SANITARY SEWER UTILITY CAPITAL IMPROVEMENT & I/I REDUCTION PLAN

for the

City of Greenwood

Johnson County, Indiana

Prepared by:

HWC ENGINEERING

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December 2013

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Johnson County, Indiana

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Deputy Mayor:	Terry McLaughlin
Board of Public Works & Safety:	Mike Newbold Kevin Hoover Shan Rutherford
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Section One – Introduction

1.1 Introduction

The City of Greenwood, by and through its Board of Public Works & Safety, operates a Sanitary Sewer Utility (the "Utility") within the city limits and additional areas outside its corporate limits. A map of the Utility's service area and its collection system is shown in Figure 1.1. The sewage collected is transported to the City of Indianapolis sanitary system for treatment and is governed by a Sewer Use Agreement as amended. That system is currently owned and operated by Citizens Energy Group (CEG). In addition, the Indiana Department of Environmental Management (IDEM) regulates CEG which in turn passes such regulations on to wholesale customers such as Greenwood. IDEM can also issue enforcement actions directly upon the City of Greenwood.

1.2 History

The City of Greenwood started sewer service before 1940, with the City's first wastewater treatment plant being construction in the late 1950's. After the late 1960s, a larger treatment plant treated the sewage and possessed a National Pollutant Discharge Elimination System (NPDES) Permit. In the mid 1970s, the City elected to construct an interceptor sewer along Pleasant Run Creek from its treatment plant to the City of Indianapolis for treatment via a connection to the South Marion County Regional Interceptor (SMCRI) and to abandon its wastewater treatment plant. Over time, and with significant growth, the collection system of Greenwood expanded as the population increased. Additional connection points to the SMCRI were added over time. Figure 1.2 shows the location of the six (6) primary SMCRI meters and the Utility's interceptor sewers.

1.3 Past Studies

The City authorized the completion of various studies over the years. Such studies investigated ways to better serve the unincorporated areas of White River Township,

service to growth areas such as those areas east of I-65, and other analyses of the collection system. In addition, as the sewer system aged, it began to deteriorate which led to increased flow to the system as a result of leaks. In the wastewater field, such increased flow is known as Inflow and Infiltration (I/I). This means storm water or clean water gets into the system taking up capacity in pipes and potentially causing surcharges or backups. The problem has grown and numerous studies have been completed to address this problem. A major study that evaluated I/I was completed in 1996/1997.

1.4 Current Situation

While the Utility has dedicated countless hours and resources to deal with the sewer system and I/I, significant areas in need of improvement still exist. On August 22, 2011, an overflow/spill occurred into a local creek at the Utility's Lone Pine Lift Station. As a result of this incident, IDEM investigated the situation, and entered into an Agreed Order with the City, effective March 23, 2012. The order required the Utility to develop a Compliance Plan related to operations, record keeping, improved data management, I/I reduction, routine maintenance and capital improvement. The Compliance Plan was approved by IDEM on July 27, 2012. The Utility began implementing the plan immediately.

Section 1.4(4) of the Compliance Plan requires the Utility to meter study in targeted areas of concern to measure flow trends on or before December 31, 2013.

Section 1.4(7) of the Compliance Plan requires the Utility to develop a Comprehensive Plan to eliminate I/I based upon severity and to develop an objective ranking system to prioritize projects on or before December 31, 2013.

Section 2.3 of the Compliance Plan requires the Utility to develop a capital improvement plan to address structural and hydraulic deficiencies on or before December 31, 2013.

1.5 Purpose

This Capital Improvement and I/I Reduction Plan is designed and intended to fulfill the requirement of Sections 1.4(4), 1.4(7) and 2.3 of the Compliance Plan.

This report establishes current conditions of the system, determines areas of need, and recommends needed immediate capital improvements as well as longer term plans based on additional field investigations to be completed.

This CIP includes sewer system investigations of targeted areas by flow monitoring with rain gauges, visual manhole inspections, and internal sewer televising. This information, along with data previously generated and obtained by staff, serve as the basis for this Plan.

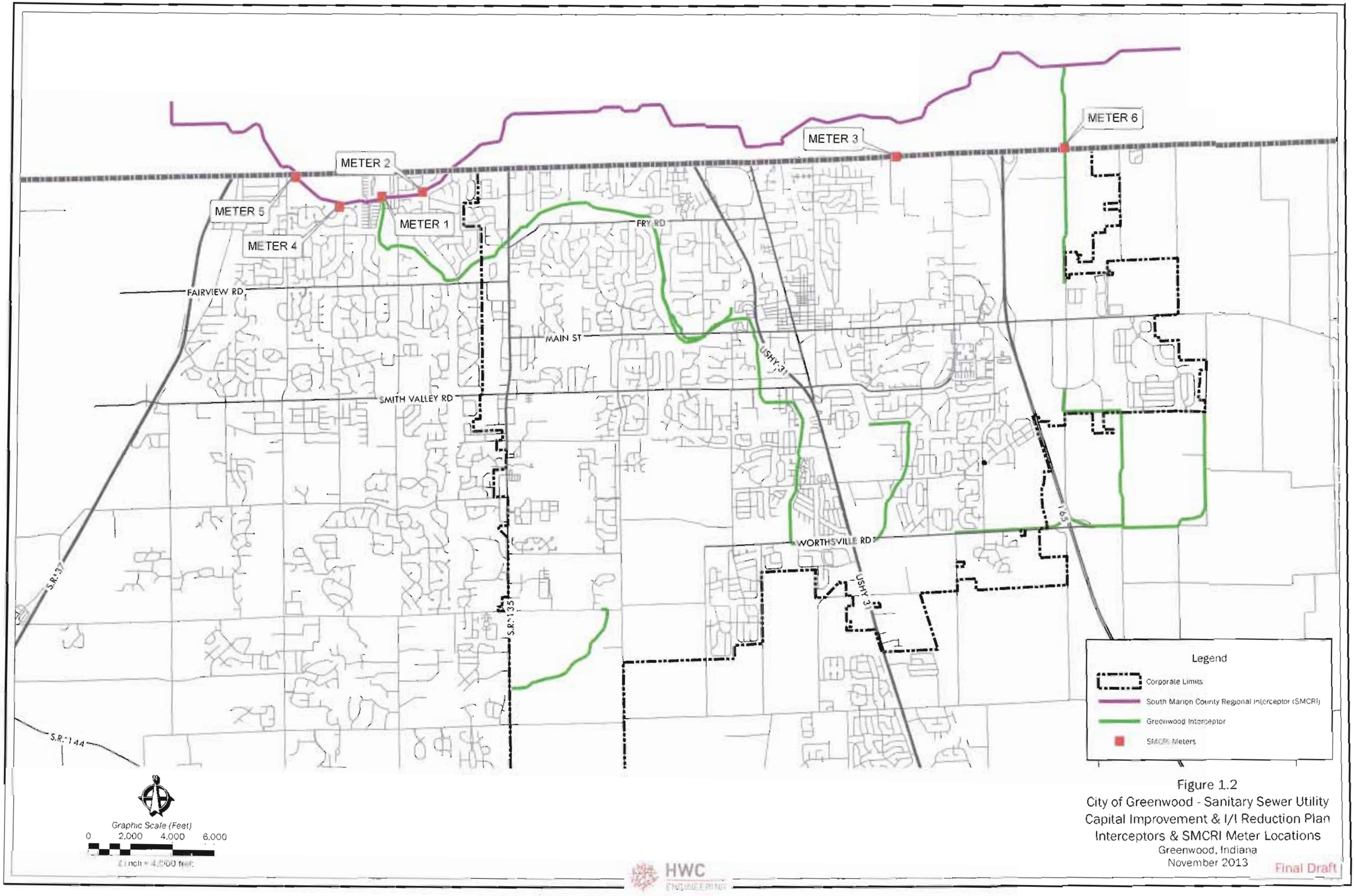


Figure 1.2
City of Greenwood - Sanitary Sewer Utility
Capital Improvement & I/I Reduction Plan
Interceptors & SMCRI Meter Locations
Greenwood, Indiana
November 2013

HWC ENGINEERING

Final Draft

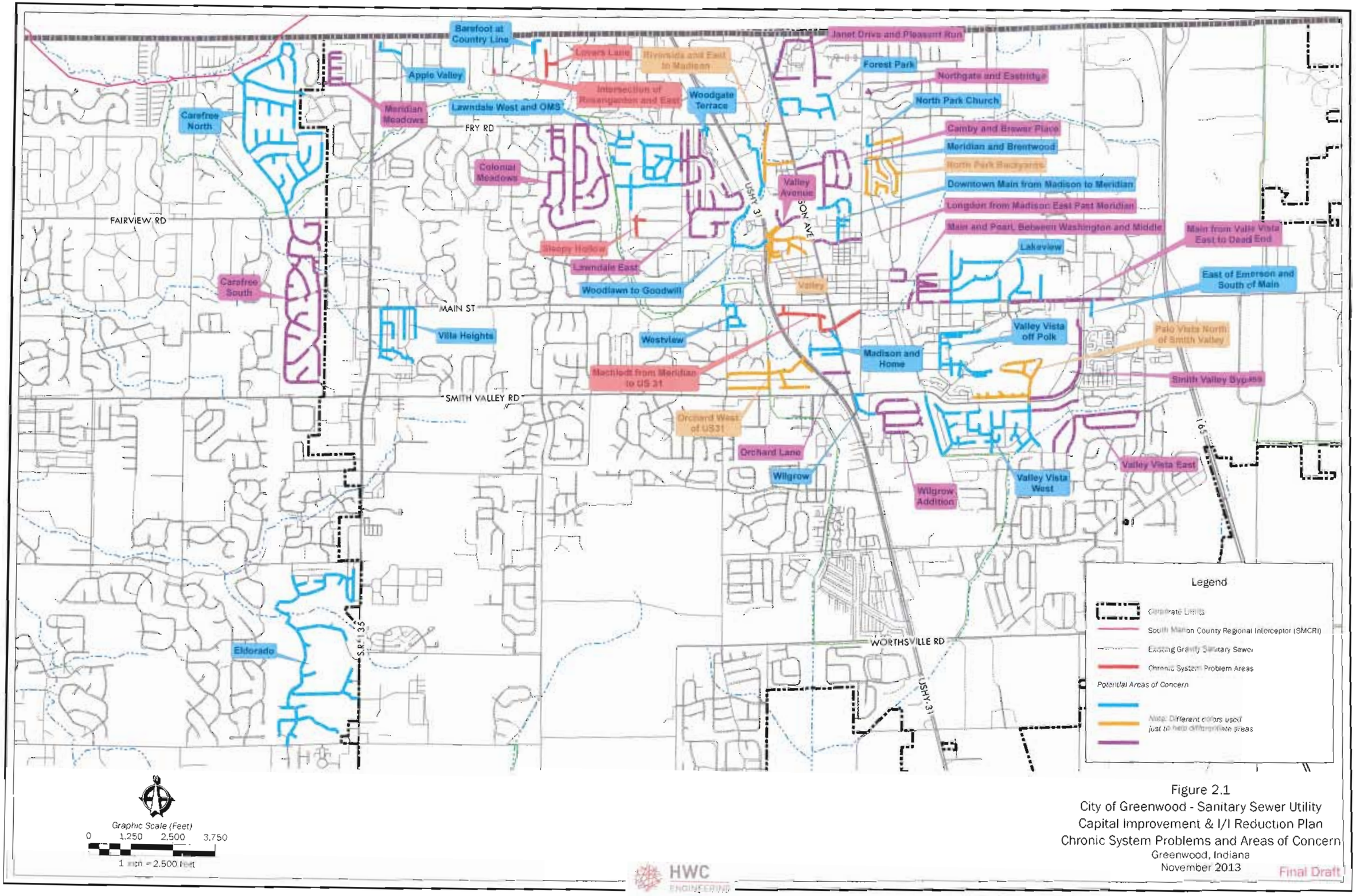


Figure 2.1
City of Greenwood - Sanitary Sewer Utility
Capital Improvement & I/I Reduction Plan
Chronic System Problems and Areas of Concern
Greenwood, Indiana
November 2013

Final Draft

Section Two – Miscellaneous Chronic and Potential System Problem Areas

Areas of the Utility's collection system have been identified by the operations staff as being problem areas, due to their knowledge from operating and maintaining the system. Examples of these chronic problem areas include, but are not limited to, the following:

- A defect is known to exist in the sewer due to past sewer televising that has been completed
- Sewer is of deteriorating condition due to its age
- Sewer has regular backup complaints from neighboring property owners

The following sections identify these areas throughout the system, provide descriptions regarding their location, and indicate the potential amount of sewer pipe and other infrastructure involved or affected.

2.1 Sewer Replacement Areas

There are four (4) areas that the Utility identified as definitively requiring replacement due to their poor condition. These areas are indicated in Figure 2.1, and are identified as: Lovers Lane, Machledt from Meridian to U.S. 31, Intersection of Rosengarten and East, and Sleepy Hollow. The first three (3) areas are identified by the roads the sewers are located along. The last area is a subdvision name that is near the Lawnwood Drive and Briarwood Drive intersection.

Table 2.1 lists the sewer replacement areas, along with the approximate lineal feet (LF) of sewer that requires replacement. In total, approximately 5,700 LF of pipe are identified. The largest area is Machledt from Meridian to U.S. 31. Not only is this area the largest in size, but it also has the largest diameter pipe involved. The other three (3) areas are all 8" pipe, but Machledt consists of primarily 15" sewers.

Table 2.1
City of Greenwood, Indiana
Sanitary Sewer Utility Capital Improvement & I/I Reduction Plan
Chronic System Problem Areas

Project Area	Lineal Feet (LF) of Sewer
Lovers Lane	1,211
Machledt from Meridian to US31	3,284
Intersection of Rosengarten and Easy	171
Sleepy Hollow	1,063
Total	5,729

2.2 Potential Areas of Concern

In addition to the four (4) chronic problem areas identified in Section 2.1, 39 areas in the collection system exist that the Utility suspects suffer issues as well. However, the extent of these issues is unknown, due to the lack of investigative inspection, so they have been listed in Table 2.2 as "Areas of Concern." These areas have also been identified by street or subdivision names and are indicated in Figure 2.1.

The 39 areas occupy different parts of the collection system, but there is a higher concentration in the older parts of the City and system near U.S. 31. There is a significant amount of pipe that could be included, with a total of approximately 253,000 LF. The potential issues with these areas will not be known until further investigative work is completed, such as sewer televising and manhole inspections. Once the investigative work is completed, it is possible that sewer rehabilitation or replacement work will be necessary on portions of the areas. It is likely that additional investigations will reduce the amount of sewer requiring rehabilitation as some areas may be in adequate condition and/or the problems in a specific area could be due to one or several small problem spots in the sub-system which, if repaired, could address the larger issues in that particular area.

Table 2.2
City of Greenwood, Indiana
Sanitary Sewer Utility Capital Improvement & I/I Reduction Plan
Areas of Concern – Recommended for Sewer Televising and Potential Lining/Replacement

Project Area	Linear Feet (LF) of Sewer
Apple Valley	934
Barefoot at County Line	1,057
Camby and Brewer Place	5,697
Carefree North	27,851
Carefree South	18,050
Colonial Meadows	17,364
Downtown Main from Madison to Meridian	4,772
East of Emerson and South of Main	500
Eldorado	22,140
Forest Park	3,959
Janet Drive and Pleasant Run	4,855
Lakeview	8,915
Lawndale East	13,254
Lawndale West and OMS	11,494
Longdon from Madison East Past Meridian	1,498
Madison and Home	3,626
Main from Valle Vista East to Dead End	3,060
Meridian and Brentwood	220
Main and Pearl, Between Washington and Middle	5,979
Meridian Meadows	3,332
North Park Church	541
North Park Backyards	5,817
Northgate and Eastridge	332
Orchard Lane	838
Orchard West of US31	6,596
Palo Vista North of Smith Valley	6,114
Riverside and East to Madison	2,637
Smith Valley Bypass	3,491

Valley Avenue	1,595
Valley Vista East	7,786
Valley Vista Off Polk	13,480
Valley Vista West	14,407
Valley	5,477
Villa Heights	6,875
Westview	2,976
Wilgrow Addition	5,826
Wilgrow	1,070
Woodale Terrace	2,782
Woodlawn to Goodwill	5,432
Total	**252,629**

[1] Actual length of lining/replacement could be reduced following investigations. Footage shown assumes all sewer in each respective problem area is rehabilitated or replaced.

Section Three – Data Collection

3.1 Introduction

In order to identify inflow/infiltration (I/I) reduction measures for the Utility's collection system, data was collected in the Spring and Summer of 2013 in targeted areas of I/I concern within the sewer system. The data collection consisted of an I/I analysis using temporary flow meters and rain gauges, visual inspection of manholes, televising sewer pipe, and analyzing the Utility's lift station run-time data. The following sections summarize the data collection process and methodology as well as the results.

3.1.1 Flow Meter and Rain Gauge Monitoring Areas

The targeted areas of I/I concern were determined by reviewing past studies completed by the Utility, as well as obtaining input from the Utility of key problem areas. Although several past studies were reviewed, the one that contained the most pertinent information relative to system conditions and flows was an I/I flow study completed in late 1996 / early 1997, as part of a larger Phase I Study for a system Facility Plan. At that time, the I/I study consisted of 36 temporary flow meters to monitor a large portion of the collection system. Of the 36 basins that it monitored, six (6) were especially high in both dry weather flow per capita and wet weather flow per capita. Those six (6) basins were GW-05, GW-09, GW-23, GW-25, GW-27, and GW-31 as shown in Figure 3.1. Due to the high I/I exhibited by those six (6) basins and confirmation by Utility staff of continued issues in those areas, they were selected to be monitored again as part of this 2013 study.

In addition to monitoring specific basins, there have been past problems with the main interceptor along Pleasant Run Creek surcharging during rain events. The interceptor receives flow from the older areas east of U.S. 31, as well as the majority of the collection system west of U.S. 31. Due to this interceptor serving such a large area and having a recorded history of

surcharging issues, an additional six (6) flow meters were placed along the interceptor to analyze the flow in different segments of the sewer. Those flow meters were named GW-001, GW-002, GW-003, GW-004, GW-005, and GW-006. The two (2) zeros in the I.D. were meant to help differentiate the interceptor flow meters from the basin flow meters.

Figure 3.1 provides a map of the twelve (12) flow meter locations, along with the locations of three (3) rain gauges that were also monitored. These rain gauges are labeled as GW-RG01A, GW-RG02A, and GW-RG03. The rain gauges were positioned to monitor three (3) locations, spaced evenly within the collection system.

3.1.2 Manhole Inspection and Sewer Televising

Due to the high flows of the Pleasant Run Interceptor, the final 16,445 feet of the interceptor were selected to be televised during the monitoring period. The televising allowed the condition of the sewer to be analyzed and sources of infiltration assessed. Figure 3.1 shows the section of the interceptor that was televised. The manholes along the sewer televising route were also visually inspected for condition assessment. A more detailed view of this monitoring area is included in Figure 3.2, with the manhole identification numbers listed.

3.1.3 ADS Environmental Services

The flow monitoring, manhole inspections, and sewer televising were all completed by a subconsultant, ADS Environmental Services. The results of its work are summarized in this Section of the report, but the full collection of data and I/I analysis report may be found in Appendix 1.

3.2 Flow Meter Service Areas

3.2.1 Basin Flow Meters

The six (6) basin flow meters each served a specific neighborhood or section of the system, while the six (6) interceptor flow meters served a broader area of flow contribution. The service areas that contributed to the six (6) basin flow meters are highlighted in Figure 3.1. Due to the large scale of this figure, a closer view of each basin area is provided in Figures 3.4 through 3.9. The ID numbers of the manholes in which the basin flow meters were installed, along with the sewer pipe sizes as measured during the meter installation, are listed in Table 3.1.

3.2.2 Interceptor Flow Meters

The broad service area that contributes to each interceptor flow meter is provided in Figure 3.3. Some interceptor flow meters are downstream of others, so some of the colored service areas add together in Figure 3.3. The following Table 3.2 works in collaboration with Figure 3.3 to help provide further clarification.

The interceptor is a single 36" pipe from its discharge to the South Marion County Regional Interceptor (SMCRI), continuing upstream until the vicinity of flow meters GW-003 and GW-004, where it splits into two parallel interceptors. Therefore, the interceptor flow meters are not all on the same pipe. The locations of the interceptor flow meters are more accurately shown in Figures 3.10 through 3.12. The ID number of the manholes where interceptor flow meters were installed, along with the sewer pipe sizes, are listed in Table 3.1.

Table 3.1
City of Greenwood, Indiana
Sanitary Sewer Utility Capital Improvement & I/I Reduction Plan
Flow Meter Installation Locations

Flow Meter ID	Manhole ID	Side of Manhole	Pipe Size (inches)
GW-001	W-26-18	Upstream	36
GW-002	W-26-56	Upstream	36
GW-003	P-30-88	Upstream	26
GW-004	P-30-87	Downstream	26
GW-005	P-31-38	Upstream	24
GW-006	P-31-37	Upstream	30
GW-05	W-35-149	Upstream	8
GW-09	W-25-106	Upstream	8
GW-23	P-29-85	Upstream	12
GW-25	P-32-42	Upstream	30
GW-27	P-32-193	Upstream	15
GW-31	P-33-85	Upstream	15

Table 3.2
City of Greenwood, Indiana
Sanitary Sewer Utility Capital Improvement & I/I Reduction Plan
Interceptor Flow Meters - Contributing Areas in Figure 3.3

Flow Meter ID	Contributing Areas
GW-001	Orange, Yellow, Red, Purple, and Blue
GW-002	Yellow, Red, Purple, and Blue
GW-003/GW-004	Red, Purple, and Blue
GW-005	Purple
GW-006	Blue

Note: GW-003 and GW-004 are listed together because there are relief points in the parallel interceptors, in which the flow from the two interceptors mixes together

3.3 Flow Analysis

The flow meter and rain gauge monitoring period took place from March 20, 2013 to June 14, 2013. During this time, several rain events occurred. The objective of the study was to determine the dry day flow that is typically in the sewer system, the I/I that is rainfall dependent, and then compare the results to the findings from the 1996-1997 study.

3.3.1 Storm Summary

Eight (8) significant rain events occurred during the monitoring period. Table 3.3 lists the rainfall totals and return frequency for each storm event for each respective rain gauge. All of the storms were less than a 1-yr return frequency, except for the storms on April 18th and May 31st. During the April 18th storm event, all of the flow meters surcharged except for GW-25 and GW-27.

Table 3.3 also lists the rainfall totals and return frequencies for the storm events during the 1996-1997 monitoring period. The 1996-1997 monitoring period involved similar sized storm events, in which the most severe event observed at a rain gauge was a nine (9)-month storm. The largest event observed at a rain gauge during the 2013 monitoring period was a 2.3-year storm.

