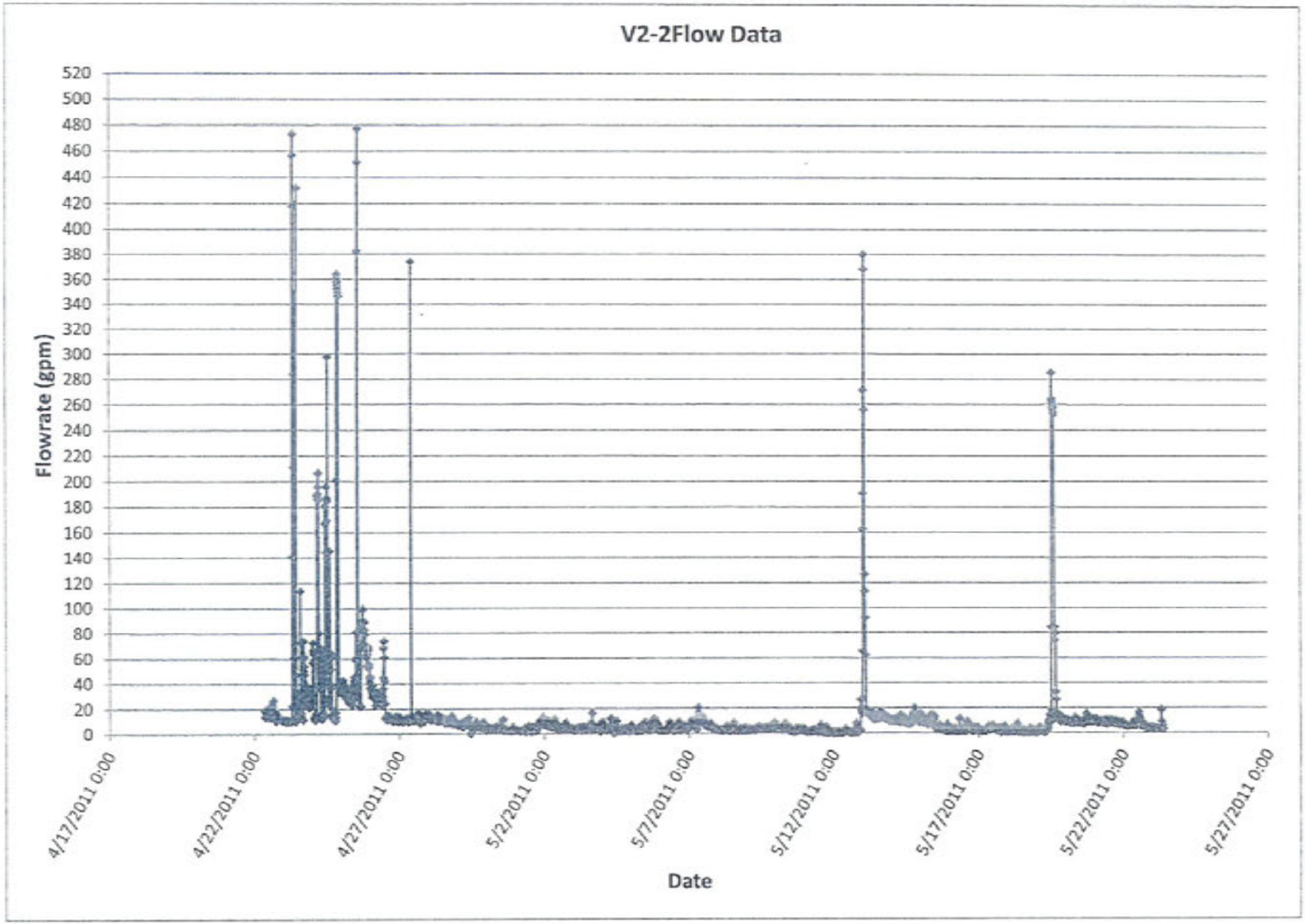
-Site V2-7 shows sharp spiking during all rain occurrences, indicating inflow into a manhole. Suggestion was made to check Sooter Inn for gutter connections to sanitary sewer.

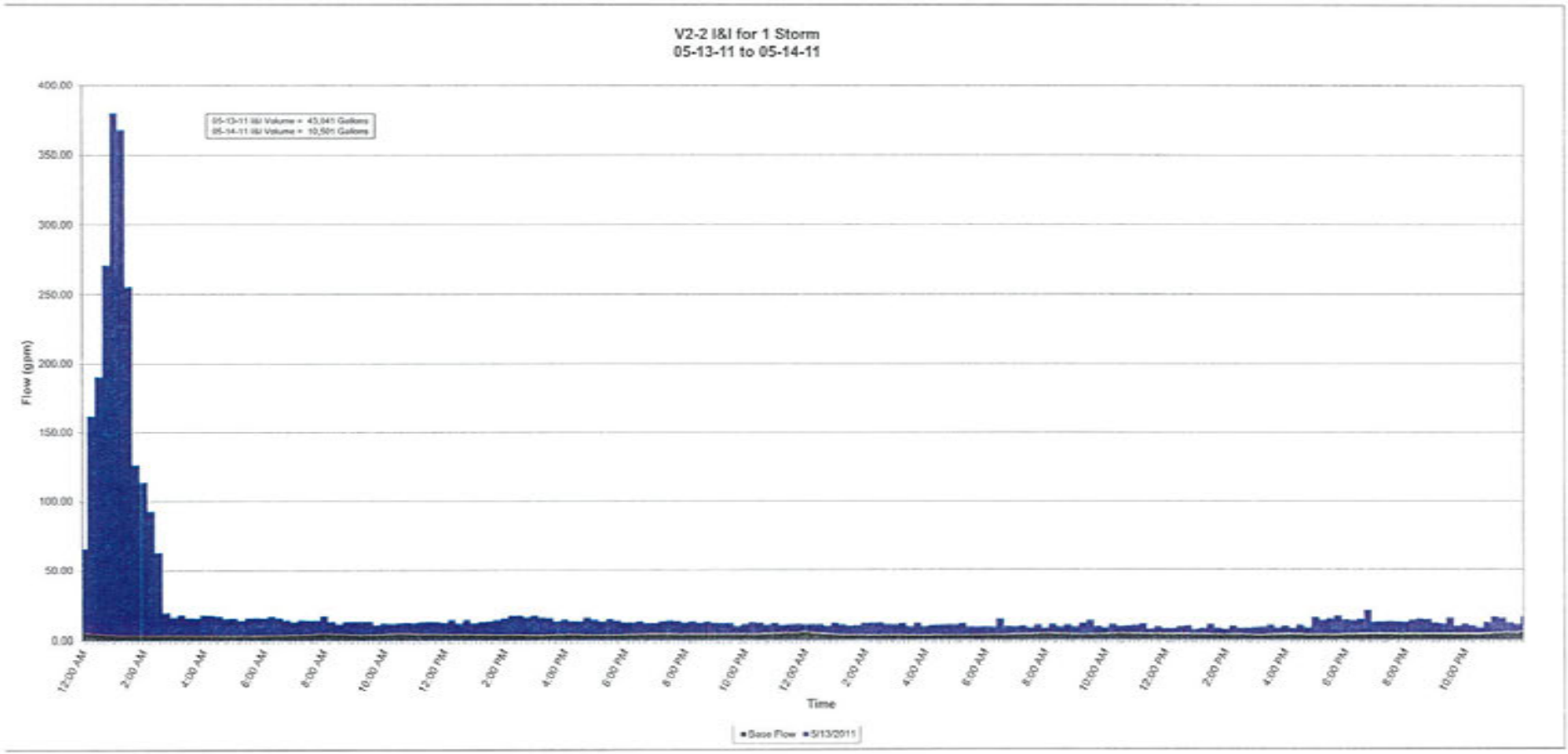
Date: 5/19/11

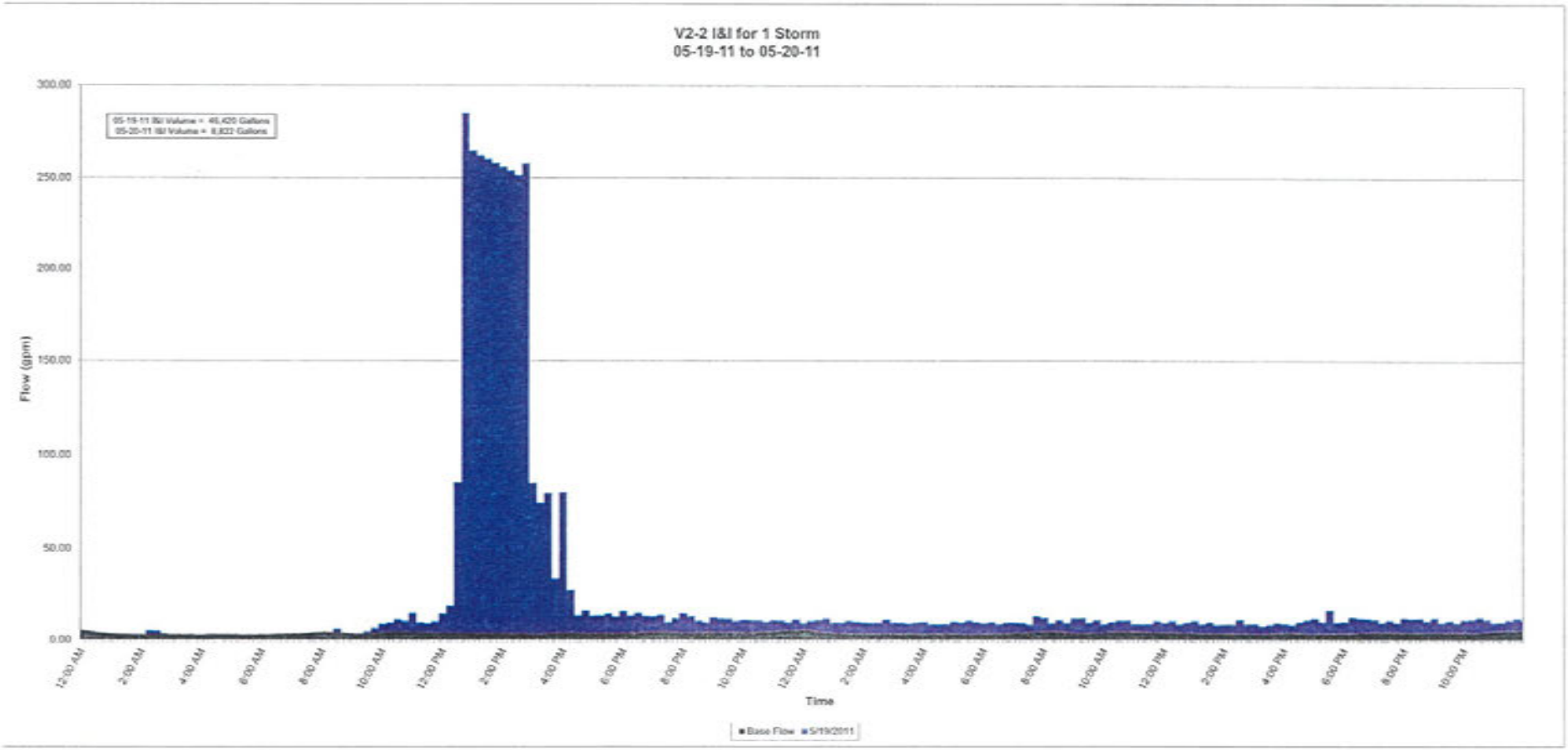
Time: 1540

Crew Members: Brian and Brandon

-Site V2-7 still shows an inflow problem. Manhole repair at V2-27 did not reduce flow in line.


V2-2Flow Data
Flowrate (gpm)
520
500
480
460
440
420
400
380
360
340
320
300
280
260
240
220
200
180
160
140
120
100
80
60
40
20
0
4/17/2011 0:00
4/22/2011 0:00
4/27/2011 0:00
5/2/2011 0:00
5/7/2011 0:00
5/12/2011 0:00
5/17/2011 0:00
5/22/2011 0:00
5/27/2011 0:00
Date


V2-2 I&I for 1 Storm
05-13-11 to 05-14-11
05-13-11 I&I Volume = 43,041 Gallons
05-14-11 I&I Volume = 10,501 Gallons
400.00
350.00
300.00
250.00
200.00
150.00
100.00
50.00
0.00
Flow (gpm)
12:00 AM
2:00 AM
4:00 AM
6:00 AM
8:00 AM
10:00 AM
12:00 PM
2:00 PM
4:00 PM
6:00 PM
8:00 PM
10:00 PM
12:00 AM
2:00 AM
4:00 AM
6:00 AM
8:00 AM
10:00 AM
12:00 PM
2:00 PM
4:00 PM
6:00 PM
8:00 PM
10:00 PM
Time
Base Flow
5/13/2011


V2-2 I&I for 1 Storm
05-19-11 to 05-20-11
05-19-11 I&I Volume = 45,420 Gallons
05-20-11 I&I Volume = 8,822 Gallons
300.00
250.00
200.00
150.00
100.00
50.00
0.00
Flow (gpm)
12:00 AM
2:00 AM
4:00 AM
6:00 AM
8:00 AM
10:00 AM
12:00 PM
2:00 PM
4:00 PM
6:00 PM
8:00 PM
10:00 PM
Time
Base Flow
5/19/2011

Flow Meter Journal

Site: V2-2

Date: 5/9/11

Time: 1600

Crew Members: Brian and Brandon

-Site V2-2 shows light to moderate spiking during this rain occurrence, although major spiking over 300 to 400 gpm has been seen. Not sure if this is bad data but spiking is still seen.

-Conclusion drawn at site V2-2: Recent rises, despite vastly differing numbers, indicate an I & I problem. Recommend moving meter to V2-44 to isolate where it is coming from. First from line to V2-45, then from line to V2-67.

Date: 5/16/11

Time: 1200

Crew members: Dane, Scott, Brian

-Site V2-2 still shows I & I, although some missing spikes indicate this may be an intermittent problem. This may show a flooding problem (a manhole near a low spot) or may have something to do with amount of rainfall, or even a difference in rainfall amount per hour between rain occurrences. Inflow is the evident problem in this string.

Date: 5/19/11

Time: 1540

Crew Members: Brian and Brandon

-Site V2-2 shows an infiltration problem, spiking at almost 300 gpm. May indicate a problem in the lines or the manholes themselves.

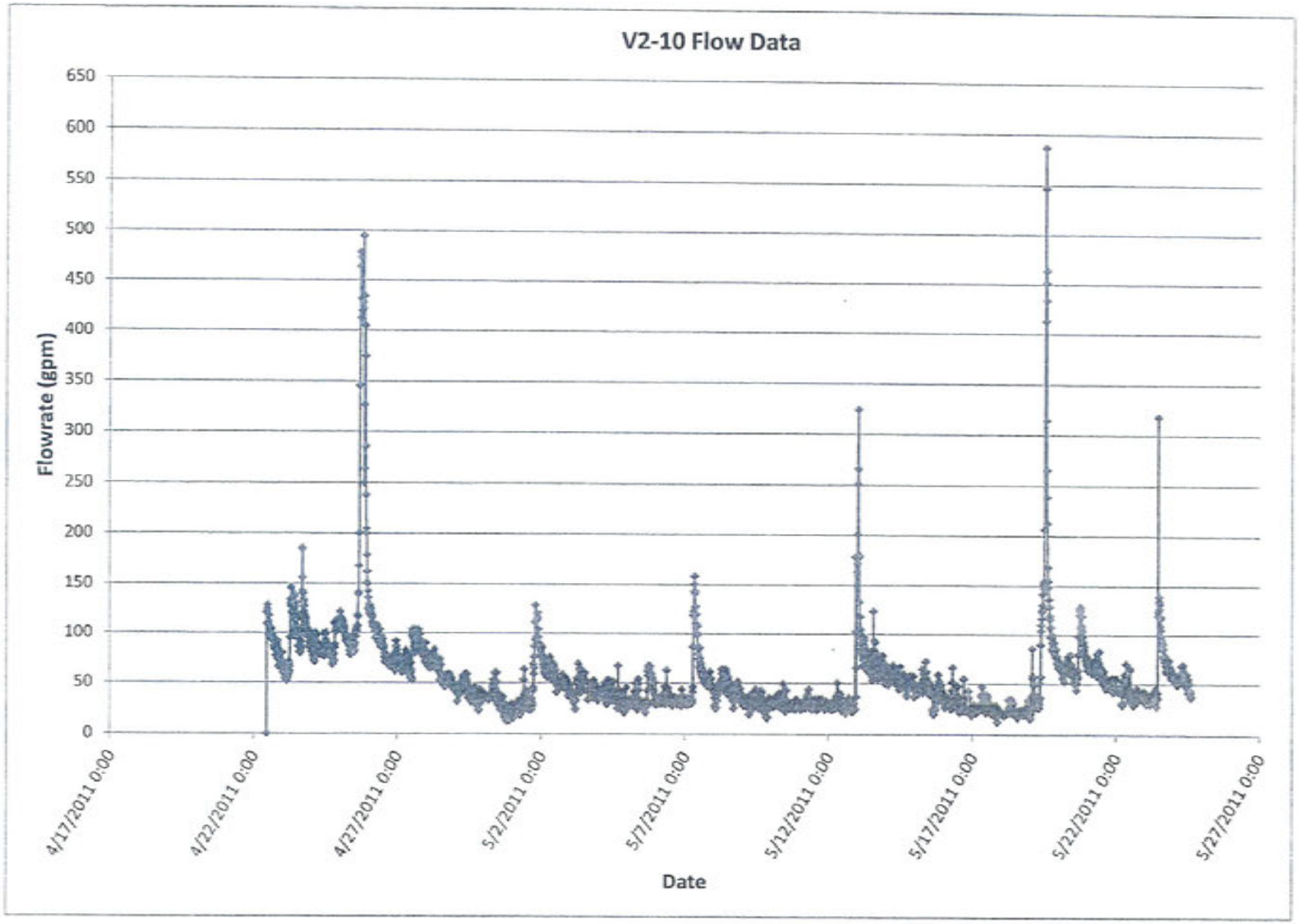
Date: 5/23/11

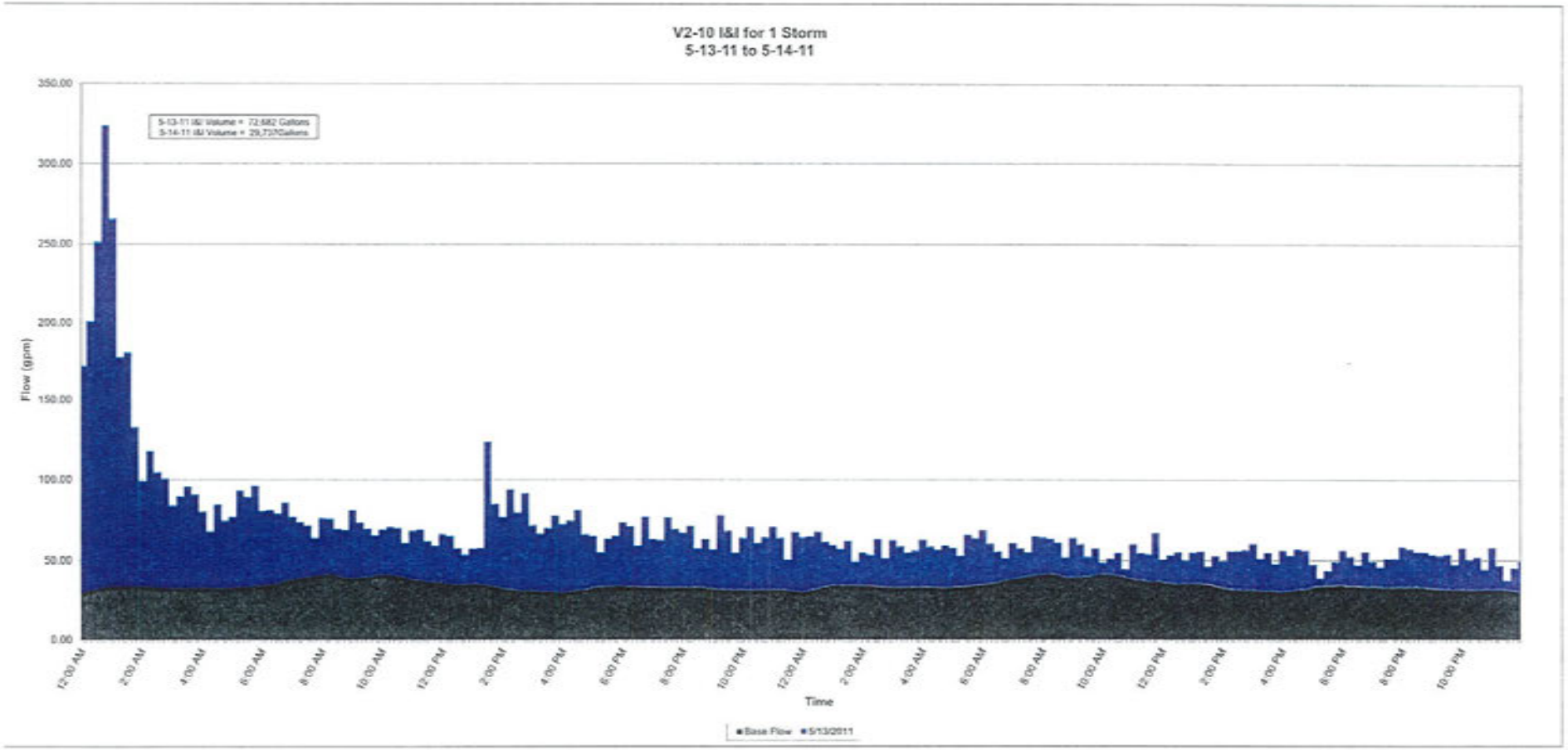
Time: 1113

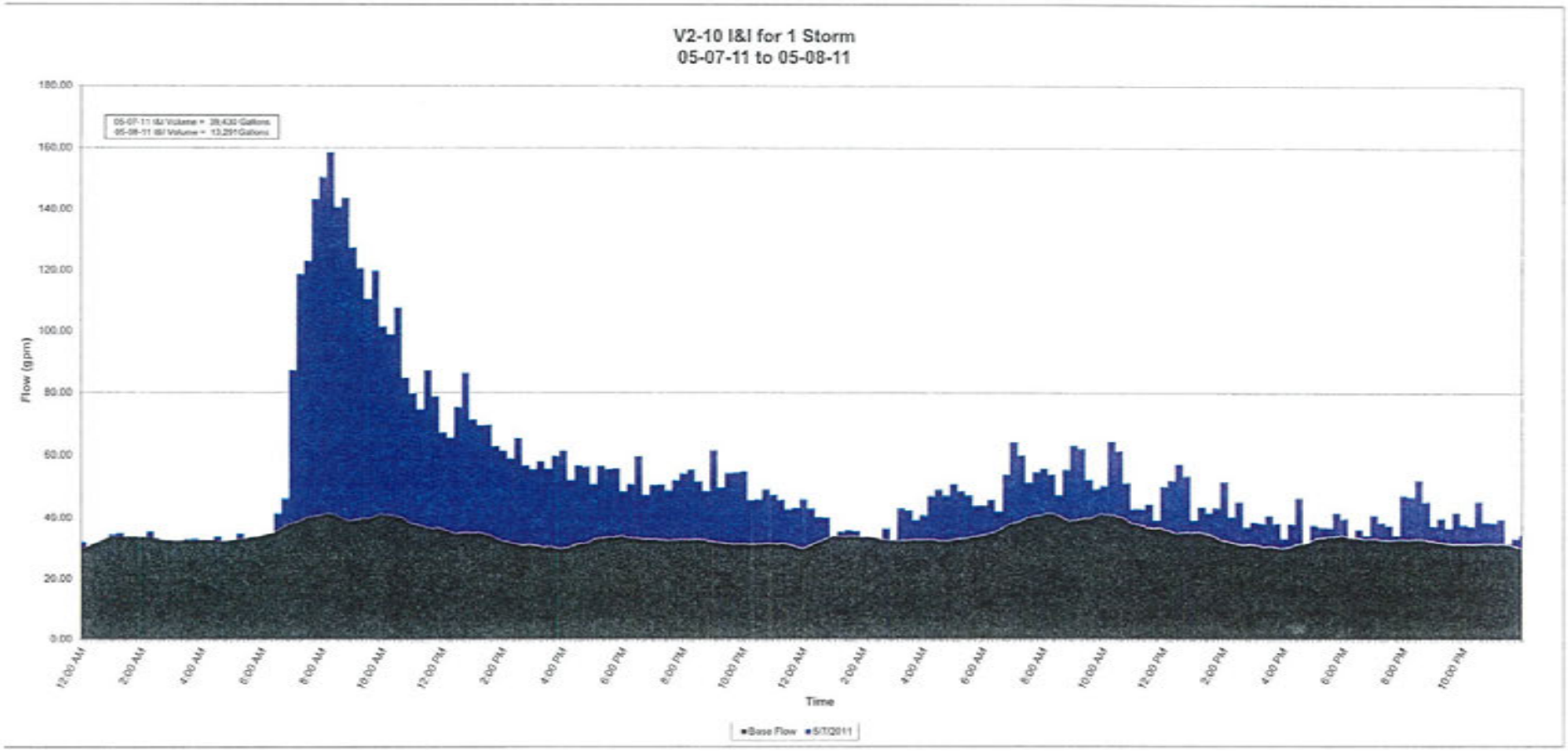
Crew: Dane, Brian, and Scott

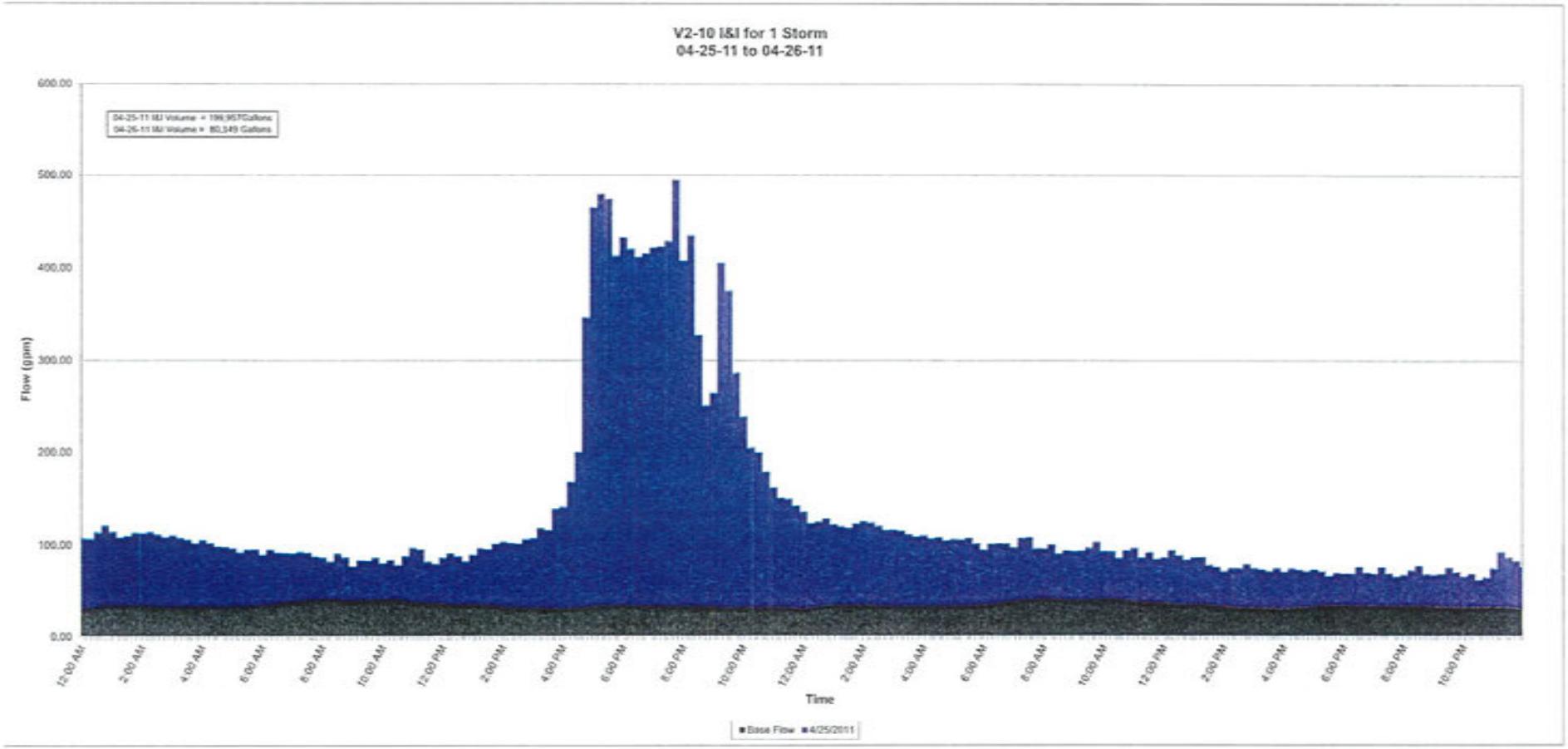
-Site V2-2 again showed spiking though the amount was not as high as previous problems. This may show the coralation between amount of rain fall during each individual occurrence. This may also prove the bad or corrupted data theory (i.e. dirty sensor, or high debris flow).

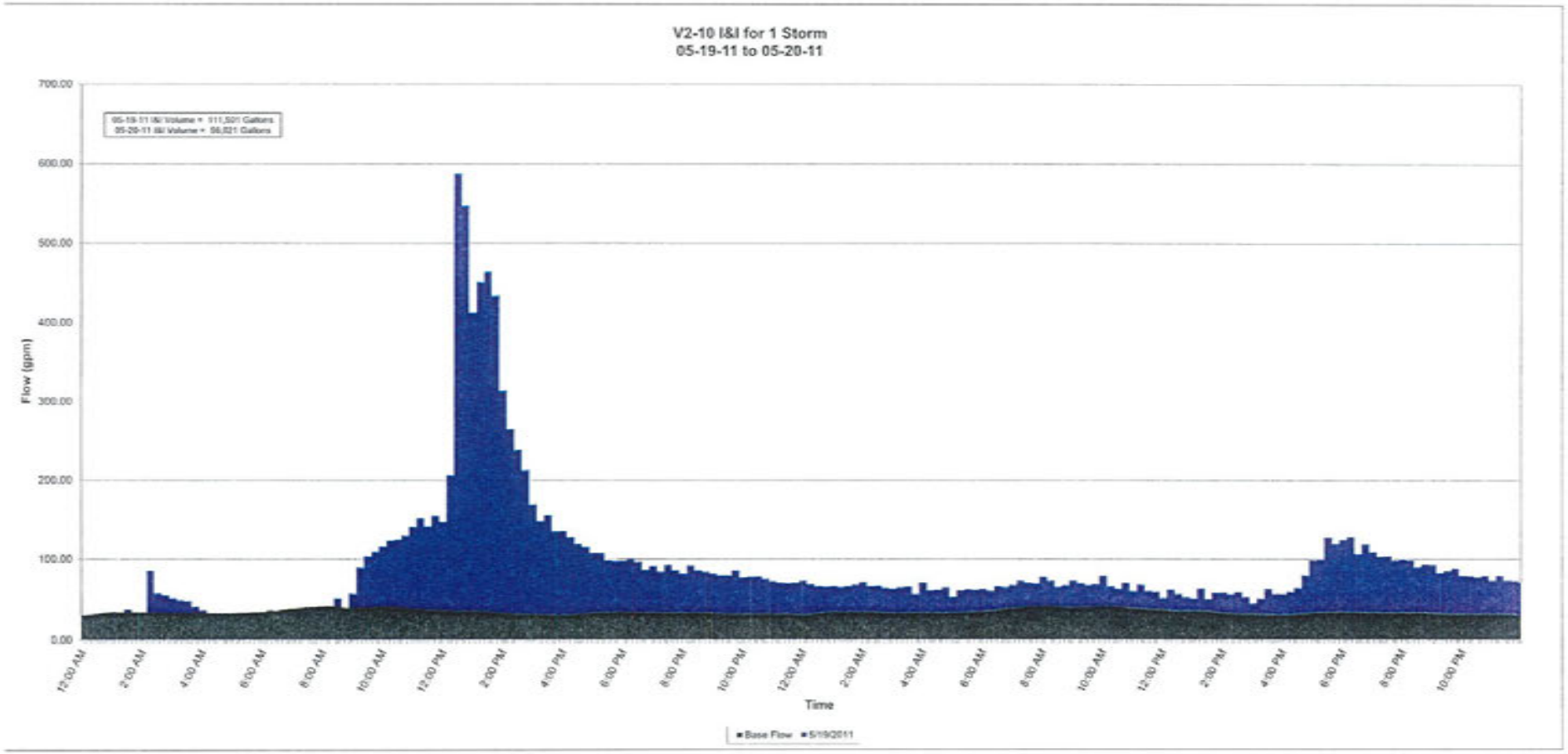
*End of Journal for V2-2


V2-10 Flow Data
Flowrate (gpm)
650
600
550
500
450
400
350
300
250
200
150
100
50
0
4/17/2011 0:00
4/22/2011 0:00
4/27/2011 0:00
5/2/2011 0:00
5/7/2011 0:00
5/12/2011 0:00
5/17/2011 0:00
5/22/2011 0:00
5/27/2011 0:00
Date


V2-10 I&I for 1 Storm
5-13-11 to 5-14-11
5-13-11 I&I Volume = 72,682 Gallons
5-14-11 I&I Volume = 29,737Gallons
350.00
300.00
250.00
200.00
150.00
100.00
50.00
0.00
Flow (gpm)
12:00 AM
2:00 AM
4:00 AM
6:00 AM
8:00 AM
10:00 AM
12:00 PM
2:00 PM
4:00 PM
6:00 PM
8:00 PM
10:00 PM
12:00 AM
2:00 AM
4:00 AM
6:00 AM
8:00 AM
10:00 AM
12:00 PM
2:00 PM
4:00 PM
6:00 PM
8:00 PM
10:00 PM
Time
Base Flow
5/13/2011


V2-10 I&I for 1 Storm
05-07-11 to 05-08-11
05-07-11 I&I Volume = 39,430 Gallons
05-08-11 I&I Volume = 13,291Gallons
180.00
160.00
140.00
120.00
100.00
80.00
60.00
40.00
20.00
0.00
Flow (gpm)
12:00 AM
2:00 AM
4:00 AM
6:00 AM
8:00 AM
10:00 AM
12:00 PM
2:00 PM
4:00 PM
6:00 PM
8:00 PM
10:00 PM
12:00 AM
2:00 AM
4:00 AM
6:00 AM
8:00 AM
10:00 AM
12:00 PM
2:00 PM
4:00 PM
6:00 PM
8:00 PM
10:00 PM
Time
Base Flow
5/7/2011


V2-10 I&I for 1 Storm
04-25-11 to 04-26-11
04-25-11 I&I Volume = 199,957Gallons
04-26-11 I&I Volume = 80,349 Gallons
600.00
500.00
400.00
300.00
200.00
100.00
0.00
Flow (gpm)
12:00 AM
2:00 AM
4:00 AM
6:00 AM
8:00 AM
10:00 AM
12:00 PM
2:00 PM
4:00 PM
6:00 PM
8:00 PM
10:00 PM
Time
Base Flow
4/25/2011


V2-10 I&I for 1 Storm
05-19-11 to 05-20-11
05-19-11 I&I Volume = 111,501 Gallons
05-20-11 I&I Volume = 66,021 Gallons
700.00
600.00
500.00
400.00
300.00
200.00
100.00
0.00
Flow (gpm)
12:00 AM
2:00 AM
4:00 AM
6:00 AM
8:00 AM
10:00 AM
12:00 PM
2:00 PM
4:00 PM
6:00 PM
8:00 PM
10:00 PM
12:00 AM
2:00 AM
4:00 AM
6:00 AM
8:00 AM
10:00 AM
12:00 PM
2:00 PM
4:00 PM
6:00 PM
8:00 PM
10:00 PM
Time
Base Flow
5/19/2011

Flow Meter Journal

Site: V2-10

Date: 5/9/11

Time: 1600

Crew Members: Brian and Brandon

-

Date: 5/16/11

Time: 1200

Crew members: Dane, Scott, Brian

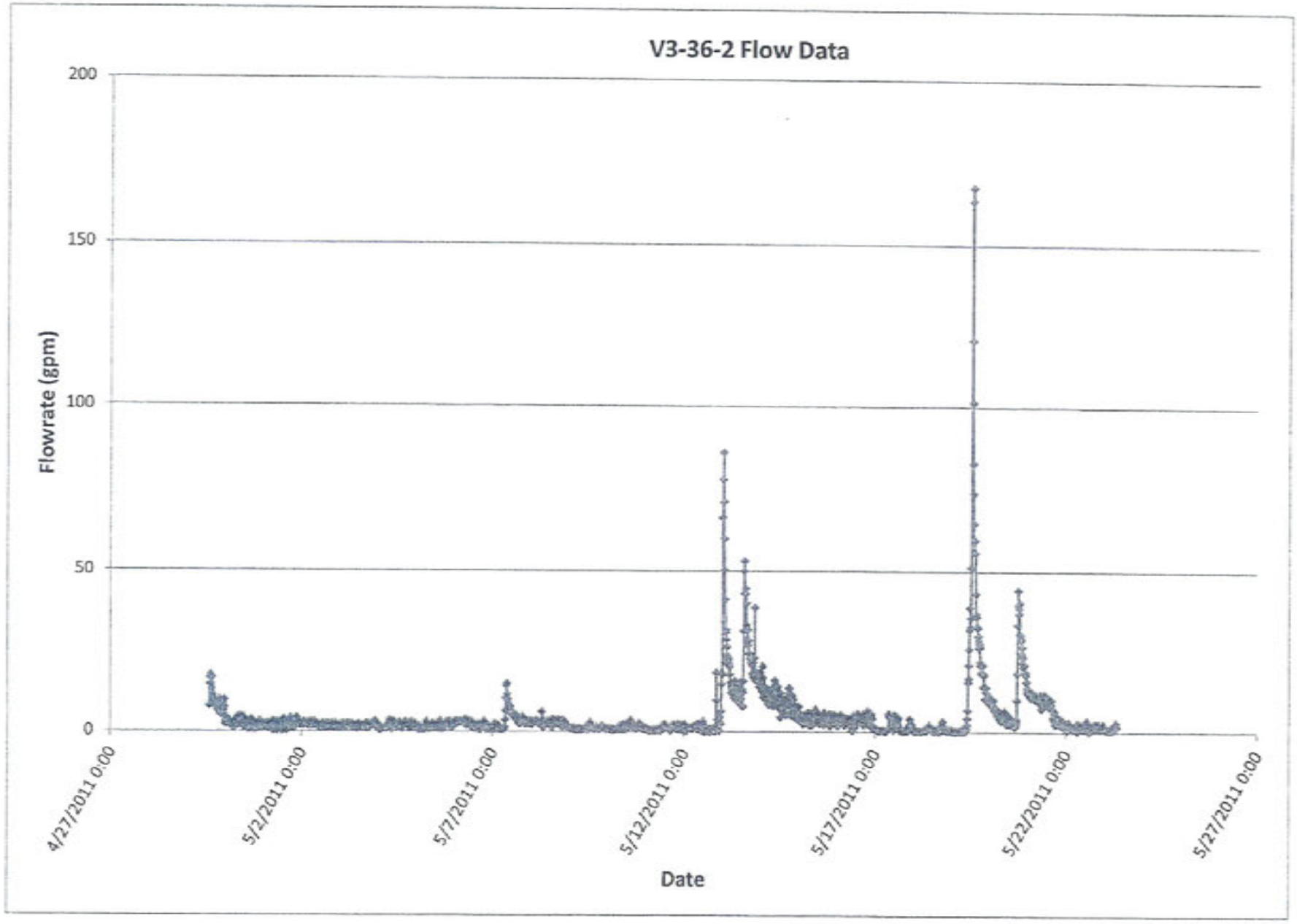
-Site V2-10 also shows sharp spiking and fall off during rain occurrences, supporting the Sooter Inn theory. Further monitoring up the string will hopefully show more.

