



# LAKE WHATCOM WATER AND SEWER DISTRICT

## 2011-2012 UPDATE OF INFLOW AND INFILTRATION ANALYSIS EXECUTIVE SUMMARY

FEBRUARY 13, 2013



## PROJECT BACKGROUND

- ❖ The District requested an update to the Inflow and Infiltration analysis that was last performed using data from 2002-2004
- ❖ Inflow is water that enters the sewer collection system from the surface,
- ❖ Infiltration is water that enters the system through cracks, separated joints, or other flaws in the pipes or manholes
- ❖ This analysis will be incorporated into the 2013 Comprehensive Sewer Plan Update



## PROJECT BACKGROUND

- ❖ District I&I Reduction Projects since 2004:
  - ✓ Installed manhole dishes in approximately 39% of the sewer manholes to minimize inflow from the surface
  - ✓ Regular video inspection of its sewer pipes during wet weather to locate pipe leaks
  - ✓ Contract for leak repair - cure-in-place pipe spot repairs in 2005, 2010, 2011 and 2012
  - ✓ Contract for repairing leaking manholes – 2012



## PROJECT BACKGROUND

- ❖ District I&I Reduction Projects since 2004 (cont.):
  - ✓ Contracted its first of a series of smoke tests in 2012 – anomalies found in Geneva included:
    1. Three illegal roof drain connections
    2. One broken sewer lateral
    3. Four buried and/or improperly set sewer manholes
    4. 22 broken cleanouts
    5. One cleanout in a driveway that had been converted into a stormwater catch basin.



## I & I ANALYSES

### ❖ Environmental Protection Agency (EPA) Criteria (Sewer System Infrastructure Analysis and Rehabilitation Handbook (EPA/625/6-91/030)):

- ✓ “No further I/I analysis will be necessary if domestic wastewater plus non-excessive infiltration does not exceed 120 gallons per capita per day (gpcd) during periods of high groundwater. The total daily flow during a storm should not exceed 275 gpcd, and there should be no operational problems such as surcharges, bypasses or poor treatment performance resulting from hydraulic overloading of the treatment works during storm events.”



## I & I ANALYSES

### ❖ Scenarios investigated:

1. Spring Weather with Rain - Presumed High Groundwater
2. Winter Weather without a Major Storm Day- Presumed High Groundwater
3. Peak Wet Weather day with rain preceding in the week - Presumed High Groundwater
4. Peak Wet Weather day with additional following in the week - Presumed High Groundwater
5. Dry Weather (no rain on dry soils)



# I & I ANALYSES

		South Shore		North Shore	
	Rain				
	inches/week	average gpdpc	peak gpdpc	average gpdpc	peak gpdpc
1. Spring (Rain on Wet Soils)					
15-Feb-12	2.4	111	178	82	102
15-Mar-12	1.4	111	132	95	104
25-Apr-12	2.1	84	105	86	96
2. Winter (Dry on Wet soils)					
29-Nov-11	0.1	69	83	58	67
6-Dec-12	0	73	79	58	67
19-Mar-12	0.31			86	96
3. Peak rain with rain before					
16-Apr-12	1.69	80	121		
27-Oct-12	2.55			86	107
17-Nov-12	3.25	120	169	96	145
4. Peak Rain with rain after					
22-Nov-11	2.26	104	174	77	125
19-Nov-12	3.03	128	169	96	134
5. Summer (Dry on soils)					
31-Aug-11	0	60	65	57	61
11-Aug-12	0	56	59	66	73

**I & I**  
**<275**  
**gpcd**

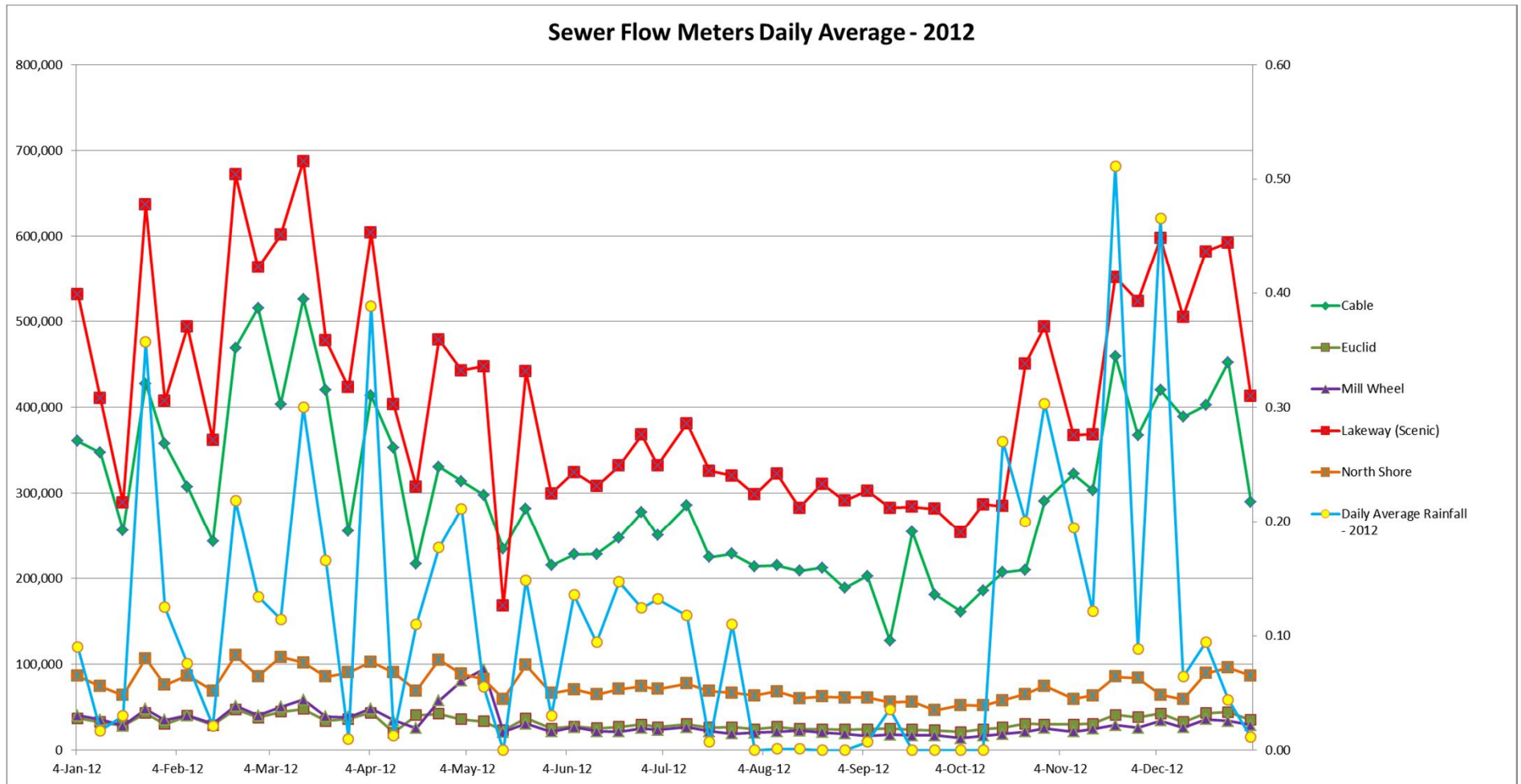
**Infiltration - < 120 gpcd**

**I & I**  
**<275**  
**gpcd**

**Base Flows**



# SEWER FLOWS VS RAIN - 2012







## SUMMARY

### ❖ Sewer Collection System Meets/Exceeds EPA Criteria:

- All storm event peak flows are less than 275 gpcd
- All high groundwater flows are less than 120 gpcd
- No operational issues during storm events

		<b>South Shore</b>		<b>North Shore</b>	
		Highest average gpcd	Highest peak gpcd	Highest average gpcd	Highest peak gpcd
High Groundwater		73	83	86	96
	Storm Event	128	178	96	145

### ❖ I&I Reduction efforts appear to be having an effect

- South Shore infiltration reduced by about 10%



## RECOMMENDATIONS

- ❖ Continue video inspection of the sewer collection system to identify defects and contract for those repairs
- ❖ Continue to smoke test areas to find anomalies, illegal connections and “lost” manholes
- ❖ Continue to inspect manholes and have leaks repaired
- ❖ Conduct an I&I analysis every two years.



## **2011-2012 Update of Inflow and Infiltration Analysis**

### **Background**

At the request of the District, we have prepared this updated analysis of the sewer collection system's inflow and infiltration (I&I). Inflow is water that enters the sewer collection system from the surface, while infiltration is water that enters the system through cracks, separated joints, or other flaws in the pipes or manholes.

This analysis was last completed using data from 2002-2004 and was included in the District's last Comprehensive Sewer Plan. In the intervening years the District has undertaken several projects to reduce the quantity of I&I that enters the collection system. The District has installed manhole dishes in approximately 39% of the sewer manholes to minimize inflow from the surface. The District also routinely uses video inspection of its sewer pipes during wet weather to locate pipe leaks and then contracts to have the leaks repaired. In recent years staff has inspected about 25% of the system in a year but the quantity should increase with the newly purchased camera system. The District contracted for cure-in-place pipe spot repairs in 2005, 2010, 2011 and 2012.

In 2012 the District also contracted to repair leaking manholes. The contractor's report indicated that they were able to stop approximately 400 gallons per minute of water leaking into the sewer system with the manhole repairs.

The District contracted its first of a series of smoke tests to look for anomalies and illegal drain connections. The first area tested was Geneva in the summer of 2012, with North Shore and Sudden Valley to be smoke tested in subsequent years. The anomalies found through the Geneva smoke tests included the following (a complete list is attached):

1. Three illegal roof drain connections
2. One broken sewer lateral
3. Four buried and/or improperly set sewer manholes
4. 22 broken cleanouts
5. One cleanout in a driveway that had been converted into a catch basin.

As established by the actions described above, the District has an ongoing and active program to reduce the quantity of inflow and infiltration that enters its sewer collection system.

### **Analysis**

For the I&I analysis we selected several different conditions from high rainfall on presumed saturated ground (Winter-Spring) to no rainfall on presumed dry ground (Summer). In comparing rain events with the previous I&I analysis covering 2002-2004, the 2011-2012 period did not have as many nor as heavy of rainfall events. Given that no two storm events are ever

the same, direct comparison with the previous data is not necessarily a good measure of the efficacy of the District's ongoing efforts.

To analyze the current impact of I&I on the District's collection systems, we reviewed sewer flows and rain data over the last 18 months. Our data set was limited due to the telemetry data being less than reliable for January-May 2011. Our evaluation criteria were based on those outlined in the Sewer System Infrastructure Analysis and Rehabilitation Handbook (EPA/625/6-91/030) for construction grant applicants:

"No further I/I analysis will be necessary if domestic wastewater plus non-excessive infiltration does not exceed 120 gallons per capita per day (gpcd) during periods of high groundwater. The total daily flow during a storm should not exceed 275 gpcd, and there should be no operational problems such as surcharges, bypasses or poor treatment performance resulting from hydraulic overloading of the treatment works during storm events."