Table 3.3
City of Greenwood, Indiana
Sanitary Sewer Utility Capital Improvement & I/I Reduction Plan
Rainfall Total and Return Frequencies

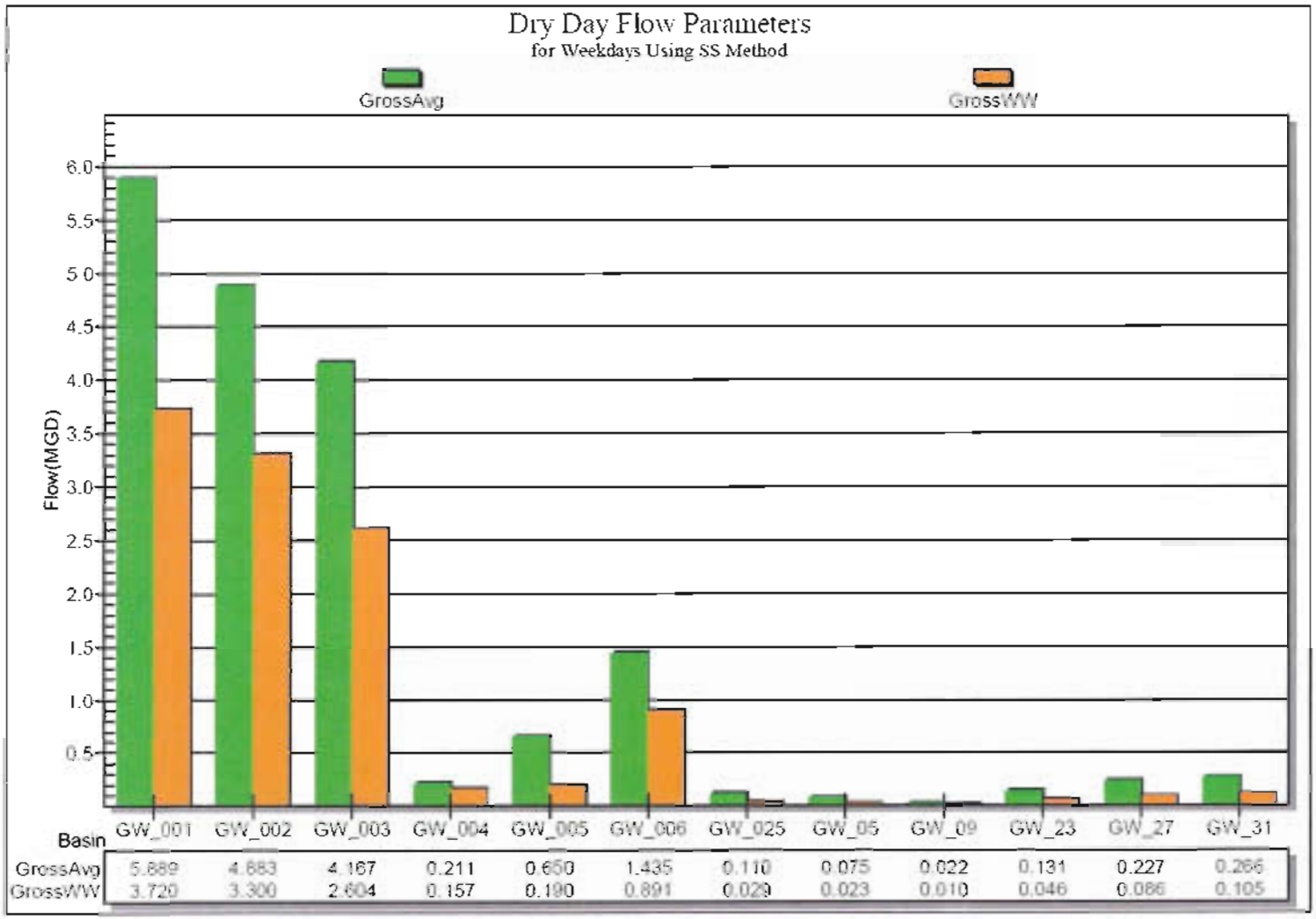
Study Year	Storm	Rainfall for Each Rain Gauge (inches)			Maximum Return Frequency for Each Rain Gauge		
		RG01A	RG02A	RG03	RG01A	RG02A	RG03
2013	4/11/2013	1	1.15	1.1	2.2-mo	3.2-mo	2.8-mo
	4/16/2013	1.09	1.08	1.38	2.8-mo	3.3-mo	4.2-mo
	4/18/2013	1.28	1.63	1.3	6.5-mo	1.2-yr	6.9-mo
	4/23/2013	1.11	1.38	1.19	3.8-mo	6.4-mo	4.5-mo
	5/9/2013	1.41	1.12	1.29	4.5-mo	3.6-mo	4.3-mo
	5/17/2013	0.66	0.52	0.85	1.4-mo	1.2-mo	4.4-mo
	5/27/2013	0.49	0.38	0.59	1.7-mo	1.1-mo	1.9-mo
	5/31/2013	1.43	2.26	1.75	5.4-mo	2.3-yr	10.3-mo
1996		RG01A	RG02B		RG01A	RG02B	
	11/24/1996	1.67	1.71		8.5-mo	9-mo	
	11/30/1996	0.58	0.5		<1-mo	<1-mo	
	12/23/1996	1.22	1.27		5-mo	5-mo	

3.3.2 Dry Day Flow

During dry days, sanitary sewer flow consists of two parts: average wastewater production (WWP) and baseline infiltration (BI). WWP is wastewater that should always be going to the sewer and BI is infiltration getting into the sewer even when it is not raining. Examples of BI sources include, but are not limited to, a leak in a pipe joint or manhole structure that allows infiltration due to high groundwater conditions or leaking plumbing fixtures that constantly pour water into the sewer system. The severity of BI can vary seasonally, because rainfall impacts groundwater levels. However, BI should stay relatively constant for weeks at a time.

The following Chart 3.1 plots the average dry day flow (indicated as "gross avg" in the chart) and WWP (indicated as "gross WW" in the chart) for all twelve (12) flow meters during the monitoring period. The difference between the two values is the BI. The six flow meters on the left side of the chart are all on the interceptor, so they have the largest volumes. Rather than look at pure flow rates, it is more beneficial to look at which flow monitors exhibited the highest BI, relative to their WWP (or the ratio between "gross avg" and "gross WW"). Analyzing the data in this regard indicates that GW-005, GW-05, GW -23, GW-25, GW 27, and GW-31 are among the worst in relative BI because their BI is at least 1.5 times the value of their WWP. In those instances, more BI is getting in the system than WWP.

Chart 3.1: Average Dry Day Flow



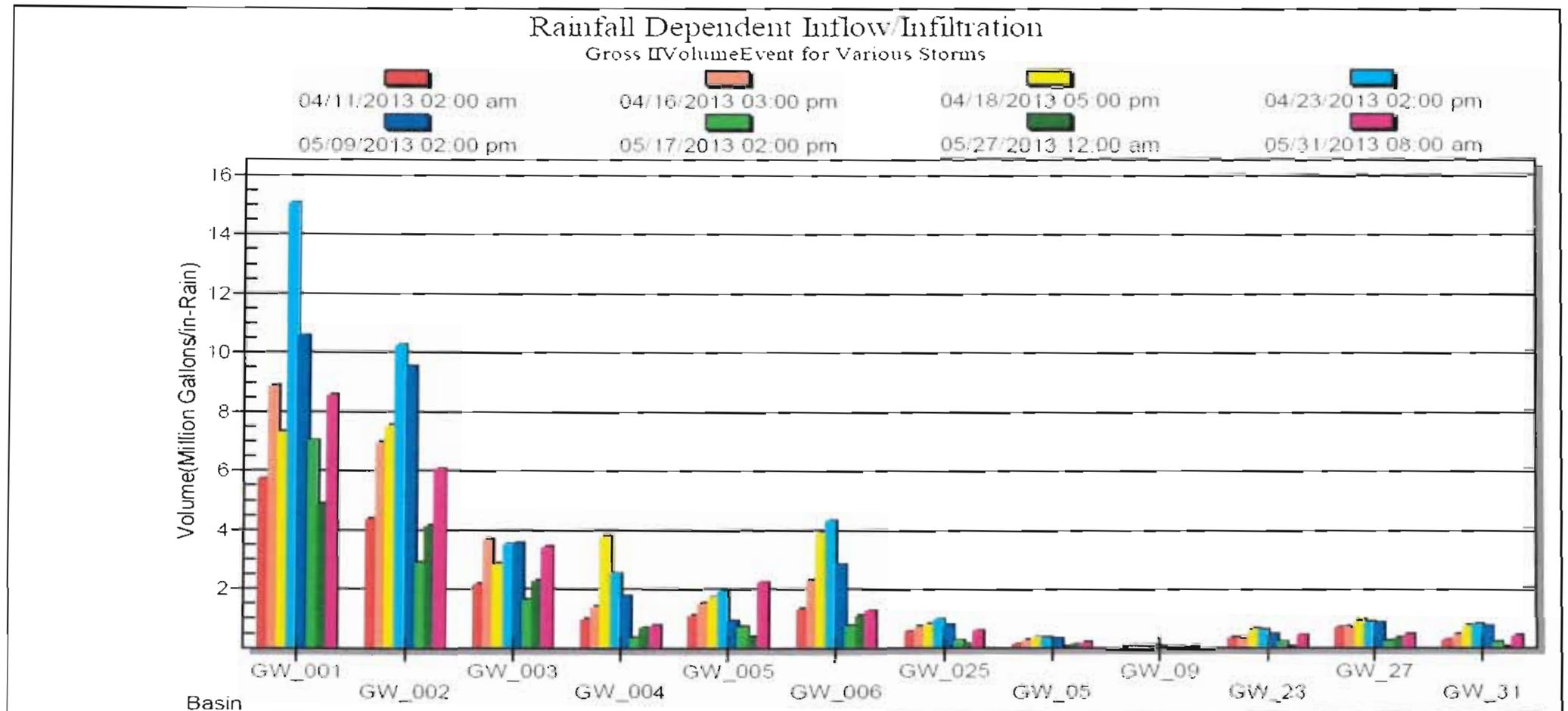
3.3.3 Rainfall Dependent Infiltration/Inflow (RDII)

In addition to BI, I/I also enters the sanitary sewer system during wet weather events. This type of I/I is referred to as rainfall dependent (RDII). Examples of RDII sources include, but are not limited to, downspouts, storm inlets, and sump pumps that are connected to the sanitary system. The rain and flow data obtained during the monitoring period was used to determine the volume of RDII for each flow meter for all storm events. The volume of RDII increases with the severity of the rain events, thus simply looking at volume of RDII is not a good basis for comparison. For this reason, the RDII volume is divided by the inches of rain for each particular storm event. Chart 3.2 plots the RDII volume per inch of rain, for each meter, and each storm event observed.

Chart 3.2 indicates that significantly more I/I is getting into the system between meters GW-001 and GW-002. These meters are on the same pipe and are close to each other as indicated in Figure 3.10. There are a couple neighborhoods whose wastewater enters the interceptor between GW-001 and GW-002, but the main difference is two (2) force mains (8" and 14") that discharge directly before GW-001. It is evident from this that the service areas that contribute to these two (2) force mains are likely high sources of I/I.

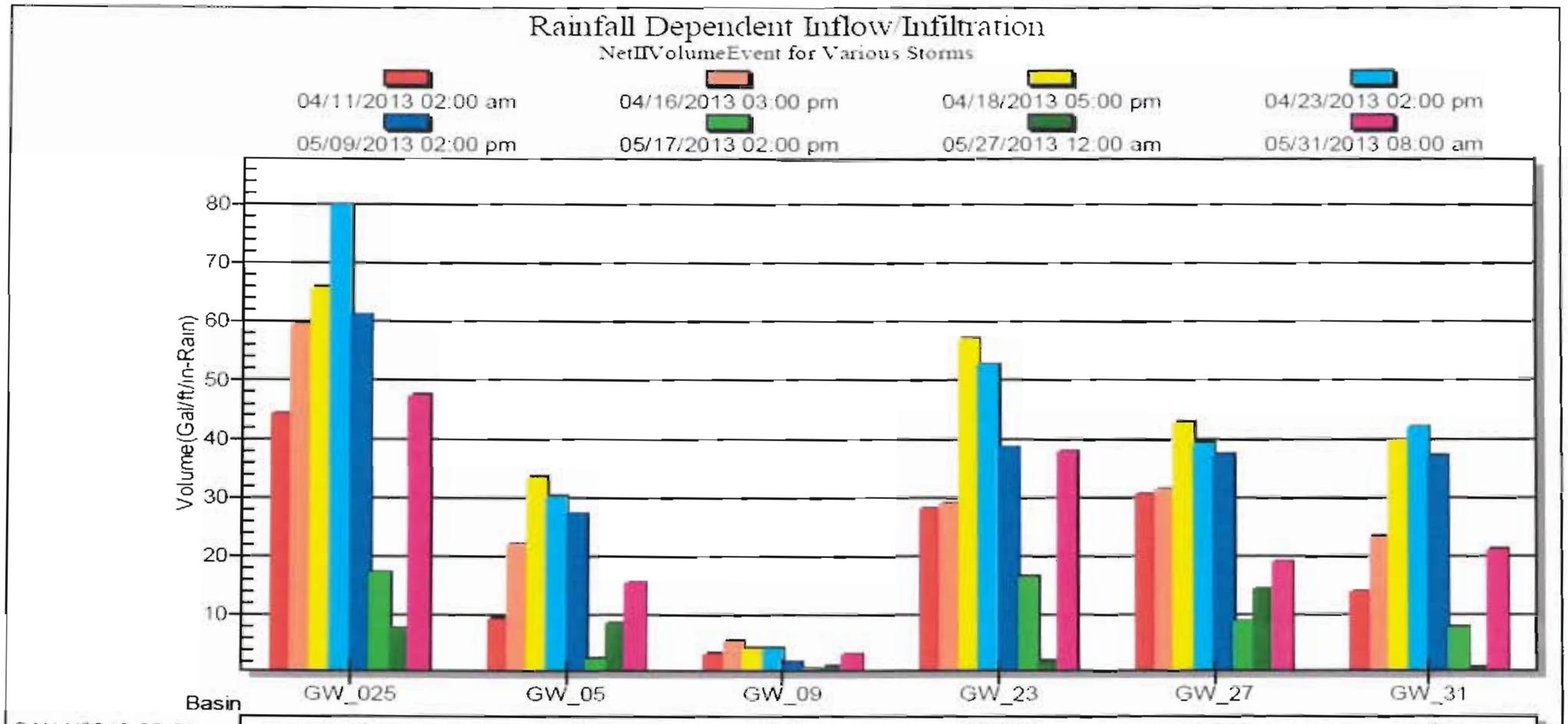
In addition to looking at volume of RDII per inch of rain, it is important to also normalize the RDII volume by the size of the sewer shed. This is because a larger sewer shed will have more linear feet of sewers and therefore more potential source of I/I. This normalization by size of sewer shed was not done for the interceptor flow meters, due to the shear amount of pipe that would need to be measured. The normalization was, however, completed for the six (6) basin flow meters and is plotted in Chart 3.3. As you can see, in Chart 3.3, GW-25 ranks among the worst in RDII normalized per inch of rain and size of sewer shed.

Chart 3.2: RDII Volume Normalized per Inch of Rain



Basin	GW_001	GW_002	GW_003	GW_004	GW_005	GW_006	GW_025	GW_05	GW_09	GW_23	GW_27	GW_31
04/11/2013 02:00 am	5.696	4.330	2.115	0.957	1.060	1.275	0.512	0.090	0.031	0.297	0.657	0.251
04/16/2013 03:00 pm	8.847	6.942	3.663	1.365	1.493	2.280	0.690	0.213	0.051	0.308	0.675	0.423
04/18/2013 05:00 pm	7.286	7.502	2.821	3.761	1.693	3.894	0.764	0.324	0.039	0.607	0.922	0.723
04/23/2013 02:00 pm	15.033	10.227	3.481	2.489	1.907	4.276	0.927	0.292	0.038	0.561	0.844	0.763
05/09/2013 02:00 pm	10.528	9.496	3.490	1.715	0.875	2.794	0.709	0.263	0.016	0.409	0.802	0.674
05/17/2013 02:00 pm	6.988	2.850	1.602	0.297	0.686	0.732	0.198	0.023	0.006	0.174	0.188	0.140
05/27/2013 12:00 am	4.824	4.103	2.251	0.664	0.340	1.065	0.088	0.083	0.010	0.020	0.306	0.014
05/31/2013 08:00 am	8.542	6.034	3.381	0.708	2.185	1.238	0.550	0.149	0.030	0.401	0.408	0.382

Chart 3.3: RDII Volume Normalized per Inch of Rain and Size of Sewer Shed



Basin	GW_025	GW_05	GW_09	GW_23	GW_27	GW_31
04/11/2013 02:00 am	43.998	9.218	3.273	27.850	30.380	13.765
04/16/2013 03:00 pm	59.293	21.920	5.456	28.828	31.235	23.183
04/18/2013 05:00 pm	65.609	33.299	4.133	56.913	42.660	39.641
04/23/2013 02:00 pm	79.664	30.054	4.088	52.544	39.038	41.805
05/09/2013 02:00 pm	60.891	27.032	1.682	38.315	37.101	36.906
05/17/2013 02:00 pm	17.010	2.330	0.666	16.299	8.677	7.654
05/27/2013 12:00 am	7.537	8.486	1.042	1.903	14.141	0.784
05/31/2013 08:00 am	47.274	15.280	3.171	37.621	18.888	20.941

Chart 3.4 plots RDII for the six (6) basin flow meters, normalized per inch of rain and size of sewer shed. In addition, it provides the information compared to the previous study completed in 1996-1997. The data is relatively even for the flow meters. except for GW-09. The RDII went down severely since 1996-1997, but the sanitary sewer utility staff did not remember any projects completed in this area. It is believed that during the 1996-1997 study, the flow meter was placed at a different location. thereby skewing the comparison of this basin only.

3.3.4 Capacity Limitations

The capacity of a sewer line is based upon the size of the pipe and its slope. These two factors dictate the volume of water that travels down the pipe and the speed at which it travels. Due to the difficulty of determining pipe size and slope throughout a sewer system, it is not often done to determine sewer capacity. However, through the collection of flow depth and flow velocity during different periods, there is the capability to plot the information and estimate the theoretical capacity of a sewer. ADS completed this for all of the flow meters and it is provided below in Table 3.4. ADS was also able to monitor during wet weather events and notice drop-offs where this theoretical capacity was not met. This lower capacity is referred to as the operational capacity and it indicates a hydraulic restriction in the sewer downstream. The operational capacity is also indicated in Table 3.4 and it reveals that hydraulic restrictions are present downstream of GW-002, GW-006, GW-05, GW-09, GW-23, and GW-31. These hydraulic restrictions can be the result of excess flows downstream or blockages and can result in sewer back-ups and overflows upstream.

Table 3.4
City of Greenwood, Indiana
Sanitary Sewer Utility Capital Improvement & I/I Reduction Plan
Theoretical and Operational Capacities

Sewer Capacity in MGD			
Meter	Theoretical	Operational	Comments
GW_001	32	32	Full pipe is 24 mgd, surcharged is 32 mgd (158")
GW_002	~32	18	Increases slightly to surcharge of 165"
GW_003	~10	8.5	Surcharge of 88"
GW_004	~10	8	Surchaged ~8 mgd, 18 Apr SSO to 10 MGD at 81"
GW_005	~2.8	2.8	Fluctuates in surcharge (52") from 2.1 to 4.2 mgd
GW_006	~21	11	Surcharged to 42", roots likely downstream
GW_025	~40	N/A	30" pipe reached only 6" deep and 2+ mgd.
GW_05	2.1	0.9	surcharge to 72"
GW_09	~1.2	0.2	surcharge to 122"
GW_23	2.7	1	surcharge to 22"
GW_27	~3	~3	15" pipe reached 12" depth
GW_31	~5	1.2	D/S debris/restruction, surcharge to 22"

3.3.5 Summary

Figure 3.13 summarizes the flow meters that indicated issues, such as high BI (GW-005, GW-05, GW-23, GW-25, GW-27, and GW-31) and capacity limitations (GW-002, GW-006, GW-05, GW-09, GW-23, and GW-31) in the areas monitored. In addition, it was observed that basin GW-25 exhibited high RDII.

3.4 Lift Station Analysis

Using Supervisory Control and Data Acquisition (SCADA) equipment, the run time of the Utility's lift stations are measured and tracked continuously. Using the capacity of the pumps in each station and the corresponding pump run time, the volume pumped from the lift stations can also be calculated. This lift station data was also monitored during this study, with an emphasis placed on the lift station reactions to wet weather events.

Chart 3.5 shows the responses of all of the lift stations during rain that took place April 16th, 2013 to April 19, 2013, which included one of the large rain events. It is evident that several lift stations spiked during the rain event, but it is difficult to discern due to the 25 lift stations that are plotted. The nine (9) lift stations that reacted the most to the rain are listed below in Table 3.5. The Turkey Pen Lift Station had the highest gallons pumped on Chart 3.5. Because the data from the Turkey Pen Lift Station is at a larger scale than the other lift stations, the stations that reacted the most to rain, excluding Turkey Pen, are shown on Chart 3.6 for legibility. As Table 3.5 indicates, all of these stations increased flow by 84%-462% during the wet weather. These stations have been indicated in Figure 3.14 to show their geographic location in the system.

Table 3.5
City of Greenwood, Indiana
Sanitary Sewer Utility Capital Improvement & I/I Reduction Plan
Lift Stations with Largest Reaction to Wet Weather

	DATE	Lift Station								
		Alden	Ashwood	Brandywine	Brentridge	Copper Leaf	Eagle Trace	Midwest	Turkey Pen	Waters Edge
FLOW (gallons)	4/23/2013	49,093	15,115	29,494	45,863	49,724	76,746	9,992	744,705	17,954
	4/22/2013	62,270	18,698	35,022	48,770	66,908	84,694	8,294	822,335	20,147
	4/21/2013	60,252	22,341	36,804	52,629	78,499	93,971	10,321	872,274	22,736
	4/20/2013	58,939	27,251	45,316	61,113	133,833	104,347	23,030	1,028,862	29,216
	4/19/2013	141,686	27,822	50,981	98,973	157,300	206,241	19,960	1,660,662	77,449
	4/18/2013	57,950	23,333	42,596	57,267	114,058	77,497	19,012	867,657	17,750
	4/17/2013	60,270	18,636	33,233	62,198	81,325	79,192	18,287	954,952	24,548
	4/16/2013	47,785	18,159	22,772	38,487	39,682	56,305	10,107	635,644	12,240
	4/15/2013	65,145	14,111	27,706	40,507	52,541	52,653	9,769	674,709	13,781
% Increase from 4/15 to 4/19		117.5%	97.2%	84.0%	144.3%	199.4%	291.7%	135.7%	146.1%	462.0%

Chart 3.5: Lift Station Volume Pumped from 4/15/13 - 4/23/13

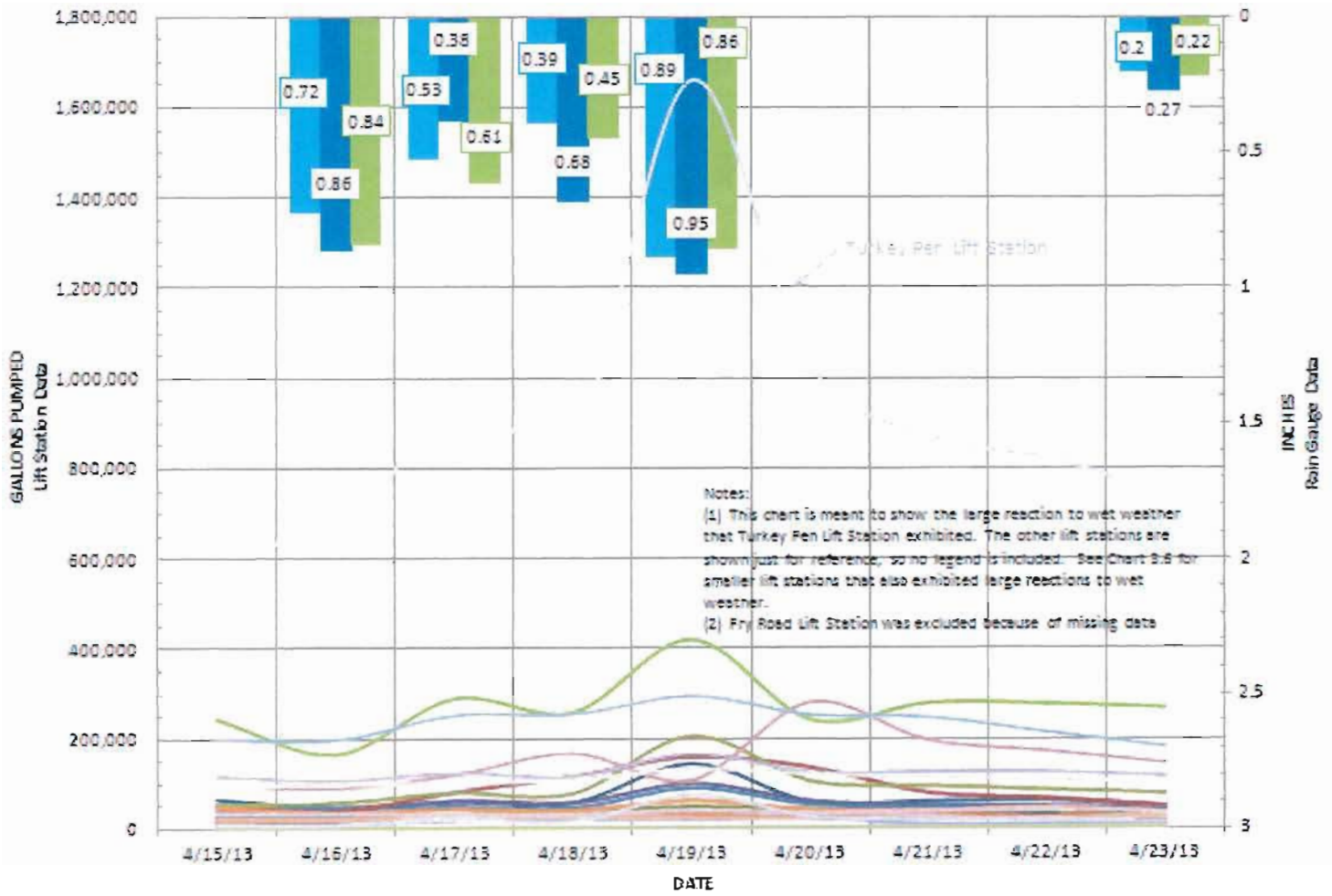
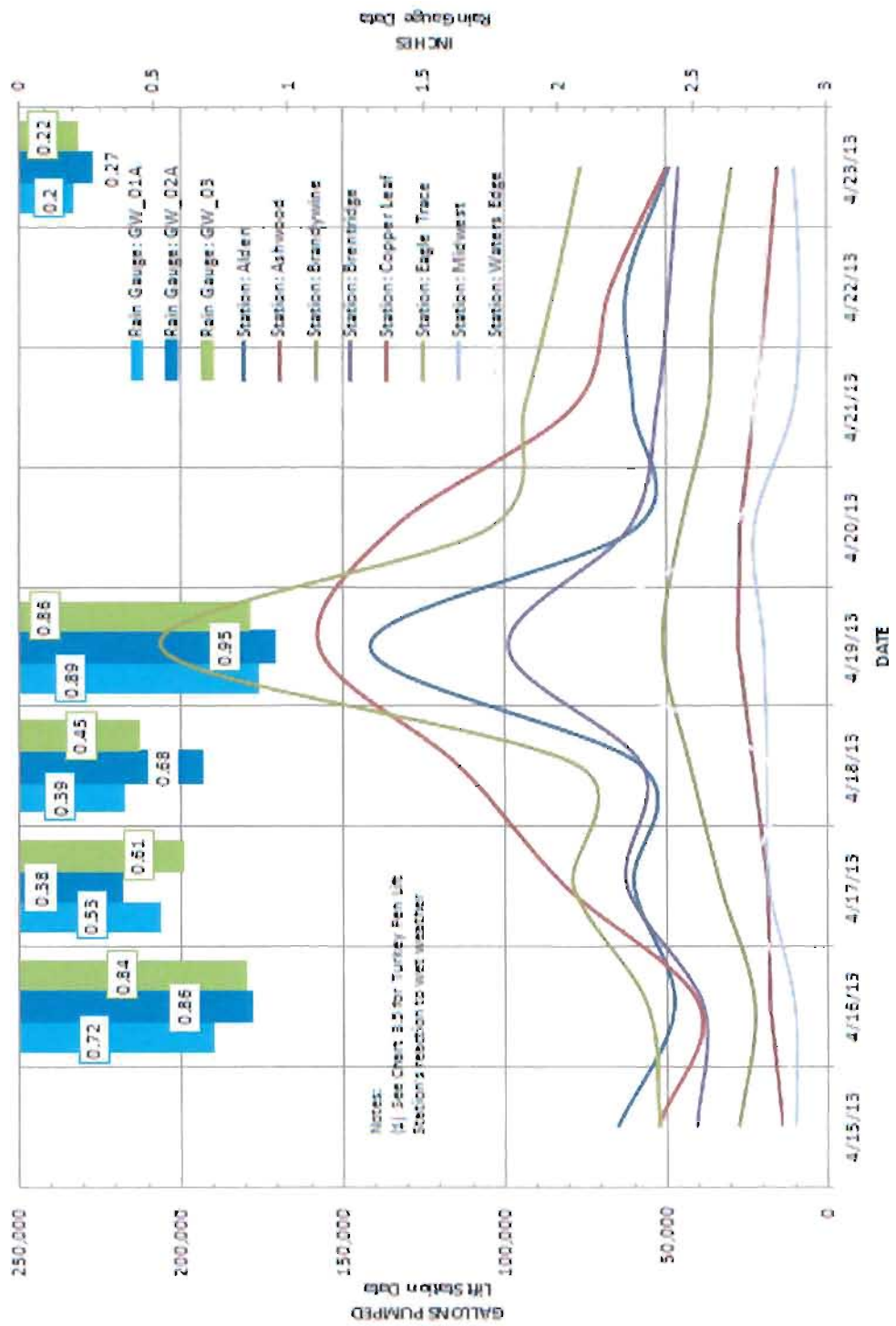


Chart 3.6: Lift Stations with Largest Reaction to Wet Weather



3.5 Manhole Inspection and Sewer Televising

The most downstream 16,445 feet of the Pleasant Run Interceptor was inspected using sewer televising equipment in June of 2013. The following month, the 43 manholes along this route were inspected. The sewer televising reports and manhole inspection reports are all provided in the ADS report in Appendix 1. Tables 3.6 and 3.7 summarize the key findings. In Tables 3.6 and 3.7, the condition of the manholes and sewer pipes have been categorized as good, moderate, or poor to help simplify, with these categories graphically shown in Figure 3.15. One of the most critical areas observed in the sewer televising was downstream of manhole W-26-19. In this manhole, the two (2) 8" and 14" force mains discharge into the interceptor. It appears hydrogen sulfide has corroded the pipe severely in some places. A point repair was completed on the interceptor, but the joint in the repair is leaking.

