

I. Executive Summary

This study was authorized on December 19, 2012 by the Franklin Engineering Department in order to evaluate and update the expected sewer demand in the West, Mayes Creek and Watson Branch Basins. This evaluation uses data from 2011 Development Report that was compiled by the Department of Planning and Sustainability, information provided by the Engineering Department, and as-built drawings from the Water Management Department. This information was implemented to produce expected sewer flows from the West Basin, Mayes Creek Basin, and Watson Branch Basin. The findings, conclusions and recommendations for the Watson Branch Drainage Basin are detailed in the following report.

II. Watson Branch Drainage Basin

i. Description

The Watson Branch Drainage Basin is located in the middle section of Williamson County and centered on the Harpeth River. The borders are roughly comprised of Rober's Knob to the north, Winstead Hill to the south, Arno Road and Highway 96 to the east, the Harpeth River to the northwest, and Bowman Lane to the southwest. The Watson Branch Basin is comprised of approximately 8,118 acres, of which 695 acres are undeveloped. The existing development in this area can be characterized as high quality, low, medium and high density, medium to heavy retail, light industrial, and office space. There are currently 9,013 existing developed lots with approximately 1,521 additional lots approved. Existing and future office/retail space is expected to reach over 22 million square

feet. It is anticipated the population in the fully developed basin will reach 27,337 residents.

The Watson Branch Basin is divided into twenty-four (24) sub-basins based on natural drainage patterns or existing sewer infrastructure. These sub-basins are classified as sub-basins 1 – 24. The majority of the sub-basins drain by gravity to the Southeast Interceptor Sewer and Watson Branch Interceptor Sewer, with the exception of a section of McKay's Mill Subdivision located in Sub-basin No. 6. This subdivision is pumped into the Spencer Creek Drainage Basin. All other flows are conveyed by gravity sewers to the City's Wastewater Treatment Plant (WWTP) located just outside the northwest corner of the basin. For the purpose of this study flows from McKay's Mill Pump Station No. 2 were included in the Watson Branch Drainage Basin. Exhibit A accurately defines the Watson Branch Drainage Basin, sub-basin areas, and existing sewer infrastructure.

ii. Development of Sanitary Sewer Flows

a. Rationale

The included Figure 1 lists the various areas delineated within the sub-basins of the Watson Branch Basin. Existing information from the 1997 Watson Branch Drainage Basin Study, 2001 Watson Branch update, and the 2011 Development Report was utilized to determine land use within the Basin.

Each sub-basin was evaluated in terms of land use, and in the majority of cases, the actual number of units proposed for specific properties were used to derive an amount of commercial space, or quantity of

residential units that are currently planned for the basins. Franklin Planning Department estimates and projections were used to identify the type and extent of future development for properties where no submittals have been made to the Planning Commission, but for which a land use has been designated.

FIGURE 1 – WATSON BRANCH DRAINAGE BASIN - LAND USE

Sub-basin	Total Acres	Undeveloped	Existing Lots	Proposed Lots	Commercial / Other Space
	(acres)	(acres)	(# units)	(# units)	(sq. ft.)
1	273	0	80	0	544,500
2	613	0	896	224	1,146,500
3	229	0	482	0	0
4	246	0	830	0	0
5	298	179	24	40	1,695,355
6	575	122	173	132	0
7	405	60	146	36	0
8	382	0	127	202	0
9	489	102	815	0	3,390,710
10	245	0	0	40	2,988,216
11	200	0	461	0	60,984
12	396	0	702	30	195,149
13	183	0	151	48	97,574
14	277	0	805	0	1,707,552
15	149	0	56	300	683,021
16	590	0	1052	0	0
17	400	0	706	358	561,053

18	422	0	800	87	0
19	200	0	36	0	0
20	338	35	154	0	439,085
21	862	197	0	0	7,683,984
22	171	0	200	24	975,744
23	82	0	73	0	0
24	93	0	244	0	0
Totals	8,118	695	9,013	1,521	22,169,427

**Proposed Franklin Christian Academy with an ultimate build out of 83,000 sf.*

The State of Tennessee Sewage Works Design Manual provides guidance for incremental flow for various land uses. They are listed in Figure 2 below.

FIGURE 2 – INCREMENTAL FLOW VALUES for VARIOUS LAND USE	
<u>Land Use</u>	<u>Incremental Flow</u>
Single Family Residence	350 gpd
Condominium/Apartment	250 gpd
Retail	0.15 gpd/sf
Office	0.10 gpd/sf

A maximum of 2.5 units per acre was used for single family units unless the area has previously been zoned at a higher density. Average projected flows from each sub-basin are calculated from the general information presented in Figures 1 and 2 above. Sanitary sewer lines must be designed for the maximum flow that will be encountered in a given area within the drainage basin. Peaking factors are applied that allow for the differences in average daily flow and

instantaneous sewer flow. These factors vary according to the number of people in the sub-area contributing to the flow. The following peaking factors listed in Figure 3 are taken from ASCE “Sewer Design & Construction Manuals and Reports on Engineering Practice” and are used in this report.

