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Subject:
Technical Memorandum 6 – Collection System Evaluation
Wastewater Treatment Capacity and Effluent Disposal Study
Murfreesboro Water and Sewer Department

The purpose of Technical Memorandum (TM) 6 is to provide an evaluation of the Murfreesboro Water and Sewer Department (MWSD) collection system relative to the treatment, discharge, and effluent disposal alternatives previously presented. The contents of this TM include a collection system infrastructure summary, an analysis of current and future needs based on the geographical distribution of wastewater flows, a discussion of the advantages and opportunities for the hydraulic modeling of the system, and an evaluation of capital investment deferrals with decentralized wastewater treatment.

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A Status of Proposed Collection System Improvement Projects

1. Collection System Infrastructure Summary

The City of Murfreesboro Water & Sewer Department (MWSD) commissioned Hazen and Sawyer to evaluate wastewater treatment capacity and effluent disposal. The Study includes an evaluation of the impacts of the treatment and disposal alternatives on the existing collection system and proposed short- and long-term infrastructure improvement projects. Several sources were used in this collection system analysis. The City provided Hazen and Sawyer with the City of Murfreesboro Wastewater Facilities Plan (SSR, 2002), GIS information of their existing and proposed infrastructure, historic flows from the Sinking Creek Wastewater Treatment Plant (SCWWTP), flow records from flow meters in the collection system, and copies of recent Notice of Overflow letters. The major objectives of Technical Memorandum (TM) 6 are as follows:

- Review existing information regarding the collection system infrastructure including previous reports, GIS data, population and wastewater projections, planned improvements, reported overflows, and flow monitoring data.
- Review recommendations made in the City of Murfreesboro Wastewater Facilities Plan (Facilities Plan) and other planned improvements proposed since publication of the Facilities Plan.
- Evaluate the effect of decentralized wastewater treatment on the collection system and the proposed infrastructure improvement projects.

1.1 Background and Existing Information

In 2002, MWSD updated the 201 Wastewater Facilities Plan. A detailed summary of the existing system was included in this Facilities Plan update along with recommendations for collection system improvements. The recommended improvements were separated into three priority ranges: short-, medium-, and long-term. At the issue date of the Facilities Plan, a large portion of the short range improvements were already in design. Since the publication of the Facilities Plan, many of these projects have been constructed. Some of the medium range improvements, totaling over $90 million in 2002, were necessary to provide service to areas where development was in progress. According to the 2010 GIS data, some of these improvements have also been constructed. As part of the current study, Hazen and Sawyer worked with MWSD staff to review the list of projects proposed since the 2002 Facilities Plan to determine what impacts each of the treatment and disposal alternatives would have on these proposed projects. The status of each of these projects, as well as which should be considered within this study, is included in Attachment A.

The largest medium range improvement identified in the Facilities Plan was to construct a relief sewer parallel to the Stones River Interceptor to provide additional capacity. The cost of this project was estimated to be $21.6 million in 2002. The City has since revised the plan for a parallel sewer to the Stones River interceptor in favor of a new Southwest Regional Pump Station (SWRPS) and force main. This pump station was reported to be rated for 20 mgd with a future firm capacity of 25 mgd. The cost of

this pump station has been estimated to be $24 million ($13 million pump station, $11 million force main).

1.2 Collection System Characterization

MWSD provided Hazen and Sawyer with GIS data for the service area from which an overall characterization of the system can be determined. Of particular importance regarding the existing buried infrastructure were the size, slope, depth and date of construction for buried gravity sewer and the capacity of the pumping stations. For the improvements proposed in the 2002 Facilities Plan, the proposed route, size, and the estimated cost were reviewed.

The existing collection system consists of approximately 570 miles of gravity sewer, 28 miles of force main, and 44 pump stations. Tables 1-1 and 1-2 provide a summary of the gravity sewer size and age distribution, respectively. Tables 1-3 and 1-4 provide a summary of the force main size and age distribution, respectively. Tables 1-5 and 1-6 provide a summary of the pump station capacity and age, respectively.