Table 3.6
City of Greenwood, Indiana
Sanitary Sewer Utility Capital Improvement & I/I Reduction Plan
Pleasant Run Interceptor - Manhole Inspection Summary

Legend	Category of Manhole Condition
	Good
	Moderate
	Poor

MH ID No.	Issue	Remedy	Additional Notes
25-020	Roots at pipe seal	Chemically seal at pipes	No frame seal
25-020A	Leak at base of wall	Chemically seal base of walls at apron	
25-053	Heavy roots at pipe seal	Chemically seal at pipes	Form flow channel
25-064	Leak at outgoing pipe seal	Chemically seal at pipes	
25-065	Heavy roots at wall joint	Patch and wipe entire manhole	
25-104	Exposed rebar and light roots	Patch and wipe wall joints, Patch and wipe base of walls at apron	
25-147	Light roots at wall joints	Chemically seal wall joints	
25-148	Leak at lower manhole wall	Chemically seal base of walls at apron	
25-149	Exposed rebar and erosion	Patch and wipe entire manhole	
25-159	Exposed rebar, Manhole eroded	Patch and wipe entire manhole	
25-178	Exposed aggregate, Light Roots	Patch and wipe entire manhole	Loose frame
25-179	Leak at pipe seal	Chemically seal at pipes	Offset frame
25-204	Light roots at wall joints	Chemically seal wall joints	No write-up
25-330	Leak at outgoing pipe seal	Chemically seal at pipes	Loose frame
25-331	Exposed Rebar	Patch and wipe base of walls at apron	Loose frame
26-001	Leak at pipe seal, Light deposits at wall joints	Patch and wipe wall joints, Patch and wipe base of walls at apron, Chemically seal at pipes	Offset frame
26-009			No frame seal
26-010	Light roots at wall joints, Exposed rebar	Patch and wipe entire manhole	
26-015	Leak at pipe seal, Leak at wall joint	Chemically seal wall joints and pipes	
26-016	Leak at pipe seal, Manhole eroded	Patch and wipe entire manhole, Chemically seal at pipes	

26-017	Leak at pipe seal	Patch and wipe entire manhole, Chemically seal at pipes	
26-018	Manhole eroded	Patch and wipe entire manhole	
26-019	Exposed rebar	Patch and wipe entire manhole	
26-056	Exposed rebar	Patch and wipe wall joints	
26-057	Leak at frame		Offset frame
26-058	Leak at pipe seal, Exposed rebar	Patch and wipe at pipes, Chemically seal at pipes	
26-059	Leak at pipe seal	Patch and wipe wall joints, Chemically seal at pipes	
26-060	Wall joint leak	Chemically seal wall joints	Loose frame
26-076	Cracks in manhole wall, Light roots	Patch and wipe entire manhole	
26-076A			Good condition
26-083	Leak at pipe seal and wall joint	Chemically seal at pipes and wall joints	Broken frame and riser
26-083-A	Missing material at frame		
27-079	Light roots at wall joints	Patch and wipe wall joints	
27-079A			No information
27-080	Missing material, Deposits at wall joints	Chemically seal wall joints	
27-081	Light roots	Chemically seal wall joints	
27-082	Leak at wall joints	Chemically seal wall joints	
27-083	Leak at pipe seal, Light roots	Chemically seal at pipes and wall joints	Offset frame
27-084	Exposed rebar, Light roots	Patch and wipe wall joints	Offset frame
27-085	Exposed rebar, Light roots, Leak at frame	Patch and wipe entire manhole	
27-086	Leak at pipe seal	Patch and wipe wall joints, Chemically seal at pipes	Offset frame
27-087	Remove tree from area		Could not evaluate (trees)
27-088	Leak at pipe seal	Chemically seal at pipes	Offset frame

Table 3.7
City of Greenwood, Indiana
Sanitary Sewer Utility Capital Improvement & I/I Reduction Plan
Pleasant Run Interceptor - Sewer Pipe Inspection Summary

Legend	Category of Sewer Condition
	Good
	Moderate
	Poor

ADS MH ID No.		Greenwood MH ID No.		Length (ft)	Notes
Start MH	End MH	Start MH	End MH		
1	2	25-204	25-179	616	Infiltration, Leak at joint, 1.0 gpm
2	3	25-179	25-178	485	Leak at joint, 0.25 gpm, Exposed rebar
3	4	25-178	25-159	262	Exposed rebar, Leak in MH, Infiltration, 0.25 gpm
4	5	25-159	25-149	480	Concrete corrosion
5	6	25-149	25-148	499	Concrete corrosion
6	7	25-148	25-147	243	Concrete corrosion, Leak at fracture, Infiltration, 0.2 gpm
7	8	25-147	25-104	401	
8	9	25-104	25-065	988	Concrete corrosion, Multiple Leaks at fractures and joints, Infiltration, 1.0 gpm
9	10	25-065	25-064	171	Concrete corrosion
10	11	25-064	25-330	923	Concrete corrosion, Infiltration, Multiple Leaks at joints, 1.5 gpm
11	12	25-330	25-331	178	Concrete corrosion
12	13	25-331	25-053	115	Concrete corrosion, Infiltration, Leak at joint, 1.5 gpm
13	14	25-053	25-020A	682	Concrete corrosion, Infiltration, Leak at joint, 0.01 gpm
14	15	25-020A	25-020	32	Concrete corrosion
15	16	25-020	26-083A	94	Concrete corrosion, Roots at joint, Infiltration, Leak at joint, 0.01 gpm
16	17	26-083A	26-083	84	Concrete corrosion, rubble/gravel
17	18	26-083	26-076A	102	Concrete corrosion, rubble/gravel
18	19	26-076A	26-076	592	Concrete corrosion, Infiltration, Multiple Leaks at joints, 0.02 gpm
19	20	26-076	26-060	372	Concrete corrosion
20	21	26-060	26-059	643	Concrete corrosion

21	22	26-059	26-058	538	Concrete corrosion
22	23	26-058	26-057	1080	Concrete corrosion, Infiltration, Multiple Leaks at joints, 1.0 gpm
23	24	26-057	26-056	46	Concrete corrosion
24	25	26-056	26-019	125	Concrete corrosion
25	26	26-019	26-018	117	Concrete corrosion, Defective point repair, Infiltration, Multiple Leaks at joints, 3.0 gpm, Rubble/gravel
26	27	26-018	26-017	238	Concrete corrosion, Infiltration, Rubble/gravel, Leak at joint, 0.1 gpm
27	28	26-017	26-016	358	Concrete corrosion, Infiltration, Leak at joint, 1.0 gpm
28	29	26-016	26-015	735	Concrete corrosion, Infiltration, Leak at joint, 0.02 gpm
29	30	26-015	26-010	375	Concrete corrosion
30	31	26-010	26-009	779	Concrete corrosion
31	32	26-009	26-001	767	Leak at MH
32	33	26-001	27-088	40	Concrete corrosion
33	34	27-088	27-087	354	Concrete corrosion
34	35	27-087	27-086	171	Concrete corrosion
35	36	27-086	27-085	532	Concrete corrosion, Infiltration, Leak at joint, 0.04 gpm
36	37	27-085	27-084	426	Concrete corrosion, Infiltration, Leak at joint, 0.03 gpm
37	38	27-084	27-083	537	Concrete corrosion
38	39	27-083	27-082	649	Concrete corrosion
39	40	27-082	27-081	57	Concrete corrosion, Infiltration, Leak at joint, 1.0 gpm
40	41	27-081	27-080	265	Concrete corrosion
41	42	27-080	27-079A	163	Concrete corrosion
42	43	27-079A	27-079	27	Concrete corrosion, Root intrusion

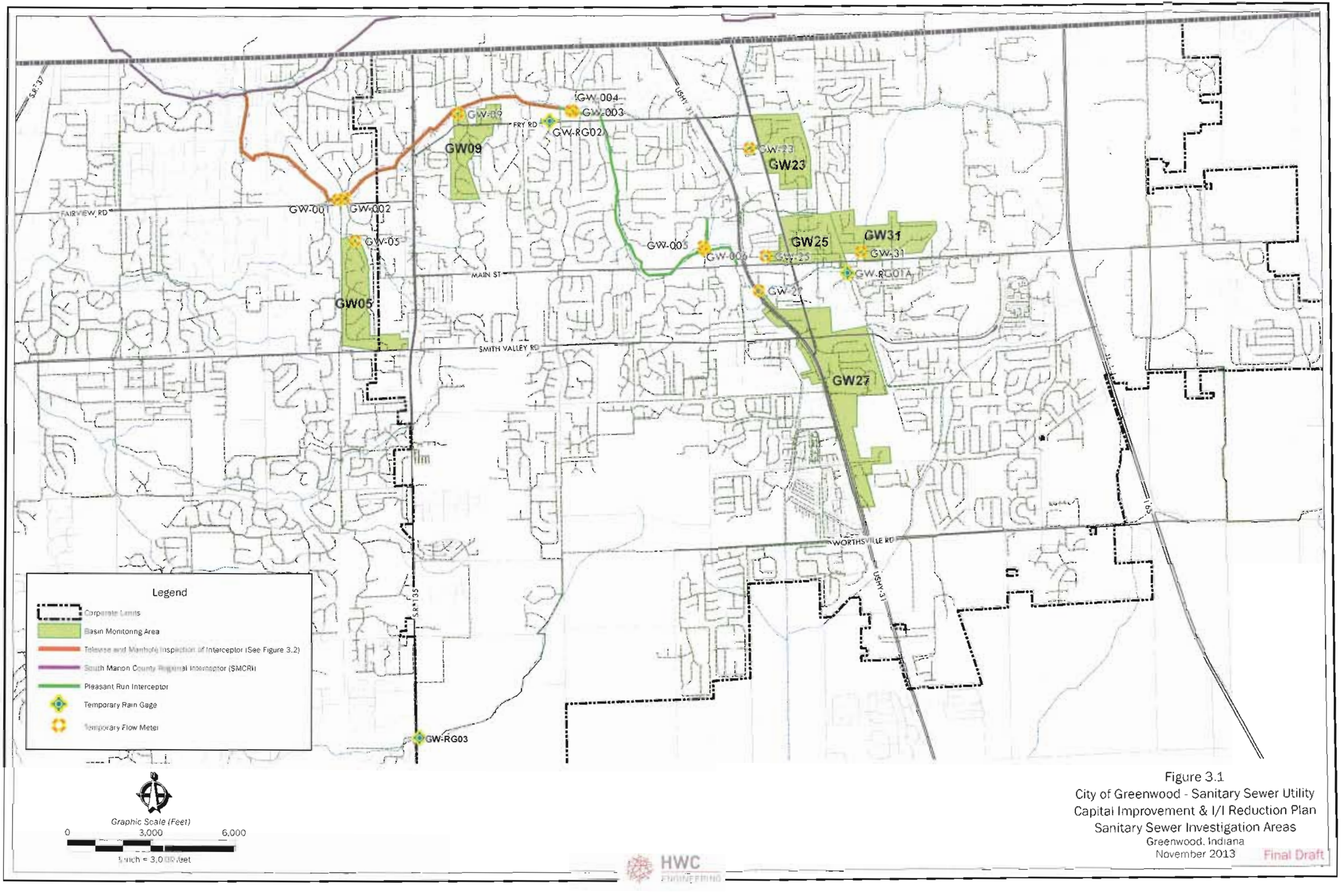


Figure 3.1
City of Greenwood - Sanitary Sewer Utility
Capital Improvement & I/I Reduction Plan
Sanitary Sewer Investigation Areas
Greenwood, Indiana
November 2013 Final Draft

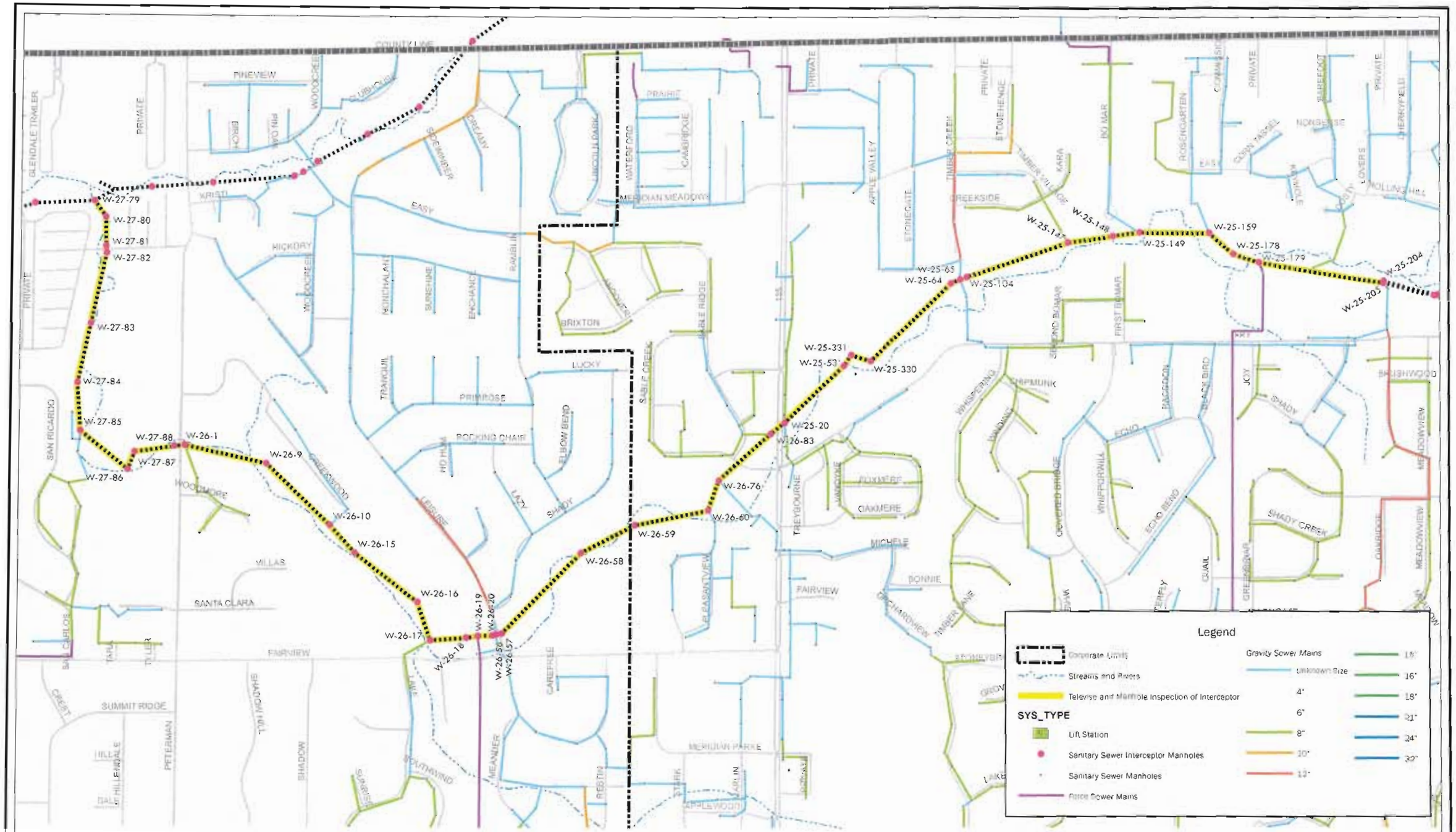


Figure 3.2
City of Greenwood - Sanitary Sewer Utility
Capital Improvement & I/I Reduction Plan
Manhole Inspection & Sewer Televising
Greenwood, Indiana
November 2013
Final Draft

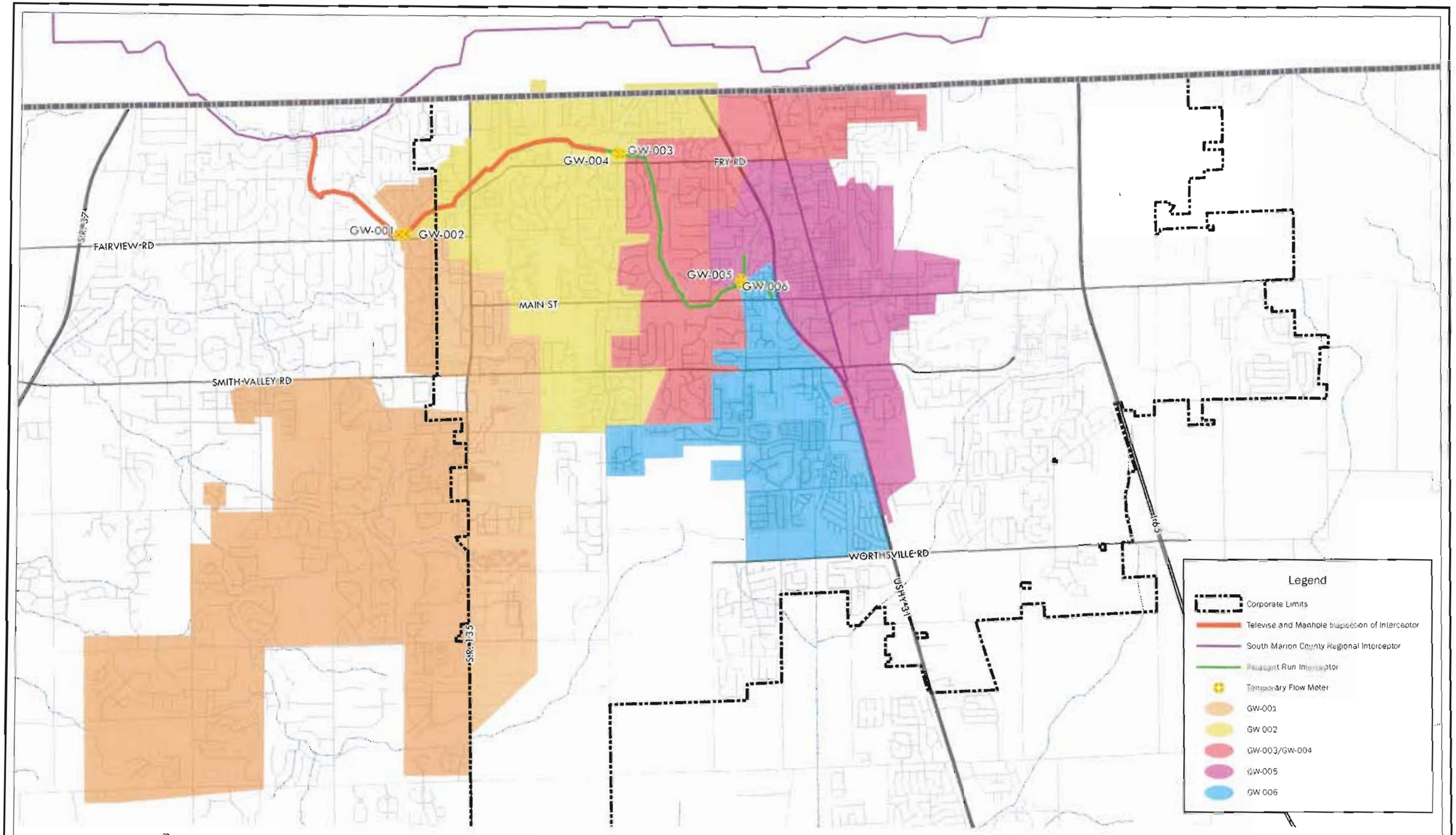


Figure 3.3
City of Greenwood - Sanitary Sewer Utility
Capital Improvement & I/I Reduction Plan
Flow Meter Contributing Areas
Greenwood, Indiana
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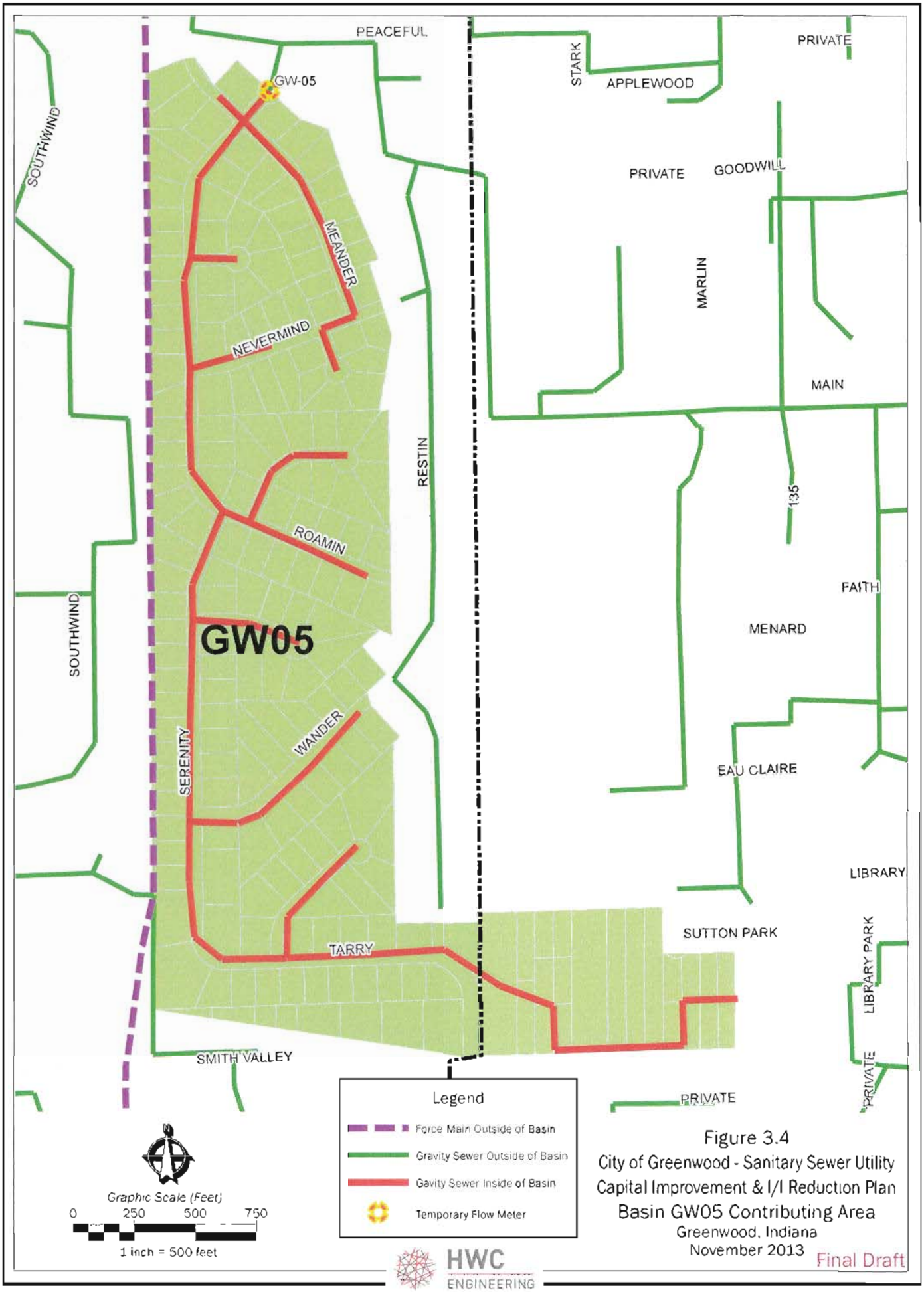