FIGURE 3 – POPULATION PEAKING FACTORS

<u>Tributary Population</u>	<u>Peaking Factor</u>
0 – 500	5
500 – 1,000	4
1,000 +	3.25

b. Projected Flows

Figure 4 represents an overview of the entire known development plan for the Watson Branch Drainage Basin. A more detailed analysis of the information contained in Figure 1 and Figure 4 is presented in Table 1 – Development of Sanitary Sewer Flows in the Appendix to this study. Table 1 contains projected flows associated with each sub-basin. The information shown in Table 1 is based on information from the 2011 Development Report, counts of actual properties on which homes have been built, or field investigations and scaled roof areas calculated from existing aerial surveys. Incremental flows and peaking factors were applied to arrive at an estimated flow for each area. Also included in Table 1 are maximum flows from the Goose Creek Pump Station that are currently being conveyed by force main to the Southeast Interceptor Sewer.

The calculations included in Table 1 project numbers of future residential units and commercial development areas and sewage flow

from each sub-basin attributable to the proposed development. A majority of the information includes plan submittals for specific proposed developments, while other information was derived from population densities. The Watson Branch Drainage Basin services an area in which growth is well established. While there are areas still to be developed, much of the basin has realized full development potential under current zoning regulations. Where needed, a value of 2.55 residential units per acre, as reported in recent U.S. census data for the City, and a floor area ration (F.A.R) of 0.28 to 1 were used to develop the amount of residential units and commercial floor space.

FIGURE 4 – WATSON BRANCH LAND USE and FLOW RESULTS

<u>Description</u>	<u>Basin Projections</u>
Total Acreage	8,118 acres
No. of Existing Residential Units	9,013 units
No. of Projected Residential Units	10,534 units
Proposed SF of Commercial / Other	22,169,427 sq. ft.
Population	27,337
Average Daily Sewage Flow	7.620 mgd
Average Daily Sewage Flow w/Goose Creek	10.635 mgd
Peak Sewage Flow	24.766 mgd
Peak Sewage Flow w/Goose Creek	34.766 mgd

Average daily sanitary sewer flow for the Watson Branch Drainage Basin is expected to average 7.620 million gallons per day (mgd) with peaks of 24.766 mgd within the 20-year study period. Adding flows from the Goose Creek Pump Station increases the total average and peak flows to approximately 10.635 and 34.766 mgd respectively. The

flow schematic in exhibit B shows the peak flows from all sub-basins and the resulting flows in the interceptors.

iii. Existing Interceptor Sewers

Previous sections have provided a rationale for projections of sewer flows from the study basin. With the flows from each sub-basin defined, existing sanitary sewer lines can be evaluated, areas of insufficient capacity can be identified, and specific infrastructure improvements can be recommended. The Watson Branch sewerage basin is presently served by six (6) interceptor sewers. Materials include clay, ductile iron (DIP), polyvinyl chloride (PVC), and fiberglass reinforced polyester (FRP) pipe. Together they cover the entire service area. Each interceptor is described below.

a. Watson Branch Interceptor

The Watson Branch Interceptor directly serves the area from Clovercroft Road west to where the Harpeth River and Watson Branch meet. The 15-inch, 18-inch and 21-inch sections from the west side of Interstate 65 to the Harpeth River were replaced with a 24-inch PVC and DIP interceptor sewer. This line is approximately 10,062 feet long and was constructed in 2005. The existing 24-inch under Interstate 65 and 15-inch to the east of Interstate 65 that serves the Williamson Medical Center area and Clovercroft area were not replaced or updated. Size, material and capacity are detailed in Figure 5 below.

FIGURE 5

EXISTING WATSON BRANCH INTERCEPTOR SEWER

<u>Description</u>	<u>Diameter</u>	<u>Material</u>	<u>Full Flow Capacity</u>
<i>Clovercroft Rd to I-65</i>	15-inch	Clay/PVC	1.993 mgd
<i>I-65 to the Harpeth River/Watson Branch</i>	24-inch	DIP	9.780 mgd
	24-inch	PVC/DIP	12.532 mgd

b. Ralston Creek Interceptor

The Ralston Creek Interceptor serves the area between Murfreesboro Road and Liberty Pike and north of Liberty Pike between Mack Hatcher By-Pass and Interstate 65. The interceptor is approximately 13,021 feet long and constructed before 1997 when the original Watson Branch Basin Study was submitted to the City of Franklin. Size, material and capacity are detailed in Figure 6 below.