Typically, the ground in this area is saturated from November through April. The attached analyses for Spring Weather-Presumed High Groundwater and Winter Weather without a Major Storm Day-Presumed High Groundwater include two-three examples which were used to determine the District's I&I levels for periods of high ground water. Also included in this analysis were examples for Dry Weather-No Rain to indicate a "baseline" level of sewer flows without I&I. Each example is based on the data gathered for the week selected.

#### A. Inflow and Infiltration South Shore

The South Shore (Sudden Valley, Geneva) sewer collection system consists of 6-inch to 10-inch gravity sewers with lift stations and force mains feeding either of two interceptor systems. The District regularly conducts video inspections of the gravity sewers to determine locations and severity of inflow and infiltration.

An analysis of the daily and weekly rainfall and sewer meter flow records show that the South Shore gravity sewer collection system shows a moderate to major flow increase during wet weather events. The attached charts graphically illustrates the total weekly rainfall and the average daily flow by week for the South Shore sewer collection system from May 2011 through November 2012. Weeks with higher rainfall are accompanied by increases in the total weekly flow through the sewer meters. Rainfall has a higher impact on sewer flows when the ground is saturated.

The analyses for Winter Weather without a Major Storm Day-Presumed High Groundwater include examples which were used to determine the District's I&I levels for periods of high ground water. The calculated average daily flow per capita ranged from 69-73 gpcd. Since these values are less than 120 gpcd, the South Shore system does not have excessive I&I due to high groundwater. These values are also less than the previous 2002-2004 values of 72-88 gpcd for Winter - no major storms, which would indicate progress in reducing infiltration from high groundwater.

The analysis of sewer flows during storm events shows a definite impact of rain-influenced infiltration (RII). In the Peak Wet Weather Day with Rainfall on Successive Days analysis, the peak sewer flow occurred on the day after the peak rainfall. The two storm events included in this section were very different in the rain patterns, but the peak daily flows per capita were within 3% of each other (169-174 gpcd).

The Peak Wet Weather Day and Antecedent Rainfall represent the potential worst-case examples of RII since the preceding rain will saturate the ground immediately prior to the major storm. Under these conditions, the calculated peak flow per capita did not exceed the 275 gpcd criteria as it had in the 2002-2004 analyses, but the 121-169 gpcd is closer to the values above for Rainfall on Successive Days. In 2002-2004 there are mitigating circumstances (e.g. the County storm system overflowing which flooded streets and inundated manholes) that resulted in unusually high levels of inflow. Based on these experiences, the District determined areas most susceptible to inflow due to flooding, and installed dish inserts into the manholes in these areas.

Also included in this analysis were examples for Dry Weather-No Rain. The calculated average daily flow per capita ranged from 56-60 gpcd for the dry conditions. These values are about the same as the 57-63 gpcd seen in 2002-2004. The estimated “peaking factor” relating the peak wet weather flow to the peak dry weather flow for South Shore is 2.77.

#### B. Inflow and Infiltration North Shore

The North Shore sewer collection system consists of 8-inch-10-inch gravity lateral sewers feeding an interceptor system with three lift stations and force mains. The District regularly conducts video inspections of the gravity sewers to determine locations and severity of inflow and infiltration.

The North Shore collection system I&I analysis was similar to the analysis described above for the South Shore collection system. We reviewed sewer flows and rain data over the last 18 months. The attached charts graphically illustrates the total weekly rainfall and the average daily flow by week for the South Shore sewer collection system from May 2011 through November 2012.

The analyses for Winter Weather without a Major Storm Day-Presumed High Groundwater include examples which were used to determine the District’s I&I levels for periods of high ground water. Each example is based on the data gathered for the week selected. The calculated average daily flow per capita ranged from 58-86 gpcd for Winter (no major storms). Since these values are much less than 120 gpcd, the North Shore collection system does not have excessive I&I due to high groundwater.

The analysis of North Shore sewer flows during storm events does not show as much of an impact of rain-influenced infiltration (RII) as seen in the South Shore collection system. For the analyses including storm events, the peak daily flow per capita was 102-145 gpcd, which is

much less than the 275 gpcd EPA criteria for daily flow defining excessive infiltration during a storm event.

Also included in this analysis were examples for Dry Weather-No Rain. The calculated average daily flow per capita ranged from 57-66 gpcd for the dry conditions. These values are about 6% higher than the South Shore collection system but lower than the 73-77 gpcd seen in 2002-2004. (This may be more indicative of the different water use patterns between North Shore and South Shore than the condition of the sewer collection system.)

The estimated “peaking factor” relating the peak wet weather flow to the peak dry weather flow for North Shore is 1.93.

### **Summary and Recommendations**

In summary, the District’s sewer collection systems substantially exceed the standards set by the EPA for acceptable inflow and infiltration. Furthermore the District has had no operational problems such as surcharges, bypasses or overflows during normal storm events, and has used the Detention Basin only once since the January 2009 flood (rain on snow event) where the volume was of any significance (around 1/2 to 2/3 full). There were a few other times the Basin was used, but the volume stored was insignificant - 1-2 feet deep or less.

In addition, the analyses appear to show a reduction of infiltration from high groundwater and a reduction in peak flows during storm events (though no single event in 2011-2012 matched the intensity of the major storm events of 2002-2004).

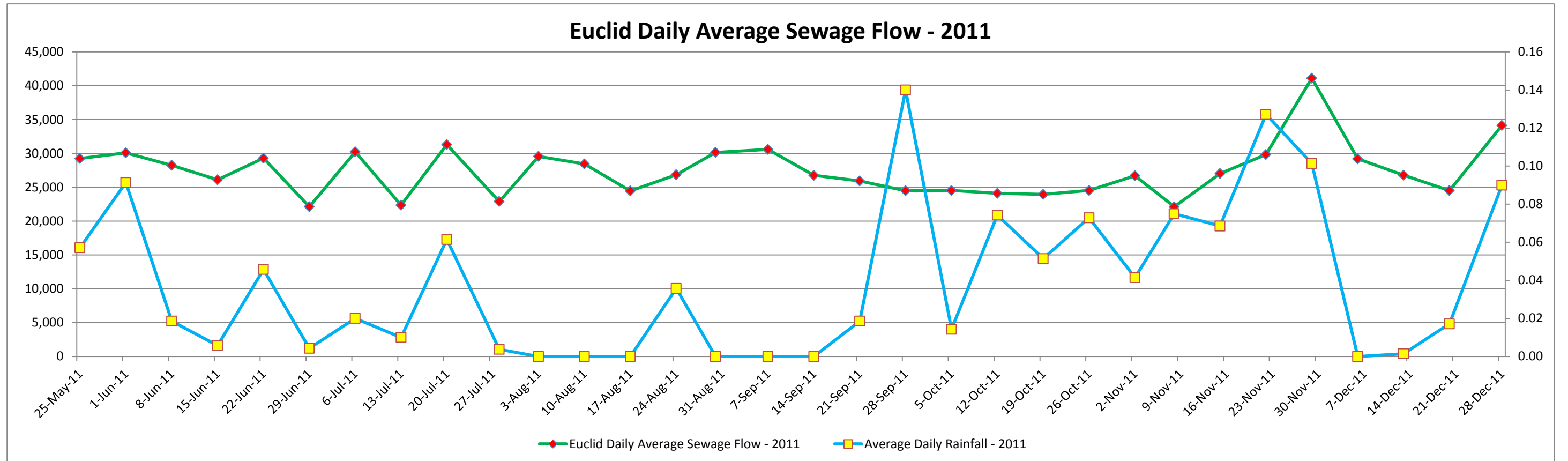
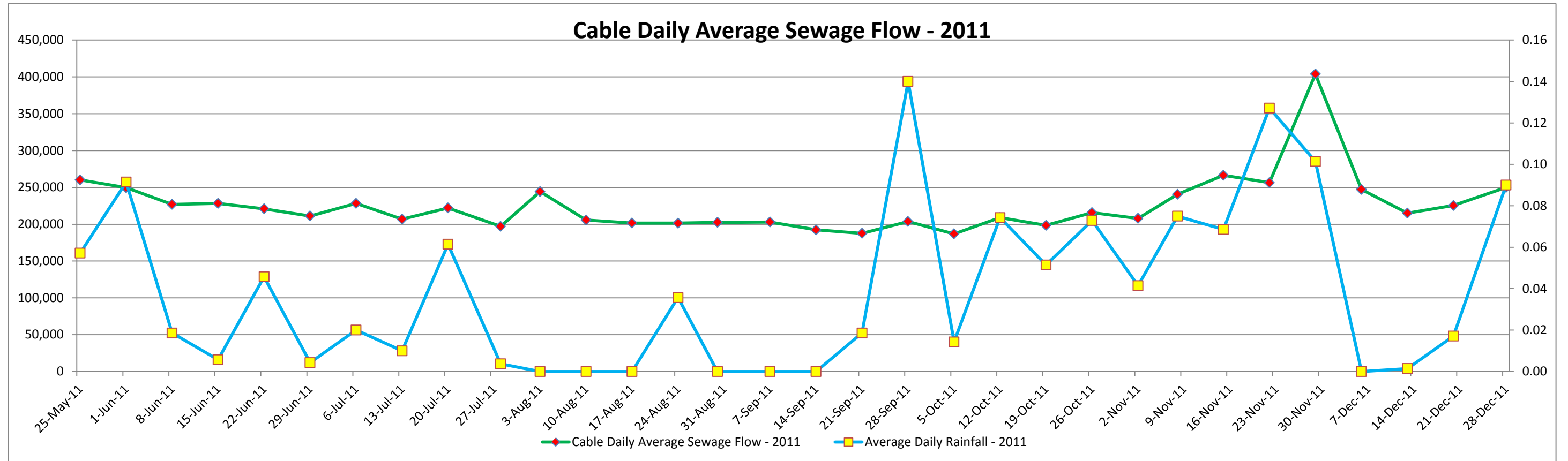
Our recommendations include:

1. Continue video inspection of the sewer collection system to identify defects and contract for those repairs
2. Continue to smoke test areas to find anomalies, illegal connections and “lost” manholes
3. Continue to inspect manholes and have leaks repaired
4. Conduct an I&I analysis every two years.