Figure 3.4
City of Greenwood - Sanitary Sewer Utility
Capital Improvement & I/I Reduction Plan
Basin GW05 Contributing Area
Greenwood, Indiana
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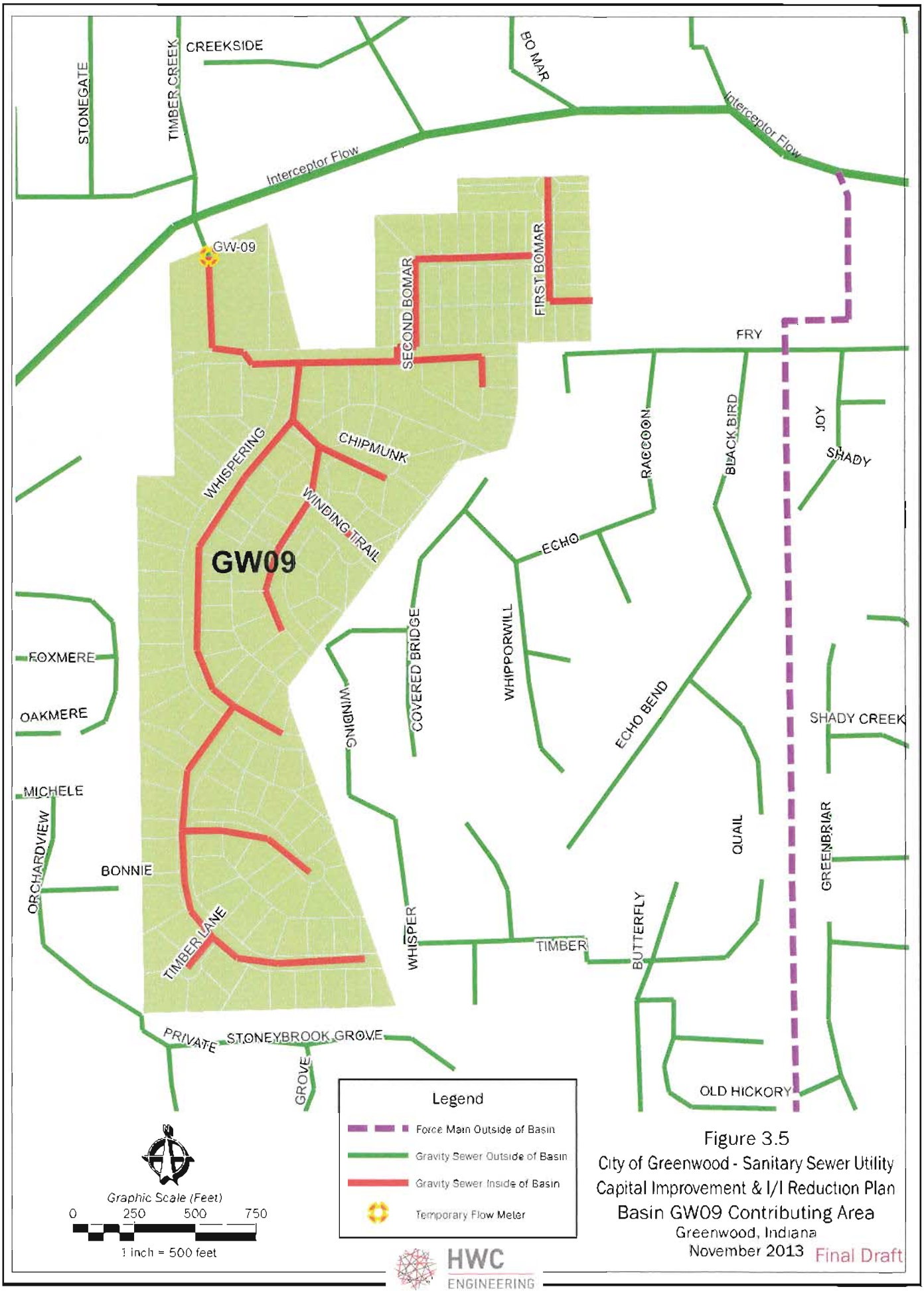

Figure 3.5
City of Greenwood - Sanitary Sewer Utility
Capital Improvement & I/I Reduction Plan
Basin GW09 Contributing Area
Greenwood, Indiana
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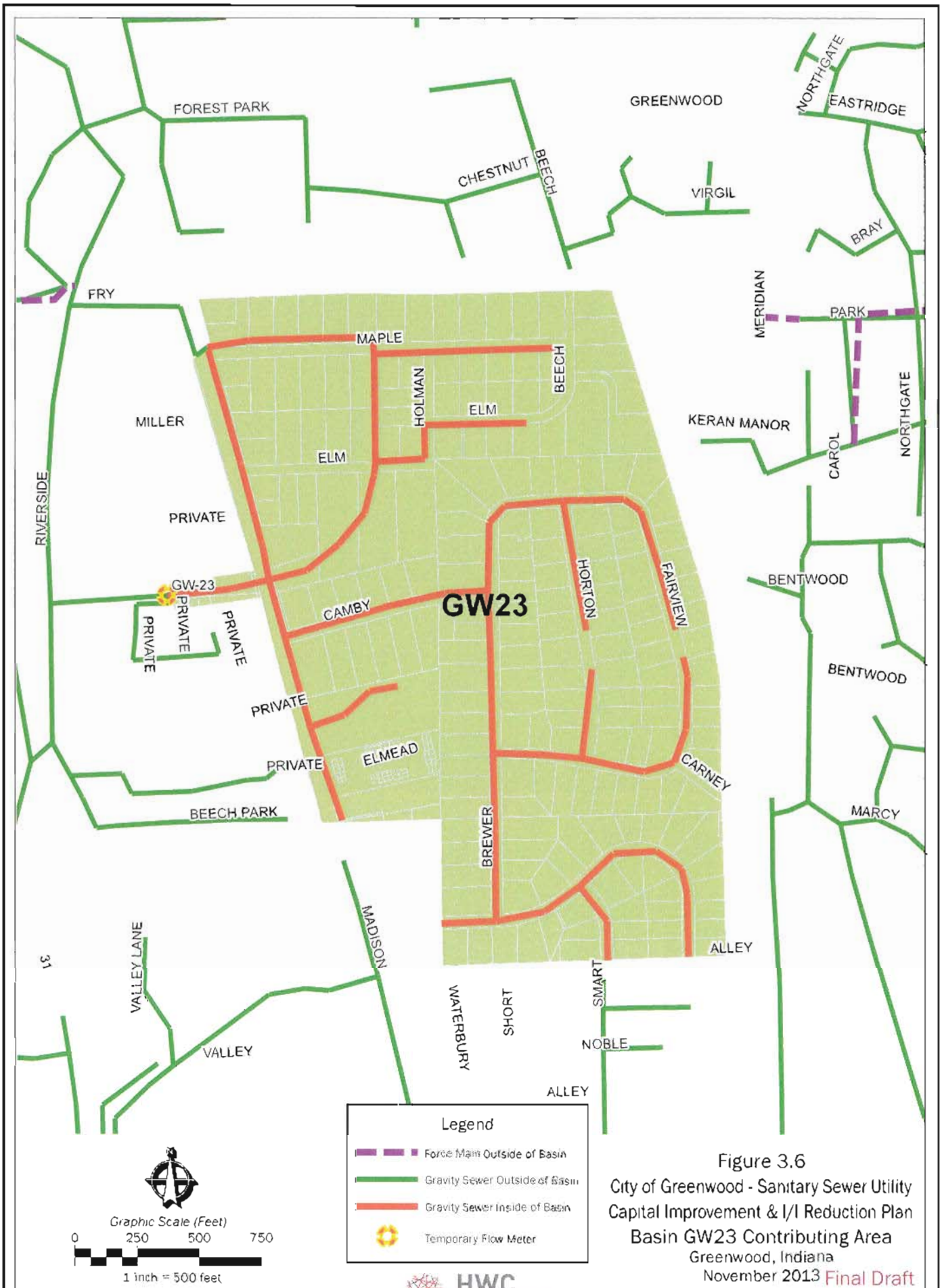

Figure 3.6
City of Greenwood - Sanitary Sewer Utility
Capital Improvement & I/I Reduction Plan
Basin GW23 Contributing Area
Greenwood, Indiana
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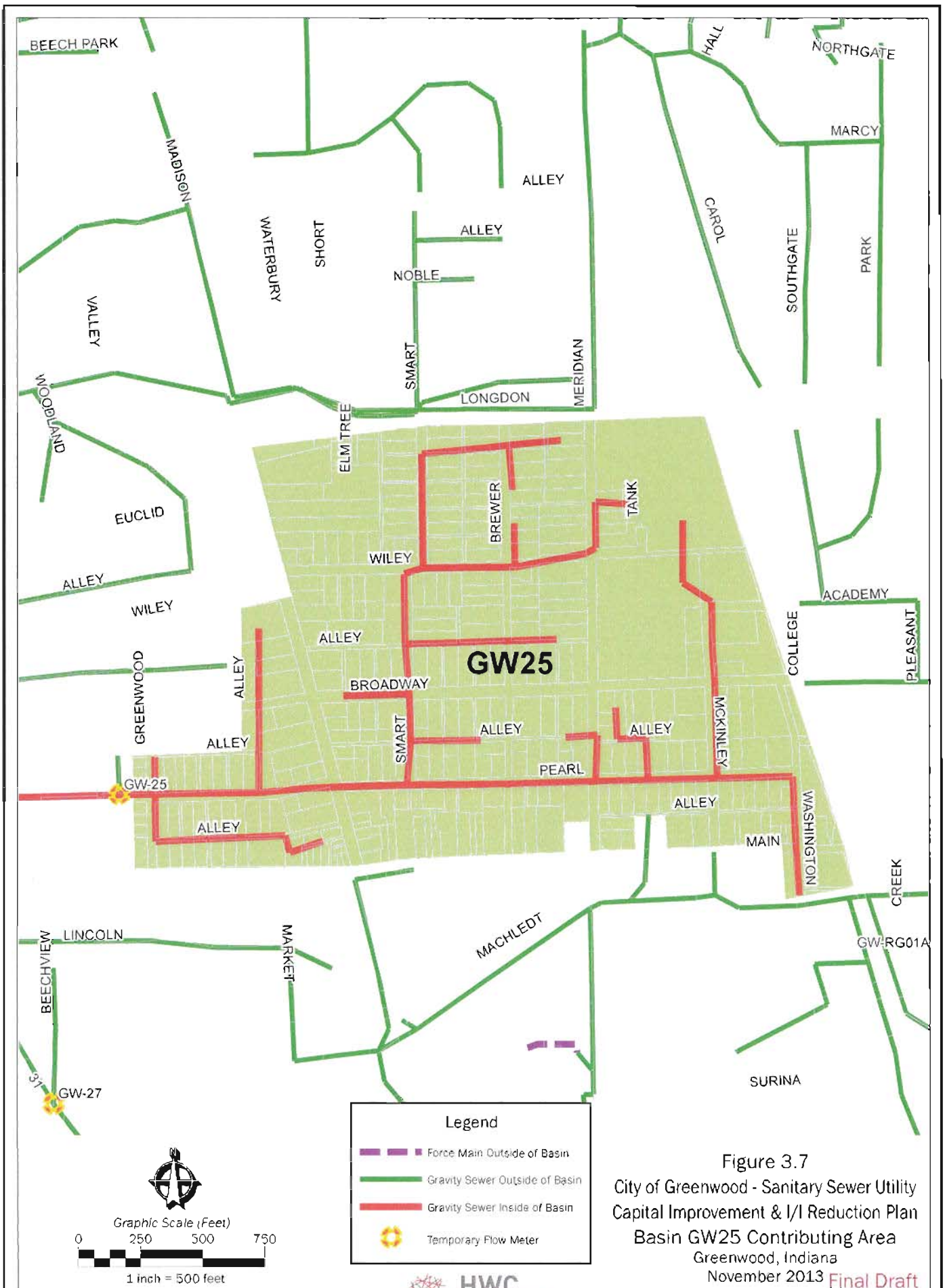

Figure 3.7
City of Greenwood - Sanitary Sewer Utility
Capital Improvement & I/I Reduction Plan
Basin GW25 Contributing Area
Greenwood, Indiana
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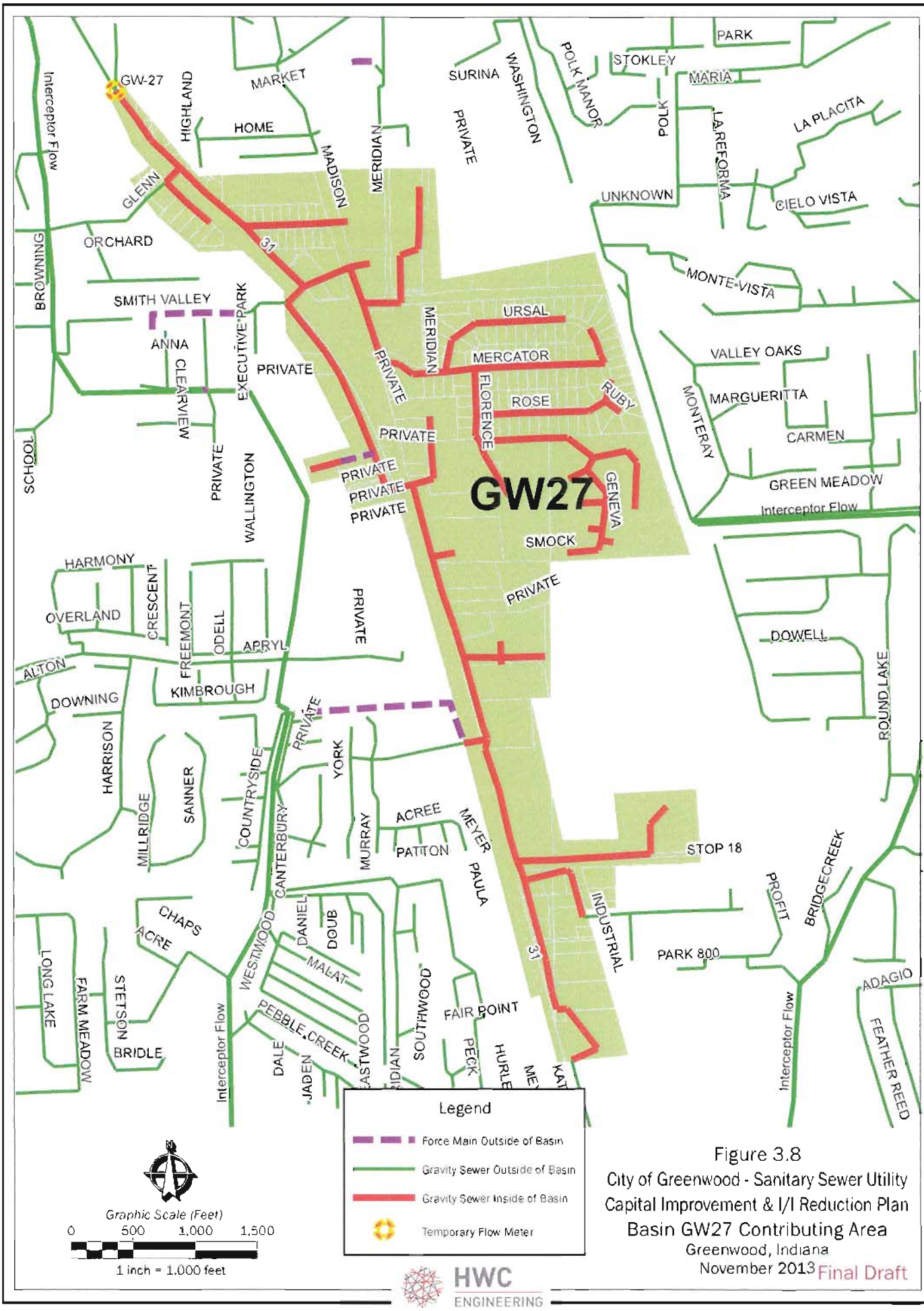

Figure 3.8
City of Greenwood - Sanitary Sewer Utility
Capital Improvement & I/I Reduction Plan
Basin GW27 Contributing Area
Greenwood, Indiana
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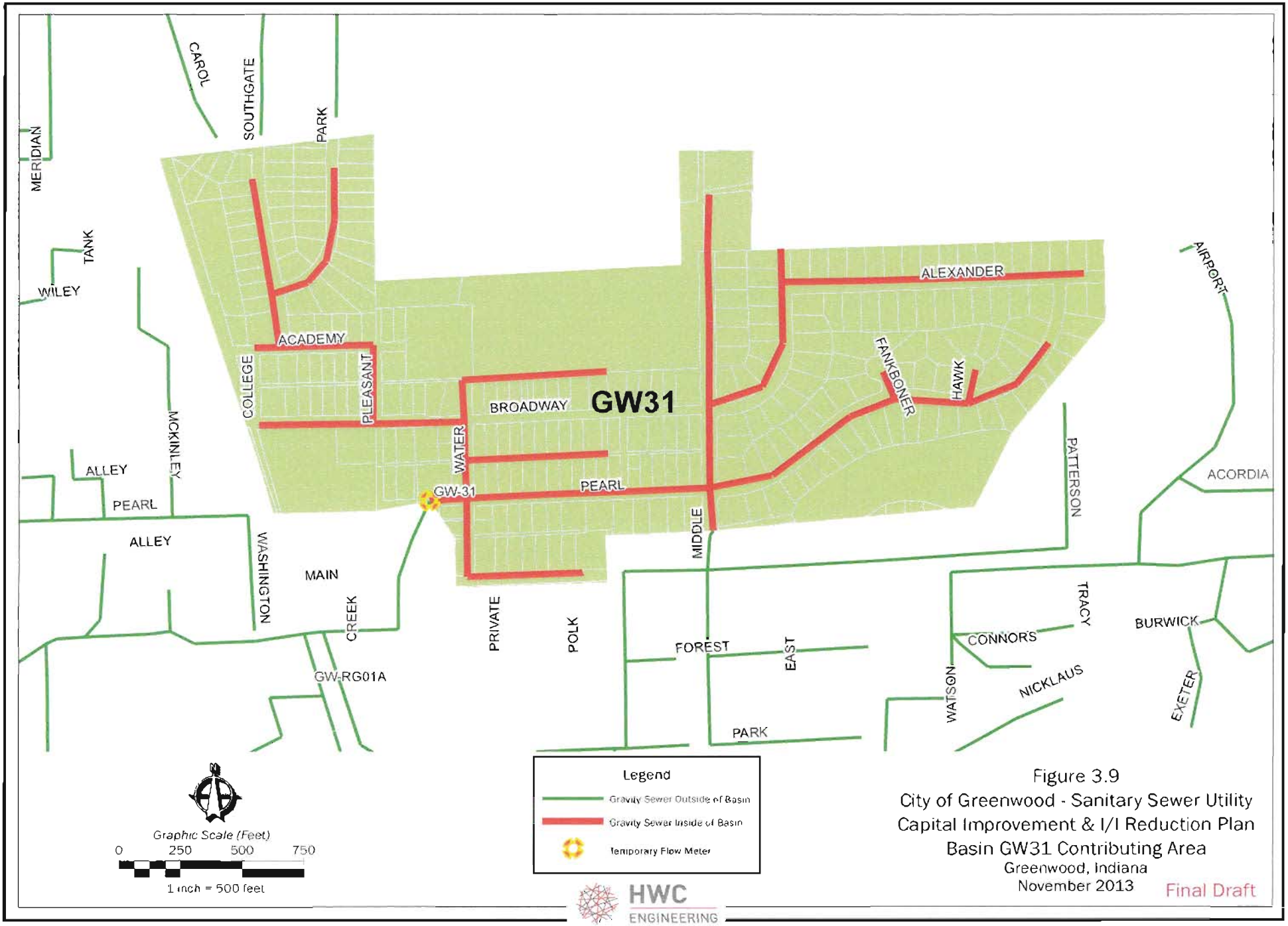

Figure 3.9
City of Greenwood - Sanitary Sewer Utility
Capital Improvement & I/I Reduction Plan
Basin GW31 Contributing Area
Greenwood, Indiana
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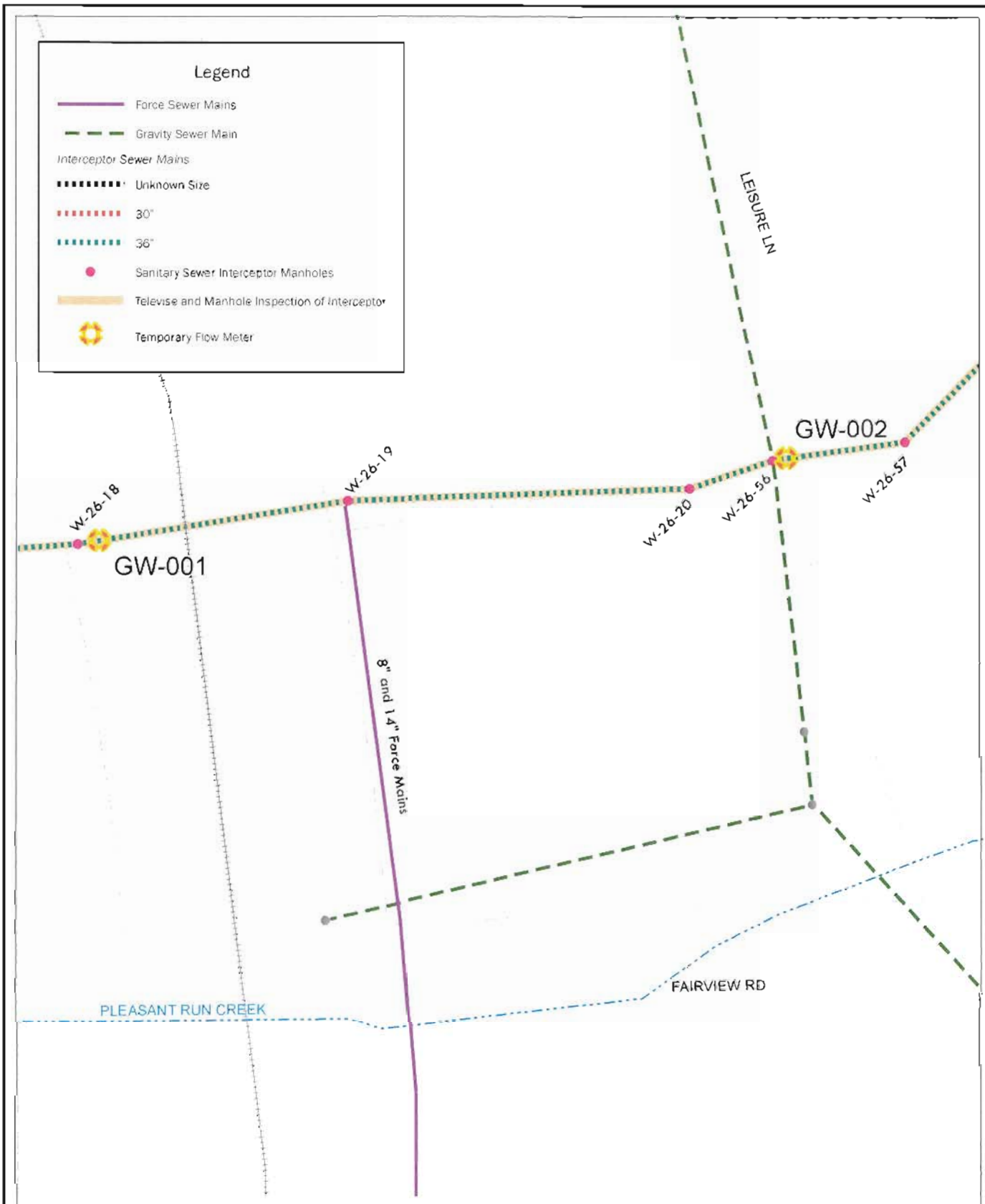