Table 1-1: Buried Gravity Sewer Size Distribution

Buried Gravity Sewer Size	Percentage of Total
12-inch and less	85.0%
18-inch and less, above 12-inch	8.9%
24-inch and less, above 18-inch	3.2%
30-inch and less, above 24-inch	0.8%
36-inch and less, above 30-inch	1.0%
48-inch and less, above 36-inch	1.0%
54-inch and less, above 48-inch	0.1%

Table 1-2: Buried Gravity Sewer Age Distribution

Buried Gravity Sewer Age[1]	Percentage of Total
Less than 5 years old	14.7%
Between 5 years and 10 years old	22.9%
Between 10 years and 20 years old	23.8%
Between 20 years and 30 years old	15.0%
Between 30 years and 40 years old	12.2%
Between 40 years and 50 years old	5.9%
More than 50 years old	5.5%

[1] *Age is unknown for approximately 140,000 feet, or 4.9% of the total length.*

Table 1-3: Buried Force Main Size Distribution

Buried Force Main Size	Percentage of Total
4-inch and less	24.6%
6-inch	19.0%
8-inch	12.6%
10-inch	3.0%
12-inch	9.3%
14-inch	13.9%
16-inch	3.2%
18-inch	11.6%
20-inch	2.3%
24-inch	0.5%

Table 1-4: Buried Force Main Age Distribution

Buried Force Main Age	Percentage of Total
Less than 5 years old	14.0%
Between 5 years and 10 years old	21.8%
Between 10 years and 20 years old	40.2%
Between 20 years and 30 years old	10.6%
Between 30 years and 40 years old	8.1%
Between 40 years and 50 years old	2.2%
More than 50 years old	3.1%

Table 1-5: Pump Station Capacity Distribution

Pump Station Capacity	Number of Stations
1.0 mgd and less	30
2.0 mgd and less, above 1.0 mgd	6
4.0 mgd and less, above 2.0 mgd	1
6.0 mgd and less, above 4.0 mgd	1
Over 6.0 mgd	1
Unknown	5

Table 1-6: Pump Station Age Distribution

Pump Station Age	Number of Stations
Less than 5 years old	7
Between 5 years and 10 years old	6
Between 10 years and 20 years old	10
Between 20 years and 30 years old	8
Between 30 years and 40 years old	6
Between 40 years and 50 years old	3
More than 50 years old	1
Unknown	3

1.3 Sanitary Sewer Overflows

MWSD provided Hazen and Sawyer with information regarding the reported sanitary sewer overflows (SSOs) from April 2007 to June 2010. This record spans over 39 months and was used to develop an understanding of the collection system and to identify problematic areas. In the evaluation period, the May 2010 storm occurred, which fell between the 500-year and the 1,000-year event classification. Due to the historic nature of this event, the overflows associated with this storm event were not included in the evaluation. Other overflows that were not included in this evaluation are overflows that occurred as a result of construction work or a tornado that struck the city during the data period. Table 1-7 summarizes the reported overflows during the evaluated period.

Table 1-7: Sanitary Sewer Overflows reported from April 2007 to June 2010

Cause of Sanitary Sewer Overflow (SSO)	Number of Occurrences	Total Estimated Volume (gal) [1]
SSO reportedly caused by blockage in line (roots, grease, rags, trash, etc.)	36	6,600
SSO at Manhole 069A0030	4	2,130,000
SSO reportedly caused by excessive precipitation (including Manhole 069A0030) [2]	17	4,910,000
SSO reportedly caused by mechanical failure at pump station (primarily bubbler issues)	8	1,700

[1] *Total Estimated Volume only includes what was reported. Many additional overflows were reported to have an unknown volume.*
[2] *SSOs caused by excessive precipitation include the SSOs at MH 069A0030.*

The breakdown of the SSO frequency and volume can be interpreted as follows:

- Many of the sewer pipe blockages were reported to be the result of tree root penetration into the system. This type of blockage has the potential to severely limit the carrying capacity of the sewer, even if not yet evidenced by upstream overflows. The method used in the Facilities Plan to determine the carrying capacity of gravity sewer assumed unobstructed pipes, meaning the actual capacity of the gravity sewer and interceptors could be less than stated. Root preventative maintenance programs help alleviate and prevent this common problem.
- The overflows occurring as a result of excessive precipitation indicate a lack of capacity in many areas of the system.
- The manhole along the Sinking Creek Interceptor (069A0030) is problematic and the SSO issue here needs to be (and is) of high priority to the City. The estimated SSO volume does not include one event as this volume was unable to be determined. The manhole is located near the main influent pump station to the Sinking Creek WWTP and the point of connection where the Stones River and Sinking Creek interceptors converge. Further, the dynamics of the operation of the main influent pump station could be leading to surcharge in the upstream pipes. The hydraulics in this area are complex. Hydraulic modeling will help determine what improvements are needed to resolve the overflow issue. Resolution of the SSO problem at manhole 069A0030 should be considered a factor in treatment/disposal alternative evaluation.

