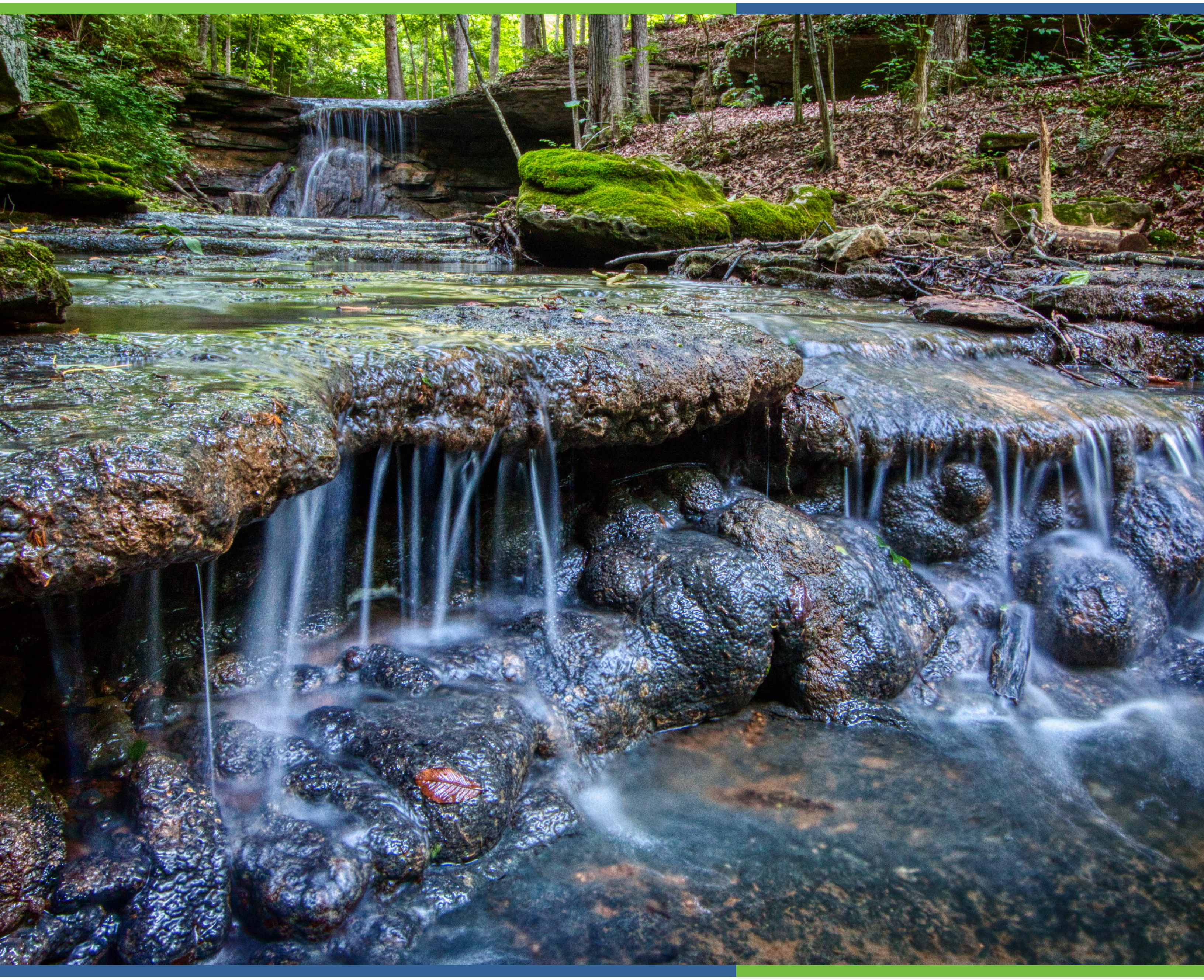
Louisville and Jefferson County
Metropolitan Sewer District

FINAL SANITARY SEWER DISCHARGE PLAN

2021 Modification
April 2021, Volume 3 of 3



PROJECT WIN Waterway Improvements Now

msd Safe, clean waterways

APRIL 30, 2021

Safe, clean waterways

2021 IOAP MODIFICATION

EXECUTIVE SUMMARY

METROPOLITAN SEWER DISTRICT

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SECTION ES: INTRODUCTION

In August 2005, the Louisville and Jefferson County Metropolitan Sewer District (MSD) entered into a Consent Decree with the Commonwealth of Kentucky by and through its Environmental and Public Protection Cabinet (Cabinet), as Plaintiff, and the United States of America, on behalf of the United States Environmental Protection Agency (EPA), as Plaintiff-Intervener. The first amendment to the Consent Decree became official in April 2009 (hereafter referred to as the ACD). The ACD requires MSD to “eliminate SSOs and Unauthorized Discharges from MSD’s SSS, CSS and WWTPs, and to address discharges from MSD’s CSO locations identified in its Morris Forman Water Quality Treatment Center (WQTC) Kentucky Pollutant Discharge Elimination System (KPDES) permit.”

Recognizing the long-term nature of the IOAP, MSD committed to an approach of adaptive management, intending to make mid-course corrections as more information is learned about the performance of projects and the related response in the sewerage systems. Adaptive Management offers MSD an opportunity to continue collecting more data to recalibrate and revalidate its hydraulic model. As projects are completed and system improvements come on-line, MSD’s model is updated to reflect current conditions. In some cases, the level of control for a particular location has already been met based upon flow monitoring data and modeling.

Based on the need to spend nearly $1 billion over the next 5 years, MSD is requesting a time extension for completion of the remaining ACD responsibilities. Much of the spending forecasted for the 5-Year CIP is required for new priorities not known when the ACD was executed. MSD remains committed to completing all projects, and requests additional time to construct the remaining mandated projects in order to allow MSD to continue to invest in its infrastructure.

After more than a year of discussion and exchange of extensive information, the parties agreed to a second ACD, the purpose of which is to extend some of the existing Final Sanitary Sewer Discharge Plan (SSDP) and Final Long-Term Control Plan (LTCP) milestones to enable MSD to prioritize significant additional environmentally beneficial spending.

Under the Second ACD, MSD is requesting a time extension for completion of the remaining SSDP projects in order to facilitate construction of: 1) improvements at the Morris Forman (WQTC) required to meet permit conditions and mitigate combined sewer overflows (CSOs); 2) improvements at the Paddy’s Run Pump Station required to mitigate CSOs and enhance the reliability of public safety; 3) rehabilitation of MSD”s most critical interceptors; and 4) a focus on asset management for MSD’s existing wastewater assets. A summary of the Second ACD requirements is provided in Table ES.0.1-1.

Table ES.0.1-1 Summary of Second ACD Provisions

SECOND ACD COMPONENT	IOAP/SECOND ACD CRITERIA	COMPLIANCE MEASURES
Integrated Overflow Abatement Plan (IOAP) Modification **Volume 1**	Reporting Frequency (Volume 1, Chapter 1)	• Semi-Annual and Annual Reporting
	Specific Remedy Projects (Volume 1, Chapter 4)	• Construct Morris Forman New Biosolids Facility by December 31, 2030 • Construct Paddy’s Run Pump Station Capacity Upgrade by December 31, 2026

SECOND ACD COMPONENT	IOAP/SECOND ACD CRITERIA	COMPLIANCE MEASURES
	Critical Interceptors Program (Volume 1, Chapter 4)	• Complete rehabilitation and replacement work for nine critical interceptors: 1) Large Diameter Interceptor Rehabilitation Program, 2) Broadway Interceptor; 3) Western Outfall, 4) Rudd Avenue Sewer, 5) I-64 & Grinstead Interceptor, 6) Harrod's Creek Force Main, 8) Buechel Branch, and 9) Prospect Area Sewers totaling approximately $70 million during FY21 through FY25 for completion by December 31, 2026.
	Asset Management Program (Volume 1, Chapter 4)	• Submit Strategic Asset Management Plan no later than June 30, 2021 • Complete an average of $25 million per year of work for asset management projects • Document spending of $125M for asset management projects during FY21-FY25 • Document spending of $125M for asset management projects during FY26-FY30 • Document spending of $125M for asset management projects during FY31-FY35
Final LTCP Modification Volume 2	Waterway Protection Tunnel (Volume 2, Chapter 4, Executive Summary Table ES1.1-3)	• Substantial Completion to be achieved no later than December 31, 2022 for the remaining LTCP project
	System-Wide Modeled Level of Control for CSOs (Volume 2, Chapter 4)	• Achieve modeled system-wide 85% or greater capture or elimination of CSS volume
Final SSDP Modification Volume 3	Remaining SSDP Projects (Volume 3, Chapter 4, Executive Summary Table ES1.1-5)	• Substantial Completion of seven SSDP projects no later than December 31, 2025 (Idlewood In-Line Storage, Kavanaugh Road PS Improvements, Raintree & Marian PS Eliminations Phase 1, Monticello PS Elimination, Cinderella PS Elimination, Leven PS Elimination, and Gunpowder PS In-Line Storage).
		• Substantial Completion of six SSDP projects no later than December 31, 2030 (Bardstown Road PS Improvements, Dell Rd & Charlane Parkway interceptor, Raintree & Marian PS Elimination Phase 2, Middle Fork Relief Interceptor & PS, Sutherland Rd Interceptor, and Mellwood System Improvements).
		• Substantial Completion of three SSDP projects no later than December 31, 2035 (Little Cedar Creek Interceptor, Goose Creek Interceptor, and Camp Taylor Rd Improvements Phase 4).

ES.1.1. CONSENT DECREE CURRENT STATE

Since 2005, pursuant to the Consent Decree and subsequent ACD, MSD has spent nearly $0.9 billion (of the $1.2 billion ACD/IOAP total) for mitigating combined sewer overflows (CSOs) and eliminating sanitary sewer overflows (SSOs) and unauthorized discharges. This section provides an update on MSD's progress related to the IOAP, Final SSDP, and Final LTCP requirements.

ES.1.1.1. IOAP PROGRESS

The programmatic IOAP requirements are summarized in Table ES.1.1-1 along with the progress MSD has made through December 31, 2020.

Table ES.1.1-1 Summary of IOAP Program

REQUIREMENT	PROGRESS
Engage Stakeholders	MSD's community input, outreach and notification program were approved and is ongoing. In 2006, MSD initiated a Wet Weather Team Stakeholder Group which is still in existence and active today. Details regarding this Group are provided in Volume 1, Chapter 3.
	MSD exceeded the original commitments made to the community by spending 35% more for community benefits including: expanded system monitoring and rain gauge networks to improve model calibration and discharge reporting; increased system storage capacity over original commitments by 25%; increased sanitary pump station capacity over original commitments by 50%; and improved community engagement and created neighborhood green spaces. Details regarding this investment are provided in Volume 2, Chapter 4.
Plumbing Modification Program	Since the program's inception, MSD has completed over 17,992 projects totaling approximately $21.7 million dollars. The countywide program is now available to all MSD customers experiencing basement backups. MSD will pay up to $4,000 per residence for plumbing modifications. Generally, installations average about $2,500.
Supplemental Environmental Projects	MSD certified completion of all required supplemental environmental projects.
Consent Decree Reporting	MSD submitted 60 quarterly Consent Decree reports and 15 Annual Consent Decree reports. Reports are available to the public on MSD's Project WIN website.
Interim and Final LTCP	MSD completed all Interim projects and has completed 24 of 25 of the Final LTCP projects. Refer to section ES.1.1.2
Interim and Final SSDP	MSD completed all Interim SSDP projects and has completed 41 of the 57 Final SSDP projects. Refer to section ES.1.1.3

ES.1.1.2. IMPROVED OHIO RIVER & BEARGRASS CREEK WATER QUALITY

Although not required by the Presumption Approach, water quality sampling and modeling (described in Volume 1, Chapter 5) supports that both Beargrass Creek and the Ohio River would be in compliance with existing water quality standards if all background loads were removed. The measured reductions of Beargrass Creek and ORSANCO Ohio River bacteria levels during wet weather compared to pre-construction support the environmental and health benefits of IOAP implementation.

The general water quality trend since 2000 has demonstrated an improvement for bacteria trends. MSD received ORSANCO sampling data on the Ohio River indicating significant reductions in median fecal coliform levels downstream of Louisville, Kentucky (refer to Figure ES.1.1-1). Graphical representation of wet weather sampling performed by MSD along Beargrass Creek is provided in Figure ES.1.1-2.

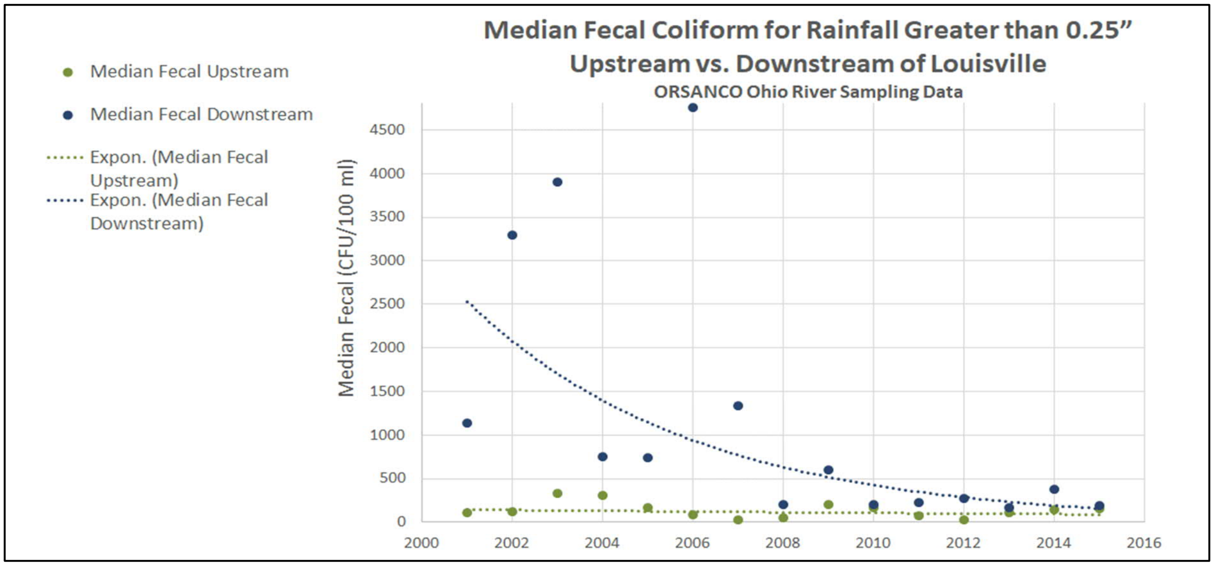

Figure ES.1.1-1 Ohio River Bacteria Trends as Published by ORSANCO in 2018

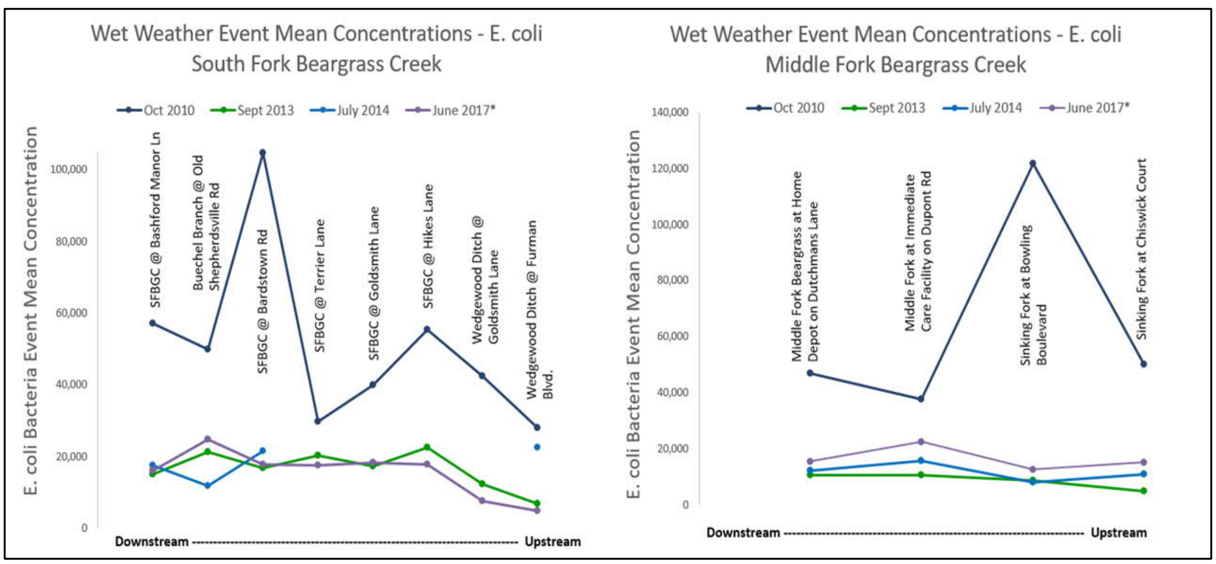

Figure ES.1.1-2 Beargrass Creek Bacteria Trends as Published by Louisville MSD

ES.1.1.3. FINAL LTCP PROGRESS

The IOAP requirements related to CSOs are summarized in Table ES.1.1-2 along with the progress MSD has made through December 31, 2020.

Table ES.1.1-2 Summary of Final LTCP Program

REQUIREMENT	ACCOMPLISHMENT
Construct 25 LTCP projects	MSD certified completion of 24 CSO LTCP projects to-date, reducing overflows to local waterways by approximately 5 billion gallons per Typical Year. The Waterway Protection Tunnel remains under construction and is scheduled to be completed December 31, 2022. The CSOs that have been mitigated through the LTCP projects are listed in Table ES.1.1-3
Construct 19 green infrastructure demonstration projects	MSD completed all green infrastructure demonstration projects as well the other green infrastructure program elements, totaling nearly $40 million for an incremental system benefit. Details regarding these projects are provided in Volume 2, Chapters 3 and 4.
Achieve 85%or greater capture throughout the combined sewer system (CSS)	The IOAP projects, when fully implemented, are modeled to achieve 95 percent capture of the wet weather combined sewage generated in the service area, which greatly exceeds EPA's Presumption Approach requirement of 85 percent. Compliance with the 85 percent capture will be achieved with completion of the Wateway Protection Tunnel. MSD expects to achieve 95 percent modeled performed by December 31, 2026 upon completion of the Morris Forman WQTC Sedimentation Basin Rehabilitation Project per the State Agreed Order Number 150220 Corrective Action Plan.
Nine Minimum Controls (NMC) Program	MSD's NMC Plan was submitted and approved by Regulators. MSD continues to implement its NMC Program. Through December 2020, MSD constructed 126 MG of system storage. The Phase 1 Real Time Control (RTC) Program provided a total of 41.05 MG of this storage. The rest of the storage volume was attributed to the basins listed in Volume 2, Chapter 4, Table 4.1-6. By December 2022, the Waterway Protection Tunnel will provide an additional 52 MG of system storage. Upon completion of the LTCP, MSD will have 178 MG of total storage available to better manage wet weather.

MSD has certified completion of 24 Final LTCP projects. The projects are listed in order of completion in Table ES.1.1-3 located at the end of the chapter.

Table ES.1.1-3 CSO Mitigations by Projects Completed under the LTCP Program
Table is located at the end of the Executive Summary

The remaining Final LTCP project is the Waterway Protection Tunnel as summarized in Table ES.1.1-4. This work will be substantially complete no later than December 31, 2022 per the Second ACD.

Table ES.1.1-4 Remaining LTCP Project

2021 FINAL LTCP PROJECT & IOAP PROJECT ID	2012 LTCP PROJECT	ESTIMATED REMAINING COST[1]	SECOND ACD DEAD-LINE[2]	CSOS MITIGATED & LEVEL OF CONTROL
Waterway Protection Tunnel Suite L_OR_MF_020_S_09B_B_A_8 L_MI_MF_127_M_09B_B_A_8 L_SO_MF_083_M_09B_B_A_8 L_OR_MF_155_M_09B_B_B_4	Story Ave. & Main St. Storage Basin I-64 and Grinstead CSO Basin Lexington Rd. and Payne St. Storage Basin 13th St & Rowan St Storage Basin	$64,437,300	12/31/2022	8 overflows per TY for CSO 020, 022, 023, 050, 051, 052, 053, 054, 055, 056, 150, 155 4 overflows per TY for CSOs 125, 126, 127, 166 0 overflows per TY for CSOs 082, 084, 118, 119, 120, 121,141, 153

[1]This table only shows the remaining forecasted project costs and does not include the total estimated cost at completion of the projects. [2]Consent Decree Completion date represents Substantial Completion of construction.

ES.1.1.4. FINAL SSDP PROGRESS

MSD is required to construct SSDP projects to eliminate sewer overflows (SSOs) for the 2-year, 5-year, or 10-year storm event. The level of control (LOC) storm event was selected for each modeled SSO location. The LOC selection and modeling referenced herein was performed in accordance with the approved IOAP, as required by the Amended Consent Decree. The IOAP requirements related to SSOs are summarized in Table ES.1.1-5 along with the progress MSD has made through December 31, 2020. Detailed information regarding the SSDP projects is provided in Volume 3.

Table ES.1.1-5 Summary of Final SSDP Program

REQUIREMENT	PROGRESS
Construct 57 SSDP projects of varying scopes to eliminate SSOs including six projects noted in the Interim SSDP	MSD certified completion of 41 (SSDP) projects through December 2020, that have eliminated 307 SSO occurrences. These locations are noted in Table ES.1.1-6.
For the 2-year storm, eliminate 100% modeled SSO volume and 100% modeled overflow locations	For the 2-year storm, eliminated 82% modeled SSO volume and 67% modeled overflow locations
For the 5-year storm, eliminate 13% modeled SSO volume and 35% modeled overflow locations	For the 5-year storm, eliminated 72% modeled SSO volume and 45% modeled overflow locations
For the 10-year storm, eliminate 10% modeled SSO volume and 18% modeled overflow locations	For the 10-year storm, eliminated 54% modeled SSO volume and 37% modeled overflow locations
Comprehensive Performance Evaluation-Composite Correction Plan (CPE-CCP) projects	Each of the small WQTCs that had SSOs in their watersheds were eliminated as part of MSD's long-term strategic plan to eliminate small WQTCs in its service area. The Jeffersontown WQTC was eliminated in 2015. Expansion of the Derek R. Guthrie WQTC to 60 MGD average day and 300 MGD peak day (for short durations) was completed in 2018 and the State approved is rerating in 2020. Similarly, expansion of the Floyd's Fork WQTC to 6.5 MGD was completed in 2012. The Hite Creek WQTC is under construction to expand its capacity to 9 MGD ADF and 24 MGD peak flow. Construction is scheduled for completion in FY22.
Capacity, Maintenance, Operation, and Management (CMOM) Program	MSD's CMOM Self-Assessment Program was submitted and approved in 2006. MSD continues to implement CMOM related capital projects.
Sewer Overflow Response Program (SORP)	MSD's SORP was submitted and approved in 2006. MSD completely revised the SORP in 2011. Final approval of the updated SORP document was received February 21, 2012. Modifications were made to the document in 2016 to reflect the elimination of the Jeffersontown WQTC and were approved on July 21, 2017. A new format was presented for the SORP in 2020 to reflect the software configuration.
Sewer Capacity Assurance Program (SCAP)	MSD's SCAP was submitted and approved in 2006. MSD submitted a revised SCAP dated November 2014 to EPA and KDEP on December 9, 2014. MSD received a letter approving that plan and acknowledging the November 2014 document superseded the 2008 SCAP on February 5, 2015

MSD certified completion of 41 SSO SSDP projects to-date and eliminated 87% of the SSOs identified in the SSDP (refer to Table ES.1.1-6 at the end of the chapter). Twelve of the projects were certified complete 1 year or more ahead of schedule. In addition, MSD has completed the 6 Interim SSDP projects listed in the ACD. More detailed regarding the Interim SSDP projects are provided in Volume 3, Chapter 1, Section 1.3.4.

Table ES.1.1-6 SSO Eliminations Under SSDP and other Programs
Table located at the end of the Executive Summary

The remaining SSDP projects are listed in Table ES.1.1-7 along with the Second ACD revised compliance dates. Although MSD is requesting a time extension through 2035, seven of the 16 remaining SSDP projects will be substantially complete by December 31, 2025. Six projects will be completed through 2030 and the remaining three projects will be completed through 2035. MSD desires to retain flexibility with scheduling this work to balance known and unknown critical capital needs.

Table ES.1.1-7 Remaining SSDP Projects

IOAP PROJECT ID		REMAINING SSDP PROJECT	ESTIMATED COST	SECOND ACD COMPLETION DATE[1]	LEVEL OF CONTROL STORM EVENT
1	S_JT_JT_NB03_M_01_C	Raintree & Marian Ct Phase 1	$125,000	12/31/2025	2-Year
2	S_CC_CC_70158_M_09A_C	Idlewood Inline Storage	$4,807,400	12/31/2025	2-Year
3	S_JT_JT_NB04_M_01_A	Monticello PS Elimination	$464,000	12/31/2025	10-Year
4	S_HC_HC_MSD1085_S_03_A	Kavanaugh Road Pump Station	$4,300,000	12/31/2025	10-Year
5	S_PO_WC_PC10_M_01_C	Leven Pump Station Elimination	$720,000	12/31/2025	2-Year
6	S_PO_WC_PC04_M_01_C	Cinderella PS Elimination	$1,500,000	12/31/2025	2-Year
7	S_HC_HN_NB02_S_09A_C_B	Gunpowder Pump Station ILS	$800,000	12/31/2025	2-Year
8	S_CC_CC_67997_M_01_C	Little Cedar Creek Interceptor	$2,400,000	12/31/2025	2-Year
9	S_CC_CC_MSD1025_S_03_B	Bardstown Road PS	$3,400,000	12/31/2030	5-Year
10	S_JT_JT_NB03_M_01_C	Raintree & Marian Ct Phase 2	$1,800,000	12/31/2030	2-Year
11	S_JT_JT_NB02_M_01_C	Dell Road & Charlaine Pkwy Int.	$8,800,000	12/31/2030	2-Year
12	S_MISF_MF_NB01_M_01_C_A1	Middle Fork Relief Interceptor, Wet Weather Storage, & Diversion Phase 2: Upper Middle Fork PS & Interceptor	$86,408,000	12/31/2030	2-Year
13	S_OR_MF_NB01_M_01_B	Mellwood System Improvements & PS Eliminations Phase 2: Mockingbird Valley PS	$2,516,100	12/31/2030	5-Year
14	S_SD_MF_NB05_M_01_A	Sutherland Interceptor	$1,065,300	12/31/2030	10-Year
15	S_SF_MF_30917_M_09_A	Camp Taylor Improvements Phase 4: Offline Storage	$23,972,300	12/31/2035	10-Year

IOAP PROJECT ID		REMAINING SSDP PROJECT	ESTIMATED COST	SECOND ACD COMPLETION DATE[1]	LEVEL OF CONTROL STORM EVENT
16	S_MI_MF_NB04_M_03_B	Goose Creek PS Improvements & Wet Weather Storage Phase 2 – Goose Creek PS Improvements	$6,978,600	12/31/2035	2-Year
Remaining Costs for SSDP Projects			**$150,056,700**		

[1]Consent Decree Completion date represents Substantial Completion of construction. The Lucas Lane Project Minor Modification was submitted in February 2021 indicating refined hydraulic modeling has demonstrated the LOC is currently met without further investment.

ES.1.1.5. MODELED SSO VOLUME AND LOCATIONS

When the CD was lodged, MSD had an estimated 218 modeled SSOs occurrences. The CD/ACD required MSD to eliminate all SSOs for the 2-year storm event. SSO occurrences are required to be reduced to a level of control for the 5-year and 10-year storm events. Under the Final SSDP MSD is required to eliminate 197 modeled SSO occurrences. A forecast of the number of modeled SSOs per the revised Second ACD compliance dates is presented in Table ES.1.1-8.

Table ES.1.1-8 Modeled Performance of SSO Occurrences

CLOUDBURST STORM EVENT	2007 NUMBER OF MODELED SSOS	2020 NUMBER OF MODELED SSOS	2025 NUMBER OF MODELED SSOS	2035 NUMBER OF MODELED SSOS	NUMBER OF MODELED SSOS AT REQUIRED LEVEL OF CONTROL
2-Year Cloudburst Storm Event	197	65	55	0	0
5-Year Cloudburst Storm Event	211	117	109	75	137
10-Year Cloudburst Storm Event	218	137	129	108	178

Sixteen (16) SSDP projects remain to be completed and these projects will eliminate 65 remaining SSOs occurrences during the 2-year storm event. When all SSDP projects are completed no later than 2035, MSD will have eliminated a total of 197 SSO occurrences for the 2-year storm. The remaining SSDP projects and SSO locations are noted in Table ES.1.1-7.

The series of graphs shown below demonstrates MSD's progress with eliminating the SSOs identified in the Final SSDP. Figure ES.1.1-3 shows the forecasted elimination schedule based upon the Level of Control agreed upon in the ACD reflecting the Final SSDP time extension associated with the Second ACD. Separate lines are shown on the graph for each cloudburst storm event level of control. This information shows the general trend to reduce 2-year storm event SSOs from nearly 200 to 0 upon completion of the Final SSDP. Similarly, the 5-year storm SSOs were agreed to be reduced from nearly 210 overflows to approximately 140 SSO occurrences; and the 10-year storm event SSOs were agreed to be reduced from approximately 220 overflows to approximately 180 SSO occurrences.

Figure ES.1.1-3 SSO Eliminations Over Time Based on Level of Control

MSD modeled the system improvements constructed through August 2020 and those forecasted to be built with the remaining SSDP projects (through 2035). The resulting modeled system performance with respect to SSO eliminations is shown in Figure ES.1.1-4. The scope of work for several of the constructed SSDP projects was revised which subsequently achieved a higher level of control and greater environmental benefit.

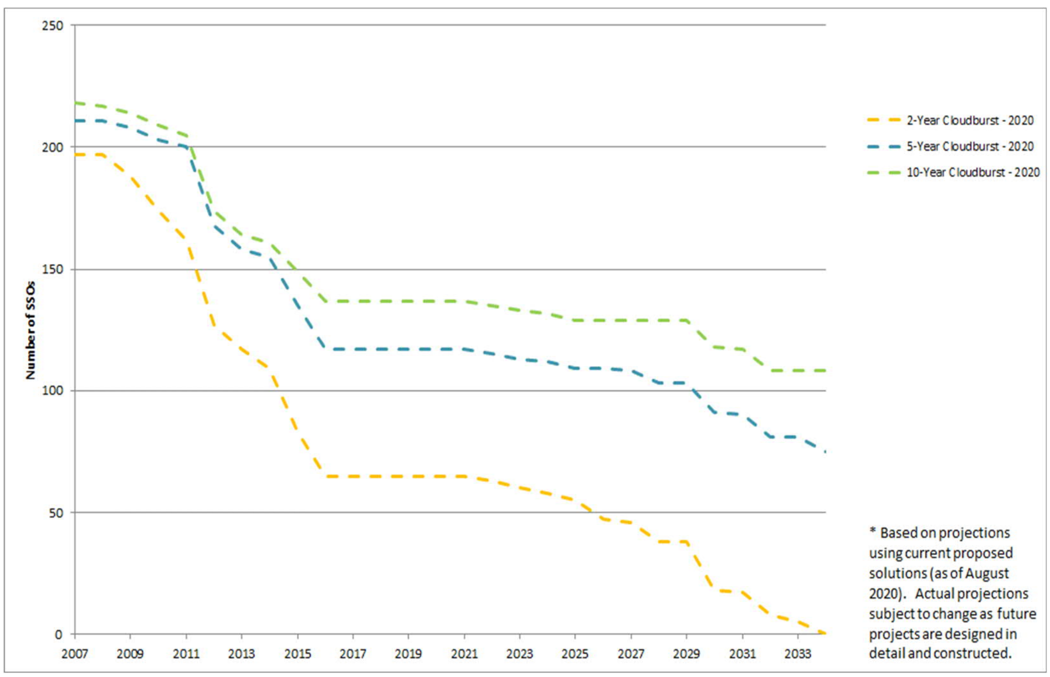

Figure ES.1.1-4 SSO Eliminations Over Time Based on Model Projections

For example, the modeled performance results at the conclusion of the Final SSDP indicates MSD will reduce the 2-year storm event SSOs from approximately 200 to 0 occurrences; 5-year storm event SSOs from approximately 210 to 75 occurrences ; and 10-year storm event SSOs from approximately 220 to 110 occurrences.

Figure ES.1.1-5 shows the comparison of SSO eliminations based upon both level of control and model predictions. The line representing the 2-year storm event is the same as the level of control shown in Figure ES.1.1-3 and Figure ES.1.1-4. However, the lines for the 5-year and 10-year storm events are lower than those in Figure ES.1.1-3 – indicating fewer SSOs are occurring compared to the IOAP/ACD requirements.

Figure ES.1.1-5 SSO Eliminations Based on Level of Control and Model Projections

MSD's investments have resulted with 65 fewer SSOs during 5-year storm events and 70 fewer SSOs during 10-year storm events as compared to the agreed upon ACD level of control. This represents **an additional 30% reduction of SSO occurrences during larger storm events than was agreed upon with the IOAP/ACD**.

In addition to having fewer SSO occurrences during larger storms, MSD has already achieved (through August 2020) a better performance than originally envisioned with the IOAP/ACD. Figure ES.1.1-6 presents a graphical depiction of the forecast for eliminating the SSOs as envisioned during 2012. All three lines showing each level of control storm (2-year, 5-year, and 10-year) indicate MSD achieved SSO eliminations faster than anticipated. For example, the original 2012 forecast that was incorporated into the IOAP/ACD estimated approximately 77 SSOs occurring for the 2-year storm event during 2020. Whereas, both the level of control line and modeled performance line in Figure ES.1.1-6 indicate MSD has already reduced SSOs to approximately 65 occurrences for the 2-year storm.

The difference for the 5-year and 10-year storm events are more pronounced. The 2020 values indicate the 2012 forecast estimated 169 SSO occurrences for the 5-year event vs. the modeled performance for the completed SSDP projects of 117 SSO occurrences. In 2012, it was assumed by 2020 MSD would have reduced the 10-year storm SSOs to 195 occurrences as compared to the 2020 modeled performance of 165 occurrences. This data suggests **MSD is achieving SSO eliminations and subsequent environmental benefits at a higher rate than required in the IOAP/ACD**.

Figure ES.1.1-6 SSO Eliminations Compared to Original Compliance Schedule

ES.1.2. MSD'S CHANGED CIRCUMSTANCES SINCE ACD LODGING

Major investments in other infrastructure rehabilitation, renewal, and replacement were limited as capital and operating spending increased to meet ACD requirements. The result of deferred investment on infrastructure renewal and replacement is that MSD now must confront a rapidly aging system of pipes, pumps, treatment plants, and flood control systems in urgent need of rehabilitation if those existing assets are to continue protecting public health and safety.

MSD's changed circumstances have resulted in critical reprioritization of needs for MSD's infrastructure, as contemplated by USEPA's 2012 Integrated Planning Framework and the passage of the Water Infrastructure Improvement Act. **These changed circumstances have added approximately $1B** to MSD's Capital Improvement Program (CIP), including $700M to the 5-year CIP as summarized in Table ES.1.2-1. A summary of each changed circumstance is provided herein.

Table ES.1.2-1 Projects Necessary to Address Changed Circumstances

MSD BUDGET ID	PROJECT	ESTIMATED COST AT COMPLETION	ESTIMATED COST IN 5-YEAR CIP
H09133	Waterway Protection Tunnel Extension – *Estimated cost represents the additional cost only. The total project cost = $151,788,400*	$30,000,000	$55,000,000
Multiple	Morris Forman WQTC Lightning Strike Repair[1]	$50,000,000	$0
Multiple	Morris Forman WQTC Corrective Action Plan	$171,771,000	$96,018,900
D18116	Morris Forman WQTC Biosolids Facility Replacement[2]	$197,800,000	$175,072,800
F21084,85	USACE FPS Reliability Improvements Program	$58,664,300	$58,664,300
F18515	Paddy's Run Pump Station Capacity Upgrade	$115,000,000	$115,000,000
Multiple	Critical Interceptor Rehabilitation Program	$70,000,000	$70,000,000
Multiple	Wastewater System Asset Management Program	$375,000,000	$125,000,000
		$1,068,235,500	**$694,756,000**

[1]All funds have already been paid for this changed circumstance. [2]Approximately $175M is forecasted to be spent during the 5-year CIP with the remaining $23M to be spent in the 6th year (FY26).

ES.1.2.1. MORRIS FORMAN WQTC LIGHTNING STRIKE OUTAGE

In April 2015, the Morris Forman WQTC experienced a catastrophic mechanical failure due to a lightning strike. As a result, there was significant damage to the primary treatment, secondary treatment, and electrical systems. The damaged infrastructure subsequently contributed to permit exceedances in the effluent for Biological oxygen Demand (BOD) and Total Suspended Solids (TSS). MSD invested $50M to repair the damage to the Morris Forman WQTC. These costs are not included in in the Estimated Cost for the 5-Year CIP because additional capital funds are not required to complete the repairs. However, it is important to realize that MSD was required to defer other Asset Management needs in order to fund this unforeseen $50M effort.

ES.1.2.2. WATERWAY PROTECTION TUNNEL UPGRADES

The Waterway Protection Tunnel is comprised of four projects consolidated from the 2009 LTCP to help control CSOs and other unauthorized discharges from MSD's sewer system. When completed, the approximate 55 million gallon storage facility will accommodate wet weather flows within the project area to limit the number of overflows to eight (8) times in a Typical Year for the Downtown area, zero (0) times in a Typical Year for the Irish Hill area, and four (4) times in a Typical Year for the Grinstead Road area. The Waterway Protection Tunnel project comprises the largest component of the remaining LTCP projects with $55M worth of work to be completed in FY21-FY25. The completion date for the tunnel was extended to December 31, 2022 (from December 31, 2020) with the Second Amendment to the Consent Decree.

In June 2018, MSD decided to extend the tunnel approximately 7,800 linear feet east to the I-64 & Grinstead CSO Basin project location to eliminate the need for this basin. A new retrieval/drop shaft was constructed at the I-64 & Grinstead location to collect flows from the nearby CSO locations. The necessary change order resulted in a price adjustment of over $30M and extended the contractor's schedule by 156 days. In addition to the tunnel extension, MSD's contractor was granted additional time for differing site conditions (35 days). MSD's contractors experienced issues with the tunnel crown at STA 102, 108 and 162. Through December 31, 2020, MSD granted 48 days for these issues, but MSD expects further notices regarding these issues. These delays do not represent all delays associated with the project. MSD's contractors provided a revised substantially complete date of September 4, 2021. However, MSD believes they are approximately 27 days behind that schedule. For example, the contractor encountered issues with the first tunnel concrete lining pours in the bifurcation.

In addition to the delays explained above, MSD's contractor requested 73 days for weather related delays; delays related to the delivery of the tunnel boring machine; and delays associated with relocations. However, MSD is disputing these days. Finally, to date, there are approximately 99 days of delay that are unaccounted for by MSD's contractor.

ES.1.2.3. MORRIS FORMAN WQTC CORRECTIVE ACTION PLAN

MSD has agreed to spend an additional $175M to reduce effluent BOD and TSS and take measures to prevent another catastrophic failure at the Morris Forman WQTC. MSD entered into an Agreed Order with the Kentucky Energy and Environment Cabinet (KDEP) and agreed to complete the $175M Corrective Action Plan (CAP) for mitigating permit non-compliance.

MSD has been working on the Morris Forman WQTC CAP projects since 2015. Many of the projects completed from 2015 – 2020 were related to providing redundancy for critical units/systems or improving the plant's resilience to avoid a similar fate. The complete list of CAP projects is provided in Table ES.1.2-2. As shown, MSD has completed several of these projects and all remaining projects are in-progress. This information is provided for informational purposes to demonstrate the level of investment MSD is making to improving the Morris Forman WQTC. This work is not part of the Second ACD.

Table ES.1.2-2 Morris Forman WQTC Corrective Action Plan

MSD BUDGET ID	PROJECT	ESTIMATED COST AT COMPLETION	ESTIMATED COST IN 5-YEAR CIP
H14108	Morris Forman WQTC Rubbertown Flow Sampling	$50,500	$0
D15022	Morris Forman WQTC MEB Leak Repair	$373,000	$0
F14179	Morris Forman WQTC Wet Cake Pump	$984,500	$0
D15127	Morris Forman WQTC Process Water Line	$365,500	$0
F13013	Morris Forman WQTC Condenser Upgrades	$395,200	$0
D15017	Morris Forman WQTC Centrifuge Electrical Controls	$1,091,900	$0
F14183	Morris Forman WQTC FEPS Generator	$3,275,500	$0
D18359	Morris Forman WQTC Delta Transformer	$98,500	$0
D18360	Morris Forman WQTC Air Dryer	$39,500	$0
D18362	Morris Forman WQTC FEPS Substation	$596,800	$0
F13016	Morris Forman WQTC High Yard Electrical Mod	$7,396,900	$0
F13023	Morris Forman WQTC Headworks Replacement	$14,940,600	$0
F09510	Morris Forman WQTC OGA Plants 1 and 2	$7,306,600	$0
D19044	Morris Forman WQTC Primary Sludge Pump Comp	$83,500	$0
D20249	District-Wide Biosolids Master Plan	$250,000	$0
F14182	Morris Forman WQTC FEPS Pump & Motor Repair	$450,000	$0

MSD BUDGET ID	PROJECT	ESTIMATED COST AT COMPLETION	ESTIMATED COST IN 5-YEAR CIP
D15020	Morris Forman WQTC Cake Pump Phase 2	$1,802,400	$0
D19227	Morris Forman WQTC Primary Sludge Line	$762,800	$0
D19237	Morris Forman WQTC Arc Flash Update	$102,700	$0
D19307	Morris Forman WQTC FEPS VFD Replacement	$813,200	$319,400
D20167	Morris Forman WQTC East Headworks HVAC	$101,900	$97,600
D20228	Morris Forman WQTC Centrifuge Rehabilitation	$1,100,000	$388,000
D18130	Morris Forman WQTC FEPS MCC Replacement	$500,000	$500,000
D20291/84	Derek R. Guthrie WQTC Dewatering Facility	$47,282,200	$34,324,300
D20285	Morris Forman WQTC LG Dryer Replacements	$49,305,200	$23,388,500
D19045	Morris Forman WQTC Sodium Hypochlorite Relocation	$3,471,000	$4,447,000
D17042	Morris Forman WQTC Sedimentation Basin Rehab	$32,514,000	$32,554,100
	Total	**$175,453,900**	**$95,042,900**

- The primary driver for the Morris Forman WQTC CAP is related to MSD's inability to process solids which led to permit exceedances for TSS and BOD. MSD initiated actions to expedite permit compliance. MSD offloaded regional biosolids from the Morris Forman WQTC by constructing a new dewatering facility at the Derek R. Guthrie WQTC. Dewatered biosolids are transported from the Derek R. Guthrie WQTC to the landfill. In addition to reducing the loading and stress on the Morris Forman WQTC, MSD expedited a project to construct two state-of-the-art dryers to replace the four broken and non-repairable dryers that completely failed in 2019.
- The Morris Forman WQTC CAP also includes a project to rehabilitate the four primary sedimentation basins. The WQTC is limited to a max wet weather flow of 240 MGD due to capacity constraints with the sedimentation basins. Each rectangular basin is approximately 275 feet long, 70 feet wide, 17 feet deep, was designed with a capacity of nearly 90 MGD for a total treatment capacity of 360 MGD. The Primary Sedimentation Basins were originally constructed in the 1950s. Most equipment serving the basins has exceeded the expected service life, and equipment performance has become unreliable. The timing for implementing this project is dependent upon Ohio River elevations and the associated impact on the sedimentation basins. MSD anticipates being able to rehabilitate one basin per year upon completion of the design phase of this project.
- Treating ≈330 MGD of wet weather flows will reduce potential discharges from the Main Diversion Structure (CSOs 210, 211, 016) and the Southwest Pump Station (CSOs 015 and 191). This will reduce the level of pollutants discharged into the Ohio River. This project is required in order for the plant to meet the total wet weather treatment capacity identified in the Final LTCP.

ES.1.2.4. MORRIS FORMAN WQTC BIOSOLIDS

In 2015, the Morris Forman WQTC began receiving higher solids loading from sewer discharges received from local distilleries. These loadings increased the level of TSS processed through the solids management system. This increase coupled with the substantial grit loading in the combined sewer system served to sandblast the centrifuges and dryers in use at the Morris Forman WQTC, which led to an accelerated level of deterioration for the biosolids equipment.

The Morris Forman WQTC is not able to consistently meet effluent permit limits for BOD and TSS due to outdated and aging biosolids processes and increased pollutant loading received from regional distilleries. MSD is proposing to invest $197.8M to replace the existing biosolids processing system with a modern facility. This project will provide MSD with the ability to fully comply with permit limits, thereby reducing the level of pollutants discharged into the Ohio River. Details regarding this project are provided in Volume 1, Chapter 4, Section 4.7.

ES.1.2.5. USACE FLOOD PUMP STATION IMPROVEMENTS

In 2018-2019, MSD partnered with United States Army Corps of Engineers (USACE) to complete the Preliminary Feasibility Study for the Ohio River Flood Protection System (ORFPS). The study identified projects needed to ensure flood protection levels meet today's standards. USACE has indicated federal funds may be available to address reliability improvements. However, capacity upgrades and back-up power needs are not eligible for USACE funding. The USACE will fund and lead the reliability improvement projects. MSD anticipates having a cost-share responsibility of approximately $58.7M but will have limited input regarding the timing of when the work is performed. USACE initially stated design will advance in FY21 with construction to begin in FY23.

ES.1.2.6. PADDY'S RUN PUMP STATION REPLACEMENT

The original station remains in operation. Additional capacity is needed to support operation of the Bells Lane Facility and to direct flow to the MFWQTC. Constructed in 1953 by USACE, the Paddy's Run Pump Station is beyond its useful life and critical infrastructure to replace. In addition to providing regional flood protection along the Ohio River, the station uniquely assists with wet weather treatment. When the Ohio River flood stage exceeds 58 feet on the lower gage, MSD relies on Paddy's Run Station to pump 50 MGD from the Bells Lane Wet Weather Treatment Facility. Without the station in operation, flow would discharge untreated through CSO 015, resulting in combined sewage ponding in upstream residential areas, including streets, basements, and first floors, before ultimately discharging to the Ohio River. This $115M project will protect the public from flooding and will prevent unauthorized discharges of combined sewage. Details regarding this project are provided in Volume 1, Chapter 4, Section 4.7.

ES.1.2.7. CRITICAL INTERCEPTOR REHABILITATION PROJECTS

MSD continues to experience an increased occurrence of critical sewer interceptor failures. Since most of the interceptors were constructed in the same era, the timing and rate for failures is not anticipated to lessen. For example, the Ohio River Interceptor was constructed 1958-1960. In August 2018, hydrogen sulfide corrosion caused a failure at the intersection of 4th and Main Streets. This was a catastrophic failure impacting multiple businesses and residents. Repair of this failure cost nearly $20M. MSD must proactively address similar interceptors having a risk score of 20 or higher. As such, $70M of critical sewer projects have been incorporated into to the 5-Year CIP as noted in Table ES.1.2-3. Details regarding these sewers are provided in Volume 1, Chapter 4, Section 4.7.

Table ES.1.2-3 Summary of Critical Interceptor Program

MSD BUDGET ID	CRITICAL INTERCEPTOR PROJECTS	ESTIMATED FY21-FY25 SPENDING
E17053	Buechel Trunk Sewer Rehabilitation	$3,000,000
A20280	Harrods Creek Force Main Repair	$8,400,000
H16075	Prospect Phase II Area Sewers Rehabilitation	$3,000,000
A19208	Broadway Interceptor Infrastructure Rehabilitation	$10,000,000
H18503	I-64 and Grinstead Infrastructure Rehabilitation	$16,000,000
A20244	Large Diameter Sewer Rehabilitation	$8,300,000
H21019	Rudd Ave Sewer Infrastructure Rehabilitation	$2,300,000
H20147	Western Outfall Infrastructure Rehabilitation	$16,000,000
H16074	Nightingale Sewer Rehabilitation	$3,000,000
	Total	**$70,000,000**

ES.1.2.8. ASSET MANAGEMENT PROGRAM

As MSD implemented the ACD and constructed new assets to mitigate unauthorized discharges, investment was diverted from management of existing assets. The level of underinvestment for Asset Management over the past 10 years has led to accelerated deterioration for multiple critical assets. If these conditions were present when the Consent Decree, ACD, and IOAP were being developed, these projects would likely have been addressed at that time. Under the Second ACD, MSD has agreed to invest an average of $25M per year for 15 years, for a total of $375M. MSD will report annually on the projects completed, in-progress, and forecasted for the next fiscal year under this program. If MSD does not satisfy the $125M spending amount during each 5-year period, the Second ACD stipulates penalties based upon the level of underperformance. Refer to Volume 1, Chapter 4, Section 4.7 for more information related to the Asset Management Program.

ES.1.2.9. CHANGED FINANCIAL CONDITIONS

MSD has experienced changed financial conditions since the ACD was executed, including the following:

- **Debt Profile**: In addition to the changed conditions with critical asset risks, financial risks have also surfaced. MSD's Board's authority to raise rates is limited to 6.9% annually. MSD's overall debt currently exceeds $2 billion as MSD continues to borrow faster than paying off debt each year. Today, MSD's debt profile has reached the point of a potential downgrade from the rating agencies. A downgrade would jeopardize MSD's ability to finance projects and would result with higher financing costs.
- **COVID19 Impact:** The COVID19 pandemic is impacting MSD's operating and capital budgets. The impacts so far have been less than initially feared but MSD continues to experience revenue reductions, delayed supplier deliveries, and volatility in the short-term municipal debt market. Revenue reductions are a direct result of rate payers not being able to pay their utility bills due to job loss and other COVID19 impacts. A few capital projects were extended into FY21 because equipment manufacturers were not able to build and ship equipment due to shortages of materials/labor attributed to the COVID19 pandemic. So far, these impacts are

not being experienced on Consent Decree projects. Finally, the pandemic brought extreme volatility in the short-term municipal debt market due to the social and economic realities. MSD is working closely with the commercial paper dealers to maintain its program. The length of the pandemic could shift investor's concerns to credit quality as municipal revenues and cash flows become impacted. MSD is moving forward with its planned 2020A Revenue Bond to refund outstanding commercial paper and notes. MSD is prepared for additional disclosure and conversation with investors to provide reassurance that MSD does not have prolonged credit concerns.

Due to these changes circumstances, the Cabinet, EPA and MSD have agreed to enter into a Second Amendment to the Consent Decree which shall continue some of the measures set forth in the Amended Consent Decree, reprioritize some specific remedial projects set forth in the 2021 IOAP Modification and add new measures to further the objectives of the Amended Consent Decree and the achievement of the levels of control for CSOs and SSOs as set forth in the approved IOAP Modification.

ES.1.3. ENVIRONMENTAL BENEFIT ANALYSIS

An environmental benefit analysis was prepared to confirm addressing the current infrastructure priorities would provide an equivalent or better environmental benefit than constructing the remaining SSDP projects by 2024.

MSD is required to construct SSDP projects to eliminate SSOs for the 2-year, 5-year, or 10-year storm event. The level of control (LOC) storm event was selected for each modeled SSO location. The LOC selection and modeling referenced in this analysis was performed in accordance with the approved IOAP, as required by the ACD. The 2012 IOAP requires MSD to achieve the following related to modeled SSOs by 2024:

- Construct 57 Final SSDP and 6 Interim SSDP projects of varying scopes to eliminate SSOs
- For 2-year storm, eliminate 100% modeled SSO volume and 100% modeled overflow locations
- For 5-year storm, eliminate 13% modeled SSO volume and 35% modeled overflow locations
- For 10-year storm, eliminate 10% modeled SSO volume and 18% modeled overflow locations

Through 2020 MSD has already over performed the expected environmental benefit for the bigger storms per the IOAP requirements by achieving the following:

- Constructed 41 of the Final SSDP and all six of the Interim SSDP projects (74% of the number of required projects).
- For 2-year storm, eliminated 82% modeled SSO volume and 67% modeled overflow locations.
- For 5-year storm, eliminated 72% modeled SSO volume and 45% modeled overflow locations.
- For 10-year storm, eliminated 54% modeled SSO volume and 37% modeled overflow locations.
- For the Ohio River, reduced median fecal coliform concentrations by 76% since 2007 based on data from ORSANCO collected 2001-2015.
- For Middle Fork and South Fork Beargrass Creek, reduced wet weather mean E-Coli concentrations an average of 70% since 2010 based on grab sample data collected in October 2010, September 2013, July 2014, and June 2017.

ES.1.3.1. ENVIRONMENTAL IMPACT OF 2-YEAR STORM

Table ES.1.3-1 summarizes the modeled performance for the 2-year storm events. As of August 2020, for the 2-year storm, MSD has reduced modeled SSO volumes from 20.8 MG in 2007 to 3.7 MG (82% reduction). Per the requested time extension, MSD will eliminate 98% of the modeled SSO volume by 2030 and achieve 100% SSO volume elimination for the 2-year storm event in 2035. The progressive performance for eliminating modeled SSO volume is shown in Figure ES.1.3-1.

Table ES.1.3-1 Two-Year Storm Event LOC and Modeled Performance

YEAR	MODELED VOLUME (MG)	% VOLUME ELIMINATED	MODELED SSO LOCATIONS	% LOCATIONS ELIMINATED
2007	20.8	0%	197	0%
2020	3.7	82%	65	67%
2030	0.4	98%	18	91%
2035	0,0	100%	0	100%
Required LOC	**0**	**100%**	**0**	**100%**

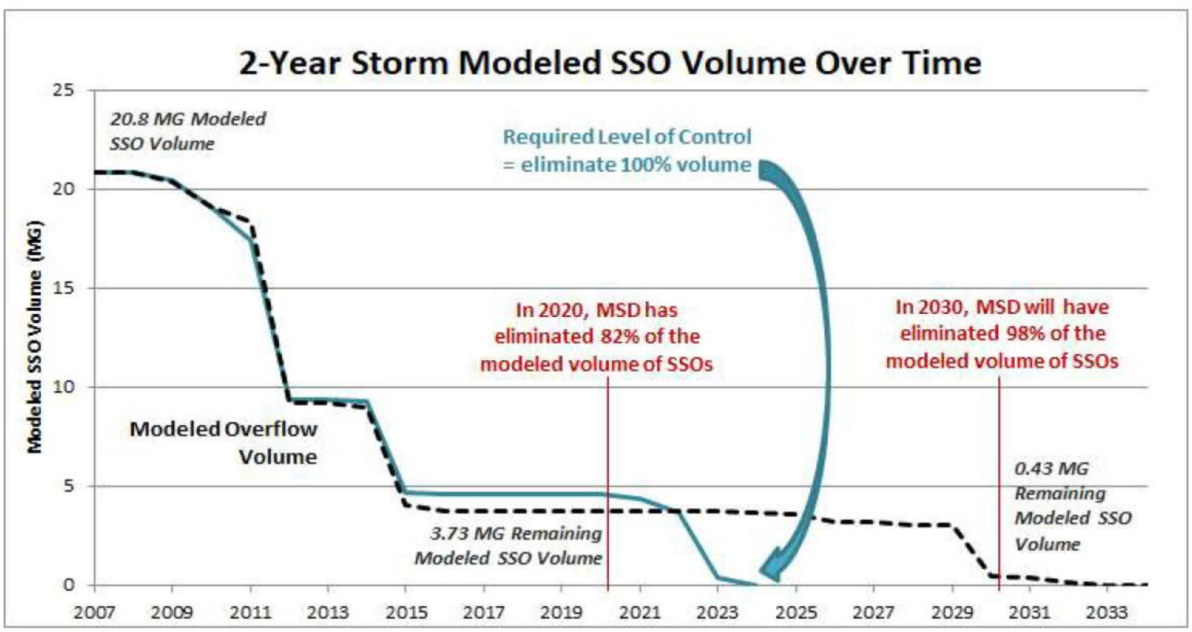

Figure ES.1.3-1 Two-Year Storm Event Modeled SSO Volumes

MSD is able to eliminate 98% of modeled SSO volume by 2030 by constructing the largest remaining SSDP project - the Upper Middle Fork (UMF) Phase 2 Project *(IOAP Project ID: IS_MISF_MF_NB01_M_01_C_A)*. This project involves replacing the existing 9 MGD UMF Pump Station with a 30 MGD Pump Station; constructing 10,200 feet of 30-inch force main and 14,000 feet of 24-inch to 36-inch relief interceptor parallel to the existing UMF Interceptor; and constructing a flow diversion structure on the existing UMF Interceptor and UMF Relief Interceptor with modulating control gates to integrate with MSD's real time control system. This project will eliminate 2.6 MG, 7.8 MG, and 13.6 MG of modeled SSO volume for the 2-year, 5-year and 10-year storm events, respectively.

With the time extension requested, the UMF Phase 2 Project will begin design in 2025 and be substantially complete in 2030. When the UMF Phase 2 Project is completed, modeled SSO volumes for the 2-year storm will be reduced by 98% and the number of modeled overflow locations by 91%. The progressive performance related to eliminating the number of SSO locations over time is shown graphically in Figure ES.1.3-2.

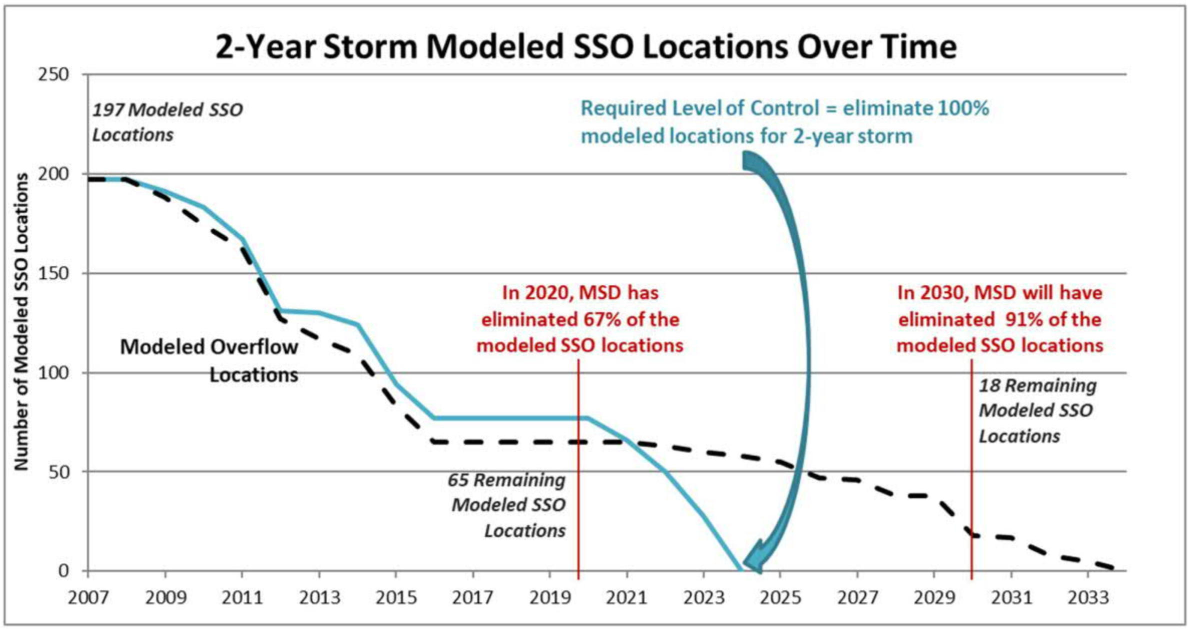

Figure ES.1.3-2 Two-Year Storm Modeled SSO Locations

The potential environmental impact of delaying completion of the UMF Phase 2 Project from 2024 to 2030, is an estimated 2.6 MG of SSO volume could occur during the 2-year storm, and approximately the same amount would overflow during the Typical Year. The Typical Year model simulation generally includes one storm event slightly larger than the 2-year storm. Therefore, for the time period of 2025 through 2030, an estimated SSO volume of 13 MG could theoretically occur assuming a 2-year storm event occurs every year.

ES.1.3.2. ENVIRONMENTAL IMPACT FOR 5-YEAR AND 10-YEAR STORMS

Many of the projects already constructed by MSD have achieved a higher level of control than required by the IOAP for the larger storm events. Through August 2020, MSD has eliminated 72% of the modeled SSO volume and 45% of the modeled SSO locations for the 5-year storm event as noted in Table ES.1.3-2. This exceeds the required minimum LOC for the 5-year storm event (14% of modeled SSO volume and 35% of modeled SSO locations). Similarly, through August 2020, MSD has eliminated 54% of the modeled SSO volume and 37% of the modeled SSO locations for the 10-year storm event; exceeding the minimum LOC of 10% of modeled SSO volume and 18% of modeled SSO locations (refer to Table ES.1.3-3).

