Wayne County Rouge Valley Sewage Disposal System
Final Order of Abatement 2117
Flow Monitoring Annual Report
for July 2012 through June 2013

Prepared: August 30, 2013
Revised: August 4, 2014

Prepared By:
Applied Science, Inc.
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and

Wayne County Department of Public Services
Environmental Services Group

Robert A. Ficano
County Executive

September 3, 2013

Ms. Laura Verona, District Supervisor
Michigan Department of Environmental Quality
Water Resources Division
Southeast Michigan District Office
27700 Donald Court
Warren, MI 48092-2793

Subject: Completion of Monitoring, Post Construction of Short Term Corrective Action Plan
Rouge Valley Sewage Disposal System
Final Order of Abatement 2117, AFO-SW12-002

Dear Ms. Verona:

Paragraph 3.4 of the Third Amendment to Final Order of Abatement 2117, AFO-SW12-002, for the Rouge Valley Sewage Disposal System (RVSDS) requires completion of a 12 month monitoring program upon completion of construction of the Short Term Corrective Action Plan.

In June of 2012, Wayne County submitted to MDEQ the document "Flow Monitoring Plan for Period Following Completion of Short Term Corrective Action Plan", which was approved by MDEQ in July of 2012. Wayne County met with you and Mr. Early to review the results of the monitoring program on November 7, 2012, March 6, 2013, and June 12, 2013.

We are pleased to inform you that Wayne County has completed the 12 month monitoring program. All of the collected data for each metering location have been reviewed and final data summaries have been created.

Please find attached a report which presents the final data for period July 1, 2012 through June 30, 2013 (by quarter), and presents analysis based on the entire year of meter data. We are scheduled to meet with you at your office to review this report at 9:30 am on September 11, 2013.

As we have discussed, Wayne County is proceeding with work to determine if a Long Term Corrective Action Plan is needed, and to develop that plan if necessary, in accordance with Paragraphs 3.4 and 3.5 of the Third Amendment to FOA 2117.

Please contact me at 313-224-8282 if you have any questions about this transmittal.

Sincerely,

Kelly A. Cave

Kelly A. Cave, P.E.
Director, Water Quality Management Division

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CC: Mr. Douglas R. Early, Environmental Engineer, WRD
Ms. Katelyn M. Wysocki, Enforcement Specialist, WRD
Mr. Ken Kucel, Deputy Director, Wayne County Department of Public Services
Ms. Elmeka Allen, Director, Wayne County Facilities Management Division
Mr. Firooz Fath-Azam, P.E., Superintendent, Wayne County FMD
Ms. Daniel Alford, P.E., Assistant Superintendent, Wayne County FMD
Mr. Razik Alsaigh, P.E., Project Engineer, Wayne County WQMD
Customer communities, Rouge Valley Sewage Disposal System

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1. INTRODUCTION

The purpose of this report is to present the flow metering data and summaries for Wayne County's Rouge Valley Sewage Disposal System (RVSDS) in fulfillment of paragraph 3.4 of the Third Amendment to Final Order of Abatement (FOA) 2117 and as proposed in the report titled "Flow Monitoring Plan for Period Following Completion of Short Term Corrective Action Plan" (FOA Monitoring Plan) dated June 19, 2012. Paragraph 3.4 requires that a 12-month monitoring period after construction of the Short Term Corrective Action Plan (STCAP). The FOA Monitoring Period occurred from July 1, 2012 through June 30, 2013 in accordance with FOA 2117 and the FOA Monitoring Plan.

The objectives of the monitoring plan were to:

1) Demonstrate the effectiveness of the STCAP improvements on system flow rates to the extent practical during a one year monitoring period;
2) Provide the flow monitoring data required for analysis of needed improvements (if any) to be implemented under a Long-Term Corrective Action Plan (LTCAP); and
3) Assist Wayne County with operation and management of the RVSDS.

Throughout the FOA Monitoring Period, quarterly reports have been submitted to present the collected data and summaries of recorded flow rates and levels. With the entire year completed, all of the collected data for each metering location have been reviewed and final data summaries have been created, including the application of any dye-dilution test adjustment factors. This annual report assembles the final data from all four quarters, presents updated quarterly data, and presents data summaries and conclusions based on the entire year of meter data.

2. MONITORING NETWORK

Wayne County executed the RVSDS monitoring as described in the FOA Monitoring Plan with only a few exceptions. Flow monitoring was achieved through the use of existing RVSDS system flow meters and level sensors, new RVSDS system flow meters, existing RVSDS community flow meters and existing Detroit Water and Sewerage Department (DWSD) flow meters for a total of 38 locations, as shown in Table 1. The actual set of flow monitoring locations is identical to the planned locations list presented in the FOA Monitoring Plan.

Table 1
Rouge Valley Sewage Disposal System
FOA Monitoring Plan Meters

Existing Wayne County Meters	P1, P3, P7, P8, P9, P10, P11, P12, P13, P14, P15, P17, P19, P20, P21, P25, LV Basin, & M22	
New Wayne County Meters	Westland	WE14, WE25, & WE28
Relocated Wayne County Meter	P24 (Relocated)	
Existing Community Meters	City of Livonia	LV4, LV11, LV14, LV15, & LV16
	Garden City	M1 & M2
	City of Novi	BG1
	WTUA*	FE19, FE20, A, B, & C
Existing DWSD Meters	WCS1, WCS2, & WCS3	

*Western Townships Utility Authority (WTUA)

Nine (9) flow meters were upgraded with long-range level sensors to allow all possible surcharged depths to be recorded. Table 2 shows the locations and upgrades that were completed. These upgrades were proposed in the FOA Monitoring Plan and implemented before the start of the FOA Monitoring Period.

Table 2
Rouge Valley Sewage Disposal System
Level Sensor Upgrades

Flow Meter	Location	Previous Range	Current Range
P10	Hines Drive East of Inkster Road	0 – 11.5 feet	0 – 30 feet
P11	Hines Drive East of Inkster Road	0 – 11.5 feet	0 – 30 feet
P12	Inkster Road North of Hines Drive	0 – 11.5 feet	0 – 30 feet
P13	Telegraph Road North of Joy Road	0 – 11.5 feet	0 – 30 feet
P14	Brady Road near Willoway Road	0 – 11.5 feet	0 – 30 feet
P15	Ecorse Road and Hannan Road	0 – 11.5 feet	0 – 30 feet
P19	Josephine Street and Lower Rouge River	0 – 11.5 feet	0 – 30 feet
P20	Michigan Avenue and Henry Ruff Road	0 – 11.5 feet	0 – 30 feet
P21	Merriman Road and Lower Rouge River	0 – 11.5 feet	0 – 30 feet

During the FOA Monitoring Period, precipitation was monitored using a network of 22 rain gages operated and maintained by Wayne County, the RVSDS communities, DWSD, and the National Oceanographic and Atmospheric Administration (NOAA) as shown in Table 3. The list of rain gages presented in Table 3 does not contain station RG as proposed in the FOA Monitoring Plan, because once the data were received, it was determined that this rain gage does not exist.

Table 3
Rouge Valley Sewage Disposal System
Rain Gages used during FOA Monitoring Period

Rain Gage	Operated By	Location
DTW	NOAA	Wayne County Metro Airport, Romulus
R10	Wayne County	11111 Wayne Road, Romulus
R11	Wayne County	14973 Northville Road, Northville Township
R12	Wayne County	7651 Merriman Road, Westland
R13	Wayne County	3501 Henry Ruff Road, Inkster
R14	Wayne County	Willow Run Airport, Van Buren Township
R15	Wayne County	20195 Trolley, Taylor
R18	Wayne County	130 4th Street, Belleville
R27	Wayne County	2001 Inkster Road, Inkster
R28	Wayne County	23800 Hines Drive, Dearborn Heights
R29	Wayne County	15145 Beech Daly Road, Redford
PG009	DWSD	Curtis and Southfield Freeway, Detroit
PG010	DWSD	16540 Rotunda Drive, Dearborn
PG012	DWSD	15600 West Grand River Avenue, Detroit
PG030	DWSD	Stoepel Park and W. Chicago, Detroit
PG032	DWSD	20920 East Street, Southfield
PG033	DWSD	30365 Schoolcraft, Livonia
PG034	DWSD	20650 West Warren, Detroit
RG01	Livonia	Schoolcraft Road, Livonia
RG02	Livonia	Whispering Willows Golf Course, Livonia
MR	WTUA	Joy Road and Haggerty Road, Canton
LR	WTUA	Michigan Avenue and Haggerty Road, Canton

Figure 1 shows the sewer flow meter and rain gage locations utilized in implementing the FOA Monitoring Plan. Detailed views of each reach are provided in Appendix A. Figure 2 shows the RVSDS meter districts.

The FOA Monitoring Plan recommended dye-dilution testing to verify the meter calibration at a subset of the system flow meters. Dye-dilution testing was completed during the FOA Monitoring Period for meters P9, P10, P11, P12, P13, P14, P25, and relocated meter P24. The three DWSD meters at the outlets of the RVSDS (WCS1, WCS2 and WCS3) were also dye-dilution tested by DWSD during the FOA Monitoring Period.

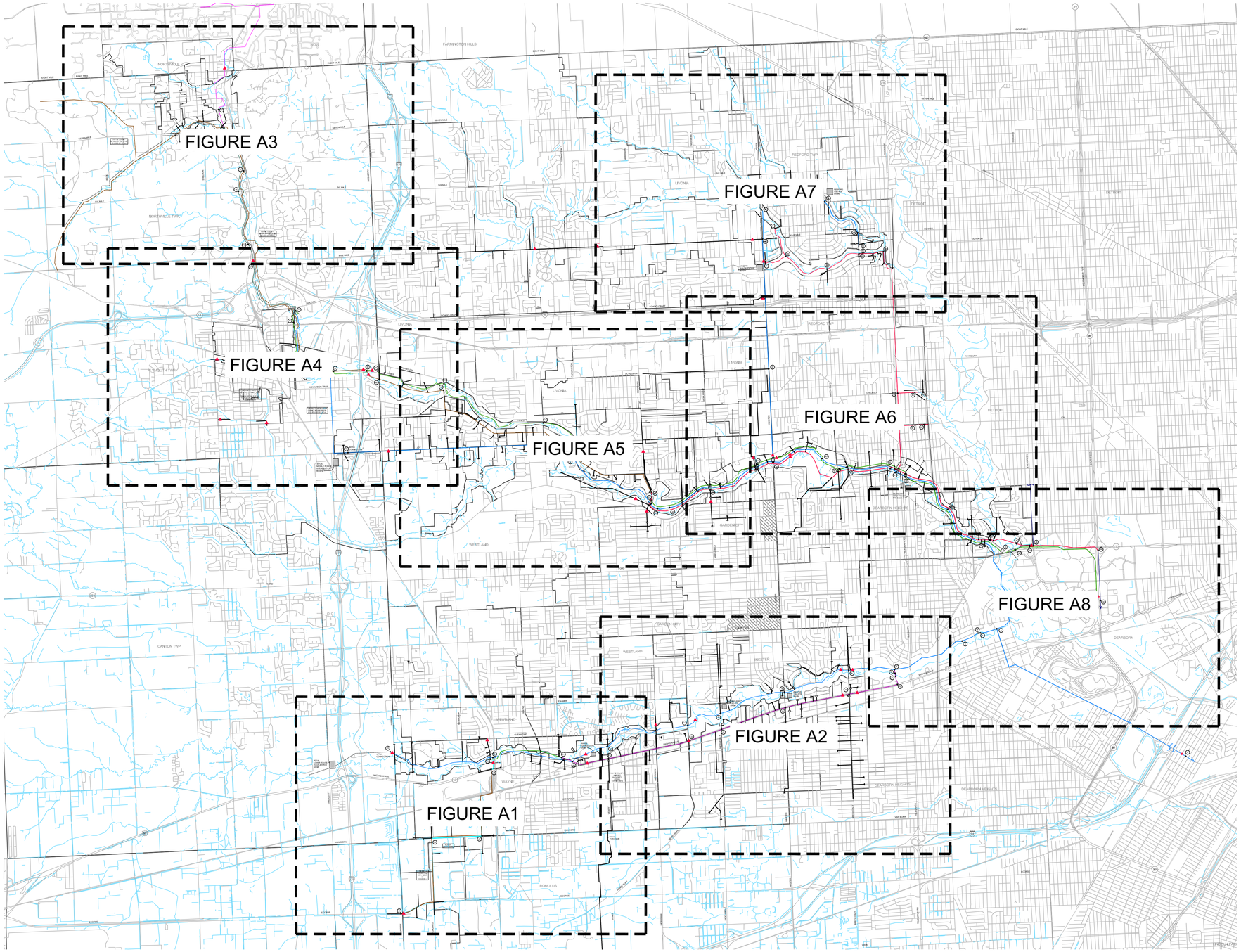
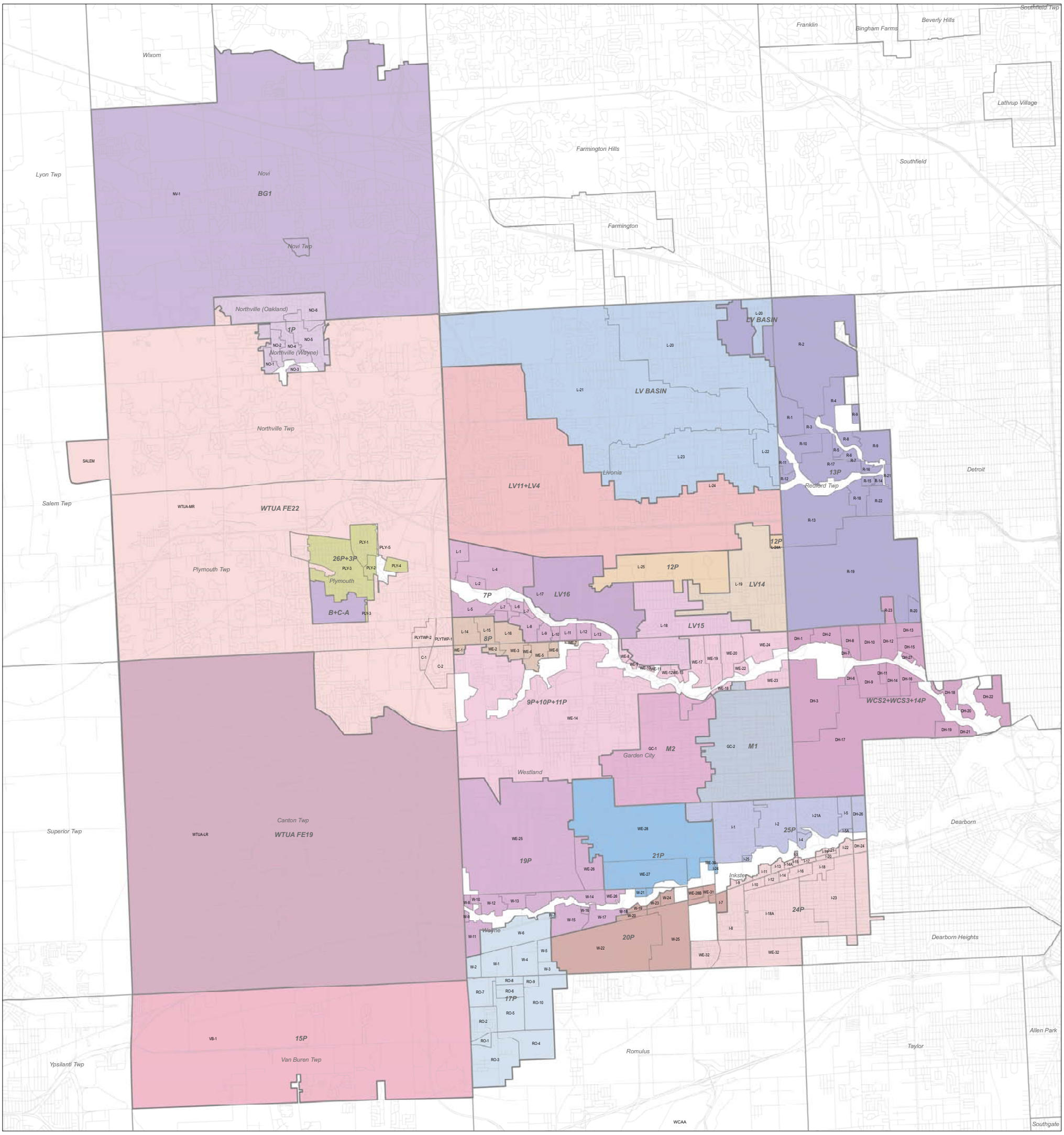