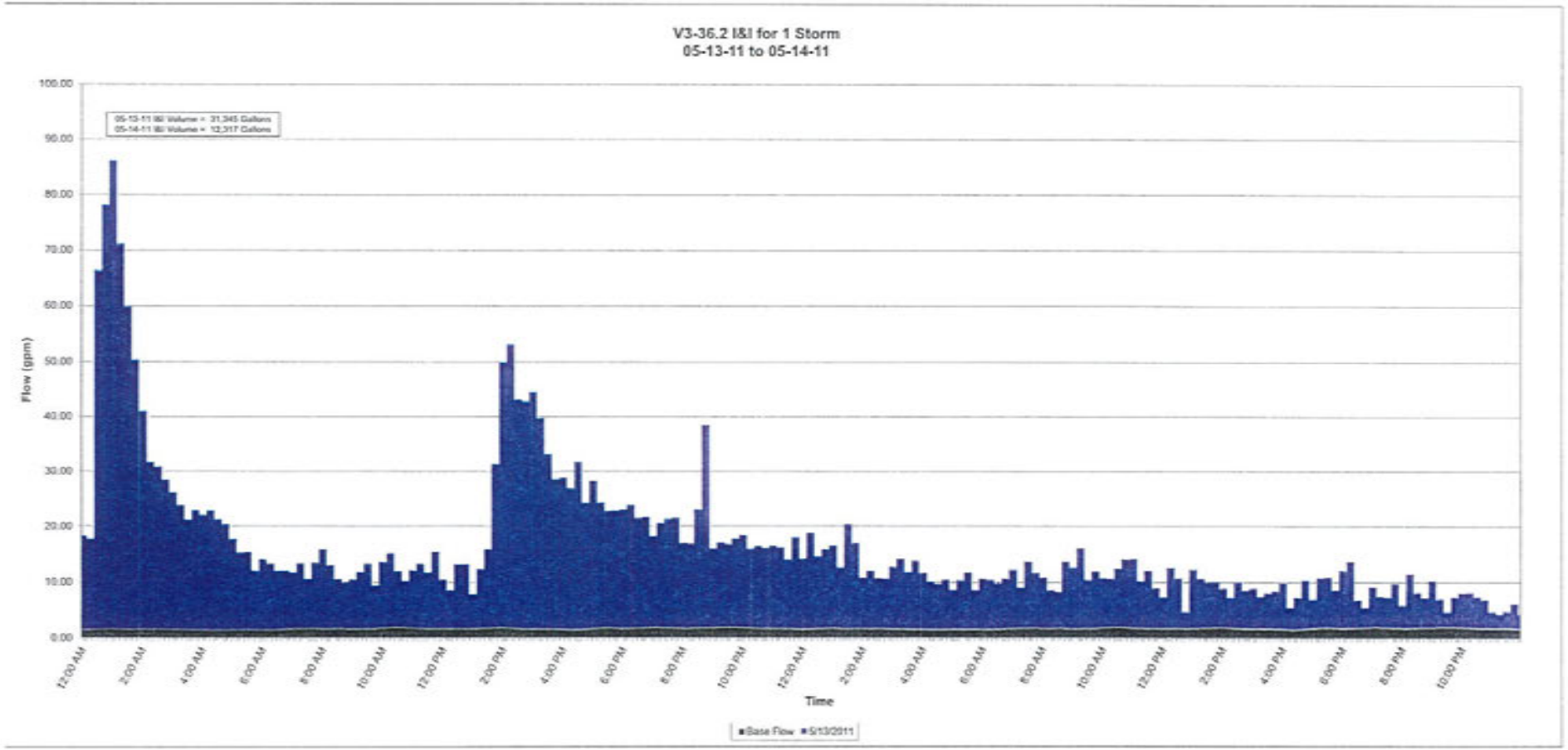
Date: 5/19/11

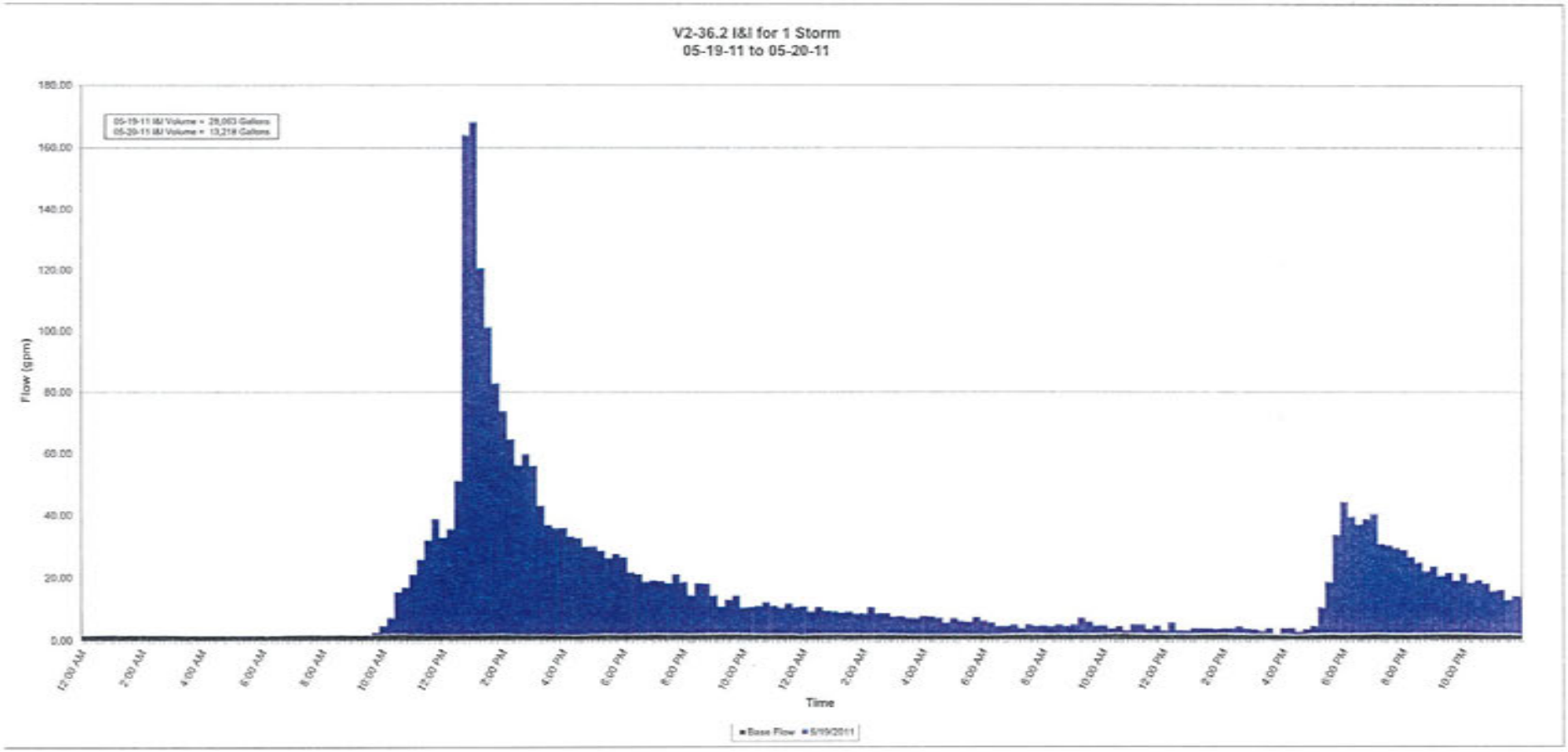
Time: 1540

Crew Members: Brian and Brandon

-Site V2-10 also still shows an inflow problem.


V3-36-2 Flow Data
200
150
100
50
0
Flowrate (gpm)
4/27/2011 0:00
5/2/2011 0:00
5/7/2011 0:00
5/12/2011 0:00
5/17/2011 0:00
5/22/2011 0:00
5/27/2011 0:00
Date


V3-36.2 I&I for 1 Storm
05-13-11 to 05-14-11
05-13-11 I&I Volume = 31,345 Gallons
05-14-11 I&I Volume = 12,317 Gallons
Flow (gpm)
100.00
90.00
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
12:00 AM
2:00 AM
4:00 AM
6:00 AM
8:00 AM
10:00 AM
12:00 PM
2:00 PM
4:00 PM
6:00 PM
8:00 PM
10:00 PM
12:00 AM
2:00 AM
4:00 AM
6:00 AM
8:00 AM
10:00 AM
12:00 PM
2:00 PM
4:00 PM
6:00 PM
8:00 PM
10:00 PM
Time
Base Flow
5/13/2011


V2-36.2 I&I for 1 Storm
05-19-11 to 05-20-11
05-19-11 I&I Volume = 28,003 Gallons
05-20-11 I&I Volume = 13,218 Gallons
180.00
160.00
140.00
120.00
100.00
80.00
60.00
40.00
20.00
0.00
Flow (gpm)
12:00 AM
2:00 AM
4:00 AM
6:00 AM
8:00 AM
10:00 AM
12:00 PM
2:00 PM
4:00 PM
6:00 PM
8:00 PM
10:00 PM
12:00 AM
2:00 AM
4:00 AM
6:00 AM
8:00 AM
10:00 AM
12:00 PM
2:00 PM
4:00 PM
6:00 PM
8:00 PM
10:00 PM
Time
Base Flow
5/19/2011

Flow Meter Journal

Site: V3-36.2

Date: 5/9/11

Time: 1600

Crew Members: Brian and Brandon

-Site V3-36 showed spiking but not as heavy as first data collection period (before sewer cutoff at MH #61?)

-Conclusion drawn at site V3-36: A majority of I & I was eliminated with cut off, however some minor I & I may still exist and further monitoring is needed up the string.

Date: 5/16/11

Time: 1200

Crew members: Dane, Scott, Brian

-Site V3-36 showed a significant spike on Friday 13th at 0100 hrs indicating a moderate I & I problem. Graphing shows a combination of inflow and infiltration. Recommend moving meter to MH# V3-42 to monitor from line to V3-47 and then to line from V3-43.

Date: 5/19/11

Time: 1540

Crew Members: Brian and Brandon

-Site V3-36 again showed spiking during rain occurrence, but no larger than what was noted in last journal entry.

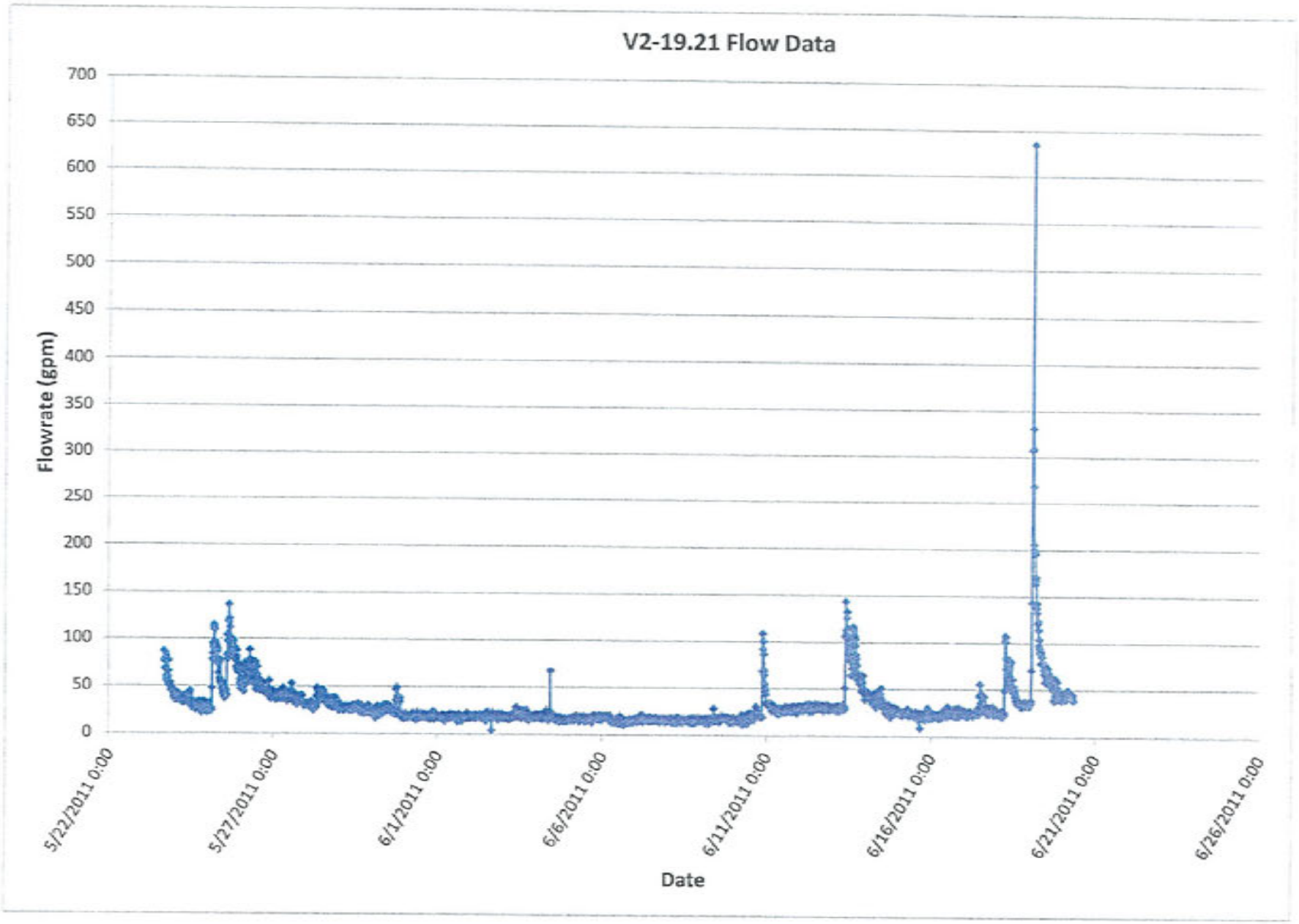
Date: 5/23/11

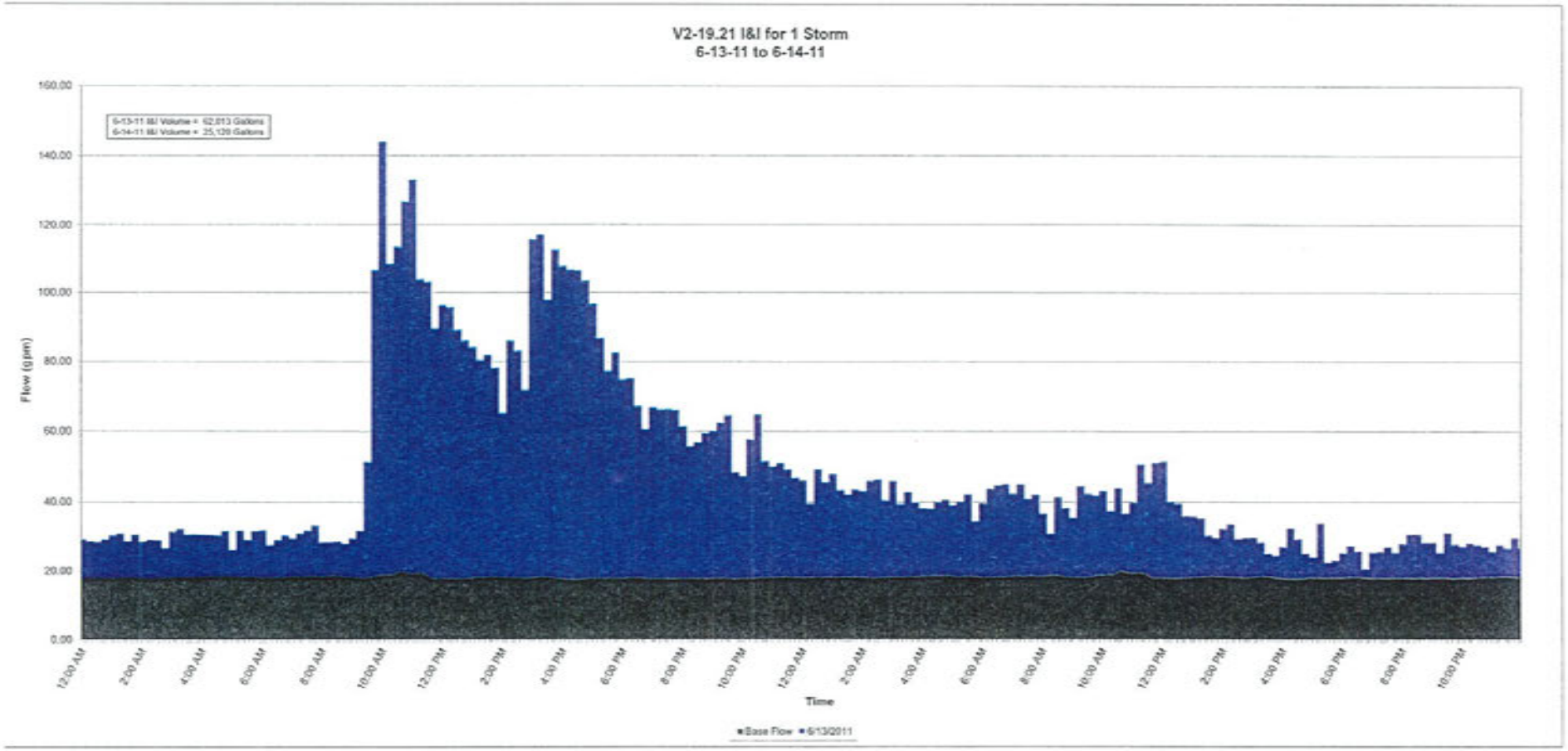
Time: 1113

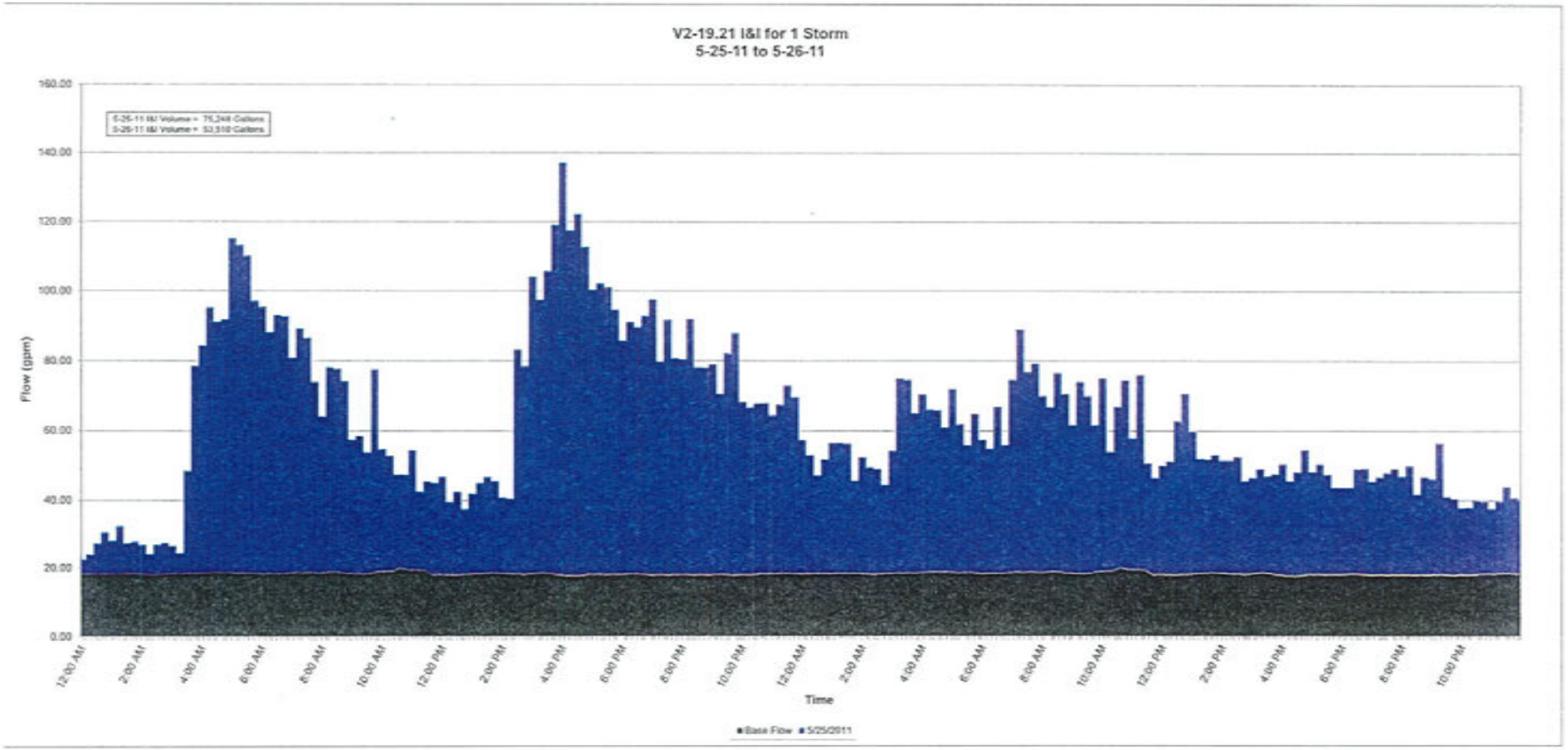
Crew: Dane, Brian, and Scott

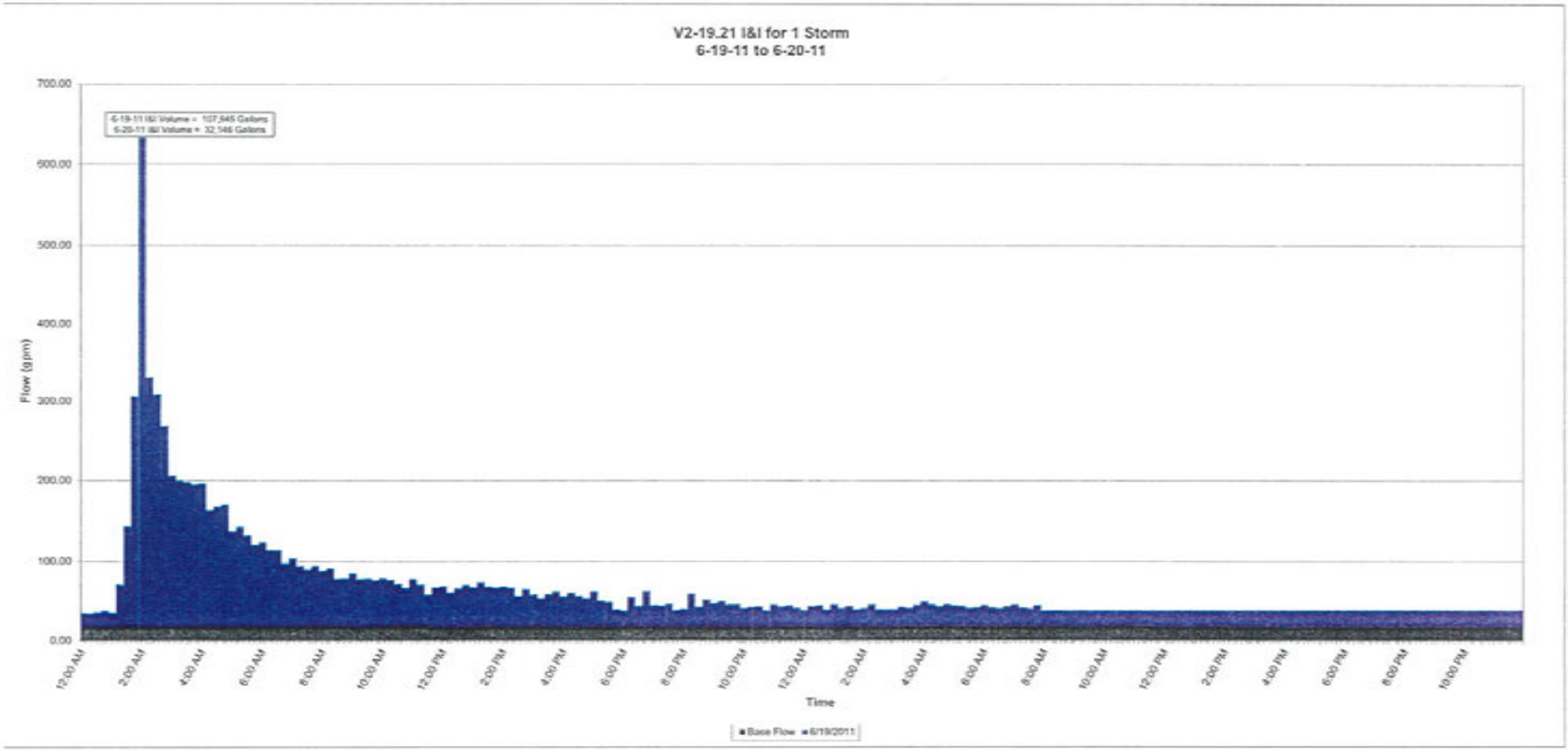
-Site V3-36 showed spiking during last rain occurrence with slow recession after indicating an infiltration problem. Old laterals from removed trailers is suspected.

*End of Site Journal for V3-36/2


V2-19.21 Flow Data
Flowrate (gpm)
700
650
600
550
500
450
400
350
300
250
200
150
100
50
0
5/22/2011 0:00
5/27/2011 0:00
6/1/2011 0:00
6/6/2011 0:00
6/11/2011 0:00
6/16/2011 0:00
6/21/2011 0:00
6/26/2011 0:00
Date


V2-19.21 I&I for 1 Storm
6-13-11 to 6-14-11
6-13-11 I&I Volume = 62,813 Gallons
6-14-11 I&I Volume = 25,139 Gallons
Flow (gpm)
160.00
140.00
120.00
100.00
80.00
60.00
40.00
20.00
0.00
12:00 AM
2:00 AM
4:00 AM
6:00 AM
8:00 AM
10:00 AM
12:00 PM
2:00 PM
4:00 PM
6:00 PM
8:00 PM
10:00 PM
Time
Base Flow
6/13/2011


V2-19.21 I&I for 1 Storm
5-25-11 to 5-26-11
5-25-11 I&I Volume = 75,248 Gallons
5-26-11 I&I Volume = 53,510 Gallons
Flow (gpm)
160.00
140.00
120.00
100.00
80.00
60.00
40.00
20.00
0.00
12:00 AM
2:00 AM
4:00 AM
6:00 AM
8:00 AM
10:00 AM
12:00 PM
2:00 PM
4:00 PM
6:00 PM
8:00 PM
10:00 PM
12:00 AM
2:00 AM
4:00 AM
6:00 AM
8:00 AM
10:00 AM
12:00 PM
2:00 PM
4:00 PM
6:00 PM
8:00 PM
10:00 PM
Time
Base Flow
5/25/2011


V2-19.21 I&I for 1 Storm
6-19-11 to 6-20-11
6-19-11 I&I Volume = 107,845 Gallons
6-20-11 I&I Volume = 32,146 Gallons
700.00
600.00
500.00
400.00
300.00
200.00
100.00
0.00
Flow (gpm)
12:00 AM
2:00 AM
4:00 AM
6:00 AM
8:00 AM
10:00 AM
12:00 PM
2:00 PM
4:00 PM
6:00 PM
8:00 PM
10:00 PM
12:00 AM
2:00 AM
4:00 AM
6:00 AM
8:00 AM
10:00 AM
12:00 PM
2:00 PM
4:00 PM
6:00 PM
8:00 PM
10:00 PM
Time
Base Flow
6/19/2011

Flow Meter Field Journal

Site:V2-19.21

Date: 5/23/11

Time: 1615

Crew: Brian, Dane, and Scott

-Installed meter in V2-19 in line to V2-21

Date: 5/26/11

Time: 1530

Crew: Brian and Brandon

-Site V2-19.21 also shows a combination of Inflow and Infiltration coming from the Vichy Road and Vessels strings. This eliminates the line coming from V2-20.

-Conclusion drawn at site V2-19.21: Spiking indicates the problem is further up the string. We will be moving the meter to V2-21 to determine which string has the problem, starting with the string from across Interstate 44.

- Date: 5/31/11

Time: 1249

Crew: Brian

-Site V2-19.21 shows minor spiking during both rain occurrences. However there are even larger spikes outside these rain events during peak usage hours. Regardless, I & I spikes are shown on the graphs so further investigation is needed.

-Conclusion drawn at site V2-19.21: Spiking during rain events indicates there in an inflow problem in these strings. I will be moving meter #1394 to manhole 21 to locate which string has the inflow problem.

Date: 6/2/11

Time: 1644

Crew: Brian

-Downloaded all 4 meters. No rain occurrences since last downloaded.

Date: 6/20/11

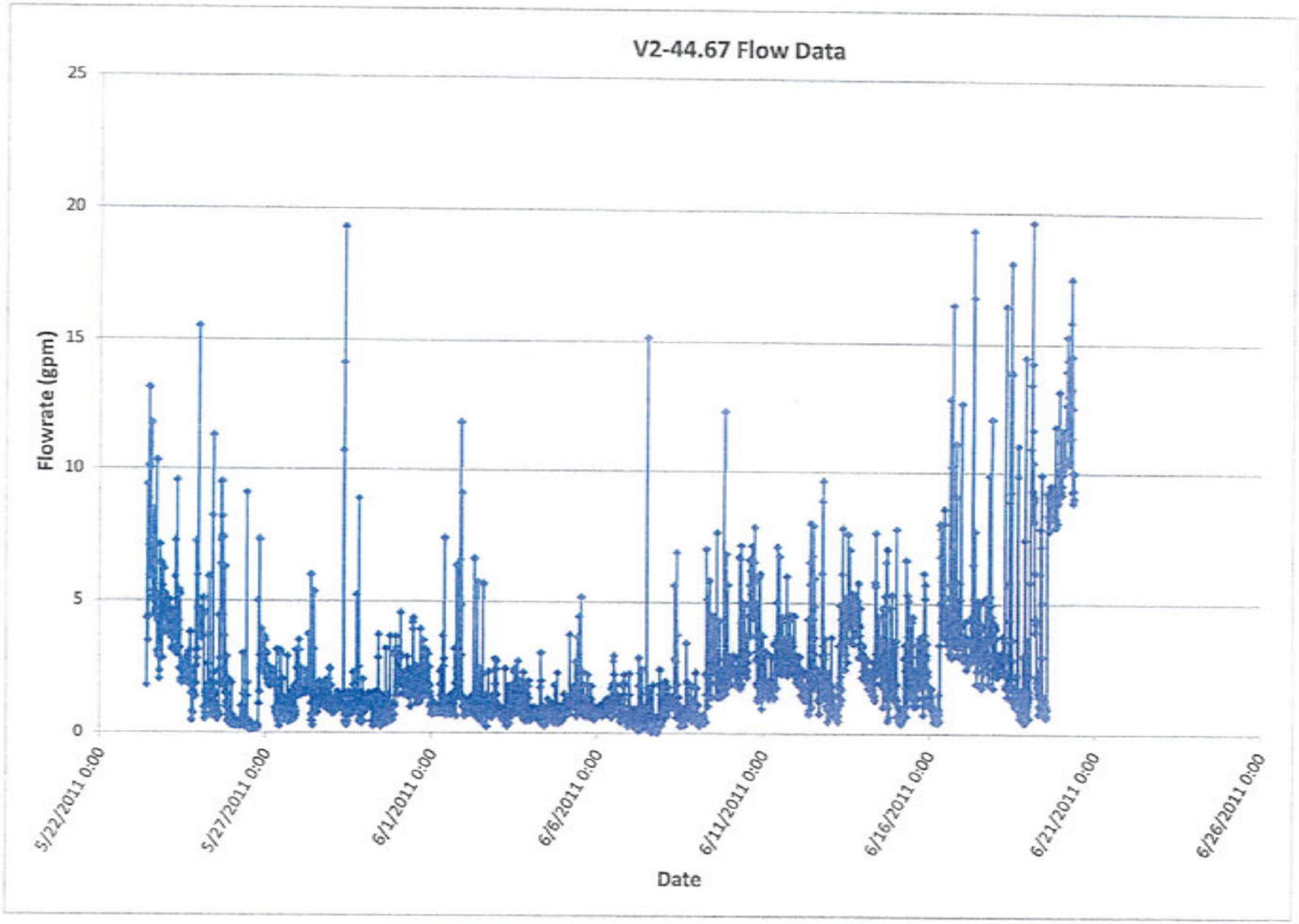
Time: 1130

Crew: Brian, Dane, and Bob

-Downloaded and moved/reset all four meters.

-Meter #1394 showed a wide variety of spiking during all rain occurrences. We moved this meter to MH# 21, line running from MH# 25 to study the string that crosses I 44.

End of journal


V2-44.67 Flow Data
25
20
15
10
5
0
Flowrate (gpm)
5/22/2011 0:00
5/27/2011 0:00
6/1/2011 0:00
6/6/2011 0:00
6/11/2011 0:00
6/16/2011 0:00
6/21/2011 0:00
6/26/2011 0:00
Date

Flow Meter Field Journal

Site: V2-44.67

Date: 5/23/11

Time: 0950

Crew: Dane, Scott, and Brian

-Installed meter in V2-44, line to V2-67

Date: 5/26/11

Time: 1530

Crew: Brian and Brandon

-Site V2-44.67 showed no spiking during any rain occurrences.

-Conclusion drawn at site V2-44.67: no I and I has been seen in this string. We will move to line running to Manhole #45.

Date: 5/31/11

Time: 1249

Crew: Brian

-Site V2-44.67 still does not show any spiking during rain events. There was a big spike on Sunday May the 29th, but there was no rain occurrence at that time.

-Conclusion drawn at site V2-44.67: No spiking was seen at this site. Will be moving meter #1392 to line running from MH# 45.

Date: 6/2/11

Time: 1644

Crew: Brian

-Downloaded all 4 meters. No rain occurrences since last downloaded.

Date; 6/20/11

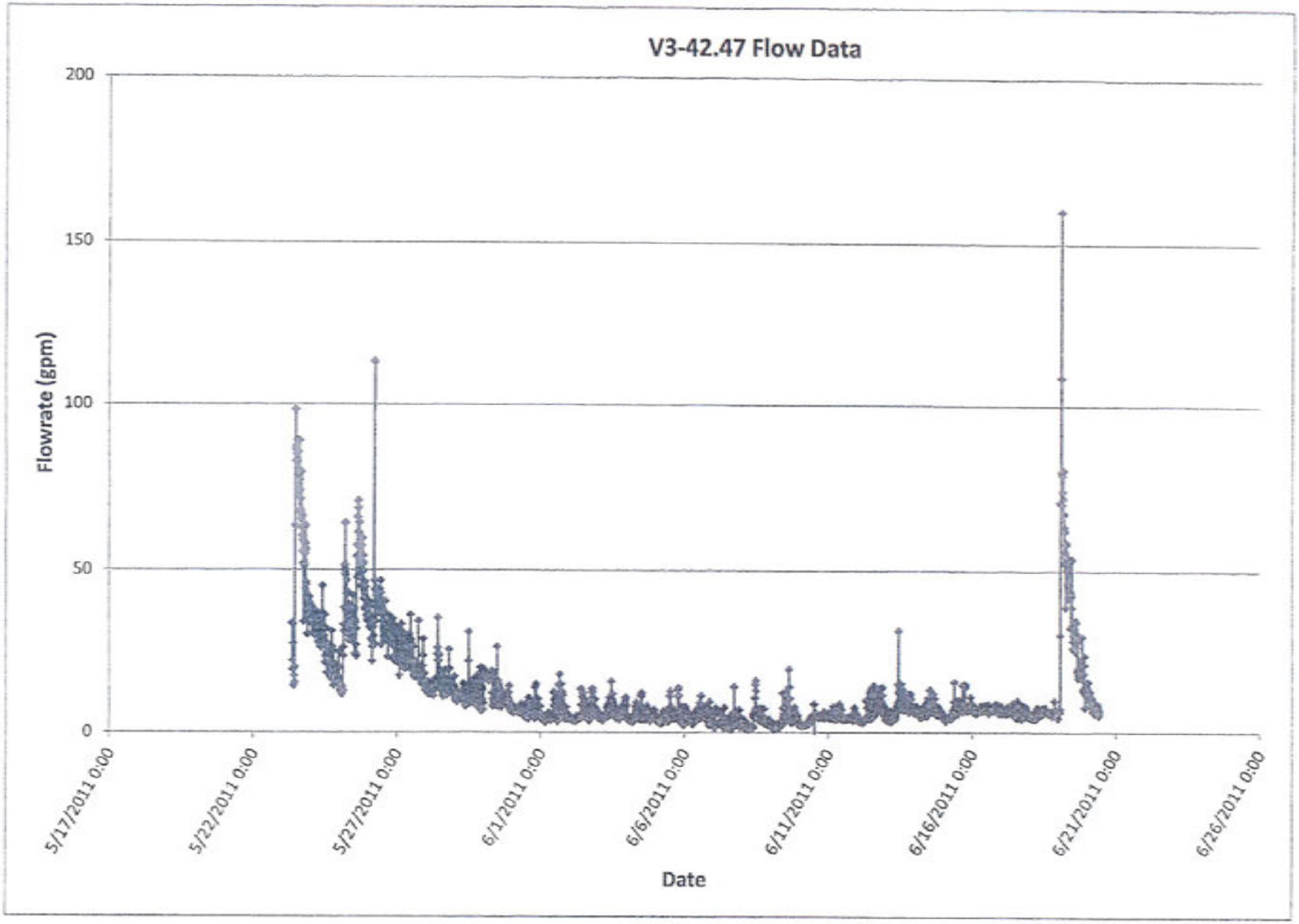
Time: 1130

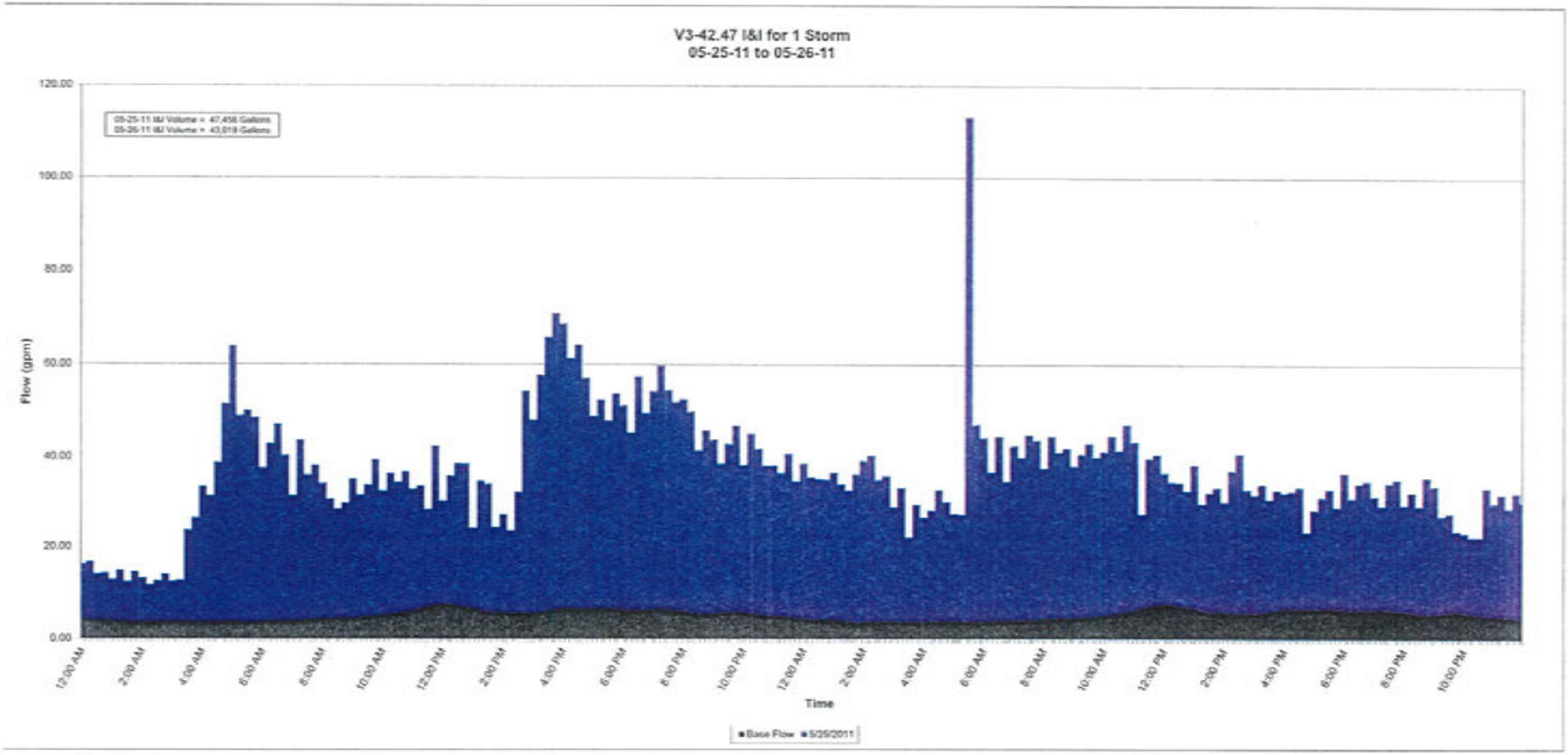
Crew: Brian, Dane, and Bob

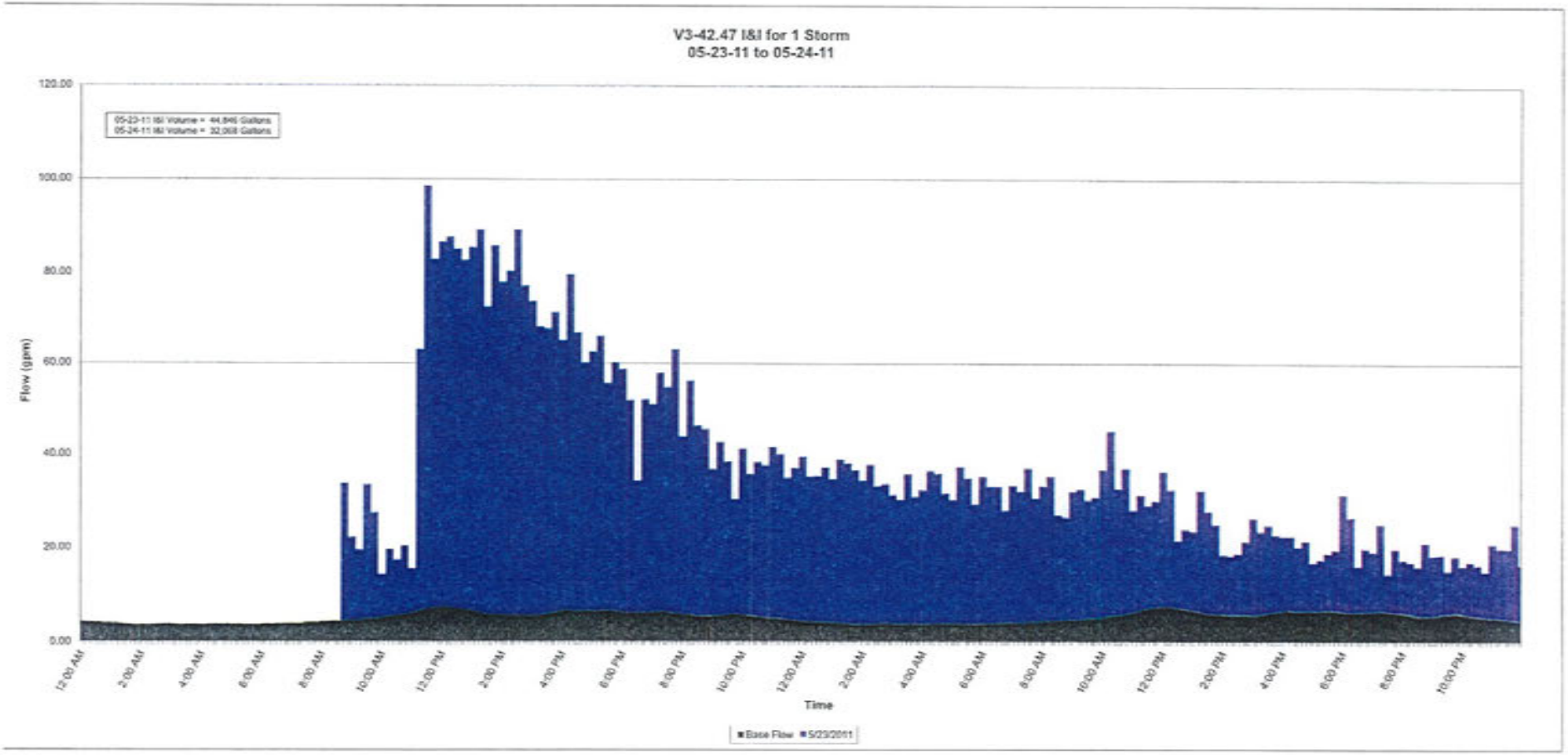
-Downloaded and moved/reset all four meters.