Table ES.1.3-2 Five-Year Storm Event LOC and Modeled Performance

YEAR	MODELED VOLUME (MG)	% VOLUME ELIMINATED	MODELED SSO LOCATIONS	% LOCATIONS ELIMINATED
2007	47.7	0%	211	0%
2020	13.4	72%	117	45%
2030	6.1	87%	91	57%
2035	4.7	90%	75	64%
Required LOC	**41.5**	**14%**	**137**	**35%**

Table ES.1.3-3 Ten-Year Storm Event LOC and Modeled Performance

YEAR	MODELED VOLUME (MG)	% VOLUME ELIMINATED	MODELED SSO LOCATIONS	% LOCATIONS ELIMINATED
2007	75.4	0%	218	0%
2020	34.5	54%	137	37%
2030	23.5	69%	118	46%
2035	21.0	72%	108	50%
Required LOC	**68.2**	**10%**	**178**	**18%**

As MSD continues to construct the remaining SSDP projects, the LOC achieved during the larger storm events will continue to increase. Upon completion of Final SSDP projects, MSD will have eliminated approximately 90% of the modeled 5-year SSO volume and 72% of the modeled 10-Year SSO volume. MSD will achieve six times the required minimum IOAP LOC for the larger storm events. This is a drastically improved environmental benefit in that the projects are capturing more flow during large storms.

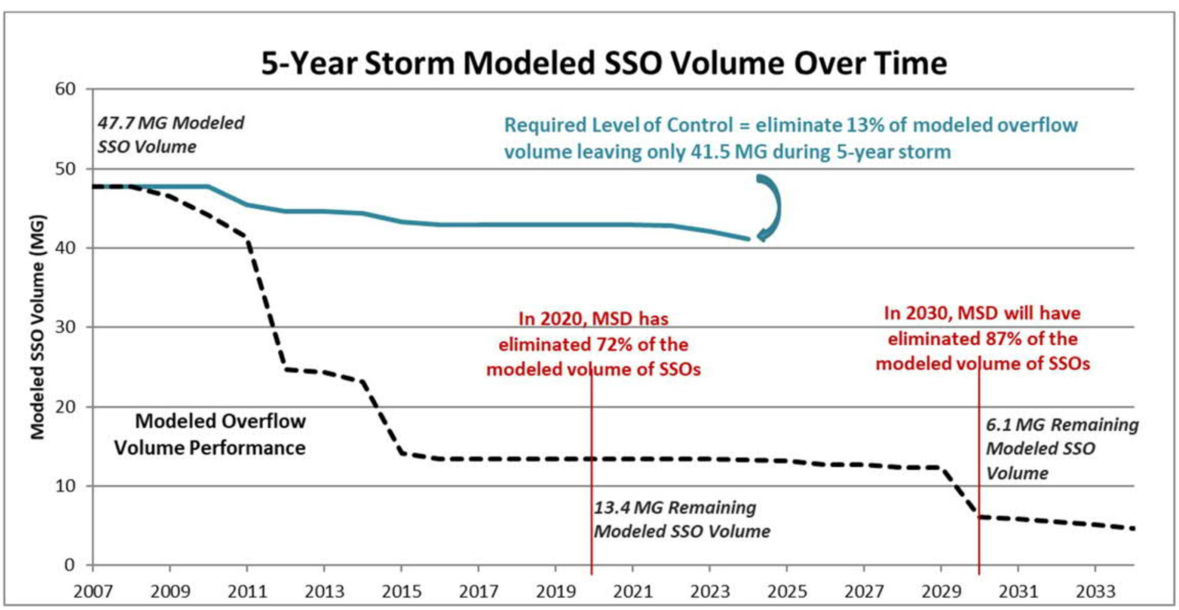

Figure ES.1.3-3 Five-Year Storm Event Modeled SSO Volumes

The progressive performance related to the 5-year storm modeled SSO volume reduction is presented in Figure ES.1.3-3. The similar figure for the 10-year storm event is provided in Figure ES.1.3-4.

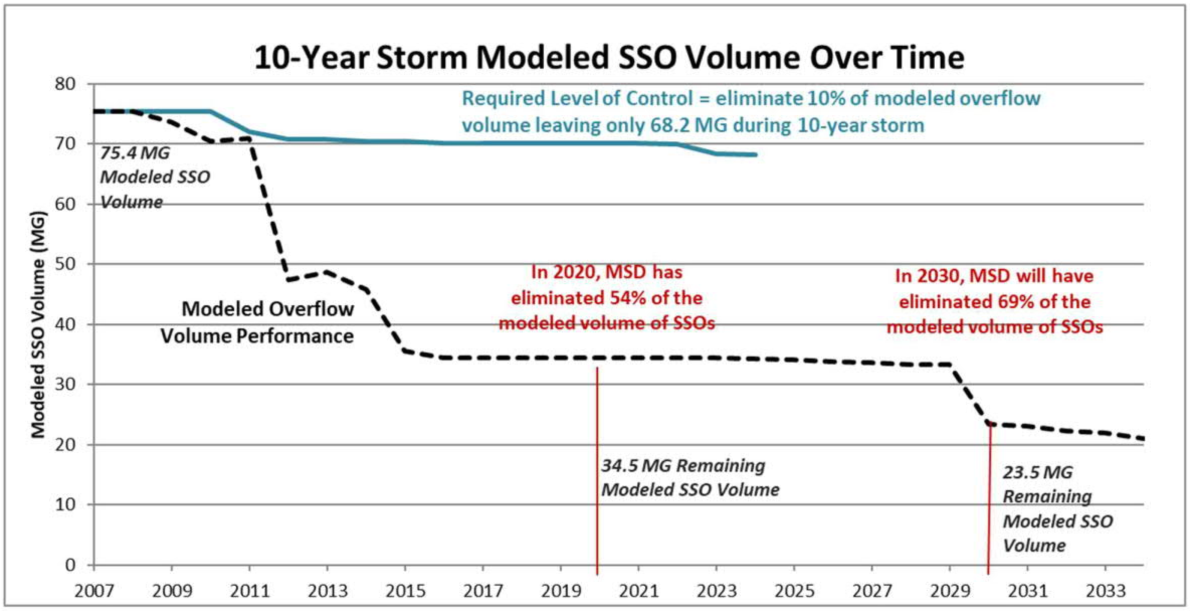

Figure ES.1.3-4 Ten-Year Storm Event Modeled SSO Volumes

Graphs showing the progressive elimination of modeled SSO locations over time for the 5-year, and 10-year storm events are provided in Figure ES.1.3-5 and Figure ES.1.3-6, respectively.

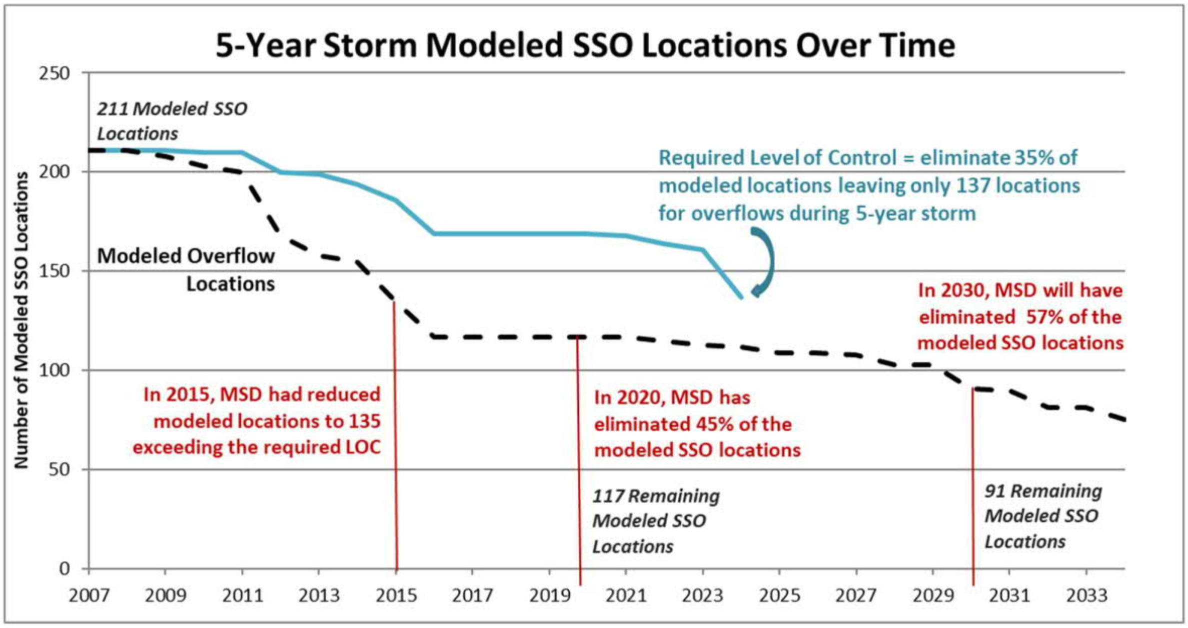

Figure ES.1.3-5 Five-Year Storm Modeled SSO Locations

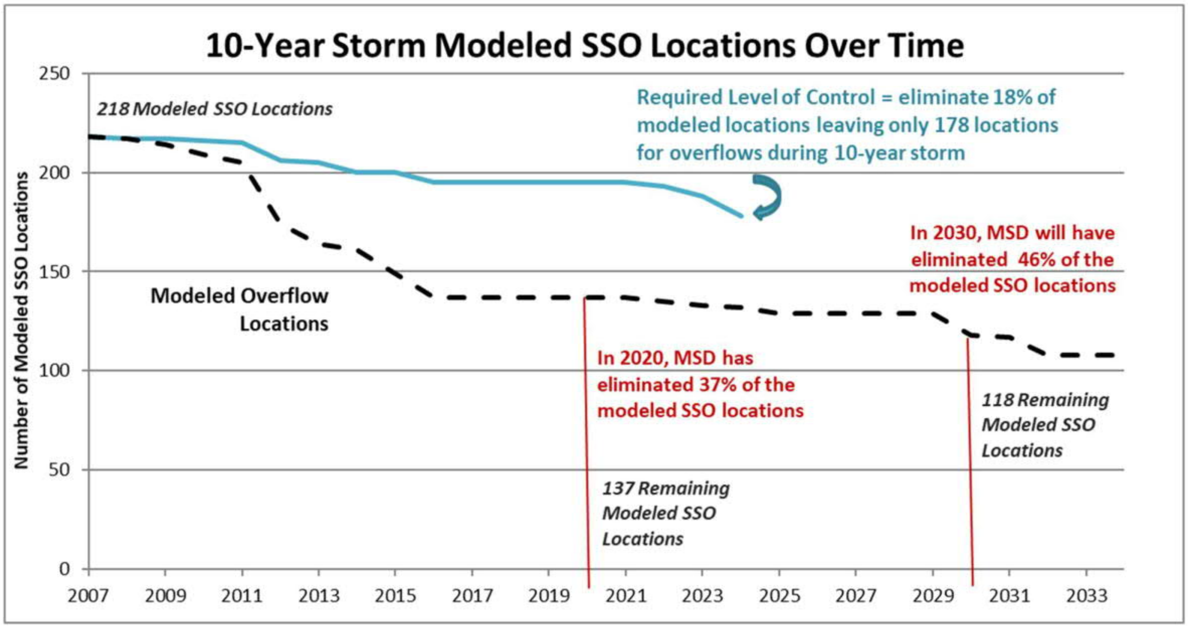

Figure ES.1.3-6 Ten-Year Storm Modeled SSO Locations

ES.1.3.3. ENVIRONMENTAL IMPACT OF MORRIS FORMAN WQTC

The Morris Forman WQTC is the largest wastewater treatment plant in the State and discharges an average of 100 MG per day of effluent. The plant treats combined sewage and discharges approximately 37 billion gallons of treated effluent annually. The wet weather capacity of the Morris Forman WQTC is 330 MGD when all treatment units are fully operational. The current condition and treatment capacity of the four Sedimentation Basins limits peak wet weather flow capacity to 240 MGD. MSD is currently designing improvements to the Sedimentation Basins that should restore peak treatment capacity to 330 MGD in 2026. Flows in excess of 240 MGD are discharged through CSOs. MSD completed model runs to assess the potential environmental impact of Morris Forman's reduced wet weather capacity.

MSD evaluated the modeled result for AAOV (annual average overflow volume) impacts to compare the environmental benefit of the UMF Phase 2 Project with the Morris Forman WQTC Sedimentation Basin Project.

- According to the model, the Upper Middle Fork Phase 2 Project mitigates approximately 45 MG of modeled CSO volume, in addition to the 2.6 MG of modeled SSO volume for the 2-year storm event.
- Having the capacity of the Morris Forman WQTC limited to 240 MGD, results in an increase of approximately 275 MG of additional AAOV.
- The additional 275 MG is primarily discharged through CSO015, CSO016, CSO191, CSO210, and CSO211.
- Therefore, the environmental impact with respect to total overflow volume of Morris Forman operating at capacity is approximately 6 times that of the UMF Phase 2 Project.

The Morris Forman WQTC Sedimentation Basin Rehabilitation Project is proposed to be added to the IOAP. Larger storm events require more capacity to treat greater flow volumes. Therefore, the environmental benefit of improving the Morris Forman WQTC outweighs the collection system benefit achieved by the UMF Phase 2 Project.

ES.1.3.4. ENVIRONMENTAL IMPACT OF PADDY'S RUN PUMP STATION

The environmental impact associated with reliable operation of the Paddy's Run Pump Station relates to 1) CSO mitigation and 2) community flood protection. The Bells Lane Wet Weather Treatment Facility has a capacity of 50 MGD. Without Bells Lane operating, CSO015 would discharge an additional 50 MGD every event for the duration of the event. However, when the Ohio River elevation is high, the Bells Lane Facility cannot operate unless the Paddy's Run Pump Station is operating. Failure of the Paddy's Run Pump Station would not allow CSOs to occur for events larger than the LOC event, resulting in combined sewage ponding in upstream residential areas, including streets, basements, and first floors.

In addition to CSO mitigation, there would be huge environmental implications if the Paddy's Run Pump Station were not fully operational during a high river or flood event. The 925 MGD Pump Station protects 214,500 people, 70,000 homes, 6,000 businesses, and 40 neighborhoods. The extent of land that would be impacted by the Paddy's' Run Station not operating as intended is shown in the inundation map provided in Figure ES.1.3-7. The map shows the results of modeling a breach in the system just north of Paddy's Run in 1937 flood conditions as determined by the USACE[1]

According to the US Department of Homeland Security[2], flooding in this area would impact the environment due to the industrial activity and the major petro-chemical industries within the Rubbertown area of Louisville. Critical chemical products such as calcium carbide (source of acetylene gas – Carbide Industries is the only manufacturer of carbide in North America), the sole source in the United States for binding materials used in solid rocket fuels (American Synthetic Rubber Company) and chlorinated polyvinyl chloride (CPVC) critical for manufacturing and construction industries in the United States. The facility managers noted a 1937-like flood at Rubbertown would result in significant loss of packaged inventory, catastrophic equipment loss, and unrecovered fixed costs for companies such as Dow Chemical, Hexion, American Synthetic Rubber Company, Arkema, Chemours, DuPont, Eckart, Carbide Industries, Zeon, Lubrizol and PolyOne.

The list of chemicals used by various industries within Rubbertown includes: Butadiene, Anhydrous Ammonia, Nitrogen, Calcium Carbide, Vinyl Fluoride, Anhydrous Hydrogen Fluoride, Difluoroethane, Hydrogen Fluoride, Hydrofluoric Acid, Chlorine, Chloroform, Aluminum Powder and Paste, Zinc Paste, Vinyl Acetate Monomer, Vinylidene Chloride, Vinyl Chloride, Phenol, Formaldehyde. If flood waters were to come in contact with these chemicals, the health and safety of the public would be affected in addition to the environment and quality of local waterways.

"[1]Preliminary Risk Characterization at Paddy's Run and Western Parkway Flood Pump Stations". TetraTech, June 30, 2017.
[2] "Resiliency Assessment, Louisville Metro Catastrophic Urban Flood Planning". The Regional Resiliency Assessment Program (RRAP). Department of Homeland Security, US Army Corps of Engineers (Louisville Metro Silver Jackets). 2019.

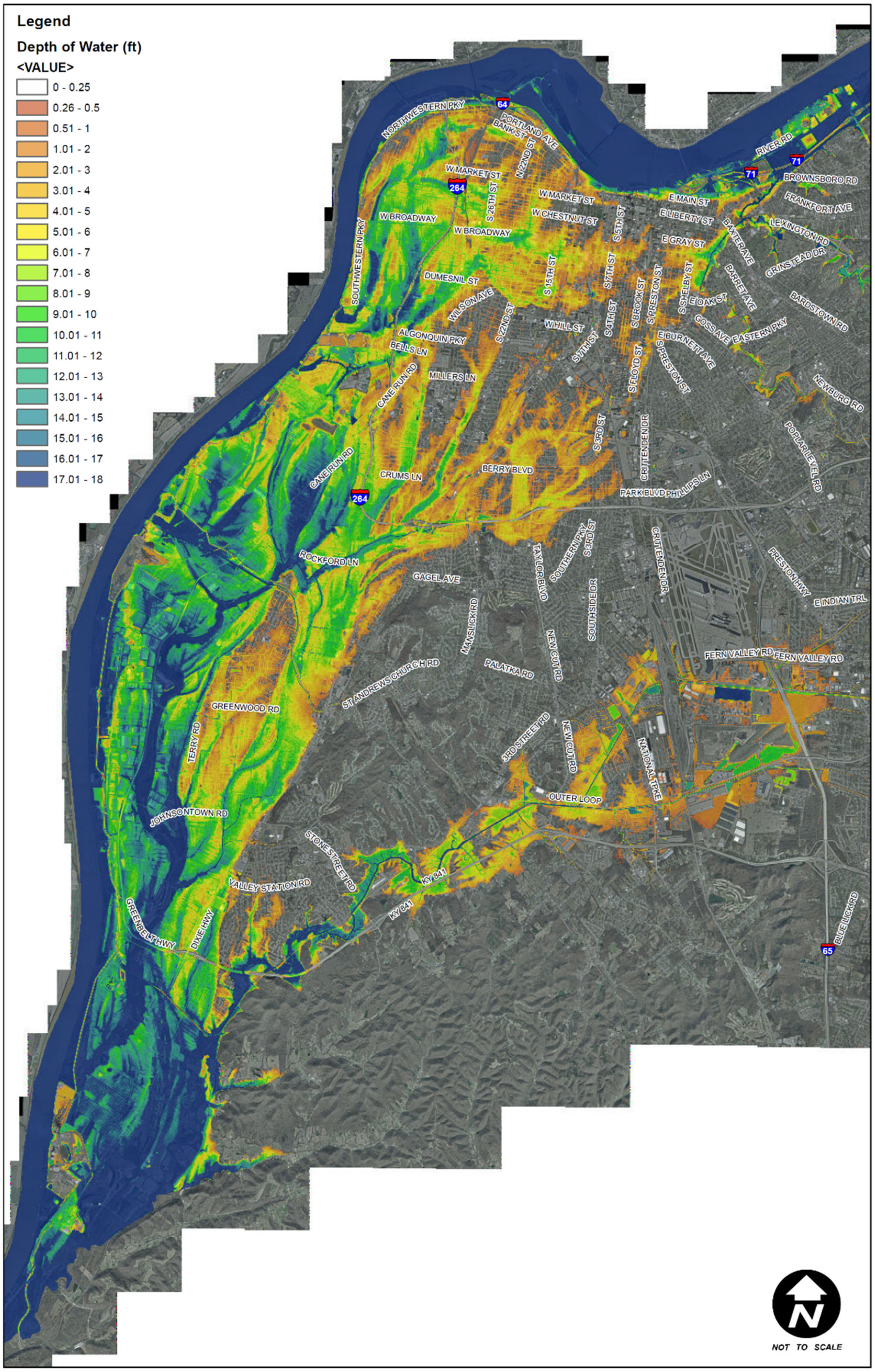

Figure ES.1.3-7 Inundation Map for 1937-Like Flood Condition Without Paddy's Run Pump Station

ES.1.3.5. ENVIRONMENTAL ANALYSIS CONCLUSION

Comparing the potential modeled volumes, suggests a greater environmental benefit is associated with the Morris Forman WQTC and Paddy's Run Pump Station projects as compared to the UMF Phase 2 Project for the following reasons:

Modeled Conditions:

- As of August 2020, MSD has eliminated 82% modeled SSO volume with only 3.73 MG remaining during the 2-year storm event.
- The SSOs are not continuous and their occurrence is solely driven by weather.
- The larger CSO modeled volume (275 MG) poses significantly more environmental impact than the smaller SSO modeled volume associated with the remaining SSDP projects (3.73 MG)

SSDP – UMF Phase 2 Project:

- The project will eliminate approximately 45 MG of modeled CSO volume (Typical Year) and 2.6 MG of modeled SSO volume (2-year storm) by 2030, just six years into the requested 10-year SSDP extension.
- Any SSOs associated with the UMF Phase 2 Project would be directed to Beargrass Creek (which discharges to the Ohio River upstream of the Morris Forman WQTC), which already has demonstrated an improved water quality compared to pre-IOAP conditions.

Morris Forman WQTC Project:

- The Morris Forman WQTC discharges approximately 100 MGD of effluent, equivalent to nearly 37 BG per year.
- The Morris Forman WQTC effluent will not comply with permit conditions for TSS and BOD until the new Biosolids Facility is constructed and on-line.
- The WQTC's limited capacity (240 MGD vs. 330 MGD) results in an additional 275 MG of modeled CSO volume during the Typical Year.

Paddy's Run Pump Station Project:

- The Bells Lane Wet Weather Treatment Facility cannot operate if the Ohio River it at high elevation and the Paddy's Run Pump Station is not operating as intended. This situation will result in an additional 50 MGD of overflow ultimately discharged to CSO015. Furthermore, the CSO discharge would be temporarily stored in streets, basements and potentially houses upstream until river floodwaters recede.
- The Pump Station protects 214,500 people, 70,000 homes, 6,000 businesses, and 40 neighborhoods from potential exposure to floodwaters containing industrial chemicals and combined sewage.

ES.1.4. INTEGRATED OVERFLOW ABATEMENT PLAN REPORT ORGANIZATION

As described previously, the IOAP is a three-volume document. Each volume details distinct aspects of the comprehensive program.

ES.1.4.1. VOLUME 1 – INTEGRATED OVERFLOW ABATEMENT PLAN

The first volume describes overarching, programmatic aspects that are common to all parts of the IOAP as well as the requirements, processes, and factors influencing the development of the Final LTCP (Volume 2) and Final SSDP (Volume 3).

- **Chapter 1 – Introduction**: The Introduction provides a general description of wet weather overflows; the history of the Consent Decree Amendments and IOAP Modifications; and the requirements of the Consent Decree. MSD's use of the Presumption Approach is highlighted in this Chapter.
- **Chapter 2 - IOAP Approach**: This chapter describes MSD's organizational vision and the watershed approach as it relates to the IOAP. Chapter 2 also describes the Waterway Improvements Now (Project WIN) program and elaborates on its strategic character. The IOAP's supporting methods, programs, and initiatives, including the role of community values in the values-based risk management process are detailed. This process provides input to the benefit/cost analysis that is the basis for the structured decision-making process used to evaluate and select which projects are priorities and will be implemented to achieve the IOAP goals.
- **Chapter 3 - Public Participation and Agency Interaction**: The Consent Decree requires that MSD assemble a Wet Weather Team (WWT) to, among other things, "develop a program for public information, education, and involvement." These three components are collectively referred to as public participation. Chapter 3 describes the role of the public participation program with engaging Louisville Metro's citizens to assist in developing, evaluating, and selecting the projects that comprise the IOAP. Chapter 3 also describes the ongoing public notification, education, and outreach program enhancements to maximize customer reach.
- **Chapter 4 - Integrated Overflow Abatement Program**: This chapter describes the overall action plan for addressing all the Consent Decree requirements. Included in these requirements is the Early Action Plan (EAP) implementation. The EAP includes an update of the compliance report for the Nine Minimum Controls (NMC) program, Sewer Overflow Response Protocol (SORP) revisions and implementation, completion of specified capital projects, and development and implementation of a CMOM program. In addition, the chapter includes an overview discussion of the development and implementation of the Interim LTCP, the Updated Sanitary Sewer Overflow Plan (SSOP), and the Interim SSDP. Many of these activities occurred in parallel to preparation of the IOAP, and in many cases, the implementation precedes completion of the IOAP; however, these activities are considered an integral part of the overall plan to achieve the required control of overflow and unauthorized discharges from the combined and sanitary sewer systems. Finally, Chapter 4 provides details related to the specific remedial projects and asset management program added to the IOAP via the Second ACD.
- **Chapter 5 - Regulatory Compliance**: This chapter describes the framework of regulatory requirements that the IOAP must satisfy in accordance with the Presumption Approach. This chapter also draws a roadmap showing how the IOAP achieves compliance with these regulations and creates an approvable LTCP and SSDP.

- **Chapter 6 - IOAP Implementation**: This chapter was replaced for the 2021 IOAP Modification. This chapter presents an implementation plan that outlines operational, financial, and post-construction compliance methodologies necessary to advance and sustain the recommendations of the IOAP. This chapter also addresses the impact of the IOAP capital and operating costs on MSD's rates.

ES.1.4.2. VOLUME 2 FINAL LTCP

The second volume of the IOAP focuses on the control and mitigation of the CSOs.

- **Chapter 1 – Introduction**: This chapter includes a history of EPA's Control Policy for CSOs and a summary of the policy's key elements. This chapter also provides general descriptions of the current CSO control efforts, control processes, and criteria for success.
- **Chapter 2 - System Characterization**: This chapter provides extensive analysis of CSO areas. Analysis includes existing baseline conditions of the CSO area, monitoring of CSO flows, CSO quality sampling, and combined modeling of the sewer system and receiving waters.
- **Chapter 3 - Development and Evaluation of Alternatives for CSO Control**: This chapter discusses the approach and factors used to identify, develop, evaluate, and select projects that make up the recommended projects and programs in the Final LTCP.
- **Chapter 4 - Selection of the Final CSO Long-Term Control Plan**: This chapter generally describes the procedures used to select the level of control, prioritize projects, and develop the Final LTCP. An overview describing LTCP progress to-date and modifications made is provided at the beginning of this chapter.
- **Note: In the 2012 IOAP, a Chapter 5** was included that provided a summary of project modifications to the IOAP between 2009 and 2012. The 2012 project modifications, in addition to schedule modifications as part of this submittal, have been incorporated into Chapters 3 and 4 of the 2021 Final LTCP. Therefore, Chapter 5 has been removed from the 2021 Final LTCP.

ES.1.4.3. VOLUME 3 FINAL SSDP

The third volume of the IOAP focuses upon control and mitigation of SSOs.

- **Chapter 1 – Introduction**: This chapter presents summaries of previous projects and programs and describes their relationship to the IOAP planning process. Previous projects and programs include the Updated SSOP, the CMOM program, the SORP, and the Interim SSDP. The final section of this chapter describes in general terms the approach used to evaluate the projects and programs of the 2021 Final SSDP.
- **Chapter 2 – System Characterization**: This chapter defines the goals of the system characterization program and provides an extensive compilation and analysis of unauthorized discharges in the SSS. This chapter includes service area maps of the unauthorized discharge areas, associated WQTCs, collection system modeling, and system monitoring. This chapter also includes a description of the computer models used to simulate the SSS areas.
- **Chapter 3 – Development and Evaluation of Alternatives for SSO Elimination**: This chapter presents the methodologies used to evaluate the various discharge elimination

solutions. It also defines and discusses strategies and technologies available to control and eliminate unauthorized discharges in the SSS. Based on these strategies and technologies, alternatives were developed for elimination of the unauthorized discharge. Finally, this chapter provides a summary of each discharge abatement alternative and the general basis for changes made to the initially selected measure(s) for projects through 2020. The evaluation criterion included feasibility screening, computer modeling, quality control, level of protection, cost estimates, and a benefit/cost analysis.

- **Chapter 4 – Selection of the Final Sanitary Sewer Discharge Plan**: This chapter includes an explanation of the values-based risk management process used to select and prioritize the Final SSDP alternatives. The final section examines the various issues associated with implementation of the alternative(s) selected as integral to the Final SSDP. Issues discussed include community values, benefit/cost analysis, environmental impact, technical concerns, prioritization of projects, and implementation schedules compatible with the Consent Decree requirements. This chapter presents a summary of the Final SSDP projects including changes made since 2009, project completion dates, technologies, and the level of protection.
- **Note: In the 2012 IOAP, a Chapter 5** was included that provided a summary of project modifications to the IOAP. The 2012 project modifications, in addition to schedule modifications as part of this submittal, have been incorporated into Chapters 3 and 4 of Volume 3. Therefore, Chapter 5 has been removed from the Final SSDP.

ES.1.5. 2021 IOAP MODIFICATIONS

A crosswalk summarizing the changes to all three IOAP volumes is provided Table ES.1.5-1.

- **Projects:** The status of the names LTCP and SSDP projects was updated including minor modification approval dates, project certification dates, and new requirements under the Second ACD.
- **New Information:** Information regarding the status of MSD's wastewater system has been updated throughout all the volumes to reflect current conditions as of December 31, 2020, where appropriate. Some information from the 2009 and 2012 documents remains to provide historical context related to the overall IOAP.
- **Presumption Approach:** Information was revised to clarify MSD is using the Presumption Approach for determining Consent Decree compliance.
- **Consolidated Information:** Information related to the Consent Decree history, public outreach/participation programs, and the Plumbing Modification Program was deleted from Volumes 2 and 3 and consolidated into Volume 1.

Table ES.1.5-1 2021 IOAP Modification Crosswalk

CRITERIA	DESCRIPTION	VOLUME 1 CHAPTERS OR SECTIONS	VOLUME 2 CHAPTERS OR SECTIONS	VOLUME 3 CHAPTERS OR SECTIONS	2012 IOAP SUBMITTAL	2021 IOAP MODIFICATION
Projects	Work Progress	Table 1.1-1 modifications	1.3.1.4 LTCP activities 4.1, LTCP revised dates Table 4.1-6 storage	1.1.1SSOP, ISSDP 2.2.1 WQTC Elims Table 4.0-1 projects	Work through 2012 was noted	Added summary of work performed 2009 - present
	Minor Project Modifications	Table ES1.1-3 Final LTCP Table ES1.1-6 Final SSDP 6.1 IOAP Schedule	Table 4.0-1 Appendix 4.0-1 Appendix 4.0-2	Table 4.0-1 Appendix 4.0-1 Appendix 4.0-2	Information was accurate through 2012.	Revised LTCP and SSDP tables to include all project modifications and provide copies of letter modifications and certifications.
	New Requirements	4.7 Second ACD requirements	Table ES1.1-3	Table ES1.1-6	N/A	New early action projects for Morris Forman WQTC and Paddy's Run Pump Station, Critical Interceptors, and Asset Management Program. LTCP & SSDP time extensions.
New Information Since 2012 IOAP Submittal	Clarified which information is from 2009, 2012, 2021	Multiple places throughout Chapters 1, 2, 3, 4, 5 and 6	Multiple places throughout Chapters 1, 2, 3, and 4. Information from the 2012 Chapter 5 was incorporated into Chapters 3 and 4.	Multiple places throughout Chapters 1, 2, 3, and 4. Information from the 2012 Chapter 5 was incorporated into Chapters 3 and 4.	Process and data remain valid and accurate. Chapter 5 was added for Volumes 2 and 3 in 2012.	New note added at the front of each chapter. Chapter 5 from Volumes 2 and 3 was deleted in 2021.
	Document Naming Nomenclature	1.1.6 Second ACD 1.4 CD requirements	1.1.2 Final LTCP	1.1.1 Final SSDP	N/A	The terms IOAP, Final LTCP, and Final SSDP refer to the 2021 versions. The amendments are referred to as the First ACD and Second ACD.

Table ES.1.5-1 2021 IOAP Modification Crosswalk

CRITERIA	DESCRIPTION	VOLUME 1 CHAPTERS OR SECTIONS	VOLUME 2 CHAPTERS OR SECTIONS	VOLUME 3 CHAPTERS OR SECTIONS	2012 IOAP SUBMITTAL	2021 IOAP MODIFICATION
	Progress since the 2012 IOAP Submittal	1.2 system information 1.1.5 minor modifications 2.2 water quality 3.5 current/future program 3.6.1 ACD reporting 3.6.2 regulatory meetings 4.1.4.2 fixed generators 4.1.4.3 revised SCAP 4.1.4.4 revised SORP 4.4. WQTC eliminations 4.5.1 source control 5.4 approvable Final LTCP 5.5 approvable Final SSDP 6.2 financial plan 6.3.1.1 rain gauge map	1.3.1.4 LTCP activities 1.3.4.2 ORSANCO 2.4.3.1 rain gauges 2.4.4 model 2.4.4.4 flow monitors 2.4.4.5 water quality 2.4.6.4 model 2.4.6.5 model 2.9.1 water quality 3.2.3.1 RTC Phase 1 3.2.5.9 dry well projects 3.2.5.10 green projects 4.1.2.1 green projects	1.3.2 CMOM Report 1.3.3 Hansen system 1.3.3 SORP 1.3.4 ISSDP 2.1.8 small WQTCs 2.2.3.1 flow monitoring 2.2.3.2. rain gauges 2.3.1. modeling 2.3.5.11 model 2.4.3 model regions 3.3 all tables 3.3.1.1 screening 3.3 benefit-cost analyses	Relevant information in 2012 Tables were labeled as outdated and referred to Volume 2, Chapter 5. In Volume 3, the tables in section 3.3 were updated or removed and the red screening box was removed that stated "SSDP information outdated refer to Chapter 5".	New information added to reflect work or pertinent information since the 2012 IOAP submittal
	Verb Tense	Multiple places throughout Chapters 1, 2, 3, 4, 5 and 6	Multiple places throughout Chapters 1, 2, 3, and 4	Multiple places throughout Chapters 1, 2, 3, and 4	No change to content	Verb changed to past tense for work that been performed
Presumption Approach	Clarification	3.7 effectiveness 5.1.1 key findings 5.2.1approaches 5.2.2, 5.2.3 water quality 6.3 compliance monitoring	2.9 receiving waters Chapter 3 Introduction 3.1.1 approach 4.4 measures of success	N/A	Both Presumption and Demonstration Approaches discussed	Added language clarifying the 2021 Final LTCP exceeds the requirements of the Presumption Approach. Deleted language not Presumption Approach.
Consolidated Information	Consent Decree Background	1.1 background	1.1 background	1.1.1 background	Background information was dispersed among three IOAP Volumes	Consolidated information from all volumes into Volume 1, Chapter 1
	Plumbing Modification Program	4.5.1 basement backups 4.5.2 private sources	1.3.1.2 LTCP Activities	1.3.1.4 PMP Program	Reduced text added reference to Volume 1	Consolidated information from all volumes into Volume 1, Chapter 4, section 4.5.1

Table ES.1.5-1 2021 IOAP Modification Crosswalk

CRITERIA	DESCRIPTION	VOLUME 1 CHAPTERS OR SECTIONS	VOLUME 2 CHAPTERS OR SECTIONS	VOLUME 3 CHAPTERS OR SECTIONS	2012 IOAP SUBMITTAL	2021 IOAP MODIFICATION
	Public Information	3.5 public program 3.7 customer survey 5.6 regulatory meetings	1.3.2 public participation 1.3.4 NMC-8 3.1.1.3 public participation 4.2 public participation	1.3.3.3 public notification, 4.3 public participation	Reduced text added reference to Volume 1	Consolidated information from volumes into Volume 1, Chapter 3, and expanded text for program through 2035.

A summary of the new projects incorporated into the Second ACD not part of the Final LTCP or Final SSDP are listed in Table ES.1.5-2.

Table ES.1.5-2 Summary of New Work Added to the Second ACD

PROJECT NAME AND IOAP ID	PROJECT DESCRIPTION	2021 TECHNOLOGY	2021 ESTIMATED COST	2021 SCHEDULE COMPLETION DATE
Morris Forman WQTC New Biosolids Facility *L_OR_MF_A*	Construct new thermal hydrolysis treatment process to be used in tandem with a combination of repurposed and new systems components.	Thermal Hydrolysis Process (THP)	$197,800,000	12/31/2030
Paddy's Run Pump Station Capacity Improvements *L_OR_MF_B*	Construction of a new 5,250, sq foot Pump Station rated at 1,900 MGD to replace the existing outdated facility.	New Pump Station	$115,000,000	12/31/2026
Buechel Trunk Sewer Rehabilitation *C_SF_MF_B*	Rehabilitation of approximately 20,500 feet of 12-inch to 30-inch sewers.	Sewer Lining & Point Repair	$3,000,000	12/31/2026
Harrods Creek Force Main Repair *C_HC_HC_A*	Repair of 3,200 feet of 18-inch to 30-inch force main.	Sewer Lining & Point Repair	$8,400,000	12/31/2026
Prospect Phase II Area Sewers Rehabilitation *C_HC_HC_B*	Rehabilitation of approximately 2,000 feet of 6-inch to 15-inch sewers.	Sewer Lining & Point Repair	$3,000,000	12/31/2026
Broadway Interceptor Infrastructure Rehabilitation *C_OR_MF_A*	Rehabilitation of approximately 5,4000 feet of 84-inch to 96-inch sewers.	Sewer Lining & Point Repair	$10,000,000	12/31/2026
I-64 and Grinstead Infrastructure Rehabilitation C_MI_MF_A	Rehabilitation of approximately 13,700 feet of 8-inch to 123-inch sewers.	Sewer Lining & Point Repair	$16,000,000	12/31/2026
Large Diameter Sewer Rehabilitation *C_OR_MF_B*	Program including the inspection, pre-design services, design work to the 60% design level and construction phase professional services.	Sewer Lining & Point Repair	$8,300,000	12/31/2026
Rudd Ave Sewer Infrastructure Rehabilitation *C_OR_MF_C*	Rehabilitation of approximately 4,020 feet of 120-inch to 138-inch sewers,	Sewer Lining & Point Repair	$2,300,000	12/31/2026
Western Outfall Infrastructure Rehabilitation *C_OR_MF_D*	Rehabilitation of approximately 18,350 feet of 108-inch to 141-inch sewers.	Sewer Lining & Point Repair	$16,000,000	12/31/2026
Nightingale Sewer Rehabilitation *C_SF_MF_A*	Rehabilitation of approximately 49,500 feet of 6-inch to 18-inch sewers.	Sewer Lining & Point Repair	$3,000,000	12/31/2026
Strategic Asset Management Plan (SAMP) *C_DW_DW_A*	Submittal of a draft plan outlining how MSD will prioritize and perform asset management.	Report	N/A	06/30/2021
Asset Management Program FY21 – FY25 *C_DW_DW_B*		Various	$125,000,000	12/31/2025

PROJECT NAME AND IOAP ID	PROJECT DESCRIPTION	2021 TECHNOLOGY	2021 ESTIMATED COST	2021 SCHEDULE COMPLETION DATE
Asset Management Program FY26 – FY30 *C_DW_DW_C*	Improvements to existing WQTC, Pump Station, Flood Pump Station, sewers, and related assets serving the wastewater system.	Various	$125,000,000	12/31/2030
Asset Management Program FY31 – FY35 *C_DW_DW_D*		Various	$125,000,000	12/31/2035

Notes regarding IOAP Naming Nomenclature *First Letter_Second Grouping_Third Grouping_ Fourth Grouping*

- First letter represents the Program: L = LTCP; S = SSDP; C = combined LTCP & SSDP
- Second grouping of letters represents the major basin the project is located in: CC = Cedar Creek; DW = District-Wide; FF = Floyds Fork; GC = Goose Creek; HC = Harrods Creek; MC = Mill Creek; MI = Middle Fork Beargrass Creek; MU = Muddy Fork Beargrass Creek; OR = Ohio River; PE = Pennsylvania Run; PO = Pond Creek; SF = South Fork Beargrass Creek
- Third grouping of letters represents the wastewater treatment plant that receives the flow from the project sewers: CC = Cedar Creek WQTC; DW = District-Wide; FF = Floyds Fork WQTC; HC = Hite Creek WQTC; MF = Morris Forman WQTC; WC = West County (DRG) WQTC
- Fourth grouping of letters represents a unique identifier to differentiate between projects of the same project that are located in the same basin and WQTC. These letters begin with “A” and continue as needed.

ES.1.5.1. IOAP 2021 MODIFICATION TO VOLUME 1

The revisions incorporated into Volume 1 of the IOAP provide context for the Second ACD finalized in 2021. In some places, the order which background information was presented was revised to be chronological. The 2021 updates and programmatic compliance status related to the Final LTCP are summarized herein.

- **Current System Information**: Information regarding the status of MSD's wastewater system has been updated to reflect current conditions as of December 31, 2020 where appropriate throughout all chapters.
- **Historical Context**: Some information from the 2009 and 2012 documents remains to provide historical context related to the overall IOAP. A crosswalk summarizing the Volume 1 changes between the 2012 and 2021 IOAP documents was provided in Table 1.0-1.
- **Water Quality**: As acknowledged in the ACD, bacteria levels have decreased in the Ohio River and Beargrass Creek since the IOAP was started according to ORSANCO and MSD wet weather sampling data.
- **Public Participation & Agency Interaction**: Since 2015, MSD's Community Engagement Strategy has been expanded for significant capital projects, enhancing advertising and marketing strategies, developing social media platform messaging, ramping up earned media opportunities, pursuing additional education programs and partnerships, and overall re-branding to promote safe, clean waterways. A foundational component of the future program will be one of continuous improvement, striving to ultimately advance customer behavior objectives of the IOAP.
- **Regulatory Reporting**: MSD shall submit to the Cabinet and EPA a Mid-Year Status Report summarizing the first 6 months of its fiscal year, July 1st through December 31st. The Mid-Year Status Report summarizing the final 6 months of the fiscal year will be captured as a component of the Annual Report as set forth below. The first Mid-Year Status Report shall be submitted by February 28, 2022 and will reoccur annually by February 28th of each year. MSD shall submit an Annual Report for the preceding fiscal year period of July 1st through June 30th by September 30th of each year.
- **Comprehensive Performance Evaluation**: Each of the small WQTCs that had SSOs in their watersheds were eliminated as part of MSD's long-term strategic plan to eliminate small WQTCs in its service area. Expansion of the Derek R. Guthrie WQTC to 60 MGD average day and 300 MGD peak day (for short durations) was completed in 2018 and the State approved is rerating in 2020. Similarly, expansion of the Floyd's Fork WQTC to 6.5 MGD was completed in 2012. The Hite Creek WQTC is under construction to expand its capacity to 9 MGD ADF and 24 MGD peak flow. Construction is scheduled for completion in FY22.
- **Plumbing Modification Program**: Since the program's inception, MSD has completed over 17,992 projects totaling approximately $21.7 million dollars. The countywide program is now available to all MSD customers experiencing basement backups. MSD will pay up to $4,000 per residence for plumbing modifications. Generally, installations average about $2,500.
- **Specific Remedial Projects and Programs**: A new Section 4.7 was added to Chapter 4 to document the work MSD agreed to incorporate into the Second ACD related to the Morris

Forman WQTC New Biosolids Facility, Paddy's Run Pump Station Capacity Upgrade, Critical Interceptors Projects, and the Asset Management Program.

- **Morris Forman WQTC New Biosolids Facility**: MSD will construct a modern biosolids processing facility at the Morris Forman WQTC that utilizes a thermal hydrolysis pretreatment process (THP) to create a useable biogas. Benefits of the new facility include improved effluent quality; production of 4 MW of power; decreased consumption of natural gas; and reduced landfill utilization capacity. This project will be substantially complete no later than December 31, 2030.
- **Paddy's Run Pump Station Capacity Upgrade**: MSD will construct a new 5,250 sq foot pump station rated at 1,900 MGD, install the associated discharge piping system over the existing levee to a new outfall structure on the Ohio River, and demolish the existing pump station. This project will be substantially complete no later than December 31, 2026.
- **Morris Forman WQTC Sedimentation Basins Rehabilitation**: The Morris Forman WQTC is limited to a max wet weather flow of 240 MGD due to capacity constraints with the sedimentation basins. When the four sedimentation basins have been fully rehabilitated, they will enable the WQTC to process up to 330 MGD. This will reduce the level of pollutants discharged into the Ohio River. This project will be substantially complete no later than December 31, 2026 as required in the Agreed Order with the State. This project is not part of the Second ACD but is referenced given its relevance to restoring wet weather treatment capacity to the Morris Forman WQTC.
- **Critical Interceptors Projects**: MSD has agreed to complete nine critical sewer rehabilitation projects totalling an estimated $70 during FY21 through FY25 (by December 31, 2026).
- **Asset Management (AM) Program**: MSD agreed to invest an average of $25M per fiscal year on wastewater AM improvements totaling no less than $125M in five-year increments through 2035. As such, MSD will invest $125M from FY21 to FY25 for existing wastewater collection system and WQTC assets; $125M from FY26 to FY30; and $125M from FY31 to FY35. This time frame coincides with the time extension granted for the remaining SSDP projects. MSD will document annual and 5-year progress in its Consent Decree Annual Report. MSD will submit its Strategic Asset Management Plan to the Regulators no later than June 30, 2021.
- **Presumption Approach**: The Presumption Approach requires a program to meet any of the following three criteria: elimination or capture for treatment of 85 percent of the combined sewer flow generated during a wet weather event; allow no more than an average of four overflows per year; or a reduction of not less than the mass of pollutants that were identified as causing water quality impairments. The 2021 IOAP will be compliant with the Presumption Approach.
- **Financial Plan**: MSD updated the information in Volume 1, Chapter 6, Section 6.2 to reflect current financial criteria as of December 31, 2020 including the 5-year CIP forecast for FY21 through FY25.

ES.1.5.2. LTCP 2021 MODIFICATION TO VOLUME 2

The second volume describes MSD's planning approach and implementation of the 25 LTCP projects. The revisions incorporated into Volume 2 of the IOAP provide context for Second ACD. In some places, the order which background information was presented was revised to be chronological. The 2021 updates and programmatic compliance status related to the Final LTCP are summarized herein.

- **Second ACD**: The initial Final LTCP initially included 28 gray projects and 19 green demonstration projects. Through the adaptive management process 27 of the 28 gray projects were modified. Some projects were consolidated, and others were split into multiple projects. The result was 25 Final LTCP projects, of which MSD has certified completion for 24. The Waterway Protection Tunnel remains under construction and will be completed by December 31, 2022. All green demonstration projects were constructed by MSD.
- **Current System Information**: Information regarding the status of MSD's wastewater system has been updated to reflect current conditions as of December 31, 2020 where appropriate throughout all chapters.
- **Historical Context**: Some information from the 2009 and 2012 documents remains to provide historical context related to the overall IOAP. A crosswalk summarizing the Volume 2 changes between the 2012 and 2021 IOAP documents was provided in Table 1.0-1.
- **Public Participation**: Information regarding MSD's public outreach and participation programs was deleted from Volume 2, Chapters 3 and 4, and updated and consolidated into Volume 1, Chapter 3.
- **Ohio River Water Quality Monitoring**: MSD continues to receive Ohio River water quality data from ORSANCO. During the contact recreation season, ORSANCO regularly samples for E-coli and fecal coliforms. On a weekly basis ORSANCO samples for river conditions and E-coli. On a bimonthly basis, ORSANCO samples for various water quality parameters to evaluate attainment of established water quality criteria. Every two years, ORSANCO completes the Ohio River Water quality Conditions 305(b) Report to confirm the river is of sufficient quality for its intended uses. Every ten years, ORSANCO evaluates water quality trends including ecological conditions. Information and result of ORSANCO's water quality programs is found at www.ORSANCO.org.
- **Beargrass Creek Water Quality Monitoring**: MSD continues to collect water quality samples from 16 sites along Beargrass Creek. MSD staff compiled bacteria and flow data collected near the Big 4 sites used to compute Event Mean Concentrations (EMCs) for 4 wet weather sample events: October 2010; September 2013; July 2014; and June 2017. It was determined that the June 2017 event too much antecedent rain to be considered a qualifying event.
- **Flow Monitoring:** MSD has greatly expanded its long-term flow monitoring network, including monitors on the combined sewer outfalls. MSD has been utilizing data from this network to recalibrate the hydrologic and hydraulic models used to size overflow abatement projects and refine individual project approaches and sizes based on an improved understanding of the sewer system operation and the relationship of certain overflows to one another.
- **In-Stream Monitoring**: MSD's program has an extensive in-stream monitoring effort for tributary streams and emergency spill responses, including ambient monitoring at 28 Long Term Monitoring Network (LTMN) locations across Jefferson County to monitor multiple physical and biological parameters in accordance with the MS4 permit. Recreational contact monitoring is conducted seasonally from May through October at 27 of the 28 ambient monitoring sites for E. coli.

- **Green Infrastructure**: Through December 2020, MSD has completed all green infrastructure demonstration projects as well the other green infrastructure program elements, totaling nearly $42 million for an incremental system benefit. MSD's commitment to capture and treat or remove 95 percent of the systemwide CSO volume exceeds the requirements of the CSO Policy Presumption Approach. Additional or future green infrastructure projects are not necessary to achieve the required LOC. The approach presented throughout Chapter 3 to develop and implement the program remains accurate.
- **System Storage**: Through December 2020, MSD had constructed or developed 126 MG of system storage. The Phase 1 Real Time Control Program provided a total of 41 MG of this storage. The remainder of the storage volume was attributed to the basins listed in Table 4.1-6, or additional RTC/ILS projects. By December 2022, the Waterway Protection Tunnel will provide an additional 52 MG of system storage. Upon completion of the LTCP, MSD will have 178 MG of total storage available to help manage wet weather.

ES.1.5.3. SSDP 2021 MODIFICATION TO VOLUME 3

The third volume describes MSD's planning approach and implementation of the 60 Sanitary Sewer Discharge Plan (SSDP) projects. The revisions incorporated into Volume 3 of the IOAP provide context for Second Amended Consent Decree (ACD) negotiated in 2021. In some places, the order which background information was presented was revised to be chronological. The 2021 updates and programmatic compliance status related to the Final SSDP are summarized herein.

- **Second ACD**: The Final SSDP initially included 60 projects. Through the adaptive management process, three projects have bene deleted. Of the 57 Final SSDP projects, 41 have been completed and 16 projects remain (refer to Table ES.1.1-6 respectively). The dates for completing the remaining SSDP projects were extended to 2025, 2030, or 2035. and Table ES.1.1-7
- **Current System Information**: Project modifications due to improved system characterization data, hydraulic model recalibration and other changed conditions are described in Chapters 3 and 4 to reflect current 2021 conditions.
- **Historical Context**: Some information from the 2009 and 2012 documents remain to provide historical context related to the overall IOAP. A crosswalk summarizing the Volume 3 changes between the 2012 and 2021 IOAP documents was provided in Table 1.0-1 of Volume 3.
- **Public Participation**: Information regarding MSD's public outreach and participation programs was deleted from Volume 3, Chapters 1 and 4, and updated and consolidated into Volume 1, Chapter 3.
- **Sanitary Sewer Overflow Plan (SSOP)**: MSD prepared and submitted the Updated Sanitary Sewer Overflow Plan (SSOP) on February 10, 2006. Activities required under the Updated SSOP have been completed.
- **Plumbing Modification Program (PMP):** Information regarding the PMP was deleted from Volume 3, Chapter 1 and updated and consolidated into Volume 1, Chapter 4, Section 4.5.1.
- **Capacity, Management, Operations, and Maintenance (CMOM) Program**: The CMOM Self-Assessment Report was submitted to EPA and KDEP on February 10, 2006. MSD

received a letter of approval on August 22, 2006. Although the program implementation deadlines from the CMOM Self-Assessment Report were previously met, MSD continues to enhance the activities. Highlights of the CMOM program implementation are provide annually in the Consent Decree Annual Report.

- **Sewer Overflow Response Protocol (SORP):** MSD initially submitted the Sewer Overflow Response Protocol (SORP) to EPA and KDEP on February 10, 2006, received comments on March 13, 2006, resubmitted on May 12, 2006 and received an approval letter for the SORP on August 22, 2006. MSD completely revised the SORP in 2011. Final approval of the updated SORP document was received February 21, 2012. Modifications were made to the document in 2016 to reflect the elimination of the Jeffersontown WQTC and were approved on July 21, 2017.

- **Interim Sanitary Sewer Discharge Plan (ISSDP)**: MSD submitted an Interim Sanitary Sewer Discharge Plan (ISSDP) for approval on September 30, 2007. Comments were received on January 8, 2008. MSD resubmitted the revised ISSDP on March 7, 2008 and received an approval letter for the ISSDP on July 24, 2008. All projects required by the ISSDP have been completed and certified.

- **Elimination of Small WQTCs**: During the development of the 2009 IOAP, MSD operated fifteen small WQTCs in addition to six regional plants. All fifteen of the small WQTCs, and one regional WQTC, have been eliminated and the flow has been rerouted to MSD's regional WQTCs.

- **Flow Monitoring**: As of December 2020, MSD has approximately 35 meters installed in long-term locations and 60 temporary meters that can be moved to validate/calibrate targeted areas of specific models. These values will continue to fluctuate as new meters are purchased and older meters are retired, but MSD is committed to maintaining a sufficient quantity of meters to monitor large system changes and reviewing targeted areas in detail.

- **Rain Gauge Network**: MSD has since expanded its rain gauge network, and rainfall data is gathered at 46 rain gauge sites. Some of the sites are outside of MSD's service area to better predict incoming rain events and to analyze rainfall patterns.

- **Rainfall Derived Infiltration/Inflow**: Since the 2009 IOAP, RDI/I have been evaluated in areas where rehabilitation was targeted. In some cases, rehab successfully reduced the RDI/I substantial amounts, and in other cases reductions were less successful. Prior to final design of an SSDP project, models are calibrated to their current condition, and future RDI/I reduction is removed from the model for final project sizing.

- **Hydraulic Models**: In 2010, each model was updated, and calibration was verified, and the results were used in the 2012 SSDP. Since the 2012 SSDP, each modeled area is generally reviewed every two years to determine if an update to the model is necessary. Models in rapidly growing areas are sometimes updated more frequently.