2. Current and Future Needs Based on Geographical Distribution of Wastewater Flow

The primary needs of the collection system are to maintain and upgrade the buried infrastructure to provide service to existing customers and to avoid future SSO events, particularly the re-occurring event along the Sinking Creek Interceptor at manhole number 069A0030. The expected growth in the service area is primarily in areas without existing sewer service, so this buried infrastructure will be new construction. If decentralized wastewater treatment is not utilized, most wastewater flow will continue to be routed through the existing interceptors and pump stations, eventually requiring line upsizing or parallel relief for the existing infrastructure.

The Facilities Plan compared the carrying capacity of the interceptors with average daily flow (ADF) and wet weather peak flow (WWPF). The Facilities Plan stated that by the year 2020, the peak flow was projected to meet or exceed the capacity of eleven of the fourteen interceptors. Since the publication of the Facilities Plan, there has been construction of new interceptors and relief sewer for certain stressed interceptors. Hazen and Sawyer revisited the population growth and flow projections in TM 1. Table 2-1 provides the flow projected by Hazen and Sawyer compared to the carrying capacities of these existing interceptors as determined in the 2002 Facilities Plan. This table excludes the Southwest interceptor since a parallel relief sewer was constructed in 2006. According to this comparison, there are six interceptors that currently lack capacity during wet weather events and two more will lack capacity by 2030. Improvements for interceptors that currently lack capacity should be considered a high priority.

Table 2-1: Interceptor Capacities and Expected Flows

			2010		2020		2030	
Interceptor [1]	**Size (inch)**	**Capacity (mgd)**	**ADF [2] (mgd)**	**WWPF [3] (mgd)**	**ADF (mgd)**	**WWPF (mgd)**	**ADF (mgd)**	**WWPF (mgd)**
Sinking Creek	30	11.9	6.2	20.6	7.5	24.7	9.1	29.9
Stones River	42	20.6	8.1	21.0	10.3	27.0	13.5	36.1
Stones River Ext	30	6.5	4.3	11.2	6.1	16.1	8.8	23.9
Bushman Creek	18	3.3	2.1	6.5	2.7	8.2	3.4	10.3
Northeast	18	3.3	1.4	4.3	1.8	5.5	2.3	7.1
VA	21	3.0	1.3	3.3	1.6	4.1	2.1	5.2
Lower Lytle Creek	21	3.2	0.9	2.2	1.0	2.4	1.1	2.7
Lower Lytle Creek 2	30	6.5	2.2	5.9	2.4	6.4	2.7	7.1
Upper Lytle Creek	30	6.5	0.3	0.8	0.5	1.2	0.8	1.9
Bradyville Rd	24	4.6	1.5	3.9	1.5	3.9	1.5	3.9
Samsonite Relief	21	4.0	0.2	0.5	0.3	0.6	0.3	0.8
Overall Creek	36	16.5	1.7	8.1	2.4	11.5	3.7	17.5

[1] *Sewer capacities are from the City of Murfreesboro Wastewater Facilities Plan (SSR, 2002).*
[2] *Average daily flow. Reference TM 1.*
[3] *Wet weather peak flow.*

3. Advantages and Opportunities for Hydraulic Modeling of the System

Currently, MWSD does not have an area-wide collection system hydraulic model. Hydraulic models can be constructed at a varying degree of detail depending on the desired outcome. Portions of the system can be modeled with greater accuracy than other areas where less concerns exist. A hydraulic model can be utilized to aid in effective master planning and improvement prioritization. Benefits of a hydraulic model are as follows:

- Create a dynamic link between rainfall, new development, modifications, population changes and overflow.
- Provide estimated quantity and locations for SSO reports to the State.
- Understand upstream and/or downstream impacts of new work or sewer modifications.
- Determine when existing sewers or pump station are compromised.
- Understand the cause of overflows.
- Assist in capital improvement budgeting.
- Assist in inflow and infiltration mitigation projects.