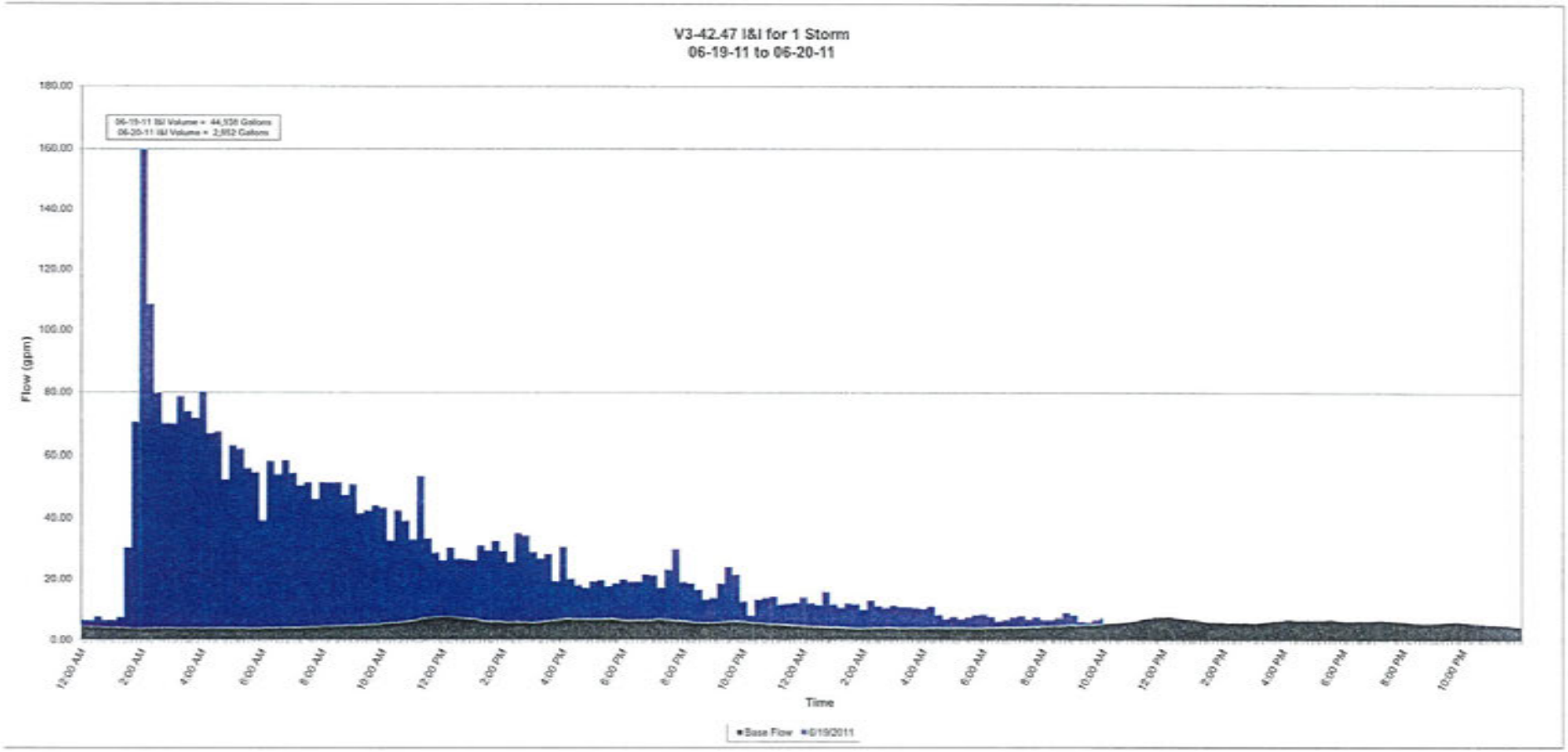
-Meter #1392 still did not show any spiking during any rain event. Meter was moved to line running from MH# V2-45.

End of Journal


V3-42.47 Flow Data
200
150
100
50
0
Flowrate (gpm)
5/17/2011 0:00
5/22/2011 0:00
5/27/2011 0:00
6/1/2011 0:00
6/6/2011 0:00
6/11/2011 0:00
6/16/2011 0:00
6/21/2011 0:00
6/26/2011 0:00
Date


V3-42.47 I&I for 1 Storm
05-25-11 to 05-26-11
05-25-11 I&I Volume = 47,456 Gallons
05-26-11 I&I Volume = 43,019 Gallons
120.00
100.00
80.00
60.00
40.00
20.00
0.00
Flow (gpm)
12:00 AM
2:00 AM
4:00 AM
6:00 AM
8:00 AM
10:00 AM
12:00 PM
2:00 PM
4:00 PM
6:00 PM
8:00 PM
10:00 PM
12:00 AM
2:00 AM
4:00 AM
6:00 AM
8:00 AM
10:00 AM
12:00 PM
2:00 PM
4:00 PM
6:00 PM
8:00 PM
10:00 PM
Time
Base Flow
5/25/2011


V3-42.47 I&I for 1 Storm
05-23-11 to 05-24-11
05-23-11 I&I Volume = 44,845 Gallons
05-24-11 I&I Volume = 32,068 Gallons
120.00
100.00
80.00
60.00
40.00
20.00
0.00
Flow (gpm)
12:00 AM
2:00 AM
4:00 AM
6:00 AM
8:00 AM
10:00 AM
12:00 PM
2:00 PM
4:00 PM
6:00 PM
8:00 PM
10:00 PM
12:00 AM
2:00 AM
4:00 AM
6:00 AM
8:00 AM
10:00 AM
12:00 PM
2:00 PM
4:00 PM
6:00 PM
8:00 PM
10:00 PM
Time
Base Flow
5/23/2011


V3-42.47 I&I for 1 Storm
06-19-11 to 06-20-11
06-19-11 I&I Volume = 44,538 Gallons
06-20-11 I&I Volume = 2,952 Gallons
Flow (gpm)
180.00
160.00
140.00
120.00
100.00
80.00
60.00
40.00
20.00
0.00
12:00 AM
2:00 AM
4:00 AM
6:00 AM
8:00 AM
10:00 AM
12:00 PM
2:00 PM
4:00 PM
6:00 PM
8:00 PM
10:00 PM
12:00 AM
2:00 AM
4:00 AM
6:00 AM
8:00 AM
10:00 AM
12:00 PM
2:00 PM
4:00 PM
6:00 PM
8:00 PM
10:00 PM
Time
Base Flow
6/19/2011

Flow Meter Field Journal

Site: V3-42.47

Date: 5/23/11

Time: 0830

Crew: Dane, Scott, and Brian

-Installed meter in Manhole V3-42 line to V3-47

Date: 5/26/11

Time: 1530

Crew: Brian and Brandon

-Site V3-42.47 shows a combination of Inflow and Infiltration from this string. We will be moving this meter to the line coming from manhole #43 but we believe that all the I and I is coming from this string.

Date: 5/31/11

Time: 1249

Crew: Brian

-Site V3-42.47 showed spiking during rain occurrences on both Friday and Saturday, although some spiking occurred throughout the entire weekend.

-Conclusion drawn at site V3-42.47: I & I spiking has been seen again at this site. I will be moving this meter to the other incoming line to eliminate the string from MH# 43.

Date: 6/2/11

Time: 1644

Crew: Brian

-Downloaded all 4 meters. No rain occurrences since last downloaded.

Date: 6/20/11

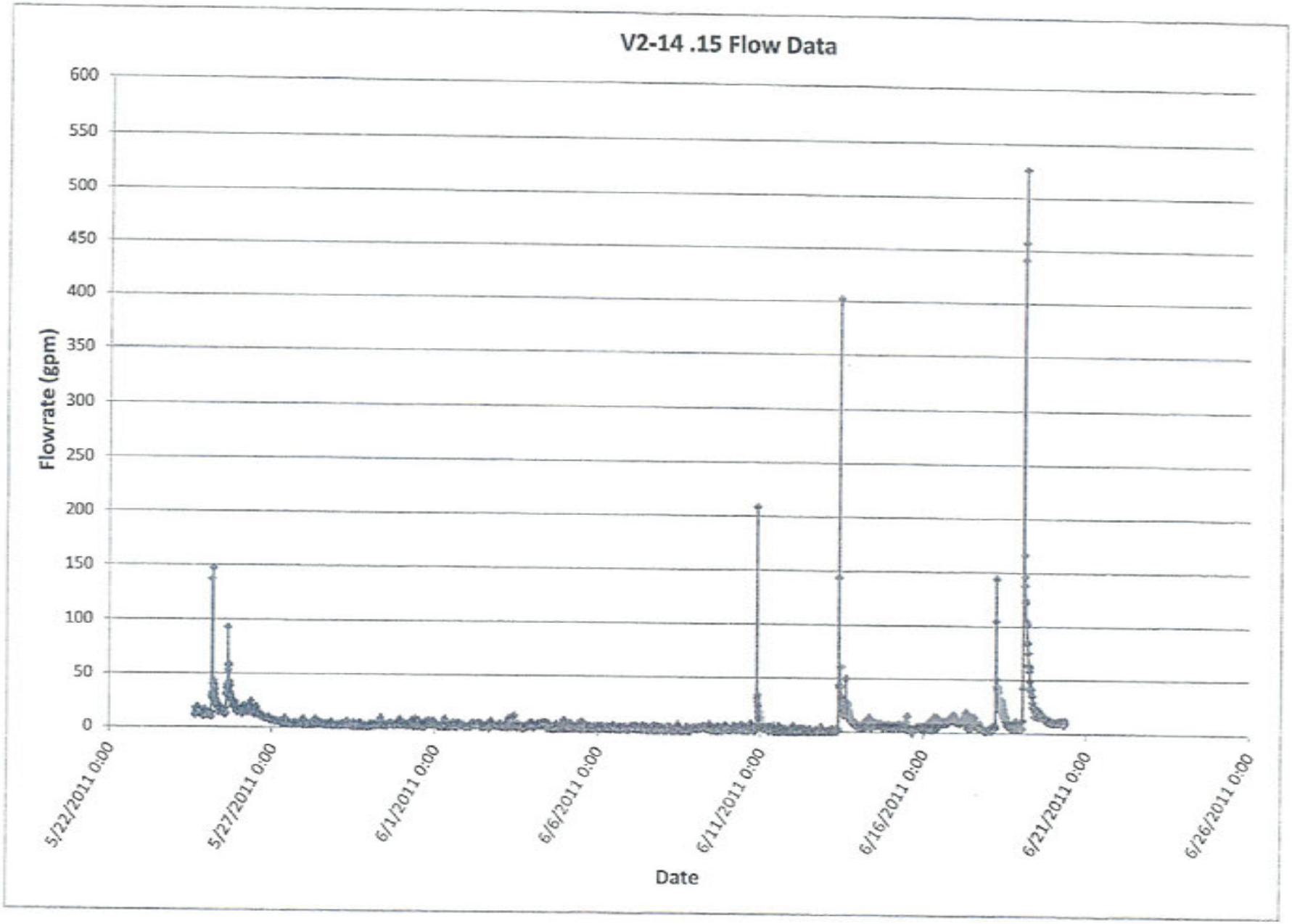
Time: 1130

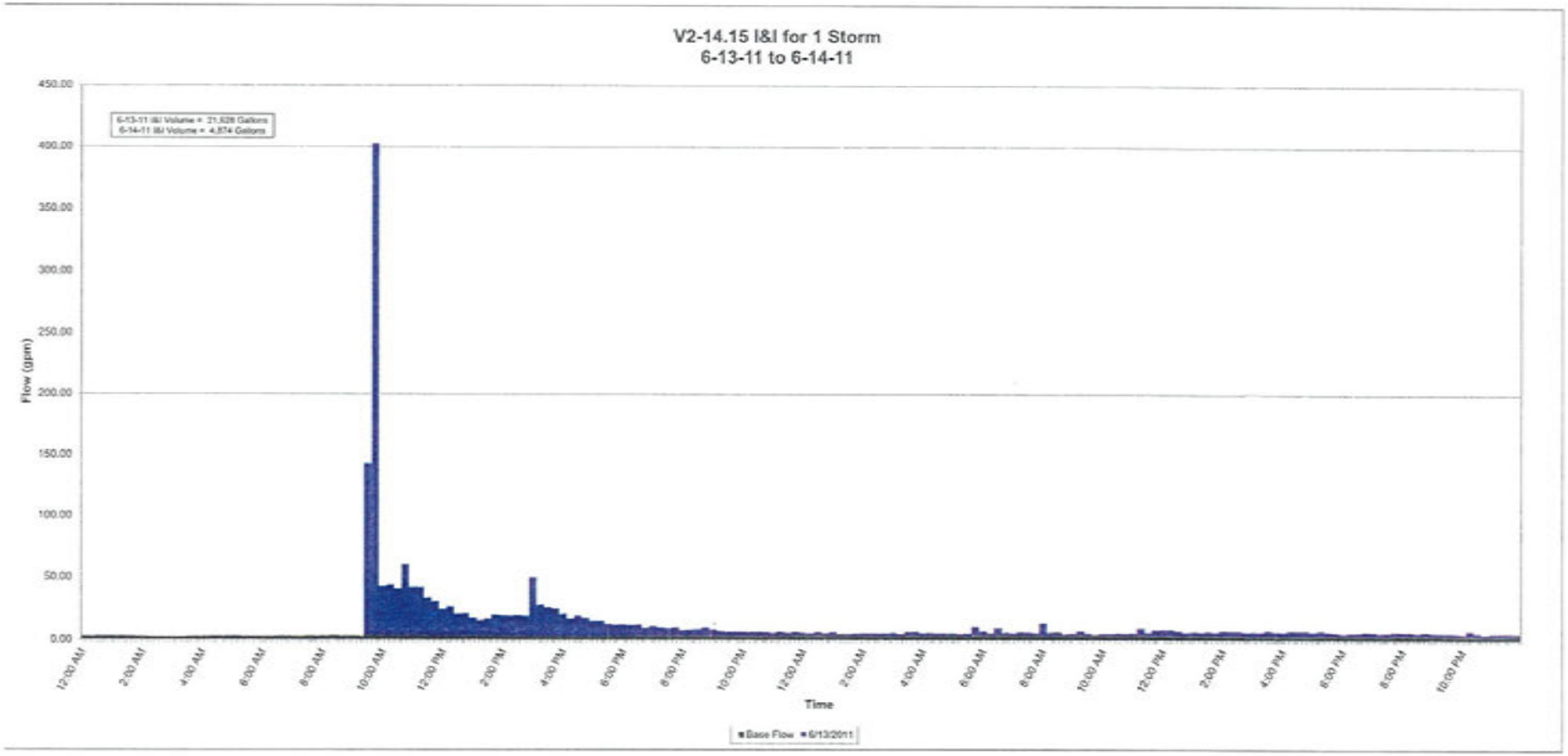
Crew: Brian, Dane, and Bob

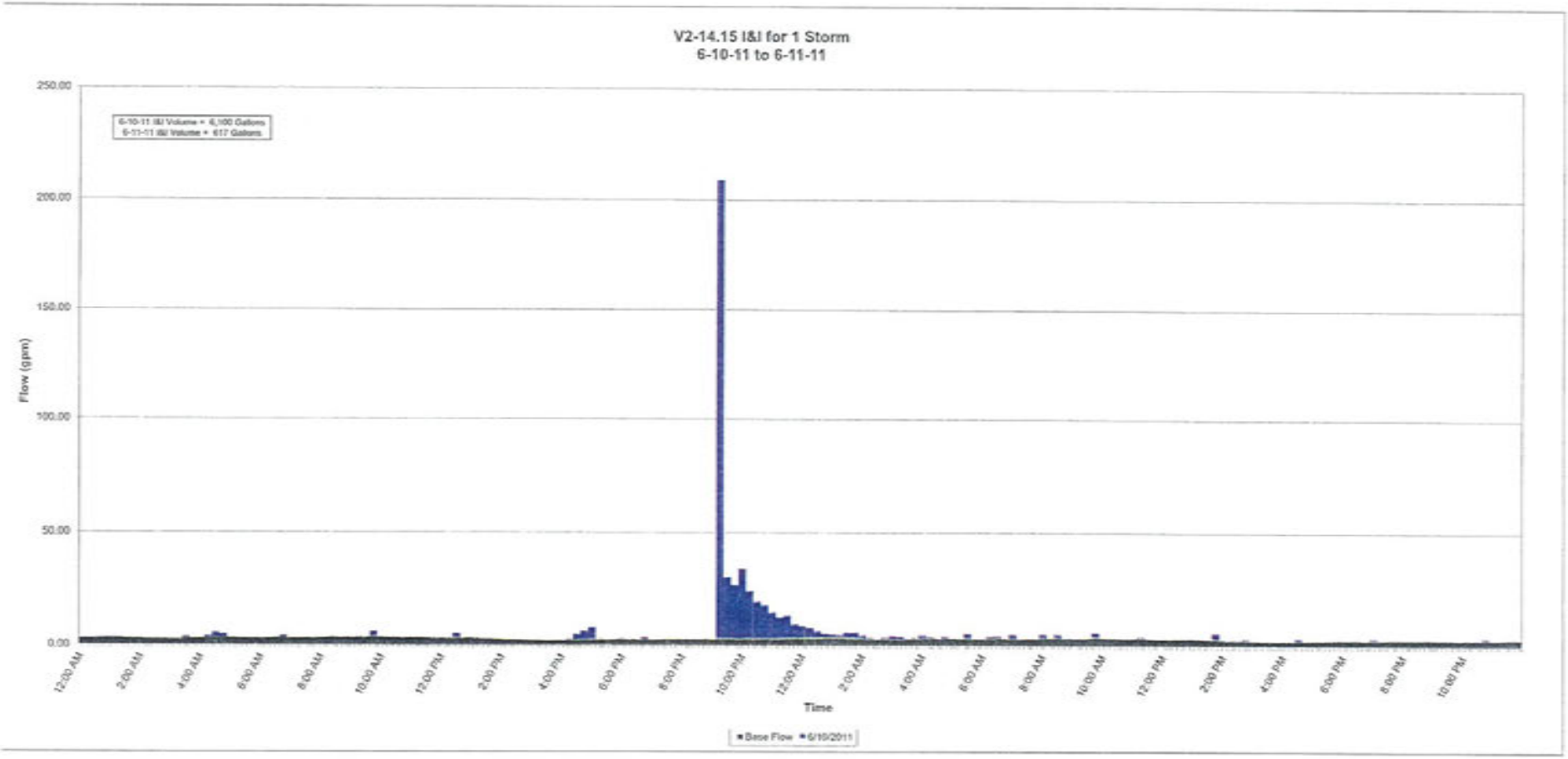
-Downloaded and moved/reset all four meters.

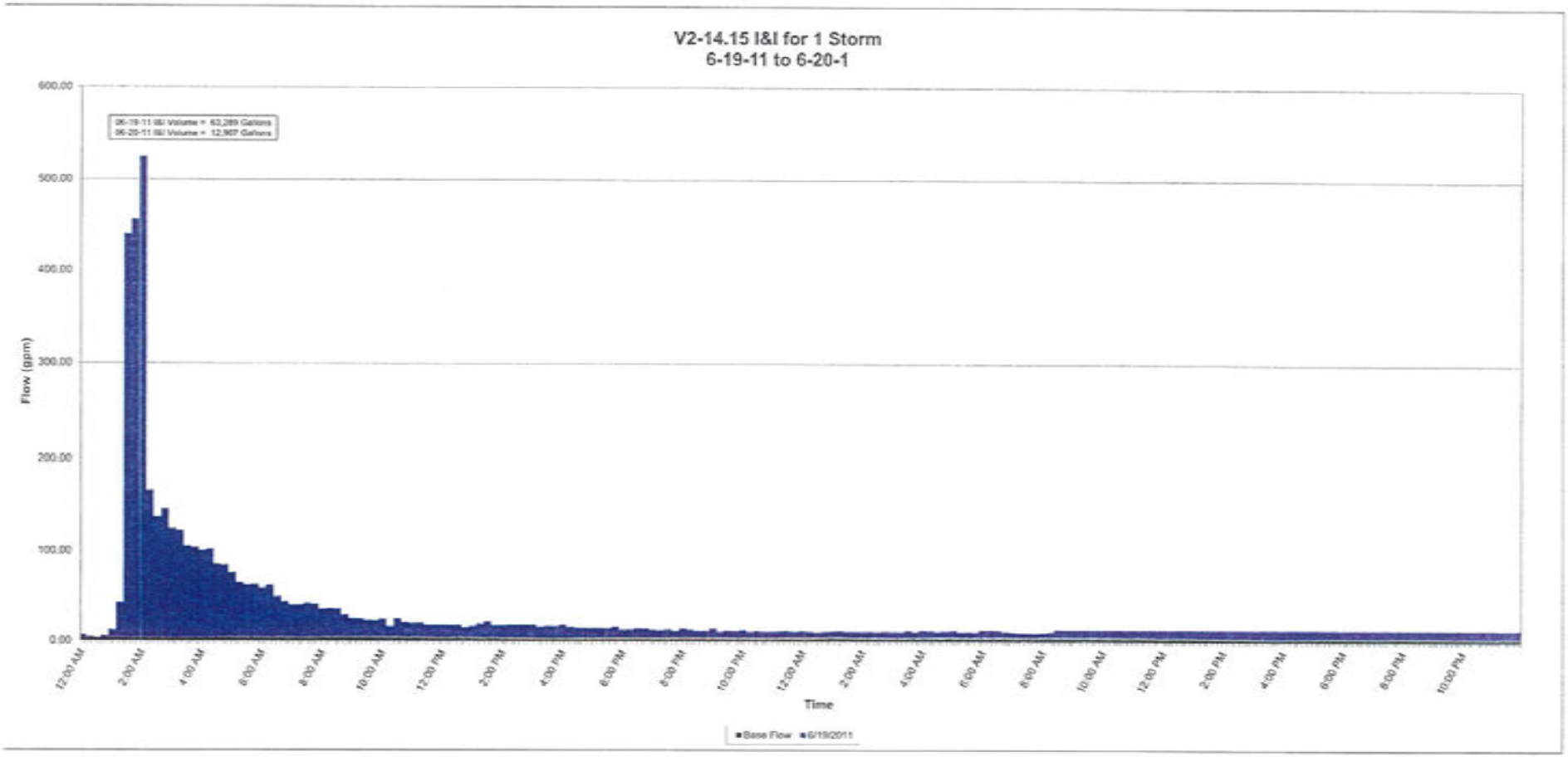
-Meter #1393 showed minor spiking during all rain occurrences, with a combination of Inflow and Infiltration. We moved this meter to line running from MH# 43 to eliminate this string.

End of Journal


V2-14 .15 Flow Data
Flowrate (gpm)
600
550
500
450
400
350
300
250
200
150
100
50
0
5/22/2011 0:00
5/27/2011 0:00
6/1/2011 0:00
6/6/2011 0:00
6/11/2011 0:00
6/16/2011 0:00
6/21/2011 0:00
6/26/2011 0:00
Date


V2-14.15 I&I for 1 Storm
6-13-11 to 6-14-11
6-13-11 I&I Volume = 21,828 Gallons
6-14-11 I&I Volume = 4,874 Gallons
Flow (gpm)
450.00
400.00
350.00
300.00
250.00
200.00
150.00
100.00
50.00
0.00
12:00 AM
2:00 AM
4:00 AM
6:00 AM
8:00 AM
10:00 AM
12:00 PM
2:00 PM
4:00 PM
6:00 PM
8:00 PM
10:00 PM
12:00 AM
2:00 AM
4:00 AM
6:00 AM
8:00 AM
10:00 AM
12:00 PM
2:00 PM
4:00 PM
6:00 PM
8:00 PM
10:00 PM
Time
Base Flow
6/13/2011


V2-14.15 I&I for 1 Storm
6-10-11 to 6-11-11
6-10-11 I&I Volume = 6,100 Gallons
6-11-11 I&I Volume = 617 Gallons
250.00
200.00
150.00
100.00
50.00
0.00
Flow (gpm)
12:00 AM
2:00 AM
4:00 AM
6:00 AM
8:00 AM
10:00 AM
12:00 PM
2:00 PM
4:00 PM
6:00 PM
8:00 PM
10:00 PM
12:00 AM
2:00 AM
4:00 AM
6:00 AM
8:00 AM
10:00 AM
12:00 PM
2:00 PM
4:00 PM
6:00 PM
8:00 PM
10:00 PM
Time
Base Flow
6/10/2011


V2-14.15 I&I for 1 Storm
6-19-11 to 6-20-1
06-19-11 I&I Volume = 62,289 Gallons
06-20-11 I&I Volume = 12,967 Gallons
600.00
500.00
400.00
300.00
200.00
100.00
0.00
Flow (gpm)
12:00 AM
2:00 AM
4:00 AM
6:00 AM
8:00 AM
10:00 AM
12:00 PM
2:00 PM
4:00 PM
6:00 PM
8:00 PM
10:00 PM
12:00 AM
2:00 AM
4:00 AM
6:00 AM
8:00 AM
10:00 AM
12:00 PM
2:00 PM
4:00 PM
6:00 PM
8:00 PM
10:00 PM
Time
Base Flow
6/19/2011

Flow Meter Field Journal

Site: V2-14.15

Date: 5/24/11

Time: 1526

Crew: Brian, Dane, and Brandon

-Installed meter in V2-14 line to V2-15

Date: 5/26/11

Time: 1530

Crew: Brian and Brandon

-Site V2-14.15 confirms that there is a problem in the String running to Sooter Inn. We will be moving this meter up this string to isolate the problem.

-Conclusion drawn at site V2-14.15: Spiking indicates an inflow problem in this string. Recommend moving this meter to V2-18.

Update: Crew inspected cleanout in Sooter Inn parking lot and found the cap sitting on top the cleanout. A work order will be filled out as there needs to be some concrete saw cut and removed so the cap will fit and seal correctly.

Date: 5/31/11

Time: 1249

Crew: Brian

-Site V2-14.15 also shows minor spiking during Friday and Saturdays rain events. Though they are sharp spikes, I think this may be an infiltration given the time of rise compared to when the actual event began. Another possibility is that it may indicate, that if it is inflow, the distance from the meters current site where the problem may be. Either way, further investigation is needed and we will be moving the meter further up this string.

-Conclusion drawn at site V2-14.15: Minor spiking shows that a problem does exist in this string, however the amount shown further downstream does not account for the total problem. We will be moving the meter into the line coming from MH# 51 to isolate where the biggest problem is.

Date: 6/2/11

Time: 1644

Crew: Brian

-Downloaded all 4 meters. No rain occurrences since last downloaded.

Date: 6/20/11

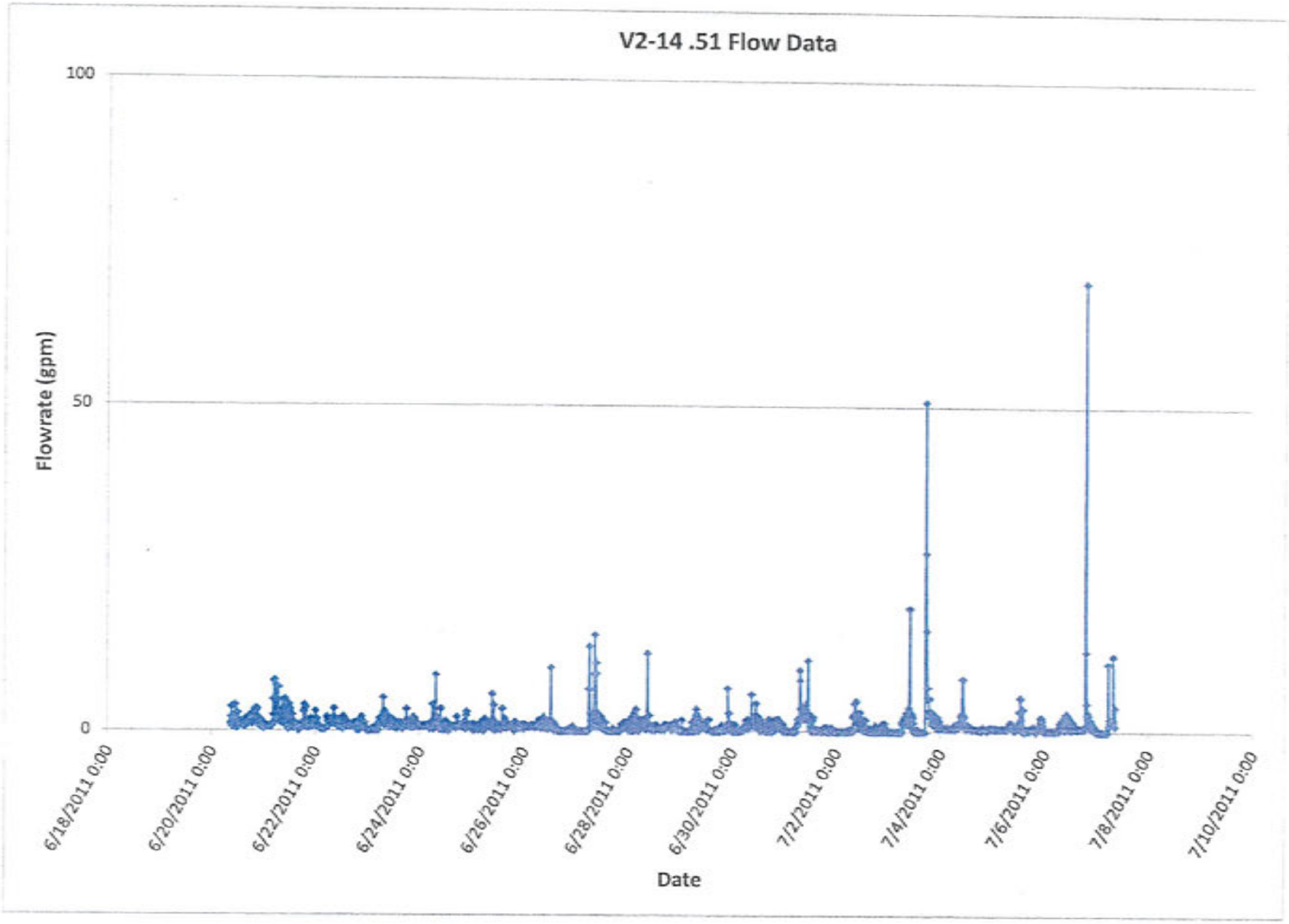
Time: 1130

Crew: Brian, Dane, and Bob

-Downloaded and moved/reset all four meters.

-Meter #1395 showed a heavy inflow problem coupled with a with a lesser infiltration problem. Sharp rises and falls then dropping to a slower decrease indicates these problems. The meter was then moved into line running from MH# 51 to study this string.

End of journal


V2-14 .51 Flow Data
100
50
0
Flowrate (gpm)
6/18/2011 0:00
6/20/2011 0:00
6/22/2011 0:00
6/24/2011 0:00
6/26/2011 0:00
6/28/2011 0:00
6/30/2011 0:00
7/2/2011 0:00
7/4/2011 0:00
7/6/2011 0:00
7/8/2011 0:00
7/10/2011 0:00
Date

Flow Meter Field Journal

Site: V2-14.51

Date: 6/23/11

Time: 0940

Crew: Brian

-Downloaded all four units

-Site V2-14.51 also showed sporadic spiking during this rain event. Inflow is the definite problem. However the sporadic peaks indicate this may be a low manhole. Also the highest amount of gpm was only 8, so this may just be a lid not seated or sealed right. This string may also need to be walked and inspected to ascertain the problem. Also the manholes in the parking lots of the businesses along 63 need to be inspected.

-Conclusion drawn at V2-14.51: Minor sharp spikes indicate a minor inflow problem. Inspection of manhole lids and height is recommended.

Date: 6/28/11

Time: 1230

Crew: Brian

-Downloaded meters

-Site V2-14.51 shows inflow during heavy rain and sporadic infiltration during most rain. Both are a minor problem. I need to check manholes in parking lots behind the businesses along 63. Also the off road manholes need to be checked to make sure they are above ground and not taking on water themselves. I also need to check the businesses along 63 for cleanouts and make sure they are properly sealed. This string is all PVC pipe with most using standard ring and lids so I don't believe that there will be many problems with the pipe and very few problems with the ring and lids themselves. I do need to make sure that the rings are sealed correctly and that those that don't have the standards are not the lids with the vents on them.

-Conclusion drawn at V2-14.51: Although there is not a lot of I and I in this string, minor problems do exist and I believe that with some physical inspection I can eliminate further study using the flow meters from this string. However I will not move until I can do my physical inspection.