Table ES.1.1-3 Final LTCP Projects Including Project Modifications

	FINAL LTCP PROJECT NAME AND IOAP ID	RECEIVING STREAM	2009 CSO(S) CONTROLLED & LEVEL OF CONTROL	2009 TECHNOLOGY AND SIZE	2009 COST ESTIMATE	2009 FINISH DATE	2012 CSO(S) CONTROLLED & LEVEL OF CONTROL	2012 TECH AND SIZE	2012 COST ESTIMATE	2012 FINISH DATE	MODIFICATION APPROVAL YEAR AND DESCRIPTION	2021 CSO(S) CONTROLLED & APPROVED LEVEL OF CONTROL	2021 TECH AND SIZE	2021 COST ESTIMATE	2021 COMPLETION SCHEDULE DATE OR CERTIFIED YEAR
1	CSO108 Dam Modification, *L_SO_MF_108_S_09A_B_A_4*	Beargrass Creek South Fork	4 overflows per TY for CSO 108	CSO Structure Improvements	$150,000	2010	4 overflows per TY for CSO 108	CSO Structure Improvements	No Change	No Change	2018. Project remains the same, based on additional calibration of the hydraulic model, the level of control was changed from 4 to 8 overflows per Typical Year.	8 overflows per TY for CSO 108	CSO Structure Improvements	$107,600	2010
2	Adams Street Sewer Separation (*formerly Storage Basin*), *L_OR_MF_172_S_09B_B_A_0*	Ohio River	0 overflows per TY for CSO 172	0.12 MG Storage Basin	$983,000	2012	0 overflows per TY for CSO 172	Sewer Separation	$20,000	2012	2012. Sewer separation replaced 0.12 MG storage basin. Upon inspection of the sewer system, all but two catch basins were separated already during recent redevelopment. MSD completed remaining separations.	0 overflows per TY for CSO 172	Sewer Separation	$92,300	2012
3	CSO 123 Downspout Disconnection, *L_MI_MF_123_S_08*	Beargrass Creek Middle Fork	CSO 123	Downspout Disconnection	$315,000	2012	No Change	Downspout Disconnection	No Change	No Change	No Change	CSO 123	Downspout Disconnection	Costs included under Green Program	2012
4	34th Street Flood Pump Station DWO Elimination, *L_OR_MF_019_S_03_A_B*	Ohio River	CSO019	Flow Control	$541,000	2012	No Change	Flow Control	No Change	No Change	No Change	LOC and CSOs Controlled Not Relevant	Flow Control	$646,000	2012
5	4th Street Flood Pump Station DWO Elimination, *L_OR_MF_022_M_03_A_A*	Ohio River	CSOs 022, 023	Flow Control	$944,000	2012	No Change	Flow Control	No Change	No Change	No Change	LOC and CSOs Controlled Not Relevant	Flow Control	$986,400	2012
6	27th Street Flood Pump Station DWO Elimination, *L_OR_MF_019_S_03_A_A*	Ohio River	CSO019	Flow Control	$476,000	2013	No Change	Flow Control	No Change	No Change	No Change	LOC and CSOs Controlled Not Relevant	Flow Control	$726,700	2013
7	Shawnee Flood Pump Station DWO Elimination, *L_OR_MF_189_M_03_A_A*	Ohio River	CSOs 104, 105, 189	Flow Control	$411,000	2013	No Change	Flow Control	No Change	No Change	No Change	LOC and CSOs Controlled Not Relevant	Flow Control	$1,065,100	2013
8	CSO 206 Sewer Separation, *L_MI_MF_206_S_08_A_A_0*	Beargrass Creek Middle Fork	CSO 206	Sewer Separation	$3,842,000	2013	No Change	Sewer Separation	No Change	No Change	No Change	0 overflows per TY for CSO 206	Sewer Separation	$577,300	2013
9	CSO058 In-Line Storage & Green Infrastructure, *L_OR_MF_058_S_08_A_A_0*	Ohio River	0 overflows per TY for CSO 058	Sewer Separation	$1,361,000	2014	8 overflows per TY for CSO 058	Sewer Separation	No Change	No Change	2014, 2020. In 2014 project changed to weir modifications to address surcharging in lieu of ineffectual sewer separation. In 2020 project incorporated into 13th & Rowan remedy.	8 overflows per TY for CSO 058	Sewer Separation	Costs included in Waterway Protection Tunnel LTCP Project #25	2014
10	17th Street Flood Pump Station DWO Elimination, *L_OR_MF_190_S_03_A_A*	Ohio River	CSO 190	Flow Control	$625,000	2014	No Change	Flow Control	No Change	No Change	No Change	LOC and CSOs Controlled Not Relevant	Flow Control	$756,500	2014
11	CSO140 In-Line Storage & Green Infrastructure Controls, *L_MI_MF_140_S_08_A_A_0*	Beargrass Creek Middle Fork	0 overflows per TY for CSO 140	Sewer Separation	$3,150,000	2015	0 overflows per TY for CSO 140	CSO Structure Improvements	$574,000	2015	2012. Reconstructed the CSO structure to increase the low flow line to a 42-inch diameter opening which increased the conveyance capacity in lieu of sewer separation.	0 overflows per TY for CSO 140	CSO Structure Improvements	$54,700	2015

Table ES.1.1-3 Final LTCP Projects Including Project Modifications

	FINAL LTCP PROJECT NAME AND IOAP ID	RECEIVING STREAM	2009 CSO(S) CONTROLLED & LEVEL OF CONTROL	2009 TECHNOLOGY AND SIZE	2009 COST ESTIMATE	2009 FINISH DATE	2012 CSO(S) CONTROLLED & LEVEL OF CONTROL	2012 TECH AND SIZE	2012 COST ESTIMATE	2012 FINISH DATE	MODIFICATION APPROVAL YEAR AND DESCRIPTION	2021 CSO(S) CONTROLLED & APPROVED LEVEL OF CONTROL	2021 TECH AND SIZE	2021 COST ESTIMATE	2021 COMPLETION SCHEDULE DATE OR CERTIFIED YEAR
12	CSO160 In-Line Storage & Green Infrastructure, *L_OR_MF_160_S_08_A_A_0*	Ohio River	0 overflows per TY for CSO 160	Sewer Separation	$237,000	2015	0 overflows per TY for CSO 160	In-Line Storage and Sewer Separation	$231,000	2015	2012. In-line storage provided by a combination of raising the existing overflow weir and installing 88 feet of 72-inch diameter pipe.	0 overflows per TY for CSO 160	In-Line Storage and Sewer Separation	$248,200	2015
13	CSO093 Structural Modifications & Green Infrastructure, *L_SO_MF_093_S_08_A_A_0*	Beargrass Creek South Fork	0 overflows per TY for CSO 093	Sewer Separation	$952,000	2015	0 overflows per TY for CSO 093	CSO Structure Improvements	$488,000	2015	2012. Reconstruction of the CSO structure replaced the existing leaping weir with a more conventional overflow weir in lieu of sewer separation.	0 overflows per TY for CSO 093	CSO Structure Improvements	$1,693,200	2015
14	Story Avenue & Spring Street Green Infrastructure (*formerly Storage Basin*), *L_SO_MF_130_S_09B_B_A_8*	Beargrass Creek South Fork	8 overflows per TY for CSO 130	0.01 MG Storage Basin	$1,077,000	2016	8 overflows per TY for CSO 130	Green Projects	$896,000	2016	2012. Construction of a suite of green infrastructure projects in lieu of the storage basin.	8 overflows per TY for CSO 130	Green Projects	$1,070,000	2016
15	CSO190 Green Infrastructure Solution (*formerly 18th & Northwestern Pkwy Storage Basin*), *L_SO_MF_190_S_09B_B_A_8*	Ohio River	8 overflows per TY for CSO 190	1.31 MG Storage Basin	$4,514,000	2017	8 overflows per TY for CSO 190	1.24 MG Storage Basin	$5,039,000	2017	2015. Green infrastructure solutions for CSO 190 replaced the storage basin at 18th and Northwestern Parkway.	8 overflows per TY for CSO 190	Green Infrastructure	$6,418,200	2017
16	Bells Lane Wet Weather Treatment Facility *(formerly Paddy's Run)*, *L_OR_MF_015_M_13_B_B_8*	Ohio River	8 overflows per TY for CSO 015, 191	50 MGD Treatment Facility	$24,940,000	2014	8 overflows per TY for CSO 015, 191	50 MGD Treatment Facility, 25 MG Storage via Real Time Control Optimization of Main Diversion Structure	$68,472,000	2016	2012, 2016. Optimization of flow through Morris Forman's Main Diversion Structure and MSD's Real Time Control strategy added storage volume. Additional time for construction was requested due to size increase, moving the site, offline storage, and integration of Southwestern Pump Station. Changed completion deadline from December 31, 2016 to September 30, 2017.	8 overflows per TY for CSOs 015 and 191	50 MGD Treatment Facility, 25 MG Storage via Real Time Control Optimization of Main Diversion Structure	$51,761,000	2017
17	Nightingale Pump Station Replacement & Storage, *L_SO_MF_018_S_03_A_A*	Beargrass Creek South Fork	0 overflows per TY for CSO 018	60 MGD Pump Station, 0 MG Storage	$15,710,000	2016	0 overflows per TY for CSO 0180 overflows per TY for CSO 018	33 MGD Pump Station with 7.7 MG Storage	$22,123,000	2016	2012, 2016. In 2012 reduced pumping capacity from 60 MGD to 33 MGD and added a 7.7 MG Storage Basin. In 2016, changed completion deadline from December 31, 2016 to June 30, 2017.	0 overflows per TY for CSO 018	33 MGD Pump Station with 7.7 MG Storage	$38,032,000	2017
18	Logan & Breckenridge Street Storage Basin, *L_SO_MF_092_M_09B_B_D_8* *(includes former Beargrass Creek Parallel Interceptor Project)* *(includes former Calvary - Creekside Storage Basin Project)*	Beargrass Creek South Fork	8 overflows per TY for CSOs 091, 113, 117, 146, 149, 152	Logan 11.83 MG Basin Calvary 3.46 MG Basin Combined 15.29 MG	Logan $30,320,000 Calvary $13,720,000 Combined $44,040,000	2017	8 overflows per TY for CSOs 091, 097, 106, 110, 111, 113, 117, 137, 146, 148, 149, 151, 152	Calvary Creekside Basin & Beargrass Parallel Interceptor eliminated and consolidated with 16.6 MG storage at the Logan Street Basin	$48,243,000	2018	2016. Technical functionality of project remained the same. Modified project to bury the basin and allow community-accessible open space above it.	8 overflows per TY for CSOs 091, 097, 106, 110, 111, 113, 117, 137, 146, 148, 149, 151, 152	16.6 MG Storage Basin	$92,821,600	2017

Table ES.1.1-3 Final LTCP Projects Including Project Modifications

	FINAL LTCP PROJECT NAME AND IOAP ID	RECEIVING STREAM	2009 CSO(S) CONTROLLED & LEVEL OF CONTROL	2009 TECHNOLOGY AND SIZE	2009 COST ESTIMATE	2009 FINISH DATE	2012 CSO(S) CONTROLLED & LEVEL OF CONTROL	2012 TECH AND SIZE	2012 COST ESTIMATE	2012 FINISH DATE	MODIFICATION APPROVAL YEAR AND DESCRIPTION	2021 CSO(S) CONTROLLED & APPROVED LEVEL OF CONTROL	2021 TECH AND SIZE	2021 COST ESTIMATE	2021 COMPLETION SCHEDULE DATE OR CERTIFIED YEAR
19	Southern Outfall In-Line Storage at 43rd Street (SOR1) (*formerly Algonquin Parkway Storage Basin*), *L_OR_MF_211_M_13_B_A_8*	Ohio River	*former project subsequently eliminated and replaced in 2012: 8 overflows per TY for CSO 016, 210, 211*	*former project subsequently eliminated and replaced in 2012: 4.84 MG Storage Basin*	*former project subsequently eliminated and replaced in 2012: $17,300,000*	*former project subsequently eliminated and replaced in 2012: 2018*	8 overflows per TY for CSO 016, 210, 211	11.4 MG In-Line Storage	$3,544,000	2018	2012. Optimized operating rules between the Bells Lane Wet Weather Treatment Facility and the Morris Forman WQTC's Main Diversion Structure demonstrated that only inline storage was needed at SOR1 and SOR2. Eliminated the Algonquin storage basin portion of the project.	8 overflows per TY for CSOs 016, 210. 211	11.4 MG In-Line Storage	$2,999,500	2018
20	Central Relief Drain CSO In-Line Storage, Green Infrastructure & Distributed Storage, *LOR_MF_155_M_09B_B_B_4-1*	Ohio River	N/A	N/A	N/A	N/A	8 overflows per TY for CSOs 028, 029, 034, 036, 178, 181, 193, 195, 196, 197, 199, 200X, 202	Diversion, Weir Modifications, Green Infrastructure	$2,184,000	2020	2012. Project was added to the IOAP in order to split the Central Relief Drain work from the 13th Street & Rowan Project.	8 overflows per TY for CSOs 028, 029, 034, 036, 178, 181, 193, 195, 196, 197, 199, 200X, 202	Diversion, Weir Modification, Green Infrastructure	$569,572	2018
21	Morris Forman WQTC Headworks Improvements *(formerly Algonquin Parkway Storage Basin and formerly SOR2), L_OR_MF_160_S_08_A_A_0*	Ohio River	*former project subsequently eliminated and replaced in 2012: 8 overflows per TY for CSO 016, 210, 211*	*former project subsequently eliminated and replaced in 2012: 4.84 MG Storage Basin*	*former project subsequently eliminated and replaced in 2012: $17,300,000*	*former project subsequently eliminated and replaced in 2012: 2018*	8 overflows per TY for CSOs 016, 210, 211	In-Line Storage at two locations SOR1, SOR2	$3,544,000	2018	2012. In 2012, eliminated SOR2 project and replaced with flow control improvements at the Main Diversion Structure and rehabilitation of Morris Forman WQTC Headworks in order to increase maximum sustainable treatment capacity to 330 MGD.	8 overflows per TY for CSOs 016, 210, 211	Flow Control, Treatment Improvement	$13,175,805	2018
22	Clifton Heights Storage Basin, *L_MU_MF_154_M_09B_B_A_8*	Beargrass Creek Muddy Fork	8 overflows per TY for CSOs 132, 154, 167	6.55 MG Storage Basin	$13,870,000	2018	4 overflows per TY for CSOs 132, 154, 167	4.28 MG Storage Basin	$14,166,000	2018	2012, 2014. In 2012 revised basin from 6.55 MG to 4.28 MG and level of control from 8 overflows per Typical Year to 4. In 2014, revised basin size to 7.0 MG.	4 overflows per TY for CSOs 088, 131, 132, 154, 167	7.0 MG Storage Basin	$33,390,500	2018
23	Portland CSO Basin, *L_OR_MF_019_S_13_B_A_8*	Ohio River	8 overflows per TY for CSO 019	6.37 MG Storage Basin	$20,000,000	2019	No Change	6.37 MG Storage Basin	No Change	No Change	2015. Increased basin size from 6.37 MG to 6.7 MG. The larger size does not reduce CSO occurrences significantly but does provide a reduced residual AAOV.	8 overflows per TY for CSO 019	6.7 MG Storage Basin	$37,894,500	2019

Table ES.1.1-3 Final LTCP Projects Including Project Modifications

		FINAL LTCP PROJECT NAME AND IOAP ID	RECEIVING STREAM	2009 CSO(S) CONTROLLED & LEVEL OF CONTROL	2009 TECHNOLOGY AND SIZE	2009 COST ESTIMATE	2009 FINISH DATE	2012 CSO(S) CONTROLLED & LEVEL OF CONTROL	2012 TECH AND SIZE	2012 COST ESTIMATE	2012 FINISH DATE	MODIFICATION APPROVAL YEAR AND DESCRIPTION	2021 CSO(S) CONTROLLED & APPROVED LEVEL OF CONTROL	2021 TECH AND SIZE	2021 COST ESTIMATE	2021 COMPLETION SCHEDULE DATE OR CERTIFIED YEAR
24		Southwestern Parkway Storage Basin, *L_OR_MF_105_M_13_B_A_0*	Ohio River	0 overflows per TY for CSOs 104, 105, 189	5.08 MG Storage Basin	$17,620,000	2018	0 overflows per TY for CSOs 104, 105, 189	11.07 MG Storage Basin	$30,937,000	2018	2012, 2015, 2018. In 2012, increased basin size form 5.08 MG to 11.07 MG. In 2015, increased basin size from 11.07 MG to 20 MG, with a level of control of 8 overflows per Typical Year and no net system-wide increase in AAOV. In 2018, Revised project deadline to June 30, 2019 and corrected inline storage volume submitted with 2015 minor modification fact sheet to 6.3 MG.	8 overflows per TY for CSOs 104, 105, 189	20 MG Storage basin, 6.3 MG In-Line Storage	$80,623,100	2019
25	Waterway Protection Tunnel	*(formerly I-64 & Grinstead CSO Basin), L_MI_MF_127_M_09B_B_A_8)*	Beargrass Creek Middle Fork	8 overflows per TY for CSOs 125, 126, 127, 166	2.74 MG Storage Basin	$12,950,000	2014	4 overflows per TY for CSOs 125, 126, 127, 166	8.5 MG Storage Basin + Storm water Diversions	$48,591,000	2020	2012, 2015, 2016, 2018.In 2012, basins sizes were adjusted based on re-calibration. In 2015, basin sizes were adjusted as part of Basin Balancing Modification. In 2016, revised design to a 31.8 MG tunnel solution that consolidates CSO controls for 13th Street and Rowan Street, Story Avenue and Main Street, and Lexington and Payne Street Storage Basins. In 2018, changed project name to "Waterway Protection Tunnel" and revised design to a 52.2 MG tunnel solution that consolidates CSO controls for Ohio River Tunnel and I-64 & Grinstead Drive Storage Basin.	8 overflows per TY for CSOs 020, 022, 023, 050, 051, 052, 053 ,054, 055, 056, 058, 062, 150, 155 4 overflows per TY for CSOs 125, 126, 127, 166 0 overflows per TY for CSOs 082, 083, 084, 118, 119, 120, 121, 141, 153	52.2 MG CSO Storage Tunnel	$253,401,700	2022
		(formerly 13th Street & Rowan Street Storage Basin), L_OR_MF_155_M_09B_B_B_4)	Ohio River	4 overflows per TY for CSOs 022, 023, 050, 051, 052, 053 ,054, 055, 056, CRD, 150, 155	14.44 MG Storage Basin	$49,680,000	2020	8 overflows per TY for CSOs 022, 023, 050, 051, 052, 053 ,054, 055, 056, 058, 150, 155	4.36 MG Storage Basin	$27,863,200	2020					
		(formerly Story Avenue & Main Street Storage Basin), L_OR_MF_020_S_09B_B_A_8)	Ohio River	8 overflows per TY for CSO 020	0.13 MG Storage Basin	$1,580,000	2013	8 overflows per TY for CSO 020	5.42 MG Storage Basin	$12,576,000	2020					
		(formerly Lexington Road & Payne Street Storage Basin), L_SO_MF_083_M_09B_B_A_8)	Beargrass Creek South Fork	8 overflows per TY for CSOs 082, 084, 118, 119, 120, 121,141, 153	7.31 MG Storage Basin	$25,200,000	2020	0 overflows per TY for CSOs 082, 084, 118, 119, 120, 121,141, 153	8.18 MG Storage Basin	$25,904,000	2020					

Table ES.1.1-6 Final SSDP Projects Including Project Modifications

	FINAL SSDP PROJECT NAME AND IOAP ID	RECEIVING STREAM	2009 SSO(S) ELIMINATED & LEVEL OF PROTECTION	2009 TECH AND SIZE	2009 COST ESTIMATE	2009 FINISH DATE	2012 SSO(S) ELIMINATED & LEVEL OF PROTECTION	2012 TECH AND SIZE	2012 COST ESTIMATE	2012 FINISH DATE	MODIFICATION APPROVAL YEAR AND DESCRIPTION	2021 SSO(S) ELIMINATED & APPROVED LEVEL OF PROTECTION	2021 TECH AND SIZE	2021 COST ESTIMATE	2021 COMPLETION SCHEDULE DATE OR CERTIFIED YEAR
CEDAR CREEK AREA															
1	Running Fox PS Elimination *S_CC_CC_MSD1080_S_01-C*	Little Cedar Creek	2-yr, 3-hr storm for MSD1080-LS	Flow Diversion	$99,000	2023	No change	Flow Diversion	$59,700	2023	No change	2-yr, 3-hr storm for MSD1080-LS	Flow Diversion	$59,700	2010
2	Fairmount Rd PS Off-line Storage *S_FF_CC_81316_M_03_C_A*	Big Run	N/A	N/A	N/A	N/A	2-yr, 3-hr storm for 81316, 97362	Off-Line Storage	$13,439,000	2015	2012. Project added to send the flows from eliminated Jeffersontown WQTC to the Cedar Creek WQTC.	2-yr, 3-hr storm for 81316, 97362	Off-Line Storage	$14,753,500	2015
3	Idlewood Inline Storage *S_CC_CC_70158_M_09A_C*	Cedar Creek	2-yr, 3-hr storm for 28998, 28984, 63094, 63095, 70158	Inline Storage	$2,921,000	2023	No change	Inline Storage	$2,317,000	2023	2021.Revised completion date to December 31, 2025.	2-yr, 3-hr storm for 28998, 28984, 63094, 63095, 70158	Inline Storage	$4,087,400	2025
4	Bardstown Rd PS Improvements *S_CC_CC_MSD1025_S_03_B*	Big Run	5-yr, 3-hr storm for 88545	PS Upgrade	$401,000	2021	No change	PS Upgrade	$401,000	2021	2021.Revised completion date to December 31, 2030.	5-yr, 3-hr storm for 88545	PS Upgrade	$3,400,000	2030
5	Little Cedar Creek Interceptor Improvements *S_CC_CC_67997_M_01_C*	Little Cedar Creek	2-yr, 3-hr storm for 67997, 67999, 86423, 86424, 89195, 89196, 89197	Pipe Upgrades	$2,921,000	2024	No Change	Pipe Upgrades	$2,921,000	2024	2021.Revised completion date to December 31, 2025. Future. Modeling on-going, project may be eliminated.	2-yr, 3-hr storm for 67997, 67999, 86423, 86424, 89195, 89196, 89197	Pipe Upgrades	$2,400,000	2025
HITE CREEK AREA															
6	Floydsburg Rd SSES, Rehabilitation and PS Upgrade *S_HC_HC_MSD1086_M_07_C_A*	Floyds Fork, South Fork Harrods Creek	2-yr, 3-hr for MSD1086-PS, 90776, 108956, 108957, 108958	I/I Reduction	$59,000	2016	No change	I/I Reduction	$59,000	2010	No change	2-yr, 3-hr for MSD1086-PS, 90776, 108956, 108957, 108958	I/I Reduction	$50,200	2010
7	Meadow Stream PS & Force Main Upgrade *S_HC_HC_MSD1082_S_09A_C*	Floyds Fork	2-yr, 3-hr storm for 91087, MSD1082-PS	0.5 MG Storage Basin	$1,198,000	2010	10-yr, 3-hr storm for 91087, MSD1082-PS	3.89 MGD PS, new 18-inch FM	$1,011,900	2012	2012. Project changed from small storage basin to PS upgrade and new FM due to capacity needs of Crestwood. Changed LOC from 1.82 inch to 2.6 inch.	10-yr, 3-hr storm for 91087, MSD1082-PS	3.89 MGD PS, new 18-inch FM	$1,011,900	2012
8	Kavanaugh Rd PS Improvements *S_HC_HC_MSD1085_S_03_A*	Hite Creek	10-yr, 3-hr storm for MSD1085-PS	PS & FM Upgrades	$1,729,000	2024	No change	PS & FM Upgrades	$1,729,000	2024	2021.Revised completion date to December 31, 2025.	10-yr, 3-hr storm for MSD1085-PS	PS & FM Upgrades	$4,300,000	2025
FLOYDS FORK AREA															
9	Woodland Hills PS Diversion *S_FF_FF_NB01_S_01_C_A*	Pope Lick	2-yr, 3-hr storm for 33003, 65531	Flow Diversion	$21,000	2011	No change	Flow Diversion	$19,400	2011	No change	2-yr, 3-hr storm for 33003, 65531	Flow Diversion	$19,400	2010
10	Eden Care PS SSO Investigation *S_FF_FF_NB02_S_13_C*	Floyds Fork	N/A storm for Eden Care PS (MSD1105-PS)	Monitoring	N/A	2012	N/A	Monitor	N/A	2012	2012. One overflow documented at this location. MSD cleaned sewers in the vicinity and had no documented overflows for more than 3 years.	N/A	Monitoring Complete	N/A	2012

Table ES.1.1-6 Final SSDP Projects Including Project Modifications

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11	Ashburton PS Improvements and Diversion *S_FF_FF_NB03_M_01_C_A*	Floyds Fork	2-yr, 3-hr storm for Olde Copper Court PS (MSD0165-PS), Ashburton PS (MSD0166-PS)	FM & Pipes Upgrade	$168,000	2021	No change	FM & Pipes Upgrade	$30,300	2009	No change	2-yr, 3-hr storm for Olde Copper Court PS (MSD0165-PS), Ashburton PS (MSD0166-PS)	FM & Pipes Upgrade	$30,300	2009
JEFFERSONTOWN AREA															
12	Jeffersontown WQTC Elimination *S_JT_NB01_M_01_C_A*	Chenoweth Run	2-yr, 3-hr storm for 28390, 28391, 28392, 28395, 28551, 31733, Jeffersontown WQTC (28173, 64505, MSD0255, ISO28-SI)	Offline Storage, Pipe Upgrades, WQTC Eliminations	$28,386,000	2015	No change	Offline Storage, Pipe Upgrades, WQTC Eliminations	$38,773,700	2015	2010. Modified elimination plan to move new PS to Municipal Yard and divert portion of service area to Cedar Creek WQTC.	2-yr, 3-hr storm for 28390, 28391, 28392, 28395, 28551, 31733, Jeffersontown WQTC (28173, 64505, MSD0255, ISO28-SI)	Offline Storage, Pipe Upgrades, WQTC Eliminations	$38,773,700	2015
13	Chenoweth Hills WQTC Elimination and PS Improvements *S_JT_JT_NB01A_M_03_C*	Chenoweth Run	2-yr, 3-hr storm for Chenoweth Run PS (MSD0196-PS, 86052, 64096), Chenoweth WQTC PS (MSD0263A-PS), Chenoweth Hills WQTC (MSD0263)	Flow Diversion, WQTC Eliminations	$3,749,000	2015	No change	Flow Diversion, WQTC Eliminations	$3,749,000	2015	2015. Eliminated Pump Stations and WQTC via gravity to Cedar Creek.	2-yr, 3-hr storm for Chenoweth Run PS (MSD0196-PS, 86052, 64096), Chenoweth WQTC PS (MSD0263A-PS), Chenoweth Hills WQTC (MSD0263)	Flow Diversion, WQTC Eliminations	$3,011,700	2015
14	Dell Rd & Charlane Parkway Interceptor *S_JT_JT_NB02_M_01_C*	Beatty Brook	2-yr, 3-hr storm Charlane Pkwy (28250, 28249, 28340, 28336, 104289,) Dell Rd (28413, 28414, 28415, 28416, 28417)	Pipe Upgrades	$1,347,000	2022	No Change	Pipe Upgrades	$1,347,000	2022	2021.Revised completion date to December 31, 2030.	2-yr, 3-hr storm Charlane Pkwy (28250, 28249, 28340, 28336, 104289,) Dell Rd (28413, 28414, 28415, 28416, 28417)	Pipe Upgrades	$8,800,000	2030
15	Raintree and Marian Court PS Eliminations Phase 1 *S_JT_JT_NB03_M_01_C*	Beatty Brook	2-yr, 3-hr storm for Marian Ct PS (28729), Raintree PS (MSD0149-PS)	Flow Diversion	$371,000	2021	2-yr, 3-hr storm for Marian Ct PS (28729), Raintree PS (MSD0149-PS)	Flow Diversion	$371,000	2021	2021.Revised completion date to December 31, 2025.	2-yr, 3-hr storm for Marian Ct PS (28729), Raintree PS (MSD0149-PS)	Flow Diversion	$165,700	2025
16	Raintree and Marian Court PS Eliminations Phase 2 *S_JT_JT_NB03_M_01_C*		2-yr, 3-hr storm for 28719, 28711	Pipe Upgrades	$1,062,000	2021	2-yr, 3-hr storm for 28719, 28711	Pipe Upgrades	Cost combined with Phase 1	2021	2021.Revised completion date to December 31, 2030. Future: Lag in schedule allows flow monitoring for Phase 1 PS eliminations.	2-yr, 3-hr storm for 28719, 28711	Pipe Upgrades	$1,800,000	2030
17	Monticello PS Elimination *S_JT_JT_NB04_M_01_A*	Fern Creek	10-yr, 3-hr storm for Monticello Place PS (MSD0151-PS, 27969)	Flow Diversion	$304,000	2022	10-yr, 3-hr storm for Monticello Place PS (MSD0151-PS, 27969)	Flow Diversion	$207,000	2022	2021.Revised completion date to December 31, 2025. Future: Flow monitoring and calibration underway – project may not be necessary.	10-yr, 3-hr storm for Monticello Place PS (MSD0151-PS, 27969)	Flow Diversion	$464,000	2025

Table ES.1.1-6 Final SSDP Projects Including Project Modifications

	FINAL SSDP PROJECT NAME AND IOAP ID	RECEIVING STREAM	2009 SSO(S) ELIMINATED & LEVEL OF PROTECTION	2009 TECH AND SIZE	2009 COST ESTIMATE	2009 FINISH DATE	2012 SSO(S) ELIMINATED & LEVEL OF PROTECTION	2012 TECH AND SIZE	2012 COST ESTIMATE	2012 FINISH DATE	MODIFICATION APPROVAL YEAR AND DESCRIPTION	2021 SSO(S) ELIMINATED & APPROVED LEVEL OF PROTECTION	2021 TECH AND SIZE	2021 COST ESTIMATE	2021 COMPLETION SCHEDULE DATE OR CERTIFIED YEAR
MIDDLE FORK AREA															
18	Middle Fork Relief Interceptor, Wet Weather Storage, Upper Middle Fork LS Diversion Phase 1: Buechel Basin *S_MISF_MF_NB01_M_01_C_A1*	Middle Fork Beargrass Creek	2-yr, 3-hr storm for 02932, 02932, 02933, 02935, 08537, 23211, 23212, 27005, 51221, 51160, 51161, 45835, 47583, 47593, 47596, 47603, 47604, 90700, IS021A-SI, 08935-SM	Storage Basin	$15,170,000	2023	No Change	Storage Basin	$33,684,200	2013	No Change	2-yr, 3-hr storm for 02932, 02932, 02933, 02935, 08537, 23211, 23212, 27005, 51221, 51160, 51161, 45835, 47583, 47593, 47596, 47603, 47604, 90700, IS021A-SI, 08935-SM	Storage Basin	$33,684,200	2013
19	Middle Fork Relief Interceptor, Wet Weather Storage, Upper Middle Fork LS Diversion Phase 2: UMFLS & Relief Interceptor *S_MISF_MF_NB01_M_01_C_A1*	Middle Fork Beargrass Creek	2-yr, 3-hr storm for 02932, 02932, 02933, 02935, 08537, 23211, 23212, 27005, 51221, 51160, 51161, 45835, 47583, 47593, 47596, 47603, 47604, 90700, IS021A-SI, 08935-SM	1.6 MG Offline Storage, PS & FM Upgrades	$19,889,000	2023	No Change	1.6 MG Offline Storage at UMFLS, PS & FM Upgrades	$19,889,000	2023	2018. Replaced offline storage at UMFLS with new 30 MGD PS at UMF Site. 2021.Revised completion date to December 31, 2030.	2-yr, 3-hr storm for 02932, 02932, 02933, 02935, 08537, 23211, 23212, 27005, 51221, 51160, 51161, 45835, 47583, 47593, 47596, 47603, 47604, 90700, IS021A-SI, 08935-SM	New 30 MGD PS, Pipe & FM Upgrades	$86,408,000	2030
20	Goose Creek PS Improvements and Wet Weather Storage Phase 1: Devondale PS *S_MI_MF_NB04_M_03_B*	Goose Creek	5-yr, 3-hr storm 46891, 62418, 91629, 91630, 10593, 43472, 21628-W	Offline Storage, PS & FM Upgrades	$2,775,000	2023	No Change	Offline Storage, PS & FM Upgrades	$2,775,000	2016	2015. Combined project with Bancroft WQTC elimination. Moved storage and PS to Bancroft site instead of Devondale PS.	5-yr, 3-hr storm 46891, 62418, 91629, 91630, 10593, 43472, 21628-W	Offline Storage, PS & FM Upgrades	$5,242,800	2016
21	Goose Creek PS Improvements and Wet Weather Storage Phase 2: Goose Creek PS Improvement *S_MI_MF_NB04_M_03_B*	Goose Creek	5-yr, 3-hr storm 46891, 62418, 91629, 91630, 10593, 43472, 21628-W	PS & FM Upgrades	$1,676,000	2023	No Change	PS & FM Upgrades	$1,676,000	2023	2021.Revised completion date to December 31, 2035.	5-yr, 3-hr storm 46891, 62418, 91629, 91630, 10593, 43472, 21628-W	PS & FM Upgrades	$6,978,600	2035
22	Anchor Estates PS Elimination Phase 1: Anchor PS Elimination *S_MI_MF_NB06_M_01_A_A_1*	Middle Fork Beargrass Creek	10-yr, 3-hr storm for 0056-W, 00746, MSD0057-LS	Flow Diversion	$66,000	2016	No Change	Flow Diversion	$66,000	2016	No Change	10-yr, 3-hr storm for 0056-W, 00746, MSD0057-LS	Flow Diversion	$83,200	2016
23	Anchor Estates PS Elimination Phase 2: Vannah Way PS Elim. *S_MI_MF_NB06_M_01_A_A_1*	Middle Fork Beargrass Creek	10-yr, 3-hr storm for 01106	, Flow Diversion	$2,275,000	2011	No Change	, Flow Diversion	$3,878,900	2011	No Change	10-yr, 3-hr storm for 01106	, Flow Diversion	$3,878,900	2011
24	Hurstbourne I/I Investigation & Rehabilitation *S_MI_MF_NB07_S_07_C*	Hurstbourne Creek	2-yr, 3-hr storm for 01793	I/I Reduction	$569,000	2011	No Change	I/I Reduction	$773,200	2011	No Change	2-yr, 3-hr storm for 01793	I/I Reduction	$773,200	2011
SOUTHEASTERN DIVERSION AREA															
25	Parkview Estates I/I Investigation & Rehabilitation *S_SD_MF_NB03_S_07_C*	South Fork Beargrass Creek	2-yr, 3-hr storm for 47250	I/I Reduction	$302,000	2011	No Change	I/I Reduction	$29,600	2011	No Change	2-yr, 3-hr storm for 47250	I/I Reduction	$29,600	2011
26	Klondike Interceptor *S_SD_MF_NB04_S_01_B_A*	South Fork Beargrass Creek	5-yr, 3-hr storm for 25676, 26650, 26651	Pipe Upgrades	$666,000	2014	No Change	Pipe Upgrades	$2,231,000	2014	No Change	5-yr, 3-hr storm for 25676, 26650, 26651	Pipe Upgrades	$2,231,000	2014
27	Sutherland Interceptor *S_SD_MF_NB05_M_01_A*	South Fork Beargrass Creek	10-yr, 3-hr storm for 16649	Pipe Upgrades	$623,000	2023	10-yr, 3-hr storm for 16649	Pipe Upgrades	$623,000	2023	2021.Revised completion date to December 31, 2030.	10-yr, 3-hr storm for 16649	Pipe Upgrades	$1,065,300	2030
28	Beargrass Interceptor Rehabilitation Phase 2 *S_SD_MF_NB06_S_13_C*	South Fork Beargrass Creek	2-yr, 3-hr storm for 51594	Pipe Rehabilitation	$59,000	2010	2-yr, 3-hr storm for 51594	Pipe Rehabilitatio n	$29,700	2010	No Change	2-yr, 3-hr storm for 51594	Pipe Rehabilitatio n	$29,700	2010
POND CREEK AREA															

Table ES.1.1-6 Final SSDP Projects Including Project Modifications

	FINAL SSDP PROJECT NAME AND IOAP ID	RECEIVING STREAM	2009 SSO(S) ELIMINATED & LEVEL OF PROTECTION	2009 TECH AND SIZE	2009 COST ESTIMATE	2009 FINISH DATE	2012 SSO(S) ELIMINATED & LEVEL OF PROTECTION	2012 TECH AND SIZE	2012 COST ESTIMATE	2012 FINISH DATE	MODIFICATION APPROVAL YEAR AND DESCRIPTION	2021 SSO(S) ELIMINATED & APPROVED LEVEL OF PROTECTION	2021 TECH AND SIZE	2021 COST ESTIMATE	2021 COMPLETION SCHEDULE DATE OR CERTIFIED YEAR
29	Charleswood Interceptor Extension *S_PO_WC_PC03_M_01_C*	Fishpool Creek	2-yr, 3-hr storm 25477, 25478, 25480, MSD0130-PS	Pipe Upgrades	$886,000	2015	2-yr, 3-hr storm 25477, 25478, 25480, MSD0130-PS	Pipe Upgrades	$1,213,400	2015	No Change	2-yr, 3-hr storm 25477, 25478, 25480, MSD0130-PS	Pipe Upgrades	$1,213,400	2015
30	Cinderella PS Elimination *S_PO_WC_PC04_M_01_C*	Fishpool Creek	2-yr, 3-hr storm 60679, MSD1013-PS, 35309	Flow Diversion	$3,395,000	2025	2-yr, 3-hr storm 60679, MSD1013-PS, 35309	Flow Diversion	$1,500,000	2025	2021.Revised completion date to December 31, 2025.	2-yr, 3-hr storm 60679, MSD1013-PS, 35309	Flow Diversion	$1,500,000	2025
31	Lantana PS I/I Investigation & Rehabilitation *S_PO_WC_PC05_M_07_C*	Pennsylvania Run	2-yr, 3-hr storm 25484, 93719, MSD0101-PS	I/I Reduction	$21.000	2011	2-yr, 3-hr storm 25484, 93719, MSD0101-PS	Investigation Complete	$164,000	2011	No Change	2-yr, 3-hr storm 25484, 93719, MSD0101-PS	Investigation Complete	$164,000	2011
32	Government Center PS Elimination *S_PO_WC_PC06_M_01_C*	Pennsylvania Run	10-yr, 3-hr storm for MSD0180-PS	Flow Diversion	$1,909,000	2011	10-yr, 3-hr storm for MSD0180-PS	Flow Diversion	$353,600	2011	No Change	10-yr, 3-hr srm for MSD0180-PS	Flow Diversion	$353,600	2011
33	Avanti PS Elimination *S_PO_WC_PC07_M_01_A*	Little Cedar Creek	2-yr, 3-hr storm for 21229-W	Flow Diversion	$32,000	2009	2-yr, 3-hr storm for 21229-W	Flow Diversion	$32,000	2009	No Change	2-yr, 3-hr storm for 21229-W	Flow Diversion	$32,000	2009
34	Lea Ann Way System Improvements *S_PO_WC_PC08_M_01_C*	Fern Creek	2-yr, 3-hr storm 19360, 19369, 29933, 29948, 29943, 31083, 31084, 79076, MSD1010-PS	Pipe Upgrades	$987,000	2015	2-yr, 3-hr storm 19360, 19369, 29933, 29948, 29943, 31083, 31084, 79076, MSD1010-PS	Pipe Upgrades	$4,863,900	2015	2012. Combined SSES projects and performed additional sewer inspection and rehabilitation.	2-yr, 3-hr storm 19360, 19369, 29933, 29948, 29943, 31083, 31084, 79076, MSD1010-PS	Pipe Upgrades	$4,863,900	2015
35	Caven Ave PS Elimination & Offline Storage Phase 1: Caven Ave PS Elimination *S_PO_WC_PC09_M_09B_C*	Fishpool Creek	2-yr, 3-hr storm for 27116, MSD0133-PS	Offline Storage	$1,672,000	2016	2-yr, 3-hr storm for 27116, MSD0133-PS	Flow Diversion	$2,923,000	2016	2012. Elimination of nearby WQTC allowed for PS elimination instead of offline storage.	2-yr, 3-hr storm for 27116, MSD0133-PS	Flow Diversion	$2,923,000	2016
E	Caven Ave PS Elimination & Offline Storage Phase 2: Outer Loop Storage *S_PO_WC_PC09_M_09B_C*		2-yr, 3-hr storm for 70212, 17724	Offline Storage	Cost combined with Phase 1	N/A	2-yr, 3-hr storm for 70212, 17724	Project Eliminated	N/A	N/A	2012. Project eliminated due to new flow monitoring and model re-calibration.	2-yr, 3-hr storm for 70212, 17724	Project Eliminated	N/A	N/A
36	Leven PS Elimination *S_PO_WC_PC10_M_01_C*	Pennsylvania Run	2-yr, 3-hr storm for 36419, MSD1019-PS	Flow Diversion	$352,000	2022	2-yr, 3-hr storm for 36419, MSD1019-PS	Flow Diversion	$352,000	2022	2021.Revised completion date to December 31, 2025.	2-yr, 3-hr storm for 36419, MSD1019-PS	Flow Diversion	$720,000	2025
37	Edsel PS I/I Investigation & Rehabilitation *S_PO_WC_PC11_M_07_C*	Fern Creek	2-yr, 3-hr storm for 92098, MSD1048-PS	I/I Reduction	$389,000	2011	2-yr, 3-hr storm for 92098, MSD1048-PS	I/I Reduction	$1,289.800	2011	No Change	2-yr, 3-hr storm for 92098, MSD1048-PS	I/I Reduction	$1,289.800	2011
OHIIO RIVER FORCE MAIN (ORFM) AREA															
38	Mellwood System Improvements, PS Eliminations, Phase 1: Mellwood PS *S_OR_MF_NB01_M_01_B*	Muddy Fork Beargrass Creek	5-yr, 3-hr storm 26752, 41374, 41416, MSD0007-PS, MSD0010-PS, 24472, MSD0023-PS, 24152-W, MSD0024-PS	PS Replacement	$2,369,000	2012	5-yr, 3-hr storm 26752, 41374, 41416, MSD0007-PS, MSD0010-PS, 24472, MSD0023-PS, 24152-W, MSD0024-PS	Flow Diversion, PS and Pipe Upgrades	$2,369,000	2012	No Change	5-yr, 3-hr storm 26752, 41374, 41416, MSD0007-PS, MSD0010-PS, 24472, MSD0023-PS, 24152-W, MSD0024-PS	PS Replacement	$3,275,800	2012
39	Mellwood System Improvements, PS Eliminations, Phase 2: Mockingbird Valley & Winton PS *S_OR_MF_NB01_M_01_B*			Flow Diversion, PS and Pipe Upgrades	$1,302,000	2024		Flow Diversion, PS and Pipe Upgrades	$1,302,000	2024	2021.Revised completion date to December 31, 2030.		Flow Diversion, PS and Pipe Upgrades	$2,516,100	2030

Table ES.1.1-6 Final SSDP Projects Including Project Modifications

	FINAL SSDP PROJECT NAME AND IOAP ID	RECEIVING STREAM	2009 SSO(S) ELIMINATED & LEVEL OF PROTECTION	2009 TECH AND SIZE	2009 COST ESTIMATE	2009 FINISH DATE	2012 SSO(S) ELIMINATED & LEVEL OF PROTECTION	2012 TECH AND SIZE	2012 COST ESTIMATE	2012 FINISH DATE	MODIFICATION APPROVAL YEAR AND DESCRIPTION	2021 SSO(S) ELIMINATED & APPROVED LEVEL OF PROTECTION	2021 TECH AND SIZE	2021 COST ESTIMATE	2021 COMPLETION SCHEDULE DATE OR CERTIFIED YEAR
40	Leland Road SSO Investigation *S_OR_MF_NB02_A_13_C*	Cherrywood Creek	N/A storm for 96020	Condition Assessment	N/A	N/A	N/A	Condition Assessment	N/A	N/A	2012. One overflow documented at this location. MSD cleaned sewers in the vicinity and had no documented overflows for more than 3 years.	N/A	Assessment Completed	N/A	2012
41	Derington Ct. PS I/I Investigation & Rehabilitation *S_OR_MF_NB03_S_07_C*	Goose Creek	2-yr, 3-hr storm for MSD0095-PS	I/I Reduction	$290,000	2012	2-yr, 3-hr storm for MSD0095-PS	I/I Reduction	N/A	2012	No Change	2-yr, 3-hr storm for MSD0095-PS	I/I Reduction	Included in FY12 I/I Budget	2012
42	Prospect WQTC Elimination, Harrods Creek PS, ORFM System Improvements Phase 1: WQTC Eliminations *S_OR_MF_NB04_M_3_B_B*	Little Goose Creek	5-yr, 3-hr storm 40870, 40871, 40872, 42680, 65633, 65635, 22436, MSD0123-PS, MSD1044-PS, MSD0183-PS, MSD0192-PS, MSD0193-PS, MSD1063-PS, MSD0292	WQTC Elimination	$34,062,000	2015	5-yr, 3-hr storm 40870, 40871, 40872, 42680, 65633, 65635, 22436, MSD0123-PS, MSD1044-PS, MSD0183-PS, MSD0192-PS, MSD0193-PS, MSD1063-PS, MSD0292	WQTC Elimination	$34,062,000	2015	No Change	5-yr, 3-hr storm 40870, 40871, 40872, 42680, 65633, 65635, 22436, MSD0123-PS, MSD1044-PS, MSD0183-PS, MSD0192-PS, MSD0193-PS, MSD1063-PS, MSD0292	WQTC Elimination	$1,941,900	2015
43	Prospect WQTC Elimination, Harrods Creek PS, ORFM System Improvements Phase 2: HCPS & FM *S_OR_MF_NB04_M_3_B_B*			PS and Pipe Upgrades		2015		PS and Pipe Upgrades		2015	No Change		PS and Pipe Upgrades		2015
44	Prospect WQTC Elimination, Harrods Creek PS, ORFM System Improvements Phase 3: ORFM System Improvements *S_OR_MF_NB04_M_3_B_B*			Flow Diversion, PS and Pipe Upgrades		2016		Flow Diversion, PS and Pipe Upgrades		2016	2015. Replaced Muddy Fork Interceptor Upsizing with Muddy Fork Offline Storage Basin.		Flow Diversion, PS Upgrade, Offline Storage Basin		2016
MILL CREEK AREA															
45	Shively Interceptor *S_MC_WC_NB01_M_01_A*	Lynnview Ditch	10-yr, 3-hr storm 04498, 04542, 81814-W, MSD0047-PS, MSD0050-PS	Pipe Upgrades	$19,034,000	2012	10-yr, 3-hr storm 04498, 04542, 81814-W, MSD0047-PS, MSD0050-PS	Pipe Upgrades	$11,473,500	2012	No Change	10-yr, 3-hr storm 04498, 04542, 81814-W, MSD0047-PS, MSD0050-PS	Pipe Upgrades	$11,473,500	2012
46	East Rockford PS Relocation *S_MC_WC_NB02_S_03_C*	Mill Creek	2-yr, 3-hr storm for 04699-W	PS Replacement and Relocation	$1,488,000	2012	2-yr, 3-hr storm for 04699-W	PS Replacement and Relocation	$541,300	2012	No Change	2-yr, 3-hr storm for 04699-W	PS Replacement and Relocation	$541,300	2012
SMALL WQTC AREA															
E	Lucas Lane PS Inline Storage *S_FF_NB01_S_09A_C_A*	Goose Creek	2-yr, 3-hr storm for MSD0199-LS	Inline Storage	$261,000	2021	2-yr, 3-hr storm for MSD0199-LS	Inline Storage	$320,000	2021	2021. Project eliminated due to more detailed model calibration.	2-yr, 3-hr storm for MSD0199-LS	Project Eliminated	N/A	N/A
47	Riding Ridge PS Improvements *S_HC_HN_NB02_S_03_C_A*	Harrods Creek	2-yr, 3-hr storm for MSD1060-LS	PS Upgrades	$31,000	2014	2-yr, 3-hr storm for MSD1060-LS	PS Upgrades	$31,000	2014	No Change	2-yr, 3-hr storm for MSD1060-LS	PS Upgrades	$19,200	2014
48	Gunpowder PS Inline Storage *S_HC_HN_NB02_S_09A_C_B*	Harrods Creek	2-yr, 3-hr storm for MSD1055-LS	Inline Storage	$251,000	2021	2-yr, 3-hr storm for MSD1055-LS	Inline Storage	$251,000	2021	2021.Revised completion date to December 31, 2025.	2-yr, 3-hr storm for MSD1055-LS	Inline Storage	$800,000	2025
E	Fox Harbor Inline Storage *S_HC_HN_NB03_S_09A_A_A*	Harrods Creek	10-yr, 3-hr storm for 62769	Inline Storage	$468,000	2021	10-yr, 3-hr storm for 62769	Inline Storage	$468,000	2021	2019. Project eliminated due to more detailed model calibration.	10-yr, 3-hr storm for 62769	Project Eliminated	N/A	N/A

Table ES.1.1-6 Final SSDP Projects Including Project Modifications

	FINAL SSDP PROJECT NAME AND IOAP ID	RECEIVING STREAM	2009 SSO(S) ELIMINATED & LEVEL OF PROTECTION	2009 TECH AND SIZE	2009 COST ESTIMATE	2009 FINISH DATE	2012 SSO(S) ELIMINATED & LEVEL OF PROTECTION	2012 TECH AND SIZE	2012 COST ESTIMATE	2012 FINISH DATE	MODIFICATION APPROVAL YEAR AND DESCRIPTION	2021 SSO(S) ELIMINATED & APPROVED LEVEL OF PROTECTION	2021 TECH AND SIZE	2021 COST ESTIMATE	2021 COMPLETION SCHEDULE DATE OR CERTIFIED YEAR
49	Fairway View PS Improvements *S_FF_LF_NB01_S_03_C_A*	Harrods Creek	2-yr, 3-hr storm for MSD1065-PS	PS Upgrades	$101,000	2014	2-yr, 3-hr storm for MSD1065-PS	PS Upgrades	$101,000	2014	No Change	2-yr, 3-hr storm for MSD1065-PS	PS Upgrades	$359,500	2014
50	Lake Forest PS SSO Investigation *S_FF_LF_NB01_S_13_C_A*	Chenoweth Run	N/A storm for MSD1169-LS	Monitor	$650,000	2012	N/A storm for MSD1169-LS	Monitor	$650,000	2012	No Change	N/A storm for MSD1169-LS	Monitor	$650,500	2012
51	St. Rene Rd PS Inline Storage *S_FF_CH_NB01_S_09A_C_A*	Chenoweth Run	2-yr, 3-hr storm for 94187	Inline Storage	$43,000	2014	2-yr, 3-hr storm for 94187	Inline Storage	$43,000	2014	2015. Project changed to PS Elimination	2-yr, 3-hr storm for 94187	Flow Diversion	Included in Jeffersontown WQTC Elimination	2014
COMBINED SEWER SYSTEM AREA															
52	Sonne PS I/I Investigation *S_OR_MF_42007_S_07_C*	Paddy Run	2-yr, 3-hr storm for MSD0042-PS	I/I Reduction	$281,000	2011	2-yr, 3-hr storm for MSD0042-PS	I/I Reduction	$846,500	2011	No Change	2-yr, 3-hr storm for MSD0042-PS	I/I Reduction	$846,500	2011
53	Camp Taylor System Improvements, Phase 1: SSES *S_SF_MF_30917_M_09_A*	Muddy Fork Beargrass Creek	10-yr, 3-hr storm 08717, 13931, 13943, 36763, 44396, 44397, 66349, 104223, 104231	SSES	$37,927,000	2014	10-yr, 3-hr storm 08717, 13931, 13943, 36763, 44396, 44397, 66349, 104223, 104231	SSES		2011	2012. Modification combined Phases 2 & 3 and expanded overall area	10-yr, 3-hr storm 08717, 13931, 13943, 36763, 44396, 44397, 66349, 104223, 104231	SSES	$12,367,100	2011
54	Camp Taylor System Improvements, Phase 2: Replace & Rehabilitate Sewers *S_SF_MF_30917_M_09_A*			Sewer Replacement & Rehabilitation				Sewer Replacement & Rehabilitation		2017			Sewer Replacement & Rehabilitation	$29,345,500	2013
55	Camp Taylor System Improvements, Phase 3: Replace & Rehabilitate Sewers *S_SF_MF_30917_M_09_A*			Sewer Replacement & Rehabilitation											2017
56	Camp Taylor System Improvements, Phase 4: Offline Storage *S_SF_MF_30917_M_09_A*			Offline Storage				Offline Storage		2024	2021.Revised completion date to December 31, 2035. Future: Monitoring on-going – project may not be necessary		Offline Storage	$23,972,300	2035
57	Hazelwood PS I/I Investigation & Rehabilitation *S_MC_MF_55665_S_07_C*	Manslick Branch	2-yr, 3-hr storm for 55665	I/I Reduction	$184,000	2011	2-yr, 3-hr storm for 55665	I/I Reduction	$382,000	2011	No Change	2-yr, 3-hr storm for 55665	I/I Reduction	$382,100	2011
INTERIM SSDP															
1	Hikes Lane Interceptor and Highgate Springs	South Fork Beargrass Creek and Wedgewood Ditch	2-yr, 3-hr storm for 18134, 18298, 18302, 18483, 18595, 49224, 49236, 49672, 49673, MSD0012-PS	New Sewer	$23,183,000	2012	N/A	N/A	N/A	N/A	N/A	N/A	N/A	$13,821,500	2012
2	Southeastern Diversion Structure & Interceptor	South Fork Beargrass Creek	8426, 8427, 8430, 8431, 18654, 30680, 30681, 30701, 30702, 30704, 49647, 63779, 72571-X	Diversion Structure	$1,906,000	2012	N/A	N/A	N/A	N/A	N/A	N/A	N/A	$8,589,600	2012
3	Northern Ditch Diversion Interceptor	Northern Ditch	MSD0271	New Sewer	$21,639,000	2011	N/A	N/A	N/A	N/A	N/A	N/A	N/A	$14,104,600	2011

Table ES.1.1-6 Final SSDP Projects Including Project Modifications

	FINAL SSDP PROJECT NAME AND IOAP ID	RECEIVING STREAM	2009 SSO(S) ELIMINATED & LEVEL OF PROTECTION	2009 TECH AND SIZE	2009 COST ESTIMATE	2009 FINISH DATE	2012 SSO(S) ELIMINATED & LEVEL OF PROTECTION	2012 TECH AND SIZE	2012 COST ESTIMATE	2012 FINISH DATE	MODIFICATION APPROVAL YEAR AND DESCRIPTION	2021 SSO(S) ELIMINATED & APPROVED LEVEL OF PROTECTION	2021 TECH AND SIZE	2021 COST ESTIMATE	2021 COMPLETION SCHEDULE DATE OR CERTIFIED YEAR
4	Sinking Fork Relief Sewer	Middle Fork Beargrass Creek, Upper Sinking Fork	21103, 25012, 63319	New Sewer	$1,741,000	2010	N/A	N/A	N/A	N/A	N/A	N/A	N/A	$1,437,300	2009
5	Beechwood Village Sanitary Sewer Replacement	Upper Sinking Fork	2-yr, 3-hr storm for 21061, 21089, 21101, 21153, 21156	Sewer Replacement, Rehab	$12,519,000	2011	N/A	N/A	N/A	N/A	N/A	N/A	N/A	$7,982,100	2010
6	Derek R. Guthrie WQTC	Ohio River, Black Pond Creek, Alvey Ditch, Mendora Branch, Mill Creek	10-yr, 3-hr storm for wet weather SSOs	100 MGD High Rate Treatment Facility	$122,000,000	2012	N/A	N/A	N/A	N/A	N/A	N/A	N/A	$96,358,900	2012

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Appendix A Acronyms and Abbreviations

AACE	Association for the Advancement of Cost Engineering
ACD	Amended Consent Decree
AM	Asset Management
AO	Agreed Order
AAOV	Annual Average Overflow Volume
BG	Billions of Gallons
BGC	Beargrass Creek
BMP	Best Management Practice
BOD	Biological Oxygen Demand
CAH	Cold Water Aquatic Habitat
CAP	Morris Forman WQTC Action Plan
CD	Consent Decree
CDS	Continuous Deflection Separator
CFU	Coliform Forming Unit
CHP	Combined Heat and Power
CIP	Capital Improvement Plan
CMMS	Computerized Maintenance Management System
CMOM	Capacity, Management, Operation, and Maintenance Program
CPE-CCP	Comprehensive Performance Evaluation-Composite Correction Plan
CRCC	Customer Relations Call Center
CRRP	Critical Repair and Replacement Plan
CSO	Combined Sewer Overflow
CSOP	Combined Sewer Operational Plan
CSS	Combined Sewer System
CSSA	Continuing Sanitary Sewer Assessment
CWA	Clean Water Act
D/T	Dilution to Threshold
DAFT	Dissolved Air Flotation Tanks
DMR	Discharge Monitoring Report
DRGWQTC	Derek R. Guthrie Water Quality Treatment Center

DRI	Drainage Response Initiative
DTPD	Dry Tons Per Day
DWF	Dry Weather Flow
DWS	Domestic Water Supply
EAP	Early Action Plan
EPA	United States Department of Environmental Protection
FEPS	Morris Forman WQTC Final Effluent Pump Station
FM	Force Main
FOG	Fats, Oils, and Grease
FPSs	Flood Pump Stations
FY	Fiscal Year
GIS	Geographical Information System
GPM	Gallons Per Minute
I/I	Infiltration and Inflow
IBI	Index of Biotic Integrity
IOAP	Integrated Overflow Abatement Plan
ISSDP	Interim Sanitary Sewer Discharge Plan
JCPS	Jefferson County Public Schools
KDEP	Kentucky Energy and Environment Cabinet
KDOW	Kentucky Department of Water
KPDES	Kentucky Pollution Discharge Elimination System
LF	Linear Feet
LOC	Level of Control
LOJIC	Louisville and Jefferson County Information Consortium
LOP	Level of Protection
LS	Lift Station
LTCP	Long Term Control Plan
LTMN	Long Term Monitoring Network
M	Millions of Dollars
MCC	Motor Control Center
MG	Millions of Gallons
MGD	Millions of Gallons per Day

ML	Milliliter
MOPs	Modeled Overflow Points
MSD	Louisville-Jefferson Metropolitan Sewer District
MS4	Municipal Separate Storm Sewer System
MW	Megawatt
NASSCO	National Association of Sewer Service Companies
NMC	Nine Minimum Controls
NOV	Notice of Violation
NPDES	National Pollutant Discharge Elimination System
O&M	Operations & Maintenance
ORFM	Ohio River Force Main
ORFPS	Ohio River Flood Protection System
ORSANCO	Ohio River Valley Water Sanitation Commission
OSRW	Outstanding State Resource Water
PACP	Pipeline Assessment and Certification Program
PCCM	Post Construction Compliance Monitoring Program
PCR	Primary Contact Recreation
PLC	Programmable Logic Controller
POTW	Publicly Operated Treatment Works
PS	Pump Station
QAPP	Quality Assurance Project Plans
QA/QC	Quality Assurance/Quality Control
R&R	Renewal & Replacement
RAS	Return Activated Sludge
RCP	Reinforced Concrete Pipe
ROW	Right-of-Way
RTC	Real Time Control
S&F	Solids and Floatables
SAMP	Strategic Asset Management Plan
SCAP	Sewer Capacity Assurance Plan
SCR	Secondary Contact Recreation
SEP	Supplemental Environmental Projects

SIU	Significant Industrial User
SOPs	Standard Operating Procedures
SORP	Sewer Overflow Response Protocol
SSDP	Sanitary Sewer Discharge Plan
SSES	Sanitary Sewer Evaluation Studies
SSO	Sanitary Sewer Overflow
SSOP	Sanitary Sewer Overflow Plan
SSS	Sanitary Sewer System
SWMM	Stormwater & Wastewater Management Model
TAMP	Tactical Asset Management Plan
TDH	Total Dynamic Head
THP	Thermal Hydrolysis Process
TMDL	Total Maximum Daily Load
TSS	Total Suspended Solids
UAA	Use Attainability Analysis
UMF	Upper Middle Fork
UofL	University of Louisville
USACE	United States Army Corps of Engineers
USGS	United States Geological Survey
UV	Ultraviolet Radiation
VFD	Variable Frequency Drive
WAH	Warm Water Aquatic Habitat
WAS	Waste Activated Sludge
WASP5	Water Quality Analysis Simulation Program Version 5
WDRs	Wastewater and Stormwater Discharge Regulations
WEF	Water Environment Federation
WIFIA	Water Infrastructure Finance and Innovation Act
WIN	Waterway Improvements Now
WQT	Water Quality Tool
WQTC	Water Quality Treatment Center
WWT	Wet Weather Team
WWTPs	Wastewater Treatment Plants

APRIL 30, 2021

2021 IOAP MODIFICATION

VOLUME 3 FINAL SSDP, CHAPTER 1

METROPOLITAN SEWER DISTRICT

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APPENDICES

There are no appendices associated with this Chapter.

Chapter 1: INTRODUCTION

Special Note – 2021 IOAP Modification: The revisions incorporated into Chapter 1 of Volume 3 provide context for the Second Amended Consent Decree (ACD) negotiated in 2021. The order which background information is presented in this Chapter was revised to be chronological. A new section was added to describe the 2021 Second ACD. A crosswalk summarizing the Volume 3 changes between the 2012 and 2021 IOAP documents is provided in Table 1.0-1. Information regarding the status of MSD's wastewater system has been updated to reflect current conditions as of December 31, 2020 where appropriate. Some information from the 2009 and 2012 documents remains to provide historical context related to the overall IOAP. The 2012 IOAP submittal, Volume 3, Chapter 1 included one appendix related to the Plumbing Modification Program. This appendix has been moved to Volume 1, Chapter 4. Therefore, this Chapter has no associated appendices.

The statistical data for the sanitary sewer overflows (SSOs) reported, specifically related to individual SSO volumes and frequency, were derived from the hydraulic models calibrated in 2007. Since then, a more detailed calibration and validation effort has adjusted the average volumes and frequencies. The data presented in this and subsequent chapters represents the 2008 initial system conditions. Project modifications due to improved system characterization data, hydraulic model recalibration and other changed conditions are described in Chapters 3 and 4 to reflect current 2021 conditions.

Table 1.1-1 2021 IOAP Modification SSDP Crosswalk

CRITERIA	DESCRIPTION	VOLUME 3 CHAPTERS OR SECTIONS	2012 IOAP SUBMITTAL	2021 IOAP MODIFICATION
SSDP Projects	Work Progress	SSOP, ISSDP 2.2.1 WQTC eliminations Table 4.0-1 projects	Work through 2012 was noted	Added summary of work performed 2009 - present
	Minor Project Modifications	Table 4.0-1 Appendix 4.0-1 Appendix 4.0-2	Information was accurate through 2012.	Revised SSDP table to include all project modifications and provided copies of letter modifications and certifications.
New Information Since 2012 IOAP Submittal	Clarified which information is from 2009, 2012, 2021	Multiple places throughout Chapters 1, 2, 3, and 4	Process and data remain valid and accurate	New note added at the front of each chapter.
		1.2 Final SSDP Chapter 5	New Chapter 5 added for 2012 modifications	Chapter 5 deleted, and information integrated into Chapters 3 and 4
		1.3.2 CMOM Report 1.3.1.3 Hansen system 1.3.3 SORP 1.3.4 ISSDP 2.1.8 small WQTCs 2.2.3.1 flow monitoring 2.2.3.2. rain gauges 2.3.1. modeling 2.3.5.11 model 2.4.3 model regions 3.3 - all tables 3.3.1.1 screening 3.3 benefit-cost analyses	Information was accurate as of 2012. The tables in section 3.3 were updated or removed and the red screening box was removed that stated "SSDP information outdated refer to Chapter 5".	New information was added to reflect work or pertinent information since the 2012 IOAP submittal.

Table 1.1-1 2021 IOAP Modification SSDP Crosswalk

CRITERIA	DESCRIPTION	VOLUME 3 CHAPTERS OR SECTIONS	2012 IOAP SUBMITTAL	2021 IOAP MODIFICATION
	Verb Tense	Multiple places throughout Chapters 1, 2, 3, and 4	No change to content	Verb changed to past tense for work that been performed
Consolidated Information	Consent Decree Background	1.1.1 background	Reduced text added reference to Volume 1	Consolidated information into Volume 1, Chapter 1
	Public Information	1.3.3.3 public notification 4.3 public participation	Reduced text added reference to Volume 1	Consolidated information into Volume 1, Chapter 3
	Plumbing Modification Program	1.3.1.4 PMP Program	Reduced text added reference to Volume 1	Consolidated information into Volume 1, Chapter 4, Section 4.5.1
	Level of Protection	4.1.2 Table 4.1.2	Information was accurate in 2012	LOP updated for SSDP projects.

1.1. BACKGROUND

Refer to Volume 1, Chapter 1, Section 1.1 for background information and an overview of MSD's Consent Decree, Amended Consent Decree (ACD), and the Second ACD. The background information included in this section relates specifically to the Final SSDP and MSD's measures to eliminate SSOs.

1.1.1. FINAL SSDP

MSD is required to prepare and submit a Final SSDP designed to eliminate unauthorized discharges in the separate sanitary sewer system (SSS). The Consent Decree requires the Final SSDP to include consideration of conventional and innovative or alternative designs as part of the plan, including, but not limited to, sewer rehabilitation, sewer separation, relief sewers, above ground or below ground storage, high rate secondary treatment, illicit connection removal, remote wet weather secondary treatment facilities, and other appropriate alternatives. As interim milestones to the original Consent Decree, MSD was also required to update its existing Sanitary Sewer Overflow Plan (SSOP) and to prepare an Interim SSDP identifying remedial measures to eliminate specific unauthorized discharges. Both the updated SSOP and the Interim SSDP were submitted and approved. The projects required by the Interim SSDP and the Updated SSOP were completed and certified. Because these items were completed, the SSOP and Interim SSDP were removed as requirements in the Second ACD. Previous references to these documents remain in this IOAP for historical reference.

The Final SSDP is intended to identify remedial measures to eliminate unauthorized discharges from the separate SSS locations not previously addressed in the Interim SSDP. The Final SSDP contains the long-term projects including schedules, milestones, and deadlines as required by the Consent Decree. The 2009 Final SSDP also included the results of an evaluation of WQTC peak flow treatment capacity for the Jeffersontown WQTC and any WQTC that would receive additional flow as a result of any Final SSDP project. Such evaluations are consistent with the EPA publications "Improving POTW Performance Using the Composite Correction Approach," EPA CERI, October 1984, and "Retrofitting POTWs," EPA CERI, July 1989.

The Final SSDP is in coordination with elements of the Capacity, Management, Operations, and Maintenance (CMOM) programs. The Final SSDP includes the following elements and descriptions:

- Maps of known unauthorized discharges (capacity related), including the areas and sewer lines that serve as a tributary to each unauthorized discharge

- Each known unauthorized discharge location including:
    - Discharge frequency
    - Type of discharge and the receiving stream
    - Annual volume of the discharge
    - Immediate area and downstream land use (including the potential for public health concerns)
    - Studies to investigate the discharge (previously performed within the last five years, current, or proposed)
    - Rehabilitation or construction work to remediate or eliminate the discharge (previously performed within the last five years, current, or proposed)
- Prioritization of unauthorized discharge locations based upon frequency, volume, impact on receiving streams and public health
- Involvement of stakeholders in the planning, prioritization, and selection of projects
- Documentation of the prioritization process including:
    - Hydraulic modeling, including calibration, validation, addressing wet-weather inflow and infiltration (I/I) and accounting for future growth (build-out)
    - Baseline or existing conditions
    - Rules for abating SSOs and surcharged areas
    - Preliminary or initial solutions
    - Ground-truthing or field verification of preliminary locations
    - Sizing of facilities (solutions) and determining benefits and costs for facilities
    - Level of protection
    - Final costs and descriptions of preferred solutions
- Source Control, including targeted I/I reduction and plumbing modification programs
- Measures of success including: Elimination of SSOs, Reduction or elimination of basement flooding and Reduction in I/I
- Remedial measures, expeditious budgets, and schedules for design, initiation of construction and completion of construction. The schedules are phased based upon sound engineering judgment and do not extend beyond December 31, 2035
- Continuous modifications, including plans for measuring success via flow monitoring and modeling and addressing newly discovered SSOs

1.2. FINAL SSDP DOCUMENT ORGANIZATION

As the third volume of the IOAP, the Final SSDP focuses on the control and mitigation of SSOs. The following text outlines the Final SSDP with a brief description on the focus of each chapter.