To construct a hydraulic model, MWSD should first determine what areas require detailed modeling and what areas would suffice with a “backbone” model. Once the extent of the model is determined, model construction would require digital entry of the infrastructure features including: sewer districts, population, wastewater generation patterns, sewer inverts, rim elevations, pipe diameters and lengths, station pumping rates or pump curves, on and off pump station water surface elevations, overflow elevations, and hydraulic constraints on the Sinking Creek WWTP. It is recommended that pump curves for existing pump stations be generated by field drawdown testing as opposed to manufacturer pump curves or nameplate values. Experience suggests that field measured pumping rates can be drastically different than nameplate or construction specification values, especially on older and smaller pump stations. Un-controllable factors can cause a substantial difference between expected and actual pumping values, such as impeller wear, inconsistency in operating level, and a different installed impeller size than specified in the construction drawings.

Once the hydraulic model has been constructed to a determined level or accuracy, model calibration is required. This involves conducting model runs under varying circumstances and comparing the outputs to known flow monitoring results. The City has a flow monitoring program with real time flows at various locations in the collection system. Calibrating the model against rainfall data would likely require a network of multiple rain gauges in various locations throughout the City. The iterative calibration process can be laborious and time consuming. Model calibration can lead to the discovery of compromised sewers or pump stations, such as pumps operating under their expected values or gravity sewer conveying less than hydraulically predicted indicating a blockage or collapse. The method used in the Facilities Plan to determine carrying capacity of the interceptors assumed unobstructed flow and a standard manning’s

roughness coefficient. Since this method uses an assumed full pipe diameter and an unobstructed pipe roughness, the actual sewer capacities will generally be less than the theoretical calculation. Calibrating a hydraulic model against known flow rates will provide a more accurate representation of sewer capacity. Once the model predicted results and the flow monitoring data are within an acceptable degree of variation, the hydraulic model can be used to simulate future conditions. Continual update to the model is required with new development, population change, infrastructure modifications, etc.

The City could use the calibrated model to simulate rainfall events and proposed improvements, and observe the model predicted overflows. This dynamic link between rainfall events, improvements, and population growth would aid MWSD in allocating capital improvement funding and determine what impacts future development will have on existing infrastructure. Another benefit of hydraulic modeling is its ability to simulate the hydraulics during overflows. The hydraulic grade line (HGL), which represents the actual elevation of open channel flow, can be generated and plotted in locations where overflows are occurring. This HGL can be compared with free discharge elevations (e.g., manhole rims) to determine remedial methods, such as raising rims or bolting down manhole lids. Model simulation runs with the observed rainfall data can also be used for reporting estimated overflow to the state.

4. Evaluation of Capital Investment Deferrals with Decentralized Wastewater Treatment

One of the main objectives of the current study is to perform an evaluation of deferrals in planned capital investment with decentralized wastewater treatment. There are eleven treatment and disposal alternatives as described in TM 5. Table 5-1 in TM 5 provides a list of sewer districts that would be served by each of the satellite treatment facilities. An evaluation was conducted to determine what effect each of the alternatives may have on the collection system and any planned improvements. The primary goal of the evaluation is to determine if the satellite facilities for any of the alternatives will defer or eliminate recommended capital improvements per the Facilities Plan or any of the similar projects being proposed to meet sewer capacity issues.

In addition to capital cost, part of the evaluation includes energy and maintenance requirements associated with effluent pumping from the satellite facilities to effluent disposal sites. For the purpose of evaluating the effects on the collection system, the reduction in flow to the collection system's interceptors and pump stations caused by decentralized treatment was compared to the hydraulic power and maintenance required to pump effluent to a disposal location. The results of the pumping cost evaluation are included in TM 7.

The following subsections provide a description of each alternative along with a discussion of the net effect on the collection system. Table 4-1 illustrates the potential capital saving on collection systems improvement that could be deferred by each proposed treatment alternative.

4.1 Alternative 1

Alternative 1 involves expanding the existing Sinking Creek WWTP by 11 mgd and adding land application sites for disposal of the additional effluent. This alternative would not defer any improvements laid out in the Facilities Plan or any other proposed improvement. There could potentially be a reduction in SSO volume at the problematic manhole. The headworks facility at the Sinking Creek WWTP has hydraulic limitations which require the plant operators to slow down the influent pumps during wet weather flow, causing the wet well level to rise. This rise in wetwell level has the potential to surcharge upstream sewers and cause manhole 069A0030 to overflow.