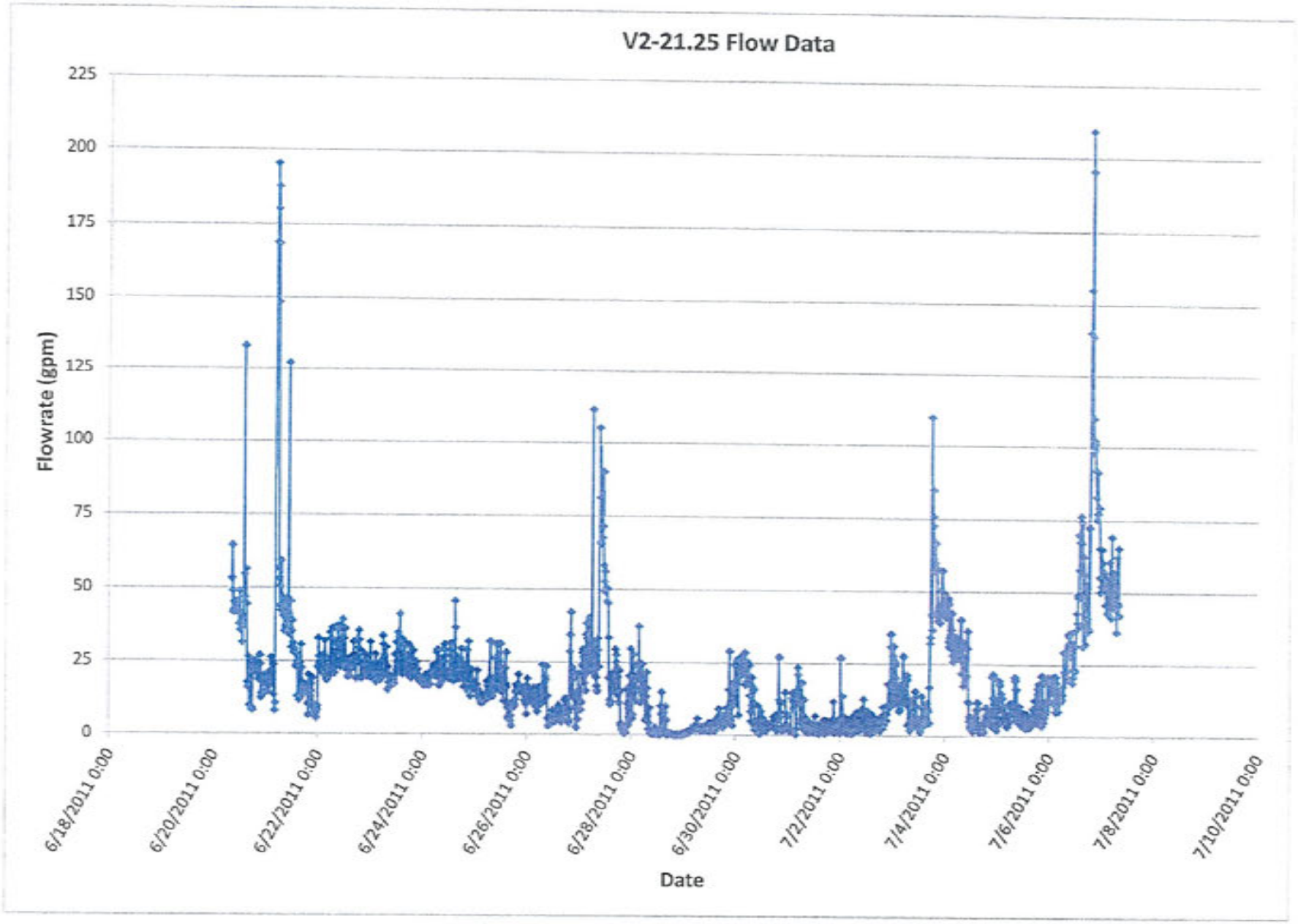
Date: 7/7/11

Time: 0930

Crew: Brian

-V2-14.51 shows a combination of I and I. Physical inspection of this string, so far, has yielded a couple of possible if not probable areas of repair. The entire string has not been done yet but I feel confident that with what I'm seeing and knowing what is yet to be inspected that these types of conditions are the problems in this string. I think that I can pull this meter from this string to move to the next.

End of journal.


V2-21.25 Flow Data
225
200
175
150
125
100
75
50
25
0
Flowrate (gpm)
6/18/2011 0:00
6/20/2011 0:00
6/22/2011 0:00
6/24/2011 0:00
6/26/2011 0:00
6/28/2011 0:00
6/30/2011 0:00
7/2/2011 0:00
7/4/2011 0:00
7/6/2011 0:00
7/8/2011 0:00
7/10/2011 0:00
Date

Flow Meter Field Journal

Site: V2-21.25

Date: 6/23/11

Time: 0940

Crew: Brian

-Downloaded all four units

-Site V2-21.25 shows major spiking during this rain event and indicates that it is an inflow problem with a little infiltration. It also may be showing a line holding water. This string will definitely need to be televised to find the problem in this instance.

-Conclusion drawn at V2-21.25: Infiltration is indicated and further study is needed to locate the source of the extra water.

Date: 6/28/11

Time: 1230

Crew: Brian

-Downloaded meters

-Site V2-21.25 shows a combination problem, with a majority of it being inflow, especially during heavier rain events. Further study is needed up this string. I plan on moving this meter to the south side of I44 to MH#28 to see if I can eliminate MH# 26 and 27 around the pond that is in the area of these two manholes. Also I plan on walking the lines behind Vessels and the other businesses along I44 to check for any signs of problems there.

-Conclusion drawn at V2-21.25: With a combination problem I plan on eliminating the inflow first since it is the worst of the two. Further study is needed and I also need to monitor the line running from 21 to 22 to see if there is any problems in that string before I remove the meter from this manhole.

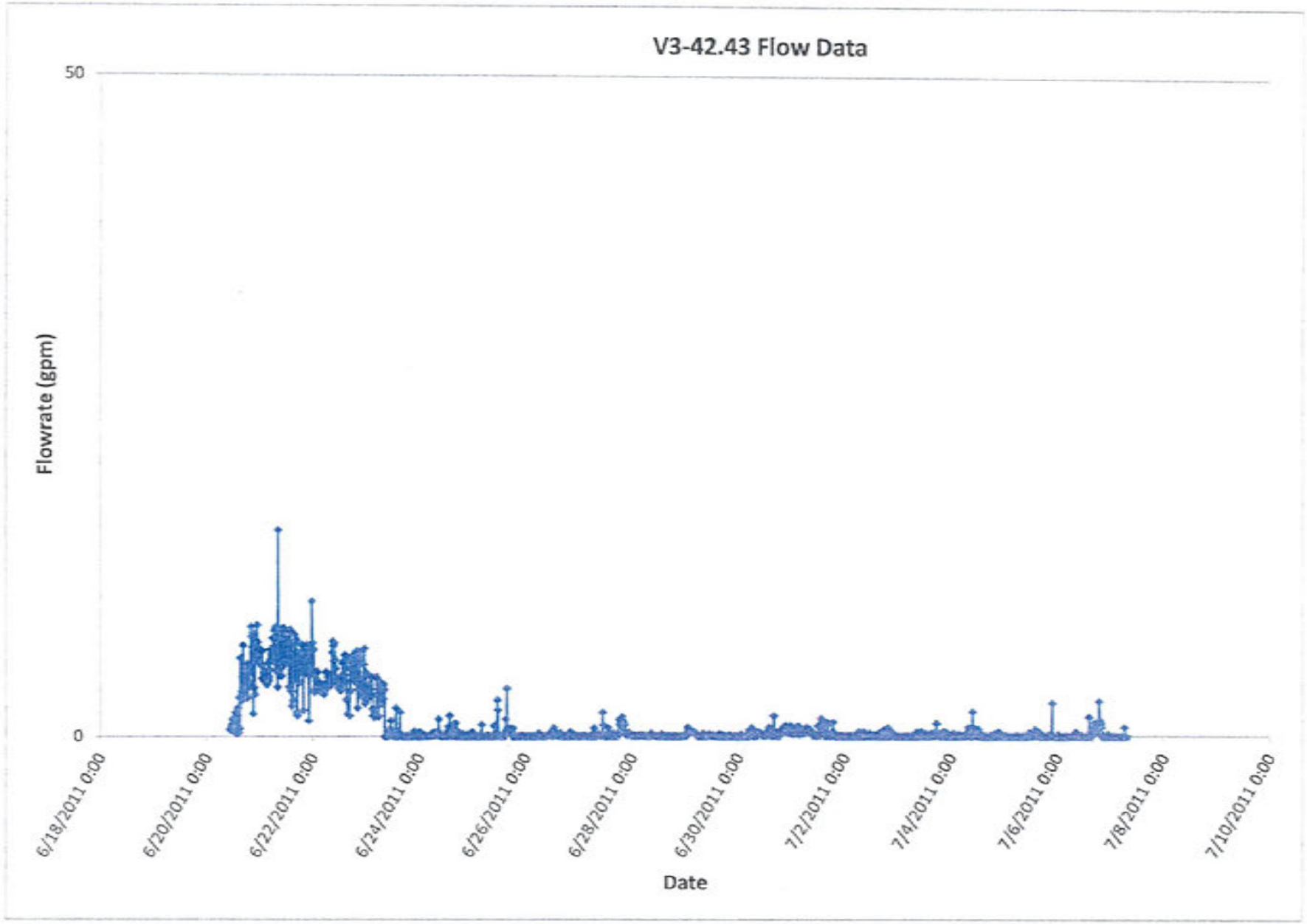
Date: 7/7/11

Time: 0930

Crew: Brian

-V2-21.25 shows spiking during the last rain occurrence, indicating an infiltration problem. This appears to be a broken line. I will move this meter up this string to isolate which line has the problem, but first I will move to the other line coming into this manhole, the line from Vichy Road, to check for problems in that string.

End of journal.


V3-42.43 Flow Data
50
0
Flowrate (gpm)
6/18/2011 0:00
6/20/2011 0:00
6/22/2011 0:00
6/24/2011 0:00
6/26/2011 0:00
6/28/2011 0:00
6/30/2011 0:00
7/2/2011 0:00
7/4/2011 0:00
7/6/2011 0:00
7/8/2011 0:00
7/10/2011 0:00
Date

Flow Meter Field Journal

Site: V3-42.43

Date: 6/23/11

Time: 0940

Crew: Brian

-Downloaded all four units

-Site V3-42.43 showed small spiking during the rain event on Tuesday the 21st. Graphing shows small spikes with slow decrease indicating infiltration. This hypothesis is supported by the slight increase in velocity meaning that the water getting into the line is meeting some resistance.

-Conclusion drawn at V3-42.43: An infiltration problem is indicated and, being that this string still supports a few residences, further study is needed. We may walk these lines and open manholes to see if the water may be getting into the manholes themselves. Also the residences themselves need to be investigated to see which ones are actually being used or are even still there. This may allow us to cut off any unused lines. Any cleanouts that can be found need to be inspected and notice given to proper authorities for repair.

Date: 6/28/11

Time: 1230

Crew: Brian

-Downloaded meters

-Site V3-42.43 shows infiltration in this string. I will fill out a work order to smoke test this string looking for possible breaks in these lines and for possible broken laterals. I don't believe there would be any illegal connections (i.e. gutter hookups or footer drains) but these need to checked for. GIS aerial photos show that there may be a line that can be cut off because of no residences needing a connection. This line is V3-45 to V3-46.

Conclusion drawn at V3-42.43: Infiltration being the evident problem, we will need to smoke test and televise this string to see where the water is getting in at. We also need to check for any possible inflow to closeout testing on this string.

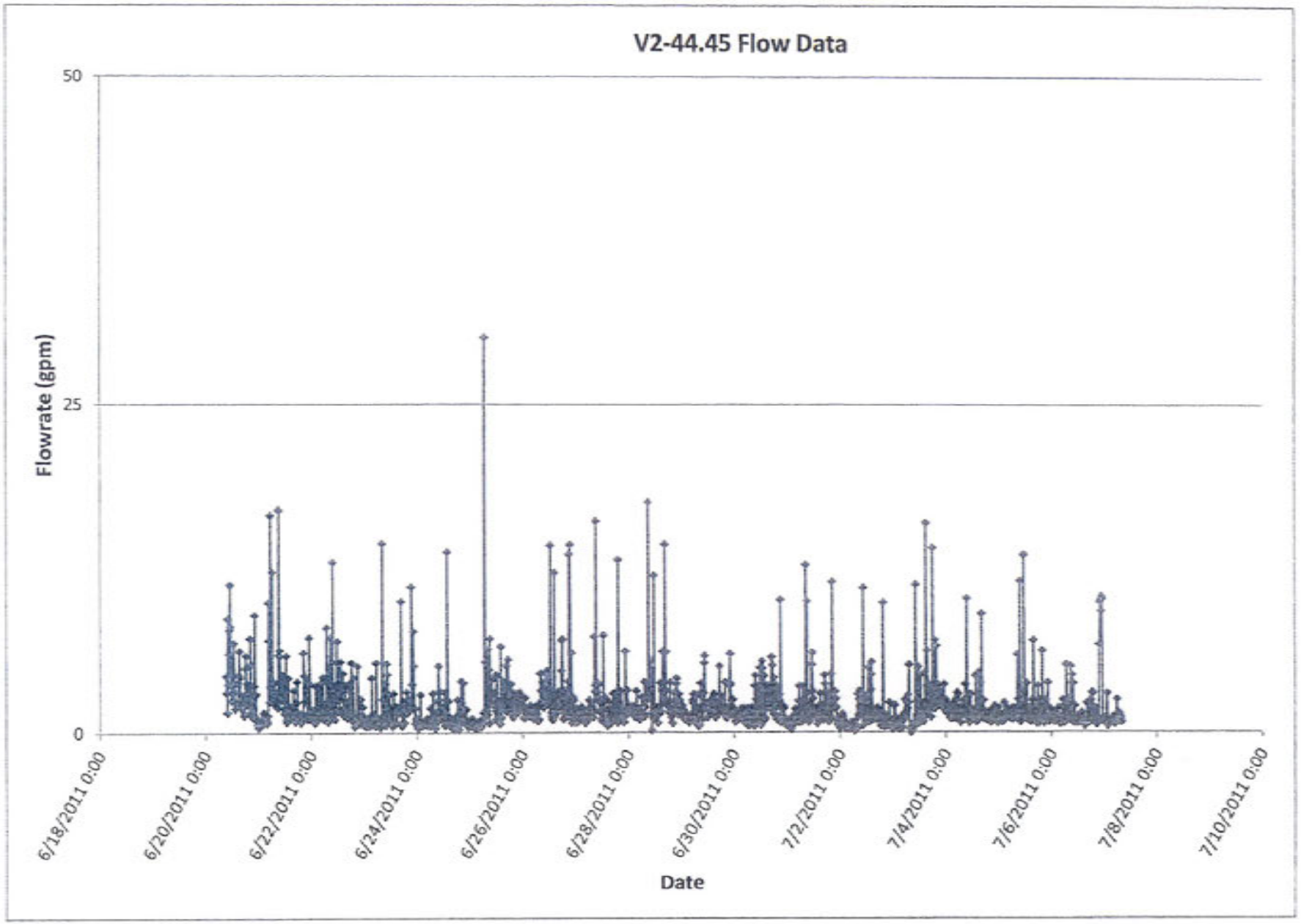
Date: 7/7/11

Time: 0930

Crew: Brian

-V3-42.43 again shows small spikes during rain events. After some physical inspection a couple of low manholes were found with one broken concrete ring. Additionally an open and exposed abandoned lateral was found towards the end of this string. Also a leaking water connection was found near this lateral, exposing it to additional inflow. However no additional cutoffs can be made in this string.

End of journal.


V2-44.45 Flow Data
50
25
0
Flowrate (gpm)
6/18/2011 0:00
6/20/2011 0:00
6/22/2011 0:00
6/24/2011 0:00
6/26/2011 0:00
6/28/2011 0:00
6/30/2011 0:00
7/2/2011 0:00
7/4/2011 0:00
7/6/2011 0:00
7/8/2011 0:00
7/10/2011 0:00
Date

Flow Meter Field Journal

Site: V2-44.45

Date: 6/23/11

Time: 0940

Crew: Brian

-Downloaded all four units

-Site V2-44.45 shows spiking, although sporadic during this rain event. Although data strings show very sharp spikes.

-Conclusion drawn at V2-44.45: Inflow is a definite problem in this string. We also walk this string to check manholes and cleanouts. I also will fill out a work order to have the line running downstream to V2-2 televised.

6/27/11 **Update:** The line from V2-2 to V2-44 was televised on 6/23/11 and no problems were found.

Date: 6/28/11

Time: 1230

Crew: Brian

-Downloaded meters

-Site V2-44.45 shows inflow spiking during the heavier rain events. Lighter rain does not seem to show up. However the flow in this line seems to have bottomed out during non event times. Total flow does not seem to account for all of the flow seen in V2-2 so I will be filling out a work order to check for illegal connections. I will also fill out a work order to have this string checked at manholes. I will also recommend that we smoke test for illegal connections.

-Conclusion drawn at V2-44.45: Inflow is evident in this string although the lack of flow, I believe, does not account for all the flow in V2-2. Meaning there is still a problem in the line to V2-2.

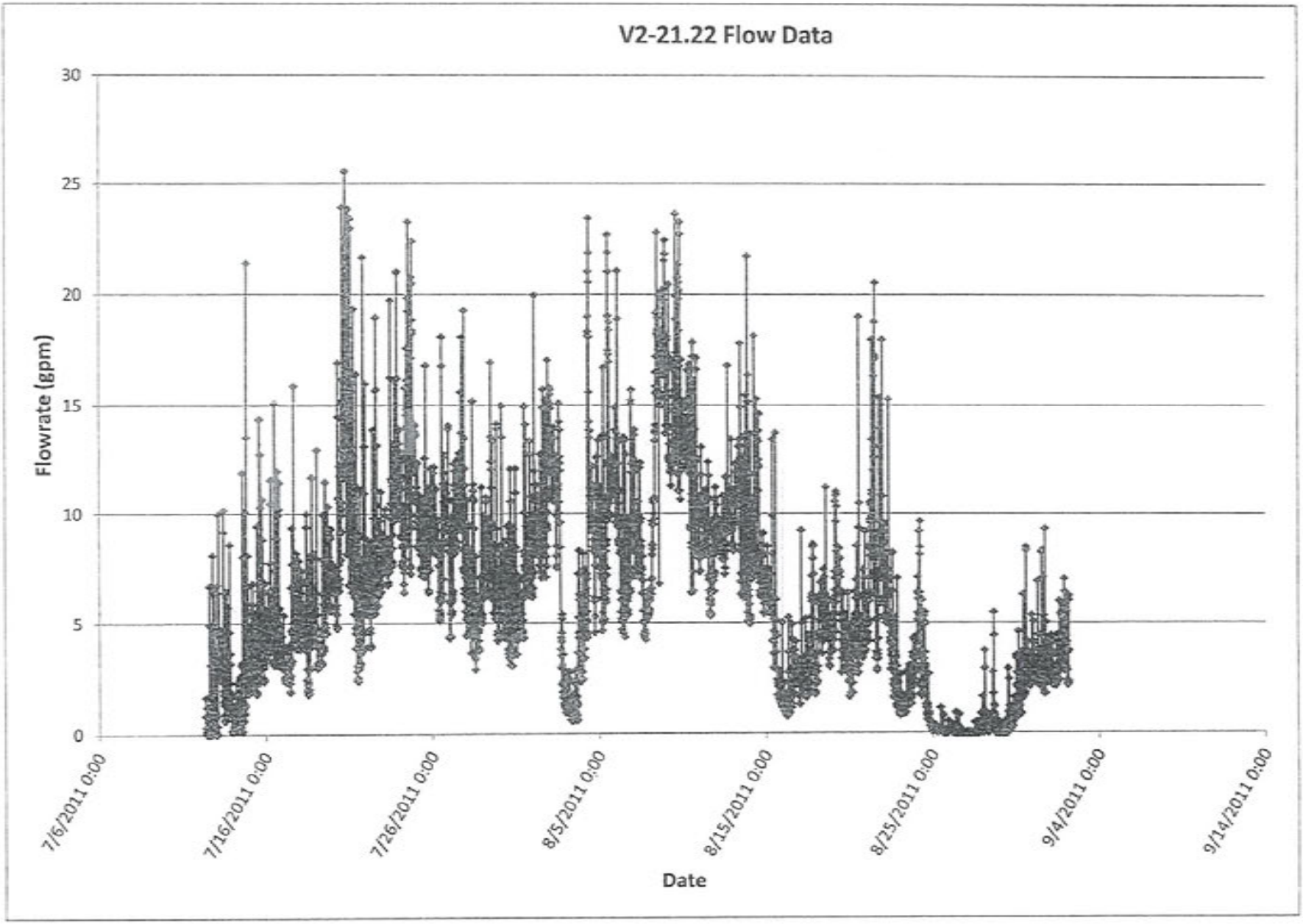
Date: 7/7/11

Time: 0930

Crew: Brian

-V2-44.45 still shows small peaks during heavier rain events. Lighter rain does not show up on graphing. I believe this supports the manhole near a low spot where as the low spot fills when it reaches the manhole then it begins to inflow. Or could possibly be a house or two with connected rain gutters. We will need to smoke test this string to identify the specific problem.

End of journal.


V2-21.22 Flow Data
Flowrate (gpm)
30
25
20
15
10
5
0
7/6/2011 0:00
7/16/2011 0:00
7/26/2011 0:00
8/5/2011 0:00
8/15/2011 0:00
8/25/2011 0:00
9/4/2011 0:00
9/14/2011 0:00
Date

Flow Meter Field Journal

Site: V2-21.22

Date: 7/13/11

Time: 1430

Crew: Brian

-Downloaded all 4 units

-Site V2-21.22 also spiked during both events and, according to graphing, is a prominent inflow problem. I plan on walking the string to check manhole lids and illegal connections. This is a short string and with the size of the peaks, I can say with some certainty that this is part of the problem seen at V2-7.

Date: 7/25/11

Time: 1030

Crew: Brian and Bob

-Downloaded all 4 meters

-V2-21.22 showed spiking during both rain events, but the higher peaks were between the occurrences. I need to identify what is on this string to see what types of buildings are tied to this string (Apt, houses, businesses, etc). These could be peaks from laundry facilities.

Date: 8/4/11

Time: 1530

Crew: Brian and Brandon

-Downloaded all 4 meters

-V2-21.22 showed major spiking, peaking around 40 gpm. Inflow is the larger problem in this string, which I believe to be a manhole problem. However infiltration is seen and televising is suggested in this string.

Date: 8/26/11

Time: 1100

Crew: Brian and Brandon

-V2-21.22 showed fluctuating spiking during most rain events. I believe this shows the problem to be dependent on the amount of rainfall during any given event. This string is also scheduled for physical inspection and I believe that this will find the problem in this string as well.

- Date: 9/8/2011

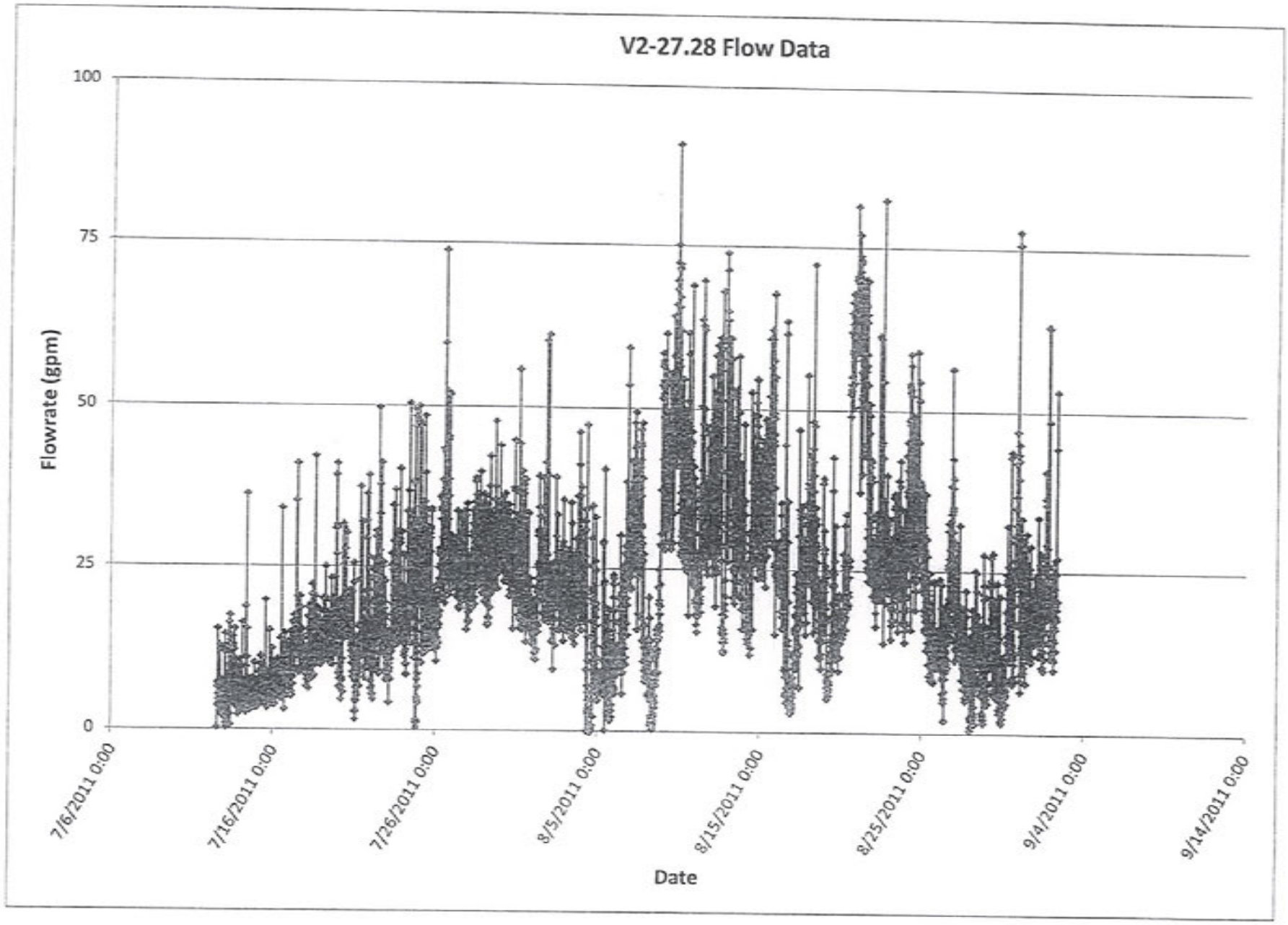
Time: 1120

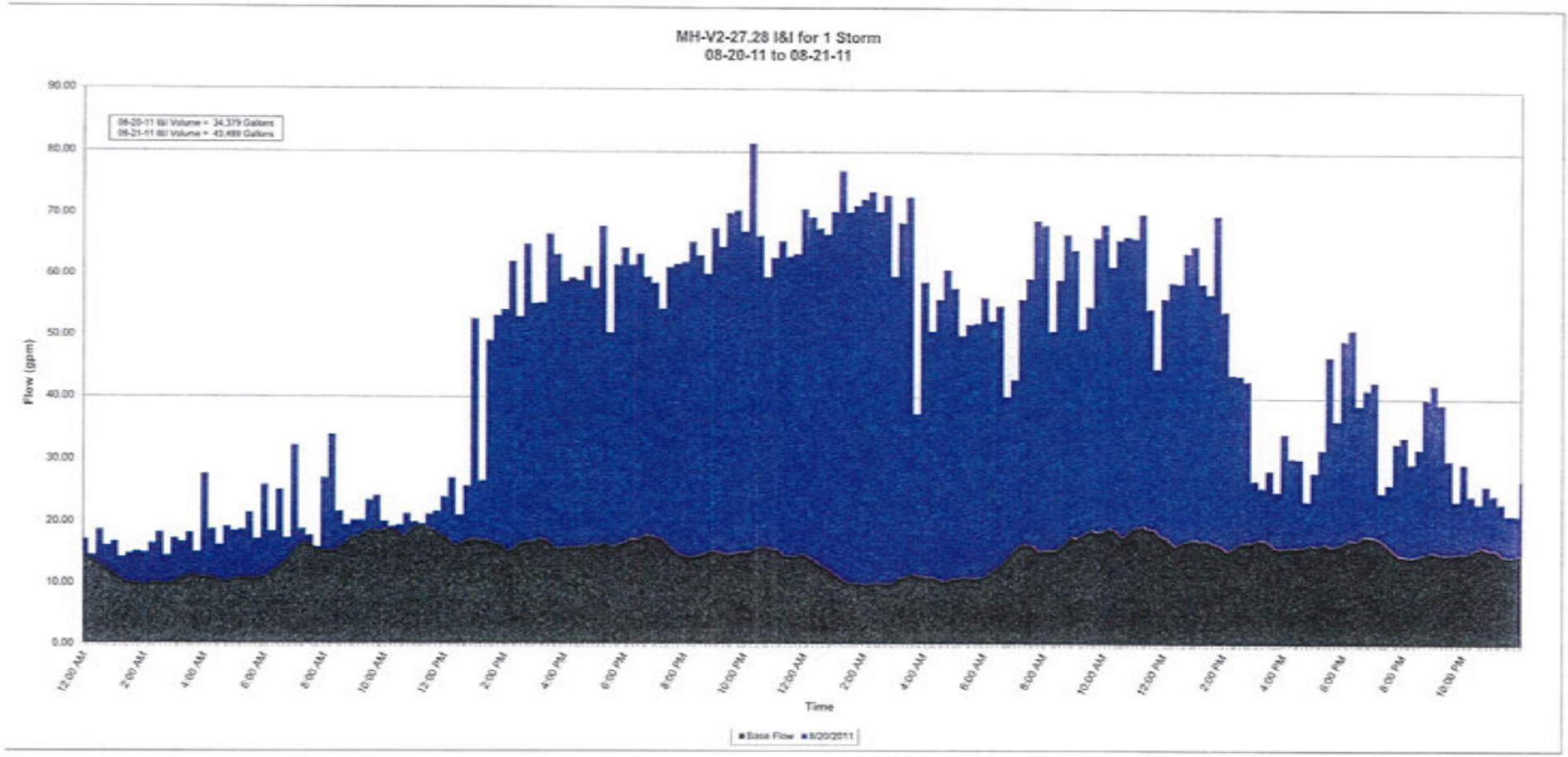
Crew: Brian and Bob

-Downloaded and pulled all 4 meters

-V2-21.22 also showed small spikes during all rain events. Visual inspection of the manholes will finish this string.

End of Journal


V2-27.28 Flow Data
100
75
50
25
0
Flowrate (gpm)
7/6/2011 0:00
7/16/2011 0:00
7/26/2011 0:00
8/5/2011 0:00
8/15/2011 0:00
8/25/2011 0:00
9/4/2011 0:00
9/14/2011 0:00
Date


MH-V2-27.28 I&I for 1 Storm
08-20-11 to 08-21-11
08-20-11 I&I Volume = 34,379 Gallons
08-21-11 I&I Volume = 43,489 Gallons
Flow (gpm)
90.00
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
12:00 AM
2:00 AM
4:00 AM
6:00 AM
8:00 AM
10:00 AM
12:00 PM
2:00 PM
4:00 PM
6:00 PM
8:00 PM
10:00 PM
12:00 AM
2:00 AM
4:00 AM
6:00 AM
8:00 AM
10:00 AM
12:00 PM
2:00 PM
4:00 PM
6:00 PM
8:00 PM
10:00 PM
Time
Base Flow
8/20/2011

Flow Meter Field Journal

Site:V2-27.28

Date: 7/13/11

Time: 1430

Crew: Brian

-Downloaded all 4 units

-V2-27.28 showed spiking during the 21st only. There was not a peak during the 20th. However this does not account for what was seen at MH-21, so a physical inspection is needed at MH 26 and I will have the lines running between MH 25 and MH 27 televised to find the problem here. I have a suspicion that there may be something going on around the pond in this area. However, it appears to be inflow.

Date: 7/25/11

Time: 1030

Crew: Brian and Bob

-Downloaded all 4 meters

-V2-27.28 showed major spiking during both events, showing a 20 gpm difference between rain and non rain times. Also showed a big spike during a non peak time. Not sure what this is, unless Vessels was washing towels or something. I may need to do some investigating into the businesses on this string. I do need to move up this string to figure out where it is exactly. However the numbers show that there is a problem between MH#25 and MH#27, meaning this string is taking on water from the pond. I need to check MH#26, otherwise this section will need to be televised to check for possible problems.

Date: 8/4/11

Time: 1530

Crew: Brian and Brandon

-Downloaded all 4 meters

-V2-27.28 shows a major spike, and that it is an inflow problem. Readings bottomed out after the rain event, as we saw around a 3" deep flow at time of download. We believe this to be a debris problem and we will need to clean this meter next week as well.

Date: 8/26/11

Time: 1100

Crew: Brian and Brandon

-V2-27.28 showed spiking during most rain events, sometimes at significant amounts. I believe this again supports the theory of a manhole near a low spot with larger amounts of rain. A physical inspection may provide a better picture of what is happening but I may move this meter further up to see what I can find when you take Vessels fitness center out of the equation.

Date: 9/8/2011

Time: 1120

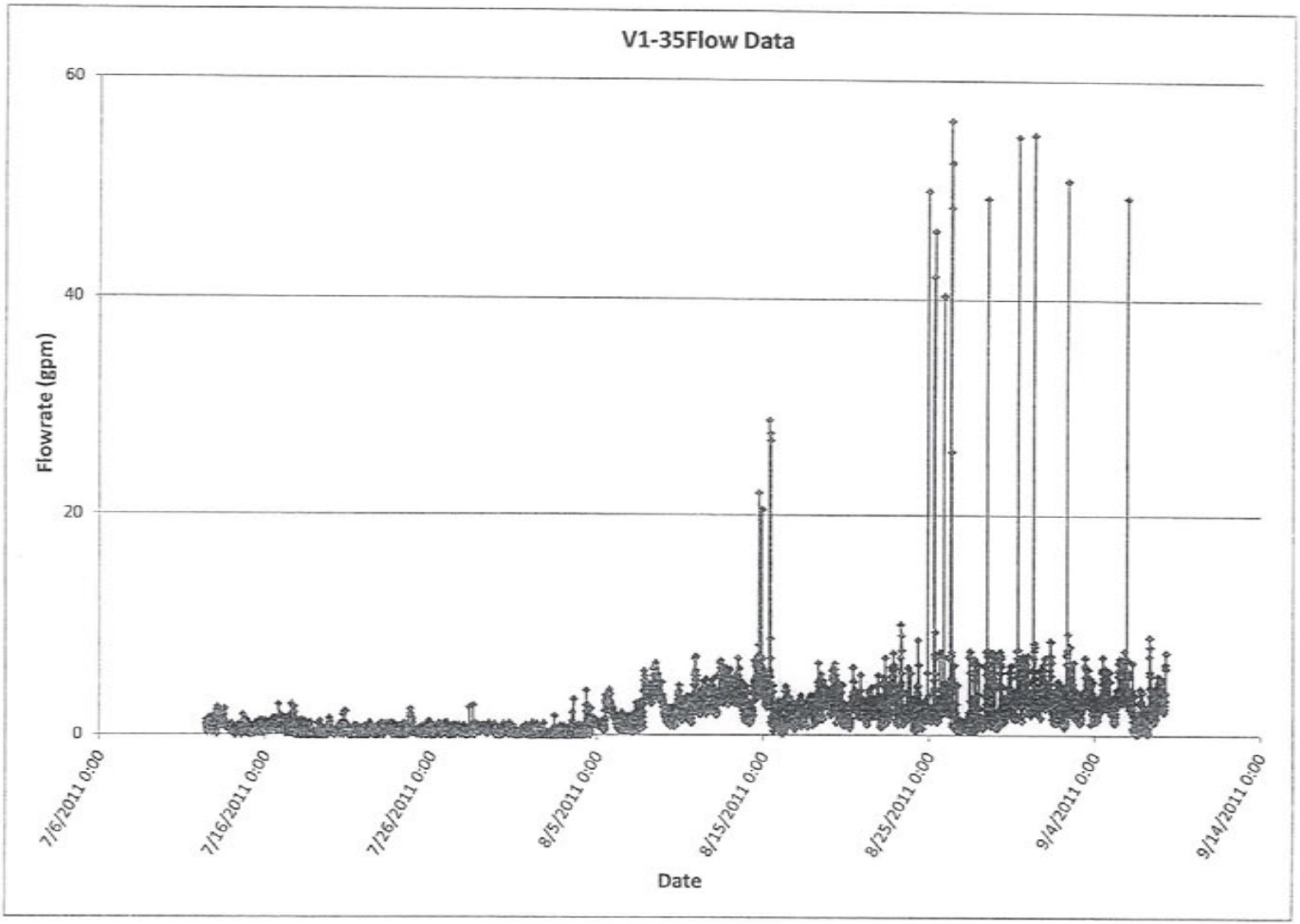
Crew: Brian and Bob

-Downloaded and pulled all 4 meters

-V2-27.28 showed spiking during all rain events. However the last event peaked just after the rain event possibly showing a line problem or a possible manhole near a low spot. V2-28 is the suspected entry point. Visual inspection will finish out this string.

End of Journal

-**Update**- 9/15/11- Physical inspection of V2-26 showed I & I at seal under ring and outer seal is cracked in multiple spots. This is an older ring and lid and non-standard. Recommend replacing this ring and lid with a standard.


V1-35Flow Data
60
40
20
0
Flowrate (gpm)
7/6/2011 0:00
7/16/2011 0:00
7/26/2011 0:00
8/5/2011 0:00
8/15/2011 0:00
8/25/2011 0:00
9/4/2011 0:00
9/14/2011 0:00
Date

Flow Meter Field Journal

Site:V1-35.36

Date: 7/13/11

Time: 1430

Crew: Brian

-Downloaded all 4 units

-Site V1-35.36 does show some inflow during both events. I need to walk the off road lines in this string to check the manholes. It does not seem to be a large problem, peaking at 2.5 gpm during the heaviest. I also need to check for illegal connections.

Date: 7/25/11

Time: 1030

Crew: Brian and Bob

-Downloaded all 4 meters

-V1-35.36 also showed very spiking of possible I and I during both rain events. However the peak for either one never reached 2.5 gpm. Event #23 being the heaviest only showed 2.39 gpm. I also need to walk this string to identify the problem.

Date: 8/4/11

Time: 1530

Crew: Brian and Brandon

-Downloaded all 4 meters

-V1-35.36 showed small, sharp spikes and appears that inflow is the larger problem in this string. Visual inspection is also required in this string. Interrogation however gave bad readings. We may need to clean this sensor.

Date: 8/26/11

Time: 1100

Crew: Brian and Brandon

-V1-35.36 showed very small spiking during some events. However these were also during peak times so this may just be residential flow during rain events. This string is scheduled for physical inspection.

Date: 9/8/2011

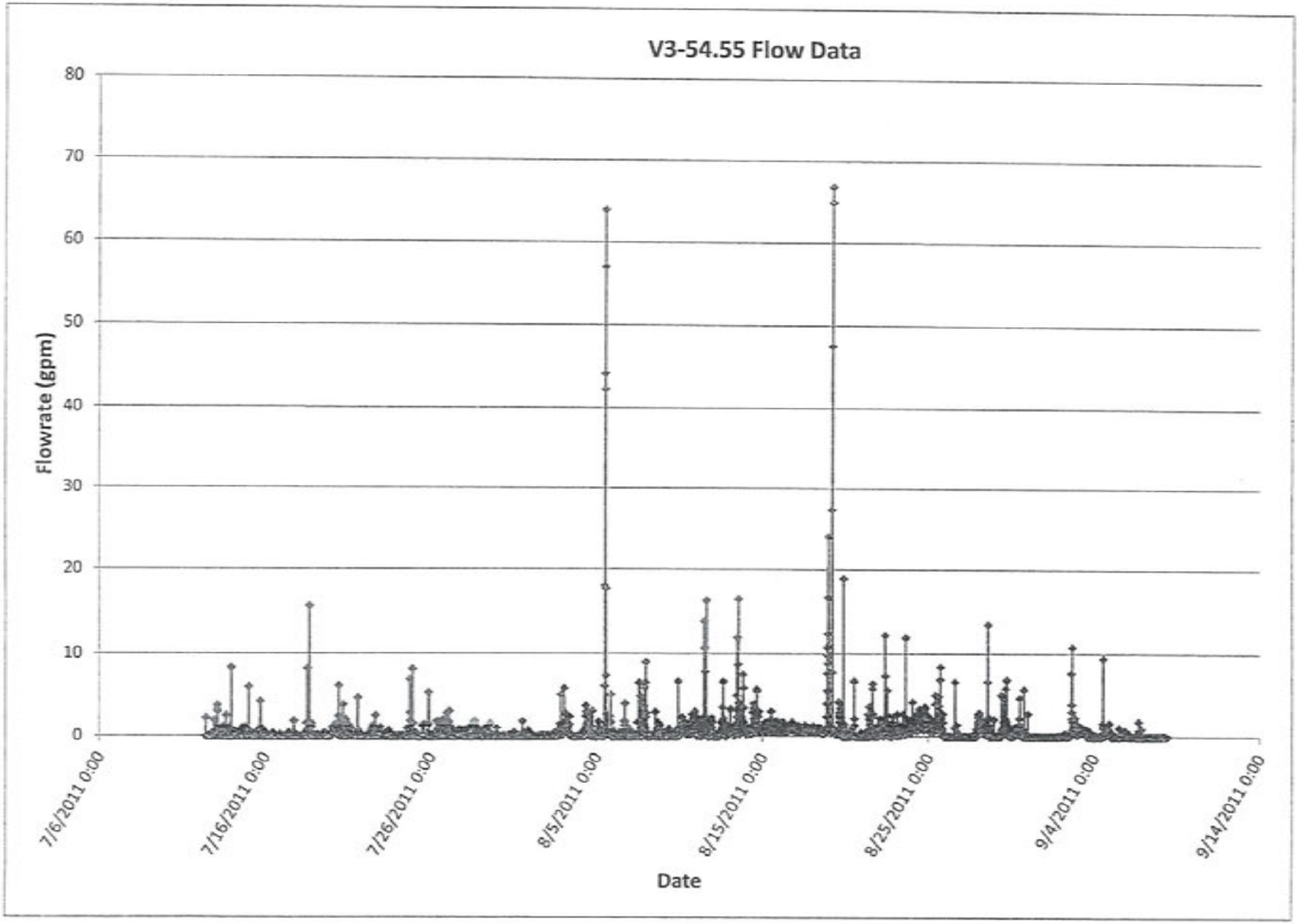
Time: 1120

Crew: Brian and Bob

-Downloaded and pulled all 4 meters

-V1-35.36 showed very small spikes during all 3 rain events, indicating that there is a very minor problem in this string. Visual inspection of manhole rings and lids will be performed as well as moving a meter to V1-36 to ascertain where its coming from. However I believe that manhole inspection will find the problem.