Chapter 1 Introduction

This chapter presents summaries of previous/ongoing projects and programs, describing the relationship to the current planning process. Previous/ongoing projects and programs include the Updated SSOP, CMOM, Sewer Overflow Response Protocol (SORP), and Interim SSDP. The final section of the chapter describes in general terms the approach used to evaluate the projects and programs of the Final SSDP.

Chapter 2 System Characterization

This chapter defines the goals of the system characterization program and provides an extensive compilation and analysis of unauthorized discharges in the separate SSS. This chapter includes MSD service area maps showing the unauthorized discharge areas and associated WQTCs, collection system modeling, and system monitoring. This chapter also includes a description of the computer models used to simulate separate SSS areas.

Chapter 3 Development and Evaluation of Alternatives for SSO Abatement

This chapter presents the methodologies used to evaluate the various discharge elimination solutions. The chapter defines and discusses strategies and technologies available to control and eliminate unauthorized discharges in the separate SSS. Discussions include alternatives for discharge elimination in each area of an unauthorized discharge. This chapter provides a summary of each discharge abatement alternative and the general basis for changes made to the initially selected measure(s) for projects through 2020. The evaluation criterion included feasibility screening, computer modeling, quality control, level of protection, cost estimates, and a benefit-cost analysis.

Chapter 4 Selection of the Sanitary Sewer Discharge Plan

This chapter includes an explanation of the values-based risk management process used to select and prioritize the Final SSDP alternatives. This chapter examines the various issues associated with implementation of the alternative(s) selected as integral to the Final SSDP. Issues discussed include community values, benefit-cost analysis, environmental impact, technical concerns, prioritization of projects, and implementation schedules compatible with the Consent Decree requirements. This chapter presents a summary of the Final SSDP projects including changes made since 2009, project completion dates, technologies, and the level of protection.

Note: In the 2012 IOAP submittal, a Chapter 5 was included that provided a summary of project modifications to the IOAP between 2009 and 2012. The 2012 project modifications, in addition to schedule modifications as part of this submittal, have been incorporated into Chapters 3 and 4 of this Volume 3.

1.3. SSDP PLANNING APPROACH, PROGRAMS, AND STUDIES

This section provides a summary of previous and ongoing programs relative to SSO control. The updated SSOP and the Interim SSDP descriptions describe programs that preceded the IOAP. The CMOM and SORP programs precede the IOAP and continue to be implemented and updated. These programs and studies serve as the foundation for the current planning effort of the Final SSDP. The following plans and programs are summarized in this section.

- Updated SSOP
- CMOM Programs
- SORP
- Interim SSDP

1.3.1. UPDATED SANITARY SEWER OVERFLOW PLAN (SSOP)

2021 Update: MSD prepared and submitted the Updated Sanitary Sewer Overflow Plan (SSOP) on February 10, 2006. This plan included an overview of the MSD sanitary sewer overflow abatement program and specific actions taken to reduce/eliminate overflows from the sanitary sewer system. This document included a list of the proposed improvements to be accomplished by December 31, 2008. Activities required under the Updated SSOP have been completed. The following description of the SSOP in this IOAP is from the 2009 IOAP and remains for historical reference.

MSD has been active in the SSO planning area for years and has focused collection system repair and rehabilitation efforts on wet weather I/I issues that contribute to SSOs. The projects have been successful in reducing SSO volume and frequencies but have not completely eliminated SSOs. Prior to the development of the Final SSDP, the SSOP was MSD’s centralized program for managing the investigation, prioritization, and rehabilitation of the separate SSS. The program goals were to reduce SSOs, basement backups, and other unauthorized discharges. This program represented MSD’s proactive approach toward eliminating excess I/I from the separate SSS. The SSOP was submitted on February 10, 2006, to the EPA and KDEP; however, no review or approval was required by the Consent Decree.

The previous studies have been divided into the following phases and are further described in the sections that follow:

- Flow Monitoring
- Sanitary Sewer Evaluation Study (SSES) and Other Sewer Investigation/Study Projects
- Hydrologic and Hydraulic Modeling
- Rehabilitation, Repair or Replacement Projects
- Post-Rehabilitation Flow Monitoring and Results

1.3.1.1. FLOW MONITORING

The goal of flow monitoring is to collect sufficient dry and wet weather data to assess I/I levels, provide calibration data to models and to assess the success of any rehabilitation. During the flow monitoring phase, sewersheds are divided into sub-basins which often coincide with key hydraulic features or SSO locations. To collect data, rain gauges and flow monitors are installed in each sub-basin and monitored for a specified period of time or until sufficient rainfall and flow responses has been obtained. Each sub-basin flow monitoring data is analyzed for typical parameters such as peaking factors, average dry weather flow, and wet weather flow characteristics in order to determine the nature of the I/I problem. This flow data serves as the basis for prioritizing projects in the sewershed, calibration of models for further study, and assessing rehabilitation. Flow-monitoring studies performed from 1997 to 2008 are summarized in Error! Reference source not found..

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Table 1.3.1 Flow Monitoring Studies (1997-2008)

SVC AREA	PROJECT NAME	FLOW MON BEGIN DATE	FLOW MON END DATE	COLLECTION PERIOD (DAYS)	# OF SUB-BASINS	# OF FLOW MON USED	# OF SIGNIFICANT RAIN EVENTS	I/I FOUND?	RESULTS DEVELOPED INTO	PROJECT COMPLETION DATE
MF	Beechwood Village Flow Monitoring	6-Mar-98	9-Aug-98	157	--	5	6	Yes	SSES Project	July-99
MF	Ohio River Force Main/Muddy Fork Flow Monitoring	15-Jan-99	12-Mar-99	56	44	7	2	Yes	SSES Projects	December-99
MF	Priority SSO Flow Monitoring Part 1: Middle Fork Beargrass Creek	19-Feb-99	4-Apr-99	45	60	1	2	Yes	SSES Projects	February-99
MF	Beechwood Village Chimney Seal and Cured-in-place Pipe Installation: Post-rehab Flow Monitoring	12-Feb-01	16-Apr-01	64	--	6	2	Reductions Found	Post-Rehab Flow Monitoring	June-01
MF	Hikes Point Chimney Seal and Cured-in-place Pipe Installation: Post-rehab Flow Monitoring	12-Feb-01	16-Apr-01	64	--		2	Reductions Found	Post-Rehab Flow Monitoring	June-02
MF	Buechel Branch Chemical Root Control: Post-rehab Flow Monitoring	3-Jan-02	3-Mar-02	60	--		2	Reductions Found	Post-Rehab Flow Monitoring	June-02
MF	Hikes Point Real-Time Control Flow Monitoring	17-Jan-02	16-May-02	120	--	5	12	Yes	RTC Model Calibration	November-02
MF	Middle Fork Flow Monitoring	9-Dec-03	16-Feb-04	70	--	23	2	--	Model Calibration	May-04
MF	County-wide Flow Monitoring	15-Jan-07	8-Jun-07	144	--	86	--	--	--	--
MF	County-wide Flow Monitoring	3-Nov-05	24-Jul-07	628	--	15	--	--	--	--
DRG	Valley Village Flow Monitoring	3-Mar-98	11-May-98	68	6	6	3	Yes	System Characterization	February-99
DRG	Priority SSO Flow Monitoring Part 2: Pond Creek (and: Silver Heights, McNeely Lake) Flow Monitoring	13-Apr-98	27-May-98	45	48	48	3	Yes	SSES Projects	February-99
DRG	Mill Creek Flow Monitoring	6-Oct-98	18-Jan-99	105	--	4	4	--	System Characterization	April-99
DRG	Pond Creek Chimney Seal and Cured-in-place Pipe Installation: Post-rehab Flow Monitoring	3-Jan-02	14-Mar-02	71	--		2	Reductions Found	Post-Rehab Flow Monitoring	2003
DRG	Mill Creek Flow Monitoring	16-Dec-01	18-Mar-02	92	6		2	Yes	System Characterization	June-02
DRG	Derek R. Guthrie Flow Monitoring	23-Dec-02	5-Feb-03	45	--	13	--	--	Model Calibration	March-03
DRG	County-wide Flow Monitoring	8-Jan-07	20-Apr-07	102	--	23	--	--	--	--
DRG	County-wide Flow Monitoring	22-May-08	23-Jul-08	62	--	10	--	--	--	--
CC	Cedar Creek Flow Monitoring	16-Mar-99	6-May-99	51	6	6	4	Some	SSES Project	November-01
CC	Cedar Creek Watershed Flow Monitoring	23-Dec-02	5-Feb-03	45	8		--	--	Model Calibration	--
CC	County-wide Flow Monitoring	23-Mar-07	2-Jul-07	101	--	7	--	--	--	--
HC	Hite Creek (and Crestwood) Flow Monitoring	2-May-00	11-Jul-00	70	1	7	--	Yes	System Characterization	September-03
		14-Aug-00	23-Oct-00	70	1	1	3	Some	Flow Monitoring Data Correction	September-03
HC	County-wide Flow Monitoring	19-May-06	21-Jun-07	398	--	2	--	--	--	--
HC	County-wide Flow Monitoring	22-Mar-07	17-Jul-07	117	--	9	--	--	--	--
FF	Pope Lick Flow Monitoring	31-Jan-98	22-Mar-98	51	6	6	2	Yes	PS Sizing & SSES Project	December-99
FF	Woodland Hills Chimney Seal and Cured-in-place Pipe Installation: Post-rehab Flow Monitoring	5-Jan-00	31-Mar-00	87	--		2	A Few Improvements	Post-Rehab Flow Monitoring	June-01
FF	Pope Lick Chimney Seal and Cured-in-place Pipe Installation: Post-rehab Flow Monitoring	12-Feb-01	16-Apr-01	64	--		2	A Few Improvements	Post-Rehab Flow Monitoring	June-01
FF	County-wide Flow Monitoring	5-Apr-07	17-Jul-07	103	--	8	--	--	--	--
FF	County-wide Flow Monitoring	16-May-07	4-Aug-07	80	--	4	--	--	--	--
JT	Jeffersontown Flow Monitoring	1-Sep-98	10-Oct-98	40	23	24	2	Yes	System Characterization	June-99

Table 1.3.1 Flow Monitoring Studies (1997-2008)

SVC AREA	PROJECT NAME	FLOW MON BEGIN DATE	FLOW MON END DATE	COLLECTION PERIOD (DAYS)	# OF SUB-BASINS	# OF FLOW MON USED	# OF SIGNIFICANT RAIN EVENTS	I/I FOUND?	RESULTS DEVELOPED INTO	PROJECT COMPLETION DATE
JT	Jeffersontown Chimney Seal Installation: Post-rehab Flow Monitoring	5-Jan-00	31-Mar-00	87	--		3	Reductions Found	Post-Rehab Flow Monitoring	June-00
JT	Jeffersontown Cured-in-place Pipe Installation: Post-rehab Flow Monitoring	3-Jan-02	14-Mar-02	71	--		2	No Conclusions	Post-Rehab Flow Monitoring	June-02
JT	Jeffersontown Flow Monitoring	23-Dec-02	5-Feb-03	45	--	10	--	--	Model Calibration	March-03
JT	Jeffersontown I/I Rehab Phase 3: Post-rehab Flow Monitoring	8-Dec-03	26-Jan-04	50	--		2	Improvements Found	Post-Rehab Flow Monitoring	May-04
JT	Countywide Flow Monitoring	13-Jan-07	23-May-07	130	--	19	--	--	--	--
PP	Prospect Flow Monitoring	22-Dec-99	19-Feb-00	60	10	10	2	Yes	System Characterization	June-00

Service Areas: MF = Morris Forman, DRG = Derek R. Guthrie (formerly West County – WC), CC = Cedar Creek, HC = Hite Creek, FF = Floyds Fork, JT = Jeffersontown, PP = Prospect

Note: Derek R. Guthrie WQTC (formerly West County Wastewater Treatment Plant)

1.3.1.2. SANITARY SEWER EVALUATION STUDY (SSES) AND OTHER SEWER INVESTIGATIONS/STUDIES

The goal of an SSES is to provide data to identify likely sources of I/I and to prioritize areas for repairs. An SSES is an important tool for diagnosing the condition of the sewer system and determining what types of repairs might be necessary and successful. The defects identified are often used with flow monitor data to prioritize areas for rehabilitation, construction, and maintenance activities. The SSES process includes several tests and inspections that complement each other, which are described in the following text. Table 1.3.2 at the end of the section lists the studies that have been performed by MSD from 1997 to 2008.

Smoke Testing

The goal of smoke testing is to identify defects by emulating water entering inflow locations. Smoke under pressure flows through inflow defects to the surface, where it can be observed and documented.

The test consists of generating nontoxic, non-staining smoke and forcing it into less-than-full sewer lines by a portable, high-volume blower. The smoke can reach distances up to 600 feet and will appear at inflow locations that lead to the surface. The location is noted, and the smoke-test crew investigates the emission point. If the emission point is determined to be an inflow source (see Figure 1.3.1), the area is photographed, and the pertinent data are entered into MSD's data management system.

Figure 1.3.1 Smoke Indicating an Inflow Source at Manhole

Smoke testing is generally low cost and is a proven method for locating collection system defects, such as structurally damaged manhole frames and damaged cleanouts, and illicit connections, such as yard connections and cross-connected storm sewers. The smoke will also identify private side defects without accessing private property. This is critical given the increasing realization that private property defects can contribute significantly to wet weather I/I sources.

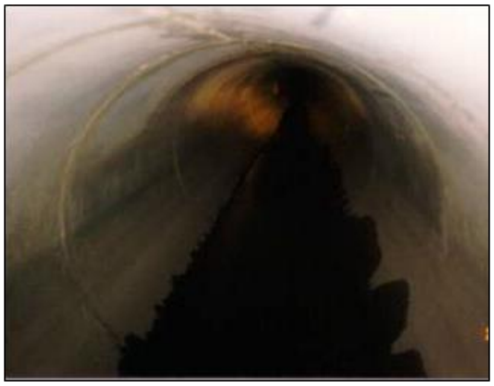
Manhole Inspections

The goal of manhole inspections is to visually identify defects that often contribute to inflow. Inspections can be done from the surface (see Figure 1.3.2), or if safety equipment is available, within the structure itself.

Inspections generally follow a checklist which is used to note the condition of various manhole features: cover, frame, risers, corbels and walls, pipe sizes, materials of construction, evidence of corrosion, and I/I (from the surface, cross connections, and illegal connections). It is also possible to lamp (shine high intensity light between manholes) the sewer between two adjacent manholes to look for defects and evidence of clogs or sedimentation.

Figure 1.3.2 Typical Manhole

Television Inspection Review



The goal of television inspection is to provide condition assessment of sewers. The pipe is cleaned if necessary, just prior to the television inspection. For television inspection review, a camera is lowered through a manhole and into the pipe and a continuous recording video inspection from within the line is completed with reference distances (See Figure 1.3.3). Inspections focus on pipe structural defects and improper connections. Beginning in 2005, the log information on each defect is used referencing Pipeline Assessment and Certification Program (PACP) codes, which is digitally linked to the video image. Inspections include noting sedimentation, pipe sags, and pipe defects.

Figure 1.3.3 Sewer Inspection

Dye Testing

The goal of dye testing is to emulate inflow sources using dyed water, which, unlike normal inflow, can be readily identified. Dye testing involves injecting dyed water into a suspected inflow source and then noting the appearance (or lack thereof) of dyed water in a nearby sanitary sewer (See Figure 1.3.4). The test will confirm potential cross-connections, inflow sources and structural defects. This test is generally used as a contingency after other tests such as smoke testing cannot positively identify potential cross-connections. After the dye has penetrated the pipeline, a television inspection may be used to precisely locate the problem area.

Figure 1.3.4 Dye Testing

Night Flow Isolation

The goal of night-flow isolation is to determine infiltration rates during periods of time when little sanitary flow can be expected, such as, during the middle of the night or early in the morning. Night flow testing consists of installing temporary weirs or other flow measuring devices at manholes to identify areas that have relatively high nighttime flows. In addition to the flow measurements, the real-time dissolved oxygen and temperature data can be noted.

The test can be conducted rather rapidly. This allows a large area to be analyzed in the course of a single night, which greatly aids in identifying high I/I areas. Water quality and temperature are also analyzed; infiltration has better water quality and lower temperature than sewer flow. Often night-flow isolation occurs over a series of nights and the preceding night's data is used to direct the subsequent night's test areas. Night-flow isolation must occur when there is no inflow and preferably, when the groundwater is higher than the pipe. This is typically a few days after a series of rainfall or in the fall months.

Wet Weather Inspections

The goal of wet weather inspections is to visually identify SSOs (See Figure 1.3.5) and surcharging. While the benefits of such inspections are obvious, it is very difficult to mobilize such inspections given the infrequency of overflow-causing rain events.

Tests can be aided by installing surcharge level indicators ahead of time. Surcharge level indicators are simple devices, which can indicate SSOs and surcharge conditions during wet weather. However, surcharge level indicators must be monitored frequently to minimize false readings. To indicate exfiltration of surcharged sewers inspections, dye may also be used. When time permits and where possible, inspections include estimating the timing of the SSO, the peak overflow rate, and the amount of overflow volume at each location.

Figure 1.3.5 Wet Weather Impact

Focused Electrode Leak Locator 41 Inspections

Figure 1.3.6 Inspection Setup

The goal of Focused Electrode Leak Locator 41 inspections is to determine defect locations through non-intrusive electrical means to complement or direct other SSES tests and inspections. Focused Electrode Leak Locator 41 is a technology that generates an electrical field from a specially-constructed electrode probe called a “sonde” and uses a second electrode (a metal stake) that is put in the ground surface adjacent to the pipe being tested (see Figure 1.3.6).

The sonde is pulled through a surcharged, non-conductive sewer pipe and the magnitude of the current flow is measured by the surface electrode. Spikes in electric current identify all types of pipe defects (within inches) that are potential locations for leaks including faulty joints, pipe cracks, and defective service connections. The variation of the current is recorded and displayed as a plot of current versus distance along the pipe. The Focused Electrode Leak Locator 41 inspection also assesses the pipe defect size and continuously tests along the pipe. This inspection is simple, accurate, reliable, repeatable, and can be used at any time of the year.

Table 1.3.2 Sanitary Sewer Evaluation Studies (SSES) 1997-2008

Service Area	Project Name	Completion Date	Smoke Testing (LF)	Manhole Inspections	Television Inspections (LF)	Dye Testing	Manhole Wet Well Investigation	Focused Electrode Leak Locator -41 (LF)	Cost
CC	Cedar Creek SSES	Nov. 2001	284,000	633	134,000	N/A	20 Hours	N/A	$246,000
FF	Pope Lick SSES	Dec. 1999	75,700	354	33,800	Yes	N/A	N/A	$388,000
HC	North County SSES	Sept. 2003	72,100	360	8,000	Yes	N/A	N/A	$291,000
JT	Jeffersontown Condition Assessment	Jul. 2005	86,000	N/A	56,000	N/A	N/A	N/A	$682,000
MF	Middle Fork SSES Phase 1A	Jul. 1998	126,350	600	31,100	Yes	N/A	N/A	$299,000
MF	Hikes Point SSES	Dec. 1998	500,000	2,143	Yes	Yes	Installed 25 flow meters and 4 rain gauges		$1,100,000
MF	Beechwood Village SSES	Jul. 1999	34,000	147	34,000	Yes	N/A	N/A	$117,000
MF	Buechel Branch SSES Phase 1	Mar. 2000	37,500	157	44,500	Yes	N/A	N/A	$50,000
MF	Middle Fork SSES Phase 1B	Jun. 2000	253,600	1,004	42,000	Yes	N/A	N/A	$434,000
MF	Middle Fork SSES Phase 2	Apr. 2002	214,814	954	38,294	Yes	N/A	N/A	$465,000
MF	Northern Ditch SSES	Sept. 2002	N/A	459	52,791	N/A	149	4,889	$272,000
PP	Prospect SSES	Oct. 2001	154,572	802	87,014	Yes	N/A	N/A	$143,000
DRG	Valley Village SSES	Feb. 1999	54,000	184	35,000	Yes	N/A	N/A	$193,000
DRG	McNeely Lake SSES	Dec. 1999	165,000	688	41,000	Yes	N/A	N/A	$494,000
DRG	Derek R. Guthrie SSES Phase 1A	Mar. 2000	242,500	932	48,400	Yes	N/A	N/A	$567,000
DRG	Derek R. Guthrie SSES Phase 1B	Sept. 2000	200,000	952	50,000	Yes	N/A	N/A	$936,000
DRG	Derek R. Guthrie SSES Phase 2	Jan. 2002	234,600	978	60,000	N/A	N/A	N/A	$491,000
DRG	Mill Creek SSES	Oct. 2002	150,000	682	30,000	Yes	N/A	N/A	$284,000
DRG	Pond Creek SSES	Oct. 2004	193,000	1,200	16,650	N/A	23,500	N/A	$306,000
		TOTALS	2,559,936	11,882	610,749		23,649	4,889	$6,151,000

Service Areas: CC = Cedar Creek, FF = Floyds Fork, HC = Hite Creek, JT = Jeffersontown, , MF = Morris Forman, PP = Prospect, DRG = Derek R. Guthrie
Note: Derek R. Guthrie WQTC (formerly West County Wastewater Treatment Plant)

1.3.1.3. HYDROLOGIC AND HYDRAULIC MODELING

The goal of hydrologic and hydraulic modeling is to provide a computer model that mimics the function of the actual sewer system, including sanitary flow and I/I sources. Once calibrated to dry and wet weather data, the model can be used to assess existing conditions, qualify and quantify deficiencies, and evaluate potential solutions. It also can serve as a tool for future planning and capacity assurance studies.

Hydrologic and hydraulic models of the MSD separate SSS have historically been constructed using the XP-SWMM (Stormwater and Wastewater Management Model) hydrologic and hydraulic modeling software. More recently, MSD's models have been converted to the Wallingford software known as InfoWorks. The models were populated with infrastructure data from MSD's Hansen Information Management System (Hansen) sewer asset database. The Hansen system is now referred to as the Infor Information Management System by the manufacturer. MSD is improving the functionality of this system in conjunction with its Strategic Asset Management Plan. Refer to Volume 1, Chapter 4 for additional information related to MSD's Asset Management Program. The Infor database includes manhole locations and depths, pipe sizes, pipe slopes, and other data. This data is supplemented with pump station data, survey data, and field investigations. The models are calibrated based on flow monitoring data and updated based on needs, resource, availability, system changes, and reporting requirements.

The hydraulic model has been used for improvement of the existing asset database, identification of significant hydraulic bottlenecks, testing rehabilitation scenarios, modeling wet weather system responses, SSO elimination alternatives, and identifying the impacts of future development scenarios. Additional detail on historic modeling, XP-SWMM model development, and future uses can be found in Volume 3, Chapter 2.

1.3.1.4. PLUMBING MODIFICATION PROGRAM

Special Note: The Plumbing Modification Program is discussed in detail in Volume 1, Chapter 4, Section 4.5.1. Information was removed from this section with the 2021 IOAP Modification to avoid duplication and/or contradicting information.

1.3.1.5. REHABILITATION, REPAIR OR REPLACEMENT PROJECTS

The goal of rehabilitation projects is to reduce or eliminate surcharging and SSOs through the actual repair of defects in areas of high I/I. MSD performs as-needed maintenance repairs based on planned maintenance, unplanned maintenance, and customer service requests. These repairs include mainline repairs, manhole repairs, property service connection repairs, and downspout disconnections. Table 1.3.3 summarizes the “repair required” work orders completed from 1997 to 2008.

Table 1.3.3 I&FP Work (1997-2008)

REPAIR REQUIRED	WORK ORDER COUNT
Slip Lining	1,559 (since October 2003)
Sewer Depression Repair	200
Sewer Cave-in	540
Property Service Connection Cave-in	845 (since January 2000)
Service Line Repair	14,407
Manhole Replaced	34
Manhole Repair	959
Manhole Raised	1,677
Manhole Lid Replacement	243
Manhole Installed	73
Manhole Frame Repair	287
Mainline Sewer Repair	1,171
Downspout Disconnection	174 (since November 2005)

Prioritization of rehabilitation areas draws on data from flow monitoring, SSES work, and computer modeling. The location and severity of the I/I issue dictates the order in which the projects are implemented. **Error! Reference source not found.** lists the individual rehabilitation projects were performed by MSD from 1997 to 2008.

Table 1.3.4 Rehabilitation Work (1997-2008)

SERVICE AREA	PROJECT NAME	COMPLETION DATE	CURED-IN-PLACE SEWER (LF)	CURED-IN-PLACE LATERAL CONNECTIONS	CHIMNEY SEAL INSTALLS	MANHOLE REHAB	COST
CC	Cedar Creek Phase 1	Oct 2001	2,859	12	432	N/A	$495,000

Table 1.3.4 Rehabilitation Work (1997-2008)

SERVICE AREA	PROJECT NAME	COMPLETION DATE	CURED-IN-PLACE SEWER (LF)	CURED-IN-PLACE LATERAL CONNECTIONS	CHIMNEY SEAL INSTALLS	MANHOLE REHAB	COST
CC	Cedar Creek Phase 2	Jun 2002	2,115	21	1,487	N/A	$1.015,000
FF	Woodland Hills Phase 2	Dec 1997	5,667	51	N/A	23	$474,000
FF	Woodland Hills Phase 1	Fall 1999	3,381	81	18	N/A	$485,000
FF	Pope Lick Phase 1A	Aug 2000	5,805	99	253	5	$941,000
FF	Pope Lick Phase 1B	Dec 2000	4,973	114	90	5	$839,000
HC	Interceptor Manhole Rehab	2004	N/A	N/A	64	21	$202,000
JT	Jeffersontown Phase 1A	Dec 1998	3,685	N/A	N/A	11	$188,000
JT	Jeffersontown Phase 1B	Jun 1999	N/A	N/A	408	N/A	$280,000
JT	Jeffersontown Manhole Rehab Pilot	Oct 1999	N/A	N/A	N/A	15	$45,000
JT	Jeffersontown Phase 1C	Oct 2001	N/A	N/A	755	N/A	$546,000
JT	Jeffersontown Phase 2	May 2002	2,540	67	920	N/A	$805,000
JT	Jeffersontown Phase 3	Sept 2003	3,247	38	320	120	$1,240,000
MF	Newmarket/Northf ield	1997	1,000	N/A	22	21	$226,000
MF	Hikes Point Phase 1A	Fall 1999	7,611	N/A	309	N/A	$670,000
MF	Old Cannons Lane	Fall 1999	2,153	20	12	N/A	$213,000
MF	Hikes Point Phase 1B	Fall 2000	Updated 1,885 LF of 15” clay sewer to 21” PVC sewer main				$656,000
MF	Hikes Point Phase 2	Jun 2001	N/A	N/A	701	N/A	$469,000
MF	Buechel Branch Phase 2	Sept 2001	chemical root control 52,888 LF		409	N/A	$423,000
MF	Hikes Point Phase 3	Oct 2001	8,062	95	N/A	N/A	$1,008,000
MF	Buechel Branch Phase 1	Nov 2001	2,782	26	N/A	N/A	$273,000

Table 1.3.4 Rehabilitation Work (1997-2008)

SERVICE AREA	PROJECT NAME	COMPLETION DATE	CURED-IN-PLACE SEWER (LF)	CURED-IN-PLACE LATERAL CONNECTIONS	CHIMNEY SEAL INSTALLS	MANHOLE REHAB	COST
MF	Beechwood Village I/I Remediation	Nov 2001	10,991	29	N/A	24	$608,000
MF	Middle Fork Phase 2	Feb 2002	1,872	47	382	N/A	$435,000
MF	ORFM Chimney Seal Reinstallation	2004	Reinstalled chimney seals disconnected by paving operations				$83,000
MF	Beechwood Village Lateral Lining	2005	Continuation of Beechwood Village Rehab Phase 1 Project from FY00				$532,000
MF	Northern Ditch Interceptor Rehab	Nov 2008	N/A	N/A	49	55	$120,000
MF	Sinking Fork Interceptor Rehab	Dec 2008	3,205	N/A	117	49	$480,000
MF	Middle Fork Interceptor Rehab	Dec 2008	958	N/A	27	35	$600,000
MF	Beargrass Interceptor (Hikes Point)	Dec 2008	Clean 4,558 LF	N/A	152	32	$200,000
MF	Goldsmith Ln/ Buechel Branch Interceptor	Dec 2008	Clean 3,737 LF	N/A	273	93	$250,000
DRG	McNeely Lake Phase 1A	Dec 2000	2,709	56	644	152	$1,068,000
DRG	WC/Valley Village	Mar 2001	3,326	Chemical root control 46,423 LF			$332,000
DRG	Derek R. Guthrie I/I Phase 2	Jun 2001	2,574	N/A	204	N/A	$461,000
DRG	Derek R. Guthrie Phase 1	Oct 2001	1,147	8	357	N/A	$362,000
DRG	Pond Creek Rehab	Nov 2001	7,036	130	N/A	N/A	$637,000
DRG	McNeely Lake Phase 1B	Nov 2001	4,624	27	N/A	N/A	$299,000
DRG	Derek R. Guthrie WQTC	May 2003	Improvements to prevent Mill Creek flood waters from entering WQTC				$180,000
TOTALS			**94,322**	**921**	**8,405**	**661**	**$18,140,000**

1.3.1.6. POST-REHABILITATION FLOW MONITORING AND RESULTS

After each rehabilitation phase, post-rehabilitation flow monitoring is performed. The monitoring program will be based on the original sub-basin monitoring. The flow monitors are placed in the same manholes that were used for preliminary testing, and are left to collect information until adequate wet weather response flow data is acquired. This monitoring often includes a control basin (one that is not rehabilitated) to normalize post-rehabilitation flow data for any seasonal discrepancies. A combination flow monitoring and calibration provides a way for data to be accurately compared for rehabilitation effectiveness.

Historically, post rehabilitation flow monitoring indicated that, in many areas, rehabilitation (pipe and lateral lining) resulted in inconsistent I/I reduction. Sometimes post-rehabilitation monitoring showed substantial reduction, yet other times it showed almost none. Private property I/I was suspected as the primary reason that rehabilitation had not proven more effective.

As a result, MSD's design rehabilitation philosophy has focused on building system capacity controls and not strictly the rehabilitation of public-side systems. Pipeline rehabilitation, however, does continue to be implemented in an ongoing capital program.

1.3.1.7. RELATION TO FINAL SSDP PLANNING

The SSOP was MSD's centralized program for managing the investigation, prioritization, and rehabilitation of the separate SSS to reduce unauthorized discharges. It documents the history of the MSD wet weather program and is related to the Final SSDP in this respect. The SSOP serves as a summary of historical efforts and findings to show the breadth and depth of past efforts in relation to eliminating SSOs. From 1997 through 2008, thirty-two projects costing nearly $16.5 million were completed and documented within the SSOP. The SSOP document serves as the obvious foundation for the Final SSDP by providing both data for evaluating current conditions and experience in adopting preferred solutions.

1.3.2. CAPACITY, MANAGEMENT, OPERATIONS AND MAINTENANCE (CMOM) PROGRAM

2021 Update: Per Paragraph 24.c. of the ACD, the CMOM Self-Assessment Report was submitted to EPA and KDEP on February 10, 2006. MSD received a letter of approval on August 22, 2006. The approved CMOM document can be viewed on the MSD Project WIN website, available at www.msdprojectwin.org.

The primary objectives of CMOM are as follows:

- Capacity – Ensuring that adequate wet and dry weather capacity is maintained in existing and new infrastructure.
- Management – Implementing programs in support of operations and maintenance activities required to ensure KPDES permit compliance and promote public health by remedying design, construction and operational deficiencies; training staff; and performing activities in a safe manner.
- Operations – Implementing written standard operating procedures to operate system components as designed to meet permit requirements.
- Maintenance – Implementing systematic, comprehensive asset maintenance and rehabilitation programs to prevent overflows, maximize system reliability, and ensure system sustainability.

Although the program implementation deadlines from the CMOM Self-Assessment Report were previously met, MSD continues to enhance the activities. Highlights of the CMOM program implementation are provided in the Consent Decree Annual Report and can be viewed on the Project WIN website, available at www.msdprojectwin.org.

The detailed descriptions of the CMOM activities contained below are from the 2009 IOAP and have not been updated. However, the overall descriptions of the program and activities are generally accurate.

According to the EPA, the purpose of the CMOM Program is to:

> *"incorporate many of the standard operation and maintenance activities that are routinely implemented by the owner or operator with a new set of information management requirements in order to:*
>
> - *Better manage, operate, and maintain collection systems*
> - *Investigate capacity constrained areas of the collection system*
> - *Proactively prevent SSOs*
> - *Respond to SSO events*
>
> *The CMOM approach helps the owner provide a high level of service to customers and reduce regulatory noncompliance."*

Like other sewer districts, MSD has been using many techniques outlined in CMOM for decades to continually enhance the system. In 2003, MSD initiated a CMOM Challenge Analysis as the first step in a comprehensive Self-Assessment Program to provide a management-level evaluation of their organizational structure and corresponding programs, activities, and tasks.

Specific objectives of the CMOM Challenge Analysis were to:

- Provide MSD's management staff with an overview of the fundamental components of EPA's proposed SSO Rule and CMOM provisions.
- Inventory and compare MSD's CMOM Program areas and activities with regards to EPA guidance material.
- Identify program activities that should be recommended for enhancement targeted at improving service or compliance performance.

The CMOM Self-Assessment Report was originally submitted to the EPA and KDEP on February 10, 2006, re-submitted on May 12, 2006, and approved on August 22, 2006. The full analysis can be found on the MSD Project WIN website at: https://www.msdprojectwin.org/library/.

Through the self-assessment process MSD documented that many activities were performing well. Nevertheless, in some cases, MSD implemented changes and improvement activities to provide continuity and consistency with other activities. The management policies, operational programs, and operational activities that were found to be performing well are listed below.

- Technical Training
- Skills Training
- Safety Training
- Safety Department
- Confined Space Entry
- General Safety Procedures
- Traffic Management
- Lock Out/ Tag Out
- Safety Equipment
- Performance Measures
- Monitoring of Street Pavement
- Mapping
- Acquisition Consideration
- Capital Improvement Program Funding

- Pretreatment Legal Support
- Septic Tank Haulers Legal Support
- "Call Before You Dig" Legal Support
- Industrial User Permitting
- Inspection and Sampling Enforcement

The self-assessment process also identified program areas and activities that would benefit from improvement, such as:

- Program 1. Continuous Sewer System Assessment
- Program 2. Infrastructure Rehabilitation
- Program 3. System Capacity Assurance Plan (SCAP)
- Program 4. Pump Station Preventive Maintenance Program
- Program 5. Gravity Line Preventive Maintenance Program
- Program 6. Sewer Use Ordinance Legal Support Program

Through continuous improved performance, MSD expects to see benefits such as:

- Reduced incidence of SSOs due to wet weather events
- Enhanced customer service response and relations
- Optimized existing resources to meet growing demands and expectations
- Financial stability through better anticipation of capital and operations and maintenance (O&M) requirements

1.3.2.1. RELATION TO FINAL SSDP PLANNING

As outlined above, the CMOM Self-Assessment Report identified areas that needed improvement, recommended specific improvements, and set a schedule for those improvements to be implemented. Implementation of improvements is critical for other programs, including the Final SSDP and the overall IOAP. MSD staff developed performance goals for the programs and activities that needed improvement and worked throughout the organization to discuss, develop, and implement the improvements.

MSD continues to improve programs with the intent of mitigating SSOs. The next step involves development and implementation of system capacity-related solutions to address issues, which is part of the Final SSDP.

Through the CMOM Program, MSD is to coordinate capacity decision criteria under a System Capacity Assurance Plan (SCAP). These criteria will:

- Improve upon existing support for each watershed's community values including a process to confirm and document the capacity of WQTCs, pump station, and conveyance systems.
- Identify hydraulic constrictions, which are characterized by upstream system capacity that is greater than downstream system capacity.
- Propose capacity improvements that support IOAP performance objectives.

- Directly affect the modeling efforts performed under the Final SSDP and the planning of SSO elimination projects.
- Confirm that sewers are designed to handle additional flow and prevent excessive I/I as a result of new connections.
- Prevent sewers already over-capacity during dry and/or wet weather from receiving new flows.
- Identify pump station and gravity line activities to be integrated into the Final SSDP.

1.3.2.2. SYSTEM CAPACITY ASSURANCE PLAN (SCAP)

The SCAP applies to the separate sanitary system only and works in conjunction with the Final SSDP to ensure that MSD's efforts for SSO abatement are successful. The SCAP is a living, dynamic document that will continue to change due to various components. Changing components include modeling improvements, map updates, Consent Decree program implementation, reporting automation, capital improvement projects, development capacity requests, and other CMOM and MSD programs. An overview of the SCAP can be found on the MSD Project WIN website at **www.msdprojectwin.org**.

The SCAP is the basis for coordinating capacity decision criteria for each separate SSS sewershed. Providing wastewater collection, conveyance, and treatment that will meet the expansion needs of MSD's customers, while protecting the environment and meeting regulatory requirements, are top priorities of MSD's facility improvements efforts.

New service connections contribute additional flow that utilizes available capacity in the system. Since wet weather capacity deficiencies have been identified as the cause for a significant portion of SSOs, it is important for MSD to have a program that ensures new sanitary flow connections do not cause or contribute to SSOs.

The objective of the SCAP is to enable MSD to authorize new sewer service connections or increases in flow from existing sewer service connections while making system improvements in accordance with the May 2006 CMOM recommendations. The SCAP process includes a programmatic approach for items such as confirming capacity of plants, pump stations, and conveyance systems; identifying hydraulic constrictions; and proposing capacity improvements that support interim and WQTC performance objectives. The SCAP contains technical information, methodology, and analytical techniques to be used that will:

- Calculate the peak flow capacity of system components (collector sewers, interceptor sewers, treatment plants and pump stations);
- Calculate the increase in flows from new service connections;
- Calculate the increase in peak flow capacity resulting from specific system improvements projects;
- Integrate current new development approvals, acquisition of sewers, and extension of service to un-sewered areas.

The SCAP also details the steps to approve new flow requests in areas of limited capacity through a flow credits "banking" system. This "banking" system requires that for every one gallon of new flow, three gallons of I/I must be removed from the system through rehabilitation. The Presumption Approach to this removal is outlined within the SCAP document; please refer to the SCAP document for additional detail.

1.3.3. SEWER OVERFLOW RESPONSE PROTOCOL (SORP)

The purpose of the SORP is to provide guidance to MSD personnel regarding response to SSOs, mitigation of the SSO's impact, public notification, and reporting of the SSO. Utilizing the SORP enables MSD to respond to SSOs in a consistent and effective manner and reduces an SSO's impact on the environment and human health.

2021 Update: Per Paragraph 24.d. of the Amended Consent Decree, MSD initially submitted the Sewer Overflow Response Protocol (SORP) to EPA and KDEP on February 10, 2006, received comments on March 13, 2006, resubmitted on May 12, 2006 and received an approval letter for the SORP on August 22, 2006.

The detailed description of the SORP program contained in this section is from the 2009 IOAP and has not been updated, but the section remains for historical reference.

MSD completely revised the SORP documentation in 2011. The draft of this revised document was submitted for comment on August 22, 2011. Comments from EPA and KDEP were received and addressed, and the document was resubmitted October 28, 2011. Final approval of the updated SORP document was received February 21, 2012. Modifications were made to the document in 2016 to reflect the elimination of the Jeffersontown WQTC, and were approved on July 21, 2017. A hard copy of the approved document has been distributed to each division throughout MSD and a viewable, downloadable electronic version has been posted to the MSD Project WIN website, available at **www.msdprojectwin.org**.

1.3.3.1. PREPARATORY ACTIONS

An important component of MSD's SORP is preparing for wet weather SSO incidents before they actually occur. By assuming an SSO could occur and taking proactive measures, MSD may prevent the SSO from actually occurring. In cases where the SSO cannot be prevented, this strategy minimizes MSD's response time, reduces the SSO's volume, and mitigates the SSO's impact.

MSD's preparatory strategy has two major components. The first is wet weather monitoring which provides early warning of events that may result in SSO conditions. If wet weather monitoring indicates that SSO conditions are likely, then the second component, the pre-positioning of personnel and equipment, is implemented.

1.3.3.2. OVERFLOW MANAGEMENT AND FIELD DOCUMENTATION

Once MSD becomes aware of a possible SSO event, a cascade of actions and responses begin. These actions include the following:

- Initial response, identifying the origin and cause of the SSO. Determining the boundaries of the SSO's impact area and performing an initial assessment of the SSO's impact are also required during the initial response. After the initial extent and impact are assessed, a control zone is established, and public notification is completed. The responding personnel determine which method, or combination of methods, will best minimize the SSO's impact.
- Mitigation, preventing an SSO from moving into non-impacted areas, and therefore limiting the extent of the impacted area. Examples of containment technologies or mitigation include sand bags, inflatable plugs, as well as spill containment equipment.
- Clean-up of the impacted area. The immediate area around the SSO site is inspected and cleaned of residual material in order to minimize public health and environmental risks.

1.3.3.3. PUBLIC NOTIFICATION AND COMMUNICATION

When an SSO occurs, MSD utilizes an event-based public notification program. These are localized, short-term, and field-based activities designed to warn the public and limit access to areas impacted by the SSO. Event-based notification methods include the use of signage, establishment of a control zone (discussed previously), and placement of door-hangers.

In addition to the event-based notification methods, MSD also practices programmatic activities. Programmatic activities are long-term, community-wide activities designed to increase awareness of SSOs including their cause and prevention, potential health hazards, environmental impacts, and MSD's abatement activities. Examples of programmatic activities include overflow advisory signs posted at SSO locations and public access areas downstream of SSOs. MSD also posts email notices and has prepared educational videos, brochures, and billing inserts in an effort to inform the public about SSOs. Refer to Volume 1, Chapter 3 for additional information related to MSD's public notification and communication programs.

1.3.3.4. REGULATORY REPORTING AND DATA MANAGEMENT

The complete and accurate documentation of SSO data is required for the purpose of regulatory reporting. In addition, such data is crucial for tracking the SSO history of system assets such as manholes, sewer lines, and pump stations. MSD also utilizes this data to make decisions regarding SSO response methods, procedures, monitoring frequencies, and abatement strategies.

Personnel responsible for responding to SSOs, including unauthorized discharges, are responsible for gathering and documenting pertinent SSO data. Work orders must be initiated within 10 hours of a verified SSO. This protocol is necessary to provide transmission of the unauthorized discharge's data to KDEP and EPA within the required timeframe. In addition, MSD submits a monthly summary of all unauthorized discharges occurring by WQTC. The summary is submitted as a component of the sewershed's respective wastewater treatment plant's Discharge Monitoring Report (DMR).

1.3.3.5. STAFF TRAINING AND COMMUNICATION

The SORP is a dynamic document that is monitored and adjusted as new or improved procedures, practices, and technologies become available. The SORP is reviewed annually and amended as appropriate. Proposed changes to the SORP are submitted to the EPA and KDEP for review and approval. MSD continually enhances the SORP training modules, ensuring MSD staff remains current on existing and updated procedures.

Knowledge of SORP procedures and practices is transferred to MSD's employees through a comprehensive training program. MSD employees receive the SORP Overview training that discusses the purpose, objectives, and scope of the SORP as well as an understanding of the requirements for its execution. Personnel involved in overflow response activities receive additional quarterly training to ensure that they possess the knowledge and skills necessary to properly implement the SORP.

1.3.3.6. RELATION TO FINAL SSDP PLANNING

MSD maintains a database of documented SSOs, which is utilized to validate hydraulic models used in the Final SSDP. In turn, the hydraulic modeling efforts have identified potential SSO points at other locations, also known as Modeled Overflow Points (MOPs). These points were screened and did not include those hydraulically connected to a known SSO or have modeled overflow volumes less than 10,000 gallons to account for modeling accuracy. All other points were field verified. Refer to Chapter 2, Section 2.4.2 for a more detailed explanation of the MOP validation process.

Additionally, follow-up monitoring will be required after implementation and final construction of solution alternatives to abate known and suspected SSOs. A phasing plan will be implemented under SORP protocols to monitor the sites for three years until it is proven, under design conditions, that the SSO has been eliminated or mitigated. Periodic flow monitoring and hydraulic-model recalibration will also be performed to report on systematic performance of SSO abatement efforts.

New MOPs or SSOs identified by new modeling or field inspection will be added to the database and will be subject to follow-up monitoring, especially if it occurs at less than the design level of protection. Areas upstream of these SSOs will also be targeted in the I/I Program as outlined in Volume 3, Chapter 2, Section 2.3.5.8.

1.3.4. INTERIM SANITARY SEWER DISCHARGE PLAN

2021 Update: MSD submitted an Interim Sanitary Sewer Discharge Plan (ISSDP) for approval on September 30, 2007. Comments were received on January 8, 2008. MSD resubmitted the revised ISSDP on March 7, 2008, and received an approval letter for the ISSDP on July 24, 2008. The approved document can be viewed on the MSD Project WIN website, available at www.msdprojectwin.org.

All projects required by the ISSDP have been completed and certified. The Derek R. Guthrie WQTC Project's completion was delayed in accordance with the construction contract documents due to existing litigation and performance by the general contractor. However, the full functionality and capacity of the plant upgrades under this project met the demands of the service area. With this understanding, a revised certification letter dated October 19, 2015, was submitted certifying that the Derek R. Guthrie WQTC Project is performing in accordance with its stated intent and purpose, and is in compliance with the Consent Decree requirements.

The detailed description of the ISSDP program contained in this section is from the 2009 IOAP and has not been updated (including verb tense), but the section remains for historical reference.

The primary goals of the Interim SSDP are to define a plan to eliminate unauthorized pumped discharges in Beechwood Village and Hikes Point, the elimination of the pumped discharge at the Highgate Springs Pump Station, and the closure of the constructed overflow at the Southeastern Diversion. The efficiency of the proposed projects will be verified using the following categories of post construction monitoring:

- Three years of observations at current SSO locations to confirm that overflows (pumped or otherwise) have been eliminated.
- Flow monitoring within the collection system to confirm flows predicted by modeling.
- Verification of full secondary treatment of all flows received at the Derek R. Guthrie WQTC (formerly West County Wastewater Treatment Plant), based on an evaluation of its first year of operation.

1.3.4.1. BACKGROUND

Most of the Interim SSDP projects are interdependent. Staging their implementation, therefore, will be an important task. The sequence of projects is outlined in Chapter 3, Section 3.2 of the Interim SSDP. In general, downstream projects will have priority for implementation to allow increased levels of wastewater to be properly conveyed via the Pond Creek Interceptor and treated at the Derek R. Guthrie WQTC. If any upstream project is completed prior to a prerequisite downstream project, it will not be connected until capacity is available.

1.3.4.2. INTERIM SSDP SOLUTION

The six projects developed in the Interim SSDP are currently being designed and coordinated with Final SSDP and IOAP projects. All projects will likely require easements and/or property acquisitions, as well as construction permits. The six Interim SSDP projects are summarized below.

Project 1: Beechwood Village Sanitary Sewer Replacement

The entire local collection system, including homeowner's service connections, will either be rehabilitated or replaced in the city of Beechwood Village and a portion of the City of St. Matthews. This will eliminate wet weather pumping of unauthorized discharges and reduce I/I currently entering the Sinking Fork Interceptor.

The sanitary portion of the project will consist of lining 19,000 linear feet (LF) of 8-inch diameter, 700 LF of 10-inch diameter and 4,000 LF of 18-inch diameter sanitary sewer pipe. The service connections at 580 homes will be replaced and modifications made to the internal plumbing of most of the homes. The project is divided into two phases, East and West, to help ease project implementation. Final design plans were substantially complete as of March 2008. Final design contract documents will be amended to include any special conditions required by customers once residential customer negotiations have been completed and all easements have been acquired. It is assumed that no temporary easements will have to be acquired through the condemnation process.

Improvements to the Beechwood Village East and West collection systems will reduce wastewater flow by reducing I/I, thereby improving downstream conditions. The only prerequisite project is the Sinking Fork Interceptor Relief Sewer (Project 2). This relief sewer is planned to take the flow from some of the new Beechwood Village sewers and must be in operation before the Beechwood Village collection system improvements can be connected. The Beechwood Village East construction contract began in the first quarter of 2009 and be completed in the first quarter of 2011. The Beechwood Village West construction contract will begin in the second quarter of 2009 and will be completed in the second quarter of 2011.

Project 2: Sinking Fork Relief Sewer

The Sinking Fork Relief Sewer will convey flows from a portion of Project 1 and will provide additional wet weather capacity downstream of the Beechwood Village East area to accommodate final SSDP projects upstream. This project consists of 2,800 LF of 24-inch diameter sanitary sewer interceptor pipe, which will extend from the 18-inch diameter interceptor being installed as part of Project 1 – Beechwood Village East. Design was completed and sent for KDEP review in December 2008. Construction began in the second quarter of 2009 and will be completed in the fourth quarter of 2010.

Project 3: Hikes Lane Interceptor and Highgate Springs Pump Station

Improvements to the Hikes Point sewer system will eliminate the need for wet weather pumping in the Hikes Point area. Improvements will also eliminate the Highgate Springs Pump Station and reduce wet weather flow into the Beargrass Interceptor. The Hikes Point sewer improvements will impact two sanitary sewer basins:

- One basin is northwest of the Watterson Expressway, (I-264) and flows by gravity to the Beargrass Interceptor via the Goldsmith Lane Trunk Sewer. The improvements will consist of 1,000 LF of relief sewer along Carson Way and Ribble Road pumped locations to a new connection into the Goldsmith Trunk. This part of the project is fully independent of other components, with preliminary design completed and final design in progress.

- The second basin is located in the general Hikes Point area south of I-264, where wet weather pumping occurs. Here the improvements will consist of 10,000-LF, 72-inch-diameter Hikes Lane interceptor, a total of 3,500 LF of smaller, new or replacement sewers, and the decommissioning of the Highgate Springs Pump Station. The flows from the Highgate Springs Pump Station will be diverted by gravity to the Southeastern Interceptor downstream of the Southeastern Diversion via the new Hikes Lane Interceptor. Once the Hikes Lane Interceptor is constructed, Highgate Springs Pump Station will be decommissioned.

Preliminary design including route selection, field investigations, geotechnical exploration, surveying, and utility research were completed in October 2008. The geotechnical evaluations, 50 percent of the surveying, and 50 percent of design are scheduled to be completed by September 2009. Design will be completed in April 2010. Construction will begin in the fourth quarter of 2010 and be completed in the fourth quarter of 2012.

Project 4: Southeastern Diversion Structure and Interceptor

Following the commissioning of the Northern Ditch Diversion Interceptor and the Derek R Guthrie WQTC, operational improvements to the Southeastern Diversion Structure will provide the necessary flexibility to increase Real Time Control (RTC) effectiveness and eliminate the need to overflow at the Southeastern Diversion Structure during wet weather. Additional work in the vicinity of the Southeastern Diversion Structure will be needed to accommodate the additional flows from the new Hikes Lane Interceptor, Project 3. This project will consist of a new Southeastern Interceptor Relief Sewer, two flow control junction boxes, and modifications to the existing Southeastern Diversion Structure. A new parallel Southeastern Interceptor Relief Sewer will run between the Southeastern Diversion and the 72-inch diameter Northern Ditch Interceptor and will transport additional flows to the Derek R. Guthrie WQTC. The Southeastern Interceptor Relief Sewer is being sized to convey flows from future Final SSDP projects and can provide in-line storage. The Southeastern Interceptor Relief Sewer sizing will accommodate other Final SSDP projects bringing additional flows to the Southeastern Diversion.

The other improvements involve the following:

- A new junction structure located near Fountain Drive will connect the Southeastern Interceptor Relief sewer to the Hikes Lane Interceptor and Buechel Branch Interceptor.
- Another structure will be required at the junction with the Northern Ditch Interceptor. This second structure will contain RTC gates to prevent overwhelming the downstream system and to utilize the Southeastern Interceptor and Southeastern Interceptor Relief sewer for in-line storage.
- The control weir in the Southeastern Diversion will be removed after the Southeastern Interceptor Relief and junction structures are complete allowing flow from the upper Beargrass Interceptor into the Southeastern Interceptor under dry conditions.
- Other modifications will include re-programming RTC gates to prevent most flow into the Beargrass Interceptor.

Construction of the Southeastern Interceptor Relief Sewer will be completed in the second quarter of 2012. The connections at the Southeastern Diversion and the Northern Ditch Interceptor cannot be completed until the Derek R. Guthrie WQTC wet weather facilities (Project 6) are operational. Derek R. Guthrie WQTC and the Northern Ditch Interceptor provide for SSO elimination at the Southeastern Diversion Structure without modifications to the Southeastern Diversion or the Southeastern Interceptor. Preliminary design, including route selection and surveying, will be completed in the third quarter of 2009. Final design including field investigations, geotechnical exploration, wetlands delineation, and utility research, will be completed in the third quarter of 2010.

Project 5: Northern Ditch Diversion Interceptor

Construction of the new Northern Ditch Diversion Interceptor will allow flows from upstream projects to reach Derek R. Guthrie WQTC. The Northern Ditch Diversion Interceptor project will consist of 13,000 LF of new 84-inch-diameter pipe constructed along Greasy Ditch from the Northern Ditch Pump Station to the Pond Creek Interceptor. A new flow control structure near Enterprise Drive to divert flow from the Northern Ditch Interceptor to the new Northern Ditch Diversion Interceptor will be constructed to control flow between the Northern Ditch Pump Station and the Derek R. Guthrie WQTC using a 144-inch weir gate and 84-inch sluice gate. There are 45 private property easements that will be required along with a Section 404 Permit from the USACE.

The Northern Ditch Diversion Interceptor is scheduled for completion in the third quarter of 2011. It cannot be connected to the Pond Creek Interceptor until expansion at the Derek R. Guthrie WQTC is complete and operational. Preliminary design including route selection was completed in October 2007. Field investigations consisting of geotechnical exploration, wetlands delineation, utility research, and final design were initiated in November 2007. The design was completed and sent for KDEP review in December 2008.

Project 6: Derek R. Guthrie WQTC

Improvements to Derek R. Guthrie WQTC will allow treatment of all wet weather flow from the other Interim SSDP improvements. The 100 million gallons per day MGD peak flow capacity secondary treatment facility will consist of the following:

- New influent pumps and piping modifications providing 200 MGD firm pumping capacity.
- Construction of a wet weather pump station with an initial capacity of 104 MGD and an ultimate capacity of 145 MGD to be in service when influent flow exceeds 200 MGD.
- New screening facility with three units, each with capacity of 172.5 MGD.
- Wet Weather Treatment Plant with 100 MGD capacity including a short-term detention basin, initially two channels and ultimately four channels, a new grit removal system, one new contact basin, six new secondary clarifiers and new chlorine contact basins.
- New 20 MG (million gallons) equalization basin.

These facilities will be located at the Derek R. Guthrie WQTC site. The proposed wet weather treatment facility is an expansion of the existing contact stabilization activated sludge process with one additional contact basin and six additional secondary clarifiers, sized to produce effluent that meets secondary treatment discharge standards when operating on relatively dilute wet weather flows.

Preliminary design for process selection and sizing, including field investigations for geotechnical exploration, wetlands delineation, and utility research, was completed in November 2008. Final design, initiated in November 2008, will be completed in the third quarter of 2009.

The construction period was established to provide two full warm-weather building seasons to reach substantial completion, allowing testing and start-up to be completed prior to the required completion date of December 31, 2011. Construction and commissioning of the Derek R. Guthrie WQTC wet weather flow equalization and wet weather treatment facilities are critical paths to implementing the overall Interim SSDP.

1.3.4.3. PRELIMINARY PROJECT SCHEDULE AND COST

The estimated capital cost to implement the Interim SSDP is approximately $200 million. Estimated costs were calculated using planning level cost estimating tools developed for projects associated with MSD's IOAP. The planning level costs are based on historical data from multiple cities, EPA documentation, and similar project data. The estimates prepared are based on the best available data and judgments by engineering firms under contract for either the planning or design of the respective project components at the time they were developed. Refined estimates will be prepared as projects move to detailed-design stages.

In accordance with the Consent Decree, the Interim SSDP will implement the corrective measures necessary for remediation of the unauthorized discharges in the Beechwood Village area and at the Southeastern Diversion Structure by December 31, 2011. Similarly, the unauthorized discharges at Hikes Point and Highgate Springs Pump Station will be eliminated by December 31, 2013.

1.4. SSDP PLANNING APPROACH

This section provides a brief summary of the Final SSDP planning approach used by MSD. The following are summarized in this section:

- Modeling Overview
- Public Participation and Agency Interaction
- Measures of Success: Performance Goals

1.4.1. MODELING OVERVIEW

A hydraulic model is the mathematical representation of a sewer system in a computer. Models use basic laws of physics, such as conservation of mass and energy, to continuously model flows through sewers systems. In addition, models are used to characterize the existing sewer conditions so that the magnitude and extent of SSOs and surcharging can be assessed. The same models are used to evaluate potential solutions. However, adequate models are dependent upon the supporting databases; therefore, much effort is placed on calibrating and validating models prior to any assessment or evaluation.

Evaluating sewers with a hydraulic model is much like evaluating an airplane using a wind tunnel. First, the model is constructed to mimic known conditions, then the shortcomings are noted and finally solutions are tested. The hydraulic model, like the wind tunnel, allows the modeler to assess a wide array of conditions and possible solutions without full-scale testing. Hydraulic models can be divided into a number of important features:

- Hydrological characterization, which uses databases on land types and soils to generate mathematical representation of rainfall and stormwater flow into the sewer system.
- The hydrological model, which uses the hydrological characterization to estimate I/I based on assumed rainfall and soil conditions.
- Base flow calculations, which estimate actual sewer flow from homes and businesses based on census data.

- Hydraulic characterization, which uses databases on manhole and sewer sizes, locations, depths and materials to generate mathematical representation of a sewer system. This characterization also includes pumps, diversions and other special structures normally found in sewer collection systems.
- The hydraulic model, which uses the I/I from the hydrological model, combines it with the base flow and uses the hydraulic characterization to predict flows and levels at any point in the system.

With the objective of the Final SSDP to eliminate SSOs, the sewer system hydraulic models must represent, as accurately as possible, known SSOs and surcharging within the system. Additionally, it is probable that the calibrated hydraulic models will identify new SSO locations. MSD determined that historical modeling efforts were not adequate for the detailed evaluations necessary to plan system improvements on a scale required by the Final SSDP. Therefore, MSD initiated a new sewer system modeling program using InfoWorks.

Prior to model calibration, MSD provided each modeling team with known system hydraulic information such as known SSO location, volume and duration; pump station runtime information; known surcharge areas; and other pertinent data for use in calibration and validation of the model results. The modelers validated SSOs and surcharging in the general location of the SSOs for various levels of protection as part of the calibration process. The models were then divided into model areas and further divided into branches based on SSO locations. The modeling process can be abridged into the components depicted in Figure 1.4.1.

Modeling is a complex task and is further explained and defined in Chapter 2. Using the model, potential solutions were developed, analyzed and optimized for each branch. Chapter 3 discusses the solution development and analysis. Chapter 4 details the optimized and selected projects. Once the optimized projects were chosen, an implementation schedule was developed along with project costs and is presented in Chapter 4.