Figure 3.10
City of Greenwood - Sanitary Sewer Utility
Capital Improvement & I/I Reduction Plan
GW-001 & GW-002 Meter Locations
Greenwood, Indiana
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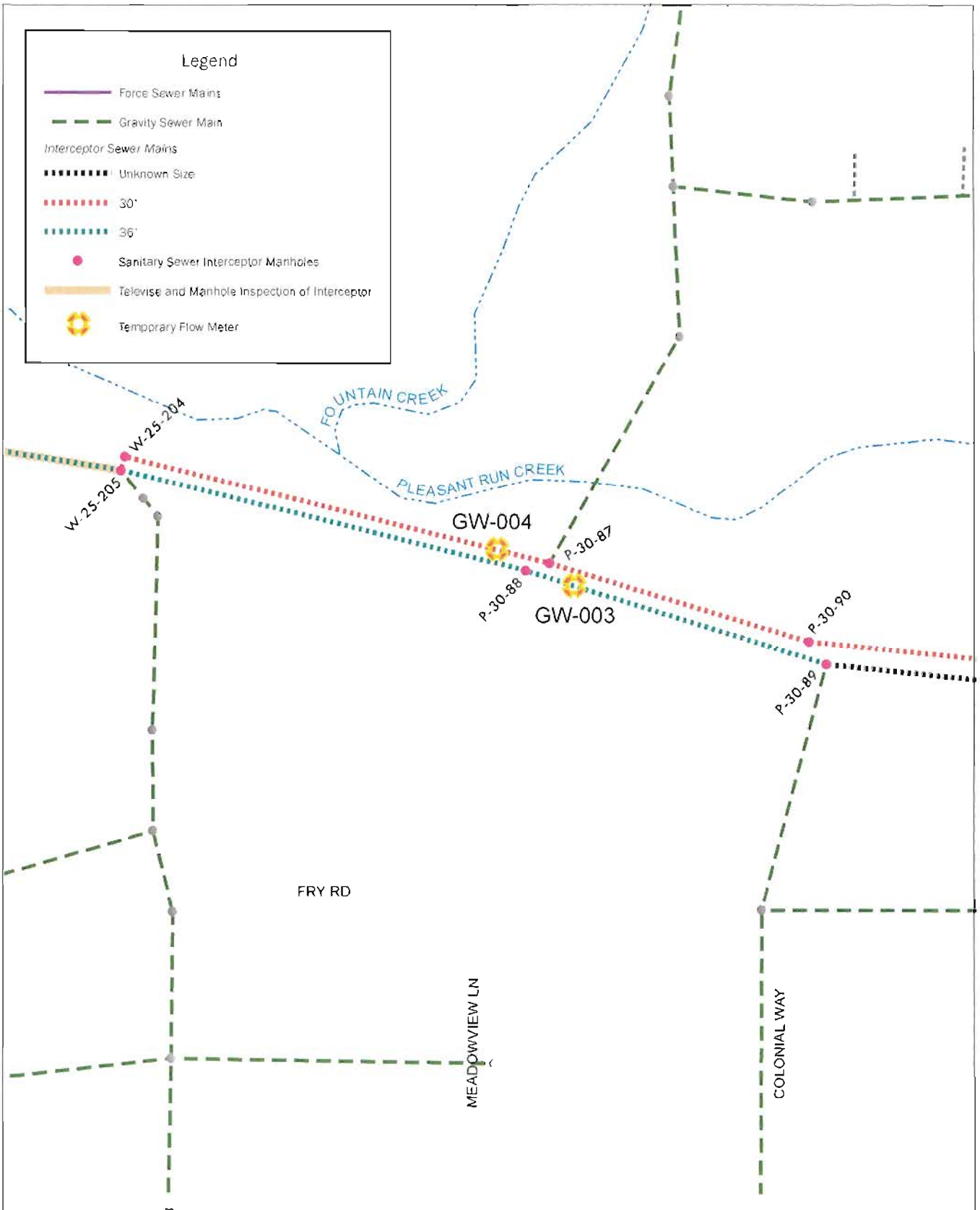

Figure 3.11
City of Greenwood - Sanitary Sewer Utility
Capital Improvement & I/I Reduction Plan
GW-003 & GW-004 Meter Locations
Greenwood, Indiana
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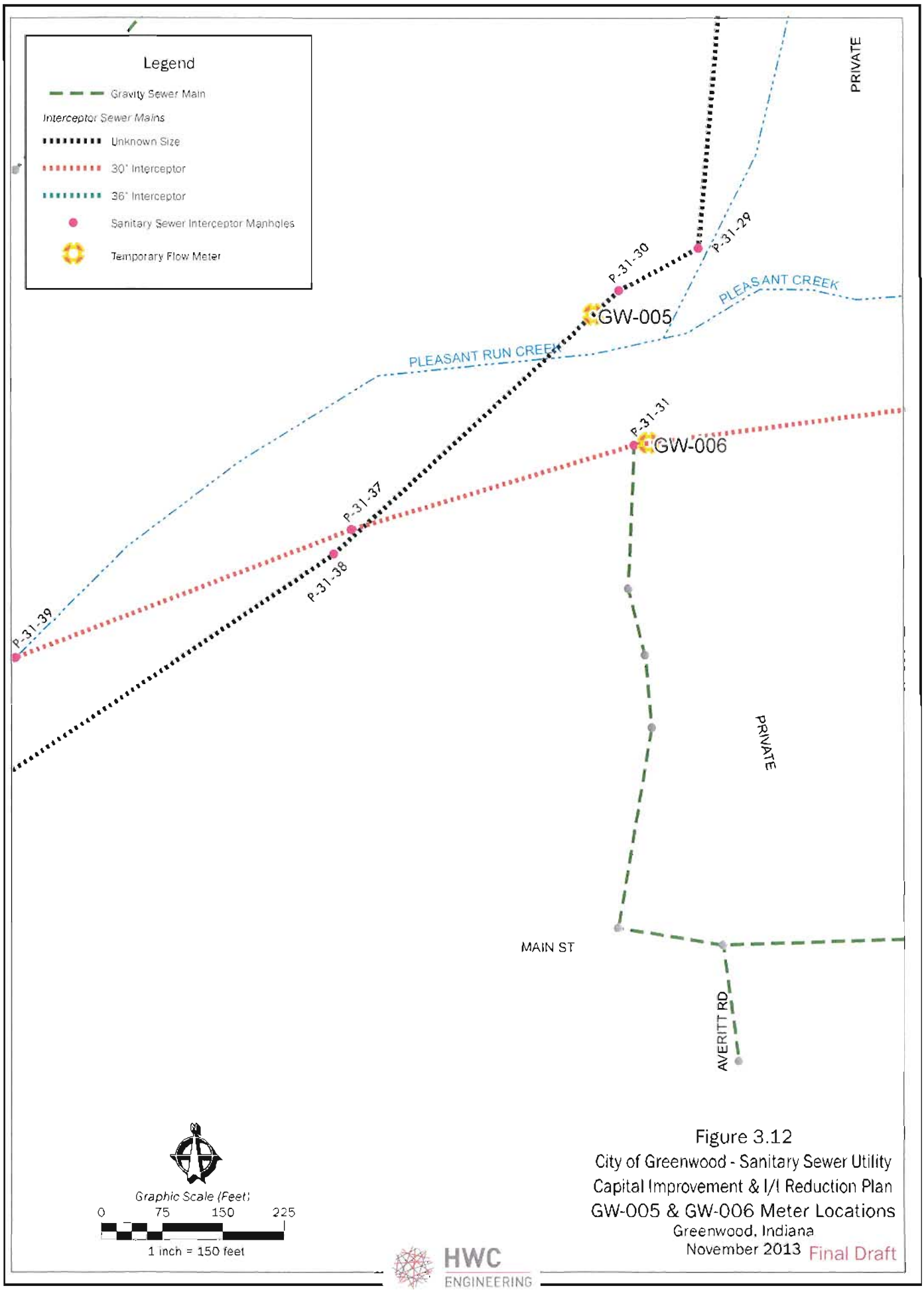

Figure 3.12
City of Greenwood - Sanitary Sewer Utility
Capital Improvement & I/I Reduction Plan
GW-005 & GW-006 Meter Locations
Greenwood, Indiana
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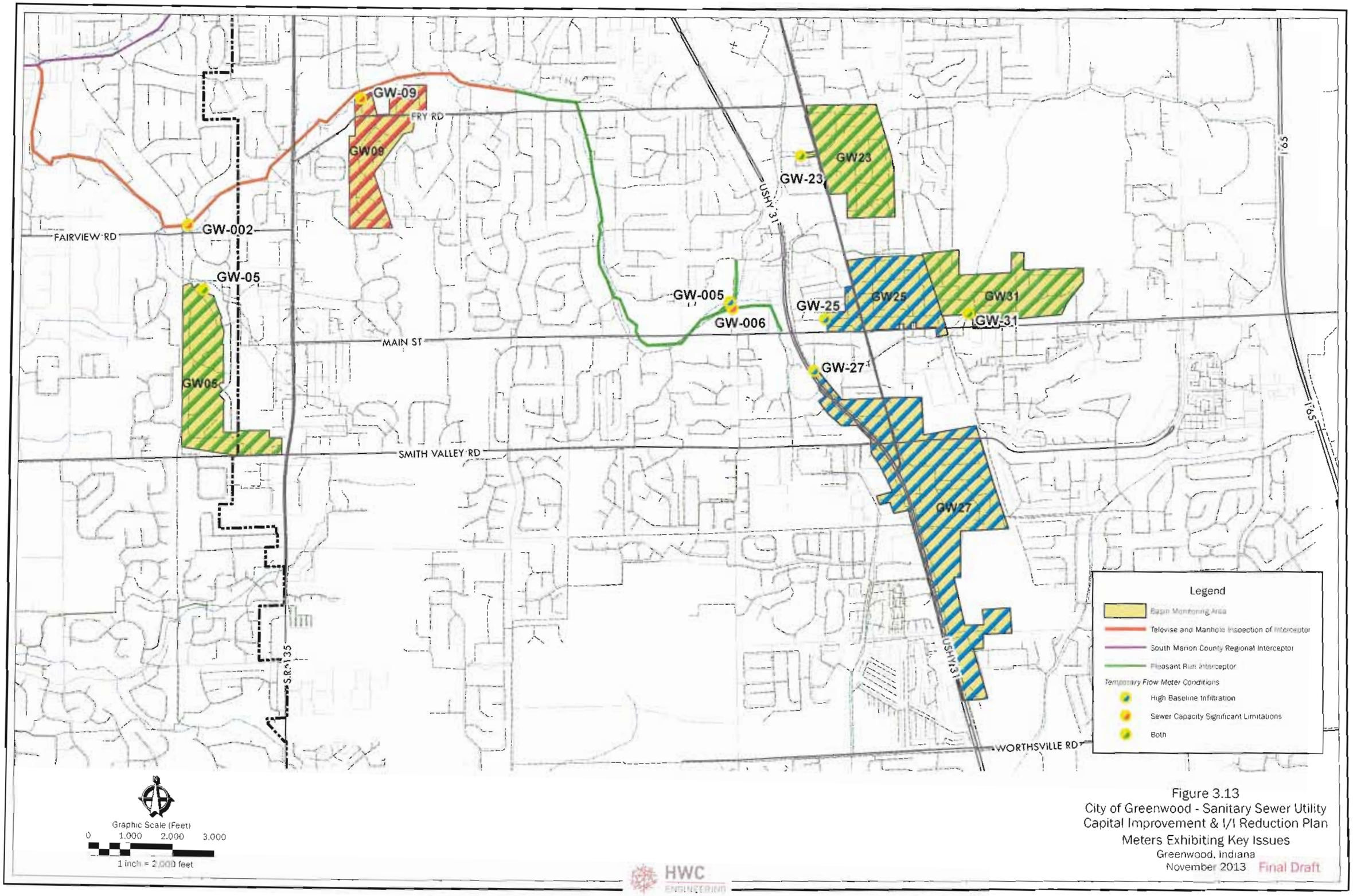

Figure 3.13
City of Greenwood - Sanitary Sewer Utility
Capital Improvement & I/I Reduction Plan
Meters Exhibiting Key Issues
Greenwood, Indiana
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SMITH VALLEY RD

WORTHSVILLE RD

USHY 31

USHY 31

S.R. 135

Brandywine / Ashton Park

Alden Place/Featherstone

Turkey Pen in Auburn Trace

Eagle Trace

Ashwood

Brentridge Estates

Midwest Bus Center

Waters Edge Section2A

Copper Leaf

Legend

Lift Station

Private Lift Station

Lift Stations with Largest Reaction to Wet Weather

Graphic Scale (Feet)

0 1,000 2,000 3,000

1 inch = 2,000 feet

Figure 3.14
City of Greenwood - Sanitary Sewer Utility
Capital Improvement & I/I Reduction Plan
Lift Stations with Largest Reaction to Wet Weather
Greenwood, Indiana
November 2013

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Legend

- Corporate Limits
- Streams and Rivers

Pleasant Run Interceptor: Sewer Main Condition

- Good
- Moderate
- Poor

Pleasant Run Interceptor: Manhole Condition

- Good
- Moderate
- Poor

Graphic Scale (Feet)

0 400 800 1,200

1 inch = 800 feet

Figure 3.15
City of Greenwood - Sanitary Sewer Utility
Capital Improvement & I/I Reduction Plan
Pleasant Run Interceptor: Manhole & Pipe Condition
Greenwood, Indiana
November 2013

Final Draft

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Section Four – Alternatives Analysis

This section of the report analyzes possible capital improvements to the sanitary system to address I/I problems and infrastructure issues that were identified during the data collection (see Section Three) or by the Utility based on historical system problems (see Section Two). The major problems identified have been evaluated and the following sections provide descriptions of alternatives for each major system item.

4.1 Southwest Service Area - 8" and 14" Force Main Flow Impact

The Utility staff indicated that during wet weather events, surcharging sometimes occurs in the Pleasant Run Interceptor. The data collected by ADS supports this, by documenting that surcharging in the interceptor occurred during one of the rain events (on April 18, 2013). This surcharging in the interceptor creates an issue by backing-up flow further upstream and keeping sewer flow from exiting the system.

The data also revealed that a significant increase in Rainfall Dependent I/I (RDII) occurs between flow meters GW-001 and GW-002. Section 3.3.3 noted that these two flow meters are in close proximity to each other, and it is likely that the discharged flow from the dual 8" and 14" force mains between these two meters were the primary source of the I/I difference. These two (2) force mains receive flow from three (3) lift stations whose flows combine in a manifold structure. The three (3) lift stations are: Eldorado, Turkey Pen, and Buckmoor. These lift stations serve a very large area in the southwest part of the collection system, due to other neighboring lift stations that pump into their collection systems. The entire service area that contributes to the 8" and 14" force mains, and the three (3) primary lift stations, are shown in Figure 4.1.

Of the twelve (12) lift stations in this southwest part of the system, half of them were among the lift stations listed in Table 3.5 as having the largest reaction to wet weather. This further supports the conclusion that this area has high RDII and contributes to the Pleasant Run Interceptor surcharging issues.

Based upon this analysis and the conclusions drawn, therefrom this area has been identified as a high priority area for capital improvements to alleviate hydraulic issues pursuant to Section 2.3 of the Compliance Plan. This study identified and summarized two (2) possible alternatives to help correct the problem.

4.1.1 Alternative No. 1: Relocate to Separate SMCRI Connection

In order to provide relief to the Pleasant Run Interceptor and help reduce the frequency of surcharges into the sewer that affects many areas of the system, one alternative solution includes re-routing the 8" and 14" force mains to a new independent South Marion County Regional Interceptor (SMCRI) connection point. Based on the flow measured during the monitoring period, it is estimated that the force mains contribute approximately 14% of the interceptor's flow at metering point GW-001 during normal conditions. During rain events, this percentage increased to as much as 18%. Therefore, re-routing these two force mains would help reduce flow in the Pleasant Run Interceptor by approximately 14-18% and correspondingly reduce the potential and frequency of surcharging during wet weather. Additionally, given the poor condition of the manhole and sewer segments around the force main discharge location due to hydrogen sulfide corrosion, relocating the force main will reduce the deterioration of this part of the system. The new discharge location would include provisions to protect the piping and manholes from this corrosion in the future.

Several options exist for re-routing the force mains to their own SMCRI connection. Figure 4.2 indicates three (3) different route options.

- The route for Option 1 involves extending the force mains west under the railroad tracks along Fairview Road, then north on Peterman Road and under the railroad tracks again, before connecting to the SMCRI near Kristi Way. In addition to the two railroad crossings, Option 1 involves two stream crossings and significant clearing due to trees adjacent to the roadways.

- Option 2 includes a route which stays on the east side of the railroad tracks and follows Leisure Lane north, then west on Long Rifle Road, south on Woodcreek Place, and north on Woodcreek Court. The connection to SMCRI would be in the same vicinity as Option 1. Although Option 2 would avoid the railroad and stream crossings implicated in Option 1, Option 2 will result in significant pavement repair because the force mains will likely need to be located in the roadways.

- Option 3 is the shortest route, which follows Leisure Lane north before going northwest in an existing sanitary sewer easement in a residential area. This option also avoids the railroad and stream crossings mentioned in Option 1.

The estimated cost of each option is indicated in Tables 4.1 through 4.3. All three (3) options involve upsizing the existing pumps in the lift stations, and the force mains discharging to a short section of gravity sewer that would then have a parshall flume metering structure prior to the SMCRI. Option 3 is the recommended option, because not only is it the least expensive, but it would not create a new metering point that would need to be negotiated with Citizens Energy Group (CEG). The existing Wood Creek SMCRI meter (Meter #2) is already at this location, and thus would only require negotiations with CEG for expanding the connection and meter currently in place.

SUMMARY SENTENCE: Alternative No. 1 helps achieve the goals of Section 2.3 of the Compliance Plan by rerouting the flow in the southwest area of the collection system to its own SMCRI connection and lessening the likelihood of surcharge events in the high risk area of the Pleasant Run Interceptor.

Table 4.1
City of Greenwood, Indiana
Sanitary Sewer Utility Capital Improvement & I/I Reduction Plan
Southwest Service Area - 8" and 14" Force Main Relocation - Option 1
Estimate of Probable Project Costs

I. Construction					
Item #	Description	Unit	Quantity	Unit Cost	Total
1	Force Main, 8"	LF	6,000	$35.00	$210,000.00
2	Force Main, 14"	LF	6,000	$60.00	$360,000.00
3	Gravity Sewer, 30"	LF	50	$250.00	$12,500.00
4	Jack & Bore, RR Crossing, 14" Casing & 8" Force Main	LF	320	$425.00	$136,000.00
5	Jack & Bore, RR Crossing, 20" Casing & 14" Force Main	LF	320	$550.00	$176,000.00
6	Directional Drill, Creek Crossing, 10" HDPE Force Main	LF	700	$130.00	$91,000.00
7	Directional Drill, Creek Crossing, 16" HDPE Force Main	LF	700	$150.00	$105,000.00
8	Manhole, 10', Installed over Existing Interceptor	EA	1	$17,500.00	$17,500.00
9	Manhole, 6', Standard	EA	1	$7,500.00	$7,500.00
10	Manhole Lining	EA	2	$4,000.00	$8,000.00
11	Connection to Existing Force Main	EA	2	$2,500.00	$5,000.00
12	Plug Valve and Box, 8"	EA	4	$2,500.00	$10,000.00
13	Plug Valve and Box, 14"	EA	4	$3,500.00	$14,000.00
14	Air Release Valve	EA	4	$5,500.00	$22,000.00
15	Parshall Flume Meter Station	LS	1	$50,000.00	$50,000.00
16	Cut and Cap Existing 8" Force Main	EA	2	$500.00	$1,000.00
17	Cut and Cap Existing 14" Force Main	EA	2	$1,000.00	$2,000.00
18	Driveway Repair	LF	450	$50.00	$22,500.00
19	Sidewalk Repair	SYS	55	$65.00	$3,575.00
20	Pavement Repair	TON	200	$120.00	$24,000.00
21	Granular Backfill	CYS	900	$45.00	$40,500.00
22	Compacted Aggregate Base	SYS	800	$25.00	$20,000.00
23	Clearing Right-of-Way	LS	1	$25,000.00	$25,000.00
24	Erosion Control	LS	1	$30,000.00	$30,000.00
25	Site Restoration (Seeding and Straw)	LS	1	$35,000.00	$35,000.00
26	Bypass Pumping	LS	1	$20,000.00	$20,000.00
27	Lift Station Pump Upgrades	EA	3	$210,000.00	$630,000.00
28	Maintenance of Traffic	LS	1	$20,000.00	$20,000.00
29	Mobilization/Demobilization (NTE 5%)	LS	1	$105,000.00	$105,000.00
				Sub-Total Construction Cost	**$2,203,075.00**
				Contingency (15%)	$330,500.00
				Total Construction Cost	**$2,533,575.00**
II. Non-Construction					
				Land Acquisition and Right-of-Way Engineering Cost	$200,000.00
				Non-Construction Cost (25%)	$683,400.00
				Total Project Cost	**$3,416,975.00**

Table 4.2
City of Greenwood, Indiana
Sanitary Sewer Utility Capital Improvement & I/I Reduction Plan
Southwest Service Area - 8" and 14" Force Main Relocation - Option 2
Estimate of Probable Project Costs

I. Construction					
Item #	Description	Unit	Quantity	Unit Cost	Total
1	Force Main, 8"	LF	6,420	$35.00	$224,700.00
2	Force Main, 14"	LF	6,420	$60.00	$385,200.00
3	Gravity Sewer, 30"	LF	50	$250.00	$12,500.00
4	Manhole, 10', Installed over Existing Interceptor	EA	1	$17,500.00	$17,500.00
5	Manhole, 6', Standard	EA	1	$7,500.00	$7,500.00
6	Manhole Lining	EA	2	$4,000.00	$8,000.00
7	Connection to Existing Force Main	EA	2	$2,500.00	$5,000.00
8	Plug Valve and Box, 8"	EA	3	$2,500.00	$7,500.00
9	Plug Valve and Box, 14"	EA	3	$3,500.00	$10,500.00
10	Air Release Valve	EA	4	$5,500.00	$22,000.00
11	Parshall Flume Meter Station	LS	1	$50,000.00	$50,000.00
12	Cut and Cap Existing 8" Force Main	EA	2	$500.00	$1,000.00
13	Cut and Cap Existing 14" Force Main	EA	2	$1,000.00	$2,000.00
14	Driveway Repair	LF	700	$50.00	$35,000.00
15	Sidewalk Repair	SYS	55	$65.00	$3,575.00
16	Pavement Repair	TON	850	$120.00	$102,000.00
17	Granular Backfill	CYS	3,400	$45.00	$153,000.00
18	Compacted Aggregate Base	SYS	2,950	$25.00	$73,750.00
19	Clearing Right-of-Way	LS	1	$15,000.00	$15,000.00
20	Erosion Control	LS	1	$30,000.00	$30,000.00
21	Site Restoration (Seeding and Straw)	LS	1	$35,000.00	$35,000.00
22	Bypass Pumping	LS	1	$20,000.00	$20,000.00
23	Lift Station Pump Upgrades	EA	3	$210,000.00	$630,000.00
24	Maintenance of Traffic	LS	1	$25,000.00	$25,000.00
25	Mobilization/Demobilization (NTE 5%)	LS	1	$93,800.00	$93,800.00
				Sub-Total Construction Cost	**$1,969,525.00**
				Contingency (15%)	$295,500.00
				Total Construction Cost	**$2,265,025.00**
II. Non-Construction					
				Land Acquisition and Right-of-Way Engineering Cost	$50,000.00
				Non-Construction Cost (25%)	$578,800.00
				Total Project Cost	**$2,893,825.00**

Table 4.3
City of Greenwood, Indiana
Sanitary Sewer Utility Capital Improvement & I/I Reduction Plan
Southwest Service Area - 8" and 14" Force Main Relocation - Option 3
Estimate of Probable Project Costs

I. Construction					
Item #	Description	Unit	Quantity	Unit Cost	Total
1	Force Main, 8"	LF	4,600	$35.00	$161,000.00
2	Force Main, 14"	LF	4,600	$60.00	$276,000.00
3	Gravity Sewer, 30"	LF	600	$225.00	$135,000.00
4	Manhole, 10', Installed over Existing Interceptor	EA	1	$17,500.00	$17,500.00
5	Manhole, 6', Standard	EA	4	$7,500.00	$30,000.00
6	Manhole Lining	EA	5	$4,000.00	$20,000.00
7	Connection to Existing Force Main	EA	2	$2,500.00	$5,000.00
8	Plug Valve and Box, 8"	EA	3	$2,500.00	$7,500.00
9	Plug Valve and Box, 14"	EA	3	$3,500.00	$10,500.00
10	Air Release Valve	EA	4	$5,500.00	$22,000.00
11	Parshall Flume Meter Station	LS	1	$50,000.00	$50,000.00
12	Cut and Cap Existing 8" Force Main	EA	2	$500.00	$1,000.00
13	Cut and Cap Existing 14" Force Main	EA	2	$1,000.00	$2,000.00
14	Driveway Repair	LF	300	$50.00	$15,000.00
15	Pavement Repair	TON	650	$120.00	$78,000.00
16	Granular Backfill	CYS	2,975	$65.00	$193,375.00
17	Compacted Aggregate Base	SYS	2,225	$25.00	$55,625.00
18	Clearing Right-of-Way	LS	1	$10,000.00	$10,000.00
19	Erosion Control	LS	1	$30,000.00	$30,000.00
20	Site Restoration (Seeding and Straw)	LS	1	$30,000.00	$30,000.00
21	Bypass Pumping	LS	1	$20,000.00	$20,000.00
22	Lift Station Pump Upgrades	EA	3	$210,000.00	$630,000.00
23	Maintenance of Traffic	LS	1	$25,000.00	$25,000.00
24	Mobilization/Demobilization (NTE 5%)	LS	1	$91,300.00	$91,300.00
				Sub-Total Construction Cost	**$1,915,800.00**
				Contingency (15%)	$287,400.00
				Total Construction Cost	**$2,203,200.00**
II. Non-Construction					
				Land Acquisition and Right-of-Way Engineering Cost	$50,000.00
				Non-Construction Cost (25%)	$563,300.00
				Total Project Cost	**$2,816,500.00**

4.1.2 Alternative No. 2: Western Regional Interceptor

A second alternative to remove the 8" and 14" force main flow from the Pleasant Run Interceptor is to install a separate interceptor on the west end of the collection system, with its own SMCRI metered connection. This concept has been considered periodically over the past 20 years and was analyzed in a previous study. The initial study was the 1990 Sanitary Sewer Master Plan for White River Township. An addendum to the study was completed in 2001 and revised in 2002, titled the Western Regional Interceptor Master Plan. Although the interceptor was never constructed, some easements for a potential route have been incorporated into new developments to help facilitate its construction in the future.