Enclosures:

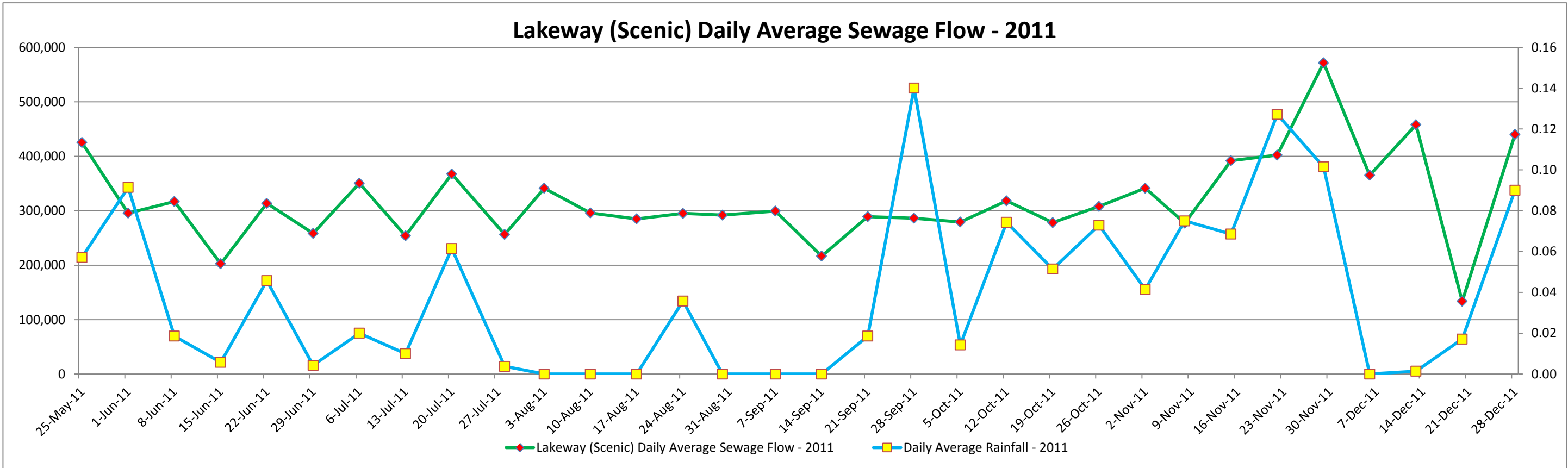
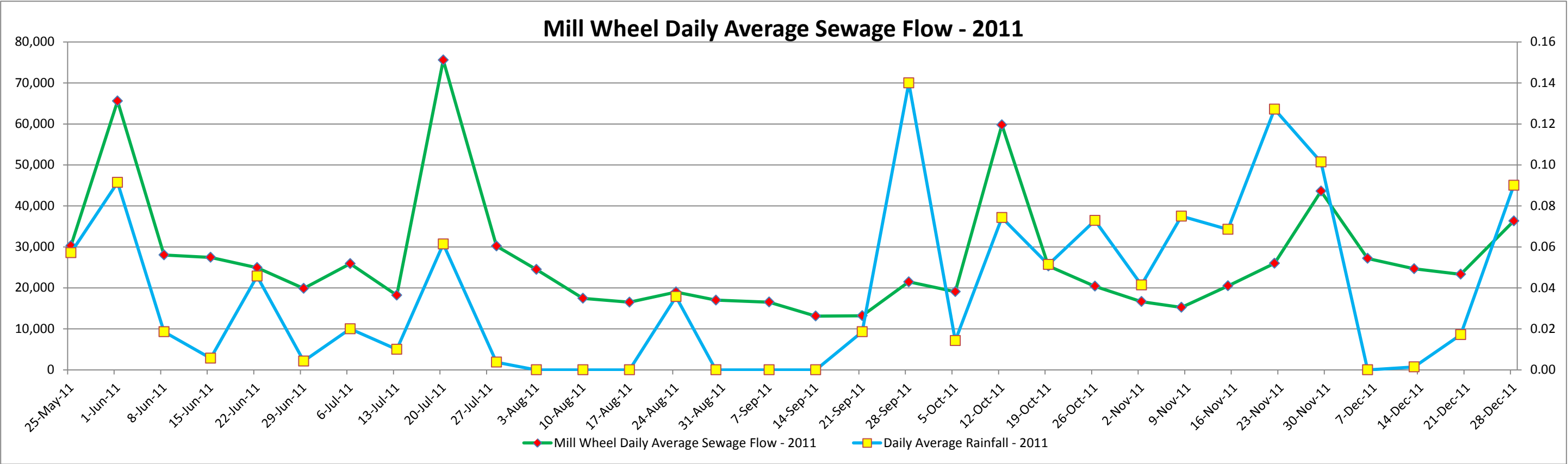
- Daily Average Flows vs Rain Data charts
- South Shore Collection System Flow Analyses
- North Shore Collection System Flow Analyses
- Geneva Smoke Testing Defects List

## AVERAGE DAILY SEWER FLOWS AND RAIN DATA



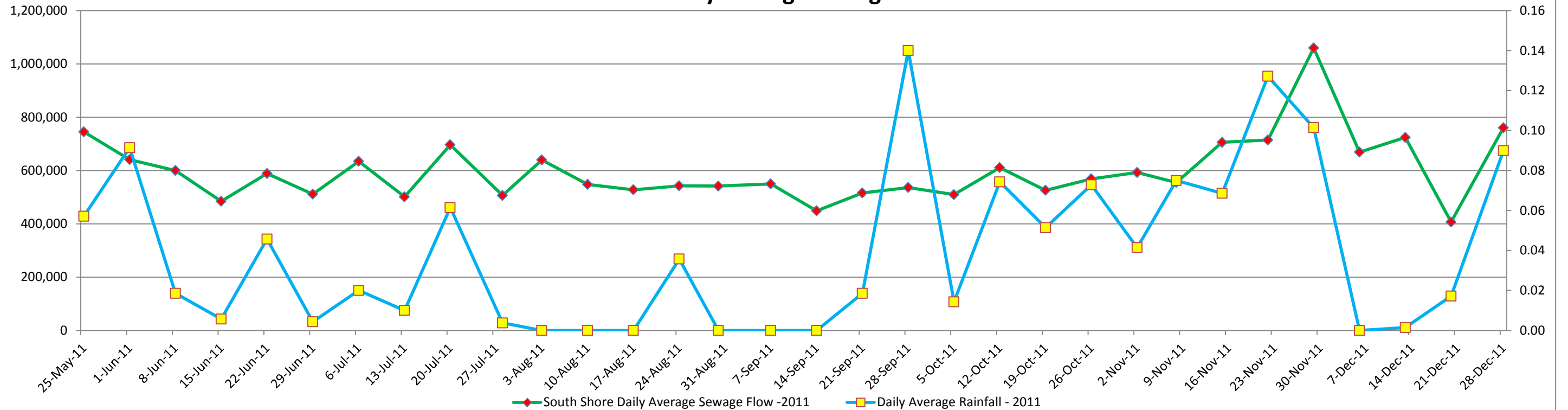


# AVERAGE DAILY SEWER FLOWS AND RAIN DATA

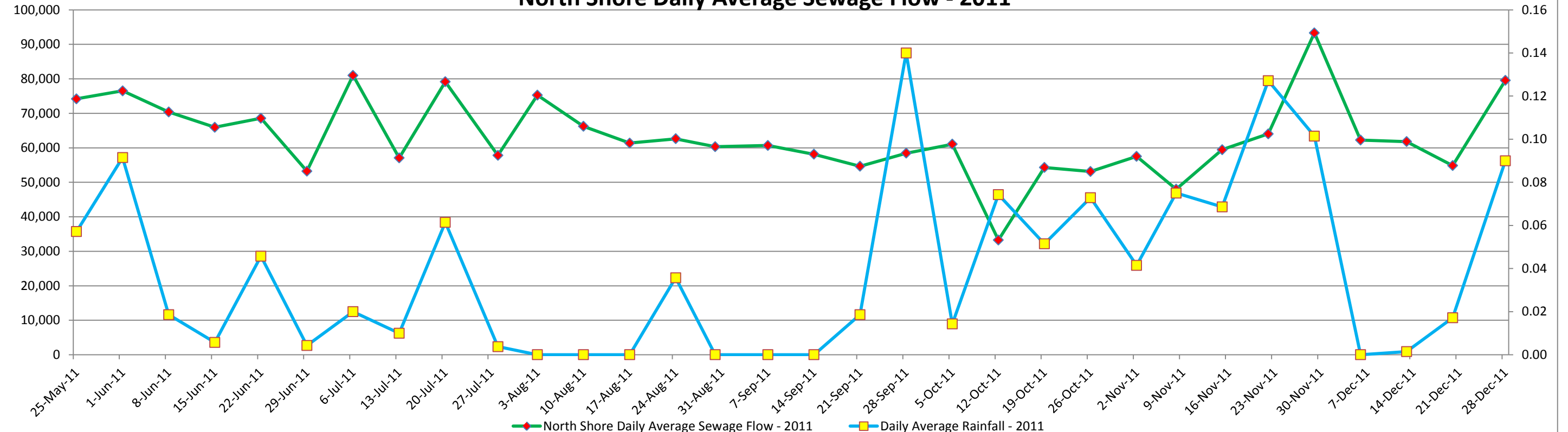


## AVERAGE DAILY SEWER FLOWS AND RAIN DATA

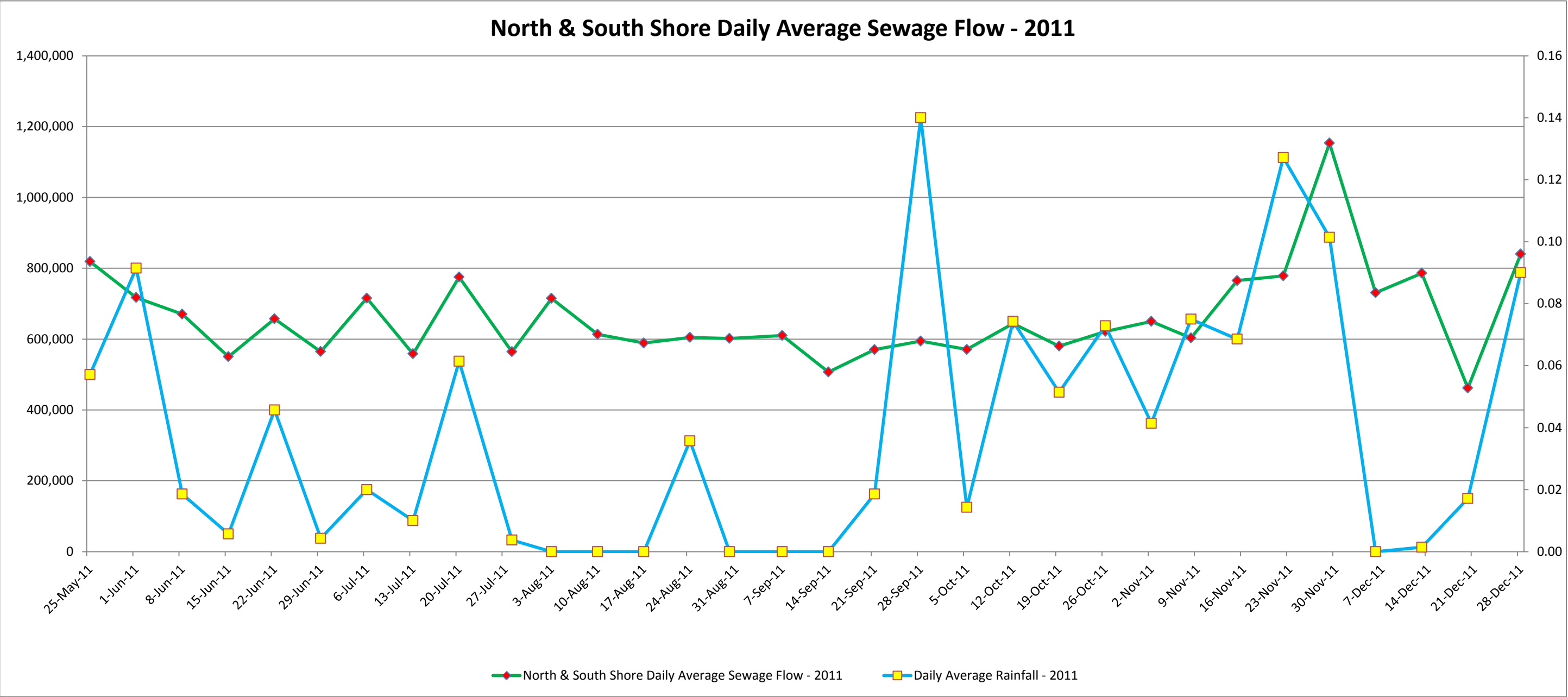
### South Shore Daily Average Sewage Flow - 2011