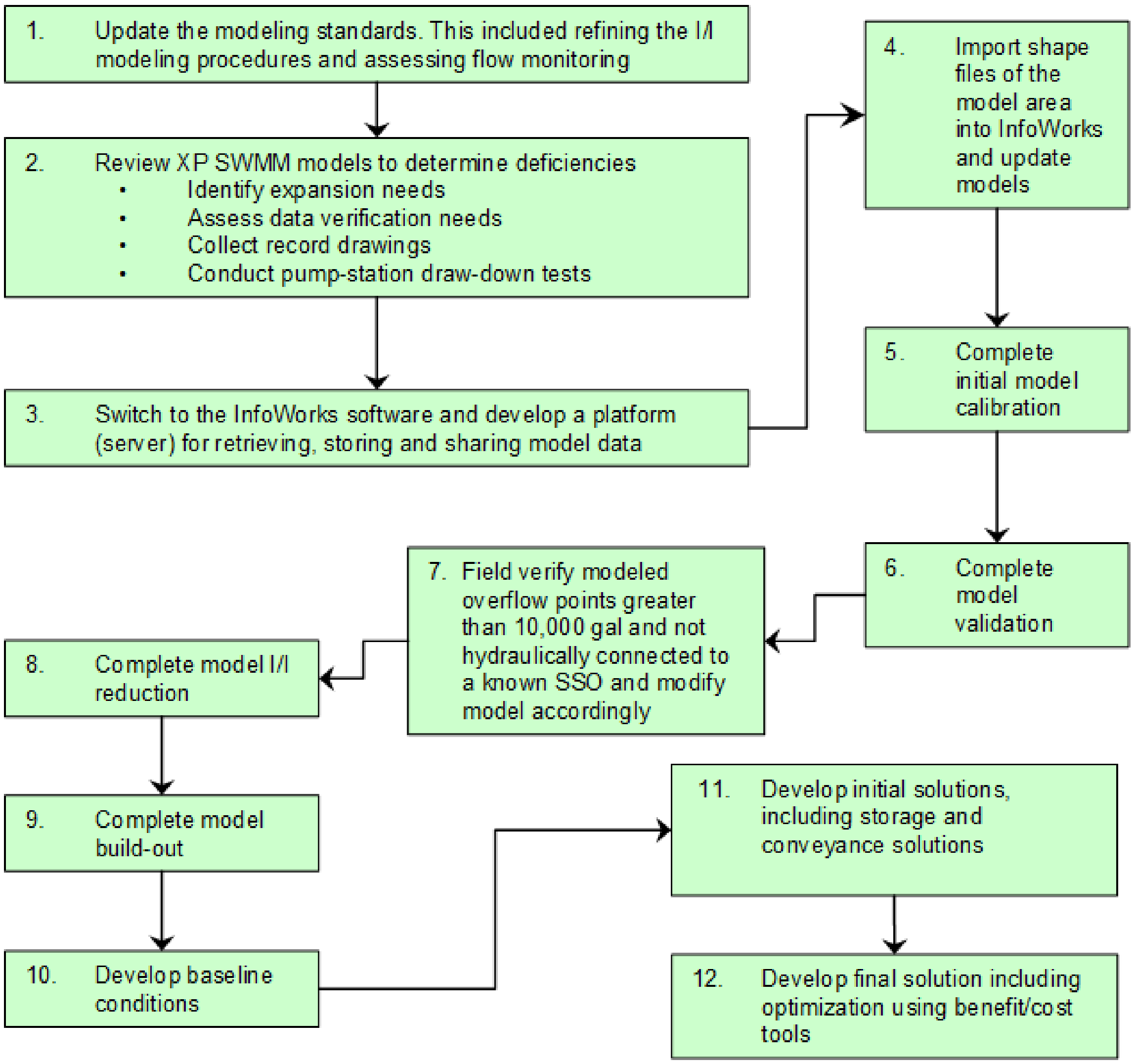


Figure 1.4.1 Modeling Flow Chart

1.4.2. CAPACITY ANALYSIS AND OTHER MODEL APPLICATIONS

System capacity analyses are based on existing conditions and impacts of future population projections, reserved capacity for future assessments and new developments, and capacity requests currently being reviewed by MSD's Development Team. The hydraulic models will be used to support future evaluations of new connection requests and system capacity. The models determine the best range of feasible options for conveyance, storage, and/or treatment to abate excess wet weather flows and eliminate SSOs. MSD performed capacity assessments, compiled a range of system improvement approaches, and developed the benefit-cost evaluations for various solutions in a manner consistent with the Final SSDP.

1.4.3. PUBLIC PARTICIPATION

Public participation is an integral component during the planning, development, evaluation, and selection stages of SSO abatement projects. By informing the public early in the planning process, potential conflicts can be identified and addressed during the development stages. The public outreach efforts include communication media, public meetings, public hearings, workshops, and discussion panels. Key target audiences include the public, property owners, advocacy groups, builders, restaurants, industries, and schools.

The backbone of the framework is the Wet Weather Stakeholder Group involvement. Effective input of Louisville Metro's community values is essential for the elements of the IOAP. The stakeholder process has provided meaningful involvement in discharge abatement, alternative development, evaluation, and prioritization. The stakeholder involvement activities have helped establish the performance objectives for the sanitary and combined sewer systems and the associated CMOM and Nine Minimum Controls (NMC) programs. Public participation and agency interaction is discussed in full detail in Volume 1, Chapter 3 of the IOAP.

1.4.4. MEASURES OF SUCCESS: PERFORMANCE GOALS

The measures of success are a means to demonstrate compliance with the Consent Decree requirements and to quantify the benefits achieved from SSO elimination projects. Ongoing measurements of the system and analysis of measured results will help guide MSD by identifying specific methods that perform better or worse than predicted in time to modify future efforts. Each project's performance goals should be tailored to site-specific situations.

A review of the Final SSDP projects after completion will evaluate how well the project accomplished the performance goals that were established before the project began, and whether the project implemented was indeed the most cost effective approach. Results from the review should show that the cost-benefit analyses and risk management approach used to choose targeted deficiencies, level of protection, project alternatives and project scheduling were effective.

Deficiencies in the system addressed by the Final SSDP include wet weather capacity related problems and generally exclude maintenance issues, which are CMOM related. Therefore, these performance goals are only meant to encompass wet weather situations within the level of protection under the IOAP. Meeting these performance goals has many potential benefits including:

- Achieving Legal and Regulatory compliance
- Reducing potential negative impacts on public health
- Reducing potential negative impacts on receiving waters
- Reducing future costs of operation
- Documenting proof of project results and effectiveness.

Chapter 4 outlines the full details of the measures of success. The four performance goals for Final SSDP projects are:

- No Wet Weather Capacity Related SSOs under the Selected Level of Protection
- No Wet Weather Capacity Related Basement Back-ups within the Level of Protection
- Sufficient Treatment Capacity within the Level of Protection
- Project Flow Monitoring Performed and Documented

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APRIL 30, 2021

2021 IOAP MODIFICATION

VOLUME 3 FINAL SSDP, CHAPTER 2

METROPOLITAN SEWER DISTRICT

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APPENDICES

Note: Appendices shown in italic text were not revised for the 2021 IOAP and remain the same as the 2012 IOAP Modification. All appendices have been provided on a separate USB flash drive and are not included in this report.

Chapter 2: SYSTEM CHARACTERIZATION

Special Note – 2021 Modification: This chapter was developed in 2009. The statistical data for the SSO's reported, specifically related to individual SSO volumes and frequency, were derived from the hydraulic models calibrated in 2007. Since then, a more detailed calibration and validation effort has adjusted some of the average overflow volumes and frequencies. Project modifications and the changed conditions that resulted in project modifications is provided in Chapter 3. The general process described for hydraulic model building was followed to develop the 2009 Final SSDP, and the descriptions for the initial model building reflect 2007 system conditions. Any subsequent calibrations or updates to the models still follow the same procedures and guidelines discussed in this chapter. The vast majority of the physical system characterization in this chapter is still accurate. The Volume 3, Chapter 2 appendices remain the same as those provided with the 2012 IOAP. A new appendix has been added for the latitude and longitude coordinates of the SSOs (Appendix 2.4.2).

2.1. SYSTEM CHARACTERIZATION OBJECTIVES

Objectives of system characterization within the context of the Final Sanitary Sewer Discharge Plan (SSDP) include:

- Calibrating and validating the hydraulic models.
- Identifying and verifying system deficiencies and problem areas, including sanitary sewer overflows (SSOs), by analysis of assembled data using validated hydraulic models.

The objectives are met by collecting system data and developing hydraulic models that are consistent with the data that represent Louisville and Jefferson County Metropolitan Sewer District (MSD)'s separate sanitary sewer system (SSS). This chapter serves as a framework for solution development to eliminate known or suspected capacity related SSOs, within the established level of protection.

2.2. EXISTING SSDP DATA

This section of the Final SSDP provides compilation and evaluation of data from three key areas:

- Existing Water Quality Treatment Center (WQTC) service areas and existing WQTC capacity evaluations.
- Existing collection systems, primarily gravity sewers and pump stations.
- Flow Monitoring and associated rain gauge network.

These compilations are focused on building representative hydraulic models and in determining collection system deficiencies.

2.2.1. WQTC SERVICE AREAS

During the development of 2009 IOAP, MSD maintained and operated six regional WQTCs and number of small WQTCs throughout its service area. Over the duration of the IOAP, MSD eliminated one regional WQTC and all of the small WQTCs. However, the initial development of the SSDP was organized using WQTC service areas, so the categorization will follow the original organization for continuity. Furthermore, the available capacities at the time of the 2009 IOAP development are important to understand the overall context of the SSDP development. This section provides a background summary of each of the original six WQTC regional service areas as well as a number of small WQTCs that made up MSD's sewer service area. Table 2.2.1 includes information on service area size, design capacities, dates of construction, and lengths and diameters of sewers.

While MSD has built the regional treatment facilities and the required interceptors to treat and convey flow in each service area, much of the collection system was built by other communities or by private developers. When MSD acquired these systems beginning in the 1960s, it also acquired the system deficiencies and operations and maintenance (O&M) concerns, many of which are the root cause of current SSOs.

2.2.1.1. CEDAR CREEK

The Cedar Creek WQTC was constructed in 1995 by MSD to provide service to one of the fastest growing areas of Jefferson County. The new facility facilitated the elimination of nine small treatment plants prior to 2009 and numerous septic systems. The plant was expanded in 2003 to its present design capacity of 7.5 million gallons per day (MGD). The Cedar Creek WQTC is located near Bardstown and Cedar Creek Roads in Southern Jefferson County. The land use consists primarily of single-family residential with a small amount of multi-family, commercial, industrial, and vacant or undeveloped land. Refer to Exhibit 2.2.1 in Appendix 2.2.1 for a 2009 map of the Cedar Creek service area.

Appendix 2.2.1 Pipe Material, 100-year Floodplain, and Non-conforming Slopes Maps
Appendix is same as 2012 IOAP Modification and is provided on external USB storage drive.

2.2.1.2. FLOYDS FORK

Construction of the Floyds Fork WQTC was completed in 2001 with a design capacity of 3.25 MGD to provide service to a fast-growing area of Jefferson County. It has since been upgraded and currently has a design capacity of 6.5 MGD. The upgrade allowed for the elimination of several small treatment plants and off-loaded some areas that were previously directed to the Jeffersontown WQTC. The Floyds Fork WQTC is located at the end of Blue Heron Road off Shelbyville Road in Eastern Jefferson County. The land use consists primarily of single-family residential housing with a small amount of apartments, commercial development, and vacant or undeveloped land. Refer to Exhibit 2.2.2 in Appendix 2.2.1 for a 2009 map of the Floyds Fork service area.

2.2.2. HITE CREEK

The Hite Creek WQTC was constructed by MSD in 1970 to provide service to the newly constructed Ford Motor Company Kentucky Truck Plant and the surrounding suburbs in eastern Jefferson County. Two expansions have occurred at the treatment plant, along with various upgrades, to increase the present design capacity to 6.0 MGD. An expansion is currently under construction to increase design capacity to 9.0 MGD. The Ford Motor Company Kentucky Truck Plant contributes approximately 1 MGD to the treatment facility. The land use consists primarily of single-family residential areas with a small amount of multi-family areas, commercial lots, vacant or undeveloped land, and the Ford Motor Company Kentucky Truck Plant. Refer to Exhibit 2.2.3 in Appendix 2.2.1 for a 2009 map of the Hite Creek service area.

Table 2.2.1 Water Quality Treatment Center (WQTC) characteristics, 2009

WQTC	SUB-SERVICE AREA	KPDES PERMIT NUMBER	YEAR BUILT	YEAR ACQUIRED BY MSD	DESIGN CAPACITY	DISCHARGE TO	SANITARY SEWER PIPE IN COLLECTION SYSTEM (MI)	PIPE SIZE RANGE	MOST COMMON PIPE MATERIALS	SANITARY PUMP / LIFT STATIONS	SCHEDULED WQTC DIVERSION DATE	EXPECTED RECEIVING WQTC
Cedar Creek	--	KY0098540	1995	1995	7.5 MGD	Cedar Creek	125	8"-36"	VCP, PVC	28	N/A	N/A
Hite Creek	--	KY0022420	1970	1970	6.0 MGD	Hite Creek	120	8"-27"	PVC	35	N/A	N/A
Floyds Fork	--	KY0102784	2001	2001	3.25 MGD	Floyds Fork	98	8"-54"	VCP, PVC	20	N/A	N/A
Jeffersontown	--	KY0025194	1956	1990	4.0 MGD	Chenoweth Run	112	8"-36"	VCP, PVC	27	2015	To be Determined
Morris Forman	--	KY0022411	1958	1958	120 MGD	Ohio River	1,000	8"-72"	VCP, RCP, PVC	118	N/A	N/A
--	Middle Fork	N/A	N/A	N/A	N/A	--	348	8"-53"	VCP, RCP, PVC	19	N/A	N/A
--	Beechwood Village	N/A	N/A	N/A	N/A	--	6.8	8"-10"	VCP	--	N/A	N/A
--	Ohio River Force Main / Muddy Fork	N/A	N/A	N/A	N/A	--	185	8"-48"	VCP, PVC	30	N/A	N/A
--	Hikes Point / Highgate Springs PS	N/A	N/	N/A	N/A	--	100	8"-36"	VCP	3	N/A	N/A
--	Buechel Branch	N/A	N/A	N/A	N/A	--	57	8"-36"	VCP	--	N/A	N/A
--	Northern Ditch	N/A	N/A	N/A	N/A	--	130	8"-72"	VCP	6	N/A	N/A
Derek R. Guthrie	--	KY0078956	1986	1986	30 MGD	Ohio River	852	8"-120"	VCP, PVC	68	N/A	N/A
--	Pond Creek	N/A	N/A	N/A	N/A	--	495	8"-120"	VCP, PVC	40	N/A	N/A
--	McNeely Lake	N/A	N/A	N/A	N/A	--	31	8"-24"	VCP, PVC	6	N/A	N/A
--	Mill Creek	N/A	N/A	N/A	N/A	--	309	8"-78"	VCP, PVC	20	N/A	N/A
--	Valley Village	N/A	N/A	N/A	N/A	--	17	8"-27"	VCP, PVC	2	N/A	N/A
Hunting Creek North	--	KY0029106	1964	1999	0.358 MGD	Harrods Creek	14	8"-15"	VCP, PVC	10	2015	HC WQTC
Hunting Creek South	--	KY0029114	1968	1999	0.251 MGD	Harrods Creek	11	8"-10"	VCP, PVC	8	2015	HC WQTC
Ken Carla	--	KY0022497	1968	1997	0.010 MGD	Harrods Creek	0.5	8"	VCP	1	2015	HC WQTC
Shadow Wood	--	KY0031810	1979	2008	0.085 MGD	Harrods Creek	2.0	8"-10"	PVC	3	2015	HC WQTC
Timberlake	--	KY0043087	1973	1999	0.200 MGD	Harrods Creek	6.0	8"-10"	PVC	11	2015	HC WQTC
Berrytown	--	KY0036501	1975	1995	0.075 MGD	Floyds Fork	5.9	8"-12"	VCP, PVC	5	2011	FF WQTC
Chenoweth Hills	--	KY0029459	1972	1990	0.200 MGD	Chenoweth Run	6.4	8"-12"	VCP, PVC	2	2015	To be Determined
Silver Heights	--	KY0028801	1963	1990	0.500 MGD	Mud Creek	6.8	8"-15"	VCP	1	Beyond 2014	DRG WQTC
Bancroft	--	KY0039021	1966	1998	0.080 MGD	Goose Creek	3.0	8"-15"	VCP	--	Beyond 2014	MF WQTC
Glenview Bluff	--	KY0044261	1976	1976	0.010 MGD	--	0.3	8"	VCP, PVC	--	Beyond 2014	MF WQTC
Lake Forest	--	KY0042226	1988	2005	0.470 MGD	Chenoweth Run	22	8"-18"	VCP, PVC	6	2011	FF WQTC
Lake of the Woods	--	KY0044342	1976	1989	0.044 MGD	Chenoweth Run	1.0	8"	VCP, PVC	1	Beyond 2014	To be Determined
McNeely Lake	--	KY0029416	1964	1986	0.205 MGD	Pennsylvania Run	4.0	8"-12"	VCP	4	Beyond 2014	DRG WQTC
Starview	--	KY0031712	1971	1988	0.100 MGD	Chenoweth Run	2.4	8"-10"	VCP, PVC	1	2011	FF WQTC
Yorktown	--	KY0036323	1968	1991	0.150 MGD	Northern Ditch	2.9	8"-15"	VCP, PVC	1	2010	DRG WQTC

Legend: KPDES – Kentucky Pollutant Discharge Elimination System, MGD - million gallons per day, VCP – vitrified clay pipe, RCP - reinforced concrete pipe, PVC - polyvinyl chloride

WQTC: HC – Hite Creek, FF - Floyds Fork, DRG - Derek R. Guthrie, MF - Morris Forman

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2.2.2.1. JEFFERSONTOWN

The Jeffersontown WQTC was constructed in 1956 and was expanded several times to its 2009 design capacity of 4.0 MGD. MSD acquired the Jeffersontown WQTC in 1990. In 1998, the system was placed under an Agreed Order by the Kentucky Department of Environmental Protection (KDEP) (Case No. 97201). The Agreed Order required various rehabilitation projects and treatment plant upgrades because the average annual hydraulic load was at 90 percent of its permitted capacity and the system experienced wet weather SSOs at the siphon just upstream of the WQTCs headworks. Improvements made by MSD to the plant from 1997 to 2000 added phosphorous removal, ultraviolet (UV) disinfection, and a new return activated sludge pump station. As part of an approved plan to eliminate blending at the facility, the WQTC was completely eliminated in 2015 by diverting some of the flow to the Morris Forman WQTC and some flow to the Cedar Creek WQTC. The Jeffersontown WQTC was located at Taylorsville Road and Watterson Trail in central Jefferson County. The land use of the service area consists primarily of single-family residential and industrial with a small amount of commercial and vacant or undeveloped land. Refer to Exhibit 2.2.4 in Appendix 2.2.1 for a 2009 map of the Jeffersontown service area.

2.2.2.2. MORRIS FORMAN

The Morris Forman WQTC is the largest treatment plant in the MSD service area with a design capacity of 120 MGD. It was originally built in 1958 as a primary treatment plant that removed only heavy, solid wastes. The plant was rededicated in 1975 as a secondary treatment facility that treated organic matter and bacteria. The plant serves most of Louisville Metro and is the bio-solids processing facility for the entire service area.

The Morris Forman service area is the largest sewershed in the MSD collection system. The majority of the land use in the service area is residential, with some smaller areas of commercial, industrial, and parks. Refer to Exhibits 2.2.5 through 2.2.7 in Appendix 2.2.1 for 2009 maps of the Morris Forman service area.

Within the Morris Forman service area are several key features associated with SSOs and known system deficiencies. These features are discussed below.

Middle Fork

The Middle Fork service area is located within the Morris Forman Service area and primarily serves the areas within the Middle Fork of Beargrass Creek watershed. The land use consists primarily of single-family residential area.

Beechwood Village

Beechwood Village is located along the Sinking Fork Interceptor in St. Matthews, which is a part of the Middle Fork service area. The land use consists of single-family residential area. The Beechwood Village separate SSS had previously experienced excessive inflow and infiltration (I/I) since the construction of the neighborhood’s sanitary sewers in the early 1960s. Available data suggests that the separate SSS was constructed to substandard conditions, adding to the infiltration problems typically associated with clay pipe. The neighborhood is also located in an area with unusually high groundwater and poor drainage. MSD acquired the system in the mid-1960s and has since been working with the neighborhood to alleviate chronic basement backups. The five locations where temporary pumping previously occurred during wet weather were the locations called out in the Consent Decree as a part of the Beechwood Village neighborhood and were addressed in the Interim SSDP.

Ohio River Force Main / Muddy Fork

The Ohio River Force Main (ORFM) / Muddy Fork service area is located along the Ohio River in northeast Jefferson County. The area consists primarily of single-family residential housing and vacant or undeveloped land along with a small number of apartments and commercial development. The service area is generally bounded on the northwest by the Ohio River, northeast by Gene Snyder Freeway (I-265) South, and south by Westport Road.

Hikes Point / Highgate Springs Pump Station

The Hikes Point / Highgate Springs Pump Station area is located at the intersection of Hikes Lane and Goldsmith Lane. The majority of the land use in the service are is residential, with some smaller areas of commercial and parks. MSD constructed Highgate Springs Pump Station in 1963, which was designed to relieve the Beargrass Interceptor and prevent surcharging in the Highgate Springs sewer system. This pump station was eliminated as part of the Interim SSDP. Prior to its elimination, during dry weather, a weir prevented flow from the 36-inch diameter Highgate Springs Interceptor from entering the station’s wet well. The flow passed through the pump station by gravity and through a 30-inch tide gate into the Beargrass Interceptor. During wet weather, the tide gate would close, and flow from the Highgate Springs Interceptor would spill into the wet well of the Highgate Springs Pump Station. For small storm events, one pump would discharge directly into the Beargrass Interceptor. For increasingly larger events, the remaining three pumps would turn on sequentially until three pumps were discharging to the creek and preventing basement backups to approximately 300 homes.

Buechel Branch

The Buechel Branch service area is located in central Jefferson County and is part of the South Fork of Beargrass Creek watershed. The land use consists primarily of residential area with some commercial and industrial area. In the late 1970s, the Southeastern Interceptor was constructed because of a system constriction on the Beargrass Interceptor. The Southeastern Interceptor extends from the Southeastern Diversion structure to the Northern Ditch Interceptor. Since 2009, the Southeastern Interceptor Relief was constructed from the Southeast Diversion structure to the newly constructed Buechel Basin.

Northern Ditch

The Northern Ditch area is located near the intersection of I-65 and Preston Highway. The majority of the land use in the service area is residential and industrial. Since 2009, the Buechel Basin, an offline sanitary storage facility has been constructed to store overflows from the Hikes Point, Buechel Branch, and Northern Ditch areas.

2.2.2.3. DEREK R. GUTHRIE

Construction of the Derek R. Guthrie WQTC (formerly known as the West County Wastewater Treatment Plant) began in 1984 and the WQTC came on-line in 1986 with a design capacity of 15 MGD. The Derek R. Guthrie WQTC eliminated over 45 small WQTCs prior to 2009 and numerous pump stations and septic systems in the Pond/Mill Creek area where water quality was significantly impaired by small WQTC permit violations and failing septic systems. As the service area and population has grown, treatment capacity has been added to increase to the present design capacity to 60 MGD. The Derek R. Guthrie modeled area serves primarily single-family residential customers, commercial, and vacant or undeveloped land. Refer to Exhibits 2.2.13 through 2.2.15 in Appendix 2.2.1 for maps of the Derek R. Guthrie service area.

There are four key features within the Derek R. Guthrie Service Area associated with SSOs and known system deficiencies. These features are outlined below.

Pond Creek

The Pond Creek area of Derek R. Guthrie is located at the intersection of Preston Highway and the I-265. The majority of the land use in the service area is residential and undeveloped/vacant land.

McNeely Lake

The McNeely Lake sewershed is located at I-265 and Smyrna Parkway in southern Jefferson County. The majority of the land use in the service area is residential and undeveloped/vacant land. The McNeely Lake area was acquired in stages during the late 1980s and 1990s. The area was comprised of six small WQTCs: The Pines; Pleasant Valley; Apple Valley; Maple Grove; Old Maple Grove; and McNeely Lake. In 1999, five of the small WQTCs were eliminated and directed to the Derek R. Guthrie WQTC. The McNeely Lake WQTC was still in service during the development of the 2009 IOAP but has since been eliminated and flow is directed to the DRG WQTC.

Mill Creek

The Mill Creek sewershed is located near the intersection of Dixie Highway and Greenwood Road. The majority of the land use is residential and undeveloped/vacant land.

Valley Village

The Valley Village sewershed is located at Dixie Highway and Watson Lane in southwestern Jefferson County. The majority of the land use is residential and undeveloped/vacant land. The Valley Village system was acquired in 1986 and the original small WQTCs were eliminated in 1989 with the construction of a gravity interceptor to the Derek R. Guthrie WQTC.

2.2.2.4. PROSPECT

The Prospect area in northeastern Jefferson County previously contained the five small WQTCs listed below, and their characteristics are outlined in Table 2.2.2. These WQTCs primarily served single-family residential customers with a small amount of multi-family residential and commercial area. These WQTCs were eliminated with the construction of the Harrods Creek Pump Station. Refer to Exhibit 2.2.8 in Appendix 2.2.1 for a map of the Prospect service area.

- Hunting Creek South WQTC
- Ken Carla WQTC
- North Hunting Creek WQTC
- Shadow Wood WQTC
- Timberlake WQTC

2.2.2.5. SMALL WQTCS

After the 1937 flood, less flood prone suburban areas became more desirable and began to be developed at an increasing rate. Suburban expansion occurred and new homes were built to use septic tanks to dispose of their sewage. However, in many suburban areas of Jefferson County, septic tanks were not a good solution due to topography, low permeability soil types, and shallow bedrock. In wet weather, groundwater would typically rise above the level of the septic tank systems, and raw sewage would stand in the yards and drainage ditches. As a solution, the Louisville Metro Board of Health agreed to allow individual septic tanks where the land could accommodate them, and to require small "package" WQTCs where septic tanks would not work well. These package WQTCs were typically operated by the developers. By mid-1972, there were about 350 small WQTCs in Jefferson County.

MSD began to acquire these systems as the regional sewer system developed. Small WQTC acquisitions became controversial, for a time, until pressure from state and federal regulators made it clear that their owners would have to make large investments to meet new water pollution regulations. Several court decisions also affirmed that MSD had the power to take over small WQTC systems when MSD sewer lines reached the area.

During the development of the 2009 IOAP, MSD operated the ten WQTC plants listed below in addition to the five plants discussed in the previous section. Each of the ten plants has been eliminated. This section is left in for historical reference.

The ten small WQTC service areas previously operated by MSD in 2009 located outside of the Prospect area are listed below and their characteristics are outlined in Table 2.2.3. These small WQTCs primarily serve single-family residential customers in multiple areas of Jefferson County. Refer to Exhibits 2.2.9 through 2.2.12 in Appendix 2.2.1 for 2009 maps of the Small WQTC service areas.

- Berrytown WQTC
- Chenoweth Hills WQTC
- Silver Heights WQTC
- Bancroft WQTC
- Glenview Bluff WQTC
- Lake Forest WQTC
- Lake of the Woods WQTC
- McNeely Lake WQTC
- Starview WQTC
- Yorktown WQTC

2.2.2.6. EXISTING TREATMENT PLANT CAPACITY EVALUATION

MSD has acquired and eliminated over 300 privately owned WQTCs and six regional plants were expanded, upgraded, or constructed. The Updated SSOP outlines WQTC operation parameters such as the year of construction, year acquired by MSD, design capacity, average influent flow, collection system size, and number of customers.

Under the CMOM Programs, MSD developed the Louisville and Jefferson County System Capacity Assurance Plan (SCAP). One of the activities of the SCAP is to confirm the flow capacities of all the WQTCs and pumping stations and compare them to current base and peak flows. The following summarizes the regional and small WQTC capacity evaluations.

Regional WQTCs

Treatment capacities at the regional WQTCs were evaluated in 2007. Evaluation included review of the most recent engineering design and construction plans, individual site visits, and performance certifications where available. WQTC performance under 2007 loading conditions was also reviewed to validate the results of the engineering studies.

Table 2.2.2 Summary of Regional WQTC Capacity Evaluation & Resulting Limitations (2007)

WQTC	RATED PERMITTED CAPACITY (MGD)	PEAK HOUR DESIGN FLOW (MGD)	2007 AVERAGE DAY FLOW (MGD)	2007 PEAK DAY FLOW (MGD)	LIMITING UNIT PROCESS (PEAK FLOW)
Morris Forman	120	350	100	204	Clarifier
Derek R. Guthrie	30	96	24	70	Clarifier
Cedar Creek	7.5	26.0	3.7	17.4	Clarifier
Hite Creek	6.0	16.0	4.0	14.0	Aeration
Jeffersontown*	4.0	9.5	3.7	17.9	Clarifier
Floyds Fork	3.25	10.4	1.80	6.77	Clarifier

*Eliminated in 2015

Small WQTCs

Treatment capacities at the small WQTCs were evaluated in 2007. Evaluation included review of the most recent engineering design and construction plans, individual site visits, and performance certifications where available. WQTC performance under 2007 loading conditions was also reviewed to validate the results of the engineering studies. Note that each of these plants has since been eliminated.

Table 2.2.3 summarizes the annual average flow capacity and the peak flow capacity of each small WQTC as well as the regional plan the flow is directed to and the elimination year of the small WQTC.

Table 2.2.3 Summary Of Small WQTC 2007 Capacity Evaluation & Subsequent Eliminations

WQTC	RATED PERMITTED CAPACITY (GPD)	PEAK HOUR DESIGN FLOW (GPD)	2007 AVERAGE DAY FLOW (GPD)	2007 PEAK DAY FLOW (GPD)	REGIONAL WQTC AFTER ELIMINATION	ELIMINATION DATE
Bancroft	80,000	183,000	37,000	65,000	Morris Forman	2014
Berrytown	75,000	275,000	95,000	640,000	Floyds Fork	2015
Chenoweth Hills	200,000	576,000	147,000	738,000	Jeffersontown	2014
Glenview Bluff	10,000	26,000	4,000	6,000	Morris Forman	2014
Hunting Creek South	251,000	630,000	180,000	768,000	Hite Creek	2015
Ken Carla	10,000	50,000	3,000	29,000	Hite Creek	2015
Lake Forest	470,000	1,034,000	384,000	1,725,000	Floyds Fork	2012
Lake of the Woods	44,000	161,000	31,000	285,000	Cedar Creek	2014
McNeely Lake	205,000	282,000	104,000	661,000	Derek R. Guthrie	2016
North Hunting Creek	358,000	792,000	325,000	786,000	Hite Creek	2015

WQTC	RATED PERMITTED CAPACITY (GPD)	PEAK HOUR DESIGN FLOW (GPD)	2007 AVERAGE DAY FLOW (GPD)	2007 PEAK DAY FLOW (GPD)	REGIONAL WQTC AFTER ELIMINATION	ELIMINATION DATE
Shadow Wood	85,000	162,000	52,000	550,000	Hite Creek	2015
Silver Heights	500,000	889,000	301,000	1,570,000	Pond Creek	2014
Starview	100,000	288,000	108,000	500,000	Floyds Fork	2014
Timberlake	200,000	646,000	76,000	606,000	Hite Creek	2015
Yorktown	150,000	432,000	194,000	876,000	Derek R. Guthrie	2011

2.2.3. COLLECTION SYSTEM EVALUATION

MSD has developed detailed design models for each WQTC service area based on Louisville and Jefferson County Information Consortium (LOJIC) data, as-built drawings, and field investigation records. The models generally include sewers ranging from large interceptors to small local 8-inch lines, pump stations, and control features such as diversion weirs or interceptor flow controls.

Additionally, GIS tools were used to characterize the system, such as system connectivity, pipe material, pipe in the 100-year floodplain, and pipe with non-conforming slope (pipe slopes that do not meet minimum MSD design criteria). The calibrated and validated hydraulic models were used to establish existing system conditions such as surcharged pipes, SSO volumes, and hydraulic restrictions (outlined later in this section), as well as identify modeled overflow points (MOPs).

2.2.3.1. EXISTING GRAVITY-SEWER CONDITION EVALUATION

GIS mapping and database queries were utilized to characterize the existing gravity sewer system. These evaluations were comprehensive and intended to provide initial assessments. In most cases, the evaluations were a review of the appropriate GIS mapping, especially those in the vicinity of known SSOs or MOPs, once identified. The statistics shown in this section are from the 2009 IOAP. While some of the systems have grown and been re-directed, the general characteristics are the same as in 2009.

The evaluations included the following by sewershed and shows references to relevant data and figures in this section:

- Sewer pipe material (Figure 2.2-1)
- Sewers in the 100-year floodplain (Figure 2.2-2)
- Sewers with non-conforming slopes (Figure 2.2-2)

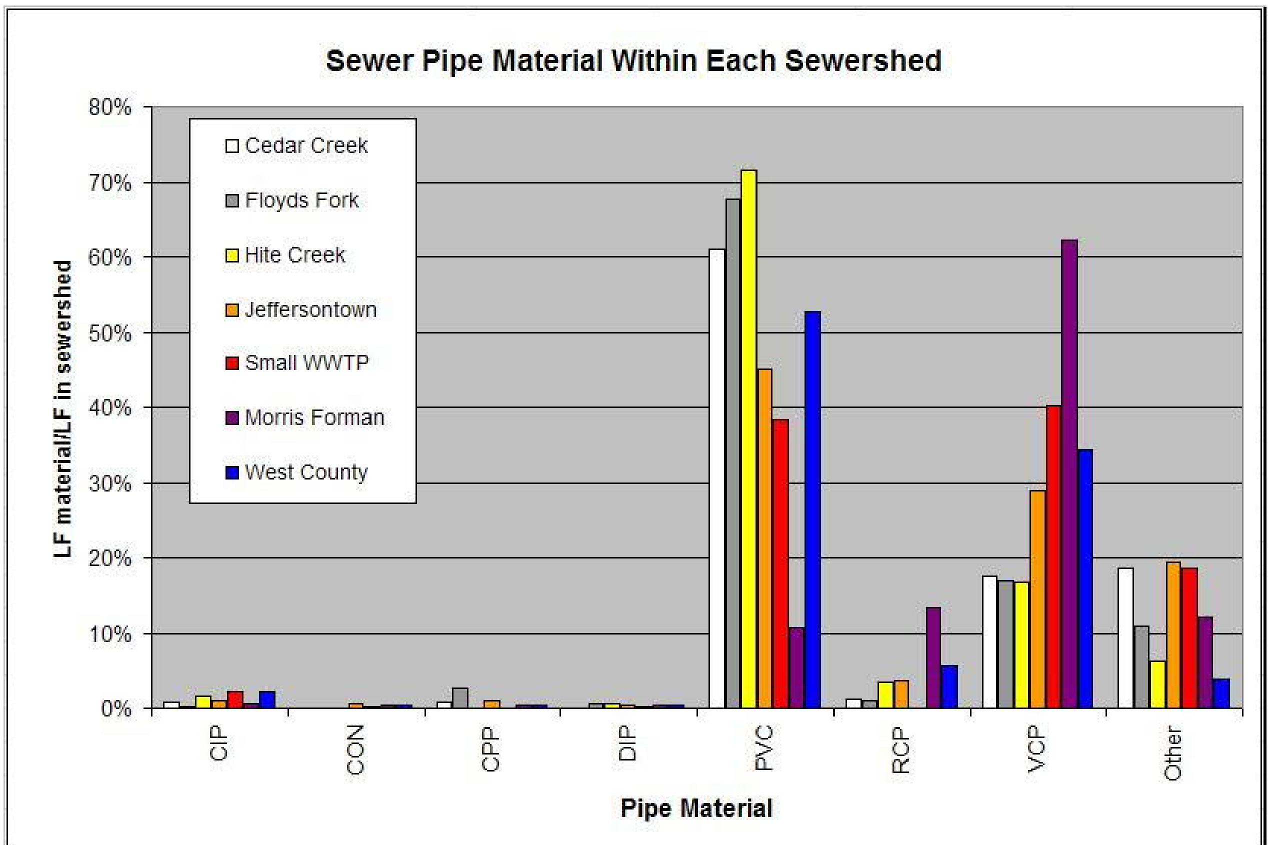
Mapping related to these evaluations are listed and available in Appendix 2.2.1:

- Sewer pipe material (Exhibits 2.2.1 through 2.2.15)
- Sewers in the 100-year floodplain (Exhibits 2.2.16 through 2.2.30)
- Sewers with non-conforming slopes (Exhibits 2.2.31 through 2.2.45)

Validated models were used to develop summaries of existing conditions for the hydraulic capacity in the gravity sewer system. These evaluations are summarized in this section and include the following:

- Locations and volume of SSOs for various levels of protection

- Surcharged sewers
- Number of hydraulic bottlenecks
- The existing conditions evaluation identified specific capacity deficiencies in the system that would need to be addressed by SSO abatement solutions.



Note: CIP (cast iron pipe), CON (poured in place concrete pipe), CPP (cured in place pipe), DIP (ductile iron pipe), PVC (polyvinylchloride pipe), RCP (reinforced concrete pipe), VCP (vitrified clay pipe), Other (brick, ABP, ACP, ADS, CMP, HPDE, PEP, ST, STL, unlisted)

Figure 2.2-1 Sewer Pipe Material Within Each Sewershed (2009)

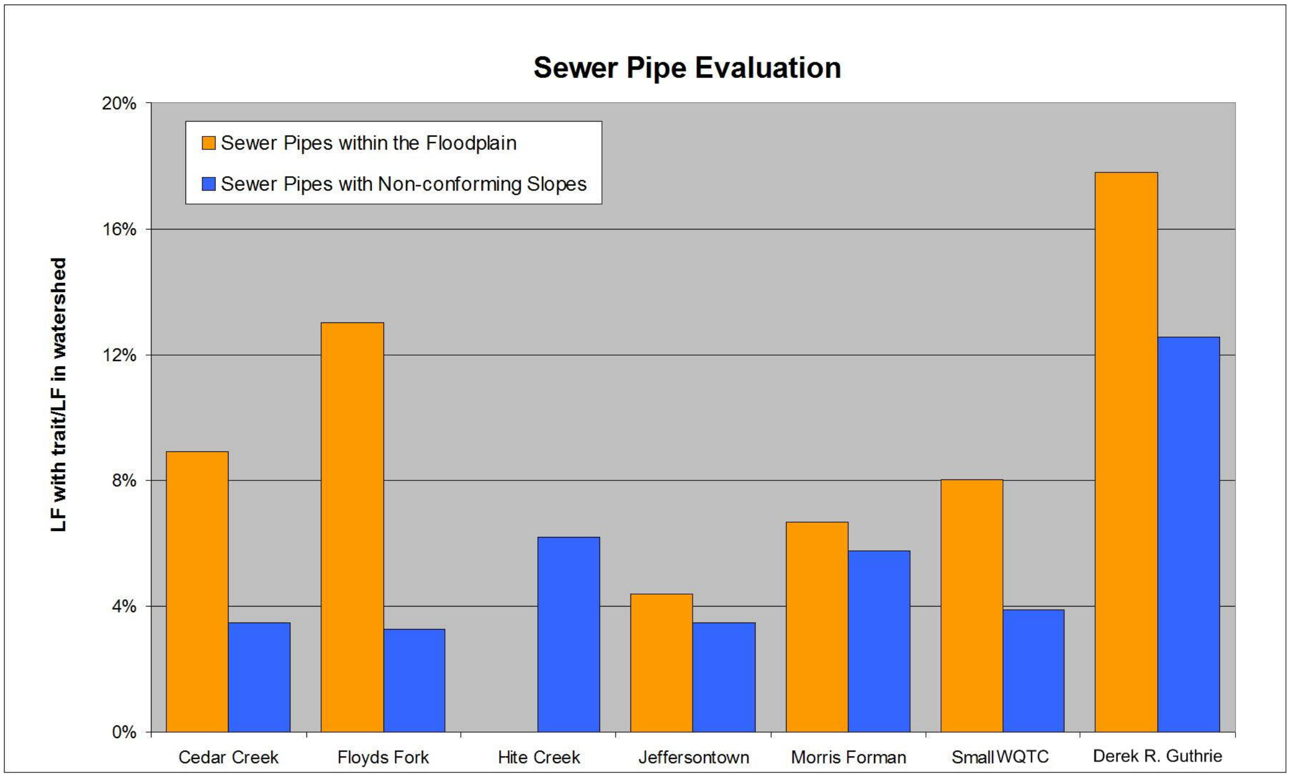


Figure 2.2-2 Sewers Located in 100-Year Floodplain and with Non-Conforming Slopes by Sewershed (2009)

2.2.3.2. PUMP STATION CAPACITY EVALUATIONS

Developing pump station performance curves that represent the station's capacity under varying system conditions is a critical element for modeling a collection system. MSD maintains a set of as-built drawing and specifications that list pump capacity. While nameplate capacity and as-built drawings can list design capacity, actual in-situ testing provides the best estimate of capacity. Prior to modeling, MSD performed drawdown tests at pump stations, including all large pump stations and those associated with SSO or surcharged areas. The drawdown test consisted of measuring a pump's ability to drawdown, or drop, in the pump station wet-well volume and the corresponding time. After accounting for inflow during the test, the average pump discharge was determined. If there were several pumps, each was tested individually.

The drawdown tests results were compared to design data to note pump stations that were not performing at designed capacity. In 2009, the design data was used at several small pump stations where drawdown tests were not performed. Since the 2009 SSDP, MSD has enhanced the pump drawdown testing program to assess pump stations performance compared to original design capacity. If the pump stations show a significant decrease in performance, pump replacement, impeller replacement, and/or other operational adjustments are implemented to improve performance and reduce the potential for unauthorized discharges.

2.2.4. FLOW MONITORING

MSD has been collecting environmental data sets for almost 20 years. Rain data have been collected continuously on a network of rain gauges across Jefferson County since the early 1990s. In 2003, a network of radar rainfall data was added to fill in the gaps in physical distance between the rain gauges. Rain data can be simultaneously evaluated with many of the other data sets to help determine the timing and impact of wet weather.

Sewer flow meters have been in place in various locations in the MSD collection system since the early 1990s. These meters have been used to assess existing conditions, locate I/I, determine SSO volumes, and assist sewer modeling efforts. The majority of the historical meters were temporary meters used for evaluation studies, but MSD has installed several permanent meters that are used for real time control (RTC) of storage within larger pipes to reduce SSOs. For purposes of this Volume of the IOAP, flow monitoring is essential for capturing flow data used for model calibration, testing the success of SSO abatement projects, and analyzing system performance after projects have been constructed.

2.2.4.1. FLOW MONITORING FOR SSDP MODELING

Prior to the 2009 IOAP development, MSD had approximately 145 flow meters temporarily installed by a contractor from January 2007 through mid-June 2007 to support hydraulic modeling and sewer system improvements planning. . As of December 2020, MSD has approximately 35 meters installed in long-term locations and 60 temporary meters that are moved, as needed, to validate/calibrate targeted areas of specific models. These values will continue to fluctuate as new meters are purchased and older meters are retired, but MSD is committed to maintaining a sufficient quantity of meters to monitor large system changes and reviewing targeted areas in detail.

One storm during the 2007 monitoring period was used specifically to calibrate and verify the models. This storm occurred on April 14, 2007, and rainfall gauges recorded depths of 1.2-inch to 1.54-inch over 21 hours during the storm event. A smaller storm was also recorded on April 11, 2007, and in some modeling areas this storm was used to assist in model calibration. These storms describe storms used during the development of the 2009 SSDP. Multiple storms have been used since the 2009 SSDP to verify and maintain the model calibrations.

2.2.4.2. RAIN GAUGE NETWORK AND RADAR RAINFALL

Rainfall data has been collected continuously on a network of rain gauges across Jefferson County since the early 1990s. During 2003, a network of radar rainfall data was added, and rainfall data was gathered continuously at 15 rain gauge sites throughout the MSD sewer system. MSD has since expanded its rain gauge network, and rainfall data is gathered at 46 rain gauge sites. Some of the sites are outside of MSD’s service area to better predict incoming rain events and to analyze rainfall patterns.

The gauges are tipping-bucket type rain gauges (see Figure 2.2-3), where rainfall enters the gauge and is funneled down to a small “bucket.” The bucket will tip and empty when 0.01 inches of rain is collected. The amount of rain (tips) is accumulated and every five minutes the data is stored in MSD’s database for an accurate history of the rainstorm.

Figure 2.2-3 Typical Rain Gauge

MSD currently receives radar rainfall data over a grid of approximately 1400 cells throughout the county and its immediate boundary (see Figure 2.2.4). These cells have rainfall depths reported every five minutes during wet weather and provide a thorough representation of the rainfall distribution differences across the county. Rainfall data is simultaneously evaluated with many of the other data sets to help determine the timing and impact of wet weather. Radar Rainfall and data from these gauges is used for model calibration, in determining "threshold" rainfall volumes for validation and for augmenting level of protection rainfall distributions.

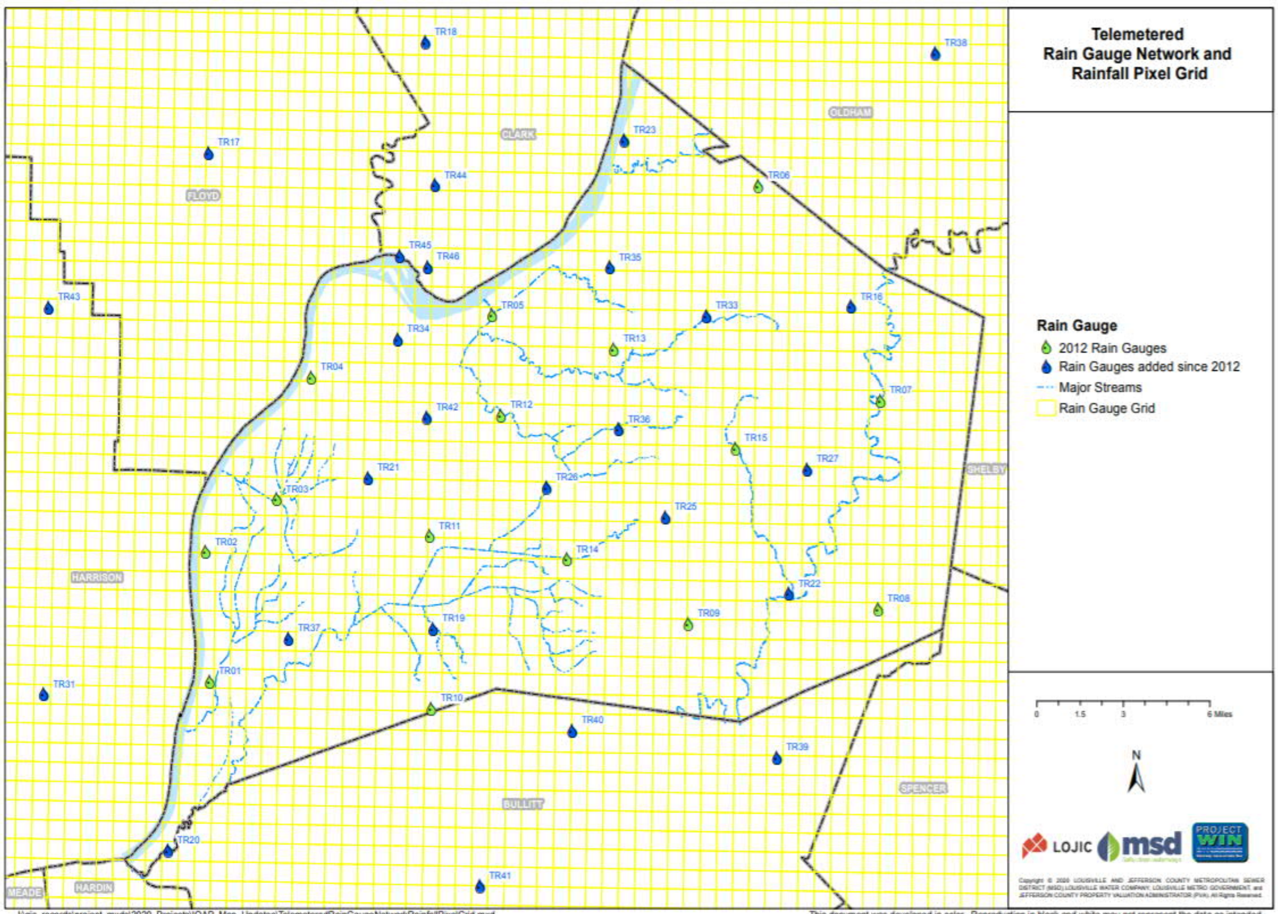


Figure 2.2-4 Telemetered Rain Gauge Network And Rainfall Pixel Grid, 2020

Additional information on the rain gauge system and rainfall data can be found on MSD's website at https://louisvillemsd.org.

2.3. CONVEYANCE SYSTEM MODELING

This section provides general background information related to model development. Detailed discussions of individual modeling efforts are discussed in Section 2.5. This section describes the procedures used to build the models used for the development of the 2009 Final SSDP. Relevant sections, especially regarding calibration metrics and validation procedures, are used as models are continuously updated based on new information or modeling in more detail.

2.3.1. MODELING HISTORY

MSD's separate SSS system within Jefferson County is divided into three main areas: Beargrass Creek, Floyds Fork/North County, and Mill Creek/Pond Creek. The Beargrass Creek sewershed includes the Morris Forman WQTC; the Floyds Fork/North County sewershed includes the Cedar Creek, Floyds Fork, Hite Creek, and Jeffersontown WQTCs; and the Mill Creek/Pond Creek sewershed includes the Derek R. Guthrie WQTC. The historical modeling in this section describes efforts prior to the development of the 2009 SSDP. These efforts were important to the development of the Final SSDP as these models were used as a basis for the new models. However, each of the models was updated following the standardized procedures document in this chapter.

The following discussion includes historic modeling efforts for the following areas:

- The Middle Fork and Beargrass Creek collection systems which flow to the Morris Forman WQTC, including Beechwood Village, ORFM/Muddy Fork, Hikes Point/Highgate Springs Pump Station, Buechel Branch, and Northern Ditch.
- The Cedar Creek collection system, which flows to the Cedar Creek WQTC.
- The Pond Creek, McNeely Lake, Mill Creek, and Valley Village collection systems, which flow to the Derek R. Guthrie WQTC.
- The Jeffersontown collection system, which previously flowed to the Jeffersontown WQTC.
- A portion of the Prospect collection system, which includes the areas previously served by Hunting Creek North, Hunting Creek South, and Timberlake WQTCs.

2.3.1.1. MIDDLE FORK OF BEARGRASS CREEK COLLECTION SYSTEM

Middle Fork (including Beechwood Village)

In 2003, the Middle Fork XP-Stormwater and Wastewater Management Model (XP-SWMM) Hydraulic Model was built and calibrated to 1998-1999 flow monitoring data. This calibration was used to analyze the system for deficient sewers and SSOs for various rainfall depths. Since the original flow monitoring data was older, new flow monitoring was performed in 2003-2004 and the model was re-calibrated. The model covered an area of approximately 14,283 acres.

Both the 1998-1999 and 2003-2004 calibrated models showed similar results: the majority of the wet weather problems were occurring in the Beechwood Village/Sinking Fork and Lower Middle Fork sub-sewersheds. These two areas contain the majority of SSO locations, SSO volume, and capacity-deficient sewers in Middle Fork. The model was used to perform capacity assessments and analyze potential improvements in Beechwood Village and other areas of Middle Fork.

Ohio River Force Main / Muddy Fork

The ORFM XP-SWMM Hydraulic Model was built and calibrated in 2000-2001 using 1998-1999 flow monitoring data. The ORFM is a dual force main consisting of 92,000 linear feet (LF) of pipe. There are eight connected pump stations and approximately 7,600 acres covered in the model. The model was used to evaluate numerous operational scenarios to determine how the system would function with different combinations of pumps in operation and at maximum flow conditions.

Hikes Point / Highgate Springs

The Hikes Point XP-SWMM Hydraulic Model was developed as part of the 1997 Sanitary Sewer Evaluation Study (SSES). This model was used to test various scenarios for in-line storage in the area affected by wet weather emergency pumped SSOs and results were used to establish design parameters for the Hikes Point Phase 1B rehabilitation project. In 2002, the model was updated and recalibrated to 2002 flow monitoring data for use with the RTC system developed by MSD. Also, at this time, the system was extended to include the Southeastern Diversion Structure. In 2003, the model was used to perform analyses for several SSO sites with the goal of determining whether emergency pumps were required and if so, at what depth of flow they should be activated. The model covers an area of approximately 5,500 acres.

In 2003-2004, the model was used as the basis for the Hikes Point System Improvement Phase 1 Project. It was used to develop a solution to eliminate SSOs, both model-predicted and known. The model was also used to determine available hydraulic capacity in the system for various storm events.

In 2004-2005, the XP-SWMM model was used for the Hikes Point Capacity Assessment Project to refine solutions developed in the system improvements project and evaluate options for redirecting flows external to the Hikes Point system throughout the area. Cost estimates were refined and ground truthing was performed to help identify the most viable abatement options.

Southeastern Diversion Structure / Buechel Branch / Northern Ditch

In the early 1990s, an evaluation of relief capacities of the Southeastern Diversion Structure and Southeastern Interceptor was conducted using the XP-SWMM program. The objective was to optimize the flow diversion approach to provide relief to the Hikes Point and Buechel Branch areas upstream of the diversion structure, but this created surcharging and SSOs upstream. Currently the flow diversion gate is normally closed during wet weather.

The Buechel Branch XP-SWMM hydraulic model was built and calibrated in 2002-2003, using 2002 flow monitoring data collected during the RTC project. The Buechel Branch RTC model covers approximately 2,800 acres and is centrally located at the intersection of Breckenridge and Nachand Lanes. The Northern Ditch area was also included in the Buechel Branch RTC model. In 2003, minor updates were made to this model, which included adding a small amount of new residential development.

2.3.1.2. CEDAR CREEK COLLECTION SYSTEM

The Cedar Creek XP-SWMM hydraulic model was originally built and calibrated in 2000-2001 using 1998-1999 flow monitoring data. This model consisted of sanitary sewers tributary to the Cedar Creek WQTC. New system infrastructure was added, and system rehabilitation projects took place in 2002-2003 so the model was updated to include the changes. The model was recalibrated for wet weather flow and dry weather flow (DWF) using flow monitoring data collected in 2002-2003.

Future conditions scenarios were analyzed in conjunction with the Jeffersontown Interceptor Condition Assessment project. Areas that were proposed to be diverted to the Cedar Creek area in the Jeffersontown Action Plan were added to the model and the effects analyzed. The Cedar Creek model covers approximately 3,600 acres of area.

2.3.1.3. POND CREEK COLLECTION SYSTEM

The Pond Creek XP-SWMM hydraulic model was built and calibrated in 2002-2003 using 1997-1998 flow monitoring data. The model consists of 10-inch and greater diameter sanitary sewer tributary to the Pond Creek and Mill Creek interceptors but does not include the Valley Village Interceptor. The model covers approximately 29,100 acres.

Derek R. Guthrie Spline Model (including Valley Village)

The Derek R. Guthrie WQTC spline hydraulic model was built by joining the Mill Creek model with a spline model of the Pond Creek system under the Derek R. Guthrie Conveyance System Improvements Project. The Valley Village interceptor was incorporated into the model. This model was originally calibrated in 2002-2003 using 1997-1998 flow monitoring data in the Pond Creek system, and 2001-2002 flow monitoring data in the Mill Creek system. The model was updated and recalibrated after system rehabilitation using 2002-2003 flow monitoring data. The model covers approximately 43,000 acres. The Derek R. Guthrie WQTC spline model was used for analysis of the proposed Pond Creek Interceptor storage basin as well as to identify system corrections to eliminate the direct entry of Mill Creek floodwaters to the system.

McNeely Lake

The McNeely Lake hydraulic model is part of the Pond Creek hydraulic model. To improve the calibration, previous flow monitoring data, pump run records, and downstream flow monitoring data were reviewed. The Derek R. Guthrie WQTC spline model was used in 2004-2005 to review hydraulic solutions on the Pennsylvania Run study area collection system due to planned and future developments.

Mill Creek

The Mill Creek model was built and calibrated in 2001-2002 using 2001 flow monitoring data. The model was built to simulate dry weather and wet weather flow in the separate SSS system. This model was part of the Derek R. Guthrie WQTC spline model, which was built by joining the Mill Creek model with the Pond Creek system model.

2.3.1.4. JEFFERSONTOWN COLLECTION SYSTEM

The Jeffersontown XP-SWMM hydraulic model was originally built and calibrated in 1998-1999 using 1997-1998 flow monitoring data. This model consisted of sanitary sewer tributary to the Jeffersontown WQTC. Model runs were performed to evaluate the system response to various storm events and was used to identify SSOs within the model. The project modeled approximately 4,650 acres. In 2001, this model was used to evaluate scenarios for inclusion in the Jeffersontown Facilities Plan submitted to the KDOW in August 2002.

A simple hydraulic isolation analysis was performed in 2002-2003 using 2002 flow monitoring data. This analysis created several artificial free outfalls within the system to evaluate the performance of the sub-basins independent of the primary interceptors. The model was revised to reflect the impact of the Jeffersontown Facilities Plan. The Facilities Plan was then updated to include anticipated flows from undeveloped areas. Finally, the model was used to evaluate various options to improve the system and eliminate unauthorized discharges. A report detailing this information and providing recommendations for capacity improvements for SSO eliminations was completed in September 2005.

2.3.1.5. PROSPECT COLLECTION SYSTEM

The Prospect XP-SWMM Hydraulic Model includes the North Hunting Creek, Hunting Creek South, and Timberlake WQTCs covering approximately 1,856 acres. The Shadow Wood WQTC was not modeled because it was privately-owned at the time. The Prospect model was built to simulate dry weather and wet weather flows and was calibrated in 2002 using 1999-2000 flow monitoring data. The model was used in conjunction with existing data and wet weather inspections to develop a comprehensive solution for the elimination of SSOs at the Gunpowder Pump Station. The project was completed in August 2004.

2.3.2. OBJECTIVES OF THE MODELING PROGRAM

Objectives and uses of the modeling program include:

- Performing alternative and solution analysis for SSO volume reduction and elimination
- Projecting capacity for new development
- Performing future analysis, with an increased investment in calibration/validation, of system upgrades due to age and asset deterioration
- Simulating storm events and system response investigation

2.3.3. SSDP MODEL DEVELOPMENT

The hydrologic and hydraulic modeling software selected for all hydraulic modeling was InfoWorks, supplied by Innovyze. The InfoWorks program is designed not only to model wet weather effects on collection systems, but to also take advantage of a large GIS database provided by LOJIC. InfoWorks has the ability to import XP-SWMM models, allowing MSD to build on extensive prior modeling, as detailed in Section 2.3.1. During the 2009 IOAP, InfoWorks CS was used as the modeling software. Since the 2009 IOAP, Innovyze released InfoWorks ICM, replacing the CS module. This module allowed for enhanced data organization as well as additional modeling capabilities, including the ability to model two-dimensional flow patterns.

In 2009, there were a total of 11 modeled areas in the Final SSDP (refer to Figure 2.3-1 at the end of the chapter). MSD provided each modeling team with known system hydraulic information such as known SSO location, volume, and duration; pump station runtime information; known surcharge areas; and other relevant data for each modeled area. This information was used by the modeling teams in calibration and validation of the models. The 2009 areas are used to organize the characterization of the SSOs and organize the projects for the Final SSDP development. Since the 2009 IOAP, the Jeffersontown WQTC and the small WQTCs have been eliminated, and the modeled areas have been absorbed into other models. Figure 2.3.1A (at the end of the chapter), shows the new modeled area.

The model development process represents the process to develop the models for the 2009 IOAP update. The modes are continuously updated to reflect changing conditions (growth, capital projects, change in I&I or pumping rates). The model updates generally follow the same guidelines where relevant.

Figure 2.3-1 Model Areas, 2009
Figure 2.3-2A Model Areas, 2020
Figure are located at the end of this chapter.

2.3.3.1. MODELING GUIDELINES

As a first step in the program, MSD developed the Hydraulic Sewer System Modeling Guideline Manual (see Appendix 2.4.3 in Volume 2). These procedures improve the detail, quality, and functionality of the sewer models while providing consistent model development criteria.

The guidelines instructed the modelers how to:

- Perform the capacity assessments
- Develop a range of system improvements
- Develop the benefit/cost ratios for the various solutions in a consistent manner
- Confirm reported results are sufficient for development of the Final SSDP

MSD developed the Modeling Guidelines to address the following:

- Update modeling standards, including refining the I/I modeling procedures and assessing flow monitoring
- Review XP-SWMM models to determine deficiencies
    - Identify expansion needs
    - Assess data verification needs
    - Collect record drawings, and
    - Conduct pump-station drawdown tests
- Switch to the InfoWorks software and develop a platform (server) for retrieving, storing, and sharing model data
- Import shape files of the model area into InfoWorks
- Develop flow monitoring basins
- Define hydrologic and hydraulic parameters
- Review modeling input and output

The following summaries provide samples of important guidelines presented in the manual related to initial model development.

Modeling Standards and Migration of Model Data

MSD developed a full set of modeling standards prior to performing any separate SSS modeling. This included calibration standards, use of flow monitoring data, use of previous models, input and export standards, Quality Assurance / Quality Control (QA/QC) procedures, and modeling techniques for I/I and pump facilities. In parallel with that effort, MSD reviewed past models and determined deficiencies in data, such as inverts and pump data. They also coordinated with MSD crews who conducted drawdown tests at key pump station facilities.

InfoWorks CS is a modeling platform designed around GIS databases and is capable of importing data from other models. Thus, InfoWorks models were not designed from "scratch."

Flow Monitor Basins

MSD determined that flow monitoring basins should have no more than 100,000 LF of pipe within its boundaries, not including areas contributing flows measured by upstream monitors. As much as practical, each basin had uniform land use and soils data.

Hydrologic Parameters

Hydrologic parameters refer to the components of the model that are manipulated to simulate rainfall dependent inflow and infiltration (RDI/I). RDI/I is simulated as rain falling on catchments. These catchments are not real, but rather mathematical abstractions used to determine the rate and volume of RDI/I over time.

MSD's system models do not account for the effects of snowmelt due to the small volume of water resulting from snowmelt for this region of the country. Likewise, evaporation is ignored due to the relatively short model runs.

Dry weather flow (DWF) is a combination of groundwater infiltration, residential, industrial, and commercial user flows. DWF is defined as the flow that occurs in absence of any runoff due to precipitation. Main features of DWF are flow volume and rate, diurnal pattern, and spatial distribution. Each is determined from flow monitoring data. DWF is allocated to individual manholes based on spatial data, such as census and land use.

Hydraulic Parameters

Hydraulic parameters represent the infrastructure of the model. This would include features such as pipes, manholes, pump stations, and force mains. The modeler provides dimensional and geographical information for each feature. The modeler also provides the node and link arrangement to mimic actual infrastructure connections.