4.2 Alternative 2

Alternative 2 involves the construction of a 12 mgd treatment plant at a location referred to as S11. A satellite treatment plant at location S11 would serve all flow upstream of the Stones River Interceptor, which will soon need additional capacity. MWSD's plan to provide the needed capacity is to construct the Southwest Regional Pump Station (SWRPS). The pump station would be rated for 20 mgd, expandable to 25 mgd, and is estimated to cost a total of $24 million ($13 million for the station and $11 million for the force main). This planned pump station would be eliminated by Alternative 2.

Although there would be a savings in capital cost by eliminating the proposed SWRPS, the effluent from the S11 satellite treatment plant would be pumped to up to four land application locations. Therefore, the consideration of how many times a unit volume of wastewater must be pumped, either as raw wastewater or treated effluent, must be considered. Further, the static elevation differences among the pump stations, treatment plant(s), and disposal sites will impact the energy (and cost) to pump the flow. It is likely that the static head between S11 and the land application sites would be greater than that between the proposed SWRPS and the Sinking Creek WWTP; however, actual elevations would need to be determined during final design. These considerations have been included in the cost evaluations described in TM 7.

Since the Stones River Interceptor is manifolded with the Sinking Creek Interceptor, removing flow off the Stones River Interceptor could have another important effect. With this decreased flow, it is plausible to expect a decrease in the volume and/or frequency of overflow at the problematic SSO located at manhole number 069A0030. This overflow is located several manholes upstream of the point where the two interceptors meet. The manifolded interceptors should be hydraulically modeled, along with the Sinking Creek WWTP influent pump station, to determine the cause of the overflow before the parallel relief sewer is constructed or eliminated.

4.3 Alternative 3

Alternative 3 involves construction of a 9 mgd treatment plant at proposed satellite facility site S1 near the existing Old Fort screw lift station and a 3 mgd treatment plant at proposed satellite facility site S10, near the DeJarnette Lane pump station.

Similarly to a satellite treatment plant at S11, the S1 satellite treatment plant would remove flow from the Stones River Interceptor, eliminating the planned SWRPS, and potentially relieving flow from the tie-in of the Sinking Creek Interceptor. There would be a savings in capital cost by eliminating the proposed SWRPS. However, similar to the discussion in Alternative 2, the pumping conditions among the collection system, treatment plant, and disposal locations must be considered. It is possible that the costs required to pump S1 effluent to the proposed land application locations would be higher than the pumping costs associated with the SWRPS. These variables are considered within the cost estimates and decision factors discussed in TM 7. Removing flow from the Stones River Interceptor also could potentially provide a decrease in the volume and/or frequency of overflow at the problematic SSO located at manhole number 069A0030.

The second satellite treatment plant at the S10 location with a 3 mgd capacity would discharge its effluent in two ways. It would discharge to land application location L8 on the northeastern edge of the service area as well as discharge seasonally to an outfall on the East Fork of the Stones River. The elevations at land application L8, satellite facility site S10, and the seasonal discharge location seem to be similar, potentially indicating low pumping costs. These variables are accounted for in the cost estimates and decision factors discussed in TM 7. The 3 mgd treatment plant at S10 would have several effects on the collection system, including the following:

- MWSD's plans to consolidate multiple pump stations could be completed. This work can be coordinated with the DeJarnette Lane pump station and the Bushman Creek Phase 1 infrastructure.
- A portion of the flow, particularly that from Sewer District 64, will be removed from the VA Sewer, which is projected to lack capacity and need a parallel sewer line. Removing Sewer District 64 would likely not eliminate the improvement, but it may defer the need. It also would reduce flow going to two pump stations, 26 and 27, that have had SSO problems in the last few years. However, if pump station consolidation is achieved and the service areas of satellite facilities S2 and S10 are combined, it is likely that the VA Relief Sewer could be eliminated.
- If the flow from the DeJarnette Lane and Bushman Creek service areas were not redirected west to the Compton Road pump station area, the removal of flow off the Sinking Creek Interceptor (Sewer Districts 9, 59, 62, and 64) could potentially be achieved with the construction of a satellite facility at S10. The Sinking Creek relief sewer projects could then be deferred or reduced. This satellite facility could also result in a decrease in the volume and/or frequency of overflow at the problematic SSO located at manhole number 069A0030. Once again, this should be hydraulically modeled to confirm before eliminating or revising relief sewer.