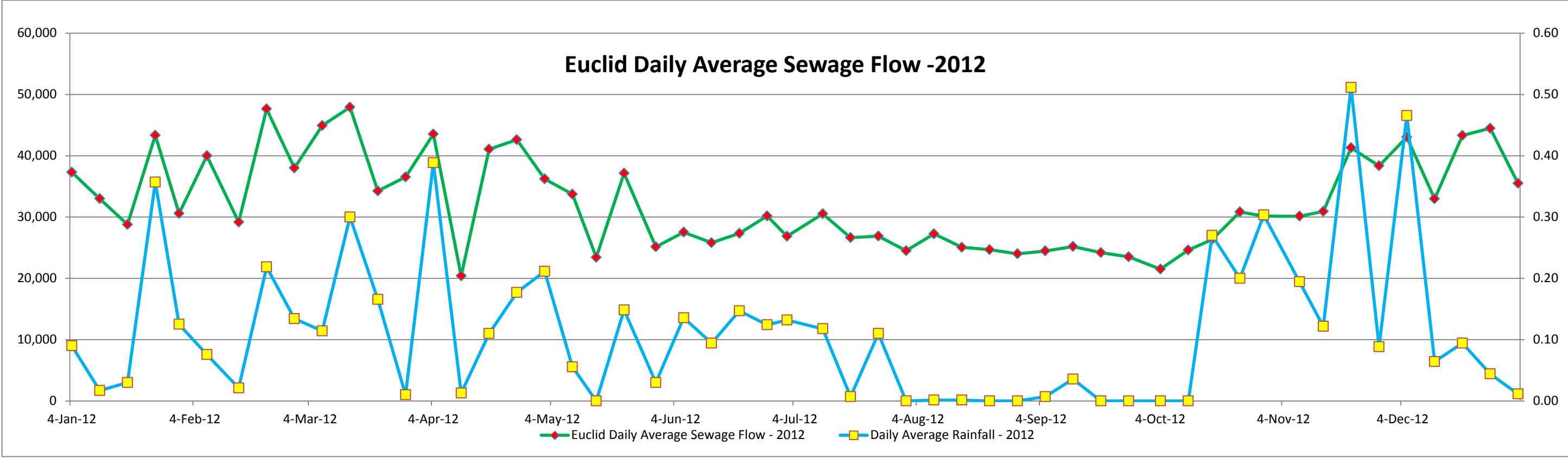
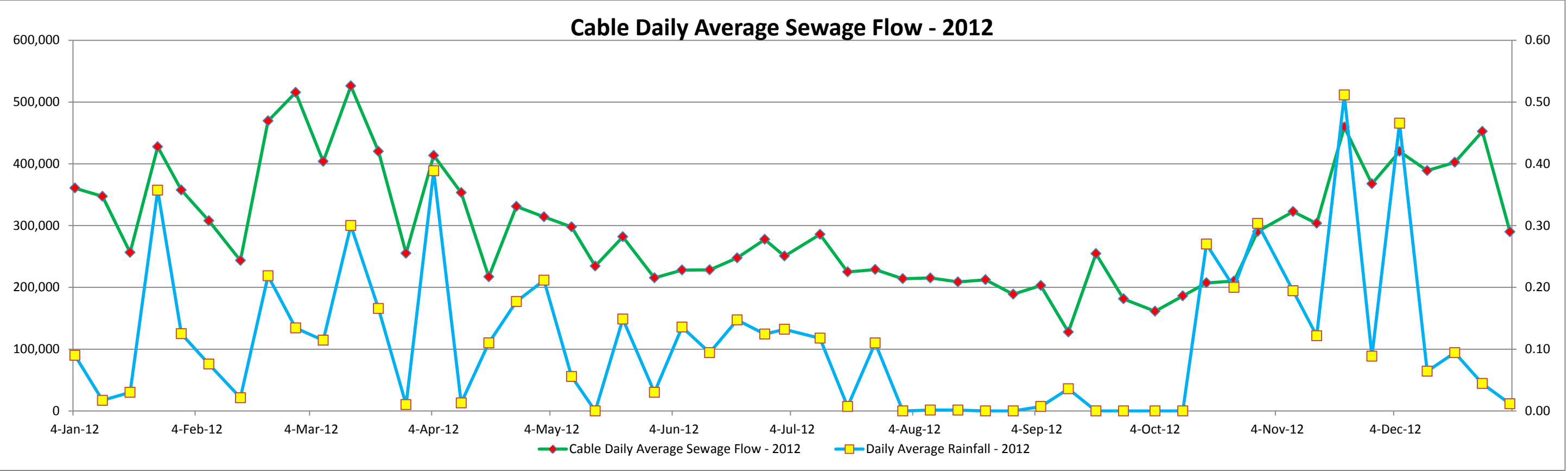
### North Shore Daily Average Sewage Flow - 2011