The 2002 updated study of the Western Regional Interceptor concept recommended three (3) phases of implementation. The first phase involved a new metered connection to the SMCRI west of S.R. 37 near Wicker Road. From that point, the interceptor was planned to extend south, and then cross S.R. 37 near the Bluff Road intersection (or Bluffdale Road intersection). Once on the east side of S.R. 37, the interceptor would continue south until Honey Creek, and then extend southeast along Honey Creek, splitting at Turkey Pen Creek. Figure 4.3 illustrates the proposed interceptor route from the 2002 study. The Phase I improvements completely remove the 8" and 14" force mains, because the Eldorado, Turkey Pen, and Buckmoor lift stations would all be served by gravity sewers instead. This option also eliminates several additional lift stations, thereby saving yearly operation and maintenance (O&M) costs for the Utility.

Table 4.4 provides an updated estimated cost of the Phase I improvements. Table 4.5 indicates the estimated yearly O&M savings due to the lift stations that are expected to be removed as a result of the Phase I improvements. The estimate in Table 4.4 was based on the estimate developed in the 2002 study, but updated and adjusted to 2013 dollars by applying inflation. The 2002 estimate did not appear to properly account for certain construction costs like pavement restoration and clearing, nor did it include non-

construction costs such as land acquisition and engineering. Cost allocations for those items were added into the estimate, and the values were compared to recent bid tabulations to help ensure accuracy. In addition, the contingency was raised to 15%, due to development in the interim period which could impact the alignment of the Phase I improvements.

Table 4.4
City of Greenwood, Indiana
Sanitary Sewer Utility Capital Improvement & I/I Reduction Plan
Western Regional Interceptor - Phase I
Estimate of Probable Project Costs

I. Construction					
Item #	Description	Unit	Quantity	Unit Cost	Total
1	Gravity Sewer, 54"	LF	9,866	$475.00	$4,686,350.00
2	Gravity Sewer, 42"	LF	10,354	$325.00	$3,365,050.00
3	Gravity Sewer, 27"	LF	7,030	$200.00	$1,406,000.00
4	Gravity Sewer, 24"	LF	10,872	$175.00	$1,902,600.00
5	Gravity Sewer, 15"	LF	7,802	$145.00	$1,131,290.00
6	Gravity Sewer, 12"	LF	11,730	$135.00	$1,583,550.00
7	Gravity Sewer, 10"	LF	12,842	$125.00	$1,605,250.00
8	Gravity Sewer, 8"	LF	9,005	$115.00	$1,035,575.00
9	Manhole, 4', Standard	EA	175	$5,000.00	$875,000.00
10	Manhole, 5', Standard	EA	23	$7,000.00	$161,000.00
11	Manhole, 6', Standard	EA	25	$9,000.00	$225,000.00
12	Manhole, 8', Standard	EA	25	$13,000.00	$325,000.00
14	Parshall Flume Meter Station	EA	1	$100,000.00	$100,000.00
22	Clearing Right-of-Way	LS	1	$73,500.00	$73,500.00
23	Construction Engineering/Layout/Staking	LS	1	$100,000.00	$100,000.00
24	Restoration (Pavement and Site)	LS	1	$250,000.00	$250,000.00
25	Maintenance of Traffic	LS	1	$30,000.00	$30,000.00
26	Mobilization/Demobilization (NTE 5%)	LS	1	$942,800.00	$942,800.00
				Sub-Total Construction Cost	**$19,797,965.00**
				Contingency (15%)	$2,969,700.00
				Total Construction Cost	**$22,767,665.00**
II. Non-Construction					
				Land Acquisition and Right-of-Way Engineering Cost	$750,000.00
				Non-Construction Cost (25%)	$5,879,500.00
				Total Project Cost	**$29,397,165.00**

Table 4.5
City of Greenwood, Indiana
Sanitary Sewer Utility Capital Improvement & I/I Reduction Plan
Estimated O&M Savings for Lift Station Abandonment

Item	Lift Station to be Taken Offline as a Result of Western Regional Interceptor	Annual O&M Cost
1	Wakefield III	$15,000.00
2	Wakefield	$15,000.00
3	Brookhaven	$15,000.00
4	Olive Branch	$15,000.00
5	Turkey Pen	$25,000.00
6	Brentridge	$15,000.00
7	Buckmoor	$25,000.00
8	Ashwood	$15,000.00
9	Eagle Trace	$15,000.00
10	Eldorado	$25,000.00
	Total Reduction in Annual O&M	**$180,000.00**

In order to serve the Phase II area, the 2002 study recommended a regional lift station along Honey Creek. A lift station, Lone Pine Farms, has already been built in this general location to serve recently occurring development. Because the Phase I Western Interceptor improvements were not in place yet, the Lone Pine Farms Lift Station's force main was routed east and discharged to a gravity sewer eventually leading to the Hurricane Creek Lift Station east of I65. By discharging the force main in this location, the Lone Pine Farms Lift Station does not hurt capacity in the Pleasant Run Interceptor and goes to a separate SMCRI metering point. However, the additional flow from the Lone Pine Farms Lift Station was not taken into account when the Hurricane Creek Lift Station was planned and designed. If the Phase I improvements were constructed, then the Lone Pine Farms force main could be re-routed to discharge north to a gravity sewer south of Olive Branch Road, thus freeing up capacity in the original Hurricane Creek Basin on the east

side of the system for development. The force main is shown on Figure 4.3 as the Phase II improvement and its cost is estimated in Table 4.6. There were other sewers recommended in Phase II of the 2002 study, but they can be omitted contingent upon future development since the Lone Pine Farms Lift Station is already in place.

Table 4.6
City of Greenwood, Indiana
Sanitary Sewer Utility Capital Improvement & I/I Reduction Plan
Western Regional Interceptor- Phase II
Estimate of Probable Project Costs

I. Construction					
Item #	Description	Unit	Quantity	Unit Cost	Total
1	Force Main, 24"	LF	10,500	$140.00	$1,470,000.00
2	Clearing Right-of-Way	LS	1	$25,000.00	$25,000.00
3	Construction Engineering/Layout/Staking	LS	1	$20,000.00	$20,000.00
4	Restoration (Pavement and Site)	LS	1	$75,000.00	$75,000.00
5	Maintenance of Traffic	LS	1	$5,000.00	$5,000.00
6	Mobilization/Demobilization (NTE 5%)	LS	1	$79,800.00	$79,800.00
				Sub-Total Construction Cost	**$1,674,800.00**
				Contingency (15%)	$251,300.00
				Total Construction Cost	**$1,926,100.00**
II. Non-Construction					
				Land Acquisition and Right-of-Way Engineering Cost	$50,000.00
				Non-Construction Cost (25%)	$494,100.00
				Total Project Cost	$2,470,200.00

The 2002 study also indicated a Phase III consisting of gravity sewers leading to a regional lift station near S.R. 37, which pumped north into the Phase I interceptor. The costs for Phase III have not been estimated in this report because this phase does not address I/I or hydraulic issues, which is the primary goal of this study. Instead, Phase III expands service for development. Figure 4.3 illustrates the Phase III service area. If the Utility has an interest in expanding the service area to include Phase III, it is recommended that the Phase III area be studied separately and the recent development factored into the review.

SUMMARY SENTENCE: Alternative No. 2 helps achieve the goals of Section 2.3 of the Compliance Plan by rerouting the flow in the western portion of the collection system to its own interceptor that discharges to a new SMCRI connection. This alternative removes much more flow from the Pleasant Run Interceptor than Alternative No. 1, thereby further decreasing the likelihood of surcharging events in this high risk area.

4.2 Southwest Lift Stations with High I/I

The elimination of the 8" and 14" force mains, serving the southwestern area of the system, from the Pleasant Run Interceptor would help reduce the frequency of interceptor surcharging during wet weather, but it would not eliminate the source of the wet weather induced problem. In order to begin the elimination of the source of the problem, the system would need to be investigated in this southwestern area to address leaks in the collection system and eliminate illegal connections such as sump pumps and roof drains. The following alternatives were developed to address these problems in this area.

4.2.1 Alternative No. 1: Total Investigative Effort

One alternative is to investigate the entire western service area in Figure 4.1, which includes all of the areas that contribute to the flow in the 8" and 14" force mains. The investigative work would include televising the sewers, conducting smoke testing, and examining homes for sump pump connections. This alternative is the most comprehensive, but it would also be the most time consuming and costly. Other wastewater utilities have conducted I/I elimination efforts like this over a wide area, but the results are varied. In a typical wastewater system, much of the I/I is in the sewer laterals within the property owner's land. Even when illegal connections are separated and mainline sewers are rehabilitated, lateral issues can continue to cause I/I albeit at reduced levels.

SUMMARY SENTENCE: Alternative No. 1 is the full investigative approach to eliminate I/I in an area identified as having high I/I, which meets the goals of

Section 1.4(7) of the Compliance Plan. It addresses the source of the problem to remove clear water sources from the sanitary sewer system.

4.2.2 Alternative No. 2: Focus on Smaller Area

Another alternative to identify and reduce contributing I/I effects in this area is to focus on a smaller subsystem, to first see the benefits achieved. In the case of the southwest lift stations, Waters Edge, Eagle Trace, and Alden Place were areas that exhibited large increases in flow due to wet weather (see Table 3.5). These three areas could be televised, smoke tested, and the focus for illegal source separation. Then, if improvements are determined in the evaluation, they could be completed, and the results monitored during wet weather events. The televising, smoke testing, and source separation efforts could be completed by the Utility using its own staff. Based on the overall cost/benefit ratio of this first area(s), subsequent areas could be selected for similar action.

SUMMARY SENTENCE: Alternative No. 2 is similar to Alternative No. 1 in that it eliminates I/I at its source. However, Alternative No. 2 achieves the goals of Section 1.4(7) in a different manner by prioritizing areas based on the severity of the issues.

4.3 Basin GW-25 (Old Town Area)

The data collection identified basin GW-25 as not only the worst basin in terms of RDII, but also one of the worst in baseline infiltration (BI). This area includes the oldest part of the City, so it is logical to hypothesize that the old pipes are allowing I/I in the system. The Utility has indicated that it has tried source separation in this area, but it is difficult due to the age of the buildings and plumbing. Although the sewers in this area were not televised as part of the current study, the Utility has indicated that they are in need of rehabilitation or replacement due to their age and its visual inspections over time. They will need to be televised prior to the lining project proposed in Section 4.3.1 in order to determine the extent of point repairs.

4.3.1 Alternative No. 1: Sewer Lining and Replacement

A combination of sewer lining and sewer replacement in basin GW-25 would help reduce RDII and BI. Figure 4.4 is a view of the basin with the streets and pipe lengths labeled. Due to Pearl Street being the oldest sewer in the system and knowledge of the poor condition of the sewer by the Utility staff, it is recommended to replace the sewer. Replacement of this sewer would also allow improvements to other infrastructure within this roadway, including pavement, curbs, and sidewalks. The other sewers in the basin are smaller in diameter and recommended to be rehabilitated "in-place" via slip lining. Table 4.7 provides an estimated cost for the Pearl Street sewer replacement. The cost for sewer replacement includes replacing the laterals back to the right-of-way line. Table 4.8 provides the estimated cost for the sewer rehabilitation. The cost for the sewer lining assumed a cured-in-place pipe (CIPP) material, and that laterals are lined back to the right-of-way line at the installation of a new cleanout. Alternative I could be completed in its entirety or in phases depending upon funding availability.

The work in the basin would either be completed or not, so no other alternative was evaluated. The consequences of not addressing the sewers in basin GW-25 is that the age and condition of the infrastructure would eventually cause a failure or an issue that would need immediate attention. In addition to continuing to allow I/I, a failure could cause issues by disrupting sewer service or damage existing city infrastructure or personal property.

SUMMARY SENTENCE: Alternative No. 1 achieves the goals of Section 1.4(7) by reducing I/I in basin GW-25, which was identified as an area with severe I/I during the data collection of this study.

Table 4.7
City of Greenwood, Indiana
Sanitary Sewer Utility Capital Improvement & I/I Reduction Plan
Pearl Street Sewer Replacement
Estimate of Probable Project Costs

I. Construction					
Item #	Description	Unit	Quantity	Unit Cost	Total
1	Gravity Sewer, 18"	LF	307	$160.00	$49,120.00
2	Gravity Sewer, 24"	LF	1,249	$175.00	$218,575.00
3	Gravity Sewer, 30"	LF	1,901	$225.00	$427,725.00
4	Manhole, 4', Standard	EA	2	$5,000.00	$10,000.00
5	Manhole, 5', Standard	EA	10	$7,000.00	$70,000.00
6	Sanitary Sewer Lateral, 6"	LF	990	$60.00	$59,400.00
7	Sanitary Lateral Connection, 18"x6" Wye	EA	12	$750.00	$9,000.00
8	Sanitary Lateral Connection, 24"x6" Wye	EA	31	$1,500.00	$46,500.00
9	Sanitary Lateral Connection, 30"x6" Wye	EA	23	$2,500.00	$57,500.00
10	Remove Existing Sewer	LF	3,460	$25.00	$86,500.00
11	Remove Existing Manhole	EA	12	$500.00	$6,000.00
12	Driveway Repair	LF	100	$50.00	$5,000.00
13	Sidewalk Repair	SYS	100	$65.00	$6,500.00
14	Pavement Repair	TON	1,560	$120.00	$187,200.00
15	Granular Backfill	CYS	11,990	$45.00	$539,550.00
16	Compacted Aggregate Base	SYS	4,720	$25.00	$118,000.00
17	Erosion Control	LS	1	$10,000.00	$10,000.00
18	Site Restoration (Seeding and Straw)	LS	1	$15,000.00	$15,000.00
19	Maintenance of Traffic	LS	1	$15,000.00	$15,000.00
20	Mobilization/Demobilization (NTE 5%)	LS	1	$96,900.00	$96,900.00
				Sub-Total Construction Cost	$2,033,470.00
				Contingency (15%)	$305,100.00
				Total Construction Cost	$2,338,570.00
II. Non-Construction					
				Non-Construction Cost (25%)	$584,700.00
				Total Project Cost	$2,923,270.00

Note: This estimate does not include full street and sidewalk replacement. It only assumes the replacement of the area disturbed for the sewer installation.

Table 4.8
City of Greenwood, Indiana
Sanitary Sewer Utility Capital Improvement & I/I Reduction Plan
Basin GW-25 Sewer Lining
Estimate of Probable Project Costs

I. Construction					
Item #	Description	Unit	Quantity	Unit Cost	Total
1	8" CIPP Liner	LF	1,673	$40.00	$66,920.00
2	10" CIPP Liner	LF	2,333	$45.00	$104,985.00
3	12" CIPP Liner	LF	1,797	$50.00	$89,850.00
4	15" CIPP Liner	LF	1,327	$60.00	$79,620.00
5	18" CIPP Liner	LF	578	$75.00	$43,350.00
6	24" CIPP Liner	LF	175	$100.00	$17,500.00
7	CIPP Sewer Lateral Installation	EA	164	$3,000.00	$492,000.00
8	Sewer Lateral Cleanout Installation	EA	164	$1,500.00	$246,000.00
9	Grinding Protruding Lateral Tap (undisributed quantity)	EA	20	$400.00	$8,000.00
10	Sanitary Sewer Point Repair (undistributed quantity)	EA	19	$5,000.00	$95,000.00
11	Manhole Rehabilitation	EA	40	$3,000.00	$120,000.00
12	Sewer Heavy Cleaning (undistributed quantity)	HR	80	$300.00	$24,000.00
13	Sewer Televising	LF	7,883	$2.50	$19,800.00
14	Pavement Repair (undistributed quantity)	TON	70	$120.00	$8,360.00
15	Granular Backfill (undistributed quantity)	CYS	440	$45.00	$19,800.00
16	Compacted Aggregate Base (undistributed quantity)	SYS	211	$25.00	$5,300.00
17	Erosion Control	LS	1	$2,500.00	$2,500.00
18	Site Restoration (Seeding and Straw)	LS	1	$2,500.00	$2,500.00
19	Maintenance of Traffic	LS	1	$15,000.00	$15,000.00
20	Mobilization/Demobilization (NTE 5%)	LS	1	$73,100.00	$73,100.00
				Sub-Total Construction Cost	$1,533,585.00
				Contingency (15%)	$230,100.00
				Total Construction Cost	$1,763,685.00
II. Non-Construction					
				Non-Construction Cost (25%)	$441,000.00
				Total Project Cost	$2,204,685.00

4.4 Pleasant Run Interceptor

The sewer televising and manhole inspections along the Pleasant Run Interceptor revealed some issues that were explained in Section 3.5. The issues are not only maintenance related, but many are to a point where they also are sources of I/I entering the interceptor. One of the main issues is an existing point repair on the interceptor that is leaking and has corrosion around it from a nearby force main discharge. Another issue is roots and leaks in manholes that require rehabilitation. The key issues are fully identified in the ADS report in Appendix 1, but they have been categorized and illustrated in Figure 3.15 for ease of understanding.

4.4.1 Alternative No. 1: Replace/Rehabilitate Poor Condition Items

Addressing the items that are categorized as poor in Figure 3.15 would help maintain the interceptor for many years to come and prevent some existing and increasing I/I over time. The estimated cost for the repairs are provided in Table 4.9 and the repairs are graphically shown in Figure 4.5. The primary expense involves completing the point repair on the interceptor between manhole W-26-19 and the railroad trestle and lining the interceptor in two different locations where there is heavy corrosion. This requires bypass pumping to maintain sanitary sewer service, which is difficult due to the large flows the interceptor receives constantly.

In addition to the point repair and sewer lining, the repairs indicated in Figure 4.5 and estimated in Table 4.9 also include manhole rehabilitation. The manhole rehabilitation would vary depending on the issues identified for the specific manhole (see Section 3.5), but it would typically include cleaning the manhole, sealing leaking pipe connections, grouting areas with exposed rebar, sealing the frame, and lining the manhole with a protective coating.

Rehabilitating the items categorized as poor would address the more severe issues, but the Utility should eventually plan on completing the items categorized as moderate in the future. The moderate category included leaks, but smaller in nature (e.g. less than 1 gpm). In addition, the moderate

category included corroded areas, but not to the point where rebar in the concrete was exposed. However, as time passes, the leaks and corrosion will continue to worsen, and eventually be in need of rehabilitation.

The consequences of not addressing the sewer/manhole conditions categorized as poor in Figure 3.15 would result in known I/I continuing to be placed into the system. The most critical area of concern being the several leaks in the interceptor west of manhole W-26-19, which would continue to get worse if not addressed. In addition, the structural concerns of the failing point repair and corrosion west of manhole W-26-19 could eventually cause a pipe collapse if left unaddressed. Due to the importance of completing the rehabilitation, no other alternatives were evaluated.

SUMMARY SENTENCE: Alternative No. 1 achieves the goals of Section 1.4(7) by reducing severe I/I that has been identified, but it also achieves the goals of Section 2.3 by addressing structural deficiencies in interceptor pipes and manholes.

Table 4.9
City of Greenwood, Indiana
Sanitary Sewer Utility Capital Improvement & I/I Reduction Plan
Pleasant Run Interceptor Rehabilitation
Estimate of Probable Project Costs

I. Construction					
Item #	Description	Unit	Quantity	Unit Cost	Total
1	Gravity Sewer, 36" Point Repair	EA	1	$30,000.00	$30,000.00
2	36" CIPP Liner	LF	1,097	$170.00	$186,490.00
3	Manhole, 6', Doghouse	EA	1	$12,000.00	$12,000.00
4	Manhole Rehabilitation	EA	17	$5,500.00	$93,500.00
5	Sewer Heavy Cleaning (undistributed quantity)	HR	17	$500.00	$8,500.00
6	Sewer Televising	LF	1,097	$3.00	$3,300.00
7	Bypass Pumping	LS	1	$50,000.00	$50,000.00
8	Maintenance of Traffic	LS	1	$5,000.00	$5,000.00
9	Mobilization/Demobilization (NTE 5%)	LS	1	$19,500.00	$19,500.00
				Sub-Total Construction Cost	**$408,290.00**
				Contingency (15%)	$61,300.00
				Total Construction Cost	**$469,590.00**
II. Non-Construction					
				Non-Construction Cost (25%)	$117,400.00
				Total Project Cost	**$586,990.00**

4.5 Utility Identified - Sewer Replacement Areas

There are chronic problem areas in the collection system that were identified in Section 2.1 as needing to be replaced due to the past observations of the Utility. According to the Utility, the poor condition of these sewers pose a threat to the proper operation of the system. Though not documented in the data collection of this study, it is likely that sources of I/I are also present, which could get worse over time if not addressed.

4.5.1 Alternative No. 1: Sewer Replacement

One alternative is to replace the sewers listed in Table 2.1 and shown on Figure 2.1 that the Utility has identified as a priority due to previous investigations and are in need of replacement. The estimated cost for these

four areas identified as (1) Lovers Lane, (2) Machledt from Meridian to U.S. 31, (3) Intersection of Rosengarten and Easy, and (4) Sleepy Hollow sewers are provided in Tables 4.10, 4.11, 4.12, and 4.13, respectively. The sewer replacement cost includes replacing service laterals back to the right-of-way line. The alternative could be completed in one large project encompassing all areas, or in individual projects.

No other alternatives were evaluated since the Utility identified these areas as a priority due to their condition. If the system priority areas are left in their current condition and not replaced, the structural issues that have been observed by the Utility would continue to get worse until a failure occurred. Addressing the items in a reactive manner after a failure could also end up costing more and disrupting service.

SUMMARY SENTENCE: Replacing the sewers that have been identified by the Utility as being in poor condition would address structural deficiencies as outlined in Section 2.3 of the Compliance Plan. It is likely these areas also have sources of I/I, so the work will also help meet the goals of Section 1.4(7) of the Compliance Plan.

Table 4.10
City of Greenwood, Indiana
Sanitary Sewer Utility Capital Improvement & I/I Reduction Plan
Lovers Lane Sewer Replacement
Estimate of Probable Project Costs

I. Construction					
Item #	Description	Unit	Quantity	Unit Cost	Total
1	Gravity Sewer, 8"	LF	1,220	$60.00	$73,200.00
2	Manhole, 4', Standard	EA	4	$5,500.00	$22,000.00
3	Sanitary Sewer Lateral, 6"	LF	350	$40.00	$14,000.00
4	Sanitary Lateral Connection, 8"x6" Wye	EA	10	$500.00	$5,000.00
5	Remove Existing Sewer	LF	1,220	$30.00	$36,600.00
6	Remove Existing Manhole	EA	4	$500.00	$2,000.00
7	Driveway Repair	LF	100	$75.00	$7,500.00
8	Sidewalk Repair	SYS	100	$65.00	$6,500.00
9	Pavement Repair	TON	200	$120.00	$24,000.00
10	Granular Backfill	CYS	2,100	$45.00	$94,500.00
11	Compacted Aggregate Base	SYS	240	$25.00	$6,000.00
12	Bypass Pumping	LS	1	$10,000.00	$10,000.00
13	Erosion Control	LS	1	$10,000.00	$10,000.00
14	Site Restoration (Seeding and Straw)	LS	1	$15,000.00	$15,000.00
15	Maintenance of Traffic	LS	1	$5,000.00	$5,000.00
16	Mobilization/Demobilization (NTE 5%)	LS	1	$16,600.00	$16,600.00
				Sub-Total Construction Cost	**$347,900.00**
				Contingency (15%)	$52,200.00
				Total Construction Cost	**$400,100.00**
II. Non-Construction					
				Non-Construction Cost (30%)[1]	$120,100.00
				Total Project Cost	**$520,200.00**

Note: This estimate does not include full street and sidewalk replacement. It only assumes the replacement of the area disturbed for the sewer installation.