FIGURE 1
ROUGE VALLEY SEWAGE DISPOSAL SYSTEM
INTERCEPTOR SCHEMATIC

SYSTEM
MONITORING
INDEX SHEET



Rouge Valley Sewage Disposal System

Incremental Meter District Map

Figure 2

Revised October 31, 2012

3. DATA PROCESSING

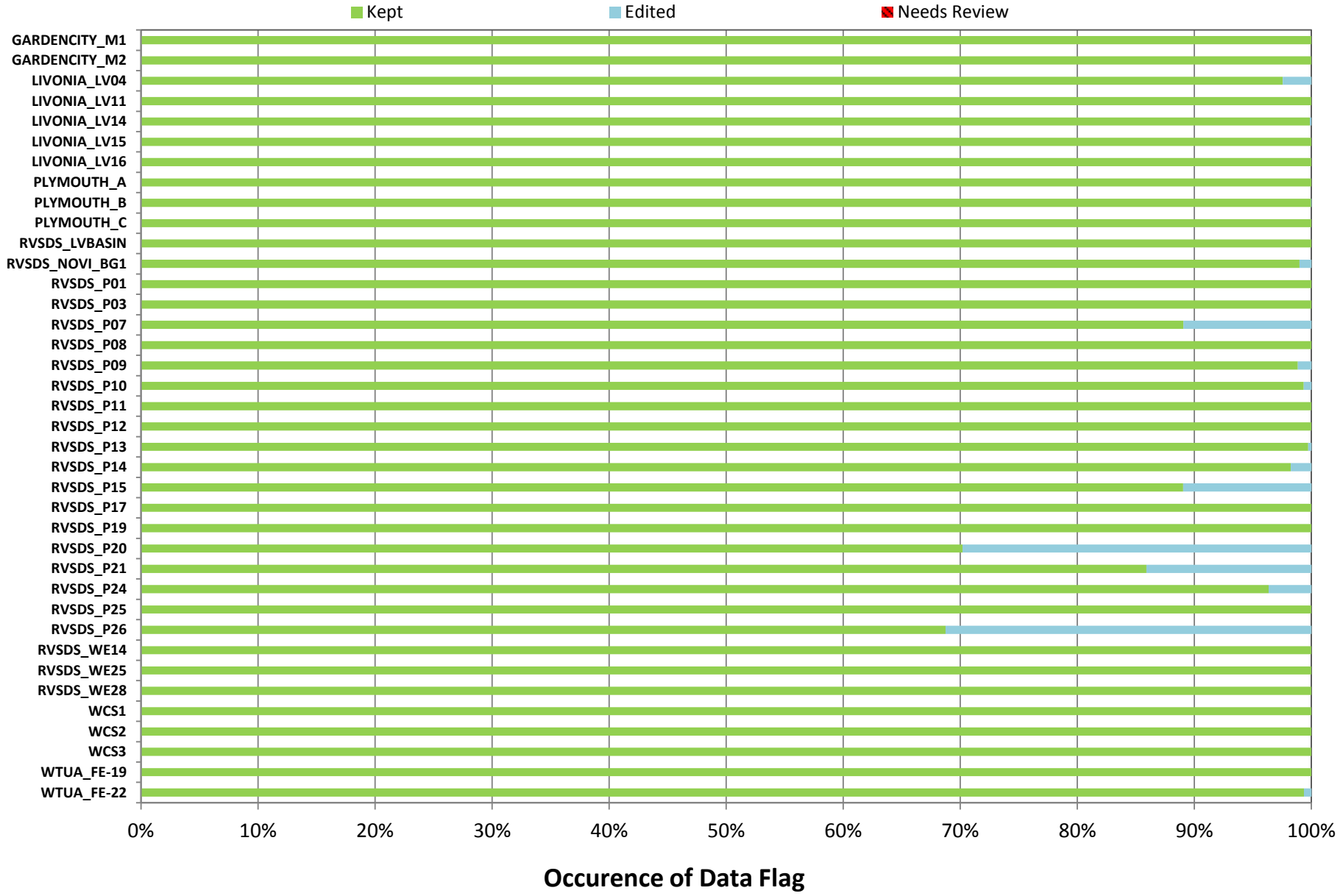
Sewer flow metering and precipitation data collected during the FOA Monitoring Period (July 1, 2012 – June 30, 2013) were processed in several stages:

- Semi-weekly data collection and review;
- Monthly data assembly, review and flagging for missing or erroneous data;
- Quarterly data assembly, review, data processing and presentation; and
- Annual data assembly, review, final data processing and presentation.

This report presents the final version of the previously issued quarterly data reports in Appendices B through E. These data were finalized at the end of the year to provide a single, consistent review of the data and uniform data processing. The year-end review also allows the effects of any maintenance and calibration, including dye-dilution testing, to be applied to all collected data from the year.

Wayne County completed a rigorous maintenance program for their monitoring locations during the FOA Monitoring Period. The effects of the increased maintenance can be seen in the completeness of the data set. The recorded data set was 97% complete, as shown in Figure 3. However, during the data review and processing, some necessary data fixes were identified for missing or erroneous data. Typically, dry weather data fixes were made using a diurnal pattern developed for periods with complete and reasonable data. Wet weather fixes were made using rating curves or a correlation to another flow meter. Rating curves and correlations were developed using data for a time when the meters were performing well. Table 4 provides a complete list of the data fixes that were needed to complete the annual data set.

Figure 3
Rouge Valley Sewage Disposal System
July 2012 to June 2013 Flow Rate Flags



Applied Science, Inc.
8/30/2013

Table 4
Rouge Valley Sewage Disposal System
Data Fixes - July 2012 to June 2013

Meter	Period		Fix Applied
	Start	Stop	
P7	8/9/2012	8/9/2012	Recalculated using continuity equation
	8/19/2012	8/19/2012	Rating curve to depth
	9/14/2012	9/14/2012	
	9/24/2012	9/24/2012	
P14	11/9/2012	11/9/2012	Correlation to P9, P10, and P11
P15	8/23/2013	8/23/2013	Rating curve to depth
	9/20/2012	9/20/2012	
	9/29/2012	9/29/2012	
	9/13/2012	9/13/2012	Diurnal pattern
P20	7/5/2012	7/5/2012	Rating curve to velocity
	10/8/2012	10/8/2012	Rating curve to depth
	10/16/2012	10/16/2012	
	11/6/2012	11/6/2012	
	11/24/2012	11/24/2012	
P21	7/1/2012	7/1/2012	Correlation to 19P
P24	7/11/2012	7/11/2012	Diurnal pattern
	9/13/2012	9/13/2012	
P26	7/1/2012	7/1/2012	Correlation to P26
	10/8/2012	10/8/2012	Rating curve to velocity
LV04	10/27/2012	10/27/2012	Diurnal pattern
	11/2/2012	11/2/2012	Recalculated using continuity equation
Plymouth B	4/11/2013	4/11/2013	Correlation to A and C

4. DATA ANALYSES

Early in the FOA Monitoring Period, a list of anticipated data analyses to be completed for the annual data set were presented to the RVSDS communities and Michigan Department of Environmental Quality (MDEQ). This list included the following analyses:

1. Dry Weather Flow Balance
2. Total Flow Balance
    a. Interceptor system
    b. Community flow rates
3. Event Analyses
    a. Storms with more than 1 inch of precipitation
    b. Peak hydraulic gradelines (HGLs) in a tabular summary and HGL profiles
    c. Peak hourly flow rates
    d. Capture factors for total system and interceptor branches
4. Preliminary Assessment of STCAP Effectiveness
    a. Total system and interceptor branch evaluation
    b. Evaluation of pre-rehabilitation conditions (year 2008 and 2009 data evaluation)
    c. Springtime high dry weather infiltration and inflow (I/I) comparison
    d. Wet weather I/I rates and capture factor comparison
    e. Plots of depth versus flow rate at key meters (hydraulic discrepancies)

This section describes how each of these items has been or will be fulfilled and presents the results of the analyses.

Before the anticipated analyses could be completed, the data set was checked for general continuity as shown in Table 5. Each metered point in the system was compared to the next upstream metered system point, wherever possible. It is expected that average flow rate at all downstream meter summations will be greater than or equal to the comparable upstream meter summations. Each summation in the continuity check met this criterion except the comparison of Meter P12 to its upstream meters. The incremental area between P12 and the upstream meters is small (about 1% of the cumulative area at P12) and has a significant commercial/industrial component, so the incremental flow may actually be very small and could be too small to meter accurately through an incremental calculation. Meter calibration will be checked along this branch in the future.

Table 5

Rouge Valley Sewage Disposal System

Flow Rate Continuity Check -- July 2012 through June 2013

Meter Grouping	Relative Location	Monthly Average Dry Weather Flow Rate (MGD)											
		Jul-12	Aug-12	Sep-12	Oct-12	Nov-12	Dec-12	Jan-13	Feb-13	Mar-13	Apr-13	May-13	Jun-13
Comparison 1													
WCS1	Downstream	33.1	32.5	30.9	31.5	31.6	32.9	36.8	43.4	45.4	38.1	42.0	41.5
P14+P24+P25	Upstream	30.3	30.3	28.8	30.0	30.2	31.1	35.6	42.4	45.1	37.9	40.8	40.5
	Incremental	2.8	2.2	2.1	1.6	1.4	1.7	1.2	1.0	0.3	0.2	1.2	1.0
Comparison 2													
WCS2 + WCS3 + P14	Downstream	30.8	31.4	28.5	29.2	29.0	31.2	36.8	44.6	49.3	39.7	42.6	40.9
P9 + P10 + P11 + P13	Upstream	26.8	27.7	25.7	27.0	27.0	28.7	32.3	39.4	43.0	35.3	38.2	37.9
	Incremental	4.0	3.7	2.8	2.2	2.1	2.5	4.5	5.1	6.3	4.4	4.3	2.9
Comparison 3													
P9 + P10 + P11	Downstream	22.4	23.2	21.7	22.8	22.8	24.1	26.7	32.4	35.0	28.8	31.3	31.3
P3 + P7 + P8 + P12 + LV14 + LV15 + LV16 + M1 + M2 + WE14	Upstream	--	--	--	--	--	--	--	28.3	30.3	24.3	27.1	27.3
	Incremental	--	--	--	--	--	--	--	4.1	4.7	4.4	4.2	4.0
Comparison 4													
P12	Downstream	6.1	6.5	6.0	6.1	6.2	6.5	7.4	8.6	9.6	7.8	8.8	8.6
LVBasin + LV11	Upstream	8.4	9.0	8.1	8.3	8.6	9.0	8.3	9.6	10.7	8.8	9.7	8.9
	Incremental	-2.2	-2.5	-2.1	-2.2	-2.5	-2.5	-0.9	-0.9	-1.1	-1.0	-0.9	-0.4
Comparison 5													
P3 + P26	Downstream	5.6	5.6	5.4	5.6	5.7	5.8	6.0	6.3	6.5	6.1	6.8	6.5
P1	Upstream	4.2	4.4	4.3	4.3	4.3	4.4	4.7	5.0	5.2	4.7	4.9	4.8
	Incremental	1.4	1.2	1.1	1.3	1.3	1.3	1.4	1.3	1.4	1.4	1.8	1.6
Comparison 6													
P1	Downstream	4.2	4.4	4.3	4.3	4.3	4.4	4.7	5.0	5.2	4.7	4.9	4.8
BG1	Upstream	4.2	4.2	4.1	4.2	4.2	4.3	4.5	4.8	4.9	4.4	4.6	4.6
	Incremental	0.1	0.2	0.1	0.1	0.1	0.2	0.1	0.3	0.3	0.3	0.3	0.2
Comparison 7													
P24 + P25	Downstream	8.4	8.1	7.8	8.4	8.7	8.6	10.8	13.4	13.9	11.0	12.8	12.0
P20 + P21	Upstream	5.9	6.2	6.2	6.3	6.5	6.6	8.0	10.0	10.1	7.7	8.7	8.3
	Incremental	2.5	1.9	1.6	2.1	2.2	1.9	2.8	3.4	3.8	3.3	4.1	3.6
Comparison 8													
P21	Downstream	4.5	4.4	4.5	4.6	4.8	4.9	5.7	6.4	6.7	5.4	6.2	6.2
P19 + WE28	Upstream	--	--	--	--	--	--	--	5.1	5.5	4.6	5.0	5.1
	Incremental	--	--	--	--	--	--	--	1.4	1.1	0.9	1.2	1.1
Comparison 9													
P19	Downstream	3.0	3.0	3.0	3.1	3.3	3.3	3.8	4.2	4.5	3.8	4.3	4.3
P17 + WE25 + FE19	Upstream	--	--	--	--	--	--	--	--	3.9	3.4	3.8	3.8
	Incremental	--	--	--	--	--	--	--	--	0.6	0.4	0.6	0.5

The meter data were also reviewed on a cumulative dry weather flow rate per capita basis, as shown in Table 6. The dry weather flow should be predominantly sanitary flow and per capita rates should be relatively uniform throughout the RVSDS. Deviations from the RVSDS average per capita flow rates of greater that ±20% for a majority of the months in the FOA Monitoring Period indicate three possible scenarios: 1) a particular district has inordinately high or low sanitary sewage production, 2) a particular district has uncontrolled or unknown sources of dry weather inflow and infiltration and/or 3) the flow meter is in need of additional calibration via dye-dilution testing. Wayne County will continue to monitor this metric and will pursue appropriate follow-up actions to understand and minimize deviations from average per capita flow rates.