MSD provided each modeler with past models and pertinent LOJIC GIS data. With this information, each modeler developed the complete sewershed model and the models were checked with InfoWorks review tools. The following represent critical components of a model's accuracy and the method used in the modeling procedure to address them.

Pump Stations

Since pump station capacity is critical to developing an accurate model, significant effort was paid to pump station representation (see Section 2.2.2.2). Each procedure was detailed by pump size within the Modeling Guideline Manual. Large pumps are typically modeled as dynamic pumps, but on occasion are modeled as fixed pumps to reflect pump drawdown results more accurately.

Boundary Conditions

In most cases, a downstream boundary condition is a known hydraulic grade line elevation at the point of interface between the modeled system and a system outside of the modeled boundary (e.g. river). During periods of high flow, backwater effects in the conveyance system caused by a high hydraulic grade line at a pump station wet well were captured and modeled.

For the Final SSDP, the following boundary conditions were used:

- For downstream branches, the boundary condition could include WQTC capacity, Interim SSDP project allotment, or existing flow to the combined sewer area.
- For upper branches not tying into a WQTC, Interim SSDP project, or combined sewer system, solutions were determined without regard to downstream impacts (i.e. no penalty for conveyance).

Model Input and Output

Model input selection and the level of detail to which the model is constructed are important to confirm the model is properly constructed. Equally important is a complete review of model output prior to acceptance of model results. After the modeling teams made a thorough review, the model was reviewed by a separate modeling firm to verify accuracy. Additional detail on the quality assurance and quality control (QA/QC) procedure is described in the next section.

2.3.4. RAINFALL DISTRIBUTION AND LEVEL OF PROTECTION

Rainfall is characterized by temporal distribution and total volume. Both of these characteristics impact design capacity, pumping rates and optimized solutions. Level of protection is the selection of a rainfall-volume frequency or level for design. This is commonly denoted by an average interval, such as a two-year storm that has a 50 percent probability of occurring in any given year.

From a practical perspective, no sewer system can be designed to consistently convey all system flow during extreme weather events. Therefore, a "design condition" must be defined that reflects the level of protection consistent with community values. The costs for capturing wet-weather events must be balanced with the benefits to community associated with capturing that event. Section 3.2.1 in the following chapter outlines the procedure used for determining consistent costs. Section 3.2.2 outlines the procedure used for determining benefits consistent with community values, as outlined in the Stakeholder process. Section 3.2.3 outlines the procedure used for determining the best benefit-cost ratio, thus defining the preferred level of protection.

In the Final SSDP, the values evaluation framework was used to determine levels of protection that reflect an appropriate level of control of unauthorized discharges for the Louisville Metro community.

2.3.4.1. BASE RAINFALL DISTRIBUTION

For the separate SSS modeling, MSD considered two storm distributions: 1) the Natural Resources Conservation Service (NRCS) "long duration" distribution and 2) the National Oceanographic and Atmospheric Administration (NOAA) "short-duration precipitation," often referred to as the "cloudburst" distribution. The Natural Resources Conservation Service method is a general large-area storm often used for design of large stormwater and flood control structures such as dams and detention facilities. The NOAA cloudburst distribution uses depth-area-reduction-factors derived from frequency analyses of local hourly precipitation data recorded at the Louisville International Airport. This distribution is typical of shorter duration storms that often cause SSOs in individual basins. It is also similar to the storms captured during the system flow monitoring used for model calibration.

Based on an analysis of over fifty years of historical weather patterns for Jefferson County, MSD determined that a three-hour, high-intensity cloudburst storm reflected the most appropriate storm pattern to use in SSO control evaluation. The NRCS long duration distribution is more appropriate for total system-wide modeling for larger service areas, such as inflow to regional wastewater treatment plants, since the attenuation of the peaks for the larger service area is less dramatic. However, the cloudburst storm is more appropriate for localized collection system modeling and provides for better calibration and validation of the hydraulic models to known SSO locations.

See Appendix 2.3.1 for additional details on the selection of the cloudburst storm.

Appendix 2.3.1 Selection of the Cloudburst Storm

Appendix is same as 2012 IOAP Modification and is provided on external USB storage drive.

2.3.4.2. SECOND STORM DISTRIBUTION

In some cases, the preferred solution for an SSO will be storage of excess wet-weather flow. Storage, however, will only be effective as an SSO abatement strategy if it can empty in short order. Otherwise, a small second storm immediately after the design storm could cause a full storage facility to overflow.

To account for this, a second smaller rainfall distribution was added after the first such that the rainfall peaks were 12 hours apart. The total rainfall depth for the second storm was consistently set at 0.46”, corresponding to a 10-day recurrence interval storm.

2.3.4.3. MODEL SIMULATIONS

During system characterization, a suite of design conditions was analyzed starting at the 1.27-inch cloudburst up to the 2.60-inch cloudburst. This allowed the opportunity to validate models and determine the extent of various deficiencies, such as surcharging, at each level. During solution optimization, the baseline storm was at the 1.82-inch cloudburst storm level. Once a solution had been identified at this level, the solution was then analyzed at a 2.25-inch cloudburst level and 2.60-inch cloudburst level to compare benefit-cost ratios for a modeled watershed branch. Solution optimization is discussed in detail in Volume 3, Chapter 4.

2.3.5. MODEL CALIBRATION, VALIDATION, AND BASELINE CONDITIONS

The following sub-sections summarize critical modeling components related to model and solution development.

2.3.5.1. MODEL CALIBRATION

Model calibration is the process of comparing model-predicted results to measured flow monitoring and rainfall data from a single, significant rainfall event and to match pump station drawdown test results. The process is iterative and proceeds until the modeled results match the measured data within a pre-defined percentage level of accuracy, called action levels. Model calibration and validation reports are located in Appendix 2.3.2.

Appendix 2.3.2 Model Calibration/Validation Reports

Appendix is same as 2012 IOAP Modification and is provided on external USB storage drive.

Action Levels

The action level of accuracy is 20 percent for the difference in base flow rate (minimum); the action level is 10 percent for the difference in flow volume and the difference in peak flow rate (maximum). The hydrograph shape, mean flow velocity, and water depth predicted by the model and measured by the flow monitoring is also qualitatively compared. Guidelines on adjusting models are detailed in MSD’s Hydraulic Sewer System Modeling Guideline Manual, Volume 2, Appendix 2.4.3.

Model Re-calibration

Model re-calibration was required after validation and verification of modeled overflow points (MOPs). MOPs are discussed in detail later in this section. Model calibration and re-calibration was completed in accordance with MSD modeling standards and protocols. The standards can be found in the Hydraulic Sewer System Modeling Guideline Manual, Volume 2, Appendix 2.4.3.

2.3.5.2. MODEL VALIDATION

Once the model is calibrated, the model is then "validated." Model validation is simply cross-checking the model performance against other recorded storm events or historical system performance data sources, such as known SSO locations, using threshold rainfall depths known to cause overflows, reported overflow volumes, and surcharged pipes. Due to lack of additional, system-wide storm events during the 2007 flow monitoring period, model validation was focused on validating the models to readily available historical overflow data.

Known SSOs

In the 2009 IOAP development, MSD provided threshold 24-hour rainfall and average reported SSO volume for each known SSO in MSD's service area. The calibrated model simulated the 2.2-inch, 2.7-inch, and 3.2-inch level (this corresponds roughly to the six-month, one-year, and two-year Natural Resources Conservation Service design rainfall events) and the modeled SSO locations and volumes were noted. In some cases, modeled SSOs occurred within a few manholes of known SSOs, these locations were considered to represent the known SSOs.

The results were compared to the initial SSO list with two goals in mind. The primary goal was to show overflows at each known SSO location for similar rainfall depth. A secondary goal was to have relative agreement in SSO volume; for example, the SSOs in the sewershed within the top third of the reported volumes were not in the lowest third of the modeled SSO volumes. If parameters needed to be adjusted, the model was modified in a manner similar to calibration modifications. The validated MOPs were not considered for this criterion since there were no reported SSO volumes associated with the locations. Initial validation took place prior to MOP investigations in the spring of 2008.

Surcharged Pipe

MSD provided maps of areas with historical basement flooding based on complaint records and installed back-flow preventers. In most cases these areas coincided with known SSO locations and known hydraulic restrictions. In the few instances where surcharging was not noted in the model, parameters were adjusted upwards to induce surcharging for a 1.27-inch storm in a manner similar to calibration modifications.

Unvalidated SSOs

In some cases, SSOs could not be induced in the model where known SSOs occurred. If the pipe slope in the area was shallow, sedimentation could be applied to the model to induce the SSO (process was performed according to modeling standards). In these cases, MSD investigated the downstream sewer system to locate blockages or other operational problems. If the problem was cleared, the SSO status was changed to "Remediated." These cases are detailed in Appendix 2.3.2 and the sewershed summaries in Section 2.5.

Recalibration

After validation was completed, the model was reviewed to confirm it met calibration standards. If it did not, the model was recalibrated and revalidated until all action items and validation goals were met. In practice, validation and any re-calibration took place simultaneously.

Appropriate Rainfall Distribution

While model calibration and validation were being conducted, MSD contracted to have a rainfall analysis performed and synthetic rainfall events produced for the Louisville Metropolitan area, based on 59 years of rainfall records at the Louisville International Airport. (See Appendix 2.3.1) The analysis indicated that the typical storm type and duration for Louisville rainfall events is the 3-hour duration cloudburst event, especially for events over the two-year recurrence interval.

MSD compared the typical Natural Resources Conservation Service Type II 24-hour rainfall distributions with the 3-hour cloudburst distributions to determine the best synthetic rainfall event to use for further validation and additional analyses. The Natural Resources Conservation Service distributions resulted in unrealistic model results that did not match calibration and validation data from storm events of similar recurrence intervals. The results typically showed higher overflow volumes, longer overflow durations, and more modeled overflow points that did not correspond with field data. The cloudburst storm overwhelmingly showed a closer resemblance to overflow recurrence intervals, approximated overflow volumes, and documented overflow locations that had been recorded over the past five years. Because of this approximation of typical events, the cloudburst storm distribution was selected for the development of overflow abatement solutions.

2.3.5.3. MODEL QA/QC PROCESS

As mentioned earlier, calibrated, and validated models were also subjected to a QA/QC process as discussed in the Modeling Guidelines. This QA/QC peer review involved a “swapping” of models based on a pre-determined assignment list. The process involved reviewing dry-weather and wet-weather flow surveys, comparing results for calibration storm, and reporting discrepancies in a QA/QC checklist and comments form. Reviews were then returned to the model development teams for responses and revisions. In some cases, recalibration was necessary.

Appendix 2.3.3 Model QA/QC Documents
Appendix is same as 2012 IOAP Modification and is provided on external USB storage drive.

Table 2.3.1 is a sample of the QA/QC checklist used by modelers to verify and validate model accuracy. Full Model QA/QC documents are provided in Appendix 2.3.3.

Appendix 2.3.3 Model QA/QC Documents
Appendix is same as 2012 IOAP Modification and is provided on external USB storage drive.

Table 2.3.1 QA/QC Checklist Sample

GENERAL REQUIREMENTS

ITEM	OK	SEE COMMENT
Model Development		
1. Standard Data Flags – Ensure data flags have been properly used. (Section 3.4.1)	☐	
2. Rainfall Data – Check the rainfall data to ensure the PIXEL number has been used for the profile ID (Section 3.4.2). Ensure pixels cover the entire modeling catchment.	☐	
3. Rainfall Data – Check rainfall data units. Rainfall data should be in inches/hour.	☐	
4. Model Building – Check the unique IDs used for nodes and links (Table 3-2 Section 3.4.3).	☐	
5. Model Building – Check pipe invert and manhole rim elevations. Generally these should range from 400ft to 800ft above sea level for Louisville.	☐	
6. Model Building - Run the network validation and check to see if there are any errors or warnings that need to be addressed.	☐	
7. Model Building – Check the simulation parameters. Generally the "Simulation: Tolerance for Volume Balance" parameter should be set to 0.01 for model stabilization. (Section 3.4.6)	☐	
8. Standard Naming Convention – Check naming convention used for groups listed in the Guidelines. (Section 3.4.8)	☐	
Hydrologic Parameters		
1. Runoff – Runoff Volume Type should be set to Fixed for all Runoff Surfaces. Can be set to SCS only if in a rural area. (Section 4.1.1)	☐	
2. Runoff – Routing Model should be set to SWMM for all Runoff Surfaces (Section 4.1.1)	☐	
3. Evaporation & Other Losses – For single storm event analysis evaporation losses should be set to zero. See Guidelines for continuous annual simulations. (Section 4.4)	☐	
4. RDII – Check to ensure the model has the proper number of dummy subcatchments to simulate the fast, medium, and slow response of for RDII. A minimum of two are required. (Section 4.5)	☐	
5. Subcatchment Areas – Check for large subcatchment areas. Ensure these areas represent the contributing area to the sewer system. For large parcels the subcatchments should only be drawn around the contributing area and not the entire parcel.	☐	
Hydraulic Parameters		
1. Conduit Data – Pipe shapes should be predominately circular except in the CSS area.	☐	
2. Datum shift – Spot check 5 pre-2002 and 5 post-2002 constructed conduits and manholes to ensure the -0.5 feet datum shift from NGVD29 to NAVD88 was properly applied. (Section 5.1)	☐	
3. Conduit Data – Check for elevations of zero, adverse slopes, and non-standard pipe diameters. (Section 5.1)	☐	
4. Conduit Data – Manning's N values should be set 0.013 in the Separate Sewer System and 0.013 – 0.016 in the Combined Sewer System based upon pipe material. (Section 5.1)	☐	
5. Conduit Data – Headloss Types should be set to 'normal'. (Section 5.1)	☐	
6. Node Data - All junction chambers and shafts should have a diameter of 4.0 feet. For pipe diameters greater than 4.0 feet the chamber diameter should equal the pipe diameter. (Section 5.2)	☐	

2.3.5.4. MODELED OVERFLOW POINTS (MOPS)

After validation and peer review, the models were simulated again at the 1.82-inch cloudburst storm level to note any modeled SSOs that were not associated with known SSOs. These SSOs were designated as MOPs. MOP locations were targeted for further analysis and field investigations. Section 2.4.2 describes the MOP investigation and validation procedures.

2.3.5.5. SYSTEM DEFICIENCIES

Once models were calibrated and validated, system deficiencies were determined for various levels of protection. The system was characterized by SSOs, surcharged pipes, and areas at or near capacity for each analyzed level, including peak flow rates, time to peak, and total SSO volumes. System deficiencies noted include hydraulic restrictions, hydraulic jumps, bottlenecks, pump limitations, flow monitoring limitations, insufficient slopes, and non-standard diameters. System deficiencies can be divided into two categories: 1) construction and 2) hydraulic, as explained below.

Construction Deficiencies

Construction deficiencies are related to operation and maintenance issues. Deficiencies may not directly cause SSOs or hydraulic issues, but they require additional maintenance and, therefore, contribute to conditions that can promote the formation of SSOs. The InfoWorks Engineering Tool includes a variety of tests to identify engineering deficiencies such as pipe slopes (which can promote silting), pipes with insufficient soil cover (which may be damaged by traffic), and excessively long pipes (which are difficult to access for inspection and cleaning).

Hydraulic Deficiencies

Hydraulic deficiencies are related to physical limitations of the system. Such systems may meet specific Engineering Standards for normal flow but are insufficient for the flows observed in the field. These deficiencies could include bottlenecks, hydraulic jumps, and surcharged pipes. While InfoWorks can identify numerous minor reductions in flow that have no impact on sewer performance, only hydraulic restrictions that result in surcharging under modeled flow are flagged as restrictions.

Hydraulic deficiencies are identified through several features integral to InfoWorks. This will take advantage of the rigorous examination of the data performed during the model construction. For example, hydraulic jumps are marked as part of the surcharge identifier. Other deficiencies require modeler evaluation. For example, pump station limitations are highlighted by surcharging upstream of the pump station but requires the modeler to confirm the pump station capacity as the true restriction.

2.3.5.6. MODEL BRANCHING

Prior to the solution development process, the models were subdivided into “branches.” These branches were analyzed separately, beginning at the most upstream branches, and proceeding downward toward the sewershed outlet or WQTC. During solution development, costs, benefits, and benefit-cost ratios were determined for each branch separately. Once a preferred solution was determined for upstream branches, development proceeded downstream.

Ideally, each branch would address a separate hydraulic issue that caused SSOs and surcharging. In practice, branches were set by grouping hydraulically connected SSOs, surcharging and system deficiencies. These groupings often contained several SSOs and often two or more groupings would be in close proximity.

Section 2.5 provides details on the branch selection for each model area. Figures 2.3.2 through 2.3.11 at the end of the chapter provide maps of each modeled area and respective branch boundaries.

Figure 2.3-3 Cedar Creek Model Area and Branch Network, 2009
Figure 2.3-4A Cedar Creek Model Area and Branch Network, 2020
Figure 2.3-5 Floyds Fork Model Area and Branch Network, 2009
Figure 2.3-6A Floyds Fork Model Area and Branch Network, 2020
Figure 2.3-7 Hite Creek Model Area and Branch Network, 2009
Figure 2.3-8A Hite Creek Model Area and Branch Network, 2020
Figure 2.3-9 Jeffersontown Model Area and Branch Network, 2009
Figure 2.3-10 Middle Fork Model Area and Branch Network, 2009
Figure 2.3-11A Middle Fork Model Area and Branch Network, 2020
Figure 2.3-12 Southeastern Diversion Model Area and Branch Network, 2009
Figure 2.3-13 ORFM Model Area and Branch Network, 2009
Figure 2.3-14 CSS Model Area and Branch Network, 2009
Figure 2.3-15 Pond Creek Model Area and Branch Network, 2009
Figure 2.3-16A Pond Creek Model Area and Branch Network, 2020
Figure 2.3-17 Mill Creek Model Area and Branch Network, 2009
Figure 2.3-18 Mill Creek Model Area and Branch Network, 2020
Figures are located at the end of this chapter.

2.3.5.7. RDI/I REDUCTION

RDI/I reduction, identified by the Wet Weather Stakeholder Group as a critical component of solution development, was an integral part of every solution. MSD developed a method to project estimated RDI/I reduction for the entire MSD service area. Appendix 2.3.4 provides a technical paper outlining this application and the modeling techniques.

Appendix 2.3.4 RDI/I Method and Modeling Techniques Technical Paper
Appendix is same as 2012 IOAP Modification and is provided on external USB storage drive.

The RDI/I reduction projections were:

- Applied to all models prior to solution evaluation.
- Based on flow monitoring results, namely peaking factors at flow monitoring basins. The peaking factors were calculated prior to modeling by comparing monitored flow to average flow determined from a period of dry weather.
- Applied only in areas with high peaking factors (greater than four).
- Conservative in that RDI/I reduction was set at a maximum of 25 percent reduction and then only at areas with peaking factors greater than 14.

It should be noted that the projected RDI/I reduction used in the models is based on estimated values. The actual RDI/I reduction will be based on the type and comprehensiveness of the rehabilitation effort. This is not to say that actual RDI/I reduction exceeding the projected reduction values used in the models cannot be accomplished. It is expected that they will in many cases. Such successful RDI/I reduction projects will provide capacity for areas where reduction is not as successful. It is, however, prudent that overly optimistic values are not used in planning and design. This is especially important in transport-based solutions where the diameter of installed piping cannot readily be changed once it is installed. The projected RDI/I reduction applied to each model is listed in the Section 2.5.

Since the 2009 IOAP, RDI/I has been evaluated in areas where rehabilitation was targeted. In some cases, rehab successfully reduced the RDI/I substantial amounts, and in other cases reductions were less successful. Prior to final design of an SSDP project, RDI/I reduction is removed from the model for final project sizing.

2.3.5.8. I/I PROGRAM

MSD has executed an on-going I/I Program for systemic improvements in the collection system during implementation of the Final SSDP. At the behest of Stakeholders MSD committed to use RDI/I removal as the first approach to eliminate SSOs. MSD recognizes that, based on past I/I Program Projects, the degree of RDI/I removal is often difficult to predict and success is not always assured. Accordingly, MSD has committed to achievable levels of RDI/I removal in areas where success is most likely.

Projected RDI/I removal was applied to all hydraulic models prior to solution development and optimization. Details of this approach are found in Appendix 2.3.4. Once optimized solutions for all SSOs had been developed, RDI/I reduction was removed from the models. The models were re-evaluated, and solutions were re-sized at the 1.82-inch cloudburst storm level. The cost differential between the two sets of solutions, one with and one without RDI/I reduction, was used to determine appropriate I/I Program costs, as presented in Chapter 3, Appendix 3.1.1, I/I Program Documentation. In 2009, it was estimated that the annual cost would average $1.6 million. This cost does not include programmatic needs for inspection and rehabilitation related to associated programs such as CMOM, SCAP, and the Nine Minimum Controls (NMCs). To provide contingency and to account for the costs to accommodate associated programs, the annual cost of the I/I program was set at $3 million.

Appendix 3.1.1 (Table 6) lists projects dependent on RDI/I reduction as part of the SSO elimination solution. Appropriate rehabilitation for these projects will take place as part of the I/I Program prior to actual capital construction of these solutions. The earliest I/I projects will likely concentrate on areas solely dependent on RDI/I removal (such as Branch MSD1086 in Hite Creek); these projects already have funds allocated for RDI/I removal. Other early candidates include areas with the highest peaking factors and thus the highest potential for RDI/I reduction. The actual schedule will be determined by MSD in conjunction with the CMOM Program, SCAP, and other associated programs.

Given the uncertainty of RDI/I removal, monitoring and adapted management techniques are critical to success of the I/I Program. Pre- and post-rehabilitation flow monitoring will take place as part of the Final SSDP (refer to Volume 3, Section 1.3.1 for a description of this program) and will include areas in the I/I program. SSOs will also be monitored under SORP guidelines (refer to Section 1.3.1.5). Post-construction monitoring will be used to demonstrate the impacts of I/I improvements on RDI/I reduction. As SSOs are eliminated they will be removed from the I/I Program. If flow monitoring and the SORP program show that RDI/I removal has been effective but insufficient, additional RDI/I removal may be implemented as part of the I/I Program or the CMOM Program. If flow monitoring and the SORP program indicate that RDI/I removal has not been effective, additional construction alternatives may occur at the SSO.

2.3.5.9. CAPITAL IMPROVEMENT PROJECTS

All MSD projects within the t five-year capital plan were considered in branch solutions. In considering these projects, modelers were given the latitude to modify design parameters (such as pipe diameter or pump capacity) to the extent of the preliminary project design. In some cases, the project was expanded and lengthened; in others, the project was shortened. In all cases, some portion of the capital project was included in the optimized solution, although this was not a requirement. The Capital Improvement Projects used in solution development in 2009 are listed for each modeled area in Section 2.5. New Capital Improvement Projects are typically added to the models during planning stages to verify the proposed project will not have a negative impact on the separate sewer system performance and to determine if any enhancements to the project could further benefit the sewer system.

2.3.5.10. BUILD-OUT DEVELOPMENT

In general, build-out was applied as additional flow using the following criteria:

- Upstream of SSOs
- Drained by gravity to the SSO
- Limited to open areas outside of 100-year floodplain, parks, and recreational areas
- Limited to buildable areas (no steep slopes or shallow bedrock)
- Developable in phases consistent with planning documents
- Single-family home equivalents, with peaked wastewater flows per MSD's Design Manual
- Flow added to the existing system at an appropriately sized interceptor
- Peak flow added to the model to coincide with peak rainfall
- Additional flows from all other areas would fall under the SCAP requirements

Appendix 2.3.5 provides the full reports describing the build-out potential and the techniques used for determining the areas. Specific build-out parameters used in solution development are listed for each modeled area in Section 2.5.

Appendix 2.3.5 Build-out Method and Modeling Techniques
Appendix is same as 2012 IOAP Modification and is provided on external USB storage drive.

2.3.5.11. FUTURE MODEL UPDATES

Following construction, calibration, and validation of models under the Final SSDP program, periodic updates to the model will be conducted. In 2010, each model was updated, and calibration was verified, and the results were used in the 2012 SSDP. Since the 2012 SSDP, each modeled area is generally reviewed every two years to determine if an update to the model is necessary. Models in rapidly growing areas are sometimes updated more frequently. Changes include new sewers, pump station eliminations, pump station upgrades, capacity upgrades, capital projects, etc. Appropriate documentation will take place for all model updates. The scale of the necessary documentation will be related to the scale of the changes to the model, the length of time since the last full model report was prepared, and the end use of the model.

2.4. SSO CHARACTERIZATION

This section discusses the initial SSO list and the process for the validation of MOPs by field investigation. It also presents the final SSO list used for Final SSDP solution development.

2021 Update: This process was used to develop the final SSO list in the 2009 Final SSDP. Characterization of the same list of SSOs is continually updated based on model calibration and completed projects. Some of the SSOs have since been removed by IOAP or Interim SSDP projects. Characterization in this section is organized by the 2009 service areas and represent the initial model characterization. Because the Jeffersontown WQTC and the small WQTCs have been eliminated, the SSOs listed in this section are now in the modeled areas as shown in **Error! Reference source not found.**. However, they are still shown described in their initial areas to provide continuity.

2.4.1. INITIAL SSOS

Identification, validation, and characterization of SSOs are a continuous process. Management of the data associated with these activities is described in the SORP.

In the Spring of 2007, flow monitoring data collected throughout the MSD collection system along with continuous rainfall data from the MSD rainfall network, were used for initial calibration of the models. The calibrated models were then validated against 126 "initial" SSOs: those known to be active, known SSOs at the beginning of the modeling process in the Fall of 2007.

For each initial SSO, the following data was developed:

- **The 24-hour "threshold rainfall" volume**. This threshold rainfall was determined by noting the minimum (non-zero) 24-hour rainfall for each SSO event at each initial SSO. The rainfall was derived from the nearest rain gauge and centered on the time the SSO was first reported to overflow.
- **Average reported volume for each initial SSO**. This data is not as dependable as threshold rainfall since SSO volumes are estimated and reported based on when the SSO was first discovered until it ceases. This data was not used in calibration. MSD used this data for general guidance in the validation phase after calibration was performed to ensure models were predicting known overflows within a reasonable range of the reported volume. Refer to Section 2.3.5.2 for a description of the Model Validation process.

As described later in this section, MOPs that became validated by field investigation were added to the initial SSO list and used in further model validation.

2.4.2. MOP VALIDATION PROCESS

Early modeling based on initial SSOs indicated that SSOs might occur at locations other than documented SSOs. A separate category, known as MOPs, was created to classify these SSOs. A MOP corresponds to a particular manhole or pump station location.

MSD's goal was to verify the existence (or lack thereof) of the MOPs through field investigations. In particular, MSD focused on "targeted" MOPs, with the following characteristics:

- Modeled overflow volumes greater than 10,000 gallons during a 1.82-inch cloudburst storm
- Not hydraulically connected to a documented SSO

The following subsections summarize the field investigation process.

2.4.2.1. INVESTIGATION PROCEDURES

The following steps briefly describe the investigation procedures developed by MSD for validating MOPs:

- Investigation teams attended MSD training for inspecting manholes and how to document findings.
- Seventy-one targeted MOPs were divided among teams by geographical location.
- During and immediately following three significant rain events in March, April, and May 2008, investigation teams performed the following:
    - For each MOP, the surrounding area was inspected for sewer debris and other waste.

- Each MOP manhole, if possible, was opened, checked, and marked with chalk for future investigations. The chalk was used to assist in future inspections for determining if surcharge conditions occurred within the manhole.
- Upstream and downstream manholes were investigated if the MOP manhole could not be accessed or flow conditions in the MOP manhole could not be determined.
- Data was documented in work orders provided by MSD.
- MSD Customer Service was notified if an active overflow was observed.
- Overflow Report Forms were completed for any observed overflow.

2.4.2.2. MOP CLASSIFICATION

Based on field investigation findings, MOPs were classified into one of six categories. A summary of each category is outlined in the following.

1. Documented - An overflow was witnessed. MOP locations coded as documented SSOs require solution development by the modelers and added to the documented SSO list.
2. Suspected - Evidence found indicating an overflow had occurred. MOP locations coded as suspected overflows require solution development by the modelers and are added to the suspected SSO list.
3. Surcharged - Evidence found indicating manhole surcharging but not an overflow. Solution required. MOP locations coded as surcharged should remain a MOP status and will require solution development by the modelers according to surcharge criteria specified in the System Capacity Assurance Plan, described in Volume 1.
4. Remediated – Manhole was found to have a bolt-down lid. No solution was required. These manholes are all located along major streamlines or within the 100-year floodplain. Upstream and downstream manholes were investigated and also found to have bolt-down lids.
5. Invalidated - No problems found, and no solution was required. Modeling teams were provided a list of invalidated MOPs and were directed to adjust I/I factors accordingly until the MOP locations have been successfully eliminated from the hydraulic models.
6. Unconfirmed - Could not locate the MOP manhole in the field, but upstream/downstream manholes displayed no problems. No solution required. These locations had upstream and/or downstream manholes that were inspected to determine flow conditions. All respective manholes displayed good flowing conditions; therefore, the unconfirmed MOP has become invalidated.

2.4.2.3. SPECIFIC FINDINGS

On March 20 and 21, 2008, two-person teams performed extensive field manhole inspections following the storm event that ended on March 19. Additionally, on April 4-5 and May 9, 2008, inspection teams revisited and field-investigated all invalidated and unconfirmed MOPs following the April 3 and 4 rain event that produced approximately four inches of rain in a 24-hour period and the May 8 rain event of similar magnitude. This was performed as follow-up reconnaissance and confirmation that invalidated MOPs were accurately categorized and unconfirmed MOPs were given a second and even third attempt to locate. In total, 211 manholes were investigated during the MOP investigation process. Detailed results from these investigations are included in Appendix 2.4.1. Figure 2.4-1 summarizes the investigation results.

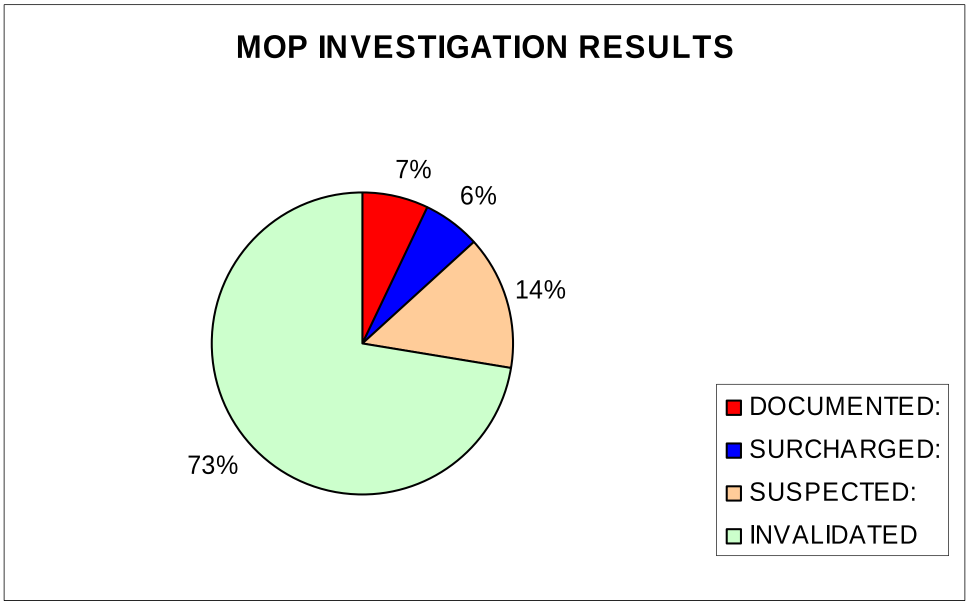


Figure 2.4-1 MOP Investigation Summary

Appendix 2.4.1 MOP Investigation Findings

Appendix is same as 2012 IOAP Modification and is provided on external USB storage drive.

2.4.2.4. RE-VALIDATION OF MODELS

After the final set of validated SSOs was developed, it was necessary to re-validate the hydraulic models to these SSOs. After this validation process was completed, the final list of targeted SSOs was compiled for project development. This list is discussed in the following section.

2.4.3. SSOS TARGETED FOR SOLUTION DEVELOPMENT

A total of 173 SSO locations were validated within the MSD system and are considered in the Final SSDP projects (refer to Volume 3, Chapter 3). **Error! Reference source not found.** summarizes the typical volume, receiving stream, model region, and service area of each SSO. **Error! Reference source not found.** also shows the 2009 and 2021 modeled areas for SSOs. The SSO volume information was averaged based on actual field investigation and was used to estimate life-cycle costs such as pumping, fines, and cleanup. A list of SSO and the coordinates of each can be found in Appendix 2.4.2.

Appendix 2.4.2 Final SSO List

The appendix has been updated with the 2021 IOAP and is provided on external USB drive.

Table 2.4.1 SSOs Targeted For final SSDP Solution Development

NO.	SSO ID	SSO NAME/ ADDRESS	RECEIVING STREAM	2009 MODEL REGION	2021 MODEL REGION	OVERFLOW TYPE	AVG PER INCIDENT (GAL)
1	MSD0199-LS	Lucas Lane	Goose Creek	Berrytown	Floyds Fork	LS	5,000
2	28984	Plumwood #1	Cedar Creek	Cedar Creek	Cedar Creek	Manhole	21,600
3	28998	Plumwood #2	Cedar Creek	Cedar Creek	Cedar Creek	Manhole	21,600
4	63094	Plumwood #4	Cedar Creek	Cedar Creek	Cedar Creek	Manhole	50
5	63095	Plumwood #5	Cedar Creek	Cedar Creek	Cedar Creek	Manhole	13
6	67997	7906 Gainsborough Court	Little Cedar Creek	Cedar Creek	Cedar Creek	Manhole	25
7	67999	7904 Shaw Court	Little Cedar Creek	Cedar Creek	Cedar Creek	Manhole	Suspected- no data
8	70158	Plumwood #3	Cedar Creek	Cedar Creek	Cedar Creek	Manhole	378,333
9	81316	Fairmount Road #1	Big Run	Cedar Creek	Cedar Creek	Manhole	500
10	86423	8314 Casualwood Way	Little Cedar Creek	Cedar Creek	Cedar Creek	Manhole	MOP - No data
11	88545	11101 Cambridge Commons Drive	Big Run	Cedar Creek	Cedar Creek	Manhole	Suspected- no data
12	89195	8104 Kimberly Way	Little Cedar Creek	Cedar Creek	Cedar Creek	Manhole	MOP - No data
13	89197	8104 Kimberly Way	Little Cedar Creek	Cedar Creek	Cedar Creek	Manhole	MOP - No data
14	97362	Fairmount Road #2	Big Run	Cedar Creek	Cedar Creek	Manhole	212,100
15	MSD1080-LS	Running Fox	Little Cedar Creek	Cedar Creek	Cedar Creek	LS	36,940
16	94187	Wet Well for St. Rene Road PS	Chenoweth Run	Chenoweth Hills	Cedar Creek	Manhole	4,380
17	33003	815 Tucker Station Road	Pope Lick	Floyds Fork	Floyds Fork	Manhole	Suspected- no data
18	65531	12400 Brierly Hill Place	Pope Lick	Floyds Fork	Floyds Fork	Manhole	Suspected- no data
19	MSD0165-PS	Olde Copper Court	Floyds Fork	Floyds Fork	Floyds Fork	LS	2,320
20	MSD0166-PS	Ashburton	Floyds Fork	Floyds Fork	Floyds Fork	LS	No Data
21	MSD0263	Chenoweth Hills WQTC	Chenoweth Run	Jeffersontown	Cedar Creek	Treatment Plant	2,767
22	MSD1105-PS	Eden Care	Floyds Fork	Floyds Fork	Floyds Fork	LS	200
23	90776	Floydsburg Road #1	Floyds Fork	Hite Creek	Hite Creek	Manhole	30,700
24	91087	Near Meadow Stream PS	South Fork Harrods Creek	Hite Creek	Hite Creek	Manhole	405,001

Table 2.4.1 SSOs Targeted For final SSDP Solution Development

NO.	SSO ID	SSO NAME/ ADDRESS	RECEIVING STREAM	2009 MODEL REGION	2021 MODEL REGION	OVERFLOW TYPE	AVG PER INCIDENT (GAL)
25	108956	Floydsburg Road #2	Floyds Fork	Hite Creek	Hite Creek	Manhole	75
26	108957	Floydsburg Road #3	Floyds Fork	Hite Creek	Hite Creek	Manhole	85,500
27	108958	Floydsburg Road #4	Floyds Fork	Hite Creek	Hite Creek	Manhole	13,000
28	MSD1082-PS	Meadow Stream	Floyds Fork	Hite Creek	Hite Creek	LS	51,000
29	MSD1085-PS	Kavanaugh Rd	Hite Creek	Hite Creek	Hite Creek	LS	176,000
30	MSD1086-PS	Floydsburg Road	Floyds Fork	Hite Creek	Hite Creek	LS	2,502
31	62769	Fox Hill Road/ Fox Hunt Court	Harrods Creek	Hunting Creek North	Hite Creek	Constructed	No data
32	MSD1055-LS	Gunpowder	Harrods Creek	Hunting Creek North	Hite Creek	Pumped	17,199
33	MSD1060-LS	Riding Ridge	Harrods Creek	Hunting Creek North	Hite Creek	Pumped	4,700
34	MSD0292	Hunting Creek South WQTC	Harrods Creek	ORFM	Hite Creek	Treatment Plant	117,436
35	MSD1063-PS	Deep Creek	Harrods Creek	Hunting Creek South	Hite Creek	LS	15,623
36	MSD1065-PS	Fairway View	Harrods Creek	Hunting Creek South	Hite Creek	LS	19,500
37	27969	4304 Rivanna Dr	Fern Creek	Jeffersontown	Cedar Creek	Manhole	Suspected- no data
38	28173	Watterson Trail	Chenoweth Run	Jeffersontown	Cedar Creek	Manhole	46,028
39	28249	Charlane Parkway/St Edwards Drive	Chenoweth Run	Jeffersontown	Morris Forman	Manhole	14,676
40	28250	Charlane Parkway Near the Street	Chenoweth Run	Jeffersontown	Morris Forman	Manhole	31,422
41	28336	Parking Lot Charlane Parkway	Chenoweth Run	Jeffersontown	Morris Forman	Manhole	247,618
42	28340	Charlane Parkway at Pool	Chenoweth Run	Jeffersontown	Morris Forman	Manhole	36,804
43	28390	10025 Grassland Road	Chenoweth Run	Jeffersontown	Morris Forman	Manhole	MOP - No data
44	28391	Grassland #3	Chenoweth Run	Jeffersontown	Morris Forman	Manhole	387,000
45	28392	Grassland #2	Chenoweth Run	Jeffersontown	Morris Forman	Manhole	2,160,000
46	28395	Grassland #1	Chenoweth Run	Jeffersontown	Morris Forman	Manhole	251,378
47	28413	3317 Dell Road	Chenoweth Run	Jeffersontown	Morris Forman	Manhole	No Data
48	28414	3322 Dell Road	Chenoweth Run	Jeffersontown	Morris Forman	Manhole	55,012
49	28415	3406/3404 Dell Road	Chenoweth Run	Jeffersontown	Morris Forman	Manhole	143,920

Table 2.4.1 SSOs Targeted For final SSDP Solution Development

NO.	SSO ID	SSO NAME/ ADDRESS	RECEIVING STREAM	2009 MODEL REGION	2021 MODEL REGION	OVERFLOW TYPE	AVG PER INCIDENT (GAL)
50	28416	Marlin Drive	Chenoweth Run	Jeffersontown	Morris Forman	Manhole	78,000
51	28417	Locust Avenue/Marlin Drive	Chenoweth Run	Jeffersontown	Morris Forman	Manhole	15,000
52	28711	9510 Taylorsville Road	Avoca Creek	Jeffersontown	Morris Forman	Manhole	Suspected- no data
53	28719	Intersection of Gleeson and Wendell	Avoca Creek	Jeffersontown	Morris Forman	Manhole	MOP - No data
54	31733	10001 Grassland Road	Chenoweth Run	Jeffersontown	Morris Forman	Manhole	Suspected- no data
55	64096	Chenoweth Run #1	Chenoweth Run	Jeffersontown	Cedar Creek	Manhole	51
56	64505	3200 Ruckreigel Pky	Chenoweth Run	Jeffersontown	Cedar Creek	Manhole	Suspected- no data
57	86052	4706 Chenoweth Run	Chenoweth Run	Jeffersontown	Cedar Creek	Manhole	Suspected- no data
58	92061	11804 Chippewa Ridge Lane	Chenoweth Run	Jeffersontown	Cedar Creek	Manhole	3,917
59	104289	3620 Charlane Pky	Chenoweth Run	Jeffersontown	Morris Forman	Manhole	Suspected- no data
60	IS028-SI	Jeffersontown WQTC Siphon	Chenoweth Run	Jeffersontown	Cedar Creek	Constructed	113,000
61	MSD0151-PS	Monticello Place	Fern Creek	Jeffersontown	Cedar Creek	LS	10,000
62	MSD0196-PS	Chenoweth Run	Chenoweth Run	Jeffersontown	Cedar Creek	LS	212,117
63	MSD0255	Jeffersontown WQTC	Chenoweth Run	Jeffersontown	Cedar Creek	Treatment Plant	1,800,658
64	MSD1169-LS	Lake Forest	Floyds Fork	Lake Forest	Floyds Fork	LS	MOP - No data
65	00746	Manhole Adjacent to Anchor Estates PS #1	Middle Fork Beargrass Creek	Middle Fork	Middle Fork	Pumped	10,762
66	01106	Vannah PS Wetwell Manhole	Middle Fork Beargrass Creek	Middle Fork	Middle Fork	Constructed	No Data
67	01793	9 Muirfield Place	Middle Fork Beargrass Creek	Southeastern Diversion	Southeastern Diversion	Manhole	109,000
68	02932	Oxmoor #1	Middle Fork Beargrass Creek	Middle Fork	Middle Fork	Manhole	1,203,000
69	02933	Oxmoor #2	Middle Fork Beargrass Creek	Middle Fork	Middle Fork	Manhole	150,000
70	02935	Oxmoor #3	Middle Fork Beargrass Creek	Middle Fork	Middle Fork	Manhole	3,420

Table 2.4.1 SSOs Targeted For final SSDP Solution Development

NO.	SSO ID	SSO NAME/ ADDRESS	RECEIVING STREAM	2009 MODEL REGION	2021 MODEL REGION	OVERFLOW TYPE	AVG PER INCIDENT (GAL)
71	08537	Northern Ditch Blow-off	Greasy Ditch	Middle Fork	Middle Fork	Constructed	No data
72	08717	Fincastle #2	South Fork Beargrass Creek	Combined	Combined	Manhole	100
73	13931	Camp Taylor #4	South Fork Beargrass Creek	Combined	Combined	Manhole	6,000
74	13943	Camp Taylor #3	South Fork Beargrass Creek	Combined	Combined	Manhole	250
75	16649	Wickland Road/ Sutherland Drive	South Fork Beargrass Creek	Southeastern Diversion	Southeastern Diversion	Constructed	1,078,972
76	22436	Manhole Adjacent to West Goose Creek PS	Goose Creek	ORFM	ORFM	Pumped	30,275
77	23211	Peabody Lane #1	South Fork Beargrass Creek	Middle Fork	Middle Fork	Constructed	2,309,980
78	23212	Peabody Lane #2	South Fork Beargrass Creek	Middle Fork	Middle Fork	Manhole	9,720
79	24472	501 Mockingbird Valley Road	Muddy Fork Beargrass Creek	ORFM	ORFM	Manhole	MOP - No data
80	25676	Alcona Lane	South Fork Beargrass Creek	Southeastern Diversion	Southeastern Diversion	Manhole	288,969
81	26650	Briarbridge Ln at South Fork Beargrass Creek	South Fork Beargrass Creek	Southeastern Diversion	Southeastern Diversion	Manhole	150
82	26651	Klondike Ln at South Fork Beargrass Creek	South Fork Beargrass Creek	Southeastern Diversion	Southeastern Diversion	Manhole	2,511,000
83	26752	Brownsboro Road at Mockingbird Valley #1	Muddy Fork Beargrass Creek	ORFM	ORFM	Manhole	25
84	27005	Bridge #6 - Cherokee Park	Middle Fork Beargrass Creek	Middle Fork	Middle Fork	Manhole	2,152,664
85	36763	3520 Fincastle Road	Camp Taylor Ditch	Combined	Combined	Manhole	Suspected- no data
86	40870	Muddy Fork PS #1	Muddy Fork Beargrass Creek	ORFM	ORFM	Manhole	41,800

Table 2.4.1 SSOs Targeted For final SSDP Solution Development

NO.	SSO ID	SSO NAME/ ADDRESS	RECEIVING STREAM	2009 MODEL REGION	2021 MODEL REGION	OVERFLOW TYPE	AVG PER INCIDENT (GAL)
87	40871	Muddy Fork PS #2	Muddy Fork Beargrass Creek	ORFM	ORFM	Manhole	150,067
88	40872	Muddy Fork PS #3	Muddy Fork Beargrass Creek	ORFM	ORFM	Manhole	183,400
89	41374	Brownsboro Road at Mockingbird Valley #2	Muddy Fork Beargrass Creek	ORFM	ORFM	Manhole	100
90	41416	3202 Brownsboro Road	Muddy Fork Beargrass Creek	ORFM	ORFM	Manhole	Suspected- no data
91	42680	Barbour Lane #1	Little Goose Creek	ORFM	ORFM	Pumped	162,000
92	43472	Near Saurel Drive PS	Goose Creek	Middle Fork	Middle Fork	Manhole	118
93	44396	Fincastle #4	South Fork Beargrass Creek	Combined	Combined	Manhole	79,500
94	44397	Fincastle #3	South Fork Beargrass Creek	Combined	Combined	Manhole	41,420
95	45835	Beargrass Road near Big Rock	Middle Fork Beargrass Creek	Middle Fork	Middle Fork	Manhole	456,021
96	46891	Goose Creek PS Wet Well	Goose Creek	Middle Fork	Middle Fork	Manhole	246,000
97	47250	1645 Rangeland Rd	No Data	Southeastern Diversion	Southeastern Diversion	Capacity	MOP - No data
98	47583	Oxmoor #4	Middle Fork Beargrass Creek	Middle Fork	Middle Fork	Manhole	2,557,520
99	47593	Near LG&E Power Station	Middle Fork Beargrass Creek	Middle Fork	Middle Fork	Manhole	359,960
100	47596	7410 Steeplecrest Circle	Middle Fork Beargrass Creek	Middle Fork	Middle Fork	Manhole	Suspected- no data
101	47603	Kindercare #1	Middle Fork Beargrass Creek	Middle Fork	Middle Fork	Manhole	120
102	47604	Kindercare #2	Middle Fork Beargrass Creek	Middle Fork	Middle Fork	Manhole	17,083
103	51160	Peabody Lane #3	South Fork Beargrass Creek	Middle Fork	Middle Fork	Manhole	55,500

Table 2.4.1 SSOs Targeted For final SSDP Solution Development

NO.	SSO ID	SSO NAME/ ADDRESS	RECEIVING STREAM	2009 MODEL REGION	2021 MODEL REGION	OVERFLOW TYPE	AVG PER INCIDENT (GAL)
104	51161	Brooklawn	South Fork Beargrass Creek	Middle Fork	Middle Fork	Manhole	438,000
105	51221	Watterson Expressway at South Fork Beargrass Creek	South Fork Beargrass Creek	Middle Fork	Middle Fork	Constructed	13,500
106	51594	Trevilian Way	South Fork Beargrass Creek	Southeastern Diversion	Southeastern Diversion	Manhole	51
107	55665	Hazelwood PS Wetwell	Upper Mill Creek	Combined	Combined	Manhole	28,000
108	62418	Goose Creek PS Near Goose Creek	Goose Creek	Middle Fork	Middle Fork	Manhole	128,000
109	65633	Barbour Lane #2	Little Goose Creek	ORFM	ORFM	Manhole	102,125
110	65635	Barbour Lane #3	Little Goose Creek	ORFM	ORFM	Manhole	25,500
111	66349	Fincastle #1	South Fork Beargrass Creek	Combined	Combined	Manhole	15
112	90700	Christian Court	Middle Fork Beargrass Creek	Middle Fork	Middle Fork	Manhole	5,400
113	91629	Old Westport Road at Goose Creek PS #2	Goose Creek	Middle Fork	Middle Fork	Manhole	15,750
114	91630	Old Westport Road at Goose Creek PS #3	Goose Creek	Middle Fork	Middle Fork	Manhole	5,250
115	96020	Leland Road	Cherrywood Creek	ORFM	ORFM	Manhole	20
116	104223	Camp Taylor #1	South Fork Beargrass Creek	Combined	Combined	Manhole	40
117	104231	Camp Taylor #2	Camp Taylor Ditch	Combined	Combined	Manhole	1,217
118	105936	Old Westport Road at Goose Creek PS #1	Goose Creek	Middle Fork	Middle Fork	Manhole	10,927
119	00056-W	Anchor Estates #1 Wetwell	Middle Fork Beargrass Creek	Middle Fork	Middle Fork	Manhole	11,929
120	08935-SM	Middle Fork at Breckenridge Lane	Middle Fork Beargrass Creek	Middle Fork	Middle Fork	Constructed	3,020,300
121	21628-W	Devondale Wet Well Manhole (PS Overflow)	Goose Creek	Middle Fork	Middle Fork	Pumped	58,013
122	24152-W	3733 Canoe Lane (Wet Well for Canoe Ln PS)	Muddy Fork Beargrass Creek	ORFM	ORFM	Constructed	60,750

Table 2.4.1 SSOs Targeted For final SSDP Solution Development

NO.	SSO ID	SSO NAME/ ADDRESS	RECEIVING STREAM	2009 MODEL REGION	2021 MODEL REGION	OVERFLOW TYPE	AVG PER INCIDENT (GAL)
123	IS021A-SI	Bowman Field Siphon	Middle Fork Beargrass Creek	Middle Fork	Middle Fork	Constructed	No data
124	MSD0007-PS	Mockingbird Valley	Muddy Fork Beargrass Creek	ORFM	ORFM	Constructed	10,840
125	MSD0010-PS	Winton	Muddy Fork Beargrass Creek	ORFM	ORFM	Constructed	45
126	MSD0023-PS	Mellwood Avenue	Muddy Fork Beargrass Creek	ORFM	ORFM	Constructed	287,472
127	MSD0024-PS	Canoe Lane	Muddy Fork Beargrass Creek	ORFM	ORFM	LS	15,769
128	MSD0042-PS	Sonne Avenue	Paddy Run	Combined	Combined	Pumped	156,075
129	MSD0057-LS	Anchor Estates #2	Middle Fork Beargrass Creek	Middle Fork	Middle Fork	LS	14,519
130	MSD0095-PS	Derington Court	Goose Creek	ORFM	ORFM	Pumped	18,875
131	MSD0123-PS	West Goose Creek	Goose Creek	ORFM	ORFM	LS	36,750
132	MSD0183-PS	Glenview Hills	Ohio River	ORFM	ORFM	LS	73,733
133	MSD0192-PS	Barbour Lane	Little Goose Creek	ORFM	ORFM	LS	38,581
134	MSD0193-PS	New Market	Muddy Fork Beargrass Creek	ORFM	ORFM	LS	16,333
135	MSD1044-PS	Phoenix Hill	Muddy Fork Beargrass Creek	ORFM	ORFM	Pumped	2,252
136	28729	9100 Marian Ct (Wet Well for Marian Ct PS)	Avoca Creek	Jeffersontown	Morris Forman	Constructed	No data
137	21229-W	Avanti Way at Fernview Road	Little Cedar Creek	Pond Creek	Pond Creek	Constructed	No data
138	MSD0149-PS	Raintree	Avoca Creek	Jeffersontown	Morris Forman	Constructed	MOP - No data
139	MSD0263A-PS	Chenoweth Hills WQTC PS	Chenoweth Run	Jeffersontown	Cedar Creek	LS	108,767
140	04498	820 Echo Bridge Road	Mill Creek	Mill Creek	Mill Creek	Manhole	Suspected- no data
141	04542	Fern Lea PS Wet Well	Heatherfield Ditch	Mill Creek	Mill Creek	Manhole	91,500
142	17724	1096 Springview Drive	Pond Creek	Pond Creek	Pond Creek	Manhole	33

Table 2.4.1 SSOs Targeted For final SSDP Solution Development

NO.	SSO ID	SSO NAME/ ADDRESS	RECEIVING STREAM	2009 MODEL REGION	2021 MODEL REGION	OVERFLOW TYPE	AVG PER INCIDENT (GAL)
143	19360	Rockwood Dr / Monaco	Northern Ditch	Pond Creek	Pond Creek	Manhole	Suspected- no data
144	19369	5221 Layne Road	Northern Ditch	Pond Creek	Pond Creek	Manhole	Suspected- no data
145	25477	6101 Price Lane Road	Fishpool Creek	Pond Creek	Pond Creek	Manhole	Suspected- no data
146	25478	6006 Cooper Chapel Road	Fishpool Creek	Pond Creek	Pond Creek	Manhole	Suspected- no data
147	25480	6112 Cooper Chapel Rd	Fishpool Creek	Pond Creek	Pond Creek	Manhole	6,500
148	25484	Near Lantana PS	Pennsylvania Run	Pond Creek	Pond Creek	Manhole	180,875
149	27116	10306 Caven Avenue	Mud Creek	Pond Creek	Pond Creek	Manhole	Suspected- no data
150	29933	6926 Sandstone Blvd	Fern Creek	Pond Creek	Pond Creek	Manhole	Suspected- no data
151	29943	6906 Sandstone Blvd	Fern Creek	Pond Creek	Pond Creek	Manhole	Suspected- no data
152	29948	Sandstone Blvd	Fern Creek	Pond Creek	Pond Creek	Manhole	75
153	31083	6924 Sandstone Blvd	Fern Creek	Pond Creek	Pond Creek	Manhole	Suspected- no data
154	31084	6916 Sandstone Blvd	Fern Creek	Pond Creek	Pond Creek	Manhole	Suspected- no data
155	35309	Marjorie Drive	Manslick Branch	Pond Creek	Pond Creek	Manhole	10,825
156	36419	10601 Leven Blvd	Pennsylvania Run	Pond Creek	Pond Creek	Manhole	Suspected- no data
157	60679	Manhole Adjacent to Cinderella PS	Fishpool Creek	Pond Creek	Pond Creek	Manhole	8,100
158	70212	1095 Springview Drive	Fishpool Creek	Pond Creek	Pond Creek	Manhole	Suspected- no data
159	79076	6308 Hanses Drive	Blue Spring Ditch	Pond Creek	Pond Creek	Manhole	Suspected- no data
160	92098	7801 Edsel Lane (Upstream of Edsel Lane PS)	Fern Creek	Pond Creek	Pond Creek	Pumped	3,600
161	93719	Wet Well for Lantana PS	Pennsylvania Run	Pond Creek	Pond Creek	Manhole	5,625
162	04699-W	East Rockford PS	Mill Creek	Mill Creek	Mill Creek	Pumped	No data
163	81814-W	Pioneer Road PS	Mill Creek	Mill Creek	Mill Creek	Pumped	32,750
164	MSD0047-PS	Fern Lea	Mill Creek	Mill Creek	Mill Creek	Pumped	141,083
165	MSD0050-PS	Garrs Lane	Mill Creek	Mill Creek	Mill Creek	Pumped	72,000
166	MSD0101-PS	Lantana Drive PS #1	Pennsylvania Run	Pond Creek	Pond Creek	LS	22,300
167	MSD0130-PS	Cooper Chapel	Fishpool Creek	Pond Creek	Pond Creek	Constructed	4,442

Table 2.4.1 SSOs Targeted For final SSDP Solution Development

NO.	SSO ID	SSO NAME/ ADDRESS	RECEIVING STREAM	2009 MODEL REGION	2021 MODEL REGION	OVERFLOW TYPE	AVG PER INCIDENT (GAL)
168	MSD0133-PS	Caven Avenue	Mud Creek	Pond Creek	Pond Creek	Pumped	15,250
169	MSD0180-PS	Government Center	Pennsylvania Run	Pond Creek	Pond Creek	LS	12,381
170	MSD1010-PS	Lea Ann Way	Northern Ditch	Pond Creek	Pond Creek	Pumped	3,024,040
171	MSD1013-PS	Cinderella	Fishpool Creek	Pond Creek	Pond Creek	LS	71,356
172	MSD1019-PS	Leven	Pennsylvania Run	Pond Creek	Pond Creek	Pumped	Suspected- no data
173	MSD1048-PS	Edsel	Fern Creek	Pond Creek	Pond Creek	LS	91,500

PS- pump station, LS – lift station, CO- cleanout, SI-siphon, W-wet well, MOP – Modeled Overflow Point

2.5. FINAL SSDP WATERSHED MODEL DEVELOPMENT

This section provides an overview of existing sewer system deficiencies and individual watershed model development, including validation, RDI/I reduction, build-out potential, and branching. System deficiencies include surcharged pipes and hydraulic bottlenecks. System deficiencies were analyzed and considered for determining causes of SSOs and SSO solution projects.

2021 Update: The data contained in this section is from the 2009 IOAP. The statistical data in Sections 2.5.1 and 2.5.2 demonstrate the conditions prior to the Final SSDP. Some projects from the SSDP have been constructed, which would impact the statistics shown. Because the SSDP is ongoing, the statistics have not been updated. 2009 data remains to demonstrate the conditions at the beginning of the program.

The information shown for each of the individual modeled areas represents the initial organization of SSOs. While some of the network branches will be moved to different sewershed areas, the individual branches still maintain their hydraulic connectivity. The descriptions represent conditions as of 2009. For each section, the map showing the original modeled area is shown, and an updated map showing the current modeled area is presented for reference. Some of the SSOs have been eliminated based on construction projects or additional flow monitoring data and calibration. Further descriptions of changes to the branches and projects constructed in each branch can be found in Chapter 3.

2.5.1. SURCHARGED PIPE CRITERIA

For the Final SSDP, surcharged pipes were categorized and analyzed using two criteria: 1) two feet below the manhole rim; and 2) five feet below the manhole rim. This criterion was formulated based on SCAP methodology. According to the SCAP, a wet weather surcharge condition is defined as a water surface level within the sewer that is less than two feet from the manhole rim elevation. If the sewer system is in a residential area with historical capacity-related backup complaints, then a surcharge condition is considered to be a water surface level within five feet of the manhole rim. Based on this data, models were analyzed at the 1.82-inch cloudburst storm under existing system conditions to determine surcharge levels.

Figure 2.5-1 shows surcharge percentages for each modeled watershed area during the 1.82-inch cloudburst storm under existing sewer system conditions. Mapping related to these evaluations are found in Appendix 2.5.1.

Appendix 2.5.1 Surcharge/Bottleneck Maps

Appendix is same as 2012 IOAP Modification and is provided on external USB storage drive.

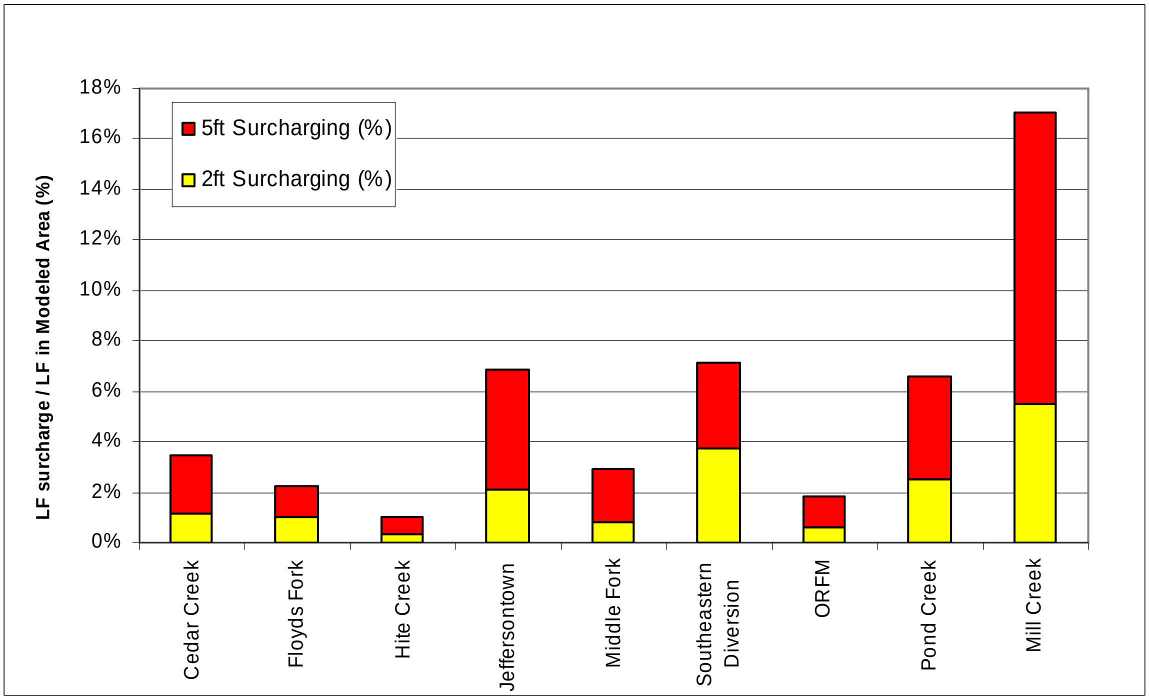


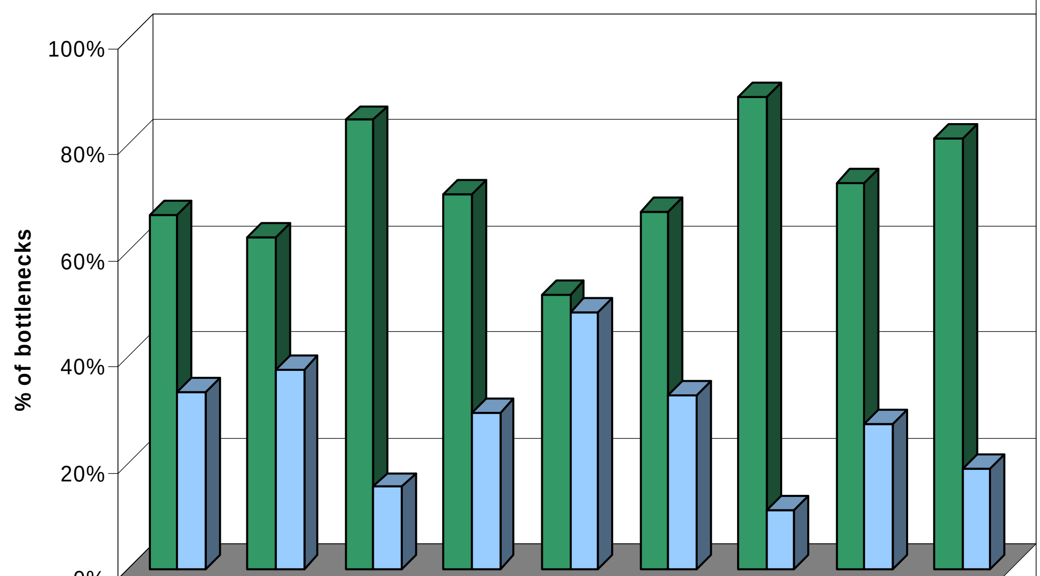
Figure 2.5-1 Total Surcharging Percent By Modeled Area (2009)

2.5.2. HYDRAULIC BOTTLENECKS

A hydraulic bottleneck is characterized by upstream system capacity that is greater than the downstream system capacity as identified by the model. The number of hydraulic bottlenecks by modeled watershed area is summarized in Table 2.5.1 and Figure 2.5-2. Most of the bottlenecks were found in the collection system, with the exception of Middle Fork where many of the bottlenecks were found in interceptor pipe (12-inch diameter and greater). Mapping related to these evaluations are found in Appendix 2.5.1.