4.4 Alternative 4

Alternative 4 involves construction of a 9 mgd treatment plant at the S1 satellite facility location. As discussed in Alternative 3, a satellite facility at S1 would remove flow from the Stones River Interceptor, making the proposed SWRPS unnecessary, and potentially providing a decrease in the volume and/or frequency of SSOs at manhole number 069A0030.

Alternative 4 also involves the construction of a 3 mgd satellite treatment in the Overall Creek basin at satellite facility site S8. Construction of a 3 mgd treatment plant at S8 would remove flow off the northern section of the Overall Creek interceptor and the associated pump station. There are currently no capacity issues or improvements called for on this interceptor or pump station. However, according to the flow projections in TM 1 and the capacity of the Overall Creek interceptor calculated in the Facilities Plan, wet weather peak flows are expected to surpass the sewer's capacity by 2030. It is possible that a satellite facility at S8 would relieve these potential capacity issues. However, as the exact locations of the potential capacity issues in this interceptor are unknown, it is not possible to determine the impact of S8. However, the further evaluation of the capacity along this interceptor is recommended. The Overall Creek interceptor is not tributary to the Stones River or Sinking Creek interceptor; rather it is conveyed to the Sinking Creek WWTP by a pump station. Without hydraulic modeling of the Sinking Creek WWTP influent pump station and interceptors immediately upstream, the effect of removing flow from the Overall Interceptor on the problematic SSO located at manhole number 069A0030 is unknown.

4.5 Alternative 5

Alternative 5 involves expanding the existing Sinking Creek WWTP by 8 mgd and construction of a 3 mgd treatment plant at S8, identical to Alternative 4. As was stated in Alternative 1, the expansion of the Sinking Creek WWTP would have no major effects on the collection system improvements proposed in the Facilities Plan. Per Alternative 4, a satellite facility at S8 would remove flow off the northern section of the Overall Creek Interceptor, but the actual effects on potential future capacity problems are unknown.

4.6 Alternative 6

Alternative 6 involves the expansion of the existing Sinking Creek WWTP by 8 mgd and construction of a 5 mgd satellite treatment facility at site S6 to treat future flows in the south-southwest portions of the service area, where significant population growth is expected. An expansion of the Sinking Creek WWTP would not result in any deferrals of the collection system improvements proposed in the Facilities Plan.

Construction of a 5 mgd satellite treatment at S6 would receive some of the future flows from the southern area (sewer districts 39, 70, 100, 35, 71, and 96), which has some of the highest expected population growth. This would likely reduce the size of the planned 20 mgd SWRPS that is estimated to cost a total of $24 million. The SWRPS would still be necessary, but removing some of the flow could reduce the capital cost and operational costs. However, similar to the discussion in Alternative 2, the pumping conditions among the collection system, treatment plant, and disposal location must be considered. It's likely that the static head between S6 and the land application sites would be greater than that between the proposed SWRPS and the Sinking Creek WWTP; however, actual elevations would need to be determined during final design. These variables are considered within the cost estimates and decision factors discussed in TM 7.

4.7 Alternative 7

Alternative 7 combines a re-rating of the SCWWTP with construction of satellite facilities in the Overall Creek basin (S4) and upstream of the Stones River interceptor (S6). Since the only planned infrastructure improvement projects in the Overall Creek basin are related to growth in the periphery of the basin that would be needed no matter the option selected, no significant planned infrastructure savings would be realized by constructing a satellite facility at S4. As mentioned in the description of Alternative 6, the construction of a satellite facility at S6 would likely reduce the size of the planned SWRPS. By treating flow from the expected future population growth in the southern portion of the service area, the capital and operating costs associated with replacement of the screw lift station with the SWRPS could be reduced. A reduction in cost in the planned pump station is incorporated into the overall costs for Alternative 7 as described in TM 7.

4.8 Alternative 8

In Alternative 8, the Sinking Creek WWTP is expanded to treat the projected wastewater flows in the service area. As discussed in Alternative 1, the expansion of Sinking Creek WWTP would not defer any improvements proposed in the Facilities Plan or projects otherwise planned since the publishing of the 2002 report. Expansion of the plant would likely include modifications to the existing, or construction of a new, headworks facility, which would remove existing hydraulic limitations that cause plant staff to throttle the influent pump station. As such, there could potentially be a reduction in SSO volume at the problematic manhole on the Sinking Creek interceptor.