4.1 Flow Balance

The recorded meter data were used to determine flow rates at various system points and for each community. Meter data were summed to show flow rates at points in the system and summed and prorated to show community flow rates. Proration is necessary because some meter districts receive flow rates from multiple communities. These flows are prorated to each community using the relative shares of year 2000 residential population served in that meter district. Community flow rates were also computed using the “meter math” formula for each community. In addition, flow rates were unitized to aid in comparisons and interpretations. This entire process is referred to as flow balancing. Three different flow balances were completed during data analysis: total flow, dry weather flow and wet weather flow.

Table 6

Rouge Valley Sewage Disposal System

Monthly Average Dry Weather Flow Rate Versus Residential Population Check -- July 2012 through June 2013

Meter Grouping	Year 2000 Residential Population	Metric	Jul-12	Aug-12	Sep-12	Oct-12	Nov-12	Dec-12	Jan-13	Feb-13	Mar-13	Apr-13	May-13	Jun-13	Percent of Area as Residential	Residential Area (acres)	Total Developed Land (Acres)
BG1	38,451	MGD	4.2	4.2	4.1	4.2	4.2	4.3	4.5	4.8	4.9	4.4	4.6	4.6	74%	5,957	8,086
		GPCD	*108.0*	*109.6*	*107.9*	*109.2*	*110.2*	*111.4*	*117.9*	*123.7*	*126.4*	*114.6*	*120.4*	*119.7*			
P1	44,725	MGD	4.2	4.4	4.3	4.3	4.3	4.4	4.7	5.0	5.2	4.7	4.9	4.8	75%	6,764	9,068
		GPCD	*94.1*	*98.0*	*95.9*	*96.4*	*97.0*	*99.2*	*104.7*	*111.9*	*115.5*	*104.7*	*110.1*	*108.0*			
P3 + P26	50,555	MGD	5.6	5.6	5.4	5.6	5.7	5.8	6.0	6.3	6.5	6.1	6.8	6.5	73%	7,234	9,864
		GPCD	*110.9*	*110.8*	*107.2*	*111.0*	*112.2*	*114.2*	*119.5*	*124.1*	*129.3*	*119.7*	*133.7*	*128.0*			
LV16	5,303	MGD	0.9	0.9	0.8	0.8	0.7	0.8	0.9	1.2	1.2	1.1	1.3	1.2	65%	739	1,138
		GPCD	*164.1*	*166.1*	*150.2*	*150.7*	*137.8*	*145.7*	*168.6*	*219.5*	*235.6*	*202.8*	*252.7*	*228.7*			
C-B-A	3,338	MGD	0.6	0.5	0.5	0.7	0.9	0.9	1.1	1.0	1.3	1.1	1.0	1.2	79%	325	413
		GPCD	*168.0*	*163.9*	*136.9*	*201.4*	*266.6*	*278.6*	*327.9*	*299.7*	*383.7*	*340.9*	*292.6*	*371.0*			
LV15	11,131	MGD	1.0	1.1	1.0	1.2	1.0	1.0	1.2	1.5	1.6	1.2	1.6	1.6	86%	982	1,141
		GPCD	*89.1*	*95.7*	*90.1*	*112.2*	*85.8*	*94.2*	*110.9*	*133.4*	*144.1*	*108.2*	*140.8*	*142.0*			
WE14	27,062	MGD	--	--	--	--	--	--	--	3.6	3.8	3.3	3.6	3.5	64%	2,119	3,289
		GPCD	--	--	--	--	--	--	--	*131.2*	*139.0*	*123.6*	*131.4*	*129.3*			
M2	14,602	MGD	1.1	1.1	1.1	1.2	1.3	1.4	1.7	2.3	2.6	2.0	2.2	2.2	82%	1,469	1,791
		GPCD	*72.8*	*77.3*	*75.6*	*84.1*	*86.3*	*96.8*	*118.7*	*159.0*	*174.7*	*136.2*	*149.2*	*149.2*			
M1	16,473	MGD	1.4	1.5	1.5	1.6	1.5	1.7	1.7	2.5	2.2	1.6	1.6	1.8	80%	1,557	1,936
		GPCD	*83.2*	*93.8*	*88.5*	*94.6*	*93.4*	*104.5*	*105.2*	*149.3*	*131.1*	*95.5*	*100.0*	*110.2*			
LV14	6,535	MGD	0.8	0.9	0.8	0.8	0.8	0.9	1.1	1.3	1.5	1.1	1.2	1.2	64%	748	1,175
		GPCD	*128.6*	*141.3*	*129.4*	*129.3*	*126.9*	*136.9*	*167.9*	*196.0*	*222.3*	*167.5*	*188.6*	*190.2*			
LV11+LV4	30,871	MGD	4.4	4.6	4.4	3.9	4.4	4.5	5.1	6.1	6.3	5.6	4.9	4.2	58%	3,272	5,628
		GPCD	*141.0*	*147.7*	*143.7*	*127.7*	*141.5*	*145.3*	*164.3*	*197.3*	*205.5*	*180.0*	*159.3*	*136.9*			
LV11+LVBasin	71,640	MGD	8.4	9.0	8.1	8.3	8.6	9.0	8.3	9.6	10.7	8.8	9.7	8.9	71%	9,124	12,896
		GPCD	*116.8*	*126.0*	*113.3*	*116.3*	*120.3*	*125.4*	*115.8*	*133.6*	*149.2*	*122.9*	*135.1*	*124.6*			
P12	72,665	MGD	6.1	6.5	6.0	6.1	6.2	6.5	7.4	8.6	9.6	7.8	8.8	8.6	67%	9,145	13,688
		GPCD	*84.5*	*89.4*	*82.2*	*83.8*	*84.7*	*89.2*	*101.8*	*118.8*	*131.6*	*106.7*	*121.1*	*117.7*			
P9+P10+P11-FE22	223,006	MGD	19.4	20.1	18.7	19.4	19.5	20.5	22.7	26.7	29.0	24.1	26.3	25.9	70%	25,728	36,629
		GPCD	*87.0*	*89.9*	*83.8*	*86.8*	*87.4*	*92.0*	*101.6*	*119.6*	*129.9*	*108.3*	*118.1*	*116.3*			
P13	51,708	MGD	4.3	4.5	4.0	4.2	4.2	4.6	5.6	7.1	8.1	6.6	6.9	6.6	76%	4,834	6,369
		GPCD	*83.9*	*87.0*	*77.8*	*81.0*	*80.9*	*89.1*	*107.5*	*136.4*	*155.8*	*127.1*	*134.3*	*128.2*			
WCS2 + WCS3 + P14 - FE22	310,356	MGD	27.7	28.2	25.5	25.7	25.7	27.6	32.7	38.9	43.3	35.1	37.6	35.5	72%	33,775	46,794
		GPCD	*89.4*	*91.0*	*82.1*	*82.9*	*82.9*	*88.9*	*105.3*	*125.2*	*139.6*	*113.0*	*121.2*	*114.4*			
P15	5,003	MGD	0.6	0.5	0.5	0.6	0.8	0.7	0.8	0.9	1.1	1.0	0.9	1.0	61%	1,010	1,667
		GPCD	*116.4*	*104.8*	*97.4*	*118.8*	*151.1*	*137.5*	*158.6*	*189.4*	*215.9*	*196.6*	*170.4*	*190.5*			
P17	8,125	MGD	1.7	1.6	1.6	1.7	1.8	1.6	1.8	1.9	2.0	1.8	1.9	2.1	45%	1,364	3,038
		GPCD	*205.4*	*199.3*	*198.3*	*206.3*	*225.3*	*195.8*	*223.6*	*230.0*	*242.1*	*220.4*	*231.6*	*254.3*			
WE25	15,600	MGD	--	--	--	--	--	--	--	--	2.0	1.6	1.8	1.7	77%	1,583	2,069
		GPCD	--	--	--	--	--	--	--	--	*125.8*	*102.9*	*118.0*	*110.6*			
P19 - FE19	30,256	MGD	3.0	3.0	3.0	3.1	3.3	3.3	3.8	4.2	4.5	3.8	4.3	4.3	59%	3,631	6,125
		GPCD	*100.2*	*97.6*	*99.6*	*103.2*	*110.0*	*108.2*	*124.3*	*138.8*	*150.0*	*125.5*	*141.6*	*142.7*			
WE28	14,400	MGD	--	--	--	--	--	--	--	0.9	1.0	0.8	0.7	0.7	81%	1,201	1,479
		GPCD	--	--	--	--	--	--	--	*59.2*	*70.0*	*53.3*	*50.9*	*51.1*			
P21 - FE19	50,487	MGD	4.5	4.4	4.5	4.6	4.8	4.9	5.7	6.4	6.7	5.4	6.2	6.2	65%	5,224	8,070
		GPCD	*88.5*	*87.8*	*89.5*	*91.3*	*94.5*	*97.5*	*112.2*	*127.7*	*132.6*	*107.3*	*122.2*	*122.4*			
P25 - FE19	66,447	MGD	5.5	5.8	5.8	6.0	6.0	6.3	7.3	8.6	9.3	7.5	8.8	8.6	68%	6,492	9,560
		GPCD	*83.3*	*87.7*	*87.2*	*90.3*	*90.4*	*94.8*	*110.2*	*130.2*	*139.5*	*112.1*	*131.8*	*128.9*			
P20	13,928	MGD	1.4	1.8	1.7	1.7	1.7	1.7	2.3	3.6	3.4	2.3	2.5	2.1	64%	933	1,462
		GPCD	*102.3*	*128.7*	*122.8*	*120.9*	*121.4*	*121.9*	*165.7*	*257.2*	*246.7*	*166.6*	*177.6*	*154.0*			
P24	34,787	MGD	2.9	2.3	2.0	2.4	2.6	2.3	3.5	4.8	4.6	3.6	4.0	3.4	71%	2,841	3,986
		GPCD	*82.2*	*66.3*	*58.6*	*68.5*	*76.1*	*65.2*	*99.2*	*137.1*	*133.0*	*103.3*	*114.2*	*97.4*			
WCS1 + WCS2 + WCS3 - FE19 - FE22 + C-B-A	414,928	MGD	39.5	39.2	35.9	36.4	36.7	38.8	45.8	54.2	58.9	47.4	52.5	49.7	71%	43,433	60,753
		GPCD	*95.2*	*94.4*	*86.5*	*87.6*	*88.4*	*93.6*	*110.4*	*130.7*	*141.8*	*114.3*	*126.6*	*119.8*			

Legend:

xx.x	Per capita flow rates are greater than 20% of the district-wide average.
xx.x	Per capita flow rates are less than 20% of the district-wide average.

4.1.1 Total Flow

Total flow was tabulated using the average flow rate at each meter location. This was reviewed in two different meter data summaries. In Table 7, the total flow summations at four branch locations were calculated. These summations were then prorated throughout the portion of the RVSDS tributary to that location using year 2000 residential population. This method "locks-in" flow rate at the interceptor locations and assumes uniform per capita contributions throughout the service area. The flow rates at the interceptor locations are shaded on the table.

In Table 8, each community's flow rate is computed using the meter math for that community. Wherever available, flow meters on the local connections are used to directly estimate flow contributions. For areas that must be computed using interceptor meters, the flow rate is proportioned by year 2000 residential population. The results of these calculations are estimated flow rates by community. A comparison of the per capita rates on Table 7 to the per capita rates on Table 8 shows whether a particular community is above or below the system average for each reach of the RVSDS.

4.1.2 Dry Weather Flow

Tables 9 and 10 present the same analyses that were described in Section 4.1.1 using data from dry weather days only. The dry weather days were identified using three statistical passes to select a set of dry weather days for the RVSDS. The resulting monthly dry/wet weather day counts are presented in Table 11. Data are summarized in Table 9 and 10 for dry weather days only, and therefore does not include the portion of the average flow that is due to wet weather event inflow and infiltration. The dry weather flow rate is most closely related to sanitary flow rates. Comparison of the per capita rates on Table 9 to the per capita rates on Table 10 shows whether the dry weather flow rate for a particular community is above or below the system average.

The community flow rates estimated in Tables 8 and 10 were computed with the community meter math formulas. These formulas do not rely heavily on the system outlet meters. Consequently, there is an opportunity to check the summation of the community flow rates to the summation of the end of system meters. This comparison is shown in the bottom two rows of each of these tables and in Figure 4. Considering the number of meters involved in this calculation, these comparisons have very good agreement. Over the course of the FOA Monitoring Period, the average monthly differences for the total and dry weather flow rates are 5 and 7% with maximum monthly differences of 10 and 11%, respectively. These small differences are expected to be reduced in the future through additional meter calibration and dye-dilution testing.