FIGURE 6

EXISTING RALSTON CREEK INTERCEPTOR SEWER

<u>Description</u>	<u>Diameter</u>	<u>Material</u>	<u>Full Flow Capacity</u>
<i>I-65 to Mack Hatcher By-Pass</i>	12-inch	PVC	1.374 mgd
<i>Mack Hatcher By-Pass to Harpeth River</i>	20-inch	DIP	5.051 mgd
	24-inch	PVC/DIP	12.532 mgd

c. Liberty Creek Interceptor

The Liberty Creek Interceptor serves the areas in the basin that lie north of Liberty Pike from Jordan Road west to the Harpeth River. The

line is approximately 3,815 long. Size, material and capacity are detailed in Figure 7 below.

FIGURE 7

EXISTING LIBERTY CREEK INTERCEPTOR SEWER

<u>Description</u>	<u>Diameter</u>	<u>Material</u>	<u>Full Flow Capacity</u>
Liberty Creek	18-inch	PVC	3.231 mgd

d. Carnton Creek Interceptor

The Carnton Creek Interceptor is approximately 6,432 feet long and serves the area south of downtown between Lewisburg Pike, Columbia Avenue, and Mack Hatcher By-Pass. An inverted siphon at the Harpeth River enables the City to serve these areas without the use of sewage pumping stations. Size, material and capacity are detailed in Figure 8 below.

FIGURE 8

EXISTING CARNTON CREEK INTERCEPTOR SEWER

<u>Description</u>	<u>Diameter</u>	<u>Material</u>	<u>Full Flow Capacity</u>
Columbia Avenue to Heath Place	18-inch	PVC	3.957 mgd
Heath Place to the Harpeth River	20-inch	DIP	6.038 mgd
	24-inch	DIP	4.890 mgd
	42-inch	DIP	23.548 mgd

e. Goose Creek Interceptor

The Goose Creek Interceptor is the newest interceptor sewer in the basin and serves the area between Mack Hatcher By-Pass and the

Harpeth River. A 36-inch and 12-inch gravity sewer removed the Sullivan Farms pumping station near Lewisburg Pike that was pumping to the Carnton Creek Interceptor. The Goose Creek Interceptor sewer is approximately 9,789 feet long. Size, material and capacity are detailed in Figure 9 below.

FIGURE 9

EXISTING GOOSE CREEK INTERCEPTOR SEWER

<u>Description</u>	<u>Diameter</u>	<u>Material</u>	<u>Full Flow Capacity</u>
<i>Harpeth River to Forest Crossing</i>	36-inch	FRP	13.208 mgd
<i>Forest Crossing to Lewisburg Pike</i>	12-inch	PVC	1.893 mgd

f. Southeast / Harpeth River Interceptor

The Southeast Interceptor receives all flow from the interceptors listed above and was constructed in 2005 to replace the existing Harpeth River Interceptor and sections of the Watson Branch Interceptor while also removing the Harpeth Meadows pumping station. The Southeast Interceptor sewer begins at the confluence of the Harpeth River and Watson Branch and continues along the Harpeth River to the City of Franklin’s Wastewater Treatment Plant (WWTP). In addition to receiving flows from the Watson Branch Drainage Basin the Southeast Interceptor also receives flows from the 30-inch Sharps Branch Interceptor. The Southeast Interceptor sewer was constructed using 48-inch and 54-inch FRP pipe and is approximately 17,270 feet long. Size, material and capacity are detailed in Figure 10 below.

**FIGURE 10
EXISTING GOOSE CREEK INTERCEPTOR SEWER**

<u>Description</u>	<u>Diameter</u>	<u>Material</u>	<u>Full Flow Capacity</u>
Harpeth River to Murfreesboro Road	48-inch	FRP	22.577 mgd
Murfreesboro Road to WWTP	54-inch	FRP	30.900 mgd
	54-inch	FRP	46.349 mgd
	54-inch	FRP	55.705 mgd

iv. Results / Recommendations

Using Table 1 in the Appendix and information provided by the City of Franklin we were able to identify potential capacity issues in the existing interceptor sewers within the Watson Branch Drainage Basin. Four (4) areas were identified. These areas are labeled in Exhibits B and C in the Appendix and described more accurately below.

a. Watson Branch Interceptor

The upper section of the Watson Branch Interceptor appears to be the only area that needs to be examined further. The 15-inch PVC and clay gravity lines from just south of Murfreesboro Road to the east side of Interstate 65 are capable of carrying average flows, however peak flows will eventually exceed full flow capacity in these sections. As a result these sections should be replaced with a larger gravity sewer capable of handling future peak flows from this area of the basin. If slopes equal to 0.1% are achieved, a 24-inch diameter gravity sewer would be adequate to serve this area. An Engineer’s Opinion of Probable Cost is shown in Figure 11 below.