AVERAGE DAILY SEWER FLOWS AND RAIN DATA

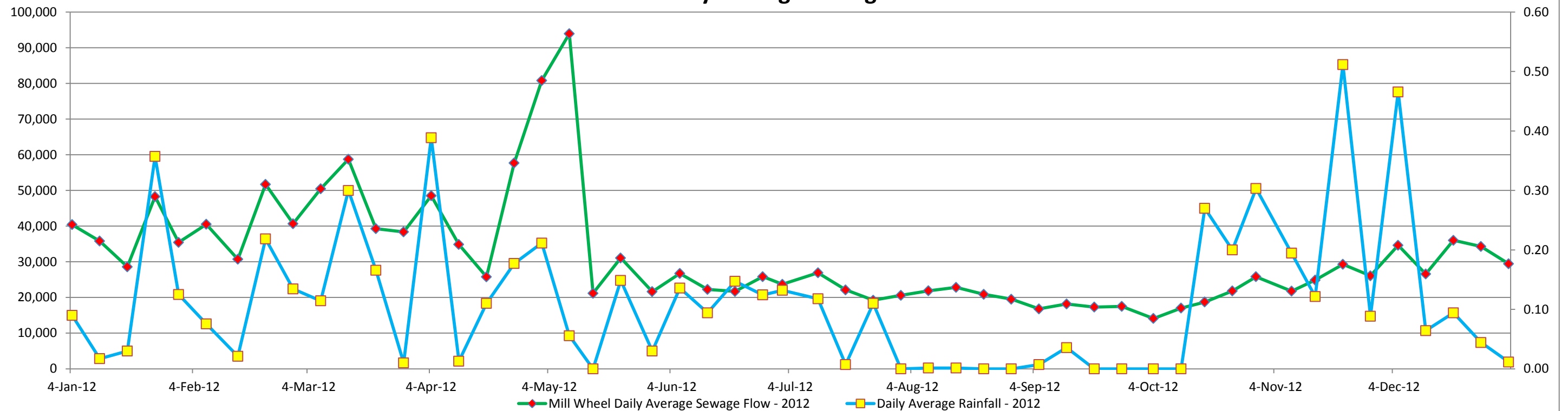


AVERAGE DAILY SEWER FLOWS AND RAIN DATA

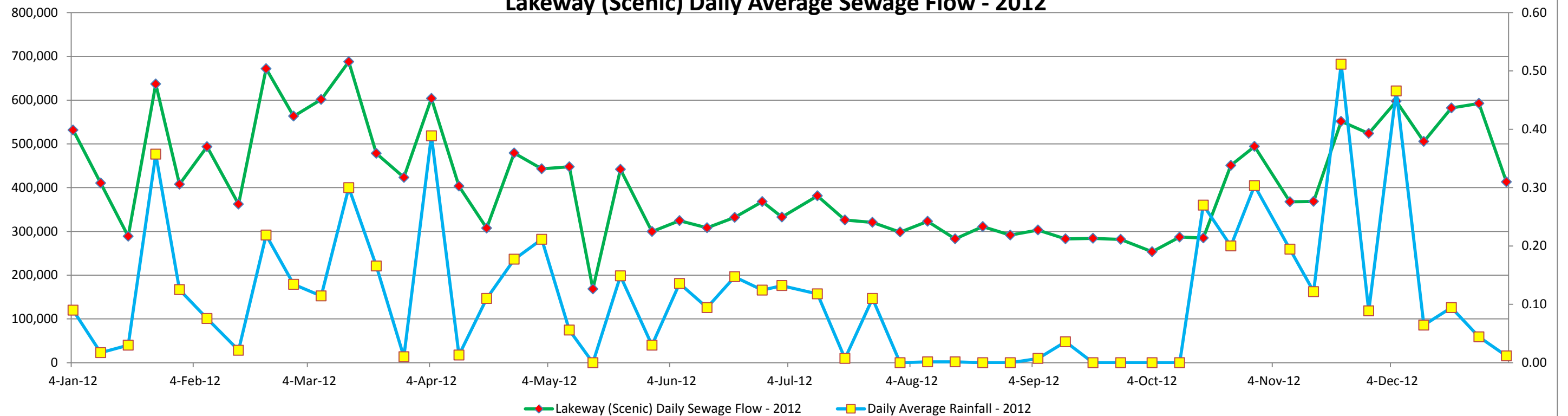


## AVERAGE DAILY SEWER FLOWS AND RAIN DATA

### Mill Wheel Daily Average Sewage Flow - 2012

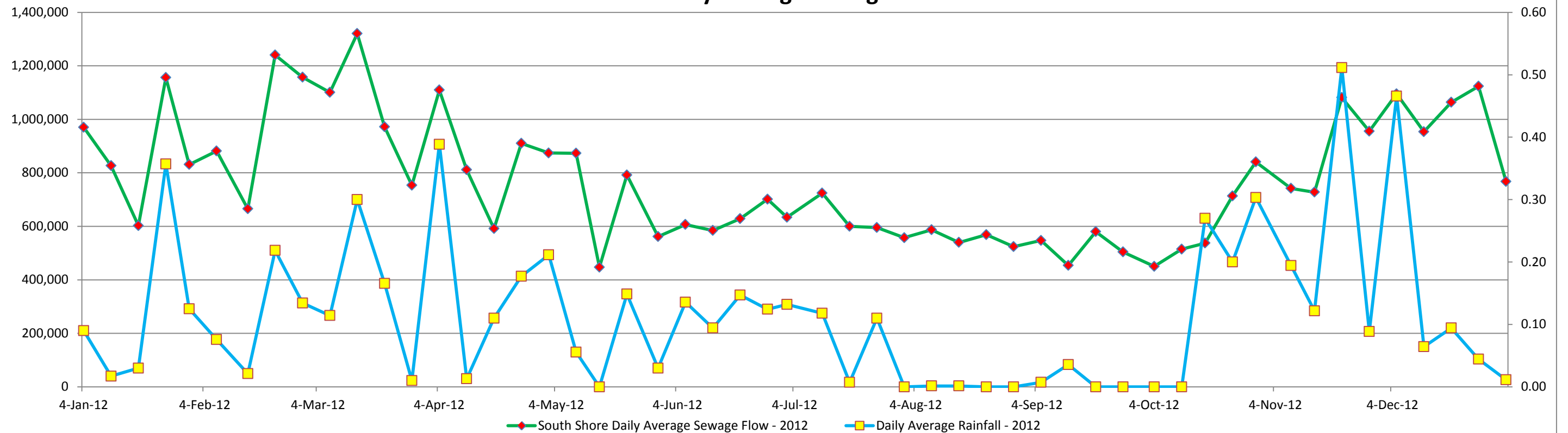


### Lakeway (Scenic) Daily Average Sewage Flow - 2012

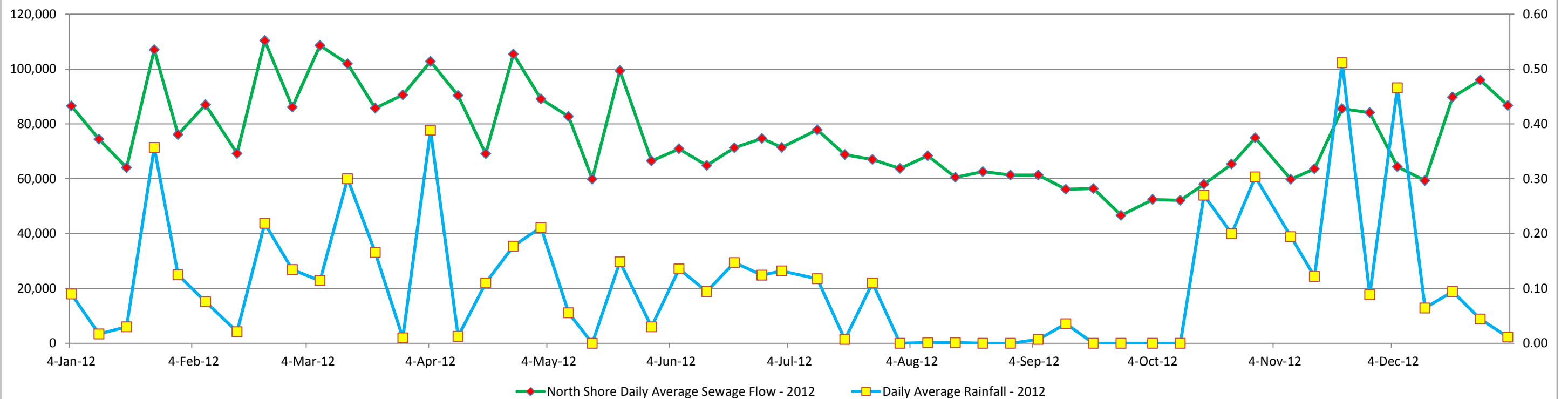


## AVERAGE DAILY SEWER FLOWS AND RAIN DATA

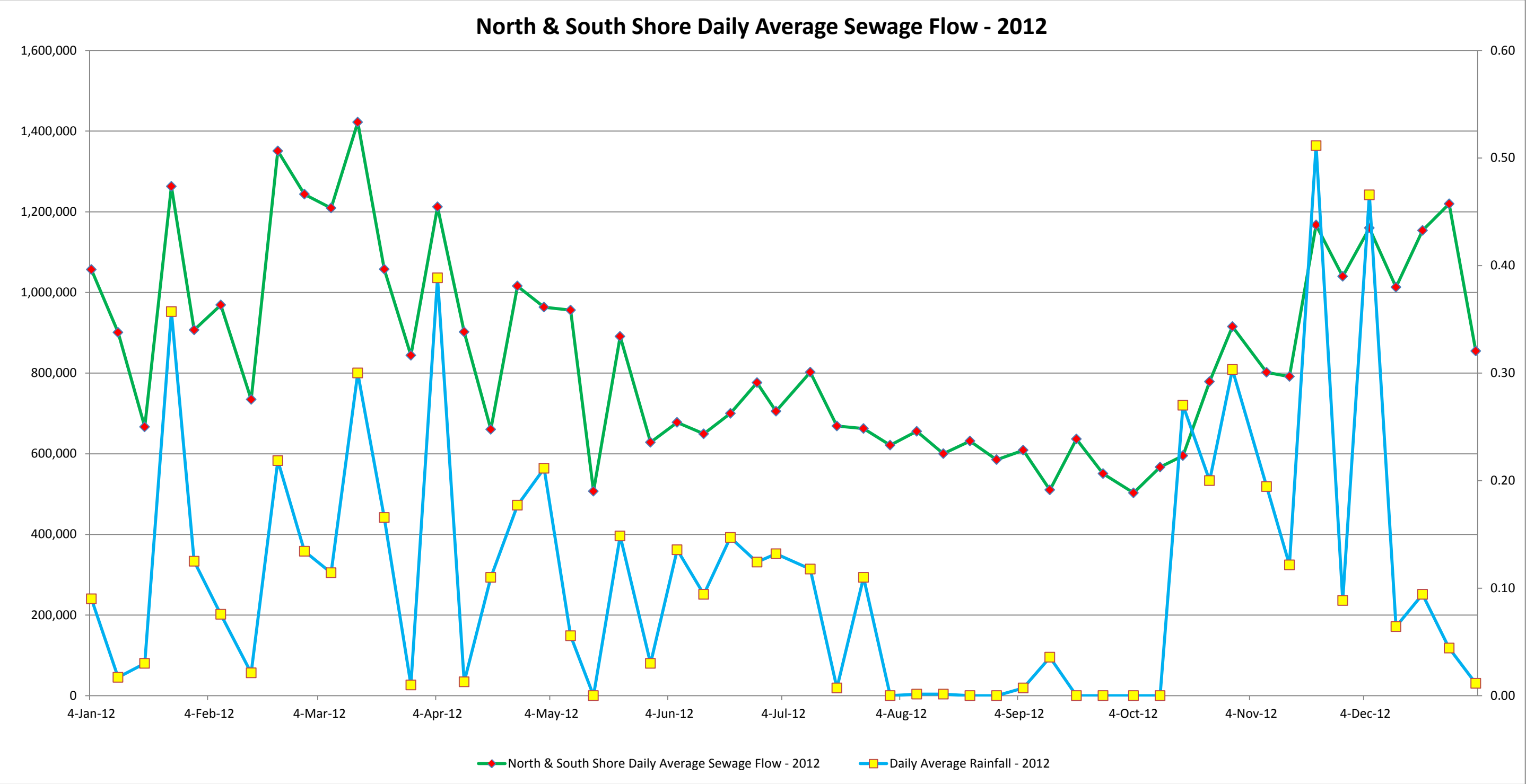
### South Shore Daily Average Sewage Flow - 2012