Table 7
Rouge Valley Sewage Disposal System
Average Flow Summary based on System Flow Meters, Prorated by Community Tributary Population -- July 2012 to June 2013

Branch	Sewage Flow Meter	Community	Year 2000 Residential Population	Total Developed Land (acres)	Current Capacity Allocation (MGD)	Average Flow Rate (MGD)												Average Flow Rate (MGD)	Average Flow Rate[3] (gal/capita/day)	Maximum Monthly Flow Rate (MGD)
						Jul-12	Aug-12	Sep-12	Oct-12	Nov-12	Dec-12	Jan-13	Feb-13	Mar-13	Apr-13	May-13	Jun-13			
Middle Rouge at Inkster Road	9P+10P+11P -WTUA FE22+C-B-A	Novi	38,451	8,086	13.2	4.2	4.3	4.2	4.2	4.2	4.3	4.8	4.8	4.9	5.3	4.7	4.8	4.6	116.3	5.3
		Northville Twp[1]	145	18	0.08	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.03	0.02	0.02	0.02		0.03
		Plymouth City	9,168	796	3.1	0.8	0.8	0.7	0.8	0.8	0.9	1.1	1.2	1.3	1.8	1.2	1.3	1.1		1.8
		Northville City	6,129	964	4.9	0.5	0.6	0.5	0.5	0.5	0.6	0.7	0.8	0.9	1.2	0.8	0.9	0.7		1.2
		Garden City	30,044	3,647	15.8	2.6	2.7	2.4	2.6	2.6	2.8	3.6	3.9	4.2	6.0	3.8	4.4	3.5		6.0
		Livonia	98,412	18,244	68.0	8.6	9.0	8.0	8.6	8.5	9.2	11.7	12.8	13.8	19.8	12.6	14.3	11.4		19.8
		Westland	43,995	4,874	26.2	3.8	4.0	3.6	3.8	3.8	4.1	5.2	5.7	6.2	8.8	5.6	6.4	5.1		8.8
		Total	**226,344**	**36,629**	**135.6**	**20.5**	**21.4**	**19.4**	**20.6**	**20.5**	**22.0**	**27.1**	**29.1**	**31.3**	**43.1**	**28.7**	**32.1**	**26.3**		**43.1**
Middle Rouge Outlet	WCS2+WCS3+14P -WTUA FE22+C-B-A	Novi	38,451	8,086	13.2	4.2	4.3	4.2	4.2	4.2	4.3	4.8	4.8	4.9	5.3	4.7	4.8	4.6	126.5	5.3
		Northville Twp[1]	145	18	0.08	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.03	0.02	0.02	0.02		0.03
		Plymouth City	9,168	796	3.1	0.8	0.8	0.7	0.8	0.8	0.9	1.1	1.2	1.3	1.8	1.2	1.3	1.1		1.8
		Northville City	6,129	964	4.9	0.5	0.6	0.5	0.5	0.5	0.6	0.7	0.8	0.9	1.2	0.8	0.9	0.7		1.2
		Garden City	30,044	3,647	15.8	2.6	2.7	2.4	2.6	2.6	2.8	3.6	3.9	4.2	6.0	3.8	4.4	3.5		6.0
		Livonia	100,511	18,597	68.8	9.8	10.1	8.2	8.6	8.1	9.3	14.1	14.5	15.9	29.1	13.9	19.2	13.4		29.1
		Westland	43,995	4,874	26.2	3.8	4.0	3.6	3.8	3.8	4.1	5.2	5.7	6.2	8.8	5.6	6.4	5.1		8.8
		Redford Twp	50,228	6,074	34.2	4.9	5.0	4.1	4.3	4.0	4.6	7.0	7.3	8.0	14.5	7.0	9.6	6.7		14.5
		Dearborn Heights	35,023	3,738	38.6	3.4	3.5	2.9	3.0	2.8	3.2	4.9	5.1	5.5	10.1	4.8	6.7	4.7		10.1
		Total	**313,694**	**46,794**	**208.3**	**30.1**	**31.0**	**26.6**	**27.9**	**26.9**	**29.8**	**41.5**	**43.3**	**46.9**	**77.0**	**41.8**	**53.3**	**39.7**		**77.0**
Lower Rouge Outlet	24P+25P-WTUA FE19	Van Buren Twp	5,003	1,667	3.2	0.4	0.4	0.4	0.4	0.4	0.4	0.6	0.7	0.7	1.1	0.7	0.7	0.6	119.2	1.1
		Romulus	1,991	752	2.3	0.2	0.2	0.2	0.2	0.2	0.2	0.3	0.3	0.3	0.4	0.3	0.3	0.2		0.4
		Wayne	19,039	2,833	18.0	1.7	1.7	1.5	1.7	1.7	1.7	2.5	2.7	2.7	4.3	2.5	2.7	2.3		4.3
		Westland	42,650	4,802	25.5	3.8	3.7	3.4	3.7	3.7	3.8	5.5	6.1	6.1	9.5	5.7	5.9	5.1		9.5
		Inkster	30,122	3,113	17.2	2.7	2.6	2.4	2.6	2.6	2.7	3.9	4.3	4.3	6.7	4.0	4.2	3.6		6.7
		Dearborn Heights	2,429	379	3.7	0.2	0.2	0.2	0.2	0.2	0.2	0.3	0.3	0.3	0.5	0.3	0.3	0.3		0.5
		Total	**101,234**	**13,546**	**70.0**	**8.9**	**8.9**	**8.2**	**8.9**	**8.8**	**9.0**	**13.1**	**14.5**	**14.4**	**22.6**	**13.4**	**14.1**	**12.1**		**22.6**
RVSDS Outlet	WCS1+WCS2+WCS3	Novi	38,451	8,086	13.2	4.2	4.3	4.2	4.2	4.2	4.3	4.8	4.8	4.9	5.3	4.7	4.8	4.6	126.2	5.3
		Northville Twp[1]	145	18	0.05	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.04	0.02	0.02	0.02		0.04
		Plymouth City	9,168	1,209	3.1	1.4	1.4	1.2	1.5	1.7	1.8	2.3	2.2	2.6	3.5	2.2	2.6	2.0		3.5
		Northville City	6,129	964	4.9	0.6	0.6	0.5	0.5	0.5	0.6	0.8	0.9	0.9	1.5	0.8	1.0	0.8		1.5
		Garden City	30,044	3,647	15.8	3.0	3.0	2.6	2.7	2.6	2.8	4.0	4.2	4.5	7.4	4.1	5.1	3.8		7.4
		Livonia	100,511	18,597	68.8	10.0	10.0	8.7	9.0	8.5	9.5	13.4	14.2	14.9	24.8	13.6	16.9	12.8		24.8
		Westland	86,645	9,676	51.7	8.6	8.7	7.5	7.7	7.4	8.2	11.6	12.2	12.8	21.4	11.8	14.6	11.0		21.4
		Redford Twp	50,228	6,074	34.2	5.0	5.0	4.3	4.5	4.3	4.7	6.7	7.1	7.4	12.4	6.8	8.4	6.4		12.4
		Dearborn Heights	37,452	4,117	42.3	3.7	3.7	3.2	3.3	3.2	3.5	5.0	5.3	5.6	9.2	5.1	6.3	4.8		9.2
		Van Buren Twp	5,003	1,667	3.2	0.5	0.5	0.4	0.4	0.4	0.5	0.7	0.7	0.7	1.2	0.7	0.8	0.6		1.2
		Romulus	1,991	752	2.3	0.2	0.2	0.2	0.2	0.2	0.2	0.3	0.3	0.3	0.5	0.3	0.3	0.3		0.5
		Wayne	19,039	2,833	18.0	1.9	1.9	1.6	1.7	1.6	1.8	2.5	2.7	2.8	4.7	2.6	3.2	2.4		4.7
		Inkster	30,122	3,113	17.2	3.0	3.0	2.6	2.7	2.6	2.8	4.0	4.2	4.5	7.4	4.1	5.1	3.8		7.4
		WTUA[2]	39,707	8,165	19.4	2.6	3.0	2.7	3.0	2.4	2.9	4.2	5.1	5.0	7.7	4.2	5.1	4.0		7.7
		Total	**454,635**	**68,918**	**294.2**	**44.8**	**45.4**	**39.7**	**41.5**	**39.6**	**43.6**	**60.4**	**63.9**	**67.0**	**107.3**	**61.0**	**74.3**	**57.4**		**107.3**

Notes:

1) Data shown for Northville Twp. applies only to that portion which is directly discharged to RVSDS and not included in data shown for WTUA.

2) The Western Townships Utilities Authority (WTUA) has two metered flow outlets to the Rouge Valley Sewage Disposal System (RVSDS) and a flow outlet to the Ypsilanti Community Utilities Authority (YCUA). While there is a contractual maximum flow rate to the RVSDS, the flow split between sewage districts is varied by WTUA. The reported average flow split from varied monthly. Therefore, the WTUA flows are included at the outlet with the percentage of the population. It is necessary to deduct the WTUA metered flow rates from the RVSDS flow rates when characterizing the Middle Rouge and Lower Rouge seperately. WTUA includes all of Canton Twp.; all of Plymouth Twp.; a small portion of Plymouth City not metered by C-B-A; and all of Northville Twp. except for 145 residents / 18 acres.

3) Average community flow rates by branch are computed by multiplying the average metered branch outlet flow rate by each communities ratio of the total residential population served by the branch, with the exception of Novi and WTUA. For Novi and WTUA, the metered flow rate from BG1, FE22, FE19, C, B and A are used to compute the community average flow rates, since these meters capture the entire community flow and were found to be reliable during previous studies.

Table 8
Rouge Valley Sewage Disposal System
Average Flow Summary by Community based on Community Meter Math -- July 2012 to June 2013

Community	Sewage Flow Meter Math[2]	Year 2000 Residential Population	Total Developed Land (acres)	Current Capacity Allocation (MGD)	Average Monthly Flow Rate (MGD)												Average Flow Rate (MGD)	Average (%)	Average Per Capita Flow Rate (GPCD)	Maximum Monthly Flow Rate (MGD)	Maximum Month (%)
					Jul-12	Aug-12	Sep-12	Oct-12	Nov-12	Dec-12	Jan-13	Feb-13	Mar-13	Apr-13	May-13	Jun-13					
Novi	100%[BG1]	38,451	8,086	13.23	4.17	4.26	4.15	4.22	4.24	4.33	4.80	4.80	4.93	5.34	4.69	4.81	*4.56*	*8%*	*118.65*	*5.34*	*6%*
Plymouth City	11.5%[3P+26P]+C-B-A+0.5%[WTUA FE22]	9,168	1,209	3.10	1.23	1.23	1.10	1.35	1.57	1.63	1.99	1.78	2.09	2.56	1.86	2.12	*1.71*	*3%*	*186.38*	*2.56*	*3%*
Northville City	13.7%[1P]+0.5%[WTUA FE22+C-B-A]	6,129	964	4.92	0.60	0.63	0.61	0.62	0.62	0.64	0.72	0.73	0.76	0.84	0.72	0.74	*0.68*	*1%*	*111.58*	*0.84*	*1%*
Garden City	98.4%[M1] + 94.8% [M2]	30,044	3,647	15.76	2.52	2.86	2.57	2.87	2.77	3.24	4.22	5.10	4.84	8.07	4.01	5.30	*4.03*	*7%*	*134.16*	*8.07*	*8%*
Livonia	7P-26P+LV16 +55.4%[8P-WTUA FE22] +64.7%[LV15]+LV14+12P+4.1%[13P]	100,511	18,597	68.81	10.46	10.98	9.77	10.06	9.56	10.28	13.18	14.50	15.69	22.41	15.17	16.75	*13.23*	*23%*	*131.66*	*22.41*	*23%*
Westland[1]	44.6%[8P-WTUA FE22]+35.3%[LV15] +WE14+5.2%[M2]+1.6%[M1] +4.5%[9P+10P+11P-WTUA FE22] +WE25+6.2%[19P-WTUA FE19] +WE28+11.2%[21P-WTUA FE19] +1.8%[25P-WTUA FE19] +3.4%[20P]+9.9%[24P]	86,645	9,676	51.71	8.46	8.56	8.07	8.24	8.17	8.56	10.73	11.59	12.24	15.19	10.32	10.97	*10.09*	*18%*	*116.47*	*15.19*	*16%*
Redford Twp	95.9%[13P] + 0.2%[WCS2+WCS3+14P-WTUA FE22]	50,228	6,074	34.17	4.62	4.79	4.07	4.41	4.15	4.72	6.67	7.36	8.05	12.03	7.21	8.09	*6.35*	*11%*	*126.39*	*12.03*	*12%*
Dearborn Heights	11.3%[WCS2+WCS3+14P-WTUA FE22] +5.4%[24P]+0.8%[25P-WTUA FE19]	37,452	4,117	42.29	3.55	3.63	3.12	3.26	3.14	3.45	4.84	5.12	5.49	9.00	4.91	6.17	*4.64*	*8%*	*123.90*	*9.00*	*9%*
Van Buren Twp	[15P]	5,003	1,667	3.23	0.59	0.54	0.49	0.62	0.76	0.70	0.89	0.99	1.10	1.34	0.88	1.02	*0.83*	*1%*	*165.02*	*1.34*	*1%*
Romulus	24.5% [17P]	1,991	752	2.33	0.42	0.41	0.40	0.41	0.45	0.40	0.48	0.47	0.49	0.60	0.47	0.53	*0.46*	*1%*	*231.99*	*0.60*	*1%*
Wayne	13.9% [17P]+15.4%[19P-WTUA FE19] +94.3%[20P]+0.2%[21P-WTUA FE19]	19,039	2,833	18.04	2.15	2.52	2.36	2.39	2.40	2.44	3.50	4.39	4.32	5.19	3.49	3.36	*3.21*	*6%*	*168.55*	*5.19*	*5%*
Inkster	2.3%[20P]+0.1%[21P-WTUA FE19] +44.7%[24P]+21.4%[25P-WTUA FE19]	30,122	3,113	17.22	2.65	2.53	2.29	2.54	2.55	2.54	3.83	4.35	4.29	6.47	3.93	3.99	*3.50*	*6%*	*116.07*	*6.47*	*7%*
WTUA	99.0% [WTUA FE22] - [C] + [A] + [B] + [WTUA FE19] + 0.3%[1P]	32,745	6,734	19.39	2.62	2.96	2.70	2.98	2.43	2.87	4.18	5.10	4.98	7.63	4.19	5.03	*3.97*	*7%*	*121.30*	*7.63*	*8%*
A	**Sum of Community Flow Rates (MGD):**				**44.03**	**45.88**	**41.71**	**43.96**	**42.79**	**45.80**	**60.03**	**66.29**	**69.26**	**96.69**	**61.84**	**68.88**					
B	**Sum of Outlet Meter Flow Rates (MGD):**				**44.77**	**45.36**	**39.74**	**41.47**	**39.59**	**43.63**	**60.43**	**63.87**	**66.99**	**107.25**	**60.99**	**74.31**					

Notes:

1) Average flow rates for Westland were calculated using two different meter math algorithms. Meters WE14 and WE25 were installed in February 2013 and WE28 was installed in March 2013 and were added to the meter math algorithm.

2) Sewage flow meter math based on populations as shown in Final Order of Abatement 2117 Flow Monitoring Annual Report for July 2012 through June 2013 (August 30, 2013)

3) Community flow rates vary between Table 7 and Table 8. Table 7 parses large tributary areas with less meters and estimates community flow rates based on population. Table 8 parses the tributary areas of each community and utilizes all available meters.