4.9 Alternative 9

Alternative 9 also plans for the expansion of the Sinking Creek WWTP to handle all future projected flows and differs from Alternatives 8 and 9 only by the treated effluent disposal method. Thus, the description of capital project cost deferrals is the same as presented in Alternatives 8 and 9.

4.10 Alternative 10

The projected capacity needs are met in Alternative 10 by re-rating of the Sinking Creek WWTP to 20 mgd and construction of a satellite facility at S1. As discussed, a satellite facility at S1 would treat flow from the upstream reaches of the Stones River interceptor, thus making the proposed SWRPS unnecessary. The resulting savings are included in the cost estimates for Alternative 10 in TM 7. The re-rating of the existing treatment plant would have little impact on the planned collection system infrastructure improvement project costs.

4.11 Alternative 11

In Alternative 11, the Sinking Creek WWTP would be re-rated to 20 mgd. In addition, a new pump station would be constructed near the existing screw lift station (i.e., near the area identified for satellite facility S1), which would pump flow from the southern portion of the service area (approximately 9 mgd) to a new satellite facility at S5 (serving an additional 1.5 mgd). The re-rating of the SCWWTP would not result in collection system infrastructure cost savings. The new pump station proposed under this alternative would have the same impact as if a satellite facility at S1 were constructed, so the proposed SWRPS could be eliminated. The proposed collection system projects near S5 are all associated with growth in the southeastern portion of the service area and, thus, no additional planned infrastructure savings would be realized by construction of a facility at S5.

Table 4-1: Summary of Potential Capital Cost Savings on Deferred Collection Systems Improvements for Eleven Recommended Alternatives

Collection System Improvement	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5	Alternative 6	Alternative 7	Alternative 8	Alternative 9	Alternative 10	Alternative 11
Southwest Regional Pump Station and Force Main [2]	-	$24 M	$24 M	$24 M	-	$3.6 M	$3.6 M	-	-	$24 M	$24 M
Sinking Creek Relief Sewer Phase 2 [1]	-	-	$4.1 M	-	-	-	-	-	-	-	-
VA Relief Sewer	-	-	Refer to Note 3	-	-	-	-	-	-	-	-
Potential Savings (millions of dollars)	$0	$24 M	$28.1 M	$24 M	$0	$3.6 M	$3.6 M	$0	$0	$24 M	$24 M

[1] *Interceptors should be hydraulically modeled to confirm adequate capacity of existing piping.*
[2] *A 15% savings was estimated for the reduction in size of the Southwest Regional Pump Station and Force Main for Alternatives 6 and 7.*
[3] *The VA Relief Sewer project could be deferred if a satellite facility constructed at S2 could also serve the area proposed for S10 in Alternative 3.*

5. Conclusions

Once a determination is made regarding decentralized wastewater treatment, the necessary collection system improvements can be established and prioritized, particularly the determination regarding a satellite treatment plant at S1 versus the proposed Southwest Regional Pump Station and Force Main. According to the comparison between the flow projections in TM 1 and the existing interceptor capacities as reported in the Facilities Plan, there are some existing interceptors that may become surcharged during wet weather. Several of the proposed collection system improvement projects will resolve these capacity limitations. Any remaining capacity limitations and the reoccurring SSO at manhole number 069A0030 should be MWSD's first priorities. It is recommended that a hydraulic model be constructed to determine the most effective improvements. The hydraulic model should be continually updated and calibrated as the system is improved. The improvements laid out in the Facilities Plan, and other proposed improvements should be simulated with various model runs (i.e., storm events, population growth, etc.) to determine the most cost-effective solutions for MWSD.

6. References

Smith Seckman Reid, Inc., Revised January 2002. City of Murfreesboro 201 Wastewater Facilities Master Plan, Collection System Evaluation, Volume 1.