[1] Assumes replacement sewer will be constructed in right-of-way of Lovers Lane and private utility easements. It is assumed that additional land acquisition will be required due to space limitations.

Table 4.11
City of Greenwood, Indiana
Sanitary Sewer Utility Capital Improvement & I/I Reduction Plan
Machledt Sewer Replacement
Estimate of Probable Project Costs

I. Construction					
Item #	Description	Unit	Quantity	Unit Cost	Total
1	Gravity Sewer, 8"	LF	250	$75.00	$18,750.00
2	Gravity Sewer, 15"	LF	3,040	$125.00	$380,000.00
3	Manhole, 4', Standard	EA	12	$6,000.00	$72,000.00
4	Manhole, 5', Standard	EA	3	$7,000.00	$21,000.00
5	Sanitary Sewer Lateral, 6"	LF	1,500	$60.00	$90,000.00
6	Sanitary Lateral Connection, 15"x6" Wye	EA	25	$750.00	$18,750.00
7	Remove Existing Sewer	LF	3,290	$35.00	$115,150.00
8	Remove Existing Manhole	EA	15	$1,000.00	$15,000.00
9	Sidewalk Repair	SYS	100	$65.00	$6,500.00
10	Pavement Repair	TON	1,850	$120.00	$222,000.00
11	Granular Backfill	CYS	24,500	$40.00	$980,000.00
12	Compacted Aggregate Base	SYS	2,150	$25.00	$53,750.00
13	Erosion Control	LS	1	$10,000.00	$10,000.00
14	Site Restoration (Seeding and Straw)	LS	1	$5,000.00	$5,000.00
15	Maintenance of Traffic	LS	1	$25,000.00	$25,000.00
16	Mobilization/Demobilization (NTE 5%)	LS	1	$101,700.00	$101,700.00
				Sub-Total Construction Cost	**$2,134,600.00**
				Contingency (15%)	$320,200.00
				Total Construction Cost	**$2,454,800.00**
II. Non-Construction					
				Non-Construction Cost (25%)[1]	$613,700.00
				Total Project Cost	**$3,068,500.00**

Note: This estimate does not include full street and sidewalk replacement. It only assumes the replacement of the area disturbed for the sewer installation.

[1] It is assumed that construction will occur in existing right-of-way of Lincoln, Market, and Machledt Street along with private easements. Based on the development of this area additional land acquisition is anticipated.

Table 4.12
City of Greenwood, Indiana
Sanitary Sewer Utility Capital Improvement & I/I Reduction Plan
Rosengarten & Easy Sewer Replacement
Estimate of Probable Project Costs

I. Construction					
Item #	Description	Unit	Quantity	Unit Cost	Total
1	Gravity Sewer, 8"	LF	180	$55.00	$9,900.00
2	Manhole, 4', Standard	EA	2	$5,000.00	$10,000.00
3	Sanitary Sewer Lateral, 6"	LF	100	$40.00	$4,000.00
4	Sanitary Lateral Connection, 8"x6" Wye	EA	3	$500.00	$1,500.00
5	Remove Existing Sewer	LF	180	$25.00	$4,500.00
6	Remove Existing Manhole	EA	2	$500.00	$1,000.00
7	Driveway Repair	LF	75	$50.00	$3,750.00
8	Sidewalk Repair	SYS	110	$65.00	$7,150.00
9	Curb Replacement	LF	200	$45.00	$9,000.00
10	Pavement Repair	TON	15	$120.00	$1,800.00
11	Granular Backfill	CYS	200	$45.00	$9,000.00
12	Compacted Aggregate Base	SYS	35	$35.00	$1,225.00
13	Bypass Pumping	LS	1	$5,000.00	$5,000.00
14	Erosion Control	LS	1	$5,000.00	$5,000.00
15	Site Restoration (Seeding and Straw)	LS	1	$10,000.00	$10,000.00
16	Maintenance of Traffic	LS	1	$10,000.00	$10,000.00
17	Mobilization/Demobilization (NTE 5%)	LS	1	$4,700.00	$4,700.00
				Sub-Total Construction Cost	$97,525.00
				Contingency (15%)	$14,700.00
				Total Construction Cost	$112,225.00
II. Non-Construction					
				Non-Construction Cost (25%)[1]	$28,100.00
				Total Project Cost	$140,325.00

Note: This estimate does not include full street and sidewalk replacement. It only assumes the replacement of the area disturbed for the sewer installation.

[1] Assumes placement of new sewer in right-of-way. Actual non-construction costs could increase if land acquisition is required.

Table 4.13
City of Greenwood, Indiana
Sanitary Sewer Utility Capital Improvement & I/I Reduction Plan
Sleepy Hollow Sewer Replacement
Estimate of Probable Project Costs

I. Construction					
Item #	Description	Unit	Quantity	Unit Cost	Total
1	Gravity Sewer, 8"	LF	1,075	$55.00	$59,125.00
2	Manhole, 4', Standard	EA	5	$5,000.00	$25,000.00
3	Sanitary Sewer Lateral, 6"	LF	500	$40.00	$20,000.00
4	Sanitary Lateral Connection, 8"x6" Wye	EA	10	$500.00	$5,000.00
5	Remove Existing Sewer	LF	1,075	$25.00	$26,875.00
6	Remove Existing Manhole	EA	5	$500.00	$2,500.00
7	Driveway Repair	LF	100	$50.00	$5,000.00
8	Sidewalk Repair	SYS	100	$65.00	$6,500.00
9	Pavement Repair	TON	75	$150.00	$11,250.00
10	Granular Backfill	CYS	850	$45.00	$38,250.00
11	Compacted Aggregate Base	SYS	75	$35.00	$2,625.00
12	Bypass Pumping	LS	1	$10,000.00	$10,000.00
13	Erosion Control	LS	1	$15,000.00	$15,000.00
14	Site Restoration (Seeding and Straw)	LS	1	$15,000.00	$15,000.00
15	Maintenance of Traffic	LS	1	$2,500.00	$2,500.00
16	Site Clearing and Grubbing	LS	1	$15,000.00	$15,000.00
17	Mobilization/Demobilization (NTE 5%)	LS	1	$13,000.00	$13,000.00
				Sub-Total Construction Cost	**$272,625.00**
				Contingency (15%)	$40,900.00
				Total Construction Cost	**$313,525.00**
II. Non-Construction					
				Non-Construction Cost (25%)[1]	$78,400.00
				Total Project Cost	**$391,925.00**

Note: This estimate does not include full street and sidewalk replacement. It only assumes the replacement of the area disturbed for the sewer installation.

[1] Assumes placement of new sewer in an existing sewer easement. Actual non-construction costs could increase if no easement exists or if additional land acquisition is required.

4.6 Utility Identified - Potential Areas of Concern

Section 2.2 identified 39 areas that the Utility feels are potential areas of concern, but require investigation to determine the extent of rehabilitation or replacement necessary. The areas are listed in Table 2.2 and shown on Figure 2.1. The extent of the issues are unknown, so it is recommended that sewer televising and manhole inspections be completed on all the sewers listed. An estimated cost for the sewer investigation is provided in Table 4.14. Only after the issues are known can the actual extent and cost of rehabilitation or replacement be determined.

Table 4.14
City of Greenwood, Indiana
Sanitary Sewer Utility Capital Improvement & I/I Reduction Plan
Areas of Concern - Sewer Sub-System Inspections/Investigations
Estimate of Probable Project Costs

I. Inspection					
Item #	Description	Unit	Quantity	Unit Cost	Total
1	Manhole Inspection	EA	1,129	$100.00	$112,900.00
2	6" Sanitary Sewer, Inspection, Televising	LF	2,450	$1.25	$3,062.50
3	8" Sanitary Sewer, Inspection, Televising	LF	173,307	$1.25	$216,633.75
4	10" Sanitary Sewer, Inspection, Televising	LF	23,248	$1.25	$29,060.00
5	12" Sanitary Sewer, Inspection, Televising	LF	26,109	$1.25	$32,636.25
6	15" Sanitary Sewer, Inspection, Televising	LF	14,273	$1.50	$21,409.50
7	16" Sanitary Sewer, Inspection, Televising	LF	4,736	$1.50	$7,104.00
8	18" Sanitary Sewer, Inspection, Televising	LF	2,726	$1.75	$4,770.50
9	21" Sanitary Sewer, Inspection, Televising	LF	769	$2.00	$1,538.00
				Sub-Total Inspection Cost	**$429,114.50**
				Inflation and Contingency Allowance (5%)	$21,500.00
				Total Inspection Cost	**$450,614.50**

4.6.1 Alternative No. 1: Sewer Replacement/Rehabilitation

Once the sewers and manholes are investigated, the problems could be addressed through either sewer replacement or rehabilitation. The replacement would only be on areas where rehabilitation is not feasible. Any rehabilitation to the sewers is recommended to be through a cured-in-place

pipe (CIPP) material. Due to the fact that the extent of the issues are unknown at this time, it is difficult to estimate the costs for this alternative. In order to get an approximate magnitude of cost for the purposes of this study, the following cost estimates assume that one-third of all the sewers in these problem areas will need to be replaced and one-third may be rehabilitated/lined (consequently, one-third of the total footage of sewer would be assumed to require no rehabilitation or replacement). Using this assumption, Table 4.15 provides the estimated cost for the sewer replacement and Table 4.16 provides the estimated cost for the sewer lining.

SUMMARY SENTENCE: Alternative No. 1 is the holistic approach to replace/rehabilitate all of the "Potential Areas of Concern" indicated in Figure 2.1. This approach helps achieve both Section 1.4(7) and Section 2.3 of the Compliance Plan, because structural, hydraulic, and I/I issues would be improved in a large portion of the collection system.

Table 4.15
City of Greenwood, Indiana
Sanitary Sewer Utility Capital Improvement & I/I Reduction Plan
Areas of Concern - Sewer Replacement
Estimate of Probable Project Costs

I. Construction					
Item #	Description	Unit	Quantity	Unit Cost[1]	Total
1	Gravity Sewer, 6"	LF	810	$55.00	$44,550.00
2	Gravity Sewer, 8"	LF	57,200	$55.00	$3,146,000.00
3	Gravity Sewer, 10"	LF	7,680	$70.00	$537,600.00
4	Gravity Sewer, 12"	LF	8,620	$80.00	$689,600.00
5	Gravity Sewer, 15"	LF	4,710	$125.00	$588,750.00
6	Gravity Sewer, 16"	LF	1,570	$140.00	$219,800.00
7	Gravity Sewer, 18"	LF	920	$175.00	$161,000.00
8	Gravity Sewer, 21"	LF	250	$200.00	$50,000.00
9	Manhole, 4', Standard	EA	365	$5,000.00	$1,825,000.00
10	Manhole, 5', Standard	EA	10	$7,500.00	$75,000.00
11	Sanitary Sewer Lateral, 6"	LF	37,500	$60.00	$2,250,000.00
12	Sanitary Lateral Connection, 6"x6" Wye	EA	15	$400.00	$6,000.00
13	Sanitary Lateral Connection, 8"x6" Wye	EA	1,150	$500.00	$575,000.00
14	Sanitary Lateral Connection, 10"x6" Wye	EA	150	$600.00	$90,000.00
15	Sanitary Lateral Connection, 12"x6" Wye	EA	175	$650.00	$113,750.00
16	Sanitary Lateral Connection, 15"x6" Wye	EA	35	$700.00	$24,500.00
17	Sanitary Lateral Connection, 16"x6" Wye	EA	30	$750.00	$22,500.00
18	Sanitary Lateral Connection, 18"x6" Wye	EA	20	$750.00	$15,000.00
19	Sanitary Lateral Connection, 21"x6" Wye	EA	5	$1,000.00	$5,000.00
20	Remove Existing Sewer	LF	81,760	$25.00	$2,044,000.00
21	Remove Existing Manhole	EA	375	$500.00	$187,500.00
22	Driveway Repair	LF	1,500	$50.00	$75,000.00
23	Sidewalk Repair	SYS	2,500	$65.00	$162,500.00
24	Pavement Repair Including Granular Backfill & Compacted Aggregate	LS	1	$5,150,000.00	$5,150,000.00
25	Erosion Control	LS	1	$750,000.00	$750,000.00
26	Site Restoration (Seeding and Straw)	LS	1	$300,000.00	$300,000.00
27	Maintenance of Traffic	LS	1	$750,000.00	$750,000.00
28	Mobilization/Demobilization (NTE 5%)	LS	1	$993,000.00	$993,000.00
				Sub-Total Construction Cost	**$20,851,050.00**
				Contingency (15%)	$3,127,700.00
				Total Construction Cost	**$23,978,750.00**
II. Non-Construction (Includes Surveying, Design, Permitting, Bidding, Inspection, Legal and Financial)					
				Non-Construction Cost (25%)	$5,994,700.00
				Total Project Cost	**$29,973,450.00**

Note: This estimate does not include full street and sidewalk replacement. It only assumes the replacement of the area disturbed for the sewer installation.

[1] Due to the variety of locations in which this work would occur, actual unit costs will likely vary by location and thus conservative averages are used. After investigations and inspections are completed and more complete scopes of work are developed for each area, detailed cost estimates for each respective area should be completed.

Table 4.16
City of Greenwood, Indiana
Sanitary Sewer Utility Capital Improvement & I/I Reduction Plan
Areas of Concern - Sewer Lining
Estimate of Probable Project Costs

I. Construction					
Item #	Description	Unit	Quantity	Unit Cost [1]	Total
1	6" CIPP Liner	LF	810	$30.00	$24,300.00
2	8" CIPP Liner	LF	57,200	$35.00	$2,002,000.00
3	10" CIPP Liner	LF	7,680	$40.00	$307,200.00
4	12" CIPP Liner	LF	8,620	$45.00	$387,900.00
5	15" CIPP Liner	LF	4,710	$55.00	$259,050.00
6	16" CIPP Liner	LF	1,570	$65.00	$102,050.00
7	18" CIPP Liner	LF	920	$80.00	$73,600.00
8	21" CIPP Liner	LF	250	$100.00	$25,000.00
9	CIPP Sewer Lateral Installation	EA	1,500	$3,000.00	$4,500,000.00
10	Sewer Lateral Cleanout Installation	EA	1,500	$1,500.00	$2,250,000.00
11	Grinding Protruding Lateral Tap	EA	250	$400.00	$100,000.00
12	Manhole Rehabilitation, 4', Standard	VFT	3,650	$300.00	$1,095,000.00
13	Manhole Rehabilitation, 5', Standard	VFT	100	$400.00	$40,000.00
14	Sanitary Sewer Point Repair	EA	75	$7,500.00	$562,500.00
15	Sewer Heavy Cleaning	HR	1,000	$350.00	$350,000.00
16	Bypass Pumping	LS	1	$200,000.00	$200,000.00
17	Driveway Repair	LF	5,000	$50.00	$250,000.00
18	Sidewalk Repair	SYS	1,000	$65.00	$65,000.00
19	Pavement Repair Including Granular Backfill & Compacted Aggregate	LS	1	$100,000.00	$100,000.00
20	Erosion Control	LS	1	$50,000.00	$50,000.00
21	Site Restoration (Seeding and Straw)	LS	1	$50,000.00	$50,000.00
22	Maintenance of Traffic	LS	1	$150,000.00	$150,000.00
23	Mobilization/Demobilization (NTE 5%)	LS	1	$647,200.00	$647,200.00
				Sub-Total Construction Cost	**$13,590,800.00**
				Contingency (15%)	$2,038,700.00
				Total Construction Cost	**$15,629,500.00**
II. Non-Construction					
				Non-Construction Cost (25%)	$3,907,400.00
				Total Project Cost	**$19,536,900.00**

[1] Due to the variety of locations in which this work would occur, actual unit costs will likely vary by location and thus conservative averages are used. After investigations and inspections are completed and more complete scopes of work are developed for each area, detailed cost estimates for each respective area should be completed.

4.6.2 Alternative No. 2: Budget Sewer Replacement/Rehabilitation

Due to the fact that the extent of the sewer issues are unknown, the Utility could budget an amount each year for replacement or rehabilitation to the sewers. Although it would take several years to complete if the areas are found to be in poor condition, budgeting an amount such as $2 million per year would help to address the issues over time without adding to the capital expense of the priority areas which are targeted to achieve a more significant impact on I/I.

SUMMARY SENTENCE: Alternative No. 2 also helps achieve the goals of Section 1.4(7) and Section 2.3 of the Compliance Plan. However, this alternative develops a budget to address the areas over time, due to the large costs involved.

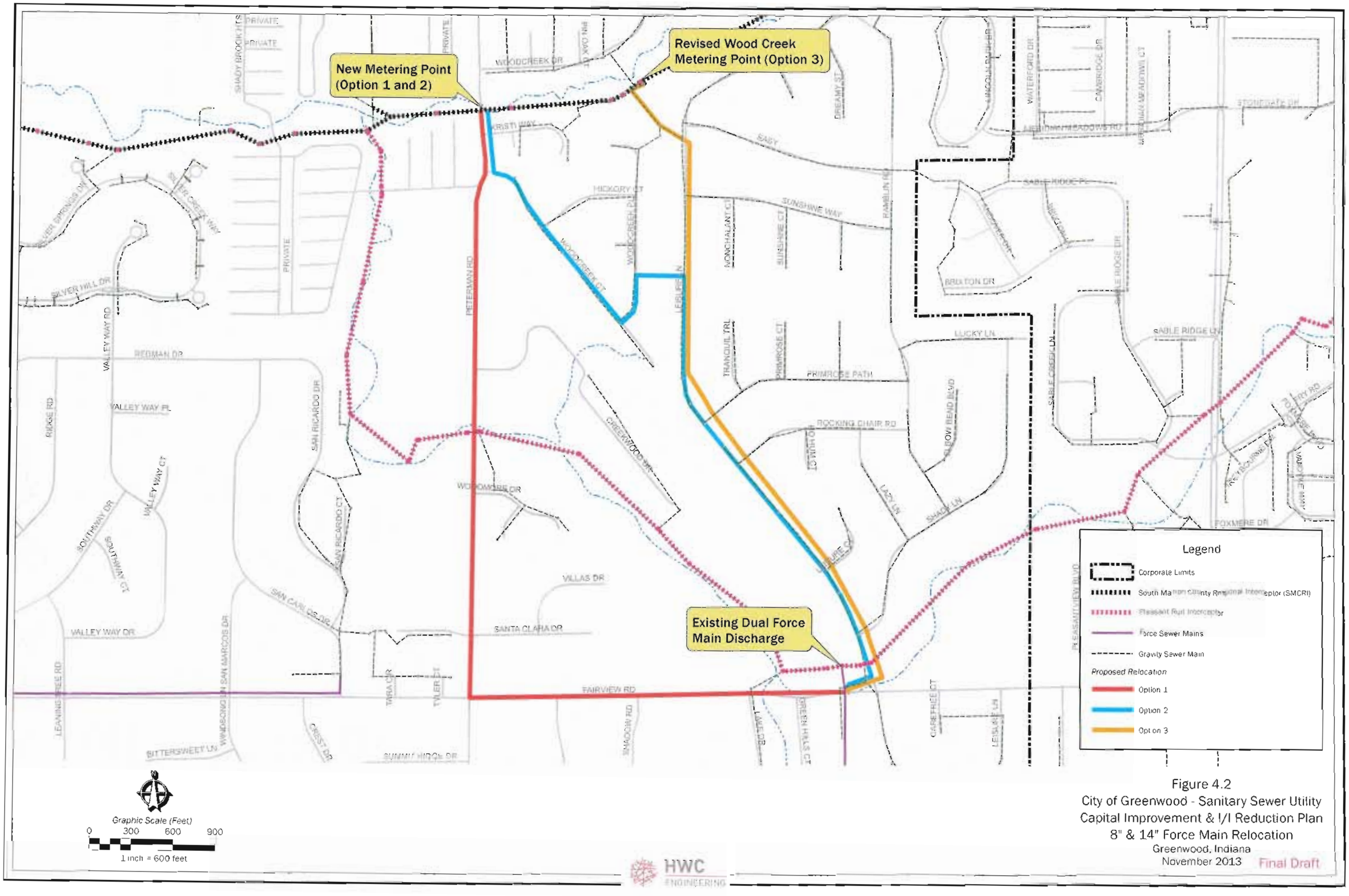

Figure 4.2
City of Greenwood - Sanitary Sewer Utility
Capital Improvement & I/I Reduction Plan
8" & 14" Force Main Relocation
Greenwood, Indiana
November 2013 Final Draft

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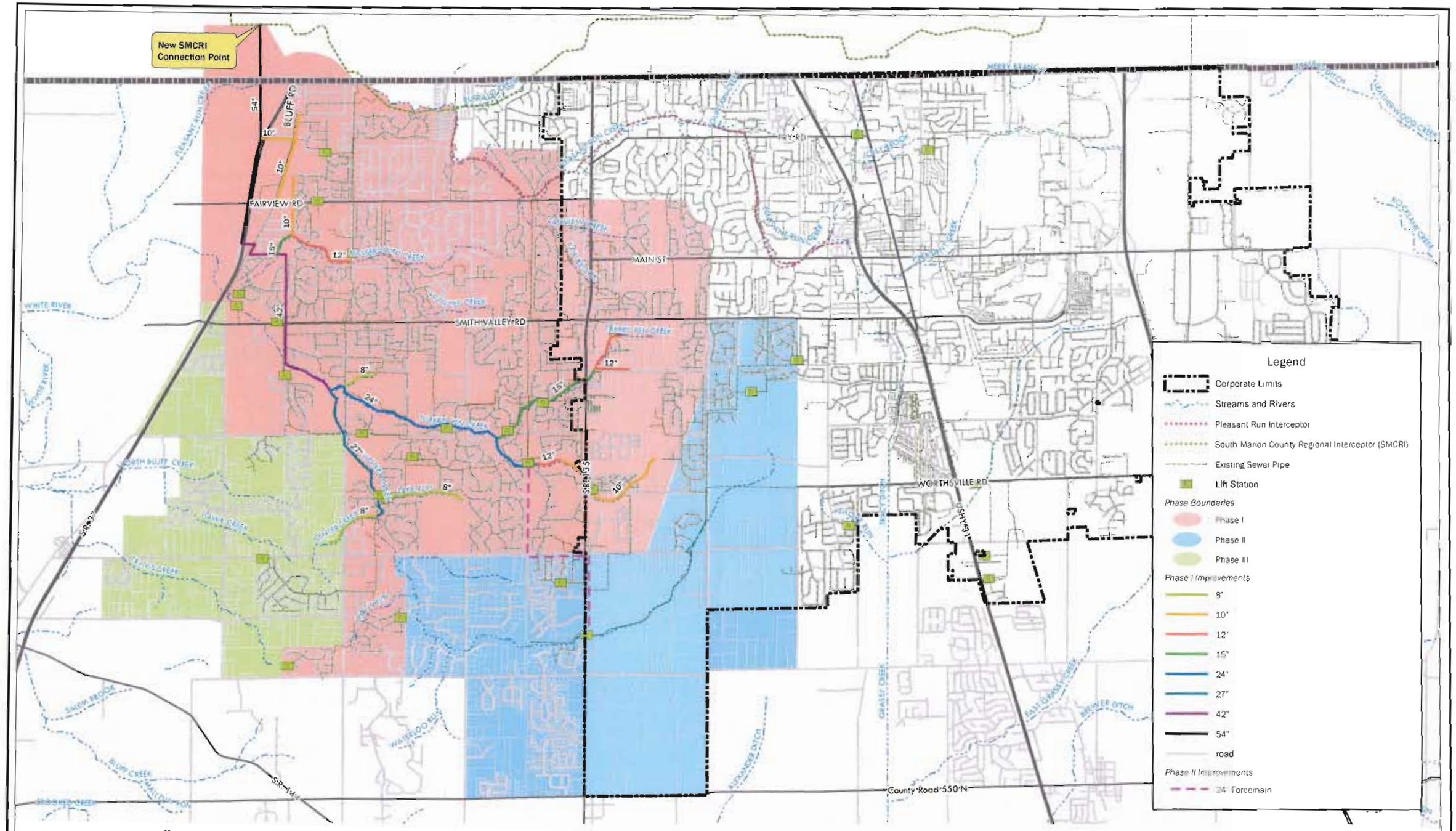

Note:
Phase Boundaries and Phase I Improvements are based on 2001/2002 Western Regional Interceptor Sewer Master Plan

Figure 4.3
City of Greenwood - Sanitary Sewer Utility
Capital Improvement & I/I Reduction Plan
Western Regional Interceptor
Greenwood, Indiana
November 2013 Final Draft

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Figure 4.4
City of Greenwood - Sanitary Sewer Utility
Capital Improvement & I/I Reduction Plan
Basin 25 Sewer Replacement/Rehabilitation
Greenwood, Indiana
November 2013 Final Draft

Point Repair of 36" Interceptor and Manhole Replacement

Legend

- Corporate Limits
- South Marion County Regional Interceptor (SMCRI)
- Pleasant Run Interceptor
- Pleasant Run Interceptor: Proposed Rehabilitation
- Sewer Rehabilitation
- Manhole Rehabilitation
- Sewer Point Repair
- Manhole Replacement

Graphic Scale (Feet)
0 400 800 1,200
1 inch = 800 feet

Figure 4.5
City of Greenwood - Sanitary Sewer Utility
Capital Improvement & I/I Reduction Plan
Pleasant Run Interceptor: Rehabilitation
Greenwood, Indiana
November 2013

Final Draft

HWC ENGINEERING

Section Five – System Recommendations

The alternative capital improvement projects identified by the Utility or from the analysis of the data collection of the system are evaluated in this Section of the report, in order to select the recommended alternatives for the Utility to implement to reduce inflow and infiltration (I/I) issues in the system and address deteriorated infrastructure. The final list of recommended projects, along with their estimated costs, are included in Table 5.1.