End of Journal


V3-54.55 Flow Data
Flowrate (gpm)
80
70
60
50
40
30
20
10
0
7/6/2011 0:00
7/16/2011 0:00
7/26/2011 0:00
8/5/2011 0:00
8/15/2011 0:00
8/25/2011 0:00
9/4/2011 0:00
9/14/2011 0:00
Date

Flow Meter Field Journal

Site:V3-54.55

Date: 7/13/11

Time: 1430

Crew: Brian

-Downloaded all 4 units

-Site V3-54.55 only showed spiking during 21st rain event. However the spike did not start immediately at start of event and ended before it ended. Also the spike never got above 4 gpm. During install, no measured flow was found and at time of download, also had no visible flow, so the established baseline is low to none. I need to monitor this string a little longer to establish the habits of the residences on it. I, however, suspect that there may not be any I and I in this string beyond this point.

Date: 7/25/11

Time: 1030

Crew: Brian and Bob

-Downloaded all 4 meters

-V3-54.55 showed very small spiking during rain occurrence #23. This leads me to believe this is a low manhole up this string as the heaviest rain was during that event. I will have to walk to check this string, also looking for open abandoned laterals.

Date: 8/4/11

Time: 1530

Crew: Brian and Brandon

-Downloaded all 4 meters

-V3-54.55 showed very little spiking. Inflow definitely is the problem. Visual inspection is required to finish out this string.

Date: 8/26/11

Time: 1100

Crew: Brian and Brandon

-Downloaded and cleaned all four units. Cleaning seems to have helped our bad readings.

-V3-54.55 showed very small spiking during all rain occurrences. This supports the theory of a low manhole or open abandoned laterals. Visual inspection will finish this string.

Date: 9/8/2011

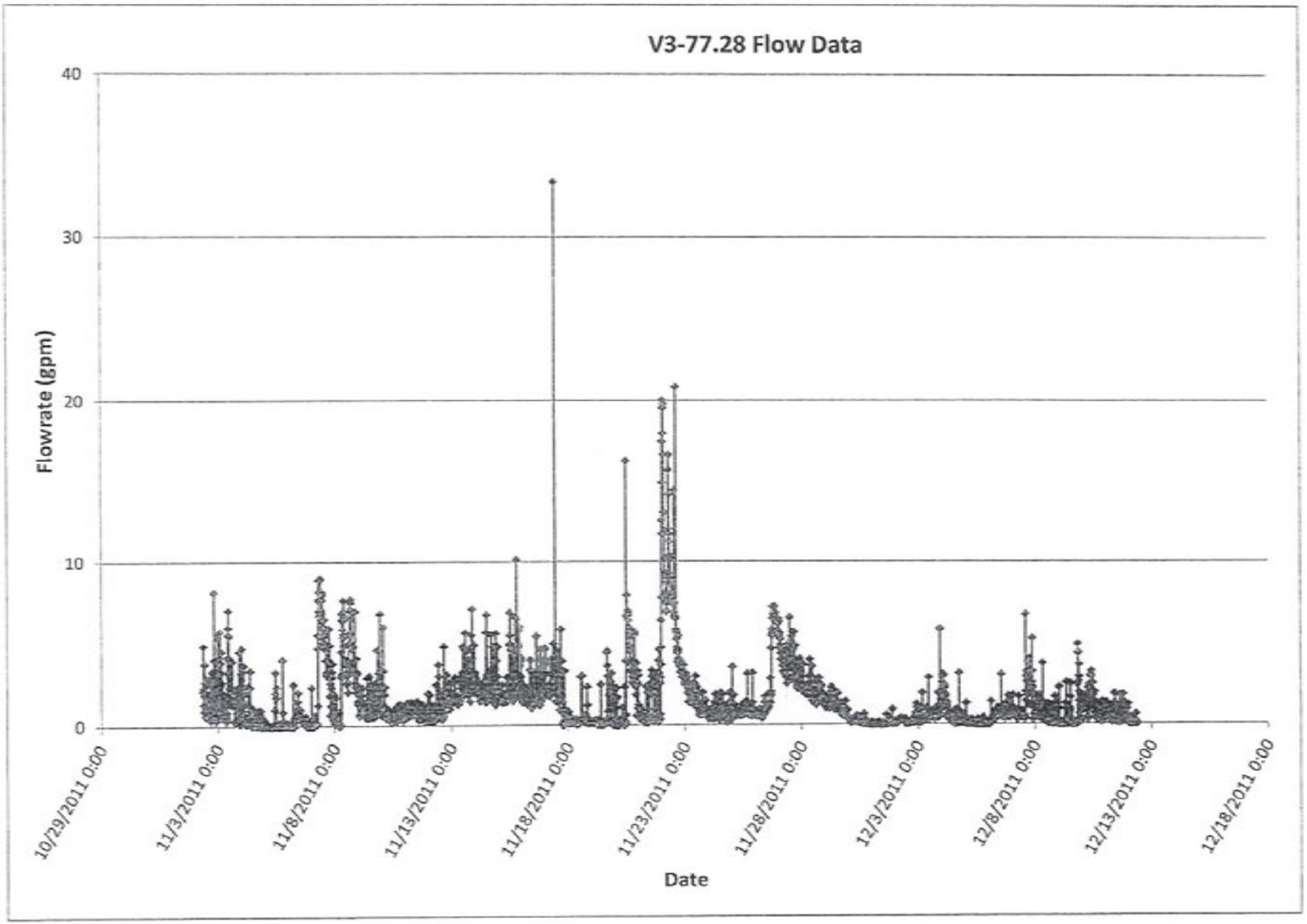
Time: 1120

Crew: Brian and Bob

-Downloaded and pulled all 4 meters

-V3-54.55 did not show any spiking during any rain event except #37. It was a minor spike and dropped before the end of the event. There is a very minor problem in this string and visual inspection is required to finish this study.

-End of Journal


V3-77.28 Flow Data
Flowrate (gpm)
40
30
20
10
0
10/29/2011 0:00
11/3/2011 0:00
11/8/2011 0:00
11/13/2011 0:00
11/18/2011 0:00
11/23/2011 0:00
11/28/2011 0:00
12/3/2011 0:00
12/8/2011 0:00
12/13/2011 0:00
12/18/2011 0:00
Date

Flow Meter Field Journal

Site:V3-77.28

Date: 11/2/11

Time: 1020

Crew: Brian and Brandon

-Finished moving and installing meters

-Meter 1392 was pulled and installed in LV1-10.79. Meters 1393 and 1395 were placed in V3-78-79 and V3-77.28, respectively.

Date: 11/10/11

Time: 1416

Crew: Brian and Brandon

-Downloaded all four meters

-V3-77.28 shows minor spiking during some rain events. However this appears to happen during peak usage times. We will need further study on this string.

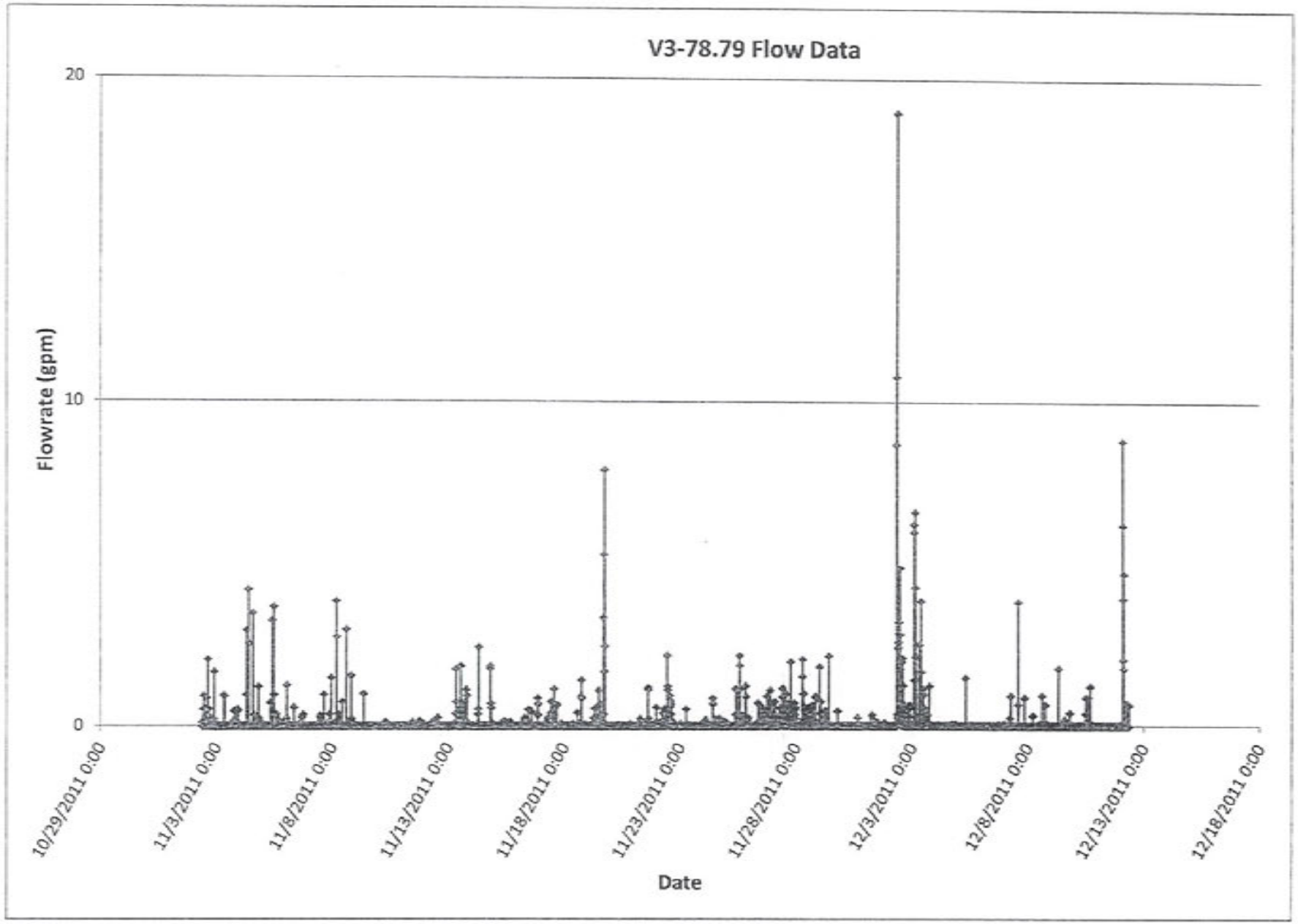
Date: 11/29/11

Time: 0800

Crew: Brian and Brandon

-Crew downloaded all 4 meters on 11/28

-V3-77.28 shows minor spiking during all rain events. The problem appears to be a combination of inflow and infiltration. This string will need to be televised and inspected.


V3-78.79 Flow Data
20
10
0
Flowrate (gpm)
10/29/2011 0:00
11/3/2011 0:00
11/8/2011 0:00
11/13/2011 0:00
11/18/2011 0:00
11/23/2011 0:00
11/28/2011 0:00
12/3/2011 0:00
12/8/2011 0:00
12/13/2011 0:00
12/18/2011 0:00
Date

Flow Meter Field Journal

Site:V3-78.79

Date: 11/2/11

Time: 1020

Crew: Brian and Brandon

-Finished moving and installing meters

-Meter 1392 was pulled and installed in LV1-10.79. Meters 1393 and 1395 were placed in V3-78-79 and V3-77.28, respectively.

Date: 11/10/11

Time: 1416

Crew: Brian and Brandon

-Downloaded all four meters

-V3-78.79 shows no spiking. There is no I & I in this string.

Date: 11/29/11

Time: 0800

Crew: Brian and Brandon

-Crew downloaded all 4 meters on 11/28

-V3-78.79 shows very minute inflow during heavier rainfall events. I believe that ring and lids again are the problem.

APPENDIX D

PREVIOUS COLLECTION SYSTEM EVALUATIONS

City of ROLLA

DEPARTMENT OF PUBLIC WORKS
901 North Elm Street
P.O. Box 979
Rolla, MO 65402

Phone: (573) 364-8659 FAX: (573) 364-8602 e-mail: shargis@rollacity.org www.rollacity.org

LETTER OF TRANSMITTAL

TO: MO DNR – MARLETTA COZAD
SOUTHEAST REGIONAL OFFICE
2155 NORTH WESTWOOD BLVD.
POPLAR BLUFF, MO 63901

DATE: OCTOBER 5, 2011

RE: PERMIT #MO-0050652 – SE WW PLANT
PERMIT #MO-0047031-VICHY RD WW PLANT
PERMIT #MO-0047023-SW WW PLANT

WE ARE SENDING YOU: [X] Attached [ ] Under Separate Cover Via _____ the following

[ ] Shop drawings [ ] Print [ ] Plans [ ] Samples [ ] Specifications

[ ] Copy of letter [ ] Change order [ ] _____

COPIES	DATE	NO.	DESCRIPTION
1			I&I Reduction Efforts September 2007 to October 2011
1			May 2011 – Flow Meter Journal
1			July 2011 – Lift Station Check
1			July 2011 – Creek Crossing Inspection
1			October 2011 – Creek Crossing Inspection
1			May 2011 – I&I Repair
1			April 2011 – Frequent Cleaning
1			June 2011 – Frequent Cleaning
1			July 2011 – Frequent Cleaning
1			August 2011 – Frequent Cleaning
1			July 2011 – Grease Trap Inspections

THESE ARE TRANSMITTED as checked below:

[ ] For approval [ ] No exceptions taken [ ] Resubmit copies for approval

[X] For your use [ ] Make corrections noted [ ] Submit copies for distribution

[X] As requested [ ] Amend and resubmit [ ] Return corrected prints

[ ] For review and comment [ ] _____

[ ] FOR BID DUE _____ 20 _____ [ ] PRINTS RETURNED AFTER LOAN TO US

REMARKS

COPY TO Bruce Volner/Rolla DNR Office SIGNED: Gary Heavin

If enclosures are not as noted kindly notify us at once.

An Equal Opportunity Employer

City Of Rolla

Sewer Dept.
I&I Reduction Efforts
9/07 thru 1/08

1. Rerouted 8" Main on South Rolla St. to be able to eliminate 3 failing Manholes.
2. Rerouted 2ea. 15" clay mains (519 feet ea.) to a 36" Trunk Line (370 feet) to be able to eliminate 3 creek crossing that were failing east of Steven dale Ct.
3. Repaired 6"Clay Main in two places along 10th st. that had failed & allowing ground water to infiltrate.
4. Repaired or replaced 6ea. Defective Manhole ring & lids
5. Completed Creek crossing inspections city wide (Dye Tested)
6. Repaired or replaced 9 ea. Private lateral taps to the city mains
7. Monitored Lines during heavy rains for surcharging (OK)
8. Footages Cleaned & Root Cut During this period (847,991)
9. Footages Televised During this period (7406)

1/08 thru 3/08

1. Repaired Manhole V1-25
2. Completed Creek Crossing inspections
3. Inspected off road lines
4. Repaired Manhole HP1-16
5. Repaired Manhole BW4-11
6. Repaired Clay line Ln2-41(20 feet)
7. Raised Manholes at Industrial park in flood plain
8. HP1-33
9. HP1-32
10. HP1-35
11. HP1-36
12. Repaired 6" private lateral from the Pepsi Plant
13. Reworked storm ditch around lift station HP-1
14. Raised Manhole HP1-37 at the lift station
15. Cleaned out storm ditch behind Pepsi Plant
16. Raised Manhole M2-8
17. Replaced 200 feet of clay line between V2-9 & V2-10
18. Raised Manhole LW6-73
19. Monitored Lines for surcharging During heavy rains OK except LW6-73 Scheduled for Line size upgrade this summer

3/08 thru 6/08

1. Replaced 200 feet of clay line between BE2-52 & BE2-53
2. Replaced 280 feet of clay line between BE2-53 & BE2-50
3. Completed Creek crossing inspections

4. Completed 2nd creek crossing inspection due to high water
5. Raised Manhole BN2-12
6. Raised Manhole LE6-51
7. Raised Manhole LW5-28
8. Raised Manhole HP1-23
9. Repaired 10 feet of 8" clay line BN2-13 to BN2-12
10. Raised Manhole V2-72
11. Replaced 140 feet of bad 4' private lateral (Beech St.)
12. Repaired 10' 6" Clay Line (112 South Elm)
13. Removed 5 down spouts from 112 & 110 South Elm
14. Raised LW2-14
15. Rerouted storm run off LW2 -14
16. Raised Manhole's BW4-18,19&20
17. Inspected & Mowed 3069 feet of off road lines

6/08 thru 9/08

1. Replaced Creek crossing BE6 67 to BE6 68
2. Continued repairing / replacing vented lids
3. Raised Man hole LE8-128
4. Repaired creek crossing LE10-145
5. Started city wide inspections on private cleanouts
6. Replaced Creek crossing on Green Tree BE3-7 to 8
7. Repaired 6 ea. Private cleanout caps (Silver leaf)

10/08 thru 01/09

1. Smoke Tested area HP1
2. Resealed Manholes HP1-19-27-44-45-38-39-40
3. Raised &resealed Manholes HP1-21-14-40A-34
4. Installed 2 ea. Cleanout caps at Brewer Science
5. Smoke tested area BW4
6. Repaired 13 private cleanout's
7. Resealed manholes Bw4-4 &BW4-33
8. Removed rain gutter from sanitary at 600 7th.
9. Notified 3 residents that there laterals were faulty
10. Replaced 52 feet of 8"damaged clay with Plastic on Mimosa Ct.
11. Raised manhole LE8-205A
12. Rerouted drainage ditch in the area of LE8-205A
13. Assisted City of Newburg opening line to stop SSO
14. On going inspections in area LE8 to find I & I occurring

01/09 thru 03/09

1. Replaced 10 feet of clay with 8" plastic BN4-34 to BN4-33

2. Raised & repaired Manholes lids LE10-54 LE10-56 LN1-11 LE1-12
3. Repaired section of clay line LE10-17co rd. 5090
4. Raised Manhole BN4-30
5. Raised Manhole LV1-42
6. Replaced 101 feet of clay line BN4-35 to BN4-36
7. Replaced 20 feet of clay line BN4-30
8. Replaced 30 feet of clay line BN4-45
9. Replaced 80 feet of clay line BN4-11a to BN4-12
10. Replaced 30 feet of clay line BN4-13 to BN4-12

03/09 thru 06/09

1. Replaced 6" clay line from LE10-90 to LE10-80 to 8"plastic 889 total feet
2. Installed 4 new manholes from LE10- 90 to LE10-80
3. Completed creek crossing inspections
4. Mowed ,walked and inspected LV1- 9 to 20 1897 feet total between 9 manholes
5. Mowed , walked and inspected LV1 - 10 to 79 80 to 79 258 total feet
6. Mowed and inspected D5-2 to LV1-20 332 feet
7. Repaired man hole LE1-8 ring and lid
8. Started Televising off road lines that have not been done
9. Replaced 3 ea. Vented Manhole lids LW3 18,24,27

06/09 thru 09/09

1. Smoke Tested LE8 (See Results Attached)
2. Smoke Tested LE4 (See Results Attached)
3. Replaced Faulkner 8" clay main with 8" Plastic
4. Continuing off road televising that have not been done
5. Assisted City of Newburgh in opening line to stop a sso occurring
6. Completed creek crossing inspection
7. continuing to mow and inspect off road lines

09/09 thru 12/09

1. Replaced Cedar Grove Force main with new 2" line
2. Replaced Cedar Grove old 4" Gravity with new 8" pvc
3. Installed 4 new manholes in Cedar Grove
4. Smoke tested Private line's in Cedar Grove
5. Repaired 2 seetions of bad private line in Cedar Grove.
6. Repaired bad out side drop on Rucker LW6-29
7. Repaired Manhole ring and lid Williams rd. & Faulkner
8. Abandoned old lift station and septic at Cedar Grove
9. Replaced two vented manhole lids on east 10th St.

10. Dug up and resealed Basswood lift station
11. Redone all the drainage ditches around Basswood lift station
12. Repaired Bad outside drop LE1-2
13. Repaired Bad outside drop LE1-12

12/09 thru 3/10

1. Televised area of sally Road
2. Televised area of M1
3. Walked off road lines leading to South West Plant
4. Walked off road lines leading to South East Plant
5. Repaired creek crossing end of Huntleigh Estates
6. Raised manholes LV1-65A,4,12
7. Completed Grease trap inspections
8. Completed Creek Crossing inspections
9. Abandoned 100 feet of 6 inch clay line no longer needed BW2-22
10. Took out man hole BW4-23A due to I&I straight through
11. Repaired manhole SR-16 off road
12. Repaired manhole SR-15 off road
13. Smoke tested area of 11th & Bishop

4-10 thru 7-10

1. Raised manholes LE10-31,321,131A,32
2. Repaired clay main in 3 places total 30 feet LN1-6 to LN1-36
3. Completed Grease trap Inspections
4. Completed Creek Crossing Inspections
5. Smoke tested tower road area
6. Raised manhole LN2-81
7. Mowed and walked 3482 feet of off road lines
8. Started televising off road line's that have never been done
9. Raised private man hole behind Paneras

7-10 thru 10-10

1. Smoke tested LV1 Area
2. Took out faulty brick manhole BN3-15
3. Mowed 4325 feet of off road sewer rite away
4. Repaired 20 feet of 10" clay line BN3-15 to BN3-48
5. Repaired 20 feet of 6" clay line at 8th & Main
6. Repaired 10 feet of 8" clay line Bishop & 9th
7. Changed out 5 vented manhole lids on off road lines
8. Repaired and or replaced the following vented lids
9. LE3-36,33,31,25,20,21,9 LE1-16, LE4-20

10-10 thru 01-11

1. Repaired and or replaced the following vented lids
2. BW1-43,BW2-19,20,BE5-15,39,LE6-34,1,LE2-33,30LE1-18,9
3. Repaired and or replaced the following vented lids

4. LW1-9,4,2,5,19 LW6-38,LW3-32,LW5-9,LN1-16,LN3-3,BE2-65
5. BE6-26,LE4-73,LE4-51B,LN3-65,V1-17
6. Completed Creek crossing inspections
7. Walked and inspected all of off road lines

01-11 thru 3-11

1. Repaired / Replaced vented manhole lids,LW1-4,11,13,14,16,17,21,24,25 V2-11,19,8,40,5
2. Replaced 300 feet 8"clay line and Brick manhole LE5-17, did away with brick manhole LE5-16
3. Raised Manholes, LE10-155, V2-27, BN5-28, D5-9, LV1-4
4. Cleared 1200 feet of sewer right away LE5 district
5. Completed creek crossing inspections
6. Completed grease trap inspections
7. Repaired manhole LW2-4
8. Continuing manhole inspections
9. Televised aprox.7600 feet of sewer main

03-11 thru 07-11

1. Received 4 new flow meters and installed in the V-1, 2, &3 areas.
2. Repaired a 6 foot section of clay line with new PVC below BN4-10
3. Replaced the following Manhole ring & lids due to leaking and improper grades,BE4- 12,20,21,22,27,30 BE1-30,32 BE5-17,18,19,23B,41,48 BE6-27,64,75 BE3-16,36
4. Completed grease trap inspections
5. Completed creek crossing inspections
6. Started mowing of all off road lines
7. Raised manhole LN1-8
8. Started Sycamore project consisting of replacing approx. 1200 feet of 8" clay line with 10"pvc along with changing out 8 brick manholes with new precast.
9. Currently updating and programming TV Truck for electronic reporting on I&I data and inspections
10. Repaired invert in manhole LW2-4
11. Disconnected approx. 3300 feet of abandoned clay lines in the Woodcrest trailer park area

07-11 thru 11-11

1. Mowed and inspected all the off road lines
2. Replaced 12 ft. of 8" broken clay line LW1-25 down stream
3. Replaced 50 ft. of 8" broken clay line BN4-62 up stream
4. Repaired manhole LE10-64 invert
5. Repaired 6 broken cleanouts in LV1 area
6. Reworked road leading to Bass Wood lift station to divert storm run off
7. Repaired manhole BN5-26
8. Completed creek crossing inspections

9. Repaired creek crossing on Vienna Rd. Bank erosion
10. Reworked drainage ditch behind Sooter Inn to divert storm run off
11. Continuing to replace and upgrade Sycamore Main
12. Repaired manhole BN1-18

Flow Meter Journal

Date: 5/9/11

Time: 1600

Crew Members: Brian and Brandon

-Downloaded Data from all 4 units. Saw spiking at all 4 sites from rain occurrence on Saturday May 7th at approximately 0800.

-Site V3-36 showed spiking but not as heavy as first data collection period (before sewer cutoff at MH #61?)

-Conclusion drawn at site V3-36: A majority of I & I was eliminated with cut off, however some minor I & I may still exist and further monitoring is needed up the string.

-Site V2-7 again shows major I & I spiking at almost 300 gpm. Also total flow indicates this with almost 4 million gallons flowed in 3-4 week span.

-Conclusion drawn at site V2-7: Given readings at V2-10 site there is heavy flow coming from Sooter inn string and from Vichy road string. Recommend moving meters from V2-7 and V2-10 to V2-9 to track Vichy road string and V2-83 to track Sooter inn string.

-Site V2-2 shows light to moderate spiking during this rain occurrence, although major spiking over 300 to 400 gpm has been seen. Not sure if this is bad data but spiking is still seen.

-Conclusion drawn at site V2-2: Recent rises, despite vastly differing numbers, indicate an I & I problem. Recommend moving meter to V2-44 to isolate where it is coming from. First from line to V2-45, then from line to V2-67.

Date: 5/16/11

Time: 1200

Crew members: Dane, Scott, Brian

-Downloaded from all 4 units. Again saw spiking at all 4 sites.

-Site V3-36 showed a significant spike on Friday 13th at 0100 hrs indicating a moderate I & I problem. Graphing shows a combination of inflow and infiltration. Recommend moving meter to MH# V3-42 to monitor from line to V3-47 and then to line from V3-43.

-Site V2-2 still shows I & I, although some missing spikes indicate this may be an intermittent problem. This may show a flooding problem (a manhole near a low spot) or may have

something to do with amount of rainfall, or even a difference in rainfall amount per hour between rain occurrences. Inflow is the evident problem in this string.

-Site V2-7 shows sharp spiking during all rain occurrences, indicating inflow into a manhole. Suggestion was made to check Sooter Inn for gutter connections to sanitary sewer.

-Site V2-10 also shows sharp spiking and fall off during rain occurrences, supporting the Sooter Inn theory. Further monitoring up the string will hopefully show more.

-**Update:** 1430- Crew completed work order to raise MH# V2-27 to eliminate inflow. May leave meter number 1394 in MH# V2-7 to monitor possible effects this may have on this string.

Date: 5/19/11

Time: 1540

Crew Members: Brian and Brandon

-Downloaded all 4 units after heavy rain occurrence. Found evidence of surcharge in V2-7 with no SSO.

-Site V3-36 again showed spiking during rain occurrence, but no larger than what was noted in last journal entry.

-Site V2-2 shows an infiltration problem, spiking at almost 300 gpm. May indicate a problem in the lines or the manholes themselves.

-Site V2-7 still shows an inflow problem. Manhole repair at V2-27 did not reduce flow in line.

-Site V2-10 also still shows an inflow problem.

Date: 5/23/11

Time: 1113

Crew: Dane, Brian, and Scott

-Downloaded and moved meter numbers 1392 and 1393

-Meter number 1392 was placed in V2-44, line from V2-67. This line had very little flow and may not give a clear baseline, but should show information needed if there is I & I in this string.

-Meter number 1393 was placed in V3-42, line from V3-47.

-Site V3-36 showed spiking during last rain occurrence with slow recession after indicating an infiltration problem. Old laterals from removed trailers are suspected.

-Site V2-2 again showed spiking though the amount was not as high as previous problems. This may show the correlation between amounts of rain fall during each individual occurrence. This may also prove the bad or corrupted data theory (i.e. dirty sensor, or high debris flow).

-Thunderstorms prevented the other two meters from being moved.

-**Update:** After Rain crew returned to move meter 1394 to V2-19.21

Date: 5/26/11

Time: 1530

Crew: Brian and Brandon

-Downloaded data from all 4 units. Saw spiking in 3 of the units.

-Site V2-44.67 showed no spiking during any rain occurrences.

-Conclusion drawn at site V2-44.67: no I and I has been seen in this string. We will move to line running to Manhole #45.

-Site V3-42.47 shows a combination of Inflow and Infiltration from this string. We will be moving this meter to the line coming from manhole #43 but we believe that all the I and I is coming from this string.

-Site V2-19.21 also shows a combination of Inflow and Infiltration coming from the Vichy Road and Vessels strings. This eliminates the line coming from V2-20.

-Conclusion drawn at site V2-19.21: Spiking indicates the problem is further up the string. We will be moving the meter to V2-21 to determine which string has the problem, starting with the string from across Interstate 44.

-Site V2-14.15 confirms that there is a problem in the String running to Sooter Inn. We will be moving this meter up this string to isolate the problem.

-Conclusion drawn at site V2-14.15: Spiking indicates an inflow problem in this string. Recommend moving this meter to V2-18.

Update: Crew inspected cleanout in Sooter Inn parking lot and found the cap sitting on top the cleanout. A work order will be filled out as there needs to be some concrete saw cut and removed so the cap will fit and seal correctly.

Date: 5/31/11

Time: 1249

Crew: Brian

-Downloaded all 4 meters

-Site V2-44.67 still does not show any spiking during rain events. There was a big spike on Sunday May the 29th, but there was no rain occurrence at that time.

-Conclusion drawn at site V2-44.67: No spiking was seen at this site. We will be moving meter #1392 to line running from MH# 45.

-Site V3-42.47 showed spiking during rain occurrences on both Friday and Saturday, although some spiking occurred throughout the entire weekend.

-Conclusion drawn at site V3-42.47: I & I spiking has been seen again at this site. I will be moving this meter to the other incoming line to eliminate the string from MH# 43.

-Site V2-19.21 shows minor spiking during both rain occurrences. However there are even larger spikes outside these rain events during peak usage hours. Regardless, I & I spikes are shown on the graphs so further investigation is needed.

-Conclusion drawn at site V2-19.21: Spiking during rain events indicates there in an inflow problem in these strings. I will be moving meter #1394 to manhole 21 to locate which string has the inflow problem.

-Site V2-14.15 also shows minor spiking during Friday and Saturdays rain events. Though they are sharp spikes, I think this may be an infiltration given the time of rise compared to when the actual event began. Another possibility is that it may indicate, that if it is inflow, the distance from the meters current site where the problem may be. Either way, further investigation is needed and we will be moving the meter further up this string.

-Conclusion drawn at site V2-14.15: Minor spiking shows that a problem does exist in this string, however the amount shown further downstream does not account for the total problem. We will be moving the meter into the line coming from MH# 51 to isolate where the biggest problem is.

Date: 6/2/11

Time: 1644

Crew: Brian

-Downloaded all 4 meters. No rain occurrences since last download.

Date: 6/20/11

Time: 1130

Crew: Brian, Dane, and Bob

-Downloaded and moved/reset all four meters.

-Meter #1392 still did not show any spiking during any rain event. Meter was moved to line running from MH# V2-45.

-Meter #1393 showed minor spiking during all rain occurrences, with a combination of inflow and infiltration. We moved this meter to line running from MH# 43 to eliminate this string.

-Meter #1394 showed a wide variety of spiking during all rain occurrences. We moved this meter to MH# 21, line running from MH# 25 to study the string that crosses I 44.

-Meter #1395 showed a heavy inflow problem coupled with a with a lesser infiltration problem. Sharp rises and falls then dropping to a slower decrease indicates these problems. The meter was then moved into line running from MH# 51 to study this string.

Date: 6/23/11

Time: 0940

Crew: Brian

-Downloaded all four units

-Site V3-42.43 showed small spiking during the rain event on Tuesday the 21st. Graphing shows small spikes with slow decrease indicating infiltration. This hypothesis is supported by the slight increase in velocity meaning that the water getting into the line is meeting some resistance.

-Conclusion drawn at V3-42.43: An infiltration problem is indicated and, being that this string still supports a few residences, further study is needed. We may walk these lines and open manholes to see if the water may be getting into the manholes themselves. Also the residences themselves need to be investigated to see which ones are actually being used or are even still there. This may allow us to cut off any unused lines. Any cleanouts that can be found need to be inspected and notice given to proper authorities for repair.

-Site V2-44.45 shows spiking, although sporadic during this rain event. Although data strings show very sharp spikes.

-Conclusion drawn at V2-44.45: Inflow is a definite problem in this string. We also walk this string to check manholes and cleanouts. I also will fill out a work order to have the line running downstream to V2-2 televised.

-Site V2-21.25 shows major spiking during this rain event and indicates that it is an inflow problem with a little infiltration. It also may be showing a line holding water. This string will definitely need to be televised to find the problem in this instance.

-Conclusion drawn at V2-21.25: Infiltration is indicated and further study is needed to locate the source of the extra water.

-Site V2-14.51 also showed sporadic spiking during this rain event. Inflow is the definite problem. However the sporadic peaks indicate this may be a low manhole. Also the highest amount of gpm was only 8, so this may just be a lid not seated or sealed right. This string may also need to be walked and inspected to ascertain the problem. Also the manholes in the parking lots of the businesses along 63 will need to be inspected.

-Conclusion drawn at V2-14.51: Minor sharp spikes indicate a minor inflow problem. Inspection of manhole lids and height is recommended.

-6/27/11 Update: The line from V2-2 to V2-44 was televised on 6/23/11 and no problems were found.

Date: 6/28/11

Time: 1230

Crew: Brian

-Downloaded meters

-Site V2-44.45 shows inflow spiking during the heavier rain events. Lighter rain does not seem to show up. However the flow in this line seems to have bottomed out during non event times. Total flow does not seem to account for all of the flow seen in V2-2 so I will be filling out a work order to check for illegal connections. I will also fill out a work order to have this string checked at manholes. I will also recommend that we smoke test for illegal connections.

-Conclusion drawn at V2-44.45: Inflow is evident in this string although the lack of flow, I believe, does not account for all the flow in V2-2. Meaning there is still a problem in the line to V2-2.

-Site V3-42.43 shows infiltration in this string. I will fill out a work order to smoke test this string looking for possible breaks in these lines and for possible broken laterals. I don't believe there would be any illegal connections (i.e. gutter hookups or footer drains) but these need to checked for. GIS aerial photos show that there may be a line that can be cut off because of no residences needing a connection. This line is V3-45 to V3-46.

Conclusion drawn at V3-42.43: Infiltration being the evident problem, we will need to smoke test and televise this string to see where the water is getting in at. We also need to check for any possible inflow to closeout testing on this string.

-Site V2-21.25 shows a combination problem, with a majority of it being inflow, especially during heavier rain events. Further study is needed up this string. I plan on moving this meter to the south side of I 44 to MH#28 to see if I can eliminate MH# 26 and 27 around the pond that is in the area of these two manholes. Also I plan on walking the lines behind Vessels and the other businesses along I 44 to check for any signs of problems there.

-Conclusion drawn at V2-21.25: With a combination problem I plan on eliminating the inflow first since it is the worst of the two. Further study is needed and I also need to monitor the line running from 21 to 22 to see if there is any problems in that string before I remove the meter from this manhole.

-Site V2-14.51 shows inflow during heavy rain and sporadic infiltration during most rain. Both are a minor problem. I need to check manholes in parking lots behind the businesses along 63. Also the off road manholes need to be checked to make sure they are above ground and not taking on water themselves. I also need to check the businesses along 63 for cleanouts and make sure they are properly sealed. This string is all PVC pipe with most using standard ring and lids so I don't believe that there will be many problems with the pipe and very few problems with the ring and lids themselves. I do need to make sure that the rings are sealed correctly and that those that don't have the standards are not the lids with the vents on them.

-Conclusion drawn at V2-14.51: Although there is not a lot of I and I in this string, minor problems do exist and I believe that with some physical inspection I can eliminate further study using the flow meters from this string. However I will not move until I can do my physical inspection.

Progress Report

- Narrowed String from V3-42 to 43. Infiltration need to smoke to find cracks. Also possible cut offs in this string.
- Isolated problems in V2-44 to 45 string. Shows inflow, but does not seem account for total flow found @ V2-2
- Found combination of I&I in string crossing under I44 to Vessels etc.. Going to move meter across highway to eliminate the pond leaking in line. Need to check lines running up to Vichy Rd Also
- Found minor I&I in both strings running thru V2-14, Line to V2-51 is minor inflow with V2-15 being a combination problem. Inflow is larger problem.