ATTACHMENT A

Status of Proposed Collection System Improvement Projects

Proposed Short-Term Improvements

Improvement	Status	Costs Estimated in Facilities Plan ($ 2002)	Estimated Costs Revised for Status and Study Impacts ($ 2002)	Comments
Sinking Creek Relief Sewer Phase I	Planned	$1,235,520	$1,235,520	
Bushman Creek Relief Sewer Phase I (Dejarnette Ln PS)	Complete	$3,673,540	$0	Project completed. Costs not included in study evaluation.
Miscellaneous - Abandon Pump Station #15	Complete	$380,120	$0	Project completed. Costs not included in study evaluation.
Southwest Relief Sewer Phase	Complete	$15,771,600	$0	Project completed. Costs not included in study evaluation.
Elam Rd/ Buchanan Rd Sewer	Complete	$7,254,130	$0	Project completed. Costs not included in study evaluation.
Salem/Barfield Sewer Phase I	Complete	$2,922,400	$0	Project completed. Costs not included in study evaluation.
Puckett Creek Interceptor Phase I	Complete	$3,556,800	$0	Project completed. Costs not included in study evaluation.
Bradyville Rd Replacement	Complete	$917,280	$0	Project completed. Costs not included in study evaluation.
Miscellaneous - Cherry Lane	Removed	$1,027,000	$0	Req'd for future development. Costs not relevant to study.
Medical Center Parkway	Complete	$4,092,530	$0	Project completed. Costs not included in study evaluation.
Total		$40,830,920	$1,235,520	

Proposed Medium-Range Improvements

Improvement	Costs Estimated in Facilities Plan ($ 2002)	Estimated Costs Revised for Status and Study Impacts ($ 2002)	Comments
Miscellaneous - Cherry Lane Area Sewers	$813,800	$0	Req'd for future development. Costs not relevant to study.
VA Relief System	$5,337,280	$5,337,280	Planned - Project costs potentially deferred with construction of S2 or NE Pump Station.
Sinking Creek Relief Sewer Phase II	$2,964,000	$2,964,000	Planned - Project costs potentially deferred with construction of S10 or NE Pump Station.
Sinking Creek Relief Sewer Phase III	$4,464,720	$4,464,720	To be considered.
Northeast Relief Sewer	$2,826,720	$0	50% Completed – Remainder not necessary – No future growth.
Bushman Creek Relief System Phase II	$8,574,800	$0	Project Removed - Southern area re-routed through Lytle Creek, Phase I – No future growth.
Bradyville Road Relief Sewer	$2,003,040	$2,003,040	To be considered in current study.
Lytle Creek Sewer Phase I	$7,974,720	$4,430,676	Portion Under Construction for $3,544,044.
Lytle Creek Sewer Phase II	$12,277,200	$0	Req'd for future development. Costs not relevant to study.
Overall Creek Interceptor Phase I	$2,731,300	$0	Portion Completed and not related to the study since for future development.
Puckett Creek Interceptor Phase II	$2,152,800	$0	Portion Completed and not related to the study since for future development.
Puckett Creek Interceptor Phase III	$436,800	$0	Completed by Developer/Development.
Miscellaneous	$611,520	$0	Completed by Developer/Development.
Stones River Relief Sewer	$21,216,000	$0	Project has been replaced with the SW Regional PS & FM costs.
Southwest Relief Sewer Phase II	$6,589,440	$2,196,458	33% of sewer is needed now. Remainder not related to the study since for future development.
Salem/Barfield Sewer Phase II	$1,279,200	$1,279,200	Project is necessary to abandon River Oaks West PS.
Salem/Barfield Sewer Phase III	$1,223,040	$0	Project Removed – Upsize not needed since Barfield PS was abandoned.
US 41/SR840 Sewer System	$7,382,440	$0	Req'd for future development. Costs not relevant to study.
SW Regional PS and FM		$24,000,000	
Total	$90,858,820	$46,675,374	

Proposed Long-Range Improvements

Improvement	Costs Estimated in Facilities Plan ($ 2002)	Estimated Costs Revised for Status and Study Impacts ($ 2002)	Comments
Northern Collection System	$22,419,540	$0	
Walter Hill Collection System	$3,608,800	$0	
East Fork Collection System	$13,564,980	$0	
Sulphur Springs Road Collection System	$2,721,420	$0	
Lytle Creek Sewer Phase III	$2,246,400	$0	Req'd for future development. Costs not relevant to study.
Salem/Barfield Sewer Phase IV	$4,368,000	$0	
Puckett Creek Interceptor Phase IV	$2,789,280	$0	
Puckett Creek Interceptor Phase V	$1,497,600	$0	
Overall Creek Interceptor Phase III	$2,184,000	$0	
Stewart Creek Collection System	$7,116,200	$0	
Total	$62,516,220	$0	