5.1 Southwest Service Area - 8" and 14" Force Main Flow

5.1.1 Comparison of Alternatives

Large cost differences exist between the two (2) alternatives identified to remove the 8" and 14" force mains from the Pleasant Run Interceptor. Alternative No. 1 (Relocate to Separate SMCRI Connection) is the least expensive at an estimated cost of approximately $2.5 million, and it reduces the flow in the interceptor which in turn will reduce surcharging effects upstream. However, Alternative No. 1 leaves the numerous lift stations that currently exist in the southwest part of the collection system. As a result, not only is this alternative not conducive for future development, but it contributes to high operating costs.

Conversely, Alternative No. 2 (Western Regional Interceptor) is much more expensive at an estimated cost of approximately $31.9 million (for both Phase I and Phase II), but places the Utility in a good position to serve future development on both sides of S.R. 37. Currently, development has stayed east of S.R. 37, but it could spread west as the final phase of I69 is constructed. Due to limited State funding, it may take several years for I69 to be constructed in this area. However, funding has already been allocated to finish I69 from Evansville to S.R. 37, north of Bloomington. Even completing I69 this far would increase traffic on S.R. 37, in the area near the proposed Western Regional Interceptor.

In addition to positioning the Utility with increased capacity for future development west near S.R. 37, Alternative No. 2 also improves capacity on the other side of the City, east of I65. As Section 4.1.2 indicated, the Lone Pine Farms Lift Station was constructed near Honey Creek and S.R. 135. Since the Western Regional Interceptor has not been constructed yet, the lift station discharge was conveyed east, eventually leading to the Hurricane Creek Lift Station. The lift station was sized based on a service boundary east of the Louisville and Indiana Railroad tracks. By redirecting flows into this station from outside the original service boundary, it limits capacity for full development in the service area near I65.

5.1.2 Recommended Alternative

It is recommended that the Utility complete a "Basis of Design" study for Alternative No. 2. The various lift stations previously constructed in the southwest part of the collection system were constructed because development was accommodated on a piecemeal basis, rather than adhering and constructing to an overall master plan. The Western Regional Interceptor would establish an overall plan for sanitary service in the western area of the system and help to better organize this part of the collection system. The complex nature of the Western Regional Interceptor project would take significant time for planning, design, and construction. Therefore, it is recommended to complete a "Basis of Design" first to evaluate potential routes, ensure the service area is current, review hydraulics, and develop a more detailed cost estimate from which the Utility can make a better defined decision for the interceptor alternative.

Before proceeding with Alternative No. 2, it is recommended that the Utility consult with Johnson County regarding economic development goals west of S.R. 37. According to the Johnson County Comprehensive Plan, completed in 2011, the future land use map (included in Appendix 2) indicates commercial and industrial land use west of S.R. 37 and suburban residential land use east of S.R. 37. With I69 already under construction, it is likely that additional development along S.R. 37 in northern Johnson County could

begin in the next few years. If the County indicates that interest in development in this area is building, and the Utility wishes to expand to serve this development, then additional development should be factored into the service area during the "Basis of Design" analysis.

5.2 Southwest Lift Stations with High I/I

5.2.1 Comparison of Alternatives

The objective of Alternative No. 1 (Total Investigative Effort) and Alternative No. 2 (Focus on Smaller Area) was to help address the sources of the system's I/I problem by eliminating I/I sources. Alternative No. 1 included the service area identified in Figure 4.1, while Alternative No. 2 focused on smaller subsystems to analyze initial results before determining whether to expand the program. The investigation phase of both alternatives could be completed with the Utility's own staff, by utilizing sewer televising, smoke testing, and source separation or by an outside contractor/firm. Alternative No. 2 could be completed by the Utility within one year, while Alternative No. 1 would take multiple years to complete due to the size of the area involved. In order to accomplish the task more quickly, a contractor could be used for Alternative No. 1 with the costs budgeted by the Utility each year in future rate adjustments.

5.2.2 Recommended Alternative

Alternative No. 2 is recommended in order to test the program on a relatively small scale due to the unknown benefits that will be achieved from this process. Some utilities I/I elimination efforts are very successful, but others are not because of the I/I source stemming from the property owner's land (e.g. leaking service lateral). In Section 4.2.2, Waters Edge, Eagle Trace and Alden Place were identified as possible subsystems to focus on. The first two areas are outside the City's corporate limits and the latter is inside the corporate limits. It is recommended that Waters Edge be analyzed, due to its smaller collection system and its larger increase in flows during wet weather

(see Section 3.4). The Utility has expressed an interest in one of the areas being inside the corporate limits, so it is recommended that Alden Place be analyzed as well. Once the improvements in the pilot neighborhoods are identified and completed, the flow can be analyzed to determine the benefits achieved and whether the pilot program should be expanded.

5.3 Basin GW-25 (Old Town Area)

5.3.1 Recommended Alternative

Basin GW-25 exhibited high baseline infiltration (BI) and rainfall dependent I/I (RDII) based upon the temporary flow monitoring data collected during the study. Alternative No. 1 (Sewer Lining and Replacement) involved addressing I/I sources within the right-of-way by conducting sewer televising, replacing the sewer and laterals within the Pearl Street right-of-way, and then rehabilitating the other sewers and laterals within basin GW-25 through a cured-in-place pipe (CIPP) lining.

It is recommended that basin GW-25 be repaired and these improvements be monitored upon completion to determine their effectiveness. If effective, additional replacement and sewer lining projects could be completed in other basins included in the flow monitoring effort with high BI and RDII, such as basin GW-23.

5.4 Pleasant Run Interceptor

5.4.1 Recommended Alternative

The issues identified during the sewer televising and manhole inspections of the Pleasant Run Interceptor could be addressed in Alternative No. 1 (Replace/Rehabilitate Poor Condition Items). A myriad of other alternatives could be considered given the condition of other areas of the interceptor and manholes.

It is recommended to complete the suggested repairs because of the importance of the interceptor and the large area it serves (see Figure 3.3). Waiting additional time to complete this maintenance would result in additional costs later. Many of the issues are corrosion related, involving exposed rebar in the manholes and pipes. By waiting, the corrosive gases in the sewer system will continue to degrade the exposed rebar, with the potential for structural failures to occur. The other issues were I/I related, and involve several leaks in the pipe that ADS estimated as allowing 12 gpm of flow into the interceptor. Replacing the leaks would prevent an estimated 17,000 gallons of I/I from entering the interceptor per day. Other defects less severe in nature could be incorporated into the Utility's annual capital improvements budget and addressed over time.

5.5 Utility Identified - Sewer Replacement Areas

5.5.1 Recommended Alternative

The Utility identified four (4) priority areas of the collection system that exhibited definite concerns. The concerns could be remedied in Alternative No. 1 (Sewer Replacement) by completely replacing the sewer and manholes. Total repair of the four (4) identified areas is recommended because of the severity of the known problems that exist. Delaying the repairs would cause the issues to worsen, thereby continuing to allow I/I to enter the system in these areas. Total replacement in these areas would avoid a sudden issue that would eventually occur if continued to be ignored.

5.6 Utility Identified - Potential Areas of Concern

5.6.1 Comparison of Alternatives

The Utility identified 39 areas in the collection system which potentially have issues. The extent of the issues will remain unknown until additional investigations and inspections including sewer televising are completed. Therefore, it is recommended that the identified sewers be televised and

manholes be inspected. Once completed, deficiencies could be addressed through Alternative No. 1 (Sewer Replacement/Rehabilitation). Due to the uncertainty of the necessary work, Alternative No. 2 (Budget Sewer Replacement/Rehabilitation) offers a different option of allocating the money each year to gradually complete the necessary projects. Alternative No. 2 is particularly beneficial given the unknown extent of the problems in each area.

5.6.2 Recommended Alternative

Alternative No. 2 is recommended because of the uncertainty of the projects that need completion. By allocating a maximum allowance of $2 million each year, the Utility can evaluate the process after five (5) years to see its impact. If the deficiencies identified during the sewer investigation are not being addressed adequately with the allotment of funding each year, then additional funds should be allocated. This annual budgeting plan also allows these repairs to be funded as part of the Utility's rate structure without inclusion into a bond issuance.

5.7 Summary

Table 5.1 includes the list of recommended projects identified by the Utility or through data collection analysis, along with each project's estimated costs. The total cost for all the recommended projects is $54,150,000.00 over the next ten (10) years. As the footer in the Table 5.1 indicates, this assumes the "Areas of Concern - Sewer Lining/Replacement" are addressed using a yearly construction budget of $2M dollars per year, for a period of five (5) years.

Figure 5.1 graphically illustrates the recommended projects. Due to the large costs involved for the various projects, Section Six provides guidance for implementing the projects.

Table 5.1
City of Greenwood, Indiana
Sanitary Sewer Utility Capital Improvement & I/I Reduction Plan
Summary of Recommended Capital Improvements (10-Year Plan)

Project Description	Estimated Cost[2]
Western Regional Interceptor - Phase I	$30,000,000.00
Western Regional Interceptor - Phase II	$2,500,000.00
Pearl Street Sewer Replacement	$2,900,000.00
Basin GW-25 Sewer Lining	$2,200,000.00
Pleasant Run Interceptor Rehabilitation	$600,000.00
Sleepy Hollow Sewer Replacement	$400,000.00
Rosengarten and Easy Sewer Replacement	$200,000.00
Lovers Lane Sewer Replacement	$500,000.00
Machledt Sewer Replacement	$3,100,000.00
Areas of Concern - Sewer Televising and Manhole Inspection	$500,000.00
Areas of Concern - Sewer Lining/Replacement [1]	$11,250,000.00
Total	**$54,150,000.00**

[1] Assumed to be five year total maximum allowance of work completed on an annual basis: $2,000,000 per year in construction costs and $250,000 per year in non-construction costs. The actual amount could vary based on inspection/televising results. Lower priority improvements recommended from inspection of system problem areas which exceed that allowance can be completed at the Utility's discretion if needed and as funding allows.

[2] Costs indicated are from Section Four, but have been rounded to less significant digits due to the overall magnitude of costs involved.

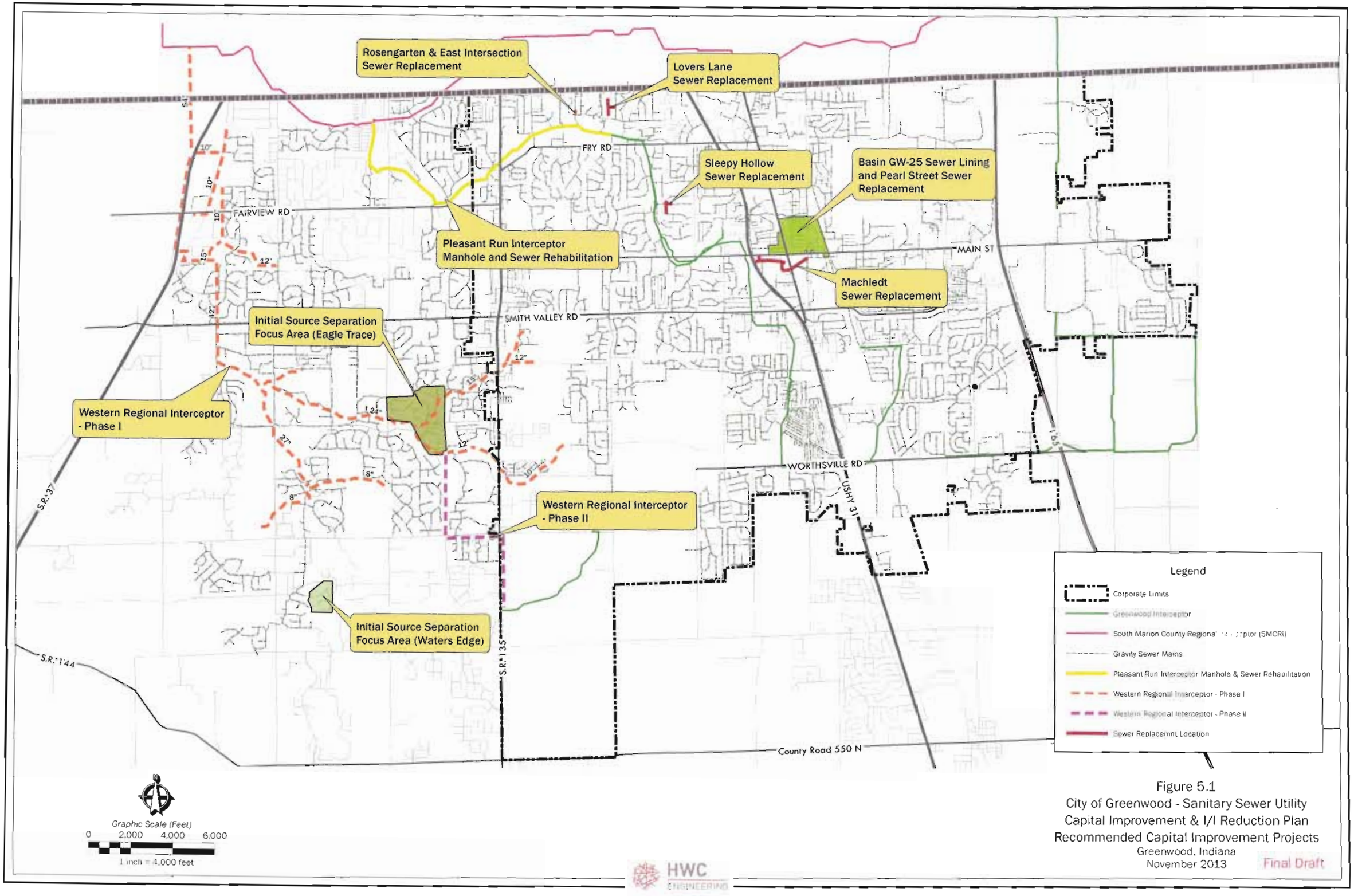

Figure 5.1
City of Greenwood - Sanitary Sewer Utility
Capital Improvement & I/I Reduction Plan
Recommended Capital Improvement Projects
Greenwood, Indiana
November 2013
Final Draft

HWC ENGINEERING

Section Six – Implementation of Capital Improvement Projects

This study has recommended several capital improvement projects to address problems in the wastewater collection system. Some of the projects are aimed to address issues identified by Utility's staff through complaints or familiarity with operations of the system. The other projects were recommended as a result of the flow monitoring and system inspections that were completed as part of this study effort.

6.1 Prioritized Project List

Table 6.1 combines the projects recommended in Section Five into one master list of capital improvements. Table 6.1 prioritizes the improvements into three (3) different phases, from Phase 1 being deemed the most critical down to Phase 3 being the least critical. All of the projects, with their Phase number, have been included in Figure 6.1. Figure 6.1 is intended to be the summary document that fulfills both Section 1.4(7) and Section 2.3 of the Compliance Plan (see Section 1.4 of this Plan for a summary of these two Compliance Plan sections).

6.2 Funding Alternatives

Several options exist for funding the infrastructure projects in Table 6.1. Possible funding sources include: State Revolving Fund (SRF) Loan Program, open market revenue bond issuance, bond anticipation notes (BANs), and funds from the Utility's regular operating budget. The following sections describe each of these funding options, their general parameters, and the process which would be required for the Utility to utilize each respective source of project revenue.

6.2.1 State Revolving Fund (SRF)

SRF provides low interest loans for drinking water and wastewater projects based upon median household income and utility user rates. The following Table 6.2 provides the current SRF interest rates for wastewater projects as of the time this report was drafted.

Table 6.2
City of Greenwood, Indiana
Sanitary Sewer Utility Capital Improvement & I/I Reduction Plan
SRF Interest Rates - Effective 10/1/13 Thru 12/31/13

Wastewater SRF Interest Rates	User Rates (Over $50)	User Rates ($30 to $50)	User Rates (Under $30)
Tier III (MHI*: under $33,669)	2.36%	2.61%	3.11%
Tier II (MHI: $33,670 to $41,566)	2.61%	2.86%	3.36%
Tier I (MHI: over $41,567)	2.86%	3.11%	3.61%

** MHI reflected in 2000 Census*
Note: Up to an additional .50% reduction may be permitted if a non-point-source project is financed along with a point source project or a project that includes green/sustainable components.

In order for a utility to receive an SRF loan, it must first make an application, then it is placed on a list and prioritized with other entities seeking loans. Each project seeking funding must have a Preliminary Engineering Report (PER) completed before any funds can be authorized. The PER is similar to this study in the way that it reviews current conditions, considers alternatives, and recommends a best solution. However, there is an environmental review to ensure the project does not negatively impact the environment, historical landmarks, or items of archaeological significance particularly since federal funding is involved with the SRF program. The completion of the PER is a good preparation for infrastructure projects, but adds some steps that are not required for typical environmental permits. If SRF funding is desired by the Utility, this study could be supplemented with the necessary information and language to allow a compliant PER to be submitted to IDEM for the selected projects.

6.2.2 Open Market Revenue Bond Issuance

Municipal revenue bonds backed by the Utility's revenue from sewer user fees provide a way to fund large infrastructure projects that allow payback over time (such as 20-30 years). The bond payments are made through the utility budget, and often require user rate increases because the payments were likely not factored into the existing user rates. At the time this report was drafted, municipal bond rates were at an 80-year low, and are comparable to SRF loans. The benefit to funding projects through a bond issuance is that additional requirements from loan/grant agencies generally do not need to be followed.

6.2.3 Bond Anticipation Notes (BANs)

BANs are commonly used by municipal public utilities for infrastructure projects in combination with other funding such as SRF loans or open market bonds. BANs are short term temporary loans which allow a municipality to sell bonds and gain revenue to fund project development costs such as engineering, legal or financial consulting services, as well as construction costs, particularly on longer or multiple phased projects. The use of BANs allows municipalities to proceed with projects on the basis of estimated construction costs and/or until multiple phases of a project can be bid such that actual funding requirements or the amount of the bond proceeds required can be determined. BANs require most of the same information as typical revenue bonds but are typically paid off by a regular bond issuance in a period of months or up to a few years once the final project costs are more definitive.

6.2.4 Utility Budget

The Utility budget may be used to fund smaller infrastructure projects, such as regular maintenance items or other projects depending upon the available unallocated revenue. The budget is funded through revenue from Utility user rates. The Utility is currently conducting a rate study which will include the need for additional capital improvements for work recommended in this Plan. It is anticipated that the Utility budget might be able to fund part of the recommended improvements in conjunction with other funding options.

6.2.5 Recommendation

The 10-year implementation schedule in Table 6.1 includes higher yearly costs in years 2015-2017 reaching a high of $16M in 2017, followed by a decrease to more steady amounts of $2M to $2.5M per year for years 2019-2023. Due to the historically low bond rates, it is recommended that the Utility consider funding larger projects in 2015-2017 through a bond

issuance. The Western Regional Interceptor project accounts for the largest amount of funding in this time period.

Pending review by the Utility's financial advisor, the bond amount may not need to be for the full 10-year estimated costs of $54,150,000. Instead, user rates may be readjusted and the costs in years 2019-2023 be addressed through a capital improvement fund in the Utility budget. This would allow the funding to continue for future years to keep addressing capital improvement and I/I reduction projects. The funding proposed annually of $2,250,000 is arbitrary based on the anticipated rehabilitation and replacement needs of the system and would allow the Utility to make continual progress toward addressing system problems. The Utility and its financial advisor should review this annual amount to ensure the impact to rates is practical for users.

6.3 Illegal Connections

Section Five recommended source separation projects to eliminate illegal connections such as sump pumps and roof drains. It is recommended that this be focused on key areas like Waters Edge and Alden Place, that exhibited high I/I during the data collection phase of the study. In August 2013, the City started to implement a city-wide project to help eliminate illegal connections. The program is called the Greenwood Water Development (GWD) Project. It is a partnership between Greenwood Utilities and the community to help reduce I/I. It began with a public information campaign to ensure downspouts discharge on the ground, into a rain barrel, or into a storm swale/sewer. The project also works to ensure sump pumps discharge onto the ground or into a storm swale/sewer.

The community is encouraged to participate in the GWD Project by inspecting their home and filling out a Downspout & Sump Pump Inflow form online. Additional public outreach could be done in neighborhoods with high I/I areas, to help ensure property owners fill out the form and make necessary corrections. In 2014, the Utility will begin a pilot program as part of GWD to encourage residents in a highly affected

neighborhood to disconnect improper connections with funding assistance from the Utility.

6.4 GIS Mapping

As part of the Compliance Plan for the sanitary sewer system approved by IDEM in 2012, the Utility is updating its sanitary sewer mapping through Geographic Information System (GIS) software. In such a large collection system, it is time-consuming to establish this mapping, but the Utility is completing it through City GIS staff that reviews record drawings and works with Utility personnel to confirm the locations of the sewer facilities. The completion of this GIS mapping will allow better decision-making regarding the collection system because information will be more readily available.

In addition, the GIS mapping will be used in the future to record capital improvements that are implemented and track problems/complaints so that they may be identified and prioritized. There are several options available to achieve an organized GIS system. A few of the popular options that relate to the Utility and evaluated during this study are provided below.

6.4.1 Johnson County Beacon Versus Independent Greenwood Site

Johnson County currently uses Beacon, a local government GIS platform hosted by The Schneider Corporation. Through Beacon, the County currently provides basic layers that include, but are not limited to, the following: parcel information, contours, and aerial photography. Discussions with the City staff have indicated a desire to incorporate sanitary sewers onto the Beacon site, but coordination with the County has not been successful. An alternative would be for the City to have its own GIS platform, separate from the County. It is recommended that the various City departments meet, to see if additional departments would like the GIS capabilities. It would only be cost effective if several forms of data were incorporated into GIS, such as sanitary sewers, storm sewers, zoning, streets, parks, etc.

6.4.2 GIS Platforms

If the City were to use their own GIS platform, separate from the County, then there are different software products available. Currently, the City uses ESRI ArcGIS for its GIS mapping. This is a popular product, which allows mapping to be easily inputted from engineer/developer CAD drawings. It is recommended that this software continued to be used, since the City is familiar with it. There are other software platforms available like WTH and 39 Degrees North, but they are more for municipalities without their own GIS staff.

6.4.3 Licensed Products Versus Descriptive Fields

In order to help track maintenance issues and help facilitate the completion of work orders, there are various additional licensed software products available. One of them is Cityworks, which is an ESRI partner that helps provide service requests, work orders, and inspection templates that can be altered to the Utility's needs. Other products are available from TC Technology, which manufactures mobile management devices that help employees obtain the latest maps while working in the field.

Conversations with the Utility have indicated that the main desire is to track problem areas and help prioritize them. Although the above products are beneficial, it is recommended that the Utility use unique GIS fields rather than purchase licensed products like the ones mentioned. The unique fields would allow information to be filtered, better meeting the vision that the Utility has described. The licensed products could be used to perform the same functions, but they become more expensive when customization like this is incorporated.

6.4.4 Descriptive GIS Fields

In order to track sanitary system issues and prioritize projects and system maintenance, the following GIS fields are recommended:

- Installation date
- Sewer lining date
- Sewer televising date
- Backup Complaint (enter a number)
    - Every time a complaint is received, an additional number would be added to this entry for the corresponding address
- Odor Complaint (enter a number)
    - Every time a complaint is received, an additional number would be added to this entry for the corresponding address
- Manhole Overflow (enter a number)
    - Every time a manhole overflows, an additional number would be added to this entry for the corresponding manhole
- Inspection Date
- Inspection Classification
    - Indicate the average classification of the pipe or manhole using NAASCO standards (see Section 6.4.5)

6.4.5 National Association of Sewer Service Companies (NAASCO)

In order to more consistently classify the condition of manholes and pipes, it is recommended that the Utility utilize NAASCO standards. NAASCO has set standards for the assessment of pipeline, manholes, and laterals. The standards are learned through training seminars and certification is achieved by passing a test. If the Utility employees were all trained in these standards, they would classify the sewer facilities in a similar manner. In addition, it is

recommended that the Utility require any consultants or contractors to follow these standards, so deliverables are consistent as well.

Appendix 1

ADS Temporary Flow Monitoring, Manhole Inspection and Internal Inspection Reports

Separate Bound Document

Appendix 2

Johnson County 2011 Comprehensive Plan – Future Land Use Map

Figure 3-2: Future Land Use Map