FIGURE 11 - ENGINEER'S OPINION OF PROBABLE COST WATSON BRANCH 24-INCH INTERCEPTOR SEWER REPLACEMENT			
<u>Description</u>	<u>Quantity/Unit</u>	<u>Unit Cost</u>	<u>Total</u>
South of Murfreesboro Road to East of I-65			
24-inch Gravity Sewer	3,350 LF	\$225.00	\$753,750.00
Manholes	15 EA	\$4,250.00	\$63,750.00
15% Misc. Allow. for Bypass, Mobilization, etc.	1 LS	\$122,650.00	\$122,650.00
15% Contingency Allow. for Legal, Engineering, Admin. & Esmts.	1 LS	\$141,019.00	\$141,019.00
TOTAL →			\$1,081,144.00

b. Royal Oaks Area

The existing 10-inch gravity line that serves the Royal Oaks area west of Interstate 65 and north of Watson Branch should be examined in more detail. Based on the information provided in Table 1 the total peak flow for this area is 1.502 mgd. Using information provided by the City the full flow capacity of the 10-inch gravity line is only 1.252 mgd. As projected flows reach 1.25 mgd, capacity in the line will be exceeded. The majority of the projected flow is contributed from office/retail customers. As mentioned before the projected average and peak flow for office/retail was calculated using a density of 0.28 units per acre. This actual density should be looked at more closely to determine if any action is required.

c. Carnton Creek Interceptor

As detailed in Figure 8, the Carnton Creek Interceptor is comprised of 18-inch, 20-inch, 24-inch, and 42-inch diameter pipe and conveys flows from Sub-basins 20, 21, and 22. The interceptor has sufficient capacity to handle average flows from these sub-basins. As the area becomes fully developed, especially Sub-basin 21, the 18-inch and 24-inch sections will not be able to accommodate the peak flows. As with the Royal Oaks area in Sub-basin 10, the projected peak flow for office/retail was calculated using a density of 0.28 units per acre. Based on our projected flows the 20-inch section of the interceptor should have sufficient capacity. The 18-inch and 24-inch should be re-evaluated as development increases in Sub-basin 21. This was also pointed out in the original Watson Branch Basin study conducted in 1997. If the densities and peak flows hold true, these lines should be upsized to 24-inch and 30-inch at minimum slopes required to produce a velocity of 2 feet per second. Actual ground surveys will be needed before design and construction of any sanitary sewer lines. An Engineer's Opinion of Probable Cost is shown in Figure 12 below.

**FIGURE 12 - ENGINEER'S OPINION OF PROBABLE COST
CARNTON CREEK INTERCEPTOR SEWER REPLACEMENT**

<u>Description</u>	<u>Quantity/Unit</u>	<u>Unit Cost</u>	<u>Total</u>
<i>18-inch and 24-inch Replacement</i>			
<i>24-inch Gravity Sewer</i>	4,277 LF	\$225.00	\$962,325.00
<i>30-inch Gravity Sewer</i>	1,605 LF	\$225.00	\$385,200.00
<i>Manholes</i>	20 EA	\$4,250.00	\$85,000.00
<i>15% Misc. Allow. for Bypass, Mobilization, etc.</i>	1 LS	\$214,879.00	\$214,879.00



15% Contingency Allow. for Legal, Engineering, Admin. & Esmts.	1 LS	\$247,111.00	\$247,111.00
TOTAL →			\$1,894,515.00

d. Southeast / Harpeth River Interceptor

The Southeast Interceptor is the largest trunk sewer in the basin and was designed to convey the total projected peak sanitary sewer flows created by the Watson Branch Drainage Basin. Since that time the City has constructed the Five-mile Creek Interceptor and Goose Creek Pump Station just south of the Watson Branch Drainage Basin. The Goose Creek Pump Station flows by force main to the Goose Creek Interceptor and is capable of pumping flows up to 10 mgd when fully expanded. Adding this flow to the Southeast Interceptor slightly exceeds the full flow capacity in certain sections of the trunk sewer, specifically the 48-inch section at 0.04% slope and the 54-inch section at 0.04%. This is not cause for too much concern considering the pump station is not currently rated for 10 mgd. If the pump station were to be expanded to its full potential then the City will need to re-evaluate these sections of pipe. The capacity of the Southeast Interceptor was originally designed to handle this flow but as densities increased throughout the basin due to redevelopment, average and peak flows in the basin increased as well. Our original study in 2007 estimated the peak flow from the east part of the basin and the Goose Creek Interceptor to be approximately 20 mgd. In six years that number has since increased to approximately 24 mgd. It should also be noted that due to the location of the Goose Creek Pump Station this flow could easily be redirected to the proposed wastewater treatment plant detailed in CDM’s IWRP Report.



APPENDIX