1 V3-36 to V3-38

2 V2-2 to V2-44

3 V2-44 to V2-67

4 V2-44 to V2-45

5 V3-54 to V3-55

6 V1-3 to V1-4

7 V2-40 to V2-41

8 V3-36 to V3-38 (second study)

9 V3-42 to V3-47

10 V3-42 to V3-43

11 V1-35 to V1-36

12 V2-1 to V2-2

13 V2-7 to V2-8

14 V2-19 to V2-21

15 V2-21 to V2-25

16 V2-21 to V2-22

17 V1-17 to V1-17

18 V2-10 to V2-11

19 V2-14 to V2-15

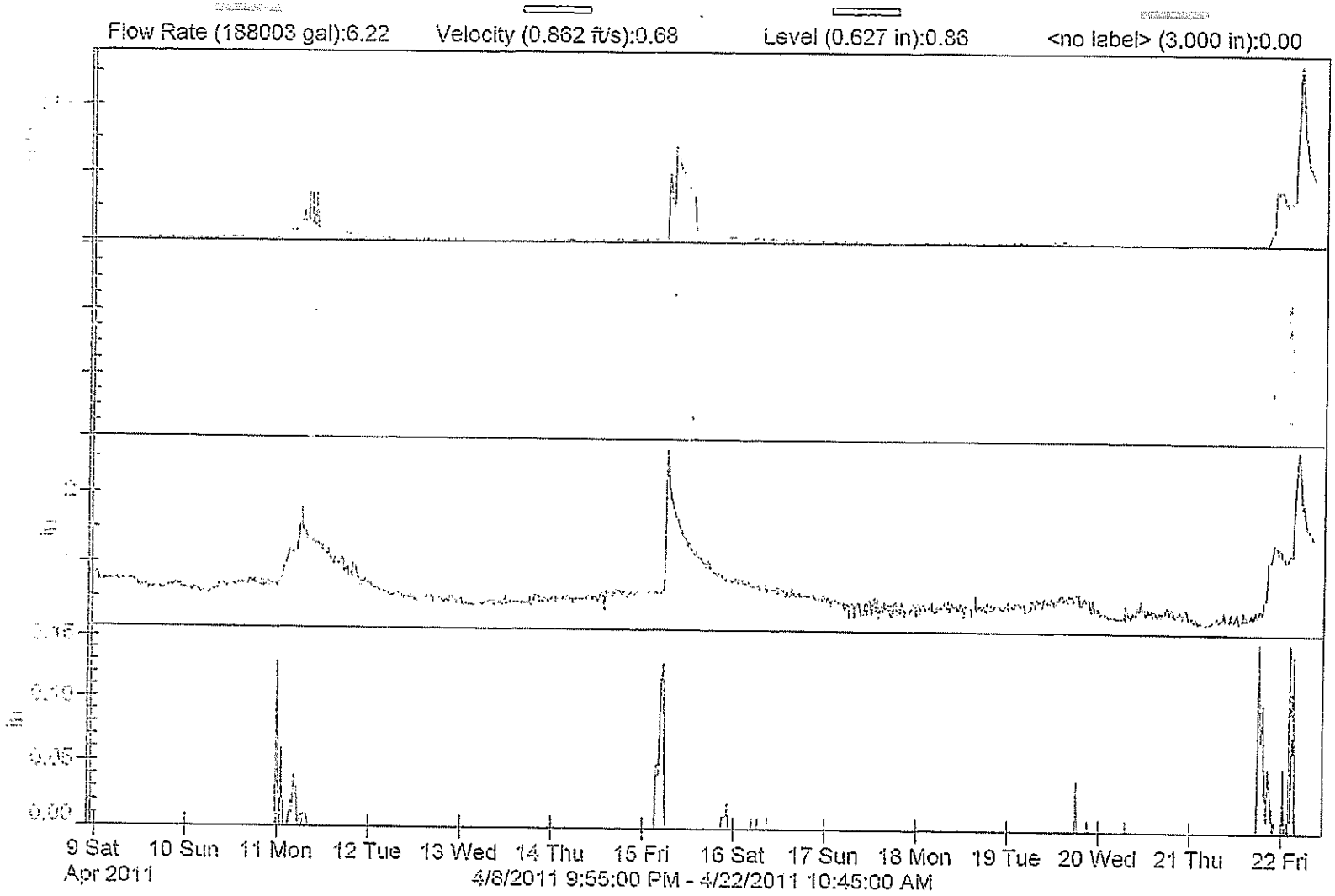
20 V2-14 to V2-51

21 V2-27 to V2-28

22 For manhole data, see attached sheets.

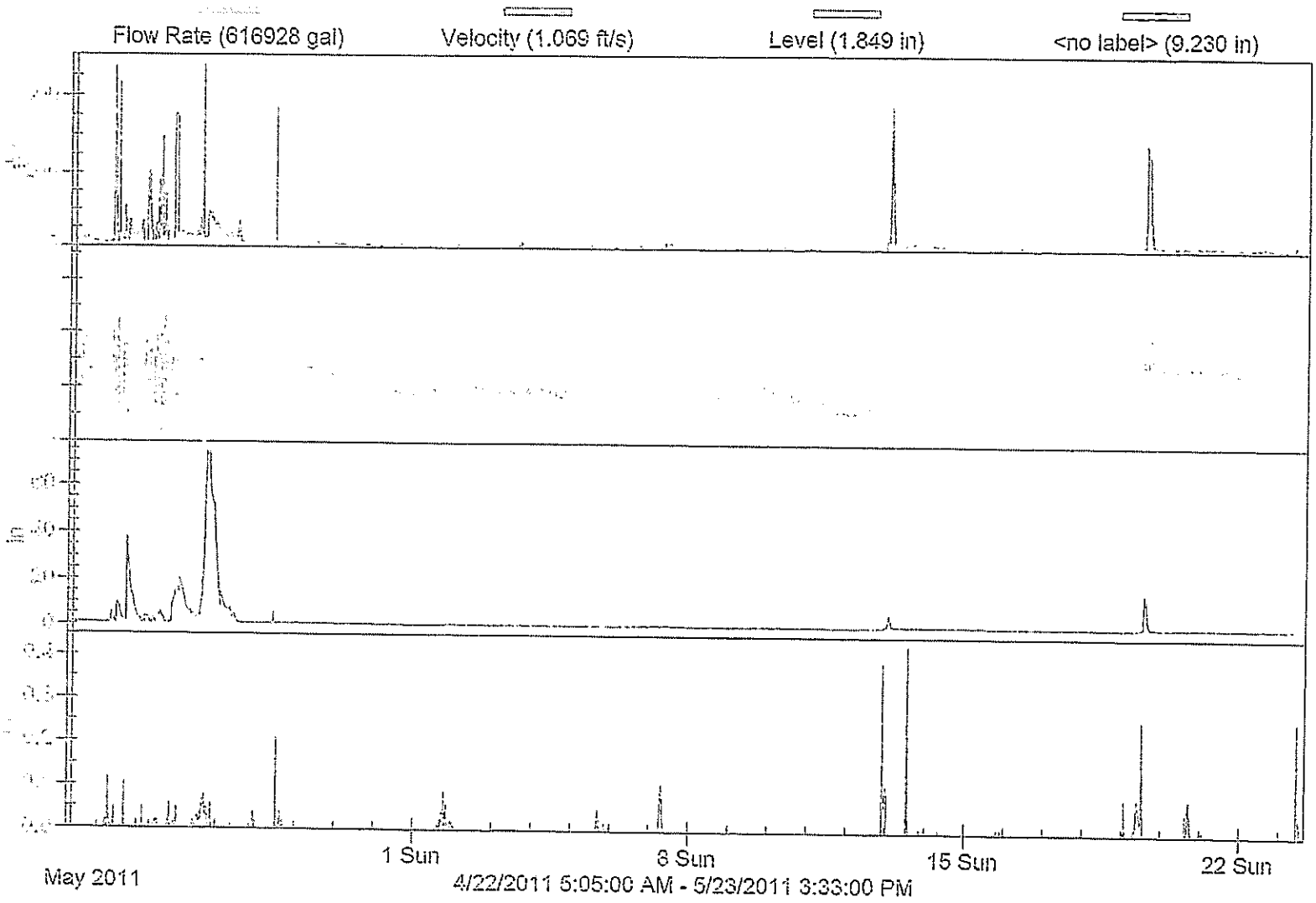
v3-36

Daily Level, Velocity & Flow Rate Graph



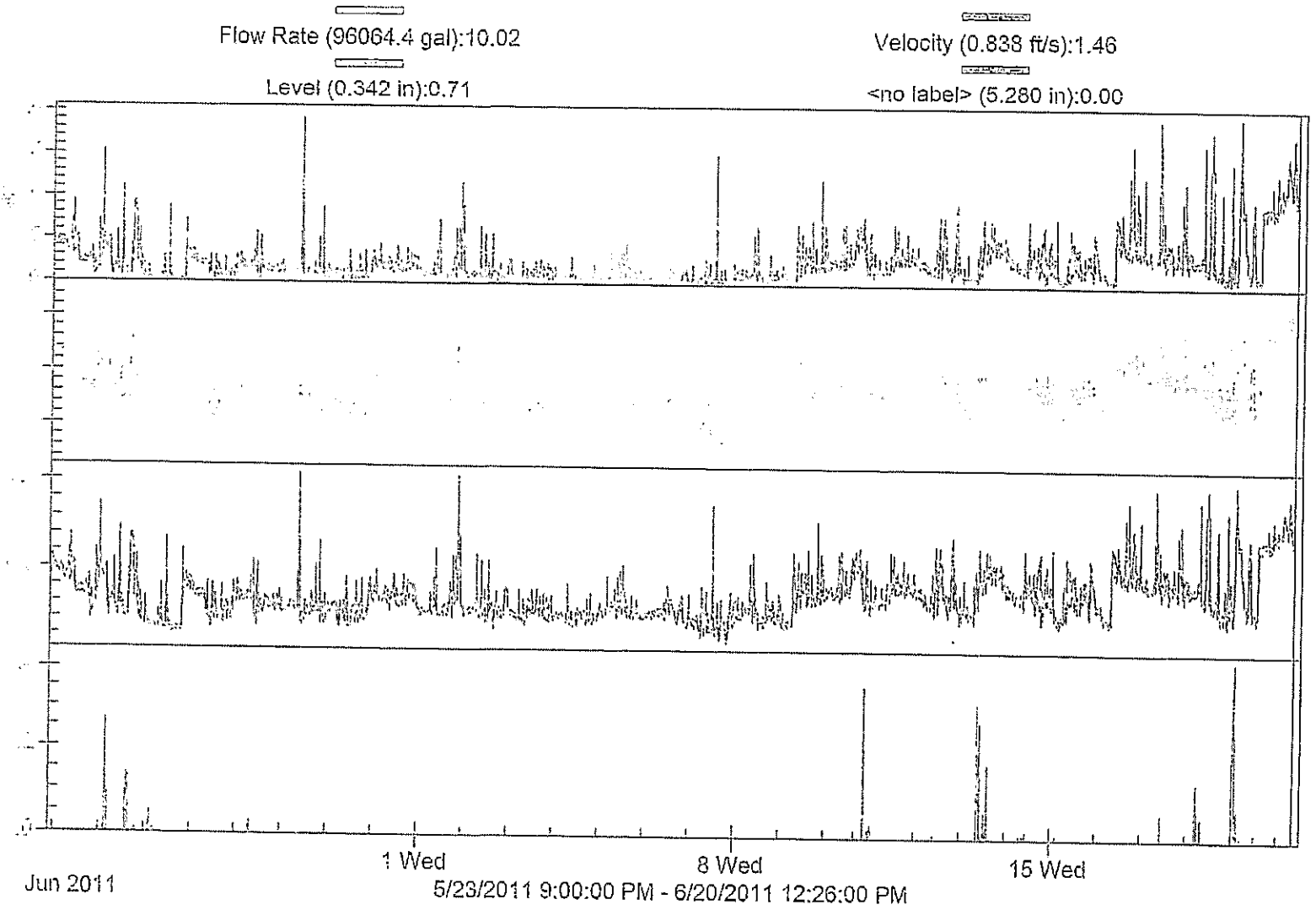
v2-2

Daily Level, Velocity & Flow Rate Graph



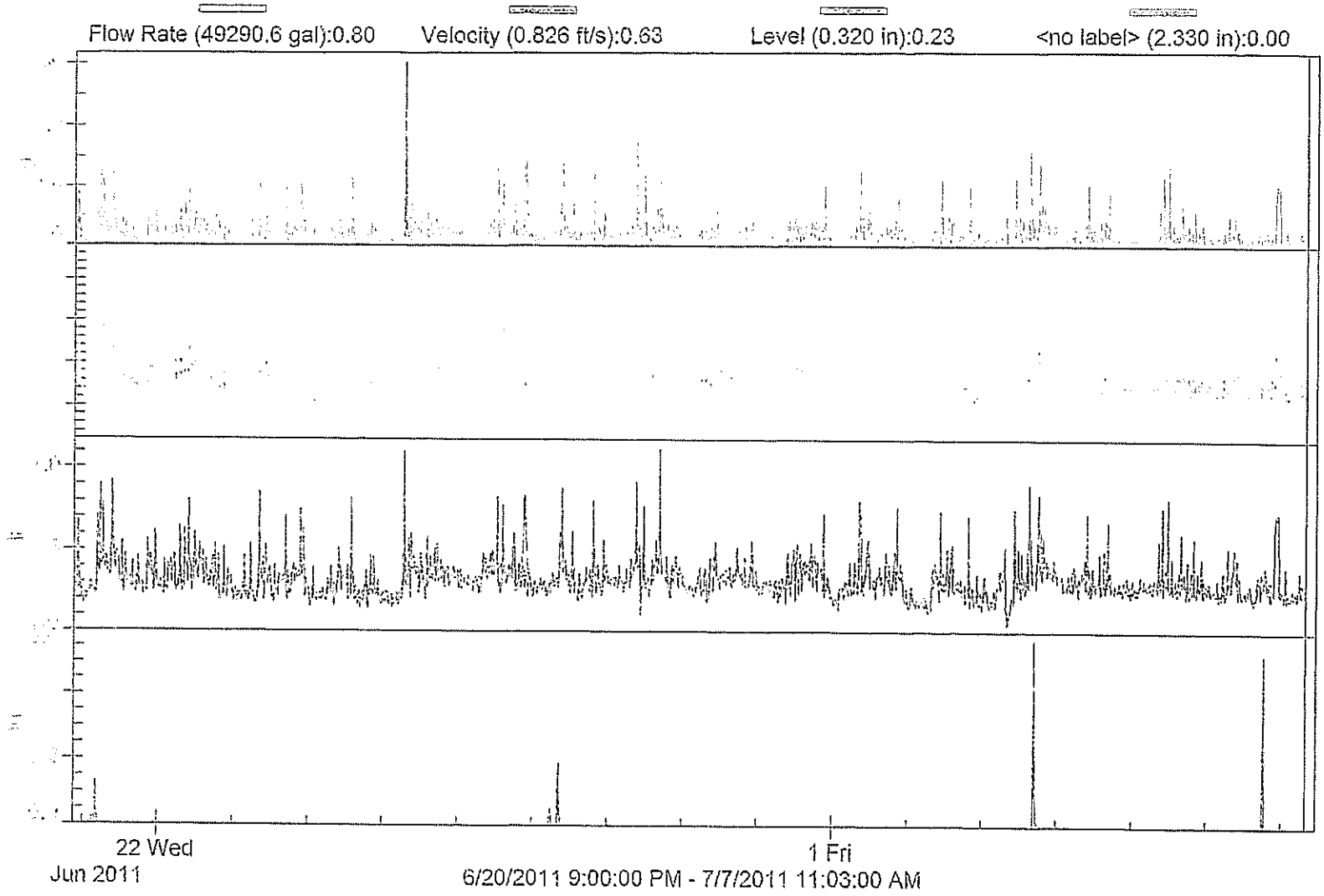
V2-44.67

Daily Level, Velocity & Flow Rate Graph



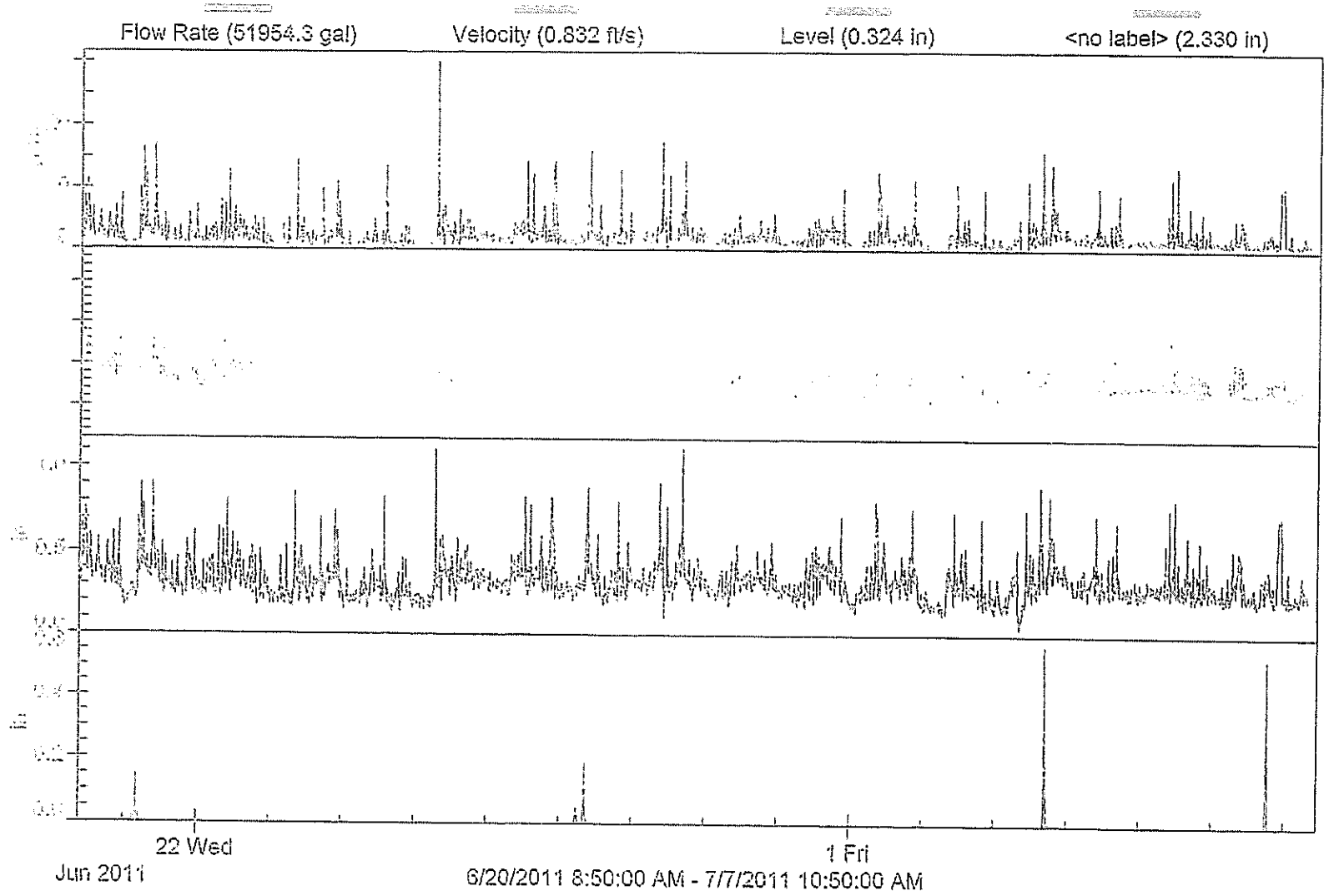
v2-44.45

Daily Level, Velocity & Flow Rate Graph



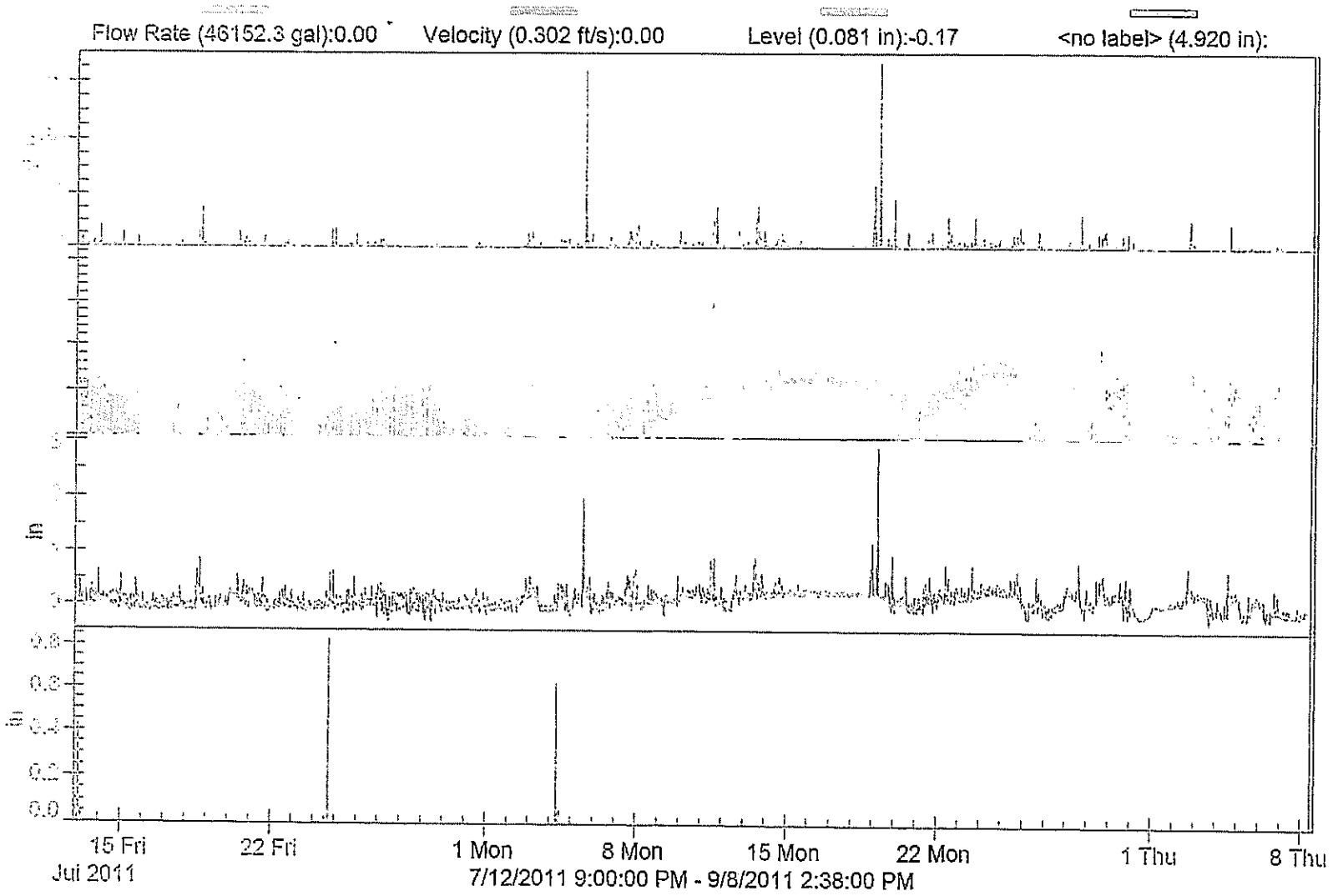
v2-44.45

Daily Level, Velocity & Flow Rate Graph



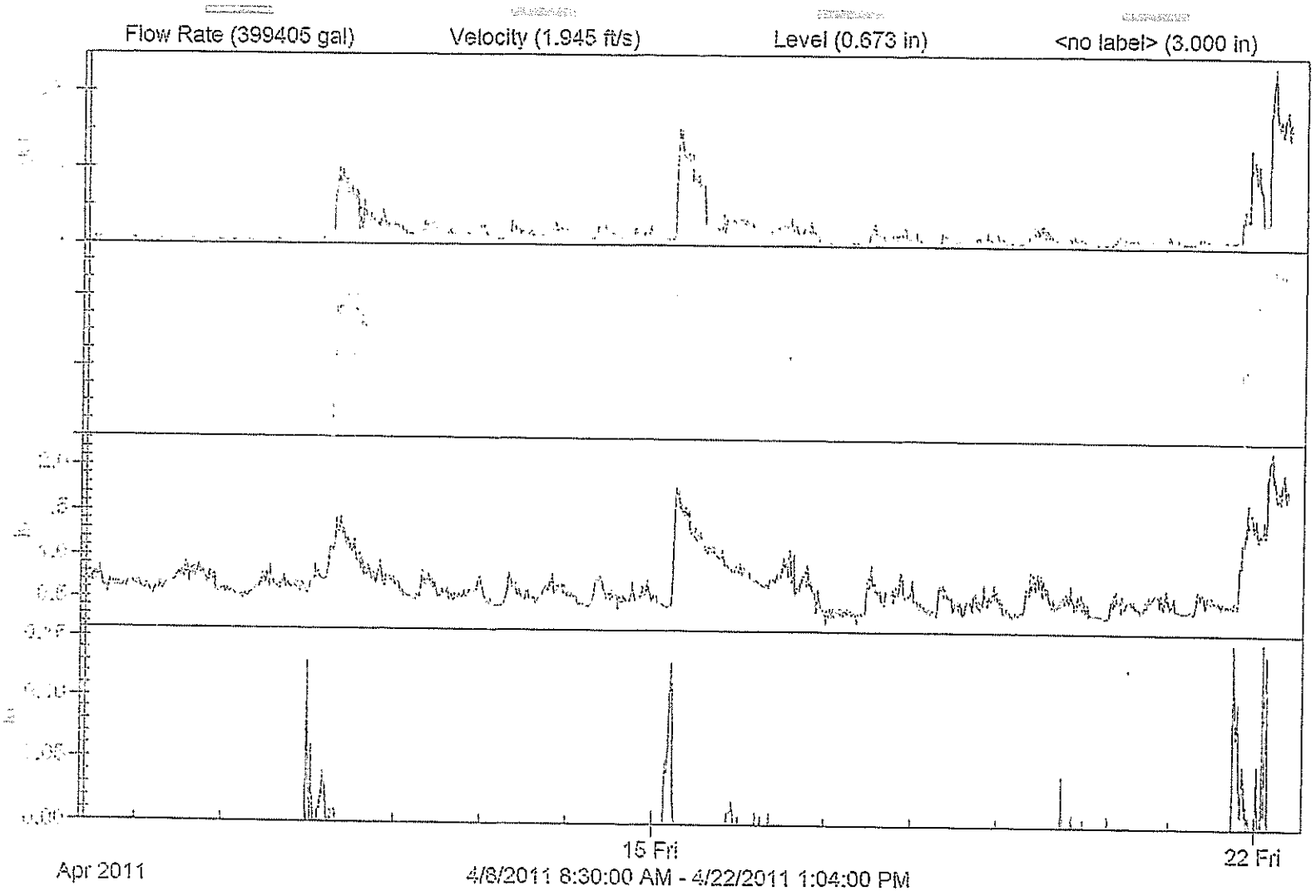
V3-54.55

Daily Level, Velocity & Flow Rate Graph



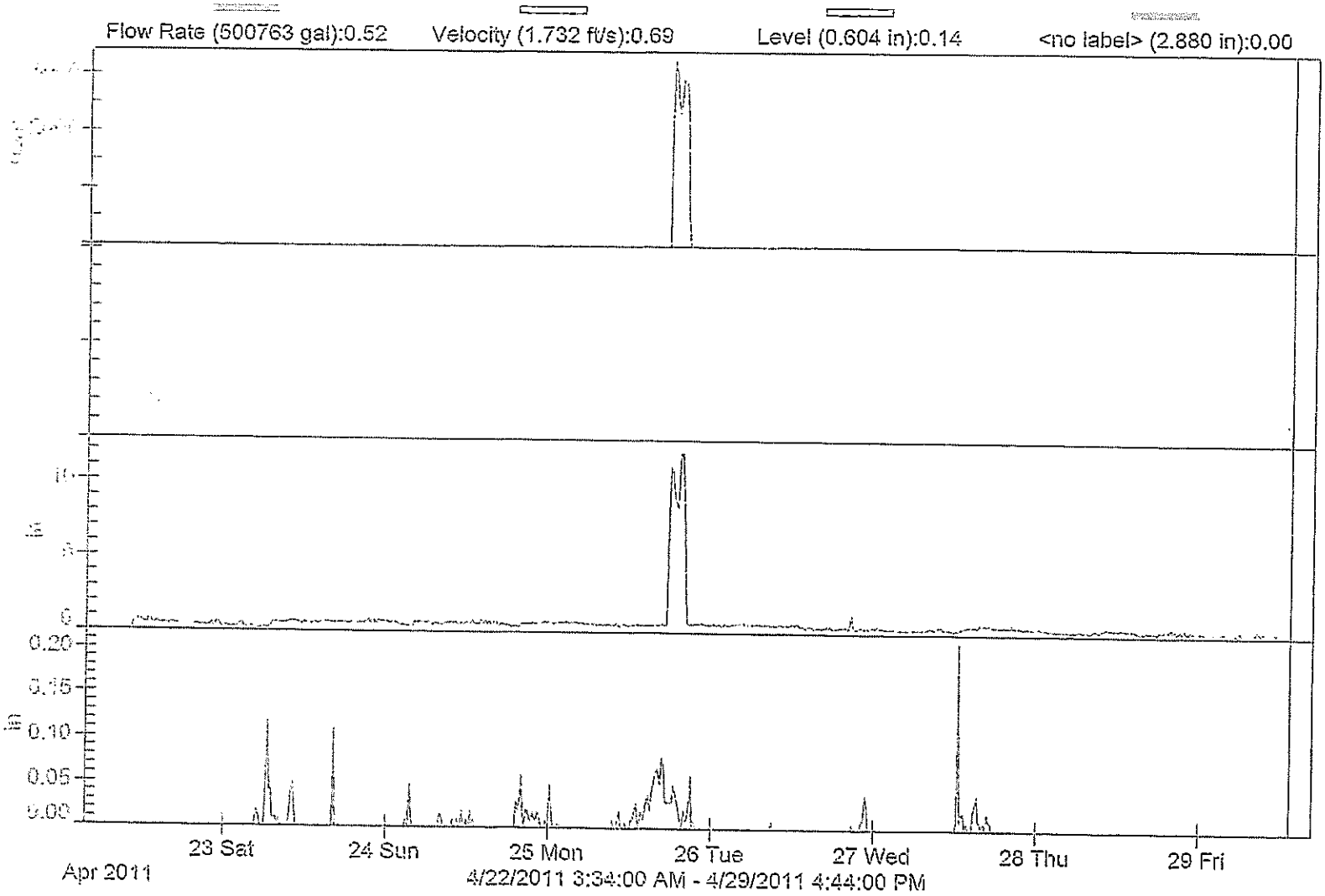
V1-3

Daily Level, Velocity & Flow Rate Graph



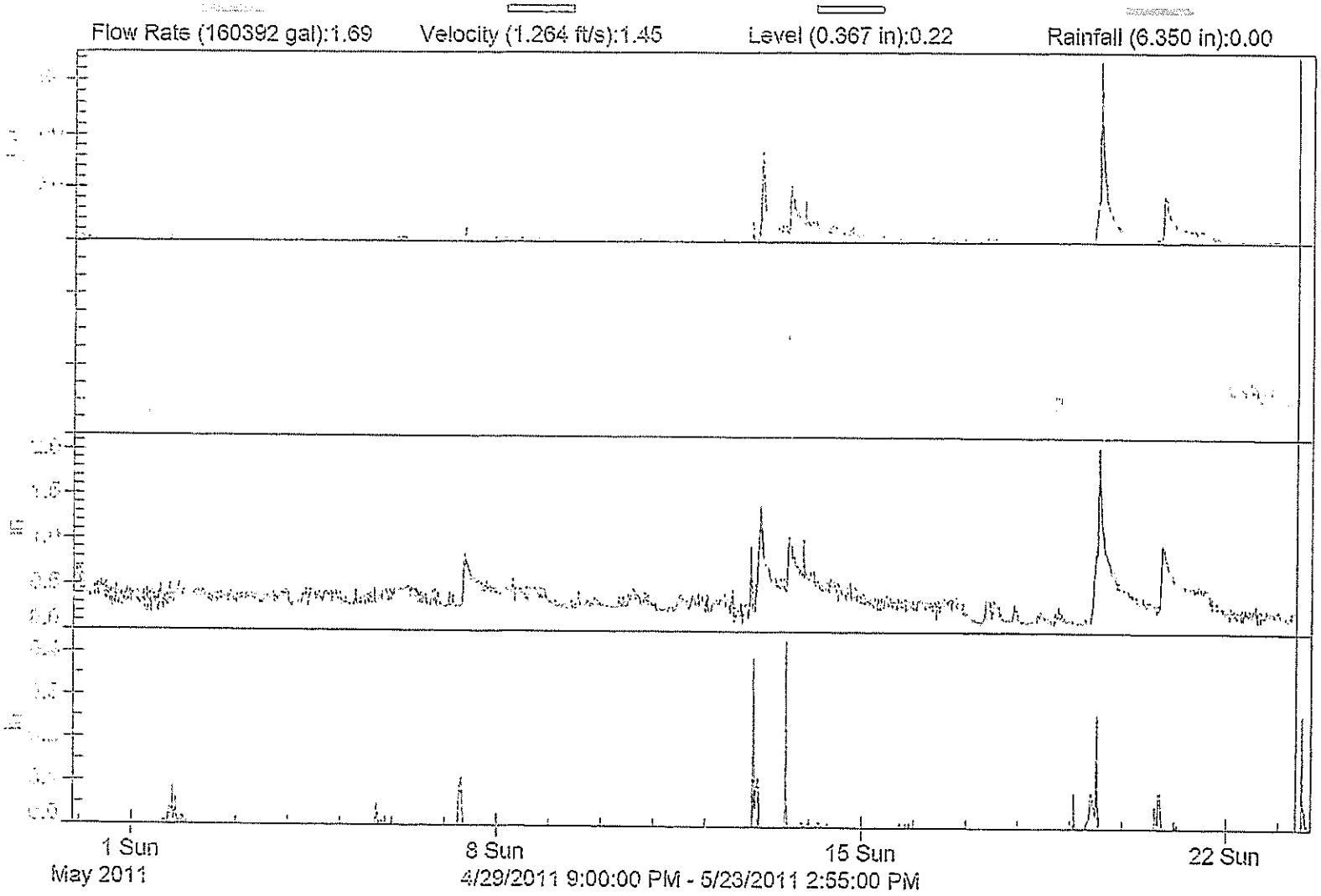
V2-40

Daily Level, Velocity & Flow Rate Graph



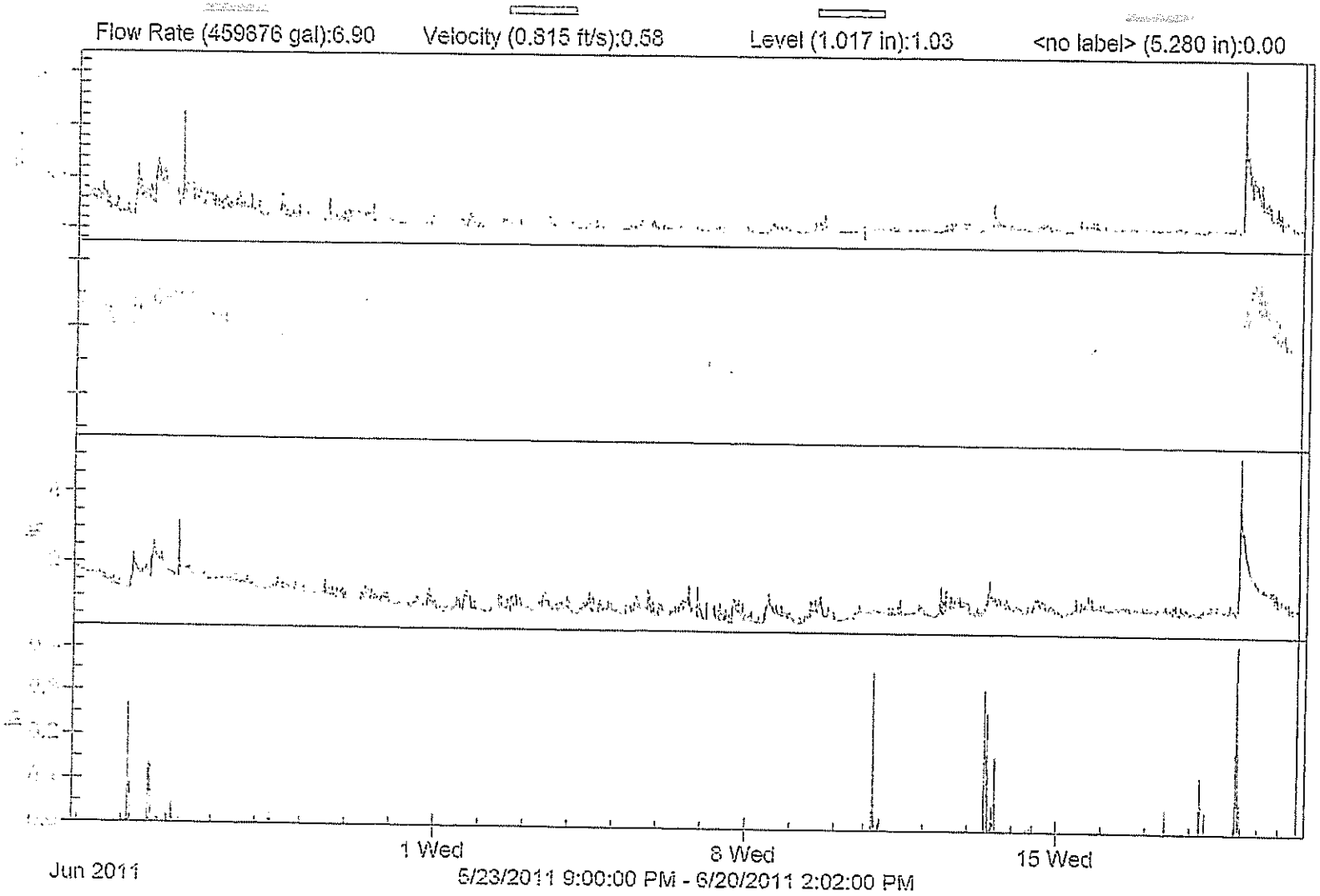
V3-36-2

Daily Level, Velocity & Flow Rate Graph



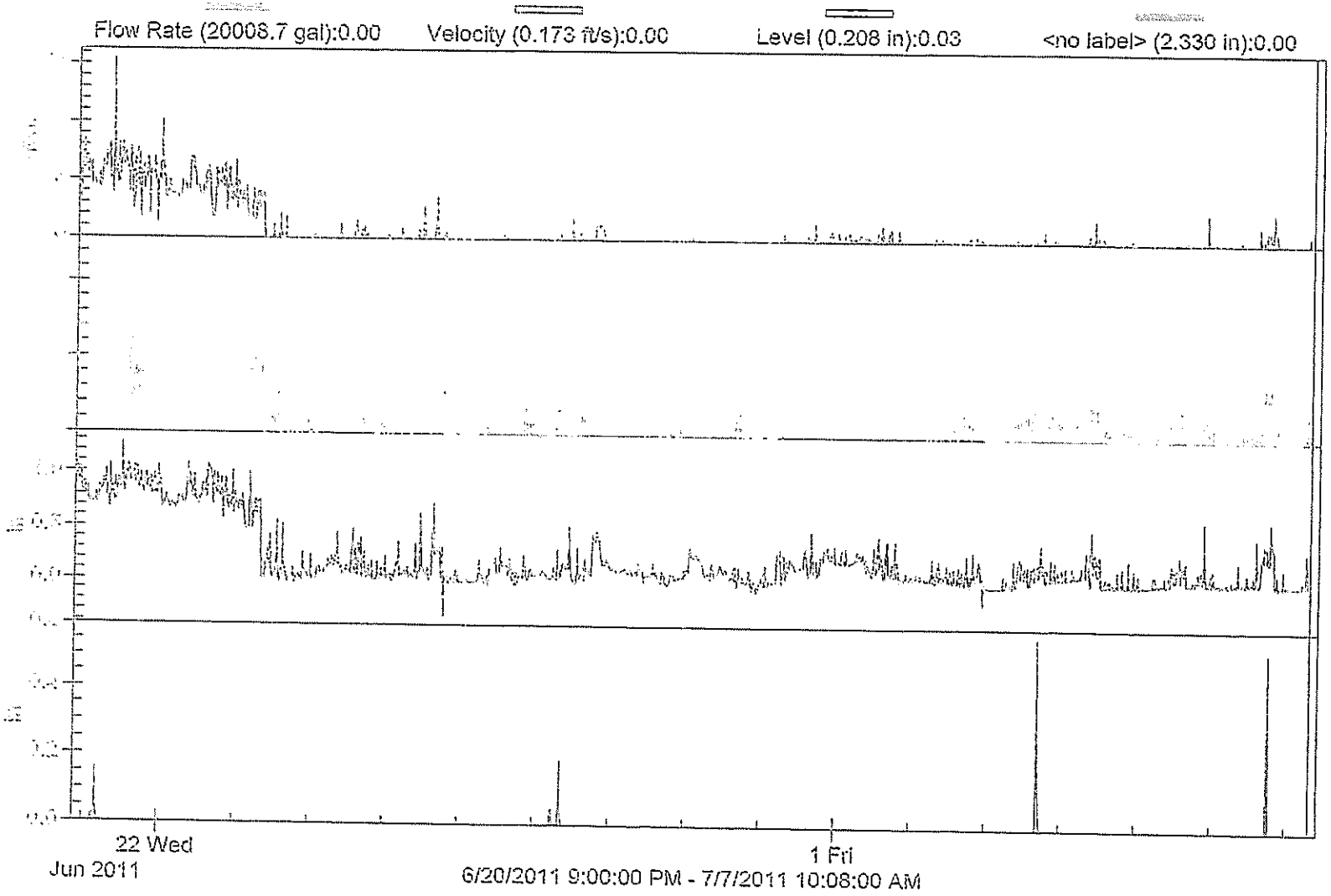
V3-42.47

Daily Level, Velocity & Flow Rate Graph



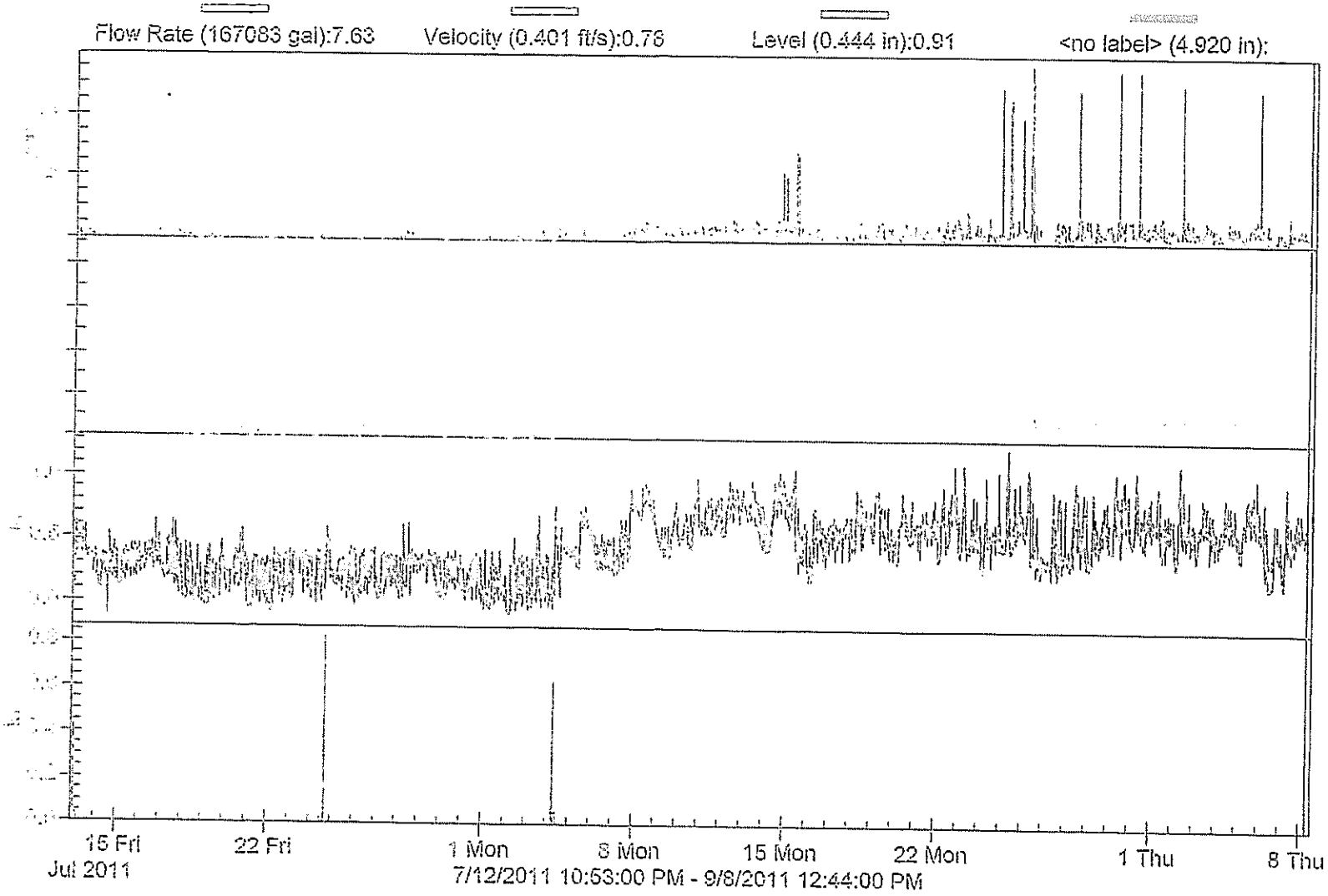
V3-42.43

Daily Level, Velocity & Flow Rate Graph



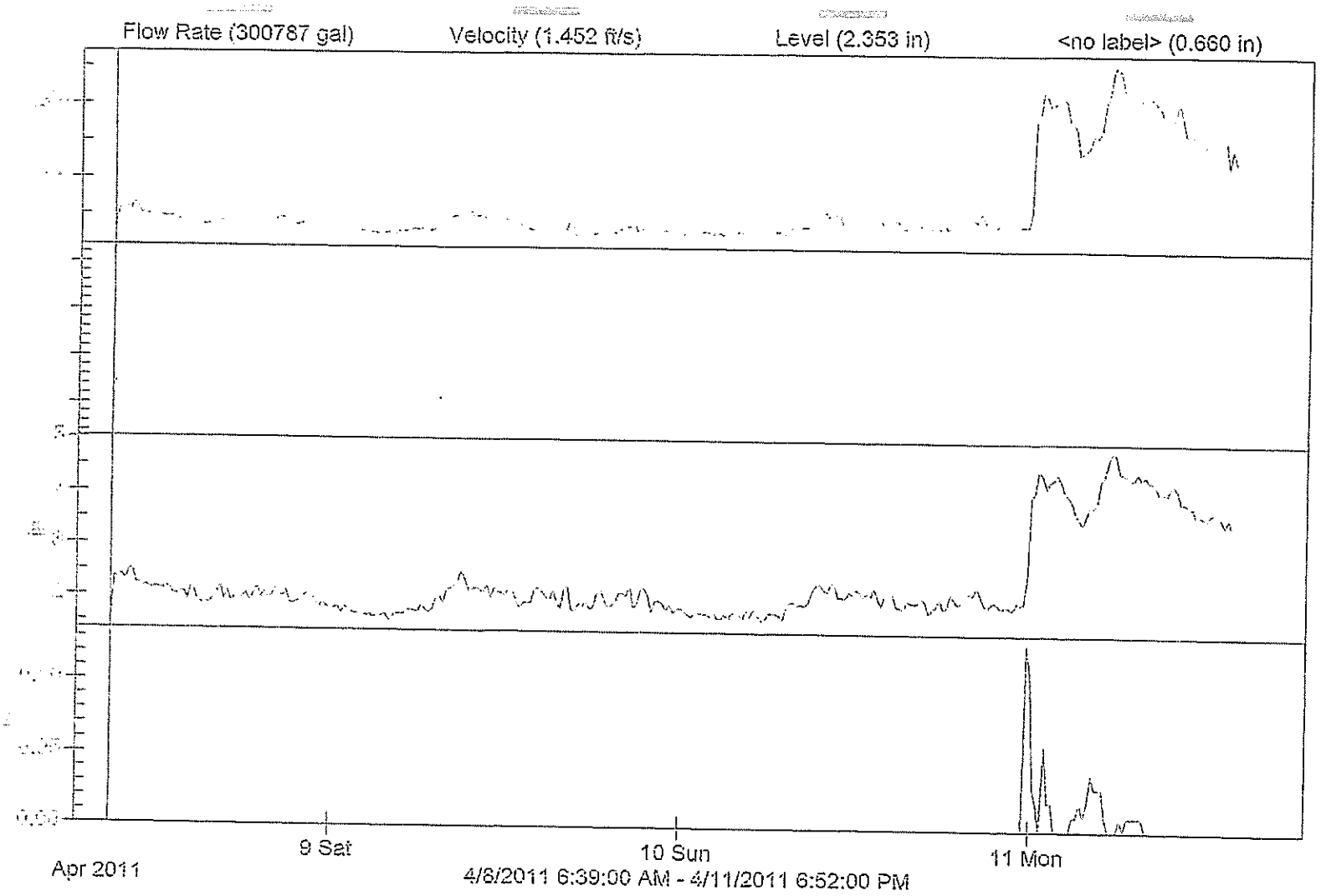
VI-35.36

Daily Level, Velocity & Flow Rate Graph



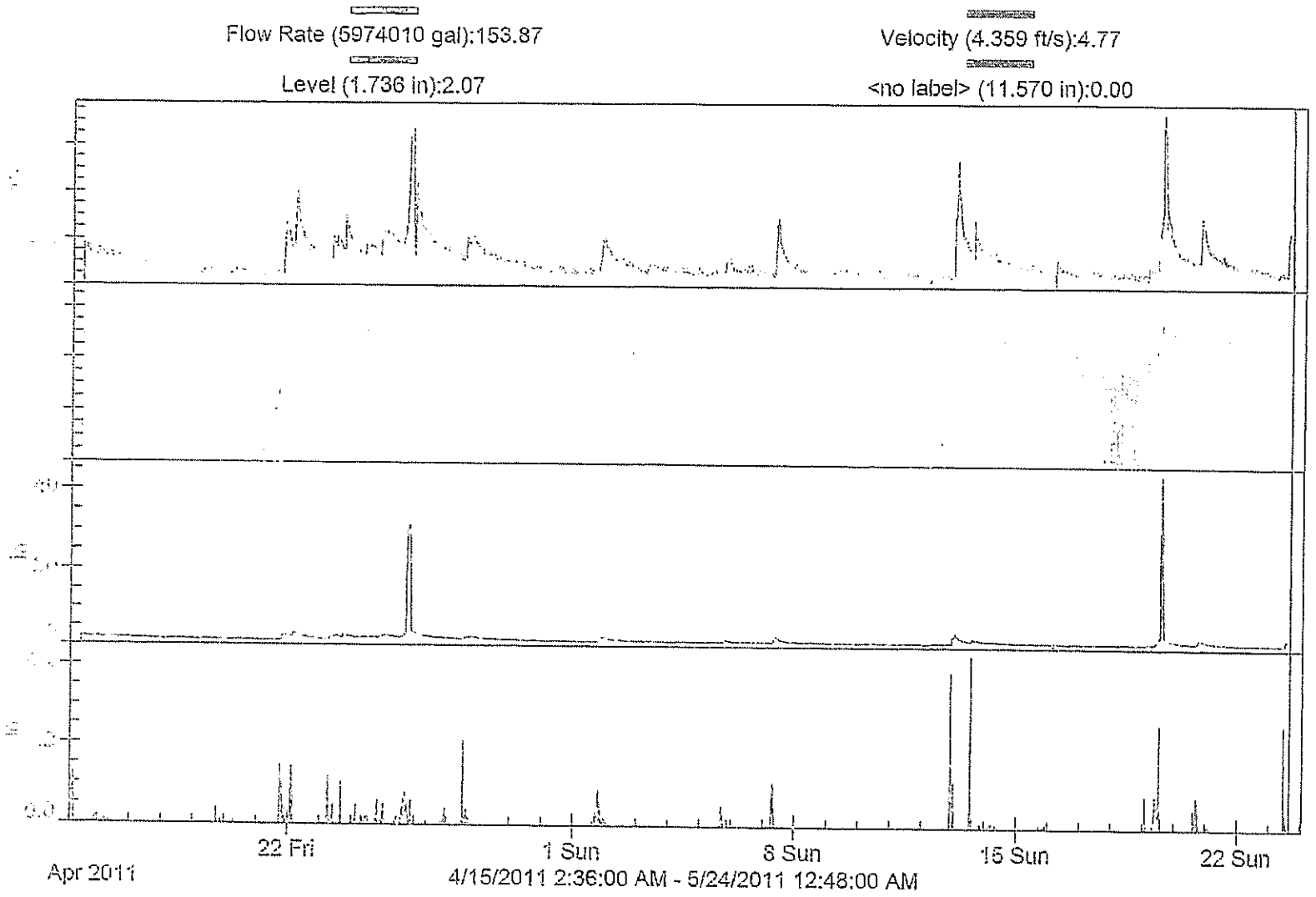
v2-1