Table 2.5.1 Number Of Separate SSS Bottlenecks By Modeled Area (2009)

MODELED BOTTLENECKS	
MODELED AREA	NUMBER OF BOTTLENECKS
Cedar Creek	18
Floyds Fork	8
Hite Creek	13
Jeffersontown	136
Middle Fork	64
Southeastern Diversion	58
ORFM	91
Pond Creek	92
Mill Creek	48
TOTAL	**516**



	Cedar Creek	Floyds Fork	Hite Creek	Jeffers-ontown	Middle Fork	SE Diversion	ORFM	Pond Creek	Mill Creek
Collectors (6" - 10")	67%	63%	85%	71%	52%	67%	89%	73%	81%
Interceptors (12" - 72")	33%	38%	15%	29%	48%	33%	11%	27%	19%

Figure 2.5-2 Summary of Separate SSS Bottlenecks in Modeled Area (2009)

2.5.3. CEDAR CREEK MODEL DEVELOPMENT

This section provides a summary of the Cedar Creek watershed model development including SSO descriptions, validation process, RDI/I reduction, build-out potential, and existing or proposed capital improvement projects relevant to the watershed. The full calibration/validation report is available for review in Appendix 2.3.2.

2.5.3.1. SSO DESCRIPTIONS FOR CEDAR CREEK

Cedar Creek is divided into five branches (see Section 2.3.5.6 for details on branching) based on SSO locations and system deficiencies. Refer to Figure 2.5.3 for a map of the Cedar Creek branching and SSO locations at the end of this chapter. Refer to Figure 2.5.3A for an updated map showing the current limits of the Cedar Creek WQTC area model. Note this includes some areas of the original Jeffersontown WQTC and some small WQTC areas. Brief descriptions of the SSOs in each branch are below.

Figure 2.5-3 Cedar Creek Sewershed Branch Network, 2009

Figure 2.5-4A Cedar Creek Sewershed Branch Network, 2021

Figures are located at the end of this chapter.

- **<u>Branch 70158</u>** addresses five SSOs: 28984, 28998, 63094, 63095, and 70158. The SSOs are due to shallow invert levels and a hydraulic bottleneck where a 15-inch diameter sewer line combines with a

10-inch diameter sewer line, which both flow into an 8-inch diameter line. The contributing area is single-family residential.

- **Branch 81316** addresses two SSOs: 81316 and 97362. These SSOs are just upstream of the Fairmount Road Pump Station, MSD1022-PS. The SSOs are most likely caused by upstream flows greater than the available pump station wet weather capacity. The area surrounding the SSO is residential with open spaces.
- **Branch 67997** addresses five SSOs: 67997, 67999, 86423, 89195, and 89197. During wet weather, the interceptor is unable to handle peak wet weather flow rates, and lower elevation manholes that are below the hydraulic grade line are shown to overflow in the model. Peak wet weather flow is the anticipated, calculated, or monitored maximum flow within the sewer system during an actual or synthetic rainfall event. The contributing area is single-family residential.
- **Branch MSD1025** addresses one SSO: 88545. This SSO is just upstream of the Bardstown Road Pump Station, MSD1025-PS. It is most likely caused by upstream flows greater than the available pump station wet weather capacity. The contributing area is single-family residential.
- **Branch MSD1080** addresses one SSO: MSD1080-LS (Running Fox Lift Station). The SSO is located in the Fox Ridge Subdivision off Beulah Church Road. It is likely caused by upstream flows greater than the available pump station wet weather capacity. The contributing area is single-family residential.

2.5.3.2. VALIDATION FOR CEDAR CREEK

There is a modeled SSO near each known SSO at the appropriate threshold rain event (explained in Section 2.3.5.2). There were five validated SSOs in the Cedar Creek model: 28984, 28998, 70158, 81316, and 97362. 28984, 28998, and 70158 are hydraulically connected with each other and were validated by modeled SSOs at 28998, 63094, and 63095. Similarly, SSOs 81316 and 97362 are hydraulically connected and were validated by a single modeled SSO at 97365.

2.5.3.3. RDI/I REDUCTION FOR CEDAR CREEK

The RDI/I reduction process for Cedar Creek follows the procedures described in Section 2.3.5.7. Table 2.5.2 summarizes the average peaking factor and projected RDI/I reduction for sub-catchments of Cedar Creek. Peaking factor is the peak flow (the monitored maximum flow within the sewer system during a rainfall event) at the flow monitor compared to average DWF at the flow monitor. The average peaking factor is computed from three major storms that occurred in the flow-monitoring period. The projected RDI/I reduction represents the percent of contributing area which was reduced for models used in MSD SSO evaluation modeling (see Appendix 2.3.4 for explanation of peaking factors, RDI/I reduction, and model refinements).

Table 2.5.2 Cedar Creek Projected RDI/I Reduction

FLOW MONITORING LOCATION (MANHOLE ID)	AVERAGE PEAKING FACTOR	PROJECTED RDI/I REDUCTION
81316	2.3	0%
87001	2.6	1%
74696	3.1	3%
83010	3.1	3%
89176	3.2	3%

Table 2.5.2 Cedar Creek Projected RDI/I Reduction

FLOW MONITORING LOCATION (MANHOLE ID)	AVERAGE PEAKING FACTOR	PROJECTED RDI/I REDUCTION
63095	3.4	4%
64023	3.8	5%
98027	8.0	23%
	AVERAGE PROJECTED RDI/I REDUCTION	**5.3%**

2.5.3.4. BUILD-OUT FOR CEDAR CREEK

In preparing solutions, potential future development (build-out) was considered. Build-out was only applied as additional flow upstream of known or suspected SSOs. The build-out process for Cedar Creek followed the procedures described in Section 2.3.5.10 and results are listed in Table 2.5.3. There are five general locations where additional flow was applied to the model to represent future development and corresponding flows.

Table 2.5.3 Cedar Creek Projected Build-Out Areas

BRANCH	BUILD-OUT INPUT LOCATION (MANHOLE/NODE ID)	FUTURE DEVELOPMENT ADDITIONAL DWF (GPD)
70158	28278	1,353
70158	28298	5,727
70158	28981	31,274
70158	28985	3,424
70158	28976	4,421
	TOTAL FUTURE PROJECTED ADDITIONAL FLOWS	**46,129**

2.5.3.5. CAPITAL IMPROVEMENT PROJECTS FOR CEDAR CREEK

MSD projects within the current five-year capital plan were considered in branch solutions. In considering these projects, modelers were given the latitude to modify design parameters (such as pipe diameter or pump capacity) to the extent of the preliminary project design. There was one Capital Improvement Project integrated into the Cedar Creek hydraulic model.

- **MSD Project C94086: Fern Hill Subdivision Interceptor No. 8**. The project takes flow from Holly Oaks Pump Station (MSD0161-PS) and Exhibition Court Pump Station (MSD1052-PS) to the Fern Creek / Nottingham Interceptor No. 6 near Stonybrook Drive and Hurstbourne Parkway, eliminating the SSOs at these pump stations. The Holly Oaks and Exhibition Court Pump Stations were eliminated.

2.5.4. FLOYDS FORK MODEL DEVELOPMENT

This section provides a summary of the Floyds Fork watershed model development including SSO descriptions, validation process, RDI/I reduction, build-out potential, and existing or proposed capital improvement projects relevant to the watershed. The full calibration/validation report is available for review in Appendix 2.3.2.

2.5.4.1. SSO DESCRIPTIONS FOR FLOYDS FORK

Floyds Fork is divided into three branches (see Section 2.3.5.6 for details on branching) based on SSO locations and system deficiencies. Refer to Figure 2.5.4 for a map of the Floyds Fork branching and SSO locations at the end of this chapter. Refer to Figure 2.5.4A for an updated map showing the current limits of the Floyds Fork WQTC area model. Note this includes some areas of the small WQTC areas. Brief descriptions of the SSOs in each branch are below.

Figure 2.5-5 Floyds Fork Sewershed Branch Network, 2009
Figure 2.5-4A Floyds Fork Sewershed Branch Network, 2021
Figures are located at the end of this chapter.

- **Branch 1** addresses two SSOs: 33003, 65531, and several surcharged areas. These SSOs are located in Douglas Hills Subdivision on Tucker Station Road. The SSO 33003 occurs at a manhole that is part of a 15-inch interceptor that runs parallel to Tucker Station Road. The SSO 65531 occurs at a manhole that is part of the same 15-inch interceptor as 33003. The SSOs are located in a residential area along a stream and are likely caused by inability of the interceptor to convey upstream flow.
- **Branch 2** addresses one SSO: MSD1105-PS (Eden Care Pump Station). The SSO is located in Martin C.B. Farm Subdivision off Blankenbaker Parkway next to the Eden Terrace Retirement Community. It is likely caused by upstream flows greater than the available pump station wet weather capacity.
- **Branch 3** addresses two SSOs: MSD0165-PS (Olde Copper Ct. Pump Station) and MSD0166-Pump Station (Ashburton Pump Station). These SSOs are located in Copperfield Subdivision near Beckley Station. In this branch, the Ashburton Pump Station pumps to a gravity line that drains into the Olde Copper Court Pump Station. The Olde Copper Court Pump Station is located alongside a small creek that is downhill from a residential area. The Ashburton Pump Station is located alongside a small creek that is downhill from a residential area. Both SSOs are most likely caused by upstream flows greater than the available pump station wet weather capacity.

2.5.4.2. VALIDATION FOR FLOYDS FORK

There is a modeled SSO near each known SSO at the appropriate threshold rain event (explained in Section 2.3.5.2) with the exception of SSO 65531. However, this SSO is hydraulically connected to SSO 33003. There were five validated SSOs in the Floyds Fork modeled area.

2.5.4.3. RDI/I REDUCTION FOR FLOYDS FORK

The RDI/I reduction process for Floyds Fork follows the procedures described in Section 2.3.5.7. Table 2.5.4 summarizes the average peaking factor and projected RDI/I reduction for sub-catchments of Floyds Fork. Peaking factor is the peak flow (the monitored maximum flow within the sewer system during a rainfall event) at the flow monitor compared to average DWF at the flow monitor. The average peaking factor is computed from three major storms that occurred in the flow-monitoring period. The projected RDI/I reduction represents the percent of contributing area which was reduced for models used in MSD SSO evaluation modeling (see Appendix 2.3.4 for explanation of peaking factors, RDI/I reduction, and model refinements).

Table 2.5.4 Floyds Fork Projected RDI/I Reduction

FLOW MONITORING LOCATION (MANHOLE ID)	AVERAGE PEAKING FACTOR	PROJECTED RDI/I REDUCTION
96911A	2.1	0%
99901	2.6	1%
46316	3.6	5%
97793	4.6	9%
84509	4.9	10%
46327	5.0	11%
97804	5.3	12%
108245A	6.6	17%
AVERAGE PROJECTED RDI/I REDUCTION		**8.0%**

2.5.4.4. BUILD-OUT FOR FLOYDS FORK

In preparing solutions, potential future development (build-out) was considered. Build-out was only applied as additional flow upstream of known or suspected SSOs. The build-out process for Floyds Fork follows the procedures described in Section 2.3.5.10 and listed in Table 2.5.5. There are two general locations where additional flow was applied to the model to represent future development and corresponding flows.

Table 2.5.5 Floyds Fork Projected Build-Out Areas

BRANCH	BUILD-OUT INPUT LOCATION (MANHOLE/NODE ID)	FUTURE DEVELOPMENT ADDITIONAL DWF (GPD)
Branch 1	33003	79,200
Branch 2	MSD1105-PS	5,500
TOTAL FUTURE PROJECTED ADDITIONAL FLOWS		**84,700**

2.5.4.5. CAPITAL IMPROVEMENT PROJECTS FOR FLOYDS FORK

MSD projects within the current five-year capital plan were considered in branch solutions. In considering these projects, modelers were given the latitude to modify design parameters (such as pipe diameter or pump capacity) to the extent of the preliminary project design.

- **Middletown Recapture**. This project eliminates the Berrytown, Starview, Middletown Industrial, and Chenoweth Run WQTCs by connecting to the Old Henry Road Force Main which delivers wastewater to the Floyds Fork WQTC. Additionally, a new Lake Forest Pump Station will be constructed to deliver the flow from these WQTCs to the Old Henry Road Force Main. Construction is expected to be complete by late 2011.

2.5.5. HITE CREEK MODEL DEVELOPMENT

This section provides a summary of the Hite Creek watershed model development including SSO descriptions, validation process, RDI/I reduction, build-out potential, and existing or proposed capital improvement projects relevant to the watershed. The full calibration/validation report is available for review in Appendix 2.3.2.

2.5.5.1. SSO DESCRIPTIONS FOR HITE CREEK

Hite Creek is divided into three branches (see Section 2.3.5.6 for details on branching) based on SSO locations and system deficiencies. Refer to Figure 2.5.5 for a map of the Hite Creek branching and SSO locations at the end of this chapter. Refer to Figure 2.5.5A for an updated map showing the current limits of the Hite Creek WQTC area model. Note this includes some areas of the small WQTC areas. Brief descriptions of the SSOs in each branch are below.

Figure 2.5-6 Hite Creek Sewershed Branch Network, 2009

Figure 2.5-5A Hite Creek Sewershed Branch Network, 2021

Figures are located at the end of this chapter.

- **Branch MSD1082** addresses two SSOs: 91087 and MSD1082-PS (Meadow Stream Pump Station). Meadow Stream Pump Station is on the south end of the city of Crestwood near I-71. The SSOs are located in a residential area along South Fork Beargrass Creek and are likely caused by upstream flows greater than the available pump station wet weather capacity.
- **Branch MSD1085** addresses one SSO: MSD1085-PS (Kavanaugh Rd. Pump Station). The SSO is located on the southwest side of Crestwood, downstream of Cherry Lane Pump Station and Kavanaugh Rd. Pump Station. The site of the SSO occurrence is between two homes, and the area surrounding the SSO is residential with open spaces. This SSO is likely caused by upstream flows greater than the available pump station wet weather capacity.
- **Branch MSD1086** addresses five SSOs: 90776, 108596, 108957, 108958, and MSD1086-PS (Floydsburg Rd. Pump Station). These SSOs are located on the south end of Crestwood just west of Floydsburg Road. The SSOs are located at the Floydsburg Road Pump Station or just upstream of the pump station. The pump station is in an industrial area with some residential area. The SSOs are likely caused by upstream flows greater than the available pump station wet weather capacity.

2.5.5.2. VALIDATION FOR HITE CREEK

There is a modeled SSO near each known SSO at the appropriate threshold rain event (explained in Section 2.3.5.2). There were five validated SSOs in the Hite Creek model. SSOs MSD1086-PS, 90776, and 108956 (associated with MSD1086-PS) are hydraulically connected and were validated by a single modeled SSO at 90776.

Reported SSOs 11877 and 30520 at the Hite Creek WQTC were originally ranked in the top third of the reported SSO volumes, but were invalidated during the modeling process because the Hite Creek WQTC influent pumping station was relocated out of the 100-year floodplain which eliminated the problem. Under normal conditions, the WQTC's wet weather capacity is sufficient and there are no SSOs.

2.5.5.3. RDI/I REDUCTION FOR HITE CREEK

The RDI/I reduction process for Hite Creek follows the procedures described in Section 2.3.5.7. Table 2.5.6 summarizes the average peaking factor and projected RDI/I reduction for sub-catchments of Hite Creek.

Peaking factor is the peak flow (the monitored maximum flow within the sewer system during a rainfall event) at the flow monitor compared to average DWF at the flow monitor. The average peaking factor is computed from three major storms that occurred in the flow-monitoring period. The projected RDI/I reduction represents the percent of contributing area which was reduced for models used in MSD SSO evaluation modeling (see Appendix 2.3.4 for explanation of peaking factors, RDI/I reduction, and model refinements).

Table 2.5.6 Hite Creek Projected RDII Reduction

FLOW MONITORING LOCATION (MANHOLE ID)	AVERAGE PEAKING FACTOR	PROJECTED RDI/I REDUCTION
00205	0.0	0%
29526	2.2	0%
30521	2.5	0%
40943	2.6	1%
29499	2.7	1%
91122	3.1	3%
MSD1082-PS	3.1	3%
90719	7.4	20%
	AVERAGE PROJECTED RDI/I REDUCTION	**3.5%**

2.5.5.4. BUILD-OUT FOR HITE CREEK

In preparing solutions, potential future development (build-out) was considered. Build-out was only applied as additional flow upstream of known or suspected SSOs. The build-out process for Hite Creek follows the procedures described earlier in Section 2.3.5.10 and listed in Table 2.5.7. There are five general locations where additional flow was added to the model to represent future development and corresponding flows.

Table 2.5.7 Hite Creek Projected Build-Out Areas

BRANCH	BUILD-OUT INPUT LOCATION (MANHOLE/NODE ID)	FUTURE DEVELOPMENT ADDITIONAL DWF (GPD)
MSD1085	90781	600
MSD1085	90811	2,000
MSD1085	102897	40,000
MSD1085	90877	64,300
MSD1086	90776	25,400
	TOTAL FUTURE PROJECTED ADDITIONAL FLOWS	**132,300**

The addition of build-out flow was considered for one other location in the Hite Creek model, areas surrounding the Meadow Stream Pump Station. Future rates amounting to 1,579,200 gpd were so large that build-out flow significantly outweighed the reported SSO amount and would have been beyond the extent of the SSO solutions development. Although portions of this flow were added at upstream locations (listed above for Kavanaugh Road and Floydsburg Road), the majority was considered outside the scope of modeling SSO solutions.

2.5.5.5. CAPITAL IMPROVEMENT PROJECTS FOR HITE CREEK

MSD projects within the current five-year capital plan were considered in branch solutions. In considering these projects, modelers were given the latitude to modify design parameters (such as pipe diameter or pump capacity) to the extent of the preliminary project design. There were no Capital Improvement Projects integrated into the Hite Creek hydraulic model.

2.5.6. JEFFERSONTOWN MODEL DEVELOPMENT

This section provides a summary of the Jeffersontown watershed model development including SSO descriptions, validation process, RDI/I reduction, build-out potential, and existing or proposed capital improvement projects relevant to the watershed. The full calibration/validation report is available for review in Appendix 2.3.2.

2.5.6.1. SSO DESCRIPTIONS FOR JEFFERSONTOWN

Jeffersontown is divided into five branches (see Section 2.3.5.6 for details on branching) based on SSO locations and system deficiencies. Branch 1A is a sub-section of Branch 1, created to minimize the extreme size of the branch. They were analyzed separately but combined for project solution development. Refer to Figure 2.5.6 for a map of the Jeffersontown branching and SSO locations at the end of this chapter. Note there is no 2021 update for Jeffersontown WQTC because the plant has been eliminated, and the modeled area has been absorbed into other models. Brief descriptions of the SSOs in each branch are below.

Figure 2.5-7 Jeffersontown Sewershed Branch Network
Figure is located at the end of this chapter.

- **Branch 1** addresses nine SSOs: 28173, 28390, 28391, 28392, 28395, 31733, 64505, MSD0025 (Jeffersontown WQTC), and ISO28-SI (Jeffersontown Siphon). The SSOs are upstream of the Jeffersontown WQTC, which is on Chenoweth Run north of Taylorsville Road. Many of the SSOs in this branch are caused by insufficient wet weather capacity in the Jeffersontown Interceptor to convey excess flow downstream. The SSO ISO28-SI is most likely caused by upstream flows greater than the available Jeffersontown WQTC wet weather capacity. The contributing area is a mix of single-family residential, industrial, and commercial.
- **Branch 1A** addresses five SSOs: 64096, 86052, 92061, MSD0196-PS (Chenoweth Run Pump Station), and MSD0263A-PS (Chenoweth Hills WQTC Pump Station). This branch has 38,200 LF of sewer in the Chenoweth Hills WQTC service area. The SSOs 64096, 86052 and MSD0196-PS are likely caused by upstream flows greater than the available Chenoweth Run Pump Station wet weather capacity. The SSO 92061 is likely caused by upstream flows greater than the available Chippewa Pump Station wet weather capacity. The SSO MSD0236A-PS is likely caused by upstream flows greater than the available Chenoweth Hills WQTC wet weather capacity. The contributing area is single-family residential.

- **Branch 2** addresses ten SSOs: 28249, 28250, 28336, 28340, 28413, 28414, 28415, 28416, 28417, and 104289. The SSOs are caused by the gravity lines having insufficient wet weather capacity. The contributing area is single-family residential.
- **Branch 3** addresses four SSOs: 28711, 28719, 28729, and MSD0149-PS (Raintree Pump Station). The SSOs 28711 and 28719 are caused by the insufficient wet weather capacity of the interceptor. The SSOs 28729 is likely caused by upstream flows greater than the available Marian Court Pump Station wet weather capacity. MSD0149-PS is likely caused by upstream flows greater than the available Raintree Pump Station wet weather capacity. Both pump stations have constructed overflow pipes in the wet well that were constructed before MSD acquired the system in 1990. The contributing area is single-family residential.
- **Branch 4** addresses two SSOs: 27969 and MSD0151-PS (Monticello Place Pump Station). The SSOs are likely caused by upstream flows greater than the available Monticello Place Pump Station wet weather capacity. The contributing area is single-family residential.

2.5.6.2. VALIDATION FOR JEFFERSONTOWN

There is a modeled SSO near each known SSO at the appropriate threshold rain event (explained in Section 2.3.5.2). There were 28 validated SSOs in the Jeffersontown model.

2.5.6.3. RDI/I REDUCTION FOR JEFFERSONTOWN

The RDI/I reduction process for Jeffersontown follows the procedures described in Section 2.3.5.7. Table 2.5.8 summarizes the average peaking factor and projected RDI/I reduction for sub-catchments of Jeffersontown. Peaking factor is the peak flow (the monitored maximum flow within the sewer system during a rainfall event) at the flow monitor compared to average DWF at the flow monitor. The average peaking factor is computed from three major storms that occurred in the flow-monitoring period. The projected RDI/I reduction represents the percent of contributing area which was reduced for models used in MSD SSO evaluation modeling (see Appendix 2.3.4 for explanation of peaking factors, RDI/I reduction, and model refinements).

Table 2.5.8 Jeffersontown Projected RDI/I Reduction

FLOW MONITORING LOCATION (MANHOLE ID)	AVERAGE PEAKING FACTOR	PROJECTED RDI/I REDUCTION
46300	2.5	0%
93434	2.5	0%
86162	2.9	2%
42026	3.0	2%
42275	3.2	3%
28111-SM	3.4	4%
64096	3.4	4%
27668	3.6	5%
31742	3.6	5%
42273-X	3.9	6%
28564	4.1	7%

Table 2.5.8 Jeffersontown Projected RDI/I Reduction

FLOW MONITORING LOCATION (MANHOLE ID)	AVERAGE PEAKING FACTOR	PROJECTED RDI/I REDUCTION
28602	4.1	7%
28173	4.2	7%
29386	4.4	8%
28553	4.8	10%
104337	5.0	10%
86057	5.1	11%
28351	6.9	18%
42268	29.7*	25%
AVERAGE PROJECTED RDI/I REDUCTION		**7.1%**

*Note: High peaking factor due to minimal dry weather flow

2.5.6.4. BUILD-OUT FOR JEFFERSONTOWN

In preparing solutions, potential future development (build-out) was considered. This build-out evaluation assumed that the Consent Decree requirements limiting new flows to the Jeffersontown system have been removed by improvements to the system that eliminate the practice of “blending” during wet weather. This will be accomplished either by eliminating the Jeffersontown WQTC or by expanding and upgrading the WQTC to take all wet weather flows through full secondary treatment. The elimination or expansion of the Jeffersontown WQTC is required by the Consent Decree to be completed no later than December 31, 2015. For the purpose of this IOAP it is assumed that after that time adequate conveyance and treatment capacity will be provided to allow development in the current Jeffersontown WQTC service area to proceed in accordance with Louisville Metro land-use plans.

The build-out process for Jeffersontown follows the procedures described in Section 2.3.5.10 and the result is listed in Table 2.5.9. There is one general location where additional flow was added to the model to represent future development and corresponding flows. The build-out potential occurs in areas that would require pumping the flow to the Jeffersontown WQTC; therefore, a build-out inflow hydrograph was created and applied at the WQTC. No additional flow will be allowed to Jeffersontown WQTC until blending is eliminated at the plant; unless the process outlined in the Amended Consent Decree is followed.

Table 2.5.9 Jeffersontown Projected Build-Out Areas

BRANCH	BUILD-OUT INPUT LOCATION (MANHOLE/NODE ID)	FUTURE DEVELOPMENT ADDITIONAL DWF (GPD)
Branch 1	MSD0255	1,180,000
TOTAL FUTURE PROJECTED ADDITIONAL FLOWS		**1,180,000**

2.5.6.5. CAPITAL IMPROVEMENT PROJECTS FOR JEFFERSONTOWN

MSD projects within the current five-year capital plan were considered in branch solutions. In considering these projects, modelers were given the latitude to modify design parameters (such as pipe diameter or pump capacity) to the extent of the preliminary project design. There was one Capital Improvement Project integrated into the Jeffersontown hydraulic model.

- **<u>Rehl Road Recapture</u>**. Construct 14,250 LF of 15"-21" interceptor, 9,500 LF of 16" force main, and a regional 4.3 MGD peak flow pumping facility located near Rehl Road and Pope Lick Road. This is intended to serve 212 acres in Jefferson County proposed to be developed. Construction is complete and the interceptor, pump station, and force main are in use.

2.5.7. MIDDLE FORK MODEL DEVELOPMENT

This section provides a summary of the Middle Fork watershed model development including SSO descriptions, validation process, RDI/I reduction, build-out potential, and existing or proposed capital improvement projects relevant to the watershed. The full calibration/validation report is available for review in Appendix 2.3.2.

2.5.7.1. SSO DESCRIPTIONS FOR MIDDLE FORK

Middle Fork is divided into four branches (see Section 2.3.5.6 for details on branching) based on SSO locations and system deficiencies. Refer to Figure 2.5.7 for a map of the Middle Fork branching and SSO locations at the end of this chapter. Refer to Figure 2.5.7A for an updated map showing the current limits of the Middle Fork area model. Note this includes some areas of the small WQTC areas and some of the original Jeffersontown WQTC area. Brief descriptions of the SSOs in each branch are below.

Figure 2.5-8 Middle Fork Sewershed Branch Network, 2009

Figure 2.5-7A Middle Fork Sewershed Branch Network, 2021

Figures are located at the end of this chapter.

- **<u>Branch 1</u>** addresses 19 SSOs: 02932, 02933, 02935, 08537, 23211, 23212, 27005, 45835, 47583, 47593, 47596, 47603, 47604, 51221, 51161, 51160, 90700, 08935-SM, and ISO21A-SI. Most of the SSOs are gravity SSOs to the Middle Fork of Beargrass Creek from manhole rims. They are caused by excess wet weather flows and partially by the condition of the interceptor under I-264. The SSO 08935-SM near the Upper Middle Fork Lift Station is a constructed overflow structure to Middle Fork Beargrass Creek along the Middle Fork Interceptor, and it overflows when the downstream interceptor becomes surcharged. It is located in a commercial area. The SSO ISO21A-SI is a constructed overflow structure to Middle Fork Beargrass Creek upstream of an inverted siphon and it overflows when the downstream interceptor and siphon become surcharged. The SSO 08537 is a constructed overflow structure that does not overflow during regular wet weather events. This overflow structure, better known as the Northern Ditch Blowoff, is located along the Northern Ditch Interceptor. The upstream contributing area consists of industrial, commercial, and residential area.
- **<u>Branch 4</u>** addresses seven SSOs: 21628-W, 43472, 46891, 62418, 91629, 91630, and 105936. The SSO 21628-W is a gravity manhole SSO near the Devondale Pump Station in a residential area, and it is most likely caused by upstream flows greater than the available Devondale Pump Station wet weather capacity. The SSO 43472 is a gravity manhole SSO in a residential area and is most likely caused by upstream flows greater than the available Saurel Road Pump Station wet weather capacity. The other SSOs in this branch are gravity SSOs from manhole rims that overflow to Goose Creek; they

are likely caused by upstream flows greater than the available Goose Creek Pump Station wet weather capacity.

- **Branch 6** addresses four SSOs: 00056-W (Anchor Estates #1 Pump Station), 00746, 01106 (Vannah Way Pump Station), and MSD0057-LS (Anchor Estates #2 Lift Station). The SSO 01106 is a constructed overflow structure in the wet well that overflows to a storm sewer and is most likely caused by upstream flows greater than the available Vannah Way Pump Station wet weather capacity. The SSOs 00056-W and 00746 are gravity manholes located in a residential area and are most likely caused by upstream flows greater than the available Anchor Estates #1 Pump Station wet weather capacity. The SSO MSD0057-LS occurs at a gravity manhole in a residential area and is likely caused by upstream flows greater than the available Anchor Estates # 2 Pump Station wet weather capacity.
- **Branch 7** addresses one SSO: 01793. This manhole is located in the Hurstbourne subdivision near Hurstbourne Country Club. The SSO at this manhole was assumed to be caused by backwater conditions in the Lower Middle Fork Interceptor due to insufficient capacity in the interceptor. In 2005, the force main at the Hurstbourne Pump Station was re-routed to relieve flow to the interceptor and the SSO did not occur again and, therefore, was believed to be eliminated. In March 2008, however, the SSO reappeared and is now assumed to be caused by insufficient wet weather capacity.

There are other SSOs in Middle Fork that are being addressed by Interim SSDP projects; these locations are described below.

SSOs 21153, 21101, 21061, 21156, and 21089 are locations that are pumped from the sanitary sewer during wet weather. These SSOs are in the Beechwood Village neighborhood and the contributing area is single family residential. The pumps are activated to eliminate residential basement backups. The cause of the overflows are downstream surcharging and significant I/I. These locations are addressed by Interim SSDP projects, namely the Beechwood Village and Sinking Fork Relief Interceptor projects.

SSOs 25012, 63319, and 21103 are gravity SSOs through manhole rims that occur during wet weather. The contributing area is mostly single family residential. The cause of the overflows are downstream surcharging and significant I/I. These locations are addressed by Interim SSDP projects, namely the Beechwood Village and Sinking Fork Relief Interceptor projects.

2.5.7.2. VALIDATION FOR MIDDLE FORK

There is a modeled SSO near each known SSO at the appropriate threshold rain event (explained in Section 2.3.5.2). There were 31 validated SSOs in the Middle Fork modeled area. There was one unvalidated SSO at manhole 01793; this area was investigated by MSD Infrastructure & Flood Protection group to determine if a downstream blockage had occurred. Investigation did not identify any blockages downstream of the manhole; therefore, this SSO will be targeted for I/I reduction and an SSES will be performed upstream of the manhole.

2.5.7.3. SEDIMENTATION FOR MIDDLE FORK

Based on validation results and a review of the interceptor condition assessment, sedimentation was needed in the model for the Middle Fork SSO validation. Sediment amounts, which are listed in Table 2.5.10, were added in the pipes downstream of the listed manhole ID in the hydraulic model. The majority of these blockages have since been removed through cleaning and rehabilitation projects completed in late 2008.

Table 2.5.10 Middle Fork Sedimentation for SSO Validation

SITE (MANHOLE ID)	SEDIMENT DEPTH (UPSTREAM PIPE DIAMETER)
63324	4 inches (18 inches)
63321	6 inches (18 inches)
45443	6 inches (27 inches)
21156	6 inches (27 inches)
21150	8 inches (21 inches)
21155	8 inches (27 inches)
AVERAGE SEDIMENT DEPTH	**6.3 INCHES**

2.5.7.4. RDI/I REDUCTION FOR MIDDLE FORK

The RDI/I reduction process for Middle Fork follows the procedures described in Section 2.3.5.7. Table 2.5.11 summarizes the average peaking factor and projected RDI/I reduction for sub-catchments of Middle Fork. Peaking factor is the peak flow (the monitored maximum flow within the sewer system during a rainfall event) at the flow monitor compared to average DWF at the flow monitor. The average peaking factor is computed from three major storms that occurred in the flow-monitoring period. The projected RDI/I reduction represents the percent of contributing area which was reduced for models used in MSD SSO evaluation modeling (see Appendix 2.3.4 for explanation of peaking factors, RDI/I reduction, and model refinements).

Table 2.5.11 Middle Fork Projected RDI/I Reduction

FLOW MONITORING LOCATION (MANHOLE ID)	AVERAGE PEAKING FACTOR	PROJECTED RDI/I REDUCTION
24551	2.2	0%
45835		0%
48763	2.4	0%
02933	2.5	0%
48758	2.5	0%
45449	2.8	2%
65746	2.8	1%
01793	2.9	2%
21150	3.1	3%
62425	3.1	3%
96675	3.5	4%
45381	3.6	5%
45440	3.7	5%
71004	3.7	5%
01268	3.8	6%
47098	3.8	6%
22610	4.0	6%
25012	4.4	8%

Table 2.5.11 Middle Fork Projected RDI/I Reduction

FLOW MONITORING LOCATION (MANHOLE ID)	AVERAGE PEAKING FACTOR	PROJECTED RDI/I REDUCTION
91629	5.5	13%
21155	5.6	13%
	AVERAGE PROJECTED RDI/I REDUCTION	**4.1%**

2.5.7.5. BUILD-OUT FOR MIDDLE FORK

There was no build-out applied to the Middle Fork watershed model for future development flows because the area is fully developed.

2.5.7.6. CAPITAL IMPROVEMENT PROJECTS FOR MIDDLE FORK

MSD projects within the current five-year capital plan were considered in branch solutions. In considering these projects, modelers were given the latitude to modify design parameters (such as pipe diameter or pump capacity) to the extent of the preliminary project design. There was one Capital Improvement Project integrated into the Middle Fork hydraulic model.

- **MSD Project F05039: Woodlawn Road Pump Station Relocation**. The project will construct 2,200 LF of gravity interceptor from the existing pump station site to the existing Muddy Fork interceptor at Foeburn Lane, as well as a diversion structure. In coordination with the widening of Westport Road the project will eliminate the existing Woodlawn Park Pump Station, which will help relieve SSO conditions at Falgate Court and in the Beechwood Village system. The project is currently under design.

2.5.8. SOUTHEASTERN DIVERSION MODEL DEVELOPMENT

This section provides a summary of the Southeastern Diversion watershed model development including SSO descriptions, validation process, RDI/I reduction, build-out potential, and existing or proposed capital improvement projects relevant to the watershed. The full calibration/validation report is available for review in Appendix 2.3.2.

2.5.8.1. SSO DESCRIPTIONS FOR THE SOUTHEASTERN DIVERSION

Southeastern Diversion was originally divided into eight branches (see Section 2.3.5.6 for details on branching) based on SSO locations and system deficiencies. Only four branches remain after modifications have taken place to the model and the SSO list and modeling process throughout the Final SSDP process. Refer to Figure 2.5.8 for a map of the Southeastern Diversion branching and SSO locations at the end of this chapter. Refer to Figure 2.5.8A for an updated map showing the current limits of the Southeast Diversion area model. Note this includes some areas of the small WQTC areas and some of the original Jeffersontown WQTC area. Brief descriptions of the SSOs in each branch are below.

Figure 2.5-9 Southeastern Diversion Sewershed Branch Network, 2009

Figure 2.5-10A Southeastern Diversion Sewershed Branch Network, 2021

Figures are located at the end of this chapter.

- **Branch 3** addresses one SSO: 47250. It is an SSO that was modeled, and field verified as significantly surcharged. This manhole is on a 12-inch diameter sewer line located on a Jefferson County School property. The contributing area is mixed with single and multi-family residential. The SSO is likely caused because the entire interceptor in the local 12-inch collection system is surcharged and cannot convey peak discharges during wet weather.

- **Branch 4** addresses three SSOs: 25676, 26650, and 26651. The other SSOs in this branch (18134, 18298, 18302, 18318-W, 49224, 49236, 49672, and 49673) are addressed in the Interim SSDP projects. The SSOs have a mixed contributing land use area of residential and commercial. The SSOs are likely caused due to surcharging in the Beargrass Interceptor during wet weather.
- **Branch 5** addresses one SSO: 16649. SSO 16649 is a constructed overflow structure in the Sutherland neighborhood, and it occurs when the local 10-inch diameter sewer becomes surcharged. The contributing area is mostly single-family residential.
- **Branch 6** addresses one SSO: 51594. Early field investigation of Manhole 51594 suggested that this manhole had a downstream blockage coupled with the Beargrass Interceptor surcharge effects causing the SSO. The Interceptor Condition Assessment Phase 1 project noted numerous obstructions and root masses in the Beargrass Interceptor near this location. The contributing area is mostly single-family residential.

There are other SSOs in Southeastern Diversion that are being addressed by a combination of the Interim SSDP projects, maintenance activities, and other branch solutions. These locations are described below.

SSOs 08426, 08427, 08430, 08431, 30701, 30702, 49647, and 63779 are SSOs along the Buechel Branch Trunk. These are known as the Pruitt Court SSOs. The contributing area is mostly residential with some commercial and industrial. There are two main causes of these SSOs: downstream surcharging in the Southeastern Diversion Structure and excessive blockages per the Interceptor Condition Assessment and model validation activities. These SSOs will be addressed by Interim SSDP projects and maintenance activities.

SSOs 23211, 23212, 51160, 51161, and 51221 are SSOs at or near the confluence of the Goldsmith Lane Trunk and the Beargrass Interceptor. The Goldsmith Lane Trunk and Beargrass Interceptor exceed capacity during wet weather. SSO 23211 was originally a constructed overflow structure but has since been welded shut. In addition, the Upper Middle Fork Lift Station currently flows through this location; it peaks at 6.6 MGD for a period of nearly 48 hours during a 1.82-inch rainfall event. Due to the significant I/I at the Upper Middle Fork Lift Station, SSOs occur at these locations. These locations will be addressed by Interim SSDP projects and the solution involving the diversion of the Upper Middle Fork Lift Station to the Hikes Lane Interceptor in Middle Fork Branch 1.

SSOs 72571-X, 30680, and 30681 will also be addressed by Interim SSDP projects. SSO 72571-X is better known as the Southeastern Diversion structure which is a constructed overflow structure. SSOs 30680 and 30681 are several manholes upstream of the Southeastern Diversion structure along the Buechel Branch Trunk. These manholes overflow due to local I/I and surcharging at the Southeastern Diversion. SSO 72751-X overflows due to two influent interceptors (30-inch and 33-inch) that flow into the structure and only one interceptor exiting (30-inch) the structure. There is an additional 60-inch interceptor exiting the structure, but the gate is left mostly closed due to downstream operational restrictions.

SSOs 18471, 18483, 18505, and 18595 are locations that are pumped from the sanitary sewer during wet weather. These overflows are in the Hikes Point area and the contributing area is single family residential. The pumps are activated to eliminate residential basement backups. The cause of the overflows are downstream surcharging and significant I/I. These locations are addressed by Interim SSDP projects, namely the Hikes Lane Interceptor project.

SSO 17571 is an overflow that is pumped from the sanitary sewer during wet weather. This overflow is near the Hikes Point area and the contributing area is single family residential. The pump is activated to eliminate residential basement backups. The cause of the overflow is downstream surcharging and significant I/I. This location is addressed by Interim SSDP projects.

SSOs MSD0012-PS and 18434 are located in the Hikes Point area and the contributing area is single family residential. MSD0012-PS is known as the Highgate Springs Pump Station, which overflows to Beargrass Creek during extreme wet weather. This was constructed as a wet weather relief to eliminate basement backups. SSO 18434 is located a few manholes upstream. The cause of these overflows is due to surcharging in the Beargrass Interceptor and significant I/I. These locations are addressed by Interim SSDP projects, namely the Hikes Lane Interceptor project.

SSOs 18134, 18298, 18302, 18370, 18318-W, 49224, 49236, 49672, and 49673 are overflows along the Beargrass Interceptor between the Southeastern Diversion and the Highgate Springs Pump Station. The contributing area is mostly residential with some commercial and industrial. The main cause of these SSOs is downstream surcharging at the Southeastern Diversion Structure and excessive wet weather flow in the Beargrass Interceptor. These locations are addressed by Interim SSDP projects, namely the Hikes Lane Interceptor project.

2.5.8.2. VALIDATION FOR THE SOUTHEASTERN DIVERSION

There is a modeled SSO near each known SSO at the appropriate threshold rain event (explained in Section 2.3.5.2). There were two validated SSOs in the Southeastern Diversion modeled area. There are three unvalidated SSOs at manholes 18134, 18370, and 51594. Manholes 18134 and 18370 are in the tributaries upstream of the Beargrass Interceptor in the Hikes Point area that will be addressed with the new Hikes Lane Interceptor (Interim SSDP project). The Interceptor Condition Assessment Phase 1 project noted numerous obstructions and root masses in the Beargrass Interceptor near Manhole 51594. This part of Beargrass Interceptor will be recommended for the next phase of the Beargrass Interceptor rehabilitation work.

2.5.8.3. SEDIMENTATION FOR THE SOUTHEASTERN DIVERSION

Based on validation results and a review of the interceptor condition assessment, sedimentation was needed in the model for the Southeastern Diversion SSO validation. Sediment amounts that are listed in Table 2.5.12 were added in the pipes downstream of the listed manhole ID in the hydraulic model. The majority of these blockages have since been removed through cleaning and rehabilitation projects completed in late 2008.

Table 2.5.12 Southeastern Diversion Sedimentation for SSO Validation

SITE (MANHOLE ID)	SEDIMENT DEPTH (UPSTREAM PIPE DIAMETER)	SITE (MANHOLE ID)	SEDIMENT DEPTH (UPSTREAM PIPE DIAMETER)	SITE (MANHOLE ID)	SEDIMENT DEPTH (UPSTREAM PIPE DIAMETER)
72555	18 inches (36")	51147	8 inches (42")	49245-T	6 inches (33")
30703-T	15 inches (30")	51221	8 inches (42")	72552	6 inches (21")
30704	14 inches (30")	72353-T	8 inches (42")	49468	6 inches (27")
08535C-T	14 inches (72")	72354	8 inches (42")	22574	6 inches (30")
50682	13 inches (36")	72396-T	8 inches (42")	22576	6 inches (30")
51186-T	13 inches (36")	73168	8 inches (42")	49664	6 inches (30")

Table 2.5.12 Southeastern Diversion Sedimentation for SSO Validation

SITE (MANHOLE ID)	SEDIMENT DEPTH (UPSTREAM PIPE DIAMETER)	SITE (MANHOLE ID)	SEDIMENT DEPTH (UPSTREAM PIPE DIAMETER)	SITE (MANHOLE ID)	SEDIMENT DEPTH (UPSTREAM PIPE DIAMETER)
51147-T	13 inches (42")	51232	8 inches (36")	49778	6 inches (30")
30683-T	11 inches (30")	63832	8 inches (36")	54003	6 inches (30")
30703	11 inches (30")	30720	7 inches (30")	66205	6 inches (30")
30705	11 inches (30")	24299	7 inches (39")	28080T	5 inches (24")
50648	11 inches (30")	26640	7 inches (33")	49446	5 inches (24")
68190	11 inches (21")	18465-T	7 inches (33")	19255	5 inches (27")
51221-T	10 inches (42")	51175	7 inches (36")	49779	5 inches (27")
49767	10 inches (21")	51187-T	7 inches (36")	49781	5 inches (27")
51222	9 inches (42")	51191	7 inches (36")	49807	5 inches (27")
23249C-AG	9 inches (48")	51203	7 inches (36")	49818	5 inches (27")
51189	9 inches (36")	26645	7 inches (27")	49703	5 inches (24")
51192-T	9 inches (36")	30683SM	7 inches (30")	25345	4 inches (18")
51194	9 inches (36")	18465	6 inches (33")	112639	4 inches (21")
49473	9 inches (27")	18704	6 inches (21")	30714	4 inches (21")
24299-T	8 inches (39")	26642	6 inches (33")	30715	4 inches (21")
30685	8 inches (33")	48885	6 inches (33")	49459	4 inches (21")
49244-T	8 inches (33")	48886	6 inches (33")	49710	4 inches (18")
49810	8 inches (27")	48894	6 inches (33")	19769	3 inches (18")
				AVERAGE SEDIMENT DEPTH	**7.7 INCHES**

2.5.8.4. RDI/I REDUCTION FOR THE SOUTHEASTERN DIVERSION

The RDI/I reduction process for Southeastern Diversion follows the procedures described in Section 2.3.5.7. Table 2.5.13 summarizes the average peaking factor and projected RDI/I reduction for sub-catchments of the Southeastern Diversion. Peaking factor is the peak flow (the monitored maximum flow within the sewer system during a rainfall event) at the flow monitor compared to average DWF at the flow monitor. The average peaking factor is computed from three major storms that occurred in the flow-monitoring period. The projected RDI/I reduction represents the percent of contributing area which was reduced for models used in MSD SSO evaluation modeling (see Appendix 2.3.4 for explanation of peaking factors, RDI/I reduction, and model refinements).

There were 32 flow monitoring locations in the Southeastern Diversion modeled area. There were six flow monitoring locations that the RDI/I reduction was adjusted from what MSD provided. These were HP22, HP24, HP25A, HP31, HP32, and HP33. These were adjusted by taking an average of adjacent flow monitoring basins. This was done because the flow monitors either had volume-balancing problems or were highly influenced by an upstream pump station. There were two instances where MOPs were invalidated so the RDI/I were redistributed.

Table 2.5.13 Southeastern Diversion Projected RDI/I Reduction

BASIN	FLOW MONITORING LOCATION (MANHOLE ID)	AVERAGE PEAKING FACTOR	PROJECTED RDI/I REDUCTION
Buechel Branch	25330	2.5	0%
Buechel Branch	51762	2.8	1%
Buechel Branch	25331	3.2	3%
Buechel Branch	49641	3.4	4%
Buechel Branch	25370	3.7	5%
Buechel Branch	49467	4.0	6%
Buechel Branch	68191	27.8*	25%
Hikes Point	16762	1.3	0%
Hikes Point	27293	1.4	0%
Hikes Point	49323	2.1	0%
Hikes Point	30684	2.2	0%
Hikes Point	48894	2.5	0%
Hikes Point	104816	2.5	0%
Hikes Point	18429	2.9	2%
Hikes Point	18434	2.9	2%
Hikes Point	26648	3.1	3%
Hikes Point	49546	3.4	4%
Hikes Point	49518	3.6	5%
Hikes Point	18475	4.1	7%
Hikes Point	71738	4.9	10%
Hikes Point	26642	5.3	12%
Hikes Point	104818	7.1	19%
Hikes Point	48864	7.9	23%
Hikes Point	73087	16.1*	25%
Hikes Point	23214	22.1*	25%
Hikes Point	43711	281.3*	25%
Northern Ditch	54546	4.0	6%
Northern Ditch	23278	5.0	11%
Northern Ditch	23288	5.2	11%
Northern Ditch	08531	5.7	14%
Northern Ditch	23275	5.9	14%
Northern Ditch	80515	6.6	17%
AVERAGE PROJECTED RDI/I REDUCTION			**8.8%**

*Note: High peaking factor due to minimal dry weather flow

2.5.8.5. BUILD-OUT FOR THE SOUTHEASTERN DIVERSION

There was no build-out applied to the Southeastern Diversion watershed model for future development flows because the area is fully developed.

2.5.8.6. CAPITAL IMPROVEMENT PROJECTS FOR THE SOUTHEASTERN DIVERSION

MSD projects within the current five-year capital plan were considered in branch solutions. In considering these projects, modelers were given the latitude to modify design parameters (such as pipe diameter or pump capacity) to the extent of the preliminary project design. There were three Capital Improvement Projects integrated into the Southeastern Diversion hydraulic model.

- **MSD Project B00234: Cavelle Avenue Sanitary Sewer**. The assessment project consists of 15 residential properties in which property owners currently use on-site disposal systems. The project will construct approximately 560 LF of separate SSS.
- **MSD Project B98235: Newburg Road at Tartain Road Sanitary**. The assessment project consists of five residential properties in which property owners currently use on-site disposal systems. The project will construct approximately 1,200 LF of gravity sewers. Alternatives to conventional sewers will be considered.
- **MSD Project E98307: Taylorsville Road at Six Mile Lane**. The assessment project consists of 12 residential properties in which property owners have requested service in this unsewered area of Jeffersontown. The project will construct approximately 1,700 LF of separate SSS for the properties.

2.5.9. OHIO RIVER FORCE MAIN MODEL DEVELOPMENT

This section provides a summary of the ORFM watershed model development including SSO descriptions, validation process, RDI/I reduction, build-out potential, and existing or proposed capital improvement projects relevant to the watershed. The full calibration/validation report is available for review in Appendix 2.3.2.

2.5.9.1. SSO DESCRIPTIONS FOR THE OHIO RIVER FORCE MAIN

The ORFM area is divided into four branches (see Section 2.3.5.6 for details on branching) based on SSO locations and system deficiencies. Refer to Figure 2.5.9 for a map of the ORFM branching and SSO locations at the end of this chapter. Refer to Figure 2.5.9A for an updated map showing the current limits of ORFM area model. Note this includes some areas of the small WQTC areas. Brief descriptions of the SSOs in each branch are below.

Figure 2.5-11 Ohio River Force Main Sewershed Branch Network, 2009

Figure 2.5-9A Ohio River Force Main Sewershed Branch Network, 2021

Figures are located at the end of this chapter.

- **Branch 1** addresses nine SSOs: 24152-W, 24472, 26752, 41374, 41416, MSD0007-PS (Mockingbird Valley Pump Station), MSD0010-PS (Winton Ave. Pump Station), MSD0023-PS (Mellwood Ave Pump Station), and MSD0024-PS (Canoe Ln Pump Station). The SSOs at MSD0007-PS, MSD0010-PS, Mellwood Avenue Pump Station (24472 and MSD0023-PS), and Canoe Lane Pump Station (24152-W and MSD0024-PS) are likely caused by upstream flows greater than the available pump station wet weather capacity. The SSOs at 26752, 41374, and 41416 are caused by insufficient wet weather capacity of the interceptor upstream of Mockingbird Valley Pump Station. The contributing area is mostly single-family residential.

- **Branch 2** addresses one SSO: 96020. The SSO is caused by a hydraulic bottleneck in the 8” gravity line. The contributing area is mostly single-family residential.
- **Branch 3** addresses one SSO: MSD0095-PS (Derington Ct. Pump Station). The SSO is likely caused by upstream flows greater than the wet weather capacity of the Derington Court Pump Station. The contributing area is mostly single-family residential.
- **Branch 4** addresses 13 SSOs in the Prospect area: 22436, 40870, 40871, 40872, 42680, 65633, 65635, MSD0123-PS (West Goose Creek Pump Station), MSD1044-PS (Phoenix Hill Pump Station), MSD0183-PS (Glenview Hills Pump Station), MSD0192-PS (Barbour Ln Pump Station), MSD0193-PS (New Market Pump Station), and MSD0292 (Hunting Creek South WQTC). The SSOs at 22436 and MSD0123-PS are caused by the head in the ORFM limiting the Goose Creek Pump Station and the insufficient wet weather capacity at the pump station to convey flow. The SSOs at 40870, 40871, and 40872 are caused by the head in the ORFM limiting the Muddy Fork Pump Station. The SSOs at 42680, 65633, 65635, and MSD0192-PS are caused by insufficient wet weather capacity at the Barbour Lane Pump Station to convey wet weather flow. The SSOs at MSD0183-PS, MSD0193-PS, and MSD1044-PS are caused by the head in the ORFM and the insufficient capacities at the pump stations to convey the wet weather flow. The SSO at MSD0292 is likely caused by upstream flows greater than the wet weather capacity at the Hunting Creek South WQTC. The contributing area at all these locations is mostly single-family residential.

2.5.9.2. VALIDATION FOR THE OHIO RIVER FORCE MAIN

There is a modeled SSO near each known SSO at the appropriate threshold rain event (explained in Section 2.3.5.2). There were 20 validated SSOs in the ORFM modeled area.

The SSO 22436 is currently a documented SSO but only validates to a 2.60-inch cloudburst storm; there is a possibility that excessive inflow exists in the small upstream system.

2.5.9.3. RDI/I REDUCTION FOR THE OHIO RIVER FORCE MAIN

The RDI/I reduction process for ORFM follows the procedures described in Section 2.3.5.7. Table 2.5.14 summarizes the average peaking factor and projected RDI/I reduction for sub-catchments of ORFM. Peaking factor is the peak flow (the monitored maximum flow within the sewer system during a rainfall event) at the flow monitor compared to average DWF at the flow monitor. The average peaking factor is computed from three major storms that occurred in the flow-monitoring period. The projected RDI/I reduction represents the percent of contributing area which was reduced for models used in MSD SSO evaluation modeling (see Appendix 2.3.4 for explanation of peaking factors, RDI/I reduction, and model refinements).

Table 2.5.14 Ohio River Force Main Projected RDI/I Reduction

FLOW MONITORING LOCATION (MANHOLE ID)	AVERAGE PEAKING FACTOR	PROJECTED RDI/I REDUCTION
42675	2.2	0%
42742	2.2	0%
42788	2.2	0%
32191	2.5	0%
22433e	2.6	1%

Table 2.5.14 Ohio River Force Main Projected RDI/I Reduction

FLOW MONITORING LOCATION (MANHOLE ID)	AVERAGE PEAKING FACTOR	PROJECTED RDI/I REDUCTION
66021	2.6	1%
44084	2.8	1%
48228	3.1	3%
27035	3.5	4%
43569	3.5	4%
40872	3.6	5%
22433w	4.4	8%
91799-10	4.7	10%
91799-12	4.8	10%
24077	6.3	16%
27435	6.3	16%
AVERAGE PROJECTED RDI/I REDUCTION		**4.9%**

2.5.9.4. BUILD-OUT FOR THE OHIO RIVER FORCE MAIN

The build-out process for ORFM included Sewer Assessment Projects only. It follows the procedures described in Section 2.3.5.10 and are listed in Table 2.5.15. Additional flow was applied to the model to represent future flow based on the following assessment projects:

- D98333 - Upper River Road / Overbrook Area Sanitary Sewer Assessment Project
- D00252 – Indian Hills North - River Road Assessment Project
- D96177 – Riviera Area Sanitary Sewer Assessment Project
- D94203 – Future Upper Muddy Fork Pump Station (Boxhill Road Sanitary Sewer Assessment Project)
- D98331 – Cabin Way Sanitary Sewer Assessment Project
- D98334 – Orion / Hillsdale Sanitary Sewer Assessment Project
- D98338 – Ten Broeck Phase II Sanitary Sewer Assessment Project
- D98343 – Winchester Acres Sanitary Sewer Assessment Project
- D96179 – Wallbrook Subdivision Sanitary Sewer Assessment Project

Table 2.5.15 Ohio River Force Main Projected Build-Out Areas

BRANCH	ASSESSMENT ID	BUILD-OUT INPUT LOCATION (MANHOLE/NODE ID)	FUTURE DEVELOPMENT ADDITIONAL DWF (GPD)
Branch 1	D98333	40388	10,800
Branch 4	D00252	40866	22,400
Branch 4	D96177	110797	34,800
Branch 4	D94203	Upper Muddy	32,800
Branch 4	D98331	44109	2,400
Branch 4	D98334	66019	16,800
Branch 4	D98338	42726	2,800

Table 2.5.15 Ohio River Force Main Projected Build-Out Areas

BRANCH	ASSESSMENT ID	BUILD-OUT INPUT LOCATION (MANHOLE/NODE ID)	FUTURE DEVELOPMENT ADDITIONAL DWF (GPD)
Branch 4	D96179	24233	6,400
Branch 4	D98343	42726	16,000
TOTAL FUTURE PROJECTED ADDITIONAL FLOWS			**145,200**

2.5.9.5. CAPITAL IMPROVEMENT PROJECTS FOR THE OHIO RIVER FORCE MAIN

MSD projects within the current five-year capital plan were considered in branch solutions. In considering these projects, modelers were given the latitude to modify design parameters (such as pipe diameter or pump capacity) to the extent of the preliminary project design. There were three Capital Improvement Projects integrated into the ORFM hydraulic model. There was also a capital project completed in 2005, which eliminated the Jarvis Lane Pump Station SSO; the constructed overflow structure was sealed and the force main was upsized. Additionally, in 2003, pump replacements occurred, and a permanent generator was placed at Glen Oaks Pump Station, which eliminated the SSO.

- **MSD Project F05039: Woodlawn Park Pump Station Relocation**. The project consists of diverting flow from the Middle Fork Modeling area to the Muddy Fork Interceptor. The project will construct 2,200 LF of gravity interceptor from the existing pump station site to the existing Muddy Fork interceptor at Foeburn Lane. In coordination with the widening of Westport Road the project will eliminate the existing Woodlawn Park Pump Station, which will help relieve sewer SSO conditions at Falgate Court and in the Beechwood Village system. The project was completed on March 31, 2009.

- **MSD Project F06298: Canoe Pump Station Elimination**. The project consists of diverting flow from the Canoe Lane Pump Station and the Fairway Lane Pump Station to the existing Muddy Fork Interceptor. The Canoe Lane Pump Station will be eliminated. The flow currently goes to the Mellwood Pump Station, but it does not have the ability to accept all wet weather flow so this project will reduce flow to Mellwood Pump Station.

- **MSD directed project to upgrade Hillsdale, Barbour Lane, Glenview Hills, and New Market Pump Stations** by a private party. The project includes replacing a 75 horsepower pump with a 200 horsepower pump in the Barbour Lane Pump Station; replacing the existing 8-inch force main with a 12-inch and replacing the existing pumps with two 107 horsepower pumps at Hillsdale Pump Station; replacing the existing pumps with two 65 horsepower pumps and replacing the 4-inch force main with a 6-inch force main at New Market Pump Station; installing a new wet well and two 65 horsepower pumps for Glenview Hills Pump Station. The construction plans for improvements are on file, MSD Record No. 15271.

2.5.10. COMBINED SEWER OVERFLOW AREA MODEL DEVELOPMENT

The CSO hydraulic model provides solutions for the modeling of SSOs within the combined sewer system (CSS) combined sewer overflow (CSO) area boundary. Although they are located within the CSS boundary, they are included in the Final SSDP in order to develop elimination projects for the SSOs. This section provides a summary of the CSO area model development including SSO descriptions, validation process, RDI/I reduction, build-out potential, and existing or proposed capital improvement projects relevant to the watershed.

2.5.10.1. SSO DESCRIPTIONS FOR THE CSO MODEL

The CSO area is divided into three branches (see Section 2.3.5.6 for details on branching) based on SSO locations and system deficiencies. Refer to Figure 2.5.10 for a map of the CSO area branching and SSO locations at the end of this chapter. Refer to Figure 2.5.10A for an updated map showing the current limits of the CSO branching area model. Brief descriptions of the SSOs in each branch are below.

Figure 2.5-12 CSO Area Branch Network, 2009

Figure 2.5-10A CSO Area Branch Network, 2021

Figures are located at the end of this chapter.