Table 9
Rouge Valley Sewage Disposal System
Dry Weather Flow Summary based on System Flow Meters, Prorated by Community Tributary Population -- July 2012 to June 2013

Branch	Sewage Flow Meter	Community	Year 2000 Residential Population	Total Developed Land (acres)	Current Capacity Allocation (MGD)	Average Dry Weather Flow Rate (MGD)												Average Flow Rate (MGD)	Average Flow Rate[3] (gal/capita/day)	Maximum Monthly Flow Rate (MGD)
						Jul-12	Aug-12	Sep-12	Oct-12	Nov-12	Dec-12	Jan-13	Feb-13	Mar-13	Apr-13	May-13	Jun-13			
Middle Rouge at Inkster Road	9P+10P+11P -WTUA FE22+C-B-A	Novi	38,451	8,086	13.2	4.2	4.2	4.1	4.2	4.2	4.3	4.5	4.8	4.9	4.4	4.6	4.6	4.4	104.2	4.9
		Northville Twp[1]	145	18	0.08	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.02	0.01		0.02
		Plymouth City	9,168	796	3.1	0.8	0.8	0.7	0.8	0.8	0.8	0.9	1.1	1.2	1.0	1.1	1.1	0.9		1.2
		Northville City	6,129	964	4.9	0.5	0.5	0.5	0.5	0.5	0.6	0.6	0.7	0.8	0.7	0.7	0.7	0.6		0.8
		Garden City	30,044	3,647	15.8	2.4	2.6	2.4	2.5	2.6	2.7	3.1	3.7	4.1	3.3	3.6	3.6	3.1		4.1
		Livonia	98,412	18,244	68.0	8.6	8.6	7.9	8.3	8.5	9.0	10.1	12.0	13.3	10.9	11.9	11.8	10.1		13.3
		Westland	43,995	4,874	26.2	3.5	3.8	3.5	3.7	3.8	4.0	4.5	5.4	5.9	4.9	5.3	5.3	4.5		5.9
		Total	**226,344**	**36,629**	**135.6**	**20.0**	**20.6**	**19.1**	**20.0**	**20.4**	**21.5**	**23.7**	**27.7**	**30.2**	**25.3**	**27.3**	**27.2**	**23.6**		**30.2**
Middle Rouge Outlet	WCS2+WCS3+14P -WTUA FE22+C-B-A	Novi	38,451	8,086	13.2	4.2	4.2	4.1	4.2	4.2	4.3	4.5	4.8	4.9	4.4	0.0	0.0	3.6	104.8	4.9
		Northville Twp[1]	145	18	0.08	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.02	0.01		0.02
		Plymouth City	9,168	796	3.1	0.8	0.8	0.7	0.8	0.8	0.8	0.9	1.1	1.2	1.0	1.1	1.1	0.9		1.2
		Northville City	6,129	964	4.9	0.5	0.5	0.5	0.5	0.5	0.6	0.6	0.7	0.8	0.7	0.7	0.7	0.6		0.8
		Garden City	30,044	3,647	15.8	2.4	2.6	2.4	2.5	2.6	2.7	3.1	3.7	4.1	3.3	3.6	3.6	3.1		4.1
		Livonia	100,511	18,597	68.8	9.6	9.1	7.9	7.9	7.9	8.7	10.9	13.1	15.0	11.8	15.0	14.1	10.9		15.0
		Westland	43,995	4,874	26.2	3.5	3.8	3.5	3.7	3.8	4.0	4.5	5.4	5.9	4.9	5.3	5.3	4.5		5.9
		Redford Twp	50,228	6,074	34.2	4.4	4.5	4.0	4.0	4.0	4.3	5.4	6.5	7.5	5.9	7.5	7.0	5.4		7.5
		Dearborn Heights	35,023	3,738	38.6	3.0	3.2	2.8	2.8	2.8	3.0	3.8	4.6	5.2	4.1	5.2	4.9	3.8		5.2
		Total	**313,694**	**46,794**	**208.3**	**28.3**	**28.8**	**25.9**	**26.4**	**26.6**	**28.5**	**33.8**	**39.9**	**44.6**	**36.2**	**38.6**	**36.7**	**32.9**		**44.6**
Lower Rouge Outlet	24P+25P-WTUA FE19	Van Buren Twp	5,003	1,667	3.2	0.5	0.4	0.4	0.4	0.4	0.4	0.5	0.7	0.7	0.5	0.6	0.6	0.5	101.9	0.7
		Romulus	1,991	752	2.3	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.3	0.3	0.2	0.3	0.2	0.2		0.3
		Wayne	19,039	2,833	18.0	1.7	1.5	1.5	1.6	1.6	1.6	2.0	2.5	2.6	2.1	2.4	2.2	1.9		2.6
		Westland	42,650	4,802	25.5	3.5	3.4	3.3	3.5	3.6	3.6	4.5	5.7	5.9	4.7	5.4	5.0	4.3		5.9
		Inkster	30,122	3,113	17.2	2.4	2.4	2.3	2.5	2.6	2.5	3.2	4.0	4.1	3.3	3.8	3.6	3.1		4.1
		Dearborn Heights	2,429	379	3.7	0.2	0.2	0.2	0.2	0.2	0.2	0.3	0.3	0.3	0.3	0.3	0.3	0.2		0.3
		Total	**101,234**	**13,546**	**70.0**	**8.4**	**8.1**	**7.8**	**8.4**	**8.7**	**8.6**	**10.8**	**13.4**	**13.9**	**11.0**	**12.7**	**12.0**	**10.3**		**13.9**
RVSDS Outlet	WCS1+WCS2+WCS3	Novi	38,451	8,086	13.2	4.2	4.2	4.1	4.2	4.2	4.3	4.5	4.8	4.9	4.4	4.6	4.6	4.4	105.3	4.9
		Northville Twp[1]	145	18	0.05	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.02	0.02	0.02		0.02
		Plymouth City	9,168	1,209	3.1	1.3	1.3	1.2	1.4	1.7	1.8	2.0	2.1	2.5	2.2	2.1	2.3	1.8		2.5
		Northville City	6,129	964	4.9	0.6	0.6	0.5	0.5	0.5	0.5	0.7	0.8	0.9	0.7	0.8	0.7	0.6		0.9
		Garden City	30,044	3,647	15.8	2.7	2.7	2.5	2.5	2.5	2.7	3.2	3.9	4.2	3.3	3.7	3.5	3.1		4.2
		Livonia	100,511	18,597	68.8	9.9	9.2	8.4	8.4	8.4	9.0	10.7	13.0	14.1	11.2	12.5	11.7	10.5		14.1
		Westland	86,645	9,676	51.7	7.7	7.9	7.2	7.2	7.3	7.7	9.3	11.2	12.1	9.6	10.8	10.1	9.0		12.1
		Redford Twp	50,228	6,074	34.2	4.5	4.6	4.2	4.2	4.2	4.5	5.4	6.5	7.0	5.6	6.3	5.8	5.2		7.0
		Dearborn Heights	37,452	4,117	42.3	3.3	3.4	3.1	3.1	3.1	3.3	4.0	4.8	5.2	4.2	4.7	4.4	3.9		5.2
		Van Buren Twp	5,003	1,667	3.2	0.5	0.5	0.4	0.4	0.4	0.4	0.5	0.6	0.7	0.6	0.6	0.6	0.5		0.7
		Romulus	1,991	752	2.3	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.3	0.3	0.2	0.2	0.2	0.2		0.3
		Wayne	19,039	2,833	18.0	1.8	1.7	1.6	1.6	1.6	1.7	2.0	2.5	2.7	2.1	2.4	2.2	2.0		2.7
		Inkster	30,122	3,113	17.2	2.6	2.8	2.5	2.5	2.5	2.7	3.2	3.9	4.2	3.4	3.8	3.5	3.1		4.2
		WTUA[2]	39,707	8,165	19.4	2.5	2.6	2.6	2.8	2.4	2.7	3.0	4.7	4.7	3.5	4.0	4.1	3.3		4.7
		Total	**454,635**	**68,918**	**294.2**	**42.0**	**41.7**	**38.5**	**39.2**	**39.1**	**41.5**	**48.8**	**58.9**	**63.6**	**50.9**	**56.5**	**53.9**	**47.9**		**63.6**

Notes:

1) Data shown for Northville Twp. applies only to that portion which is directly discharged to RVSDS and not included in data shown for WTUA.

2) The Western Townships Utilities Authority (WTUA) has two metered flow outlets to the Rouge Valley Sewage Disposal System (RVSDS) and a flow outlet to the Ypsilanti Community Utilities Authority (YCUA). While there is a contractual maximum flow rate to the RVSDS, the flow split between sewage districts is varied by WTUA. The reported average flow split from varied monthly. Therefore, the WTUA flows are included at the outlet with the percentage of the population. It is necessary to deduct the WTUA metered flow rates from the RVSDS flow rates when characterizing the Middle Rouge and Lower Rouge seperately. WTUA includes all of Canton Twp.; all of Plymouth Twp.; a small portion of Plymouth City not metered by C-B-A; and all of Northville Twp. except for 145 residents / 18 acres.

3) Average community flow rates by branch are computed by multiplying the average metered branch outlet flow rate by each communities ratio of the total residential population served by the branch, with the exception of Novi and WTUA. For Novi and WTUA, the metered flow rate from BG1, FE22, FE19, C, B and A are used to compute the community average flow rates, since these meters capture the entire community flow and were found to be reliable during previous studies.

Table 10
Rouge Valley Sewage Disposal System
Dry Weather Flow Summary by Community based on Community Meter Math -- July 2012 to June 2013

Community	Sewage Flow Meter Math[2]	Year 2000 Residential Population	Total Developed Land (acres)	Current Capacity Allocation (MGD)	Average Monthly Dry Weather Flow Rate (MGD)												Average Flow Rate (MGD)	Average (%)	Average Per Capita Flow Rate (GPCD)	Maximum Monthly Flow Rate (MGD)	Maximum Month (%)
					Jul-12	Aug-12	Sep-12	Oct-12	Nov-12	Dec-12	Jan-13	Feb-13	Mar-13	Apr-13	May-13	Jun-13					
Novi	100%[BG1]	38,451	8,086	13.23	4.15	4.22	4.15	4.20	4.24	4.29	4.53	4.75	4.86	4.41	4.63	4.60	*4.42*	*9%*	*114.92*	*4.86*	*7%*
Plymouth City	11.5%[3P+26P]+C-B-A+0.5%[WTUA FE22]	9,168	1,209	3.10	1.22	1.21	1.10	1.33	1.56	1.61	1.81	1.75	2.06	1.86	1.78	2.01	*1.61*	*3%*	*175.40*	*2.06*	*3%*
Northville City	13.7%[1P]+0.5%[WTUA FE22+C-B-A]	6,129	964	4.92	0.59	0.62	0.60	0.61	0.62	0.63	0.67	0.72	0.74	0.67	0.70	0.69	*0.66*	*1%*	*107.08*	*0.74*	*1%*
Garden City	98.4%[M1] + 94.8% [M2]	30,044	3,647	15.76	2.36	2.59	2.48	2.70	2.71	3.03	3.35	4.62	4.54	3.43	3.69	3.85	*3.28*	*7%*	*109.14*	*4.62*	*7%*
Livonia	7P-26P+LV16 +55.4%[8P-WTUA FE22] +64.7%[LV15]+LV14+12P+4.1%[13P]	100,511	18,597	68.81	10.08	10.43	9.60	9.75	9.50	10.02	11.49	13.74	15.23	12.40	14.30	13.88	*11.70*	*23%*	*116.43*	*15.23*	*23%*
Westland[1]	44.6%[8P-WTUA FE22]+35.3%[LV15] +WE14+5.2%[M2]+1.6%[M1] +4.5%[9P+10P+11P-WTUA FE22] +WE25+6.2%[19P-WTUA FE19] +WE28+11.2%[21P-WTUA FE19] +1.8%[25P-WTUA FE19] +3.4%[20P]+9.9%[24P]	86,645	9,676	51.71	8.21	8.20	7.94	8.00	8.11	8.31	9.40	11.01	11.83	8.95	9.77	9.54	*9.11*	*18%*	*105.09*	*11.83*	*18%*
Redford Twp	95.9%[13P] + 0.2%[WCS2+WCS3+14P-WTUA FE22]	50,228	6,074	34.17	4.22	4.37	3.91	4.07	4.06	4.48	5.40	6.84	7.81	6.37	6.74	6.43	*5.39*	*11%*	*107.34*	*7.81*	*12%*
Dearborn Heights	11.3%[WCS2+WCS3+14P-WTUA FE22] +5.4%[24P]+0.8%[25P-WTUA FE19]	37,452	4,117	42.29	3.33	3.36	3.04	3.09	3.10	3.29	3.94	4.72	5.22	4.22	4.53	4.26	*3.84*	*8%*	*102.57*	*5.22*	*8%*
Van Buren Twp	[15P]	5,003	1,667	3.23	0.58	0.52	0.49	0.59	0.76	0.69	0.79	0.95	1.08	0.98	0.85	0.95	*0.77*	*2%*	*153.95*	*1.08*	*2%*
Romulus	24.5% [17P]	1,991	752	2.33	0.41	0.40	0.39	0.41	0.45	0.39	0.45	0.46	0.48	0.44	0.46	0.51	*0.44*	*1%*	*219.31*	*0.51*	*1%*
Wayne	13.9% [17P]+15.4%[19P-WTUA FE19] +94.3%[20P]+0.2%[21P-WTUA FE19]	19,039	2,833	18.04	2.05	2.38	2.31	2.31	2.37	2.34	3.02	4.30	4.23	3.03	3.27	2.99	*2.88*	*6%*	*151.39*	*4.30*	*6%*
Inkster	2.3%[20P]+0.1%[21P-WTUA FE19] +44.7%[24P]+21.4%[25P-WTUA FE19]	30,122	3,113	17.22	2.50	2.32	2.20	2.39	2.51	2.41	3.17	4.07	4.14	3.26	3.71	3.40	*3.01*	*6%*	*99.82*	*4.14*	*6%*
WTUA	99.0% [WTUA FE22] - [C] + [A] + [B] + [WTUA FE19] + 0.3%[1P]	32,745	6,734	19.39	2.46	2.57	2.54	2.77	2.38	2.63	2.96	4.68	4.66	3.44	3.98	4.10	*3.26*	*6%*	*99.70*	*4.68*	*7%*
A	**Sum of Community Flow Rates (MGD):**				**42.17**	**43.19**	**40.74**	**42.22**	**42.35**	**44.11**	**50.97**	**62.61**	**66.89**	**53.46**	**58.41**	**57.23**					
B	**Sum of Outlet Meter Flow Rates (MGD):**				**41.98**	**41.74**	**38.46**	**39.15**	**39.07**	**41.49**	**48.78**	**58.95**	**63.56**	**50.89**	**56.55**	**53.85**					

Notes:

1) Average flow rates for Westland were calculated using two different meter math algorithms. Meters WE14 and WE25 were installed in February 2013 and WE28 was installed in March 2013 and were added to the meter math algorithm.

2) Sewage flow meter math based on populations as shown in Final Order of Abatement 2117 Flow Monitoring Annual Report for July 2012 through June 2013 (August 30, 2013)

3) Community flow rates vary between Table 9 and Table 10. Table 9 parses large tributary areas with less meters and estimates community flow rates based on population. Table 10 parses the tributary areas of each community and utilizes all available meters.