### North Shore Daily Average Sewage Flow - 2012

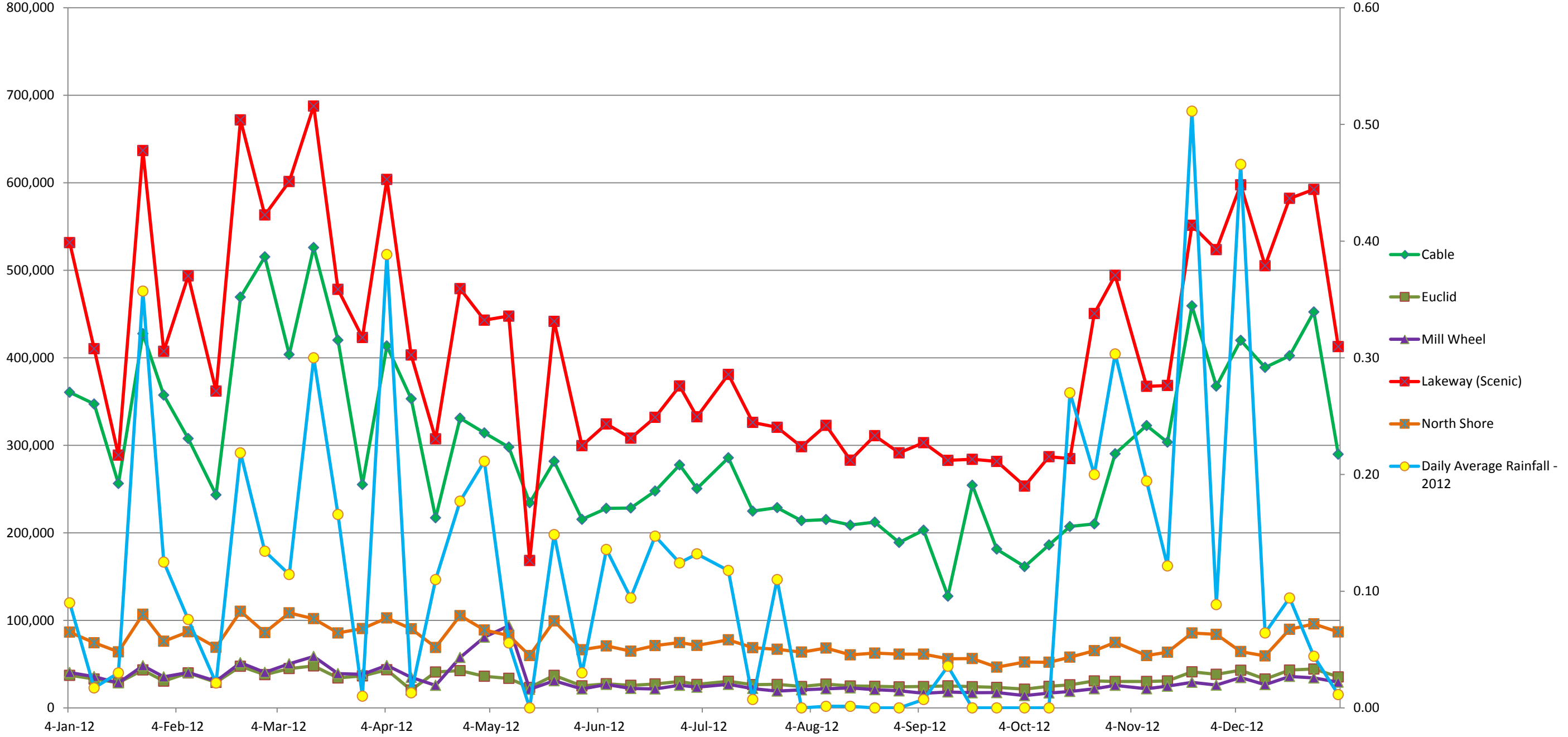


AVERAGE DAILY SEWER FLOWS AND RAIN DATA



AVERAGE DAILY SEWER FLOWS AND RAIN DATA

Sewer Flow Meters Daily Average - 2012





## South Shore Collection System

Spring Weather, Presumed High Groundwater						
	Total Metered Weekly Flow (Million Gal.)	Avg Daily Flow in this Week (Million Gal.)	Min. Daily Flow Observed in This Week (Million Gal.)	Max. Daily Flow Observed in This Week <sup>2</sup> (Million Gal.)	% of Available Interceptor Capacity Used <sup>3</sup> on Max Day	% of Total System Capacity Used <sup>3</sup> on Max Day
<b>Week Beginning 2/15/2012</b>	<b>Total Rain (in)=</b>	<b>2.4</b>				
Cable	2.55	0.36	0.24	0.59	39%	LWB Interceptor
Euclid	0.26	0.04	0.03	0.05		LWB Interceptor
Scenic	4.70	0.67	N/A	1.08	54%	LLR Interceptor
Mill Wheel	0.28	0.04	0.03	0.06		Gravity
Cable+Euclid+Scenic+Mill Wheel	7.80	1.11	0.29	1.78		60% Total to B'ham - South Shore
Approx. Active Sewer Connections:		3842				
Approx. Acreage in Basin:		1870				
Calc. Avg Daily Flow per Capita (2.6 per house) <sup>1</sup>		111				
Calc. Peak Daily Flow per Capita (2.6 per house) <sup>1</sup>				178	← Demonstrates Non-Excessive I&I for storm flow (<275 gpcpd)	
Calc. Gallons per day per acre of service area		595		952		
<b>Week Beginning 3/15/12</b>	<b>Total Rain (in)=</b>	<b>1.4</b>				
Cable	3.02	0.43	0.33	0.52	35%	LWB Interceptor
Euclid	0.30	0.04	0.04	0.05		LWB Interceptor
Scenic	4.09	0.58	0.46	0.69	34%	LLR Interceptor
Mill Wheel	0.33	0.05	0.04	0.05		Gravity
Cable+Euclid+Scenic+Mill Wheel	7.75	1.11	0.87	1.31		44% Total to B'ham - South Shore
Approx. Active Sewer Connections:		3842				
Approx. Acreage in Basin:		1870				
Calc. Avg Daily Flow per Capita (2.6 per house) <sup>1</sup>		111				
Calc. Peak Daily Flow per Capita (2.6 per house) <sup>1</sup>				132	← Demonstrates Non-Excessive I&I for storm flow (<275 gpcpd)	
Gallons per day per acre of service area		592		703		
<b>Week Beginning 4/25/2012</b>	<b>Total Rain (in)=</b>	<b>2.1</b>				
Cable	2.18	0.31	0.28	0.37	25%	LWB Interceptor
Euclid	0.25	0.04	0.03	0.04		LWB Interceptor
Scenic	2.86	0.41	0.36	0.46	23%	LLR Interceptor
Mill Wheel	0.59	0.08	0.04	0.18		Gravity
Cable+Euclid+Scenic+Mill Wheel	5.88	0.84	0.72	1.05		35% Total to B'ham - South Shore
Approx. Active Sewer Connections:		3842				
Approx. Acreage in Basin:		1870				
Calc. Avg Daily Flow per Capita (2.6 per house) <sup>1</sup>		84				
Calc. Peak Daily Flow per Capita (2.6 per house) <sup>1</sup>				105	← Demonstrates Non-Excessive I&I for storm flow (<275 gpcpd)	
Calc. Gallons per day per acre of service area		449		562		

**NOTES:**

1. Weighted average of 2.6 residents per household comes from 2/3 SV with 2.5 per house, and 1/3 Geneva with 2.9 per house.
2. Min./Max. Daily Flow data is not reliable for Scenic for all weeks; Min. Flow is N/A and Max is estimated as 1.4 - 1.7 times Avg. Daily Flow (based on LWB max/avg ratios).
3. Capacities based on the following: LWB at 1,150 gpm, LLRI at 1,400 gpm, Mill Wheel gravity at 440 gpm, and Detention Basin at 700,000 gallons.

## South Shore Collection System

Winter Weather without a Major Storm Day, Presumed High Groundwater						
	Total Metered Weekly Flow (Million Gal.)	Avg Daily Flow in this Week (Million Gal.)	Min. Daily Flow Observed in This Week (Million Gal.)	Max. Daily Flow Observed in This Week <sup>2</sup> (Million Gal.)	% of Available Interceptor Capacity Used <sup>3</sup> on Max Day	% of Total System Capacity Used <sup>3</sup> on Max Day
Week Beginning 11/29/2011	Total Rain (in)=	0.1				
Cable	1.83	0.26	0.24	0.32	21%	LWB Interceptor
Euclid	0.21	0.03	0.03	0.03		LWB Interceptor
Scenic	2.56	0.37	N/A	0.44	22%	LLR Interceptor
Mill Wheel	0.21	0.03	0.03	0.04		Gravity
Cable+Euclid+Scenic+Mill Wheel	4.81	0.69	0.29	0.82		28% Total to B'ham - South Shore
Approx. Active Sewer Connections:		3838				
Approx. Acreage in Basin:		1870				
Calc. Avg Daily Flow per Capita (2.6 per house) <sup>1</sup>		69				
Calc. Peak Daily Flow per Capita (2.6 per house) <sup>1</sup>				83	← Demonstrates Non-Excessive I&I flow (<120 gpcpd)	
Gallons per day per acre of service area		367		441		
Week Beginning 12/6/2012	Total Rain (in)=	0				
Cable	1.55	0.22	0.21	0.24	16%	LWB Interceptor
Euclid	0.20	0.03	0.03	0.03		LWB Interceptor
Scenic	3.20	0.46	N/A	0.49	24%	LLR Interceptor
Mill Wheel	0.18	0.03	0.02	0.03		Gravity
Cable+Euclid+Scenic+Mill Wheel	5.13	0.73	0.26	0.79		26% Total to B'ham - South Shore
Approx. Active Sewer Connections:		3842				
Approx. Acreage in Basin:		1870				
Calc. Avg Daily Flow per Capita (2.6 per house) <sup>1</sup>		73				
Calc. Peak Daily Flow per Capita (2.6 per house) <sup>1</sup>				79	← Demonstrates Non-Excessive I&I flow (<120 gpcpd)	
Gallons per day per acre of service area		392		420		

### NOTES:

1. Weighted average of 2.6 residents per household comes from 2/3 SV with 2.5 per house, and 1/3 Geneva with 2.9 per house.
2. Min./Max. Daily Flow data is not reliable for Scenic for all weeks; Min. Flow is N/A and Max is estimated as 1.4 - 1.7 times Avg. Daily Flow (based on LWB max/avg ratios).
3. Capacities based on the following: LWB at 1,150 gpm, LLRI at 1,400 gpm, Mill Wheel gravity at 440 gpm, and Detention Basin at 700,000 gallons.

## South Shore Collection System

Peak Wet Weather Day and Antecedent Rainfall						
	Total Metered Weekly Flow (Million Gal.)	Avg Daily Flow in this Week (Million Gal.)	Min. Daily Flow Observed in This Week (Million Gal.)	Max. Daily Flow Observed in This Week <sup>2</sup> (Million Gal.)	% of Available Interceptor Capacity Used <sup>3</sup> on Max Day	% of Total System Capacity Used <sup>3</sup> on Max Day
Week Beginning 4/16/12    Peak Day April 20, 2012    Total 24 Hour Rain: 0.83 inches, with 0.86 inches in preceding three days						
Cable	2.15	0.31	0.25	0.48	31%	LWB Interceptor
Euclid	0.25	0.04	0.03	0.04		LWB Interceptor
Scenic	2.86	0.41	0.34	0.59	29%	LLR Interceptor
Mill Wheel	0.33	0.05	0.03	0.10		Gravity
Cable+Euclid+Scenic+Mill Wheel	5.59	0.80	0.66	1.21		41%    Total to B'ham - South Shore
Approx. Active Sewer Connections:		3842				
Approx. Acreage in Basin:		1870				
Calc. Avg Daily Flow per Capita (2.6 per house) <sup>1</sup>		80				
Calc. Peak Daily Flow per Capita (2.6 per house) <sup>1</sup>				121	← Demonstrates Non-Excessive I&I for storm flow (<275 gpcpd) Includes Rain-Influenced Infiltration	
Gallons per day per acre of service area		427		648		
Week Beginning 11/17/12    Peak Day November 20, 2012    Total 24 Hour Rain: 2.22 inches, with 1.03 inches in preceding two days.						
Cable	3.58	0.51	0.24	0.75	49%	LWB Interceptor
Euclid	0.31	0.04	0.03	0.06		LWB Interceptor
Scenic	4.28	0.61	0.35	0.84	41%	LLR Interceptor
Mill Wheel	0.23	0.03	0.02	0.04		Gravity
Cable+Euclid+Scenic+Mill Wheel	8.39	1.20	0.63	1.69		56%    Total to B'ham - South Shore
Approx. Active Sewer Connections:		3842				
Approx. Acreage in Basin:		1870				
Calc. Avg Daily Flow per Capita (2.6 per house) <sup>1</sup>		120				
Calc. Peak Daily Flow per Capita (2.6 per house) <sup>1</sup>				169	← Demonstrates Non-Excessive I&I for storm flow (<275 gpcpd) Includes Rain-Influenced Infiltration	
Gallons per day per acre of service area		641		902		

### NOTES:

1. Weighted average of 2.6 residents per household comes from 2/3 SV with 2.5 per house, and 1/3 Geneva with 2.9 per house.
2. Min./Max. Daily Flow data is not reliable for Scenic for all weeks; Min. Flow is N/A and Max is estimated as 1.4 - 1.7 times Avg. Daily Flow (based on LWB max/avg ratios).
3. Capacities based on the following: LWB at 1,150 gpm, LLRI at 1,400 gpm, Mill Wheel gravity at 440 gpm, and Detention Basin at 700,000 gallons.