- **Branch 42007** addresses one SSO: MSD0042-PS (Sonne Pump Station). The SSO occurs at Sonne Pump Station which is a hauling operation site during wet weather conditions. This SSO is likely caused by upstream flows greater than the available Sonne Pump Station and force main capacity during wet weather or excess wet weather flow in the system caused by excessive I/I. This pump station was recently upgraded to 225 gpm from its original design peak flow capacity of 150 gpm. The pump station upgrade appears to eliminate the 1.27-inch cloudburst event overflows, but SSOs still occur for the 1.52-inch, 1.82-inch, 2.25-inch, and 2.60-inch cloudburst events. The contributing area is single-family residential.
- **Branch 30917** addresses nine SSOs: 08717, 13931, 13943, 36763, 44396, 44397, 66349, 104223, and 104231. This branch (known as Camp Taylor) is near the Camp Zachary Taylor Neighborhood Association and Subdivision, west of Poplar Level and the Louisville Zoo. The available sewer system information in this area is limited; therefore, an accurate cause of the SSO is unknown. It appears that the collection system is very old in some areas and the capacity is inadequate to handle excess wet weather flow.
- **Branch 55665** addresses one SSO: 55665 (Hazelwood Pump Station). The SSO occurs at Hazelwood Pump Station which is a hauling operation site during wet weather conditions. The SSO is most likely caused by excess wet weather flow in the system caused by excessive I/I. The contributing area is single-family residential.

2.5.10.2. VALIDATION FOR THE CSO MODEL

The Camp Taylor area was not modeled due to the lack of available data to build the hydraulic model. Record drawings were available but pertinent information was missing from the drawings. There was no flow monitoring data available to assess the system responses to various wet weather events. The alternative to modeling was to develop a regression equation using estimated SSO volume and total rainfall depth. The equation was applied to the total rainfall depth for various storm events to estimate the SSO volume.

The Sonne Pump Station (hauling operation site) is located within the CSO boundaries. The existing CSO model was expanded to include the service area for the Sonne Pump Station. Calibration of Sonne Pump Station was assumed to be part of the CSO model calibration. Validation was completed by using 1.27-inch, 1.52-inch, 1.82-inch, 2.25-inch, and 2.60-inch cloudburst storm events. Initial validation showed an SSO during the 1.27-inch cloudburst storm with original pump peak flow capacity. Based on pump upgrade information provided by MSD staff in June 2008, no SSO occurred during the 1.27-inch cloudburst storm event.

The Hazelwood Pump Station (hauling operation site) is located just outside of the CSO boundaries. The existing CSO model was expanded to include the service area for Hazelwood Pump Station. Calibration was based on estimated volume hauled and wet well level data. Validation runs reported SSO volumes at the pump station and upstream locations in the system.

2.5.10.3. RDI/I REDUCTION FOR THE CSO MODEL

RDI/I reduction was not applied to the CSO area model.

2.5.10.4. BUILD-OUT FOR THE CSO MODEL

There was no build-out applied to the CSO area model because the area is fully developed.

2.5.10.5. CAPITAL IMPROVEMENT PROJECTS FOR THE CSO MODEL

MSD projects within the current five-year capital plan were considered in branch solutions. In considering these projects, modelers were given the latitude to modify design parameters (such as pipe diameter or pump capacity) to the extent of the preliminary project design. One Capital Improvement Project was considered when designing solutions for the branches in the CSO area.

- **Sonne Pump Station Pump Replacement**. This project was completed in 2007. The Sonne Pump Station peak flow capacity was upgraded from 150 gpm to 225 gpm.

2.5.11. SMALL WQTC MODEL DEVELOPMENT

This section provides a summary of the Small WQTC watershed model development including SSO descriptions, validation process, RDI/I reduction, build-out potential, and existing or proposed capital improvement projects relevant to the watershed. The full calibration/validation report is available for review in Appendix 2.3.2.

2.5.11.1. SSO DESCRIPTIONS FOR SMALL WQTCS

The small WQTC areas are divided into eight branches (see Section 2.3.5.6 for details on branching) based on SSO locations and system deficiencies. Refer to Figures 2.5.11 through 2.5.13 for maps of the small WQTC branching and SSO locations at the end of this chapter. Note there are no updates for the small WQTC areas, as they have been eliminated and absorbed into other models. Brief descriptions of the SSOs in each branch are below.

Figure 2.5-13 Huntington Creek Branch Network
Figure 2.5-14 Berrytown and Lake Forest Branch Network
Figure 2.5-15 Chenoweth Branch Network
Figures are located at the end of this chapter.

- **Berrytown Branch 1** addresses one SSO: MSD0199-LS (Lucas Ln. Pump Station). The SSO is caused by limited Lucas Lane Pump Station wet weather capacity. It is located adjacent to a drainage ditch that drains to Goose Creek. The contributing area is single-family residential.
- **North Hunting Creek Branch 1** addresses one SSO: MSD1060-LS (Riding Ridge Lift Station). This SSO is likely caused by upstream flows greater than the available Riding Ridge Lift Station wet weather capacity. The contributing area is single-family residential.

- **North Hunting Creek Branch 2** addresses one SSO: MSD1055-LS (Gunpowder Lift Station). This SSO is likely caused by upstream flows greater than the available Gunpowder Lift Station wet weather capacity. The contributing area is single-family residential.
- **North Hunting Creek Branch 3** addresses one SSO: 62769, upstream of the Fox Harbor #2 Lift Station. This SSO is most likely caused by upstream flows greater than the available Fox Harbor #1 Lift Station (MSD1053-LS) and Fox Harbor #2 Lift Station (MSD1054-LS) wet weather capacity. The contributing area is single-family residential.
- **Hunting Creek South Branch 1** addresses one SSO: MSD1065-PS (Fairway View Pump Station). It is located next to the Hunting Creek golf course in a residential area. This SSO is most likely caused by upstream flows greater than the available Fairway View Pump Station wet weather capacity. The contributing areas is single-family residential.
- **Hunting Creek South Branch 2** addresses one SSO: MSD1063-PS (Deep Creek Pump Station). The SSO occurs at the Deep Creek Pump Station and is located approximately 550 feet from Harrods Creek in a residential area. This SSO is most likely caused by upstream flows greater than the available Deep Creek Pump Station wet weather capacity. The contributing area is single-family residential.
- **Lake Forest Branch 1** addresses one SSO: MSD1169-LS (Lake Forest Lift Station). The SSO occurs at the Lake Forest Lift Station and is most likely caused by upstream flows greater than the available Lake Forest Lift Station wet weather capacity. The contributing area is single-family residential.
- **Chenoweth Hills Branch 1** addresses one SSO: 94187, which is caused by MSD1084-PS (St. Rene Road Pump Station). The SSO is likely caused by upstream flows greater than St. Rene Road Pump Station wet weather capacity. It is located in a residential area, approximately 550 feet from Chenoweth Run. The contributing area is single-family residential.

2.5.11.2. VALIDATION FOR SMALL WQTCS

- **Berrytown Model.** There is one validated SSO in the Berrytown WQTC modeled area (in addition to the SSO at the WQTC) located at the Lucas Lane Pump Station (MSD0199-LS). There is a modeled SSO during the 2.25-inch cloudburst storm at the Creel Lodge Pump Station (MSD1001-LS), which is upstream of the Lucas Lane Pump Station.
- **Chenoweth Hills Model**. Excluding the SSO at the WQTC, there is one validated SSO in the Chenoweth Hills model: MSD1084-PS.
- **North Hunting Creek Model**. There are four validated SSOs in the North Hunting Creek model. There is a modeled SSO during the 1.52-inch cloudburst storm at manhole 66750, which is upstream of the Gunpowder Lift Station (MSD1055-LS).
- **Hunting Creek South Model**. Excluding the SSO at the WQTC, there are two validated SSOs in the Hunting Creek South model, and three modeled SSOs: Manhole 68563 (just upstream of Covered Cove Way Pump Station), MSD1064-PS (Westover Pump Station), both located upstream of SSO MSD1065-PS, and Manhole 66584, located upstream of SSO MSD1063-PS.
- **Lake Forest Model**. There is one validated SSO in the Lake Forest model: MSD1169-LS.

For procedures on the validation process, see Section 2.3.5.2.

2.5.11.3. RDI/I REDUCTION FOR SMALL WQTCS

RDI/I reduction was not applied to the Small WQTC models.

2.5.11.4. BUILD-OUT FOR SMALL WQTCS

There was no build-out applied to the Small WQTC models for future development flows.

2.5.11.5. CAPITAL IMPROVEMENT PROJECTS FOR SMALL WQTCS

MSD projects within the current five-year capital plan were considered in branch solutions. In considering these projects, modelers were given the latitude to modify design parameters (such as pipe diameter or pump capacity) to the extent of the preliminary project design. There were no Capital Improvement Projects integrated into the Small WQTC hydraulic model.

2.5.12. POND CREEK MODEL DEVELOPMENT

This section provides a summary of the Pond Creek watershed model development including SSO descriptions, validation process, RDI/I reduction, build-out potential, and existing or proposed capital improvement projects relevant to the watershed. The full calibration/validation report is available for review in Appendix 2.3.2.

2.5.12.1. SSO DESCRIPTIONS FOR POND CREEK

Pond Creek is divided into nine branches (see Section 2.3.5.6 for details on branching) based on SSO locations and system deficiencies. Refer to Figure 2.5.14 for a map of the Pond Creek branching and SSO locations at the end of this chapter. Refer to Figure 2.5.14A for an updated map showing the current limits of the Pond Creek area model. Note this includes some areas of the small WQTC areas. Brief descriptions of the SSOs in each branch are below.

Figure 2.5-16 Pond Creek Sewershed Branch Network, 2009
Figure 2.5-14A Pond Creek Sewershed Branch Network, 2021
Figures are located at the end of this chapter.

- **Branch 3** addresses four SSOs: 25477, 25478, 25480, and MSD0130-PS (Cooper Chapel Pump Station). The SSOs occur at or directly upstream of the Cooper Chapel Pump Station in a residential area and are most likely caused by upstream flows greater than the available Cooper Chapel Pump Station wet weather capacity. The contributing area is single-family residential.
- **Branch 4** addresses three SSOs: 35309, 60679 and MSD1013-PS (Cinderella Pump Station). The SSOs 60679 and MSD1013-PS occur at the Cinderella Pump Station in a residential area and are most likely caused by upstream flows greater than the available Cinderella Pump Station wet weather capacity. Manhole 35309 is immediately downstream of the Cinderella PS force main discharge point. Given the drawdown peak flow capacity of the pump station, there is no hydraulic reason for the line to overflow. Model-simulated sedimentation was used immediately downstream to cause the SSO. The contributing area is single-family residential.
- **Branch 5** addresses three SSOs: 25484, 93719, and MSD0101-PS (Lantana Drive Pump Station). The SSOs occur near the Lantana Dr. Pump Station in a residential area. They are most likely caused by upstream flows greater than the available Lantana Drive Pump Station wet weather capacity. The contributing area is single-family residential.

- **Branch 6** addresses one SSO: MSD0180-PS (Government Center Pump Station). The SSOs occur at the Government Center Pump Station near the parking lot of a Louisville Metro government building. They are most likely caused by upstream flows greater than the available Government Pump Station wet weather wet weather capacity. The contributing area is primarily single-family residential with some public land use.
- **Branch 7** addresses one SSO: 21229-W, which occurs at the Avanti Pump Station in a residential area. It is most likely caused by upstream flows greater than the available Avanti Pump Station wet weather wet weather capacity. The contributing area is single-family residential.
- **Branch 8** addresses nine SSOs: 19360, 19369, 29933, 29943, 29948, 31083, 31084, 79076, and MSD1010-PS. The SSO MSD1010-PS occurs at the Lea Ann Way Pump Station in a residential area. MSD Operations have replaced the three existing pumps with higher peak flow capacity pumps in 2008, and a fourth pump has been installed by a contractor as a development agreement. The pump station is now rated at 22 MGD peak wet weather capacity, which eliminates the pump station wet weather capacity problems. The SSO 79076 occurs upstream of the Lea Ann Way Pump Station and is due to backwater conditions at the pump station; this SSO should be eliminated by the pump station upgrades. The other SSOs occur upstream of the Lea Ann Way Pump Station at gravity manholes in a residential area. These SSOs are caused by upstream flows greater than the available collector system wet weather capacity. The contributing area is single-family residential.
- **Branch 9** addresses four SSOs: 27116, 70212, 17724, and MSD0133-PS (Caven Ave. Pump Station). The SSOs 70212 and 17724 occur upstream of a hydraulic constriction at I-65 and the Outer Loop and is due to backwater conditions caused by the constriction in addition to insufficient collector system wet weather capacity. SSOs 27116 and MSD0133-PS are caused by upstream flows greater than the available Caven Avenue. Pump Station wet weather wet weather capacity. The contributing area is single-family residential.
- **Branch 10** addresses two SSOs: 36419 and MSD1019-PS (Leven Pump Station). The SSOs occur at the Leven Pump Station in a residential area. They are most likely caused by upstream flows greater than the available Leven Pump Station wet weather capacity. The contributing area is single-family residential.
- **Branch 11** addresses two SSOs: 92098 and MSD1048-PS (Edsel Pump Station). The SSOs occur at the Edsel Pump Station in a residential area. The SSOs are suspected to be caused by maintenance-related issues or excessive I/I during wet weather. They are targeted for investigation by MSD I&FP to determine if a downstream blockage has occurred.

2.5.12.2. VALIDATION FOR POND CREEK

There is a modeled SSO near each known SSO at the appropriate threshold rain event (explained in Section 2.3.5.2). There were 32 validated SSOs in the Pond Creek modeled area. There were two unvalidated SSOs at manhole 35309 and Edsel Pump Station (MSD1048-Pump Station) and are believed to be maintenance-related issues or I/I induced.

- **SSO 35309** is immediately downstream of the Cinderella Pump Station force main. Given the drawdown peak flow capacity of the pump station, there is no hydraulic reason for the line to overflow. Model-simulated sedimentation was used immediately downstream to cause the SSO.

- **Valley Village SSOs (32682 and 32688)** were not validated as they are due to backwater conditions from Derek R. Guthrie WQTC and will be eliminated as part of the Interim SSDP Derek R. Guthrie WQTC improvements.

2.5.12.3. SEDIMENTATION FOR POND CREEK

Based on validation results and a review of the interceptor condition assessment, sedimentation was needed in the model for the Pond Creek SSO validation. Sediment amounts, which are listed in Table 2.5.16, were added in the pipes downstream of the listed manhole ID in the hydraulic model.

Table 2.5.16 Pond Creek Sedimentation for SSO Validation

SITE (MANHOLE ID)	SEDIMENT DEPTH
35308	6 inches
35309	6 inches
AVERAGE SEDIMENT DEPTH	**6 INCHES**

2.5.12.4. RDI/I REDUCTION FOR POND CREEK

The RDI/I reduction process for Pond Creek follows the procedures described in Section 2.3.5.7. Table 2.5.17 summarizes the average peaking factor and projected RDI/I reduction for sub-catchments of Pond Creek. Peaking factor is the peak flow (the monitored maximum flow within the sewer system during a rainfall event) at the flow monitor compared to average DWF at the flow monitor. The average peaking factor is computed from three major storms that occurred in the flow-monitoring period. The projected RDI/I reduction represents the percent of contributing area which was reduced for models used in MSD SSO evaluation modeling (see Appendix 2.3.4 for explanation of peaking factors, RDI/I reduction, and model refinements).

Table 2.5.17 Pond Creek Projected RDI/I Reduction

FLOW MONITORING LOCATION (MANHOLE ID)	AVERAGE PEAKING FACTOR	PROJECTED RDI/I REDUCTION
58046	2.4	0%
41789	2.7	1%
22349	3.5	4%
84926-42	3.7	5%
22324	3.8	6%
22340	3.8	6%
61725-21	3.8	6%
85330	4.0	7%
22304	4.4	8%
61725-36	4.4	8%
64052	4.5	8%
60325	4.8	10%
82316	5.8	14%

Table 2.5.17 Pond Creek Projected RDI/I Reduction

FLOW MONITORING LOCATION (MANHOLE ID)	AVERAGE PEAKING FACTOR	PROJECTED RDI/I REDUCTION
84926-21	7.1	19%
32685	11.6	25%
AVERAGE PROJECTED RDI/I REDUCTION		**8.4%**

2.5.12.5. BUILD-OUT FOR POND CREEK

In preparing solutions, potential future development (build-out) was considered. Build-out was only applied as additional flow upstream of known or suspected SSOs. The build-out process for Pond Creek follows the procedures described in Section 2.3.5.10 and the result is listed in Table 2.5.18. There are four general locations where additional flow was added to the model to represent future development and corresponding flows.

Table 2.5.18 Pond Creek Projected Build-Out Areas

BRANCH	BUILD-OUT INPUT LOCATION (MANHOLE/NODE ID)	FUTURE DEVELOPMENT ADDITIONAL DWF (GPD)
Branch 1	32682	211,789
Branch 4	102339	3,492
Branch 4	35308	3,903
Branch 6	31300	30,904
TOTAL FUTURE PROJECTED ADDITIONAL FLOWS		**250,088**

2.5.12.6. CAPITAL IMPROVEMENT PROJECTS FOR POND CREEK

MSD projects within the current five-year capital plan were considered in branch solutions. In considering these projects, modelers were given the latitude to modify design parameters (such as pipe diameter or pump capacity) to the extent of the preliminary project design. There were three Capital Improvement Projects integrated into the Pond Creek hydraulic model. In addition, there was a capital project completed in March 2008 that eliminated the Valley Village Pump Station SSO; a pump was repaired and placed back into service.

- **MSD Project C94103: Charleswood Subdivision Interceptor**. The project includes 3,150 LF of sewer and a system of collector sewers along Cooper Chapel Road between Charleswood Road and Price Lane. All the improvements are planned to be constructed in conjunction with the widening of Cooper Chapel Road. The Cooper Chapel Pump Station will be eliminated, and sanitary sewer service will be provided to an area currently using on-site disposal systems (58 properties). This project is scheduled to be completed in 2010.
- **MSD Project C06295: Zabel Way Pump Station Elimination**. The project included 2,000 LF of new 10-inch sewer to eliminate the Zabel Way Pump Station. This project was completed in September 2008.
- **Lea Ann Way Pump Station Upgrades**. MSD Operations have replaced the three existing pumps with higher peak flow capacity pumps in 2008. A fourth pump has been installed by a contractor as a development agreement. The pump station is now rated at 22 MGD peak flow capacity.

2.5.13. MILL CREEK MODEL DEVELOPMENT

This section provides a summary of the Mill Creek watershed model development including SSO descriptions, validation process, RDI/I reduction, build-out potential, and existing or proposed capital improvement projects relevant to the watershed. The full calibration/validation report is available for review in Appendix 2.3.2.

2.5.13.1. SSO DESCRIPTIONS FOR MILL CREEK

Mill Creek is divided into two branches (see Section 2.3.5.6 for details on branching) based on SSO locations and system deficiencies. Refer to Figure 2.5.15 for a map of the Mill Creek branching and SSO locations at the end of this chapter. Refer to Figure 2.5.15A for an updated map showing the current limits of the Mill Creek area model. Brief descriptions of the SSOs in each branch are below.

Figure 2.5-17 Mill Creek Sewershed Branch Network, 2009

Figure 2.5-15A Mill Creek Sewershed Branch Network, 2021

Figures are located at the end of this chapter.

- **Branch 1** addresses five SSOs: 04498, 04542, 81814-W (Pioneer Rd. Pump Station), MSD0047-PS (Fern Lea Pump Station), and MSD0050-PS (Garrs Lane Pump Station). The SSO 81814-W occurs at the Pioneer Road Pump Station in a residential area; the SSO is most likely caused by upstream flows greater than the available Pioneer Road Pump Station wet weather capacity. The SSOs at 04542 and MSD0047-PS occur at the Fern Lea Pump Station in a residential area; the SSOs are most likely caused by upstream flows greater than the available Fern Lea Pump Station wet weather capacity. The SSO MSD0050-PS occurs at the Garrs Lane Pump Station in a residential area; the SSO is most likely caused by upstream flows greater than the available Garrs Lane Pump Station wet weather capacity. SSO 04498 occurs along the 10" sewer line between Pioneer Road. Pump Station and Fern Lea Pump Station and most likely occurs due to backwater conditions from the Fern Lea Pump Station.
- **Branch 2** addresses one SSO: 04699-W. The SSO occurs at the East Rockford Pump Station in a residential area. This pump station is built in an area prone to surface flooding, which most likely inundates the pump station and causes the SSO.

2.5.13.2. VALIDATION FOR MILL CREEK

There is a modeled SSO near each known SSO at the appropriate threshold rain event (explained in Section 2.3.5.2). There are four validated SSOs in the Mill Creek modeled area.

- **Derek R. Guthrie SSOs (22385, 22370, 59169, and MSD0277)** were not validated as they are due to backwater conditions from Derek R. Guthrie WQTC and will be eliminated as part of the Interim SSDP Derek R. Guthrie WQTC improvements.

2.5.13.3. RDI/I REDUCTION FOR MILL CREEK

The RDI/I reduction process for Mill Creek follows the procedures described in Section 2.3.5.7. Table 2.5.19 summarizes the average peaking factor and projected RDI/I reduction for sub-catchments of Mill Creek. Peaking factor is the peak flow (the monitored maximum flow within the sewer system during a rainfall event) at the flow monitor compared to average DWF at the flow monitor. The average peaking factor is computed from three major storms that occurred in the flow-monitoring period. The projected RDI/I reduction represents the percent of contributing area which was reduced for models used in MSD SSO evaluation modeling (see Appendix 2.3.4 for explanation of peaking factors, RDI/I reduction, and model refinements).

Table 2.5.19 Mill Creek Projected RDI/I Reduction

FLOW MONITORING LOCATION (MANHOLE ID)	AVERAGE PEAKING FACTOR	PROJECTED RDI/I REDUCTION
100763	2.7	1%
33000	3.1	3%
26716-NE	3.3	4%
22382	3.4	4%
08689	3.5	4%
26716-NW	3.6	5%
81919	3.8	6%
96658	4.1	7%
59250	4.3	8%
56968	5.9	14%
AVERAGE PROJECTED RDI/I REDUCTION		**5.6%**

2.5.13.4. BUILD-OUT FOR MILL CREEK

In preparing solutions, potential future development (build-out) was considered. Build-out was only applied as additional flow upstream of known or suspected SSOs. The build-out process for Mill Creek follows the procedures described in Section 2.3.5.10 and listed in Table 2.5.20. There are five general locations where additional flow was applied to the model to represent future development and corresponding flows.

Table 2.5.20 Mill Creek Projected Build-Out Areas

BRANCH	BUILD-OUT INPUT LOCATION (MANHOLE/NODE ID)	FUTURE DEVELOPMENT ADDITIONAL DWF (GPD)
NB01	22370	23,500
NB01	22385	3,600
NB01	59169	17,100
NB01	MSD0047	9,600
TOTAL FUTURE PROJECTED ADDITIONAL FLOWS		**53,800**

2.5.13.5. CAPITAL IMPROVEMENT PROJECTS FOR MILL CREEK

All MSD projects within the current five-year capital plan were considered in branch solutions. In considering these projects, modelers were given the latitude to modify design parameters (such as pipe diameter or pump capacity) to the extent of the preliminary project design. There was one Capital Improvement Project integrated into the Mill Creek hydraulic model.

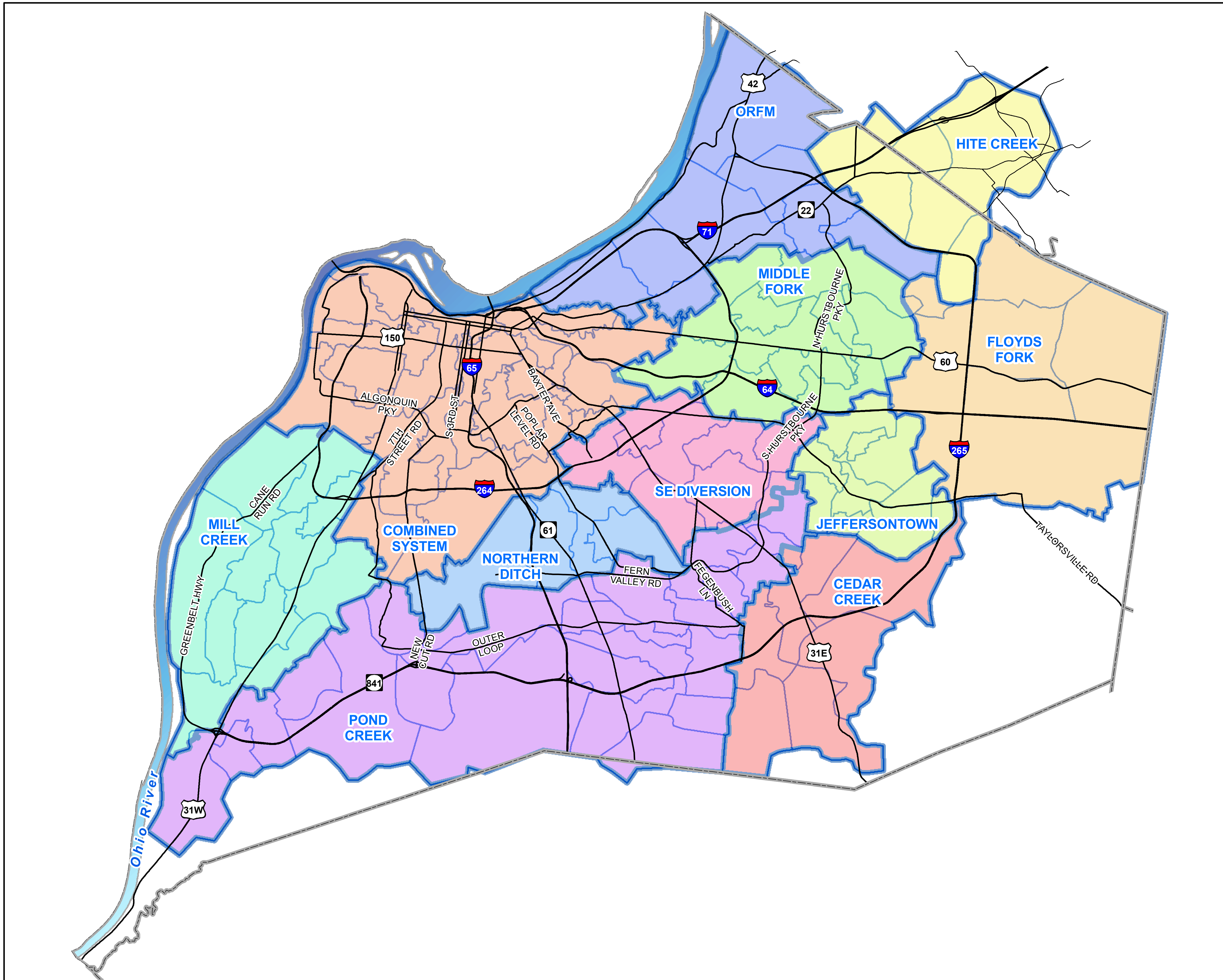
- **MSD Project Budget ID B06208 Shively Interceptor**. This project will eliminate five pump stations (Jacks Lane, Pioneer Road, Fern Lea, Garrs Lane, and City Park Pump Stations) to provide gravity.

Integrated Overflow Abatement Plan

Vol. 3 - Sanitary Sewer Discharge Plan

Final SSDP Model Areas

Figure 2.3.1



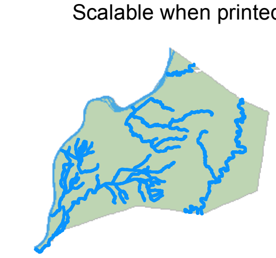
Legend

- Jefferson County Boundary
- Major Roads

System Capacity Credit Basins

- Cedar Creek
- Combined System
- Floyds Fork
- Hite Creek
- Jeffersontown
- Middle Fork
- Mill Creek
- Northern Ditch
- ORFM
- Pond Creek
- SE Diversion
- SCAP Sub Areas
- Ohio River

1 inch = 14,000 feet
Scalable when printed on 11" X 17" paper



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SDI Inc. Figure 2.3.1 Model Areas.mxd

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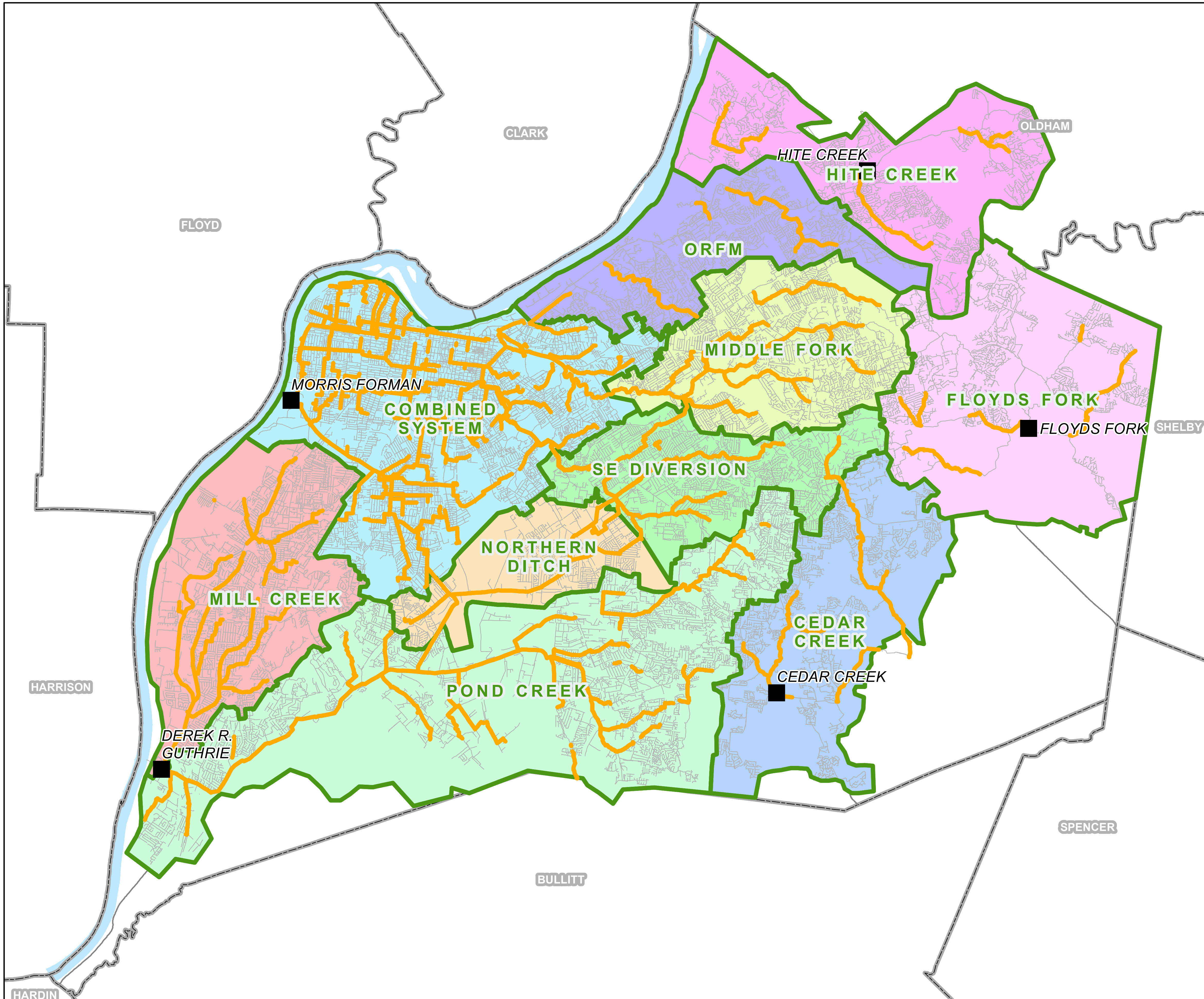
Figure 2.3.1A Model Areas



Treatment Plants
Sewer Lines
Sewer Interceptor
Surrounding County Boundaries

BASINNAME

CEDAR CREEK
COMBINED SYSTEM
FLOYDS FORK
HITE CREEK
MIDDLE FORK
MILL CREEK
NORTHERN DITCH
ORFM
POND CREEK
SE DIVERSION

0 1.25 2.5 5 Miles

N

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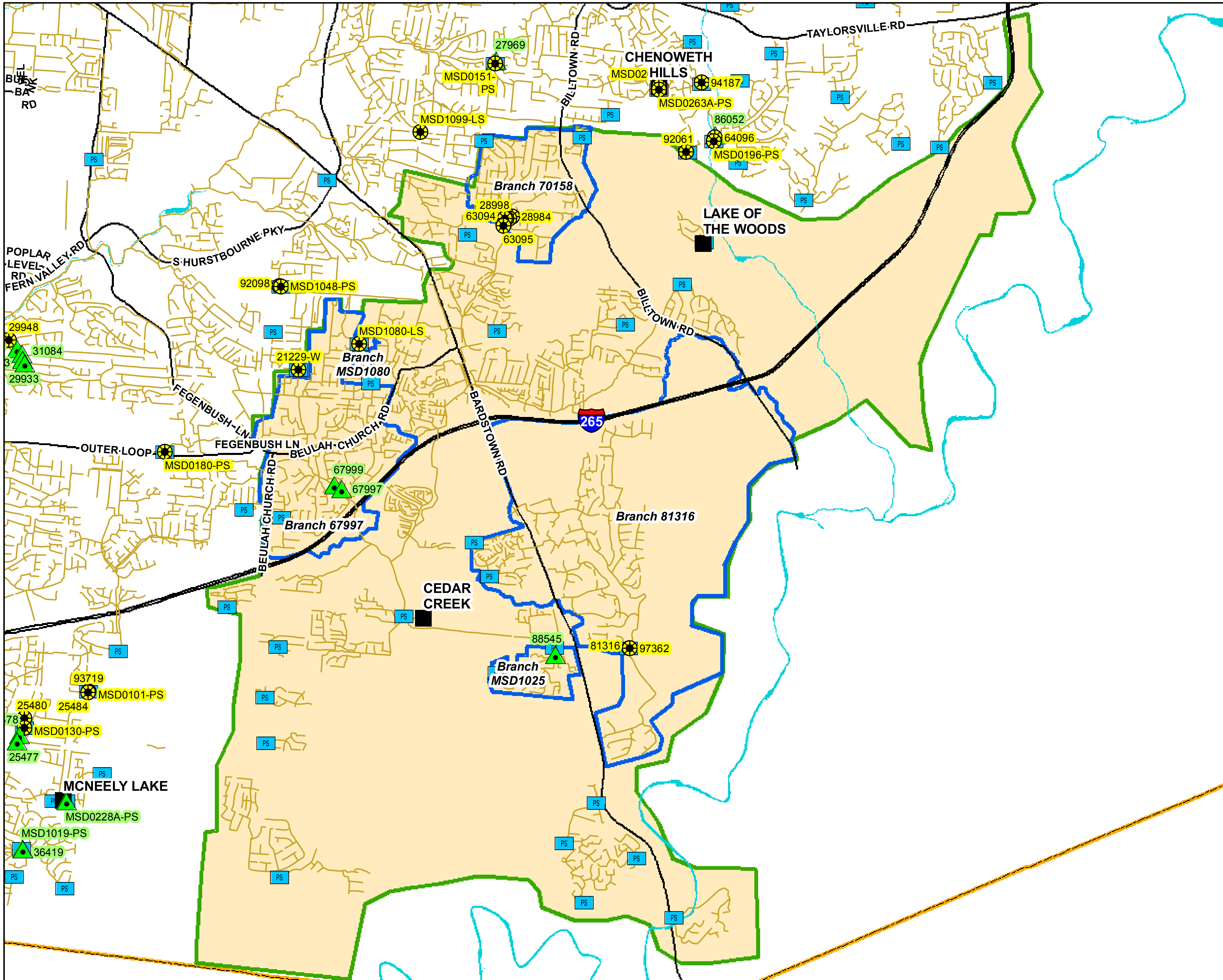
Vol. 3 - Sanitary Sewer Discharge Plan

Cedar Creek Model Area and Branch Network

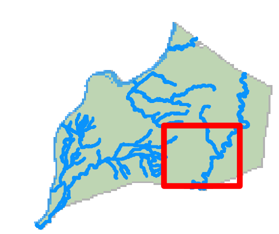
Figure 2.3.2



Legend

- Documented SSO
- Suspected SSO
- Pump Station
- WWTP
- Sewer Lines
- Major Road
- Major Stream
- Credits Catchment Boundary
- CSO Area
- Branch Boundary
- County Boundary

1 inch = 4,000 feet
Scalable when printed on 11" X 17" paper



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CMS Inc. Figure 2.3.2 Cedar_Creek_credit catchment

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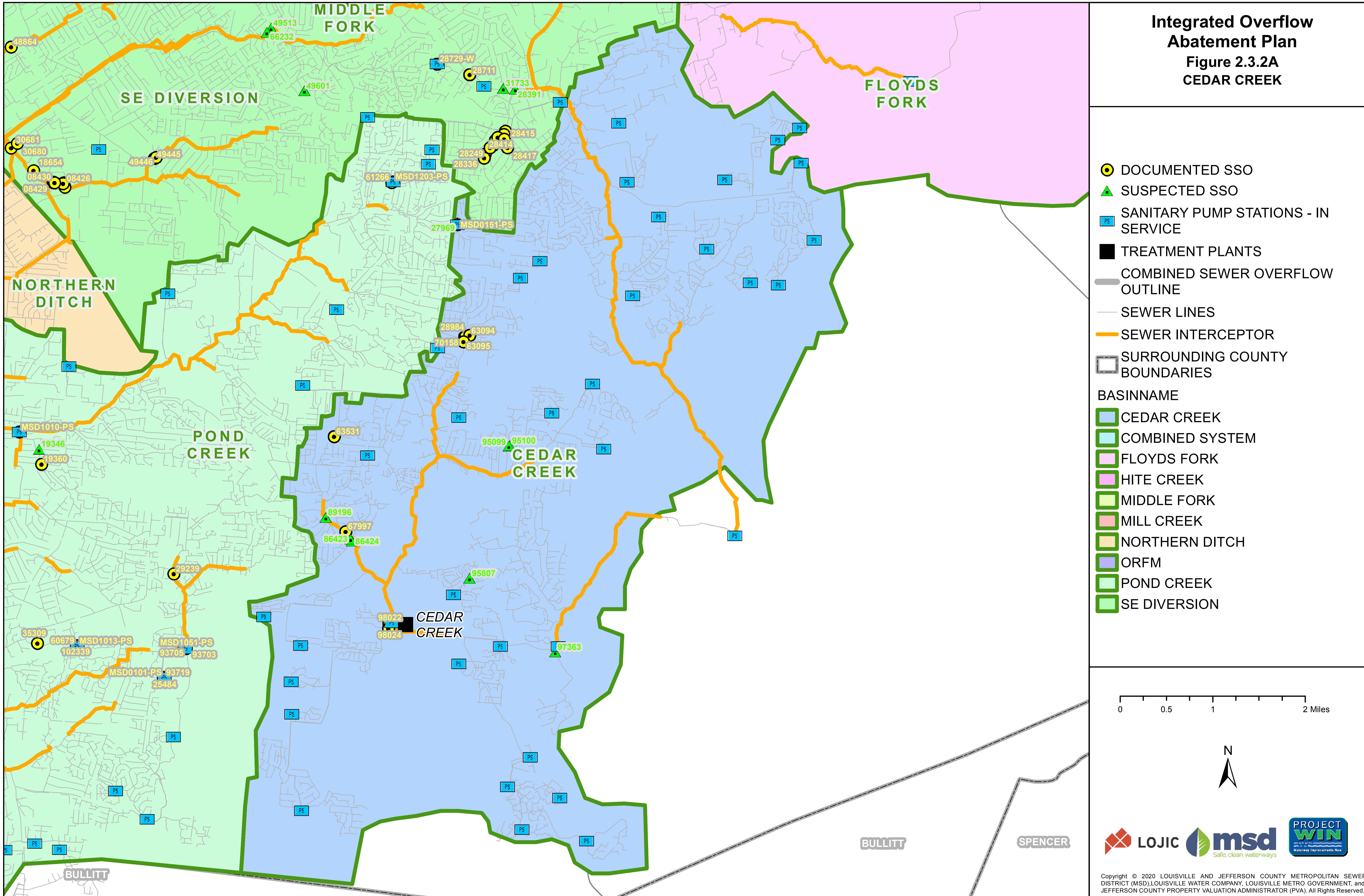
Figure 2.3.2A
CEDAR CREEK



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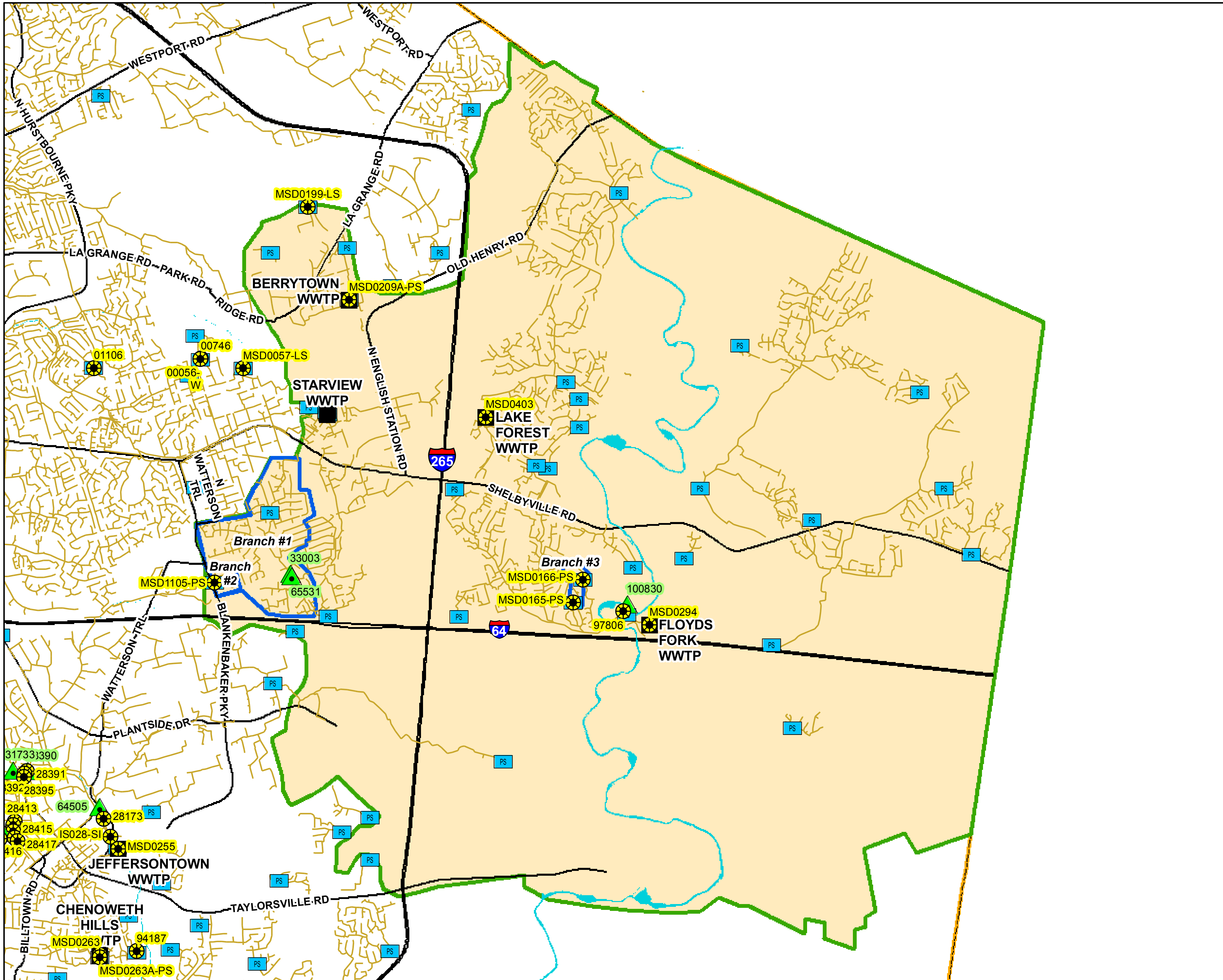
Floyd Fork Model Area and Branch Network

Figure 2.3.3



Legend

- Documented SSO
- Suspected SSO
- Pump Station
- WWTP
- Sewer Lines
- Major Road
- Major Stream
- Credits Catchment Boundary
- CSO Area
- Branch Boundary
- County Boundary

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CMS Inc. Figure 2.3.3 Floyds Fork_credit catchment

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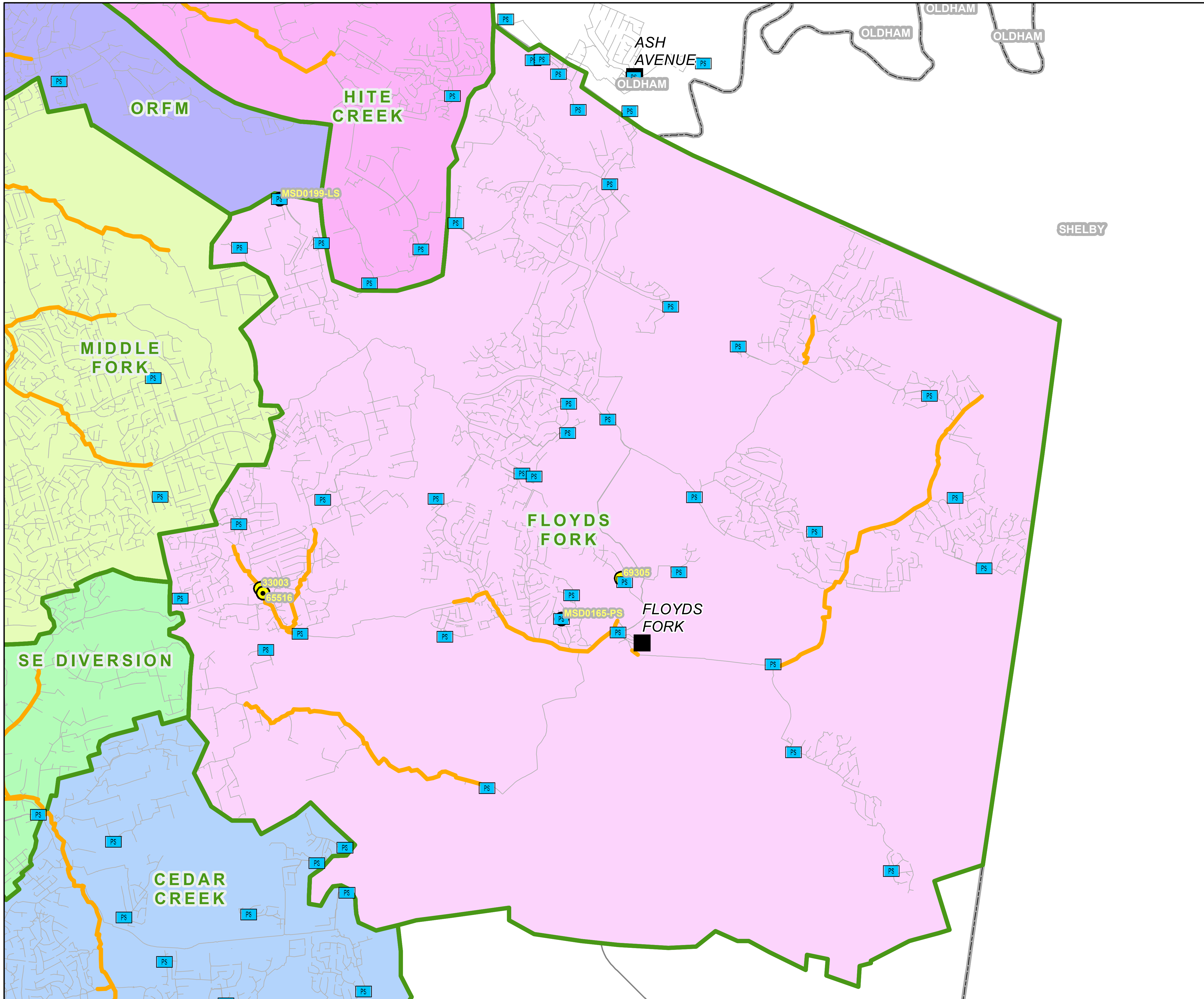

Integrated Overflow Abatement Plan

Figure 2.3.3A

FLOYDS FORK

- DOCUMENTED SSO
- SUSPECTED SSO
- SANITARY PUMP STATIONS - IN SERVICE
- TREATMENT PLANTS
- COMBINED SEWER OVERFLOW OUTLINE
- SEWER LINES
- SEWER INTERCEPTOR
- SURROUNDING COUNTY BOUNDARIES

BASINNAME

- CEDAR CREEK
- COMBINED SYSTEM
- FLOYDS FORK
- HITE CREEK
- MIDDLE FORK
- MILL CREEK
- NORTHERN DITCH
- ORFM
- POND CREEK
- SE DIVERSION

0 0.45 0.9 1.8 Miles

N

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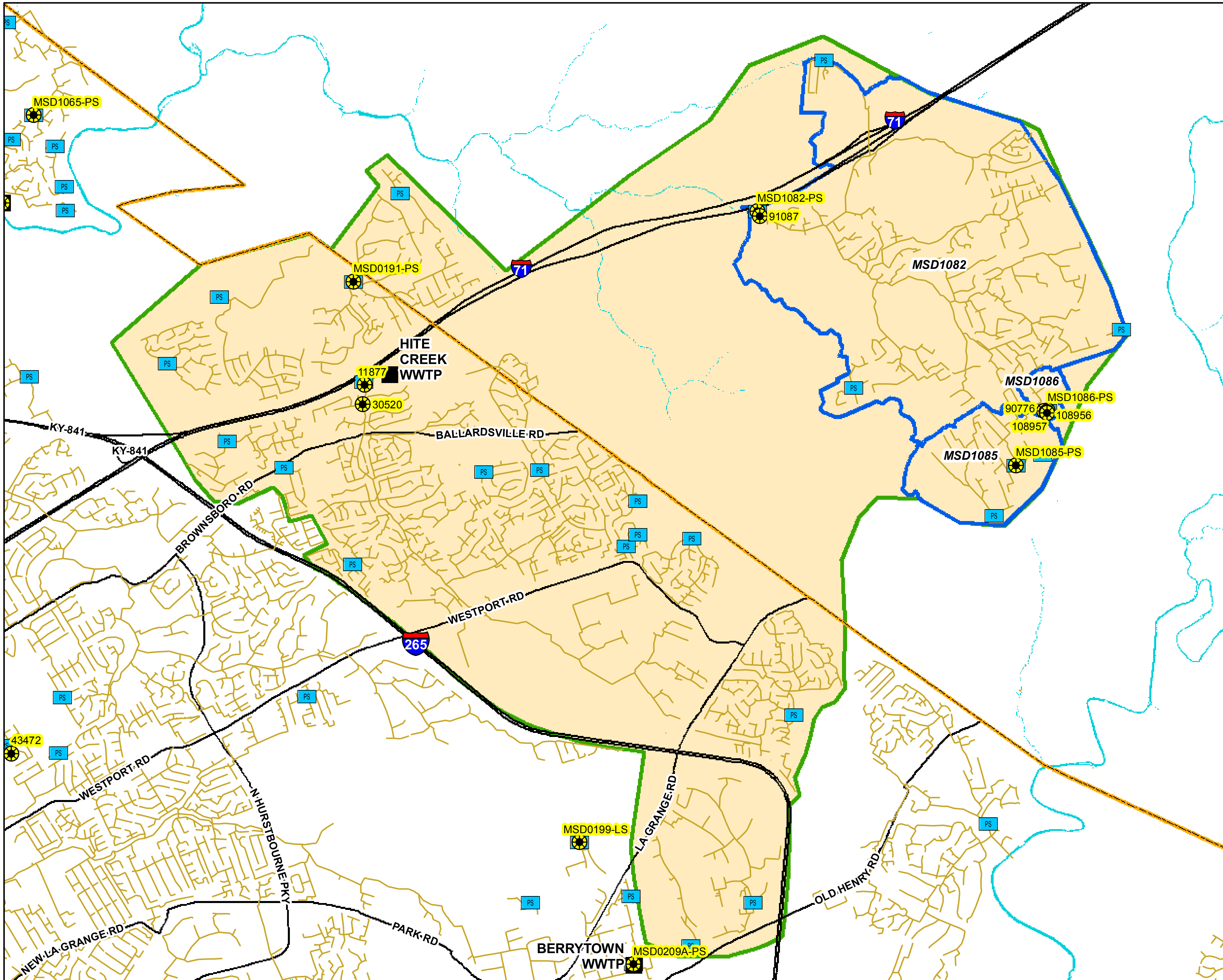
Hite Creek Model Area and Branch Network

Figure 2.3.4



Legend

- Documented SSO
- Suspected SSO
- Pump Station
- WWTP
- Sewer Lines
- Major Road
- Major Stream
- Credits Catchment Boundary
- CSO Area
- Branch Boundary
- County Boundary

1 inch = 3,500 feet
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CMS Inc. Figure 2.3.4 hite_Creek_credit catchment

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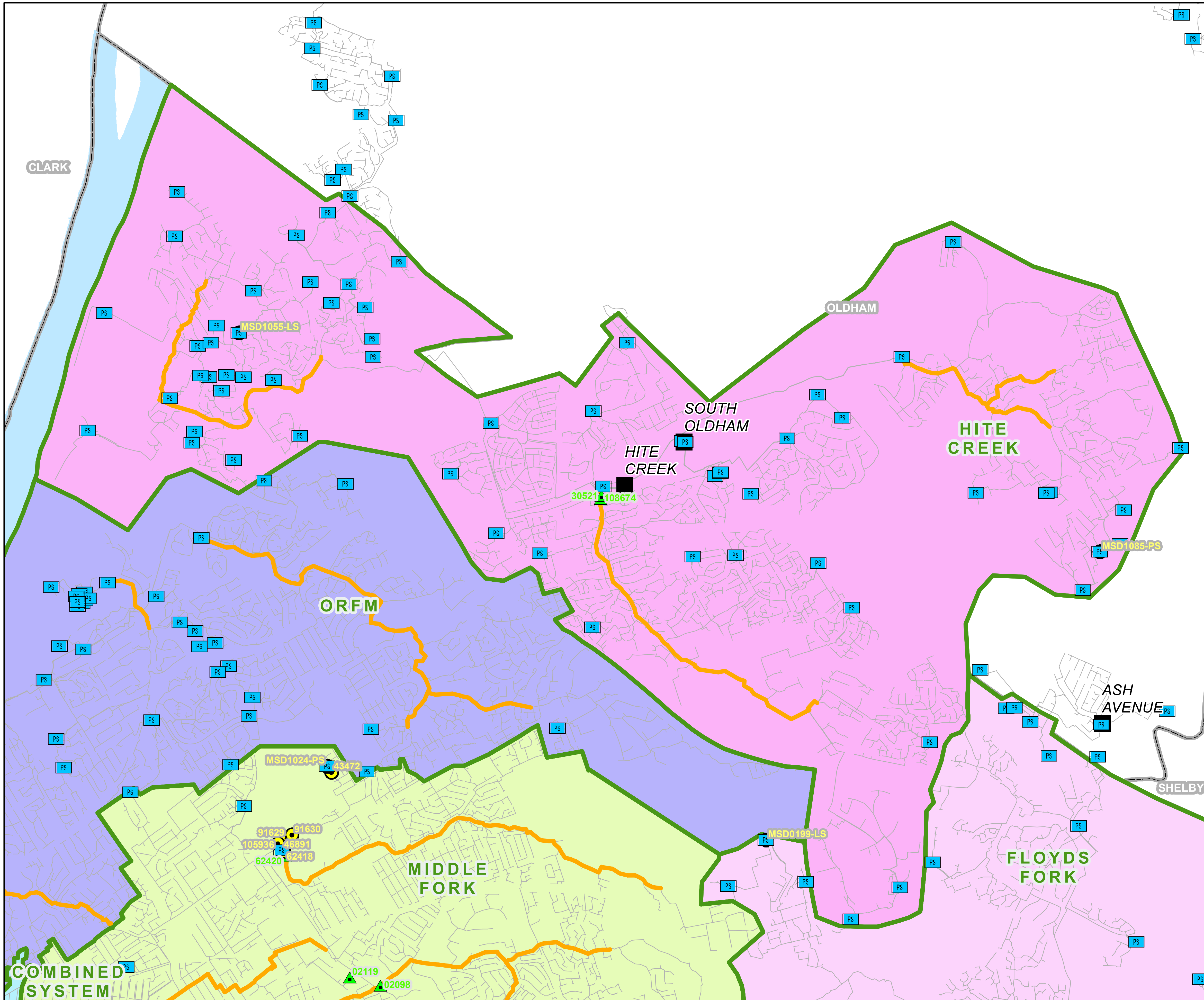
Figure 2.3.4A

HITE CREEK



DOCUMENTED SSO
SUSPECTED SSO
SANITARY PUMP STATIONS - IN SERVICE
TREATMENT PLANTS
COMBINED SEWER OVERFLOW OUTLINE
SEWER LINES
SEWER INTERCEPTOR
SURROUNDING COUNTY BOUNDARIES

BASINNAME
CEDAR CREEK
COMBINED SYSTEM
FLOYDS FORK
HITE CREEK
MIDDLE FORK
MILL CREEK
NORTHERN DITCH
ORFM
POND CREEK
SE DIVERSION

0 0.5 1 2 Miles

N

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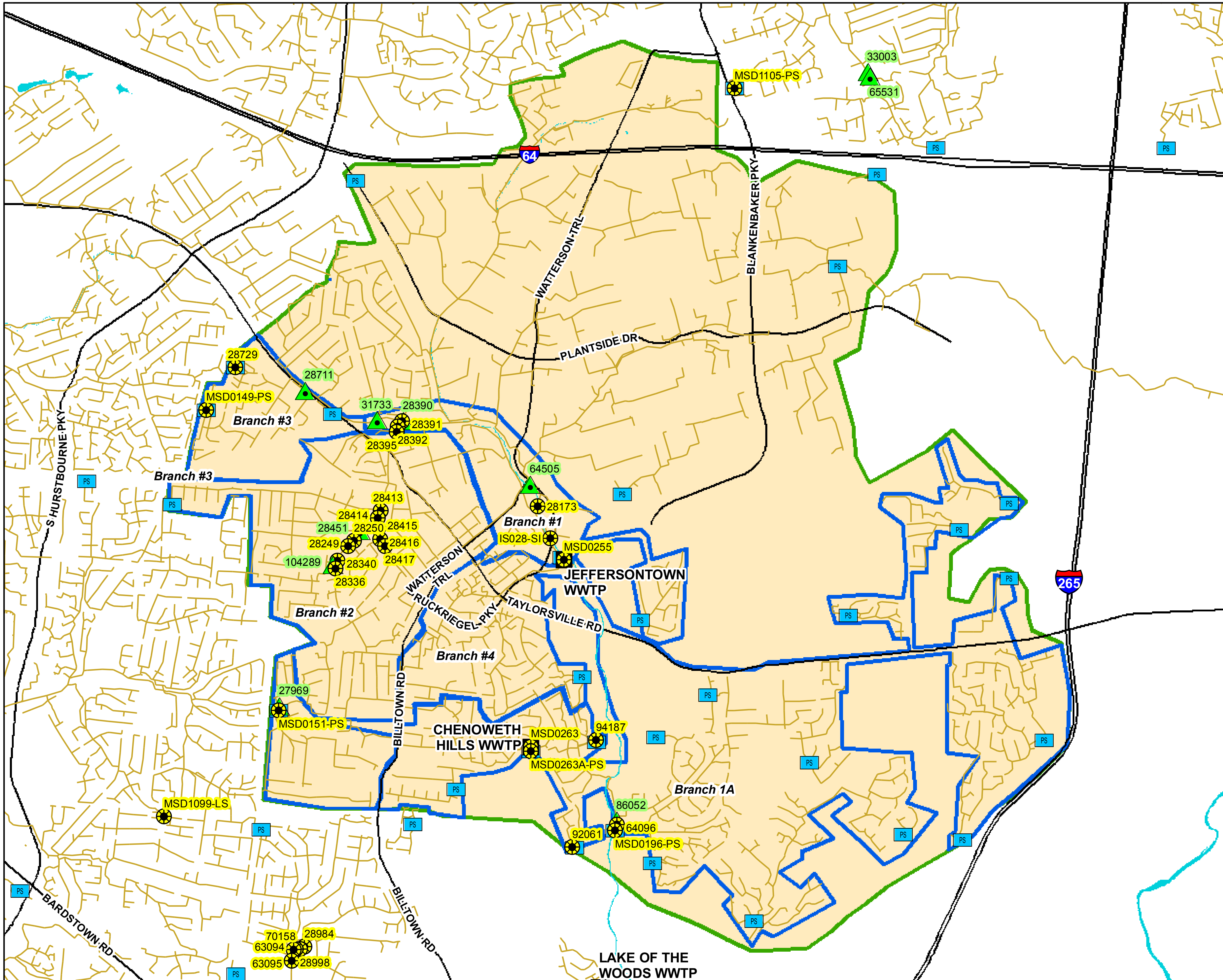

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Vol. 3 - Sanitary Sewer Discharge Plan

Jeffersontown Model Area and Branch Network

Figure 2.3.