Daily Level. Velocity & Flow Rate Graph



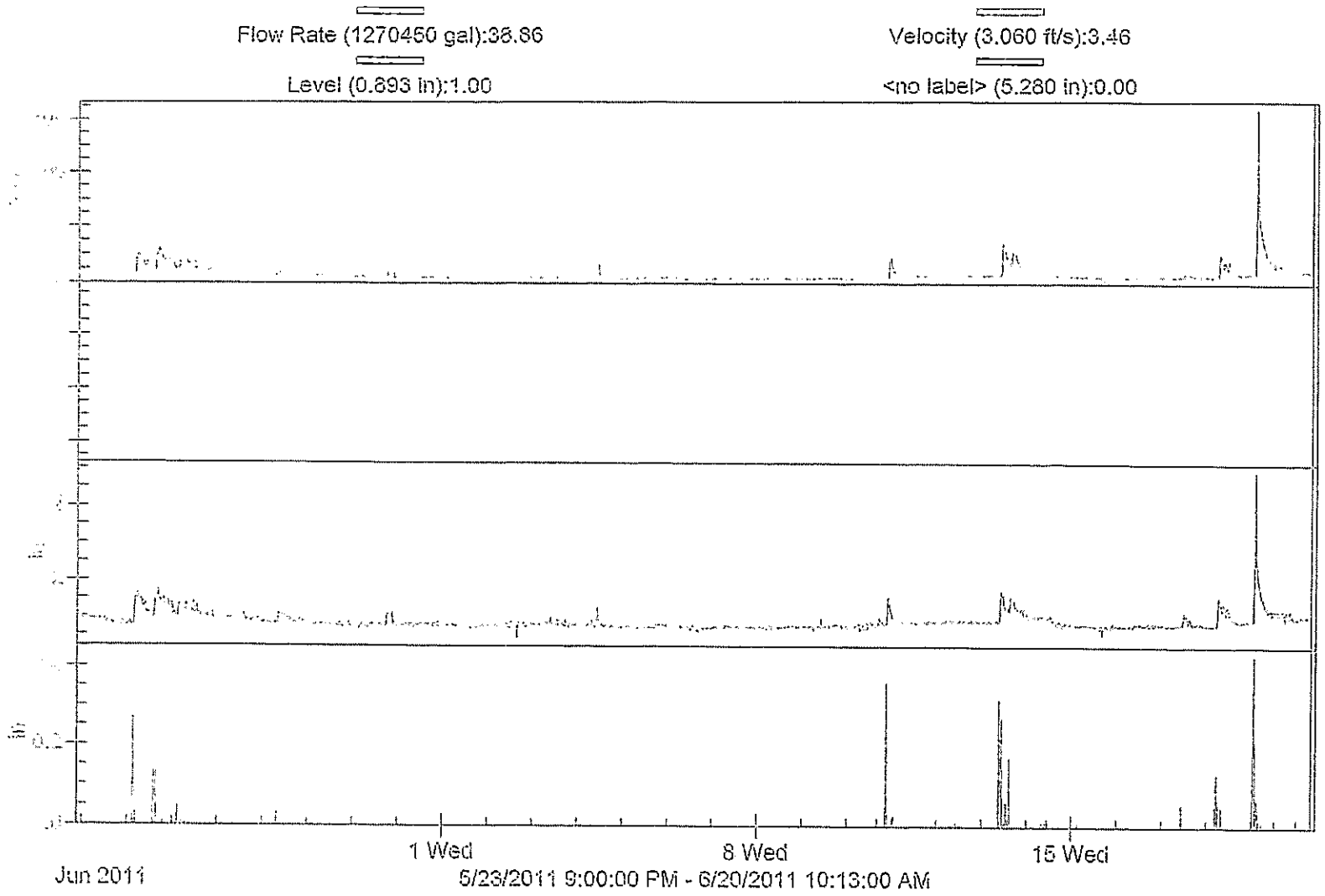
v2-7

Daily Level, Velocity & Flow Rate Graph



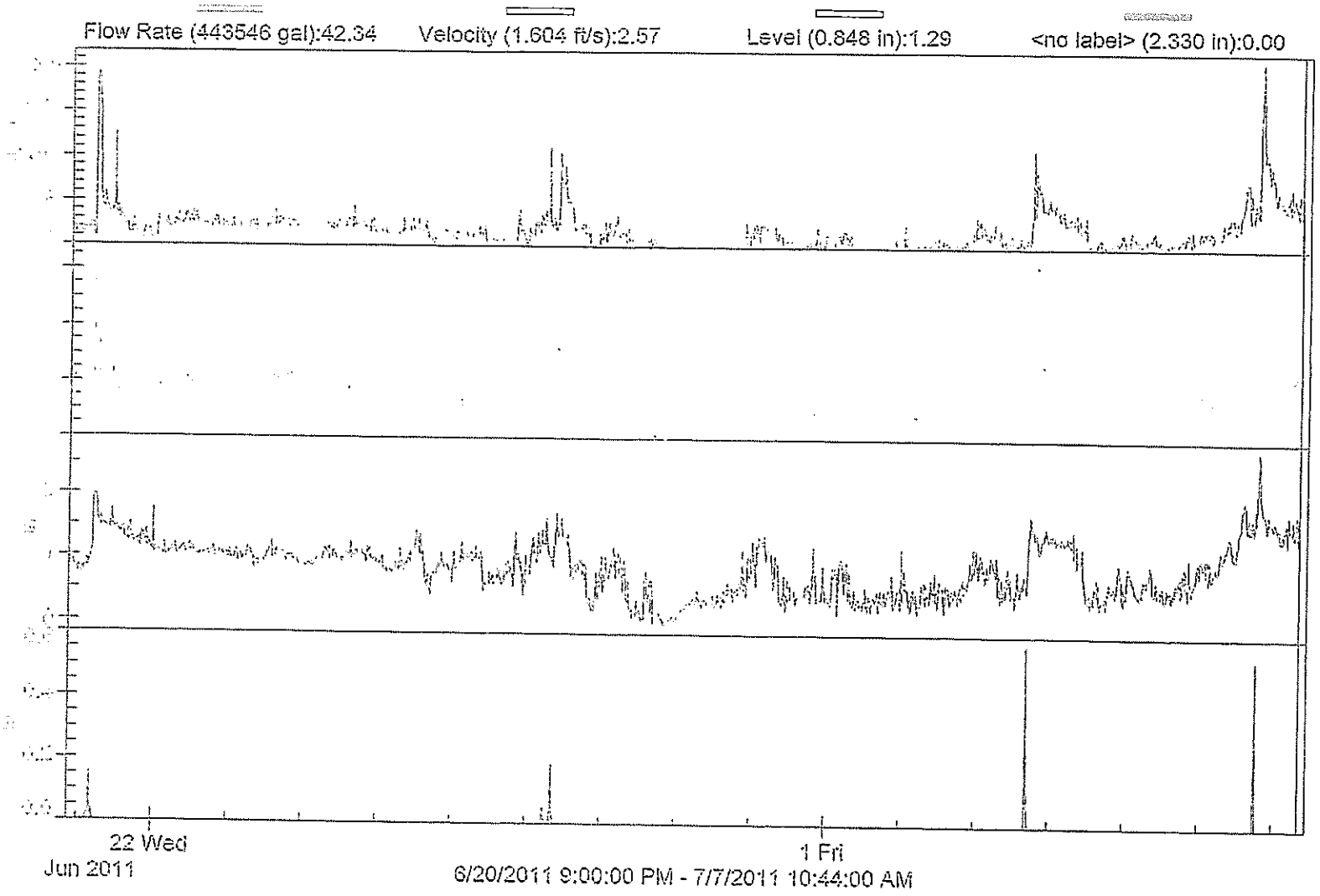
V2-19.21

Daily Level, Velocity & Flow Rate Graph



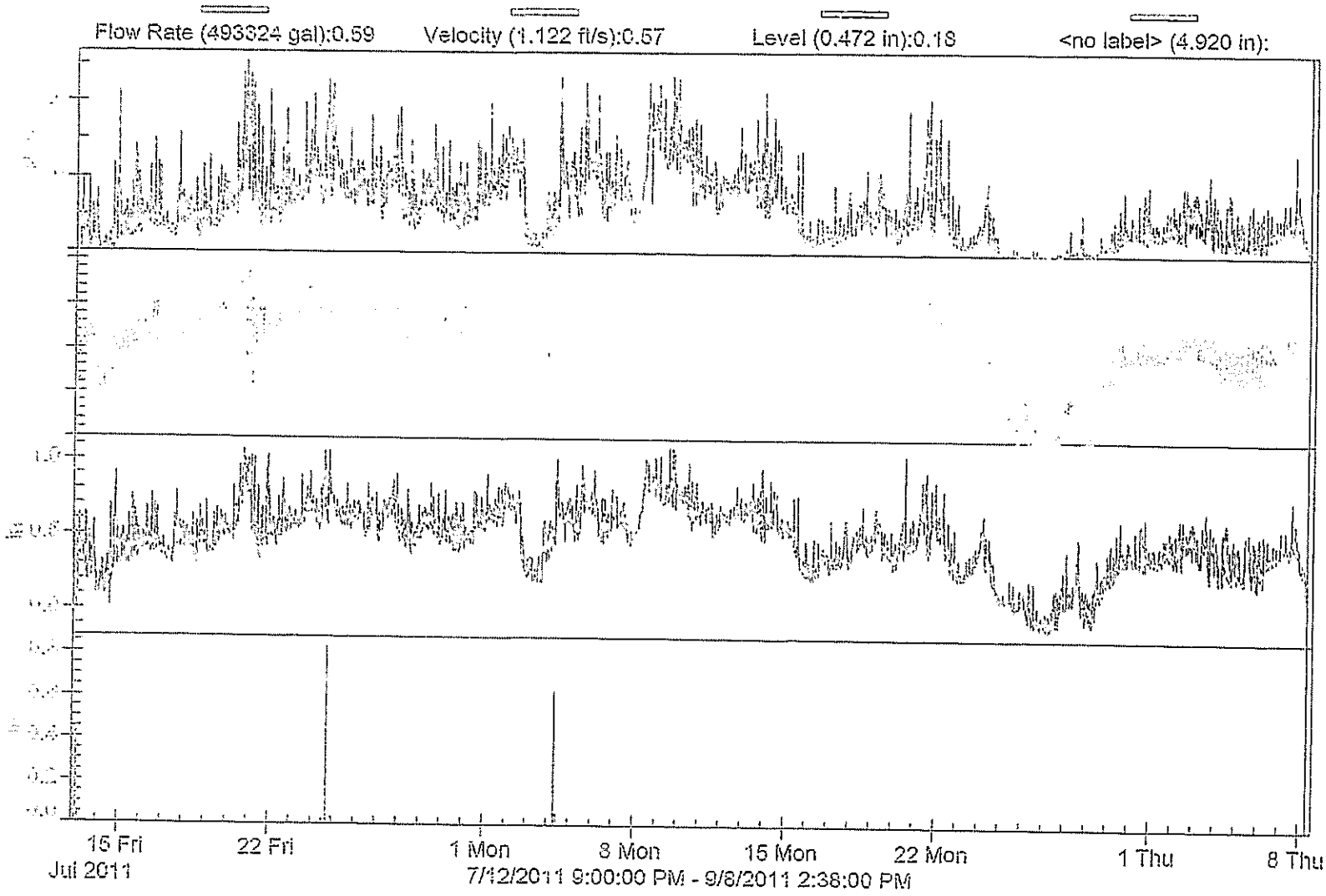
v2-21.25

Daily Level, Velocity & Flow Rate Graph



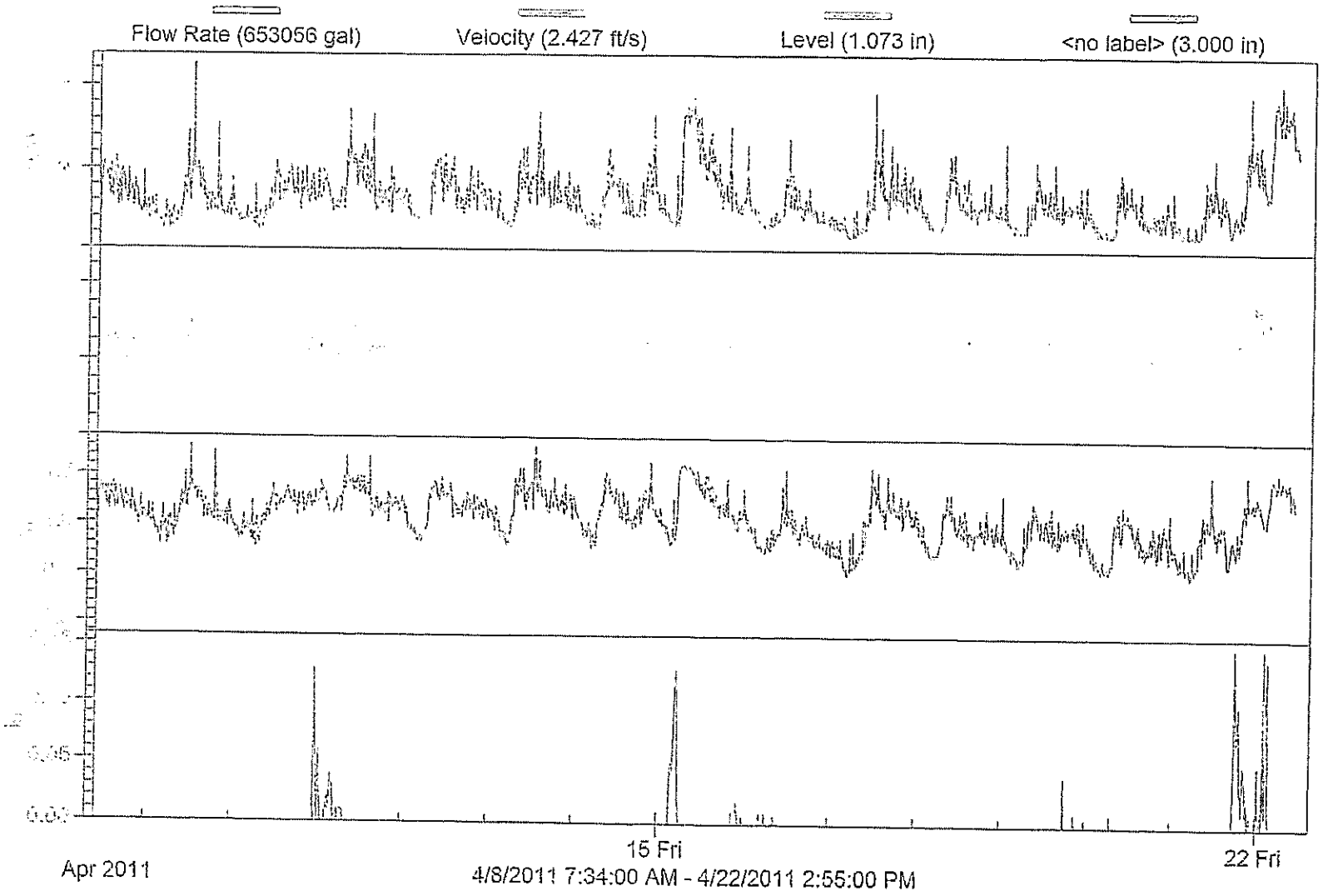
V2-21.22

Daily Level. Velocity & Flow Rate Graph



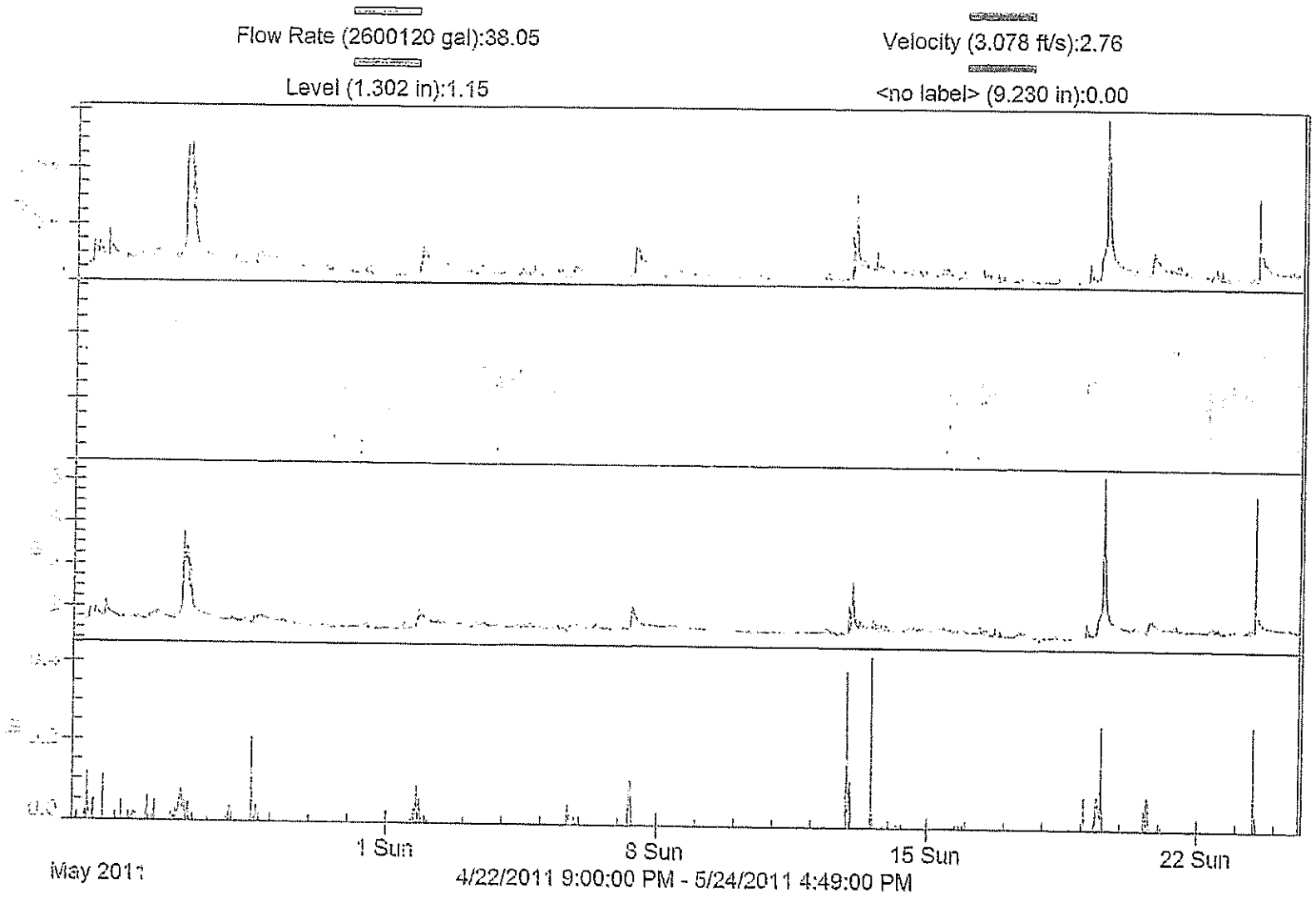
v1-17

Daily Level, Velocity & Flow Rate Graph



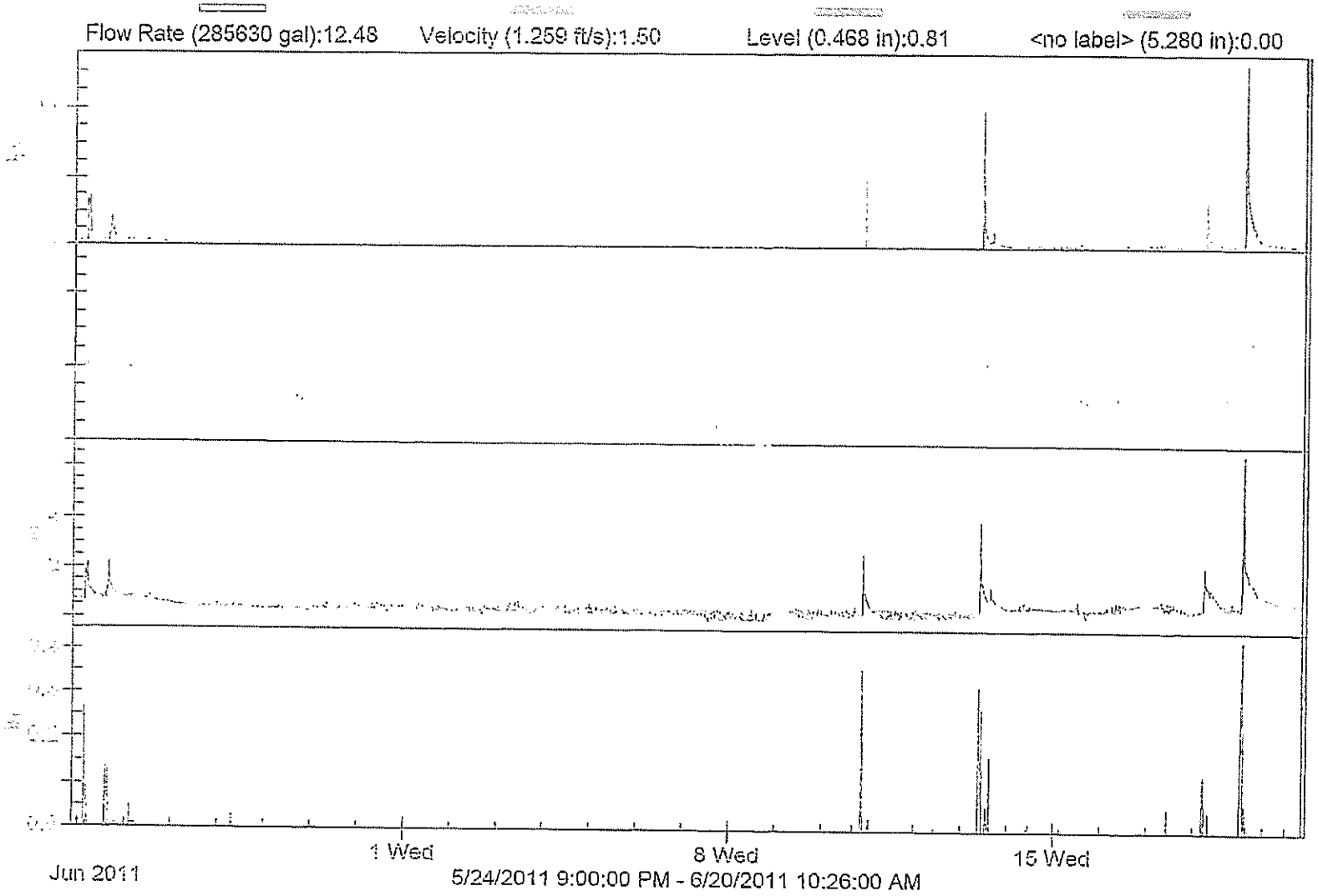
v2-10

Daily Level, Velocity & Flow Rate Graph



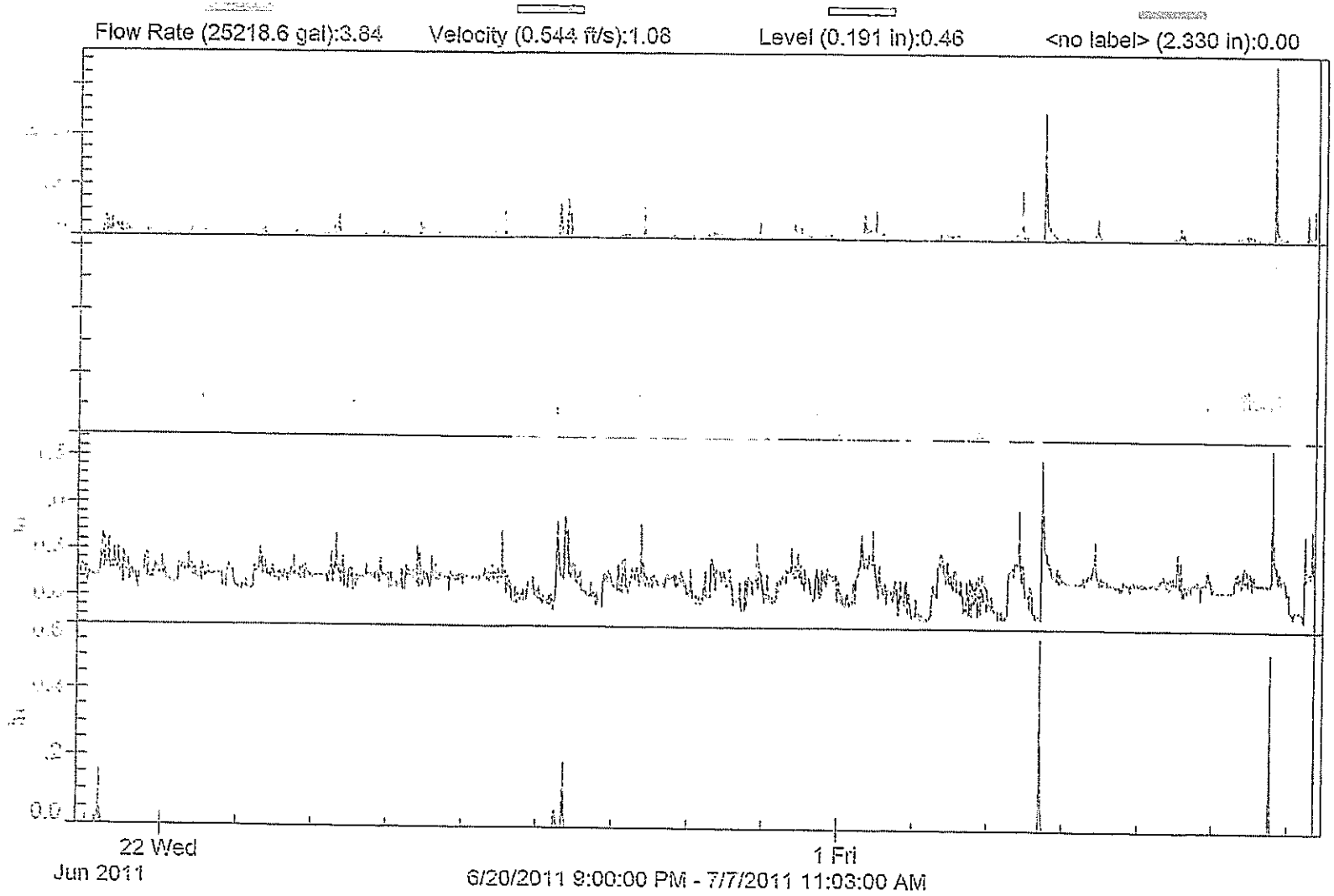
V2-14.15

Daily Level, Velocity & Flow Rate Graph



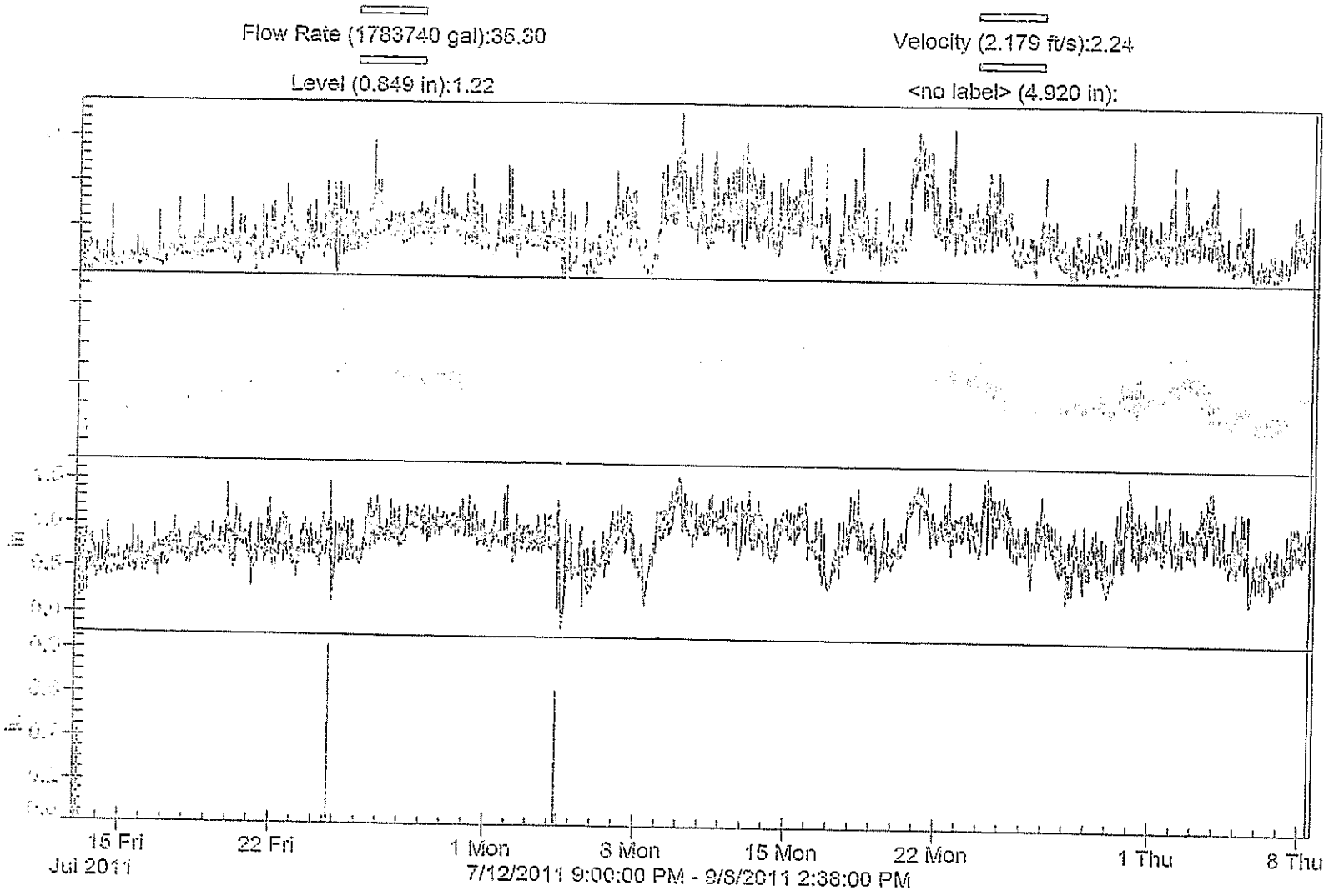
v2-14.51

Daily Level, Velocity & Flow Rate Graph



V2-27.28

Daily Level, Velocity & Flow Rate Graph



City of Rolla, Public Works
Sewer Department, Collections

Lift Stations

Date Cleaned:	7/2/10	Date Cleaned:	7/2/10
Area:	Lower 72	Area:	Upper 72
Operator:	Brian/Brandon	Operator:	Brian/Brandon
Condition:	Alot of Grease	Condition:	Alot of Grease
Date Cleaned:	7/2/10	Date Cleaned:	7/2/10
Area:	Shady-Little Oaks Rd	Area:	Basswood
Operator:	Brian/Brandon	Operator:	Brian/Brandon
Condition:	OK	Condition:	OK
Date Cleaned:	7/2/10	Date Cleaned:	7/6/10
Area:	Wellington	Area:	Cedar Grove
Operator:	Brian/Brandon	Operator:	Brian/Brandon
Condition:	OK	Condition:	OK
Date Cleaned:	7/6/10	Date Cleaned:	7/6/10
Area:	Kensington	Area:	Hy Point
Operator:	Brian/Brandon	Operator:	Brian/Brandon
Condition:	OK	Condition:	OK
Date Cleaned:	7/6/10	Date Cleaned:	
Area:	Loves	Area:	
Operator:	Brian/Brandon	Operator:	
Condition:	OK	Condition:	