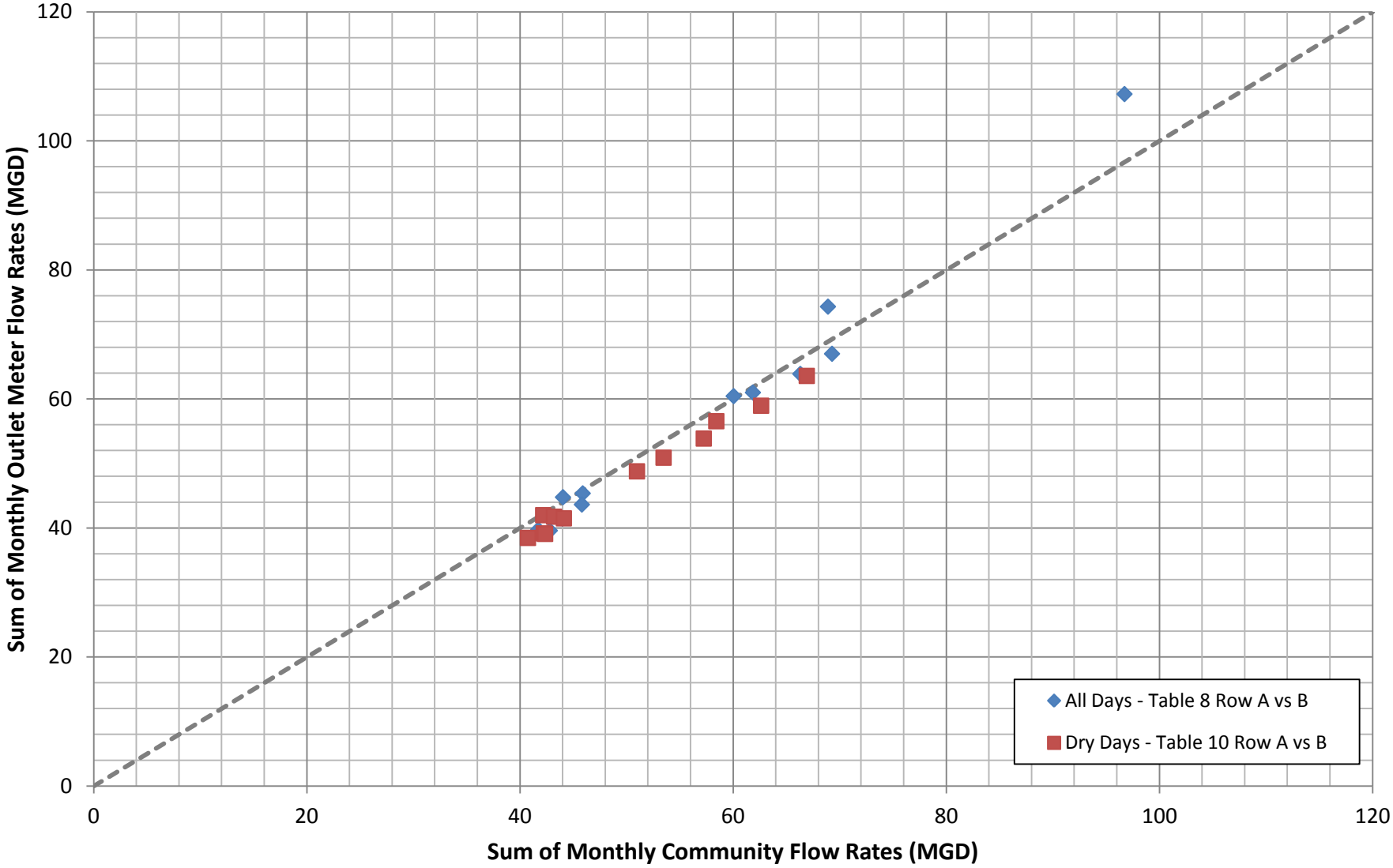
Table 11
Rouge Valley Sewage Disposal System
Dry/Wet Weather Day Count by Month - July 2012 through June 2013

Month	Number of Dry Weather Days	Number of Wet Weather Days
Jul-12	27	4
Aug-12	26	5
Sep-12	27	3
Oct-12	26	5
Nov-12	29	1
Dec-12	26	5
Jan-13	22	9
Feb-13	23	5
Mar-13	26	5
Apr-13	9	21
May-13	26	5
Jun-13	18	12
Total	285	80

Figure 4

Rouge Valley Sewage Disposal System

End of System Monthly Flow Rate Comparison - July 2012 to June 2013



4.1.3 Wet Weather Flow

For wet weather, the community meter math was applied to the time-series data and the peak hourly value was reported for three wet weather events as shown in Table 12. In reality, flow is routed and attenuated as it travels through the interceptor system. This method may not account for routing and attenuation. However, since the community meter math formulas rely on the community connection meters wherever they are available, interceptor routing and attenuation is not expected to be a significant factor for the community flow rate estimates. Table 12 flags any values that exceed the current capacity allocations and shows each community's peaking factor. The peaking factor is a ratio of the maximum hourly flow rate during the event to the average dry weather flow rate for that month, as shown in Table 10.

4.2 Event Analyses

Table 13 provides a summary of all rainfall events during the FOA Monitoring Period. There were nine events that met the criteria for a significant storm event (at least one inch of rainfall on average for all the rain gages listed in Table 3). These events had varying degrees of uniformity, as can be seen in the coefficient of variation column. The April 10 through 12, 2013 event was the largest and most uniform event during the FOA Monitoring Period, with about 2.02 inches of rain over the course of a 54-hour period. This event, however, had considerably less rainfall than the MDEQ design events for Sanitary Sewer Overflow (SSO) control: a 25-year, 24 hour design event which has 3.9 inches of rainfall in a 24-hour period or a 10-year, 1-hour design event which has 1.8 inches of rainfall in a 1-hour period. These rainfalls are based on the information provided in *Technical Paper No.40: Rainfall Frequency Atlas of the United States, 1963*.

Table 14 shows the peak hourly flow rate and peak HGLs at each meter location during the FOA Monitoring Period. It is interesting to note that these are not always concurrent, indicating that the peak HGL is driven by factors besides tributary flow rate, such as backwater from the DWSD connections. Surcharging was noted in the most downstream portion of the RVSDS only; this is likely to be a combined effect of backwater and higher inflows from several downstream communities. There is no indication of surcharging to grade for any event.

It was anticipated that profile displays of HGL during large storm events would be included in this report to show the problem areas for the peak event during the FOA Monitoring Period. Since the peak event was relatively small with limited surcharging and no SSO from the RVSDS was evident, the HGL profile was not produced.

Table 12
Rouge Valley Sewage Disposal System
Estimated Maximum Hourly Flow Rates by Community - July 2012 to June 2013

Community	Sewage Flow Meter Math	Current Capacity Allocation (MGD)	Event 5 4/10/2013 - 4/12/2013 2.02 in		Event 6 4/17/2013 - 4/19/2013 1.81 in		Event 9 6/25/2013 - 6/29/2013 1.90 in	
			Maximum Hourly Flow Rate (MGD)	Peaking Factor	Maximum Hourly Flow Rate (MGD)	Peaking Factor	Maximum Hourly Flow Rate (MGD)	Peaking Factor
Novi	100%[BG1]	13.2	9.8	2.2	10.7	2.4	9.1	2.0
Plymouth City	11.5%[3P+26P]+C-B-A+0.5%[WTUA FE22]	3.1	*3.6*	2.0	*4.8*	2.6	*3.5*	1.8
Northville City	13.7%[1P]+0.5%[WTUA FE22+C-B-A]	4.9	1.5	2.2	1.6	2.5	1.4	2.0
Garden City	98.4%[M1] + 94.8% [M2]	15.8	*22.5*	6.6	*31.3*	9.1	*17.8*	4.6
Livonia	7P-26P+LV16 +55.4%[8P-WTUA FE22]+64.7%[LV15]+LV14+12P+4.1%[13P]	68.8	34.7	2.8	47.1	3.8	36.0	2.6
Westland	44.6%[8P-WTUA FE22]+35.3%[LV15]+WE14+5.2%[M2]+1.6%[M1]+4.5%[9P+10P+11P-WTUA FE22]+WE25+6.2%[19P-WTUA FE19]+WE28+11.2%[21P-WTUA FE19]+1.8%[25P-WTUA FE19]+3.4%[20P]+9.9%[24P]	51.7	24.4	2.7	33.2	3.7	22.2	2.3
Redford Twp	95.9%[13P]+ 0.2%[WCS2+WCS3+14P-WTUA FE22]	34.2	25.9	4.1	26.9	4.2	18.8	2.9
Dearborn Heights	11.3%[WCS2+WCS3+14P-WTUA FE22]+5.4%[24P]+0.8%[25P-WTUA FE19]	42.3	13.7	3.2	18.0	4.3	13.3	3.1
Van Buren Twp	[15P]	3.2	2.5	2.6	2.9	2.9	1.9	1.9
Romulus	24.5% [17P]	2.3	1.4	3.1	1.5	3.4	1.1	2.3
Wayne	13.9% [17P]+15.4%[19P-WTUA FE19]+94.3%[20P]+0.2%[21P-WTUA FE19]	18.0	11.3	3.7	13.6	4.5	12.0	4.0
Inkster	2.3%[20P]+0.1%[21P-WTUA FE19]+44.7%[24P]+21.4%[25P-WTUA FE19]	17.2	14.7	4.5	*17.5*	5.4	13.2	3.9
WTUA	99.0%[WTUA FE22]+ WTUA FE19 + 0.3%[1P] - ([C]-[B]-[A])	19.4	17.3	3.8	*21.9*	4.8	15.8	2.9

Legend:

xx.x	Exceeds the Current Capacity Allocation by 0 to 10%
xx.x	Exceeds the Current Capacity Allocation by more than 10%

Notes:

1) The peaking factor is a ratio of the maximum flow rate observed during the event to the average monthly dry weather flow rate.

Table 13
Rouge Valley Sewage Disposal System
Summary of Rainfall Events

Period: 7/1/2012 through 6/30/2013

Significant Event No.**	Start Date/Time	Stop Date/Time	Duration (hours)	Preceeding Week Rainfall (inches)	Rainfall Depth (inches)				Coefficient of Variation*
					Minimum	Average	Maximum	Std. Dev	
1	7/26/2012 0:00	7/28/2012 6:00	54.0	0.13	0.26	1.24	2.68	0.94	76%
2	8/6/2012 2:00	8/11/2012 10:00	128.0	0.24	0.86	1.25	1.70	0.23	18%
3	1/28/2013 0:00	1/31/2013 0:00	72.0	0.09	0.19	1.28	2.11	0.46	35%
4	2/26/2013 0:00	3/1/2013 0:00	72.0	0.25	0.78	1.27	1.66	0.27	21%
5	4/10/2013 0:00	4/12/2013 6:00	54.0	0.14	1.62	2.02	2.30	0.19	9%
6	4/17/2013 12:00	4/19/2013 12:00	48.0	1.82	0.91	1.81	2.17	0.29	16%
7	5/27/2013 12:00	5/29/2013 0:00	36.0	0.24	0.83	1.05	1.43	0.14	14%
8	6/12/2013 12:00	6/13/2013 12:00	24.0	1.01	1.05	1.55	2.05	0.27	17%
9	6/25/2013 6:00	6/29/2013 0:00	90.0	0.09	1.18	1.90	2.43	0.37	20%

*The coefficient of variation (CV) is the ratio of the standard deviation to the average. It provides a normalized assessment of the degree of spatial variability for a given event. This allows comparisons to be made between events regarding their uniformity over the service area independent of the magnitude of each event. A low CV means the storm event's rainfall was evenly distributed over the district, a high CV means the storm event had pockets of intense rainfall within the district.

**Events were the average rainfall depth exceeds 1 inch are considered significant events and are numbered for use in the FOA monitoring.

MDEQ Design Events:

10-Year, 1-hour = 1.47 in (Rainfall Frequency Atlas of the Midwest 1992, Floyd A. Huff and James R. Angel)
25-Year, 24-hour = 3.60 in (Rainfall Frequency Atlas of the Midwest 1992, Floyd A. Huff and James R. Angel)
10-Year, 1-hour = 1.75 in (Technical Paper No.40: Rainfall Frequency Atlas of the United States 1963, U.S. Weather Bureau)
25-Year, 24-hour = 3.9 in (Technical Paper No.40: Rainfall Frequency Atlas of the United States 1963, U.S. Weather Bureau)

Table 14
Rouge Valley Sewage Disposal System
Maximum Peak Hydraulic Gradeline Summary - July 2012 to June 2013

Meter	Manhole ID	Interceptor Branch	Interceptor Height (inches)	Interceptor Rim (feet)	Interceptor Invert (feet)	Maximum of all Events				
						Peak Recorded Hourly Flow Rate (MGD)	Time	Peak Recorded Depth (feet)		Time
RVSDS_NOVI_BG1	NT 25	Novi Trunk Sewer	42	822.00	797.58	10.65	4/19/13 8:00	--	--	--
RVSDS_P01	NAI 1-13A	NAI	48	742.00	716.74	11.17	4/19/13 8:45	1.56	○	4/19/13 9:30
RVSDS_P03	MRIR 5C-01	MRIR	36	681.87	652.92	13.11	4/19/13 9:55	1.70	○	4/19/13 9:55
RVSDS_P26	PWI 2-05	PWI	30	664.00	649.49	1.44	4/19/13 9:55	2.50	⊙	7/26/12 4:45
RVSDS_P07	PWI I-03	PWI	48	650.20	625.72	4.36	4/19/13 11:30	1.51	○	4/19/13 11:15
LIVONIA_LV16	--	Community Sewer	48	--	--	6.35	6/13/13 3:30	2.14	○	6/12/13 18:50
WTUA_FE-22	RVI 10-11	RVI	48	685.00	645.83	23.12	4/18/13 20:05	2.24	○	4/18/13 19:45
PLYMOUTH_A	--	Community Sewer	21	--	--	1.41	4/10/13 0:00	0.67	○	6/27/13 17:00
PLYMOUTH_B	--	Community Sewer	36	--	--	3.04	6/27/13 18:00	0.80	○	6/27/13 18:00
PLYMOUTH_C	--	Community Sewer	30	--	--	6.57	1/30/13 8:00	1.07	○	4/11/13 2:45
RVSDS_P08	RVI 9-20	Rouge Valley	48	645.00	622.76	21.84	4/18/13 20:45	2.71	○	4/19/13 11:00
LIVONIA_LV15	--	Community Sewer	60	--	--	7.26	6/13/13 4:00	5.94	⊗	4/19/13 8:45
RVSDS_M22	--	Community Sewer	42	--	--	--	--	--	--	--
GARDENCITY_M2	--	Community Sewer	72	--	608.00	12.43	6/13/13 6:15	7.18	⊗	4/19/13 12:00
GARDENCITY_M1	--	Community Sewer	60	--	--	20.76	6/13/13 5:00	9.07	⊗	4/19/13 9:30
LIVONIA_LV14	--	Community Sewer	54	632.00	606.54	9.16	6/13/13 3:00	4.90	⊙	4/19/13 10:45
RVSDS_LVBASIN	RVI 12-12	RVI	54	631.00	602.99	20.71	4/19/13 10:45	11.22	⊙	4/19/13 10:35
LIVONIA_LV04	--	Community Sewer	30	--	--	7.91	4/11/13 7:00	2.46	○	4/19/13 7:00
LIVONIA_LV11	--	Community Sewer	42	630.00	612.00	13.14	6/13/13 4:45	6.51	⊙	4/18/13 1:45
RVSDS_P12	RVI 12-01	RVI	60	620.00	598.65	29.77	4/19/13 9:30	9.01	⊙	4/19/13 10:30
RVSDS_P09	NHV 3-34	MRIR	42	609.00	597.48	13.69	4/19/13 11:30	8.77	⊙	4/19/13 9:00
RVSDS_P10	RVI 6-50	RVI	66	610.00	596.00	65.61	4/19/13 10:15	8.54	⊙	4/19/13 11:30
RVSDS_P11	MR II-18	MRPIE	48	610.00	596.57	26.25	4/19/13 11:50	7.27	⊙	4/19/13 10:30
RVSDS_P13	MR IV -07	MRPIE	54	625.00	587.33	28.00	6/13/13 7:10	6.65	⊙	4/19/13 10:10
RVSDS_P14	RVI 4-16A	RVI	78	592.50	575.86	76.44	6/13/13 15:00	9.62	⊙	4/18/13 21:15
WCS2	MR 1A-C2	MRPIE	54	582.50	564.59	37.82	4/19/13 11:55	--	--	--
WCS3	MRIR 1-01B	MRIR	48	600.00	561.45	59.66	6/13/13 19:10	--	--	--
RVSDS_P15	WRVI - 54	Wayne Romulus	24	667.00	652.11	2.85	4/18/13 21:10	1.42	○	4/18/13 20:15
RVSDS_P17	LRIR 9-17	LRIR	30	640.50	632.83	6.02	4/18/13 20:50	1.27	○	4/19/13 9:30
WTUA_FE-19	--	Community Sewer	--	--	--	4.40	4/11/13 8:00	--	--	--
RVSDS_P19	RVI 15-17	RVI	48	630.00	622.50	19.44	4/18/13 19:55	2.66	○	4/18/13 19:35
RVSDS_P21	RVI 14-19	RVI	54	625.00	609.11	32.16	4/18/13 21:35	2.40	○	4/18/13 19:55
RVSDS_P25	RVI 5-14	RVI	60	598.00	589.05	49.90	4/19/13 11:35	5.69	⊙	4/18/13 22:20
RVSDS_P20	WI E-35	WI	48	624.00	619.88	10.40	4/18/13 20:00	2.90	○	4/18/13 18:40
RVSDS_P24	WI E-08	WI	52	622.00	599.99	16.31	4/18/13 19:30	5.32	⊙	4/18/13 21:35
WCS1	MR I 05B	RVI	96	--	554.79	121.64	6/13/13 10:30	--	--	--
RVSDS_WE25	--	Community Sewer	27	--	--	6.59	4/19/13 10:35	1.92	○	4/19/13 9:30
RVSDS_WE28	--	Community Sewer	30	--	--	6.39	4/18/13 19:50	1.29	○	4/18/13 19:20
RVSDS_WE14	--	Community Sewer	42	--	--	7.81	4/18/13 19:05	6.20	⊗	4/19/13 11:35