## South Shore Collection System

Peak Wet Weather Day with Rainfall on Successive Days						
	Total Metered Weekly Flow (Million Gal.)	Avg Daily Flow in this Week (Million Gal.)	Min. Daily Flow Observed in This Week (Million Gal.)	Max. Daily Flow Observed in This Week <sup>2</sup> (Million Gal.)	% of Available Interceptor Capacity Used <sup>3</sup> on Max Day	% of Total System Capacity Used <sup>3</sup> on Max Day
Week Beginning 11-22-2011 <b>Peak Rain Day 11-23-11; Total 24 Hour Rain: 0.98 inches, with 1.28 inches in following 2 days.</b>						
<b>Peak Sewer Flow on 11-24-11</b>						
Cable	2.73	0.39	0.25	0.66	43%	LWB Interceptor
Euclid	0.25	0.04	0.03	0.05		LWB Interceptor
Scenic	4.00	0.57	N/A	0.97	48%	LLR Interceptor
Mill Wheel	0.27	0.04	0.03	0.06		Gravity
Cable+Euclid+Scenic+Mill Wheel	7.25	1.04	0.30	1.73		58% Total to B'ham - South Shore
Approx. Active Sewer Connections:		3838				
Approx. Acreage in Basin:		1870				
Calc. Avg Daily Flow per Capita (2.6 per house) <sup>1</sup>		104				
Calc. Peak Daily Flow per Capita (2.6 per house) <sup>1</sup>				174	← <b>Demonstrates Non-Excessive I&amp;I for storm flow (&lt;275 gpcpd)</b> <b>Includes Rain-Influenced Infiltration</b>	
Calc. Gallons per day per acre of service area		554		928		
Week Beginning 11-19-2012 <b>Peak Rain Day 11-20-12; Total 24 Hour Rain: 2.22 inches, with 0.81 inches in following 2 days.</b>						
<b>Peak Sewer Flow on (11/21/12)</b>						
Cable	3.78	0.54	0.38	0.75	49%	LWB Interceptor
Euclid	0.32	0.05	0.04	0.06		LWB Interceptor
Scenic	4.62	0.66	0.53	0.84	41%	LLR Interceptor
Mill Wheel	0.23	0.03	0.03	0.04		Gravity
Cable+Euclid+Scenic+Mill Wheel	8.96	1.28	0.97	1.69		56% Total to B'ham - South Shore
Approx. Active Sewer Connections:		3842				
Approx. Acreage in Basin:		1870				
Calc. Avg Daily Flow per Capita (2.6 per house) <sup>1</sup>		128				
Calc. Peak Daily Flow per Capita (2.6 per house) <sup>1</sup>				169	← <b>Demonstrates Non-Excessive I&amp;I for storm flow (&lt;275 gpcpd)</b> <b>Includes Rain-Influenced Infiltration</b>	
Calc. Gallons per day per acre of service area		684		902		

### NOTES:

1. Weighted average of 2.6 residents per household comes from 2/3 SV with 2.5 per house, and 1/3 Geneva with 2.9 per house.
2. Min./Max. Daily Flow data is not reliable for Scenic for all weeks; Min. Flow is N/A and Max is estimated as 1.4 - 1.7 times Avg. Daily Flow (based on LWB max/avg ratios).
3. Capacities based on the following: LWB at 1,150 gpm, LLRI at 1,400 gpm, Mill Wheel gravity at 440 gpm, and Detention Basin at 700,000 gallons.

## South Shore Collection System

Dry Weather						
	Total Metered Weekly Flow (Million Gal.)	Avg Daily Flow in this Week (Million Gal.)	Min. Daily Flow Observed in This Week (Million Gal.)	Max. Daily Flow Observed in This Week <sup>2</sup> (Million Gal.)	% of Available Interceptor Capacity Used <sup>3</sup> on Max Day	% of Total System Capacity Used <sup>3</sup> on Max Day
Week Beginning 8/31/2011	Total Rain (in)=	0				
Cable	1.43	0.20	0.19	0.22	15%	LWB Interceptor
Euclid	0.22	0.03	0.03	0.03		LWB Interceptor
Scenic	2.40	0.34	N/A	0.37	19%	LLR Interceptor
Mill Wheel	0.12	0.02	0.02	0.02		Gravity
Cable+Euclid+Scenic+Mill Wheel	4.16	0.59	0.23	0.65		22% Total to B'ham - South Shore
Approx. Active Sewer Connections:		3838				
Approx. Acreage in Basin:		1870				
Calc. Avg Daily Flow per Capita (2.6 per house) <sup>1</sup>		60	← Lowest likely average per capita flows			
Calc. Peak Daily Flow per Capita (2.6 per house) <sup>1</sup>				65	← Lowest likely peak per capita flows	
Gallons per day per acre of service area		318		347		
Week Beginning 8/11/2012	Total Rain (in)=	0				
Cable	1.45	0.21	0.20	0.22	15%	LWB Interceptor
Euclid	0.18	0.03	0.02	0.03		LWB Interceptor
Scenic	2.09	0.30	0.29	0.32	16%	LLR Interceptor
Mill Wheel	0.16	0.02	0.02	0.03		Gravity
Cable+Euclid+Scenic+Mill Wheel	3.88	0.55	0.54	0.59		20% Total to B'ham - South Shore
Approx. Active Sewer Connections:		3842				
Approx. Acreage in Basin:		1870				
Calc. Avg Daily Flow per Capita (2.6 per house) <sup>1</sup>		56	← Lowest likely average per capita flows			
Calc. Peak Daily Flow per Capita (2.6 per house) <sup>1</sup>				59	← Lowest likely peak per capita flows	
Gallons per day per acre of service area		297		316		

### NOTES:

1. Weighted average of 2.6 residents per household comes from 2/3 SV with 2.5 per house, and 1/3 Geneva with 2.9 per house.
2. Min./Max. Daily Flow data is not reliable for Scenic for all weeks; Min. Flow is N/A and Max is estimated as 1.4 - 1.7 times Avg. Daily Flow (based on LWB max/avg ratios).
3. Capacities based on the following: LWB at 1,150 gpm, LLRI at 1,400 gpm, Mill Wheel gravity at 440 gpm, and Detention Basin at 700,000 gallons.

## North Shore Collection System

Spring Weather, Presumed High Groundwater						
	Total Metered Weekly Flow (Million Gal.)	Avg Daily Flow in this Week (Million Gal.)	Min. Daily Flow Observed in This Week (Million Gal.)	Max. Daily Flow Observed in This Week (Million Gal.)	% of Available Interceptor Capacity Used on Max Day	
Week Beginning 2/15/2012	Total Rain (in)=	2.4				
Northshore Meter	0.59	0.08	0.07	0.11	7%	Total to B'ham from NS
Approx. Active Sewer Connections:		358				
Approx. Acreage in Basin:		2125				
Calc. Avg Daily Flow per Capita (2.9 per house)		82				
Calc. Peak Flow per Capita (2.9 per house)				102	← Demonstrates Non-Excessive I&I for storm flow (<275 gpcpd) Includes Rain-Influenced Infiltration	
Gallons per day per acre of service area		40		50		
Week Beginning 3/15/12	Total Rain (in)=	1.4				
Northshore Meter	0.69	0.10	0.09	0.11	7%	Total to B'ham from NS
Approx. Active Sewer Connections:		359				
Approx. Acreage in Basin:		2125				
Calc. Avg Daily Flow per Capita (2.9 per house)		95		0	← Demonstrates Non-Excessive I&I for storm flow (<275 gpcpd) Includes Rain-Influenced Infiltration	
Calc. Peak Flow per Capita (2.9 per house)				104		
Calc. Gallons per day per acre of service area		47		51		
Week Beginning 4/25/2012	Total Rain (in)=	2.1				
Northshore Meter	0.62	0.09	0.08	0.10	7%	Total to B'ham from NS
Approx. Active Sewer Connections:		359				
Approx. Acreage in Basin:		2125				
Calc. Avg Daily Flow per Capita (2.9 per house)		86		0	← Demonstrates Non-Excessive I&I for storm flow (<275 gpcpd) Includes Rain-Influenced Infiltration	
Calc. Peak Flow per Capita (2.9 per house)				96		
Calc. Gallons per day per acre of service area		42		47		

## North Shore Collection System

Winter Weather without a Major Storm Day, Presumed High Groundwater						
	Total Metered Weekly Flow (Million Gal.)	Avg Daily Flow in this Week (Million Gal.)	Min. Daily Flow Observed in This Week (Million Gal.)	Max. Daily Flow Observed in This Week (Million Gal.)	% of Available Interceptor Capacity Used on Max Day	
Week Beginning 11/29/2011	Total Rain (in)=	0.1				
Northshore Meter	0.45	0.06	0.06	0.07	5%	Total to B'ham from NS
Approx. Active Sewer Connections:		359				
Approx. Acreage in Basin:		2125				
Calc. Avg Daily Flow per Capita (2.9 per house)		58		0		
Calc. Peak Flow per Capita (2.9 per house)				67		← Demonstrates Non-Excessive I&I flow (<120 gpcpd)
Gallons per day per acre of service area		28		33		
Week Beginning 12/6/2011	Total Rain (in)=	0				
Northshore Meter	0.43	0.060	0.06	0.07	5%	Total to B'ham from NS
Approx. Active Sewer Connections:		359				
Approx. Acreage in Basin:		2125				
Calc. Avg Daily Flow per Capita (2.9 per house)		58				
Calc. Peak Flow per Capita (2.9 per house)				67		← Demonstrates Non-Excessive I&I flow (<120 gpcpd)
Calc. Gallons per day per acre of service area		28		33		
Week Beginning 3/19/2012	Total Rain (in)=	0.31				
Northshore Meter	0.61	0.090	0.08	0.10	7%	Total to B'ham from NS
Approx. Active Sewer Connections:		359				
Approx. Acreage in Basin:		2125				
Calc. Avg Daily Flow per Capita (2.9 per house)		86				
Calc. Peak Flow per Capita (2.9 per house)				96		← Demonstrates Non-Excessive I&I flow (<120 gpcpd)
Calc. Gallons per day per acre of service area		42		47		

## North Shore Collection System

Peak Wet Weather Day and Antecedent Rainfall						
	Total Metered Weekly Flow (Million Gal.)	Avg Daily Flow in this Week (Million Gal.)	Min. Daily Flow Observed in This Week (Million Gal.)	Max. Daily Flow Observed in This Week (Million Gal.)	% of Available Interceptor Capacity Used on Max Day	
Week Beginning 10/27/12    Peak Day October 31, 2012    Total 24 Hour Rain: 1.07 inches, with 1.48 inches in preceding three days						
Northshore Meter	0.54	0.08	0.06	0.10	7%	Total to B'ham from NS
Approx. Active Sewer Connections:		322				
Approx. Acreage in Basin:		2125				
Calc. Avg Daily Flow per Capita (2.9 per house)		86				
Calc. Peak Flow per Capita (2.9 per house)				107	← Demonstrates Non-Excessive I&I for storm flow (<275 gpcpd) Includes Rain-Influenced Infiltration	
Calc. Gallons per day per acre of service area		38		47		
Week Beginning 11/17/12    Peak Day November 20, 2012    Total 24 Hour Rain: 2.22 inches, with 1.03 inches in preceding two days.						
Northshore Meter	0.66	0.09	0.05	0.14	9%	Total to B'ham from NS
Approx. Active Sewer Connections:		322				
Approx. Acreage in Basin:		2125				
Calc. Avg Daily Flow per Capita (2.9 per house)		96				
Calc. Peak Flow per Capita (2.9 per house)				145	← Demonstrates Non-Excessive I&I for storm flow (<275 gpcpd) Includes Rain-Influenced Infiltration	
Calc. Gallons per day per acre of service area		42		64		