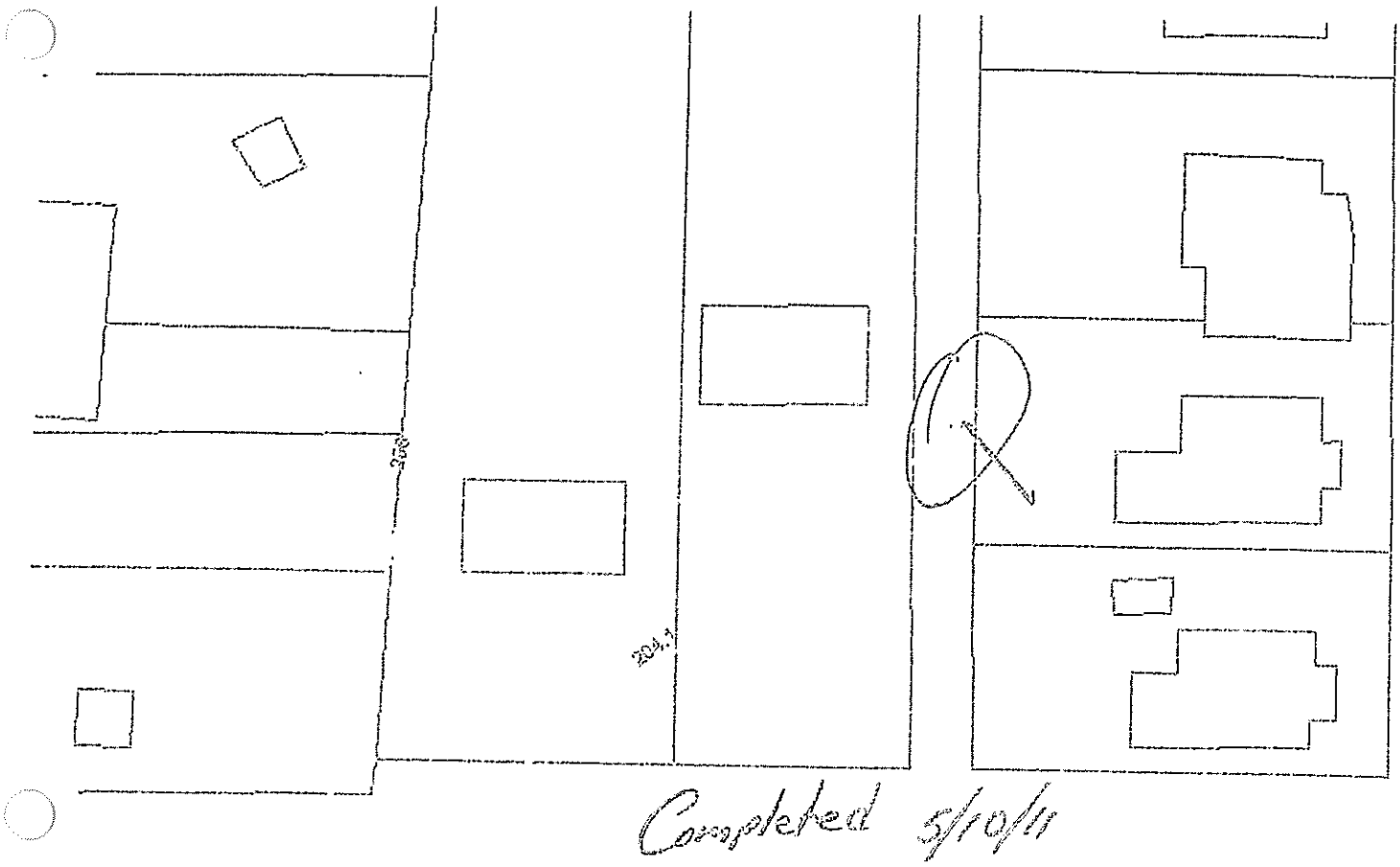
Creek Crossing Inspection

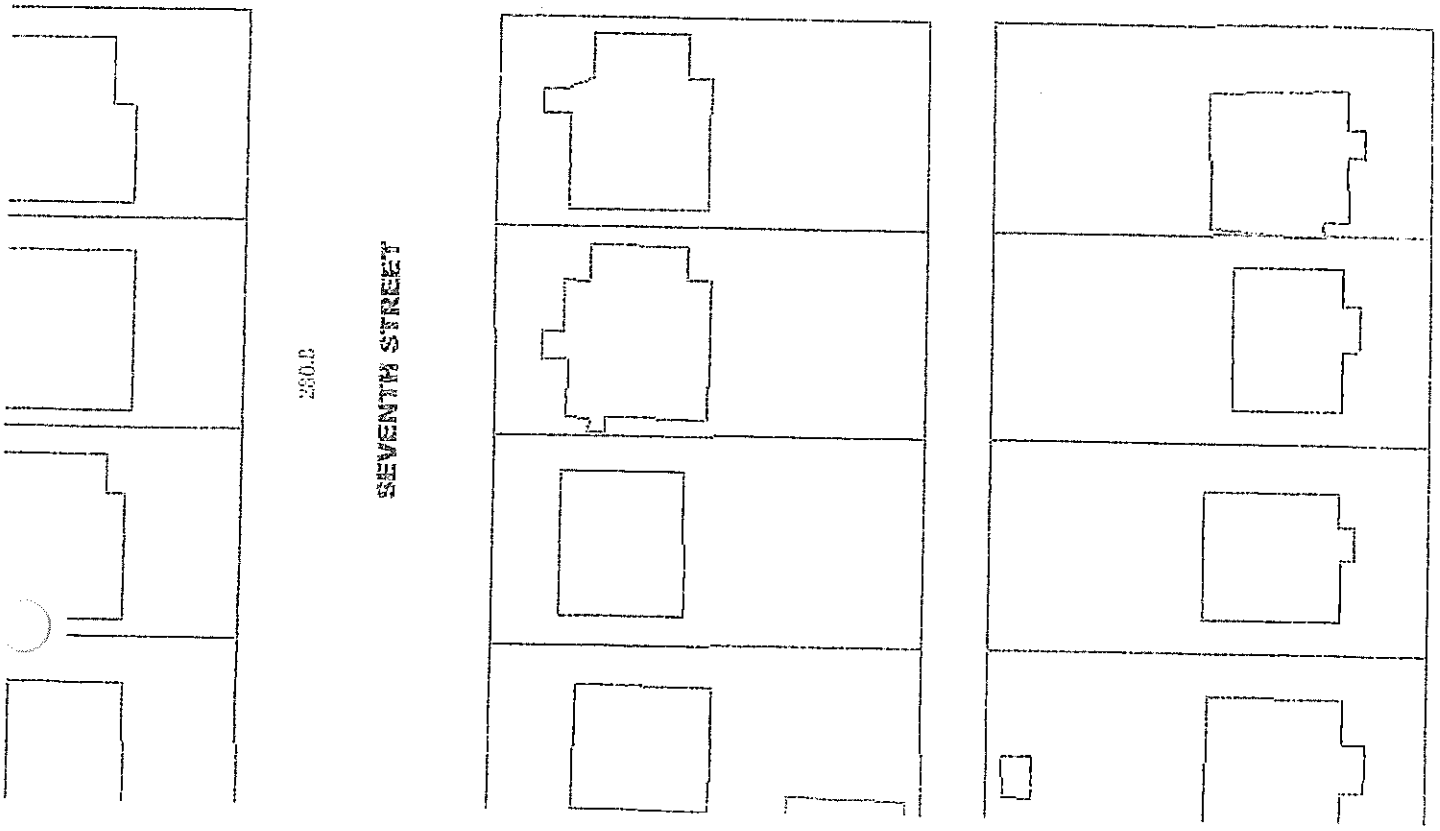
Date	Manhole #'s	Location	Dye Test	Condition	Debris	Inspector
7-12-11	LE7-30 to LE7-30A	Sheron Avenue	NO	OK	NONE	D.C. B.
"	LE7-29A to LE7-29B	Sheron Avenue	NO	washing southside	NONE	D.C. B.
"	LE4-2 to LE4-1A	Green Acres Park	NO	"	NONE	D.C. B.
"	LE6-90 to LE6-77	Behind Casey's-Hwy. 72	NO	OK	NONE	" "
"	LW6-13 to LW6-12	1st & Park	"	OK	NONE	" "
"	BN5-21A to BN5-21	Hauck & 10th St	"	"	"	" "
"	V1-18 to V1-19	Valli-Hi Detention Pond	"	"	"	" "
"	V3-19A to V2-33	Woodcrest & Vichy Rd.	"	"	"	" "
"	V3-20 to V2-1	Woodcrest & Vichy Rd.	"	"	"	" "
"	V3-28 to V3-27	Daycare - Vienna Rd.	"	"	"	" "
"	V2-19 to V2-9	Sharp Corner-Vienna Rd.	"	need concrete	"	" "
"	BN1-9 to BN1-8	Red Barn East of Twitty Dr.	"	washing out	"	" "
"	BN1-3 to BN1-4	Behind Fidelity Cable	"	"	"	" "
"	BN2-45 to BN2-108	Holt Drive	"	"	"	" "
"	BN4-87 to BN4-1	10th & Forum	"	"	"	" "
7-13-11	BN5-4 to BN5-3	Across Forum from RTI	"	OK	weeds need cut	D.C.
"	BE1-28 to BE1-29	Across Forum from Bus Barn	"	OK	"	"
"	BE2-30 to BE2-58	Suncliff	"	OK	NONE	"
7-12-11	LW6-74 to LW6-75	South End of Main St.	NO	OK	NONE	" "
7-12-11	LW6-73 to LW6-21	South End of 2nd St.	NO	OK	NONE	" "
7-13-11	BE6-36 TO BE6-37	ASHLEY DR	NO	OK	NONE	D.C.
"	BE6-67A TO BE6-68	SOEST RD	"	"	"	"
"	BE6-66 TO BE6-69	END OF COVENTRY	"	"	"	"
"	BE5-24 TO BE5-25	COVENTRY & AINTREE	"	"	"	"
"	BE3-7 TO BE3-8	WHITEHALL DR	"	OK	weeds trimmed	"
"	BE4-15A TO BE4-16	PINETREE	"	OK	NONE	"
"	BN2-57 TO BN2-56	ST JAMES RD BRIDGE@FIDELITY	"	needs trimming	NONE	"
"	LV1-79 TO LV1-10	HUNTLEIGH	"	OK	NONE	D.C. Scott
"	LE10-33 TO LE10-35	LIONS CLUB DR	"	"	"	"
"	LE10-27 TO D1-25	LIONS CLUB & ROLLA ST	"	"	"	"
"	LE10-46B TO LE10-145	RAMSEY PLACE	"	"	"	"
"	LE10-147 TO LE10-46	RAMSEY PLACE	"	"	"	"
7-13-11	LE10-322 TO LE10-321	ANN LEE DR	NO	OK	NONE	D.C. Scott
"	LE10-15 TO LE10-208	LIONS CLUB DR	"	"	"	"
"	LE10-6 TO LE10-299	TURKEY RUN & LIONS CLUB DR	"	"	"	"
"	LE10-1 TO LE9-19	SYCAMORE & HWY O	"	"	"	"
"	BN2-145 to BN2-108	OAK TREE APTS.	"	washing southside	"	"

Creek Crossing Inspection

DATE	MANHOLE #'S	LOCATION	DYE TEST	CONDITION	DEBRIS	INSPECTOR
10/08/11	LE7-30 TO LE7-30A	Sharon Avenue	N	Some erosion		Dane
"	LE7-29A to LE7-29B	Sharon Avenue	N	OK		"
	LE4-2 to LE4-1A	Green Acres Park	N	Some Erosion		"
"	LE6-90 to LE6-77	Behind Casey's-Hwy. 72	Y	OK		"
"	LW6-13 to LW6-12	1st & Park	Y	OK		"
"	BN5-21A to BN5-21	Hauck & 10th St.	N	OK		"
"	V1-18 to V1-19	Valli-Hi Detention Pond	N	OK		"
"	V3-19A to V2-33	Woodcrest & Vichy Rd.	N	OK		"
"	V3-20 to V2-1	Woodcrest & Vichy Rd.	N	OK		"
"	V3-28 to V3-27	Daycare-Vienna Rd.	Y	OK		Dane
"	V2-19 to V2-9	Sharp Corner-Vienna Rd.	N	Pipe Exposed		"
"	BN1-9 to BN1-8	Red Barn East of Twitty Dr.	N	OK	Minimal	"
"	BN1-3 to BN1-4	Behind Fidelity Cable	Y	OK		"
"	BN2-45 to BN2-108	Holt Dr.	N	Some erosion		"
"	BN4-87 to BN4-1	10th & Forum	Y	OK		"
"	BN5-4 to BN5-3	Across Forum from RTI	Y	OK		"
"	BE1-28 to BE1-29	Across Forum from Bus Barn	Y	OK	Minimal	"
"	BE2-30 to BE2-58	Suncliff	Y	OK		"
	LW6-74 to LW6-75	South End of Main St.	N	OK		"
	LW6-73 to LW6-21	South End of 2nd St.	N	OK		"
"	BN5-22 to BN4-87 WYE	Forum & 10th	N	OK		Dane
"	BE6-36 to BE6-37	Ashley Dr.	N	OK		"
"	BE6-67A to BE6-68	Soest Rd.	N	OK		"
"	BE6-66 to BE6-69	End of Coventry	Y	OK		"
"	BE5-24 to BE5-25	Coventry & Aintree	Y	OK		"
"	BE3-7 to BE3-8	Whitehall Dr.	N	OK		"
"	BE4-15A to BE4-16	Pinetree	N	OK		Dane
"	BN2-57 to BN2-56	St. James Rd. Bridge@Fidelity	N	OK		"
"	LV1-79 to LV1-10	Huntleigh	N	OK		"
"	LE10-33 to LE10-35	Lions Club Dr.	N	OK		"
"	LE10-27 to D1-25	Lions Club & Rolla St.	N	OK		Dane
"	LE10-46B to LE10-145	Ramsey Place	Y	OK		"
"	LE10-147 to LE10-46	Ramsey Place	Y	OK		"
"	LE10-322 to LE10-321	Ann Lee Dr.	N	OK		"
"	LE10-15 to LE10-208	Lions Club Dr.	N	OK		"
	LE10-6 to LE10-299	Turkey Run & Lions Club Dr.	N	OK		"
	LE10-1 to LE9-19	Sycamore & Hwy. O	Y	OK		"

RM4- 4118 I & I REPAIR





City of Rolla - Sewer Inspection

Operator: Brandon / Brian Date: 4/27/11 Weather: TV Truck / Jet Vac

	Account #	District	Manhole Start	Manhole Finish	Footage	Comments
1	~~LE6~~	LE6	32	86	133	
2	402		30	32	128	
3		BE4	1R	29	179	
4		V2	1	2	192	
5		LE8	4H	32	307	
6		BE5	38	13	418	
7			14	38	63	
8			22	14	346	
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Summary

Account #	District	Total Feet

Private Line

Address:

Hours Spent:

Problem:

Comments:

City of Rolla - Sewer Inspection

Operator: Brandon / Brian Date: 4/28/11 Weather: TV Truck (Old Van)

	Account #	District	Manhole Start	Manhole Finish	Footage	Comments
1	402	LW4	27	27A	374	
2		BE2	30A	74	241	
3			58A	30A	100	
4		LW5	22	77	99	
5			20	21	277	
6			17	20	98	
7			16	17	125	
8			15	16	132	
9			LW4-65	15	80	
10		LE6	61	62	103	
11			61	104	135	
12						
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32						

Summary

Account #	District	Total Feet

Private Line

Address:
Hours Spent:
Problem:
Comments:

Frequent Cleaning List

Clean Monthly

	Manhole Start	Manhole Finish	Footage	Date	Operator	Street
1.	LW5-22	LW5-77	99	4/28	Brandon/Brian	Stephen dale
2.	LW5-21	LW5-22	104		car oh man Hole	Stephen dale
3.	LW5-20	LW5-21	277	"	"	Stephen dale
4.	LW5-17	LW5-20	98	"	"	Stephen dale
5.	LW5-16	LW5-17	125	"	"	Stephen dale
6.	LW5-15	LW5-16	132	"	"	Stephen dale
7.	LW4-65	LW5-15	80	"	"	Stephen dale
8.	LW4-27	LW4-27A	374	4/28	"	Strobach
9.	LW3-32	LW3-32	0	"	"	Ridgeview
10.	LW6-4	LW6-4	0	"	"	Rolla Street
11.	LE8-44	LE8-32	307	4/27/11	"	Chestnut
12.	BN2-64	BN2-65	170	"	"	Tory
13.	BE2-30A	BE2-74	241	4/28	"	10th Street
14.	BE2-58A	BE2-30A	100	"	"	10th Street
15.	BE5-38	BE5-13	418	4/27	"	Johnson
16.	BE5-14	BE5-38	68	"	"	Johnson
17.	BE5-22	BE5-14	346	"	"	Johnson
18.	LV1-3	LV1-3	0	4/28	"	Line Ave.

Frequent Cleaning List

Clean Monthly

	Manhole Start	Manhole Finish	Footage	Date	Operator	Street
1.	LW5-22	LW5-77	99	6/13	Brian / SB	Stephen dale
2.	LW5-21	LW5-22	104			Stephen dale
3.	LW5-20	LW5-21	277			Stephen dale
4.	LW5-17	LW5-20	98			Stephen dale
5.	LW5-16	LW5-17	125			Stephen dale
6.	LW5-15	LW5-16	132			Stephen dale
7.	LW4-65	LW5-15	80			Stephen dale
8.	LW4-27	LW4-27A	374			Strobach
9.	LW3-32	LW3-32	0			Ridgeview
10.	LW6-4	LW6-4	0			Rolla Street
11.	LE8-44	LE8-32	307	6/16	Brian / Brandon	Chestnut
12.	BN2-64	BN2-65	170	6/13	Brian / SB	Tory
13.	BE2-30A	BE2-74	241	6/16	Brian / Brandon	10th Street
14.	BE2-58A	BE2-30A	100			10th Street
15.	BE5-38	BE5-13	418			Johnson
16.	BE5-14	BE5-38	63			Johnson
17.	BE5-22	BE5-14	346			Johnson
18.	LV1-3	LV1-3	0			Line Ave.

City of Rolla – Sewer Department

Operator: Brian/Scott Date: 6/13/11 Weather:

TV Truck
Jet Vac

	Account #	District	Manhole Start	Manhole Finish	Footage	Comments
1	4109	LWS	22	77	99	
2			21	22	104	
3			20	21	277	
4			17	20	98	
5			16	17	125	
6			15	16	132	
7			LW4-65	15	80	
8						
9						
10						
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12						
13						
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32						

Summary

Account #	District	Total Feet

Private Line

Address
Hours Spent
Problem
Comments:

City of Rolla – Sewer Department

Operator: Brian/Brandon Date: 6/16 Weather:

TV Truck
Jet Vac

	Account #	District	Manhole Start	Manhole Finish	Footage	Comments
1	4102	LE8	44	32	307	
2		BE2	30A	74	100	
3			58A	50A	241	
4		RE5	38	13	412	
5			14	38	63	
6			22	14	346	
7		LE9	29	30	336	DI Ledaral Starn 1500 Commercia
8			28	29	157	
9			28	35	162	
10			27	28	345	
11			33	34	205	
12			32	33	388	
13			31	32	243	
14			26	31	135	
15			26	27	113	
16			25	26	165	
17			24	25	246	
18			23	24	32	
19			23A	23	205	
20			17	18	362	
21			23B	23A	350	
22			36	36A	157	
23			37	36	355	
24			38	37	38	38 needs Reseated
25			39	38	349	
26			40	39	31	
27			41	40	116	
28			42	41	83	
29			43	40	362	
30		LE10				
31						
32						

Summary

Account #	District	Total Feet

Private Line

Address:
Hours Spent:
Problem:
Comments:

City of Rolla – Sewer Department

Operator: Brandon/Brian Date: 6/28/21 Weather: TV Truck: Not Van

	Account #	District	Manhole Start	Manhole Finish	Footage	Comments
1	402	~~Fisher~~	22	77	99	
2		Ln 5	21	22	104	
3			20	21	277	
4			17	20	98	
5			16	17	125	
6			15	16	132	
7			Ln4-15	15	20	
8			27	27A	374	
9						
10						
11						
12						
13						
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16						
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Summary

Account #	District	Total Feet

Private Line

Address

Hours Spent

Problem

Comments:

City of Kelly - Sewer Inspection

Operator: Branson/Brian Date: 6/22/11 Weather: TV Truck: Jet Vac

	Account #	District	Manhole: Start	Manhole: Finish	Footage	Comments
1	4102	BE5	44	32	307	
2		BE2	30A	74	241	
3		BE5	56A	39A	109	
4			38	13	416	
5			14	38	64	
6			22	14	346	
7		BE4	23	26	178	
8			22	23	280	
9			19	20	303	
10			17	16	163	
11			23	24	225	
12			21	22	255	
13			16	19	286	
14			24B	25	209	
15			20	21	292	
16			16	17	260	
17		BN5	15	16	270	
18		BE2	90	91	139	
19			90	70	246	
20		BN2	15	16	198	
21		LN2	27A	27B	160	
22						
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31						
32						

Summary

Account #	District	Total Feet

Private Line

Address:

Hours Spent:

Problem:

Comments:

City of Rolla - Sewer Inspection

Inspector: Brian / Bob Date: 7/25/11 Weather:

TV Truck: Joe Van

	Account #	District	Manhole Start	Manhole Finish	Footage	Comments
1	4102	LEle	27	28	178	6 Month
2			27	29	167	
3			27	24	104	
4		BES	6	7	245	
5			6	5	204	
6			7	8	115	
7		LE8	44	32	307	*
8		BES	38	13	418	
9			14	38	63	Monthly
10			22	14	346	
11						
12						
13						
14						
15						
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Summary

Account #	District	Total Feet

Private Line

Address

Hours Spent

Problem

Comments:

City of Rolla – Sewer Department

TV Truck

Operator: Brian / Bob Date: 7/26/11 Weather: For Val:

	Account #	District	Manhole Start	Manhole Finish	Footage	Comments
1	4102	LW4	27	27A	374	Monthly
2		BE2	30A	74	241	
3			58A	30A	100	
4		LW5	22	77	99	
5			21	22	104	
6			20	21	277	
7			17	20	98	
8			16	17	125	
9			15	16	137	
10			LW465	15	80	
11						
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Summary

Account #	District	Total Feet

Private Line

Address

Hours Spent

Problem

Comments:

City of Rolla – Sewer Department

Operator Brandon Brian Date 8/29/11 ☐ TV Truck ☒ ~~Jet Vac~~

Weather

	Account #	District	Manhole Start	Manhole Finish	Footage	Comments
1	9102	LE10	274	273	?	
2			275	274	?	
3			276	275	185	
4			277	276	411	
5			278	277	164	
6			277	278	129	
7		LW5	22	77	99	
8			21	22	104	
9			20	21	277	
10			17	20	98	
11			16	17	125	
12			15	16	132	
13			LW4-65	15	80	
14		LW4	27	27A	374	
15		LE8	44	32	307	
16		BE2	30A	34	241	
17			58A	30A	100	
18		DE5	38	13	418	
19			14	38	63	
20			22	14	346	
21		LE10	280	279	153	
22			281	280	90	
23			282	281	291	
24			287	282	182	
25			284	283	40	
26			286	284	212	
27			294	293	202	
28			296	294	249	
29			296	295	211	
30			297	296	337	
31						
32						

Summary

Account #	District	Total Feet

Private Line

Address

Hours Spent

Problem

Comments:

Grease Trap Inspections

Date

Inspected By: ~~Dane Carr~~ BT SB / 08/18

Facility	Problem Areas	Facility	Problem Areas
Sirloin Stockade (outside)	X ok	Kroger's Deli (inside)	ok
Waffle House (outside)	ok	Slice of Pie	No Trap
Shoney's (outside)	ok	The Rail (MS&T)	ok
Bandanas (outside)	ok	Huddle House (outside)	ok
Los Gas adores Mexican (inside)	ok	Leona's Kitchen (inside)	ok
Lucky House (inside)	ok	Alex's (inside)	X ok
Penelope's (outside)	ok	Loves Truck Stop (outside)	ok
Little Caesar's (inside)	X ok	~~Hickory Pit~~ (inside)	ok
Mottomo (inside) Needs cleaned		Casey's, Hwy. 72(Outside)	ok
Long John's (inside)	X ok	Gordoz (outside)	ok
Wendy's (outside)	ok	LOCKER ROOM (Violation)	NO TRAP
Arby's (inside)	ok	El Maguey (outside) Needs cleaned	X
Pizza Hut (inside)	X ok	Bruno's (inside)	ok
Pizza Inn (inside)	X ok	Casey's, 10th Street (Outside)	ok
Maid Rite (inside) Needs cleaned ~~Grease~~	X	TATER PATCH (inside) (outside)	X ok
McDonald's (Outside))	ok	Country Mart Deli (outside) Needs cleaned	
Kentucky Fried Chicken (outside)	ok	Great Wall (inside)	X ok
Dairy Queen (outside)	ok	Mandarin garden (Outside)	ok
Hardee's (outside)	ok	Subway, 63 South	No Trap
Taco Bell (outside)	ok	Subway, 10th Street (outside)	ok
Steak N Shake (outside)	ok	Subway, Bishop	No Trap
Lee's Chicken (outside) Needs cleaned		High School (inside)	
Fortune Inn (inside)	X ok	Middle School (inside	
Denny's (inside) Needs cleaned		Truman (inside)	
Donut King (inside)	ok	Jr. High School (inside)	
Zeno's (inside)	X ok	Mark Twain (inside)	
Burger King (outside)	ok	Ft. Wyman (inside)	
Domino's (inside) Needs cleaned		RTI Store (inside)	X
Papa John's (inside)	X ok	Rolla Manor Care (inside)	ok
T.J. Hall (inside) Closed For Construction	X	Presbyterian (outside)	X ok
Havener Center (outside)	ok	Heritage Park (inside) Needs clean	
Chicago Tasters (inside) Needs cleaned		Park Side (Outside)	ok
Pryor's Pizza (inside) Needs clean.		Elsumbrero (outside	ok
Applebee's (outside)	X ok	~~Napoli's (outside)~~	~~closed~~
Wal-Mart Deli (inside)	ok	Benton Square (outside)	ok
Wal-Mart McDonald's (outside)	ok	~~K-mart Deli (inside) closed~~	~~closed~~
Imo's (inside)	ok	Jimmy Johns (outside)	ok
G & D Steak House (inside)	ok	Kai (outside)	ok
Colton's Steak House (outside)	ok		
Panera Bread	No Trap		
Kyoto (outside) Lids need Repaired	NEED CLEANED		
Sonic (outside)	OK		

APPENDIX E

PROJECTED PUBLIC SECTOR DEFECTS AND I/I FLOWS

Appendix E
Projected Public Sector Defect and I/I Flows

	Upper MH				Lower MH				Main Line Pipe				Total		
Sub-Basin	Projected Upper MH Defects	1-Year Unit Flow per Defect (gpm)	Total 1-Yr Storm Event I/I Flow (gpm)	Total 10-Yr Storm Event I/I Flow (gpm)	Projected Lower MH Defects	1-Year Unit Flow per Defect (gpm)	Total 1-Yr Storm Event I/I Flow (gpm)	Total 10-Yr Storm Event I/I Flow (gpm)	Projected Main Line Pipe Defects	1-Year Unit Flow per Defect (gpm)	Total 1-Yr Storm Event I/I Flow (gpm)	Total 10-Yr Storm Event I/I Flow (gpm)	Total 1-Yr Storm Event I/I Flow (gpm)	Total 10-Yr Storm Event I/I Flow (gpm)	Total 10-Yr Storm Event I/I Flow (mgd)
V1	60	0.70	42	75	74	0.35	26	26	329	0.40	132	132	199	233	0.33
V2	53	0.70	37	67	66	0.35	23	23	430	0.40	172	172	232	262	0.38
V3	56	0.70	39	71	70	0.35	25	25	460	0.40	184	184	248	280	0.40
Basin Total	169	0.70	118	213	211	0.35	74	74	1219	0.40	488	488	680	774	1.12
Vichy Rd. WWTP Total	**169**	**0.70**	**118**	**213**	**211**	**0.35**	**74**	**74**	**1219**	**0.40**	**488**	**488**	**680**	**774**	**1.12**
BN1	19	0.85	16	29	24	0.40	10	10	65	0.50	33	33	58	71	0.10
BN2	80	0.80	64	115	99	0.40	40	40	285	0.50	143	143	246	297	0.43
BN3	47	0.80	37	67	58	0.40	23	23	492	0.50	246	246	307	337	0.48
BN4	60	0.80	48	86	74	0.40	30	30	588	0.50	294	294	371	409	0.59
BN5	61	0.80	49	88	77	0.40	31	31	573	0.50	287	287	367	406	0.58
Basin Total	266	0.80	214	385	333	0.40	133	133	2004	0.50	1002	1002	1349	1520	2.19
LE1	42	0.80	34	61	53	0.40	21	21	517	0.50	259	259	314	341	0.49
LE2	34	0.80	27	48	42	0.40	17	17	222	0.50	111	111	154	176	0.25
LE3	36	0.80	29	52	45	0.40	18	18	580	0.50	290	290	337	360	0.52
LE5	25	0.80	20	36	32	0.40	13	13	198	0.50	99	99	132	148	0.21
LE4	64	0.80	51	92	80	0.40	32	32	710	0.50	355	355	438	479	0.69
LE6	86	0.80	68	123	107	0.40	43	43	947	0.50	474	474	585	640	0.92
LE7	15	0.80	12	21	18	0.40	7	7	150	0.50	75	75	94	104	0.15
LE8	142	0.80	114	205	178	0.40	71	71	708	0.50	354	354	539	630	0.91
LE9	7	0.80	6	10	9	0.40	4	4	34	0.50	17	17	26	31	0.04
LE10	119	0.80	95	171	149	0.40	60	60	379	0.50	189	189	344	420	0.61
Basin Total	570	0.80	456	821	712	0.40	285	285	4445	0.50	2223	2223	2963	3328	4.79
LN1	21	0.80	17	30	26	0.40	10	10	264	0.50	132	132	159	172	0.25
LN2	53	0.80	42	76	66	0.40	26	26	518	0.50	259	259	328	361	0.52
LN3	45	0.80	36	65	56	0.40	22	22	530	0.50	265	265	323	352	0.51
Basin Total	118	0.80	95	170	148	0.40	59	59	1313	0.50	656	656	810	886	1.28
BW1	18	0.80	14	25	22	0.40	9	9	626	0.50	313	313	336	347	0.50
BW2	26	0.80	20	37	32	0.40	13	13	169	0.50	85	85	118	134	0.19
BW3	48	0.80	38	69	60	0.40	24	24	578	0.50	289	289	352	382	0.55
BW4	67	0.80	54	97	84	0.40	34	34	742	0.50	371	371	458	501	0.72
Basin Total	158	0.80	127	228	198	0.40	79	79	2115	0.50	1058	1058	1264	1365	1.97
LW1	22	0.80	18	32	28	0.40	11	11	260	0.50	130	130	159	174	0.25
LW2	30	0.80	24	44	38	0.40	15	15	325	0.50	163	163	202	222	0.32
LW3	41	0.80	33	59	51	0.40	20	20	457	0.50	229	229	282	308	0.44
LW4	57	0.80	45	82	71	0.40	28	28	494	0.50	247	247	321	357	0.51

Appendix E
Projected Public Sector Defect and I/I Flows

	Upper MH				Lower MH				Main Line Pipe				Total		
Sub-Basin	Projected Upper MH Defects	1-Year Unit Flow per Defect (gpm)	Total 1-Yr Storm Event I/I Flow (gpm)	Total 10-Yr Storm Event I/I Flow (gpm)	Projected Lower MH Defects	1-Year Unit Flow per Defect (gpm)	Total 1-Yr Storm Event I/I Flow (gpm)	Total 10-Yr Storm Event I/I Flow (gpm)	Projected Main Line Pipe Defects	1-Year Unit Flow per Defect (gpm)	Total 1-Yr Storm Event I/I Flow (gpm)	Total 10-Yr Storm Event I/I Flow (gpm)	Total 1-Yr Storm Event I/I Flow (gpm)	Total 10-Yr Storm Event I/I Flow (gpm)	Total 10-Yr Storm Event I/I Flow (mgd)
LW5	62	0.80	49	89	77	0.40	31	31	728	0.50	364	364	444	484	0.70
LW6	61	0.80	49	88	76	0.40	30	30	678	0.50	339	339	418	457	0.66
Basin Total	273	0.80	218	393	341	0.40	136	136	2943	0.50	1471	1471	1826	2001	2.88
LV1	11	0.80	8	15	13	0.40	5	5	37	0.50	18	18	32	39	0.06
Basin Total	11	0.80	8	15	13	0.40	5	5	37	0.50	18	18	32	39	0.06
BE1	39	0.80	31	56	48	0.40	19	19	333	0.50	166	166	217	241	0.35
BE2	32	0.80	26	47	40	0.40	16	16	258	0.50	129	129	171	192	0.28
BE3	50	0.80	40	73	63	0.40	25	25	313	0.50	156	156	222	254	0.37
BE4	24	0.80	19	34	29	0.40	12	12	287	0.50	144	144	174	189	0.27
BE5	39	0.80	31	56	49	0.40	20	20	330	0.50	165	165	216	241	0.35
BE6	36	0.80	29	52	45	0.40	18	18	233	0.50	116	116	163	186	0.27
BE7	2	0.80	1	3	2	0.40	1	1	18	0.50	9	9	11	12	0.02
BE8	2	0.80	2	3	3	0.40	1	1	5	0.50	3	3	6	7	0.01
Basin Total	224	0.80	179	323	280	0.40	112	112	1776	0.50	888	888	1180	1323	1.91
HP1	28	0.80	22	40	35	0.40	14	14	74	0.50	37	37	73	91	0.13
Basin Total	28	0.80	22	40	35	0.40	14	14	74	0.50	37	37	73	91	0.13
D1	4	0.80	3	6	5	0.40	2	2	12	0.50	6	6	11	14	0.02
D5	6	0.80	5	9	7	0.40	3	3	15	0.50	8	8	15	19	0.03
Basin Total	10	0.80	8	14	12	0.40	5	5	27	0.50	14	14	27	33	0.05
OZARK	1	0.80	1	1	1	0.40	0	0	2	0.50	1	1	2	3	0.00
Basin Total	1	0.80	1	1	1	0.40	0	0	2	0.50	1	1	2	3	0.00
SE WWTP Total	**1659**	**8.00**	**1328**	**2391**	**2074**	**4.00**	**830**	**830**	**14736**	**5.00**	**7368**	**7368**	**9526**	**10588**	**15.2**
M1	11	0.70	8	14	14	0.35	5	5	57	0.40	23	23	35	41	0.06
M2	7	0.70	5	8	8	0.35	3	3	96	0.40	38	38	46	50	0.07
Basin Total	17	0.70	12	22	22	0.35	8	8	153	0.40	61	61	81	91	0.13
SALLY	7	0.70	5	9	9	0.35	3	3	20	0.40	8	8	16	20	0.03
Basin Total	7	0.70	5	9	9	0.35	3	3	20	0.40	8	8	16	20	0.03
SW WWTP Total	**25**	**1.40**	**17**	**31**	**31**	**0.70**	**11**	**11**	**173**	**0.80**	**69**	**69**	**97**	**111**	**0.16**
Grand Total	**1853**	**-**	**1464**	**2635**	**2316**	**-**	**914**	**914**	**16127**	**-**	**7925**	**7925**	**10303**	**11474**	**16.52**