Key	
LRIR	Lower Rouge Interceptor Relief
MR	Middle Rouge
MRIR	Middle Rouge Interceptor Relief
NAI	Northville Arm Interceptor
NHV	North Huron Valley
NT	Novi Truck Sewer
PWI	Parkway Interceptor
RVI	Rouge Valley Interceptor
WIE	Wayne Interceptor Extension
WRVI	Wayne-Romulus-Van Buren Interceptor

Key	
Within sewer:	○
Surcharging sewer, grade elevation unknown:	⊗
Surcharging sewer, grade elevation known:	⊙
Above grade:	●
Data Not Available:	--

District-wide capture coefficients were computed for the three largest events during the FOA Monitoring Period. The system branch analyses were not completed because the events were small, the system responses were mild and the total system capture coefficients were low. Table 15 presents the capture coefficients from the three events. The analysis of these events is shown on Figures 5, 6, and 7.

Table 15
Rouge Valley Sewage Disposal System
Total System Capture Coefficients

Significant Event No.	Start Date/Time	Stop Date/Time	Average Rainfall (inches)	Capture Coefficient
5	4/10/2013 0:00	4/12/2013 6:00	2.02	5.3%
6	4/17/2013 0:00	4/19/2013 12:00	1.81	8.0%
9	6/25/2013 6:00	6/29/2013 0:00	1.90	4.5%

A full capture coefficient analysis will be completed under a future Wayne County project.

4.3 Preliminary Assessment of STCAP Effectiveness

The recently completed improvements to the RVSDS under the STCAP included the following work to reduce infiltration and inflow (I/I) and SSOs from the RVSDS:

- Sewer interceptor rehabilitation (segment lining, spot repairs, joint repairs),
- Improvements to Lift Station 1A (LS1A) including a second pair of downstream siphons under the Rouge River,
- Improvements to regulators and junction chambers,
- Manhole rehabilitation, and
- Improvements to connections of Hines Park comfort stations to the RVSDS within the Rouge River floodplain.

This report presents a preliminary assessment of the effectiveness of the STCAP improvements in reducing I/I. A more rigorous analysis of whether a LTCAP is needed to meet the

requirements of FOA 2117 is being completed separately. The effectiveness of the STCAP improvements in reducing I/I has been initially assessed by:

1) Reviewing recorded flow rates before and after STCAP work was completed, and
2) Using recorded meter level data to evaluate the hydraulic grade line of the RVSDS interceptor system after STCAP work was completed.