## North Shore Collection System

Peak Wet Weather Day with Rainfall on Successive Days						
	Total Metered Weekly Flow (Million Gal.)	Avg Daily Flow in this Week (Million Gal.)	Min. Daily Flow Observed in This Week (Million Gal.)	Max. Daily Flow Observed in This Week (Million Gal.)	% of Available Interceptor Capacity Used on Max Day	
Week Beginning 11-22-2011 <b>Peak Rain Day 11-23-11; Total 24 Hour Rain: 0.98 inches, with 1.28 inches in following 2 days.</b> <b>Peak Sewer Flow on 11-24-11</b>						
Northshore Meter	0.59	0.08	0.06	0.13	9%	Total to B'ham from NS
Approx. Active Sewer Connections:		358				
Approx. Acreage in Basin:		2125				
Calc. Avg Daily Flow per Capita (2.9 per house)		77				
Calc. Avg Peak Flow per Capita (2.9 per house)				125	← <b>Demonstrates Non-Excessive I&amp;I for storm flow (&lt;275 gpcpd)</b> <b>Includes Rain-Influenced Infiltration</b>	
Calc. Gallons per day per acre of service area		38		61		
Week Beginning 11-19-2012 <b>Peak Rain Day 11-20-12; Total 24 Hour Rain: 2.22 inches, with 0.81 inches in following 2 days.</b> <b>Peak Sewer Flow on (11/21/12)</b>						
Northshore Meter	0.70	0.10	0.08	0.14	10%	Total to B'ham from NS
Approx. Active Sewer Connections:		359				
Approx. Acreage in Basin:		2125				
Calc. Avg Daily Flow per Capita (2.9 per house)		96				
Calc. Avg Peak Flow per Capita (2.9 per house)				134	← <b>Demonstrates Non-Excessive I&amp;I for storm flow (&lt;275 gpcpd)</b> <b>Includes Rain-Influenced Infiltration</b>	
Calc. Gallons per day per acre of service area		47		66		

## North Shore Collection System

Dry Weather						
	Total Metered Weekly Flow (Million Gal.)	Avg Daily Flow in this Week (Million Gal.)	Min. Daily Flow Observed in This Week (Million Gal.)	Max. Daily Flow Observed in This Week (Million Gal.)	% of Available Interceptor Capacity Used on Max Day	
Week Beginning 8/30/2011	Total Rain (in)=	0				
Northshore Meter	0.42	0.06	0.06	0.06	4%	Total to B'ham from NS
Approx. Active Sewer Connections:		358				
Approx. Acreage in Basin:		2125				
Calc. Avg Daily Flow per Capita (2.9 per house)		57	←————— Lowest likely average per capita flows			
Calc. Avg Peak Flow per Capita (2.9 per house)				61	← Lowest likely peak per capita flows	
Gallons per day per acre of service area		28		30		
Week Beginning 8/11/2012	Total Rain (in)=	0				
Northshore Meter	0.48	0.07	0.06	0.08	5%	Total to B'ham
Approx. Active Sewer Connections:		359				
Approx. Acreage in Basin:		2125				
Calc. Avg Daily Flow per Capita (2.9 per house)		66	←————— Lowest likely average per capita flows			
Calc. Avg Peak Flow per Capita (2.9 per house)				73	← Lowest likely peak per capita flows	
Gallons per day per acre of service area		33		36		

2012 Sewer Smoke Testing Defect List										
Area	US MH	DS MH	Size	Length	Street/Location	Smoke In House/Bldg	Roof Vent Smoke	Smoke From Cleanout	Smoke From Roof Drain	Other Defect
High Priority										
Geneva	G9-100	G9-99	8	267	Easement	NO	YES	YES	YES	ROOF DRAIN HOOKED TO CLEAN OUT
Geneva	GT-25	GT-24	8	393	Lake Whatcom Blvd	NO	YES	YES	YES	SMOKE FROM ROOF DRAIN AT HOUSE 2027
Geneva	G5-20	G5-19	8	128	Strawberry Point	NO	YES	YES	NO	Smoke out of the ground at house 38
Geneva	G15E	G15-21	8	110	alley	NO	YES	NO	NO	Smoke around mh G15-21
Geneva	G15-4	G15-3	8	327	Coronado Ave	NO	YES	NO	NO	Smoke around mh G15-3
Geneva	G6-11	G6-10	8	178	Easement. Geneva	NO	YES	NO	NO	there are 4 mhs above mh G6-12 behind fire
Geneva	G7-11	G7-12	8	245	Lake Whatcom Blvd	NO	YES	NO	NO	Smoke around m/h G7-12 at riser in ditch
Geneva	G4-13	G4-12	8	158	Coronado ave	NO	YES	YES	NO	c/o has a drain top on it in driveway at 1020
Geneva	G9-126	G9-101	8	38	Parkstone In	NO	YES	NO	NO	SMOKE AROUND M/H G9-126
Meduim Priority										
Geneva	G9-110	G9-108	8	331	Parkstone Ln	NO	YES	YES	NO	SMOKE AT CLEAN OUT AT HOUSE 1344
Geneva	GL-4	GL-3	8	119	Lowe Ave	NO	YES	YES	NO	BROKEN CAP AT FIRST CLEAN OUT, BROKEN PIPE AT
Geneva	GL-3	GL-2	8	147	Lowe Ave	NO	YES	NO	NO	2ND CLEAN OUT AT HOUSE# 1440
Geneva	G9-51	G9-50	8	278	Cedarbrook ct	NO	YES	NO	NO	cap off
Geneva	G5-5	G5-4	8	121	Easement	NO	YES	YES	NO	Broken c/o at 2660 and 2672
Geneva	G5-4	G5-3	8	149	Easement	NO	YES	NO	NO	smoke under deck
Geneva	G7-30	G7-29	8	249	Columbus Ave	NO	YES	YES	NO	Broken c/o at 4112 smoke from under front stairs
Geneva	LAS3	LAS2	8	188	Lasalle Ave	NO	YES	YES	NO	Broken c/o at 4736 Lassalle
Geneva	LAS2	LAS1	8	270	Beecher Ave	NO	YES	YES	NO	Smoke outside c/o at 4740 Lassalle
Geneva	G4-14	G4-13	8	345	Coronado ave	NO	YES	YES	NO	Broken c/o at house # 1029
Geneva	G6-10	G6-1	8	272	Austin Ct	NO	YES	YES	NO	station and parking lot broken c/o
Geneva	G1-56	G1-55	8	383	Austin Ct	NO	YES	YES	NO	smoke broken c/o at 1201
Geneva	G6-12	G6-12A	8	154	By play field	YES	YES	NO	NO	under a tree behind house 4540 cable st
Geneva	G12-9	G12-8	8	410	Geneva St	NO	YES	YES	NO	city's clean out broken. c/o not on map
Geneva	G12-2	G12-1	8	375	Fir Way	NO	YES	YES	NO	broken c/o at house 4530
Geneva	G1-4	G1-3	8	210	Euclid Ave	NO	YES	NO	NO	open c/o at house # 1701
Geneva	G12-14	G12-13	8	442	Freemont	NO	YES	NO	NO	broken c/o at house # 4424
Geneva	G9-16	G9-15	8	200	Euclid	NO	YES	YES	NO	BROKEN C/O AT HOUSE 1105
Geneva	G9-25	G9-24	8	342	Lowe Ave	NO	YES	NO	NO	broken c/o at 1322 lowe ave
Geneva	G9-125	G9-121	8	324	Easement	NO	YES	YES	NO	broken c/o at 1209 Lakeview dr in the bushes
Geneva	G9-121	G9-136	8	103	Easement	NO	YES	NO	NO	c/o open at trailer park 1209 lakeview dr
Geneva	G6-3	G6-2	8	313	Austin Ct	NO	YES	YES	NO	Smoke in c/o

						Smoke In	Roof Vent	Smoke From	Smoke From	Other
Area	US MH	DS MH	Size	Length	Street/Location	House/Bldg	Smoke	Cleanout	Roof Drain	Defect
Low Proirity										
Geneva	G9-81	G9-80	8	406	Easement	NO	YES	NO	NO	NO SMOKE AT HOUSE# 1109
Geneva	G9-48	G9-51	8	284	Cedarbrook ct	NO	NO	YES	NO	No smoke at 3925 cleanout
Geneva	G9-59	G9-58	8	269	York st	NO	YES	NO	NO	NO SMOKE AT HOUSE 4104
Geneva	G91	G9-65	8	204	willowbrook pl	NO	YES	YES	NO	
Geneva	G9-57	G9-56	8	261	Susan ct	NO	YES	YES	NO	
Geneva	G7-42	G7-41	8	75	Easement	NO	YES	NO	NO	mh G7-42 not found. Mh G7-41 under flower pot next to brick
Geneva	G1-72	G1-51	8	43	Lake Whatcom Blvd	NO	YES	NO	NO	smoke at school
Geneva	G1-89	G1-88	8	336	Lakeview St	NO	YES	NO	NO	no smoke at 1211
Geneva	G1-88	G1-87	8	353	Lakeview St	NO	YES	NO	NO	no smoke at 1218 and 1220
Geneva	G1-87	G1-91	8	166	Lakeview St	NO	YES	NO	NO	no smoke at 1228
Geneva	G1-60	G1-59	8	327	Morgan St	NO	YES	YES	NO	
Geneva	G7-18	G7-4	8	209	Lake Whatcom Blvd	NO	YES	NO	NO	No smoke at house 2757
Geneva	G6-12	G6-11	8	197	Geneva St	YES	YES	NO	NO	Smoke in kitchen at House 4540 Cable St
Geneva	G1-55	G1-54	8	301	Spring St	NO	YES	NO	NO	No smoke at 4720
Geneva	G6-8	G6-7	8	246	Easement. Cable St	NO	YES	NO	NO	No smoke at 4800
Geneva	G6-7	G6-6B	8	201	Easement Cable St	NO	YES	NO	NO	No smoke at 4811
Geneva	G6-12A	G6-12B	8	78	Easement	NO	YES	YES	NO	behind fire station
Geneva	G6-12B	G6-12C	8	112	Easement	NO	YES	NO	NO	behind fire station
Geneva	G6-12C	G6-12D	8	69	Easement	NO	YES	NO	NO	Fire station parking lot
Geneva	G12-11	G12-10	8	296	Fremont St	NO	YES	NO	NO	No smoke at house 4625, 4610
Geneva	G12-10	G6-5A	8	23	Fremont St	NO	YES	NO	NO	No smoke at house , 4645
Geneva	G12-1	G6-3B	8	359	Fir Way	NO	YES	NO	NO	no smoke at house 1125
Geneva	G10-2	G10-1	8	203	Glen Cove Ln	NO	YES	NO	NO	no smoke from house # 1527
Geneva	G1-5	G1-4	8	110	Euclid Ave	NO	YES	NO	NO	no smoke at house # 1623
Geneva	G1-2	G1-1	8	214	Euclid Ave	NO	YES	NO	NO	no smoke at house # 11715
Geneva	G12-15	G12-14	8	353	Lakeview ST	NO	YES	NO	NO	no smoke at house #1116
Geneva	G9-15	G9-14	8	144	Euclid	NO	YES	NO	NO	No smoke on house 1105
Geneva	G9-14	G9-13	8	213	Euclid	NO	YES	NO	NO	No smoke on house 930
Geneva	G9-7	G9-6	8	213	Euclid	NO	YES	NO	NO	No smoke at house 1409
Geneva	G9-77	G9-76	8	141	Ridgewood Ave	NO	YES	NO	NO	no smoke from house 1299 richmond
Geneva	G9-76	G9-25	8	63	Lowe Ave	NO	YES	NO	NO	No smoke from house 1345 Lowe ave
Geneva	G9-22	G9-21	8	282	Lowe Ave	NO	YES	NO	NO	smoke out of pipe house being remodel
Geneva	G9-21	G9-20	8	102	Lakeway Dr	NO	NO	NO	NO	No smoke out of house 4215 Lakeway Dr