Figure 5

Rouge Valley Sewage Disposal System

Capture Coefficient Analysis - Event 5: April 10 to 12, 2013

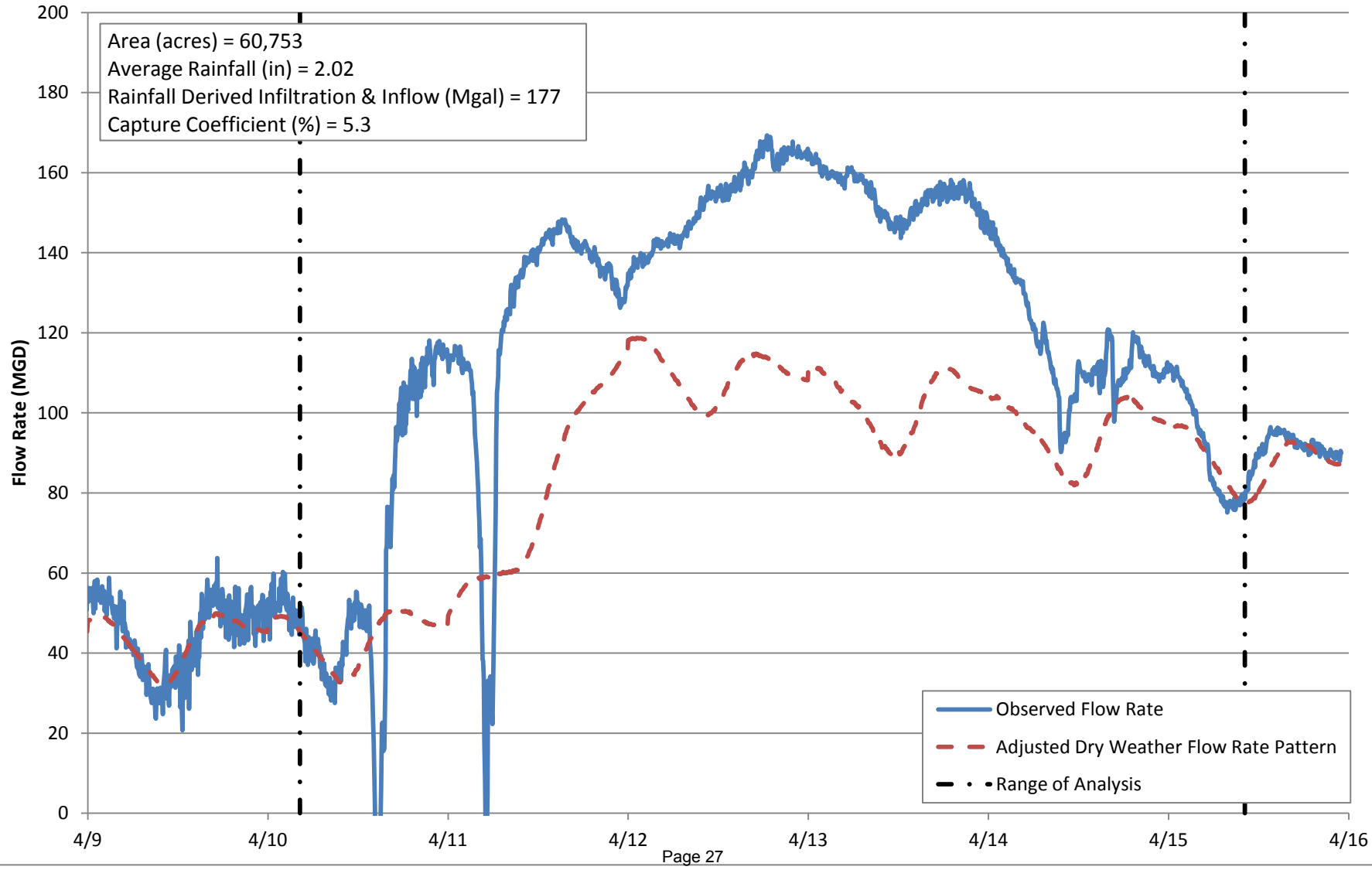


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Figure 6

Rouge Valley Sewage Disposal System

Capture Coefficient Analysis - Event 6: April 17 to 19, 2013

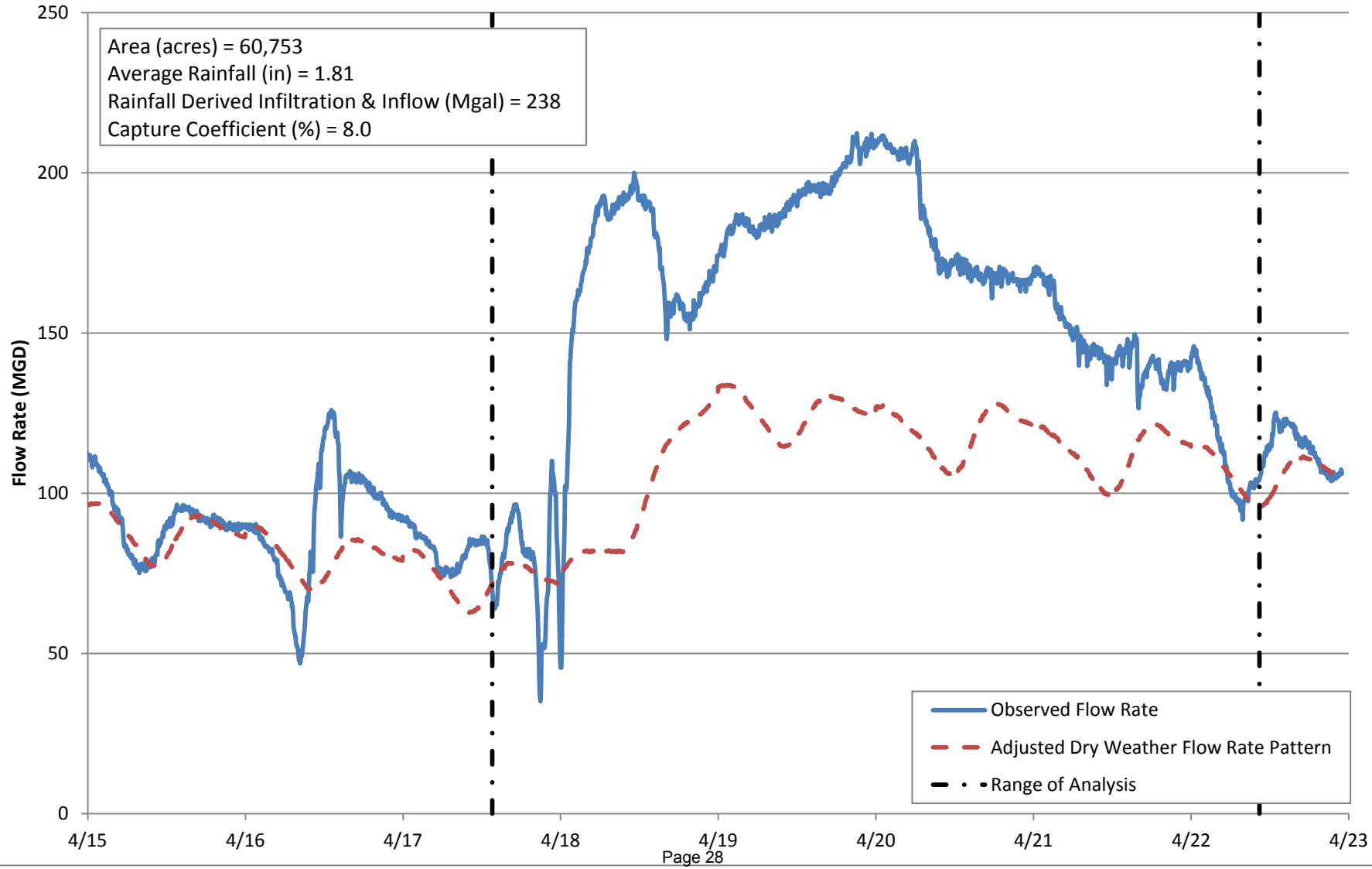

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Figure 7

Rouge Valley Sewage Disposal System

Capture Coefficient Analysis - Event 9: June 25 to 29, 2013

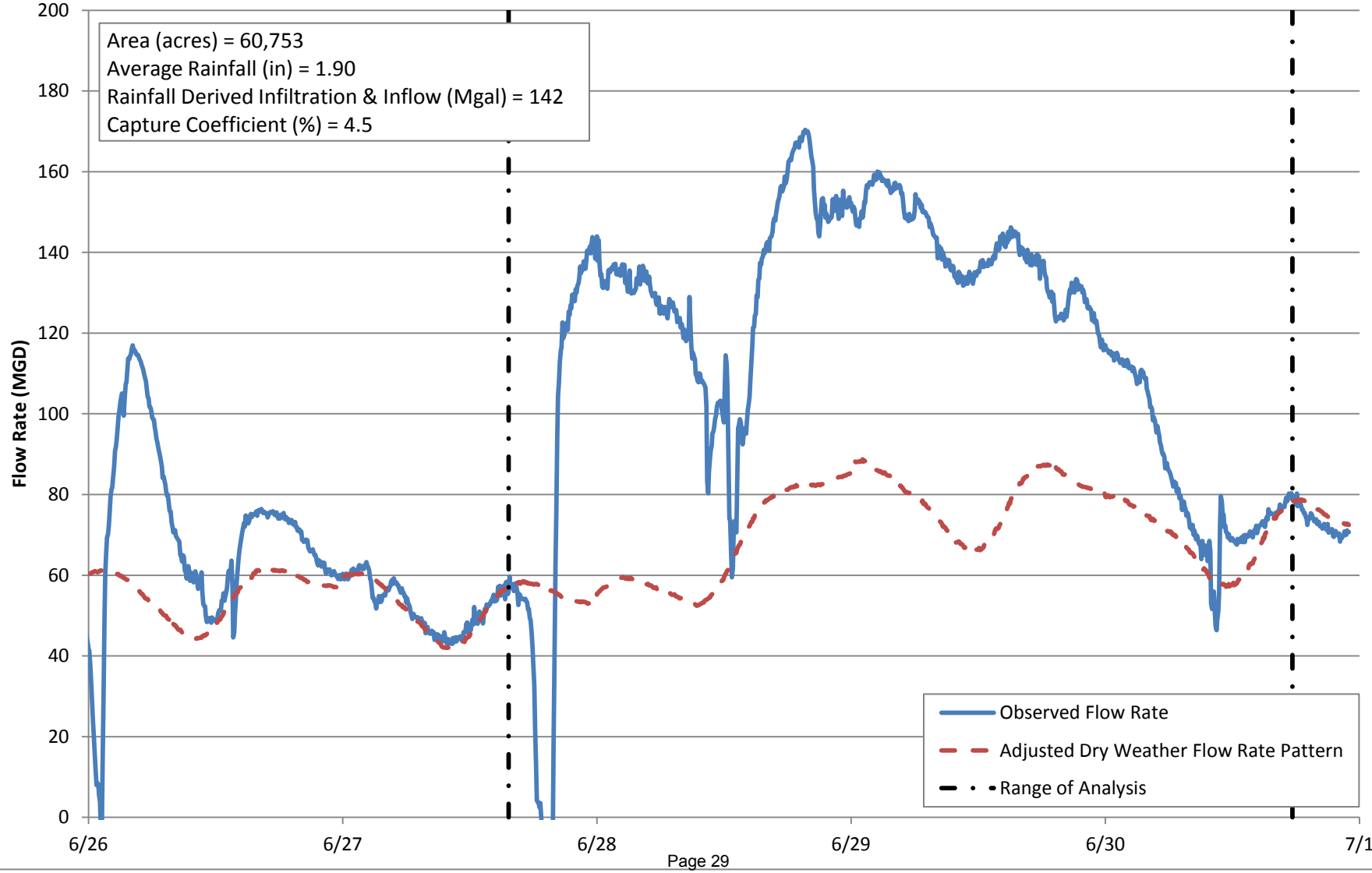

Table 16 presents a summary of dry weather flows for the total system and at key system locations before and after completion of the STCAP. Locations were selected to show the total system and several local areas. The historic data is presented for two individual dry weather days that were selected to represent system flows in a summertime low dry weather condition (August 31, 2008) and a springtime high dry weather condition (March 13, 2008). Likewise, for the FOA Monitoring Period, the monthly dry weather flow from the driest month (September 2012) and wettest month (March 2013) were shown. The total annual rainfall in 2008 and in the one-year FOA Monitoring Period are comparable. The summertime in both years were marked by an extended period without rain (six weeks in 2008 and five weeks in 2012).

The comparison shows that for dry weather periods, there is little change in the dry weather flow at these locations, indicating that the sanitary contribution has not changed significantly since the pre-rehabilitation period. During the spring, the post-rehabilitation dry weather flow is significantly lower. This is certainly an indication that there is less I/I in the post-rehabilitation period. However, the post-rehabilitation I/I during the summer is lower than the pre-rehabilitation values, including in areas where system improvements were not implemented under the STCAP, though not as sharply lower as for the total system. This indicates that some of the reduction is likely due to the hydrologic effects of 2012 and early 2013 being unusually dry periods.

Because all of the storm events that occurred during the FOA Monitoring Period were small in comparison to the MDEQ criteria for SSO control, the preliminary assessment of STCAP effectiveness reducing I/I during wet weather is limited to plotting depth versus flow rate at select locations for a rain event during the FOA Monitoring Period. Figures 8 and 9 show plots of depth versus flow rate for the period surrounding Event No. 6 (April 17-19, 2013) at Meters P9, P10 and P11 on the Middle Rouge interceptor system and Meters P24 and P25 on the Lower Rouge interceptor, respectively. The intent of these plots is to check for hydraulic discrepancies. As can be seen, the recorded data all fall along a repeatable band of flow rate versus depth. If a hydraulic discrepancy was present, the recorded data would depart from the general trend. It is possible that these same locations may exhibit a discrepancy for larger events.

Table 16
Rouge Valley Sewage Disposal System
Preliminary Assessment of STCAP Effectiveness

Meters	Description	Dry Weather Flow Rate (MGD)			
		2008		2012 - 2013 FOA Monitoring Period	
		8/31/2008	3/13/2008	September 2012	March 2013
BG1	Novi	3.7	5.4	4.1	4.9
LV15	Livonia Connection L-18, along Merriman	0.8	2.1	1.0	1.6
M1 + M2	Garden City	2.5	7.9	2.6	4.7
LV14	Livonia Connection L-19, west of Inkster	0.8	2.1	0.8	1.5
LV4 + LV11	Livonia Connections L-24 and L-24, along Inkster	3.2	8.1	4.4	6.3
WCS1 + WCS2 + WCS3 - FE19 - FE22 + C - B - A	Total District-WTUA, Novi, and part of Plymouth	31.7	95.0	35.9	58.9
WCS1 + WCS2 + WCS3	Total District	37.5	108.6	38.5	63.6
	Annual Precipitation at DTW (in)	34.0		34.9	

Notes:

1) Rainfall data collected at the Detroit Metropolitan Wayne County Airport (DTW) station number 94847, and retrieved from the National Climatic Data Center website.

2) Annual reported rainfall from January 2008 to December 2008 and from July 2012 to June 2013

3) 8/31/2008 and September 2012 are representative of summertime low dry weather conditions.

4) 3/13/2008 and March 2013 are representative of springtime high dry weather conditions.

Figure 8

Rouge Valley Sewage Disposal System

Flow Depth Versus Flow Rate - Event 6: April 17 - 19, 2013

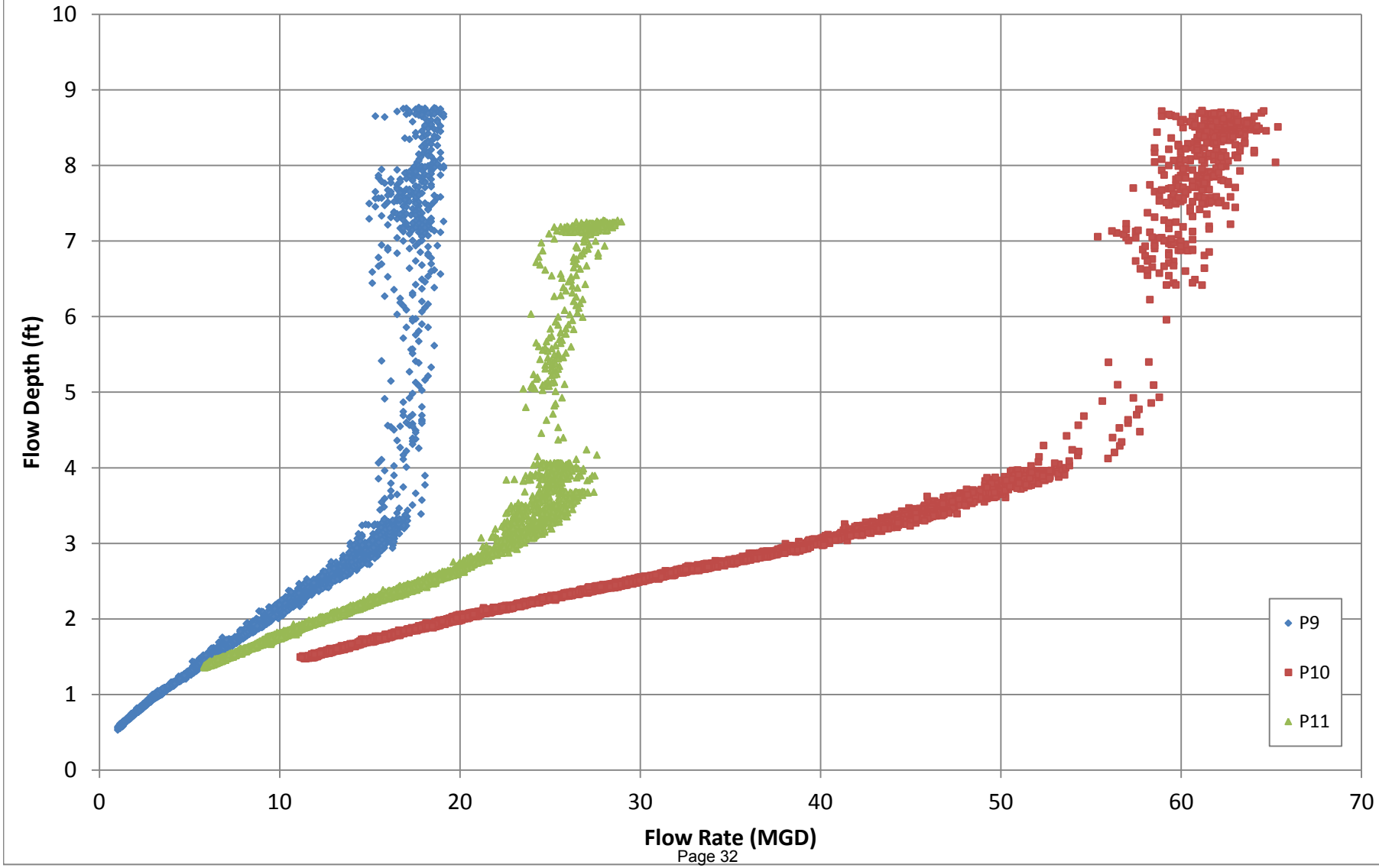

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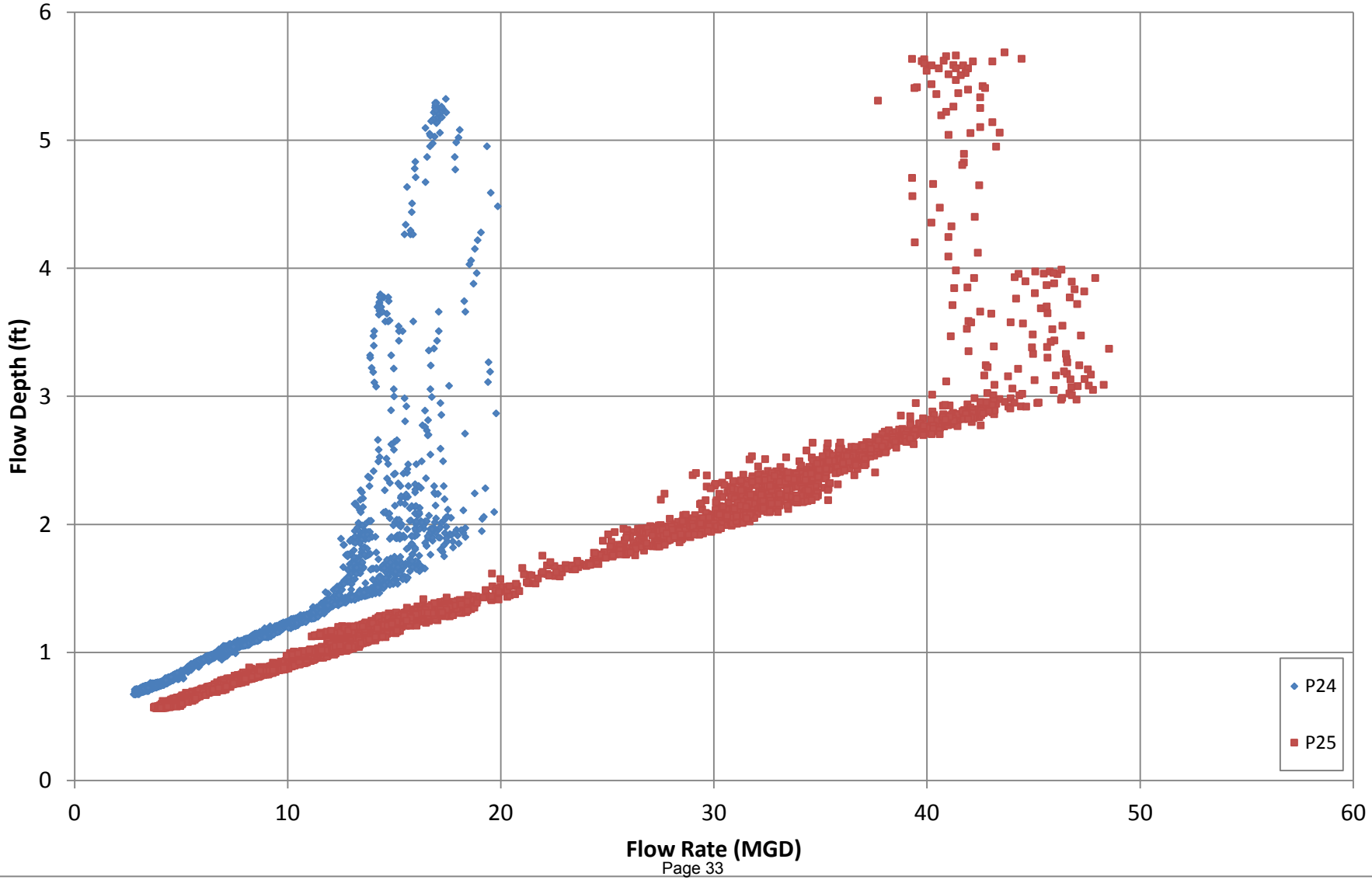
Figure 9

Rouge Valley Sewage Disposal System

Flow Depth Versus Flow Rate - Event 6: April 17 - 19, 2013



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5. ADDITIONAL USES FOR FOA MONITORING PROGRAM DATA

The high quality data collected for the RVSDS during the FOA Monitoring Plan will be useful during the forthcoming analysis of needed improvements to the RVSDS (if any) to be implemented under a LTCAP in accordance with FOA 2117. Wayne County will continue the RVSDS monitoring network into the future in support of the LTCAP and to provide quality, timely data to assist with operation of the RVSDS for the benefit of all system customers.

6. CONCLUSIONS

Through review of the final assembled data set for the FOA Monitoring Program (July 1, 2012 – June 30, 2012), the following conclusions were drawn:

- The RVSDS meter network provided high quality data throughout the FOA Monitoring Period.
- No SSOs were indicated by the meter data.
- The data shows that there were lower dry weather flow rates in the spring of 2013 as compared to March of 2008. It is likely that the flow rates reflect STCAP effectiveness or drier hydrologic conditions. It is also possible that this is a combined effect of both factors.
- While there were nine storm events that met the criteria to be termed “significant”, the magnitude and duration of these storms were all considerably smaller than the magnitude and duration of a design storm event.
- Wayne County will continue the FOA monitoring program into the future in support of the LTCAP for the RVSDS and to provide quality, timely data to assist with operation of the RVSDS for the benefit of all system customers.

Appendix A

System Reach Maps

Appendix B

Quarter 1 - Final Data Summary
(July 2012 through September 2012)

Appendix C

Quarter 2 - Final Data Summary
(October2012 through December 2012)

Appendix D

Quarter 3 - Final Data Summary
(January 2013 through March 2013)

Appendix E

Quarter 4 - Final Data Summary
(April 2013 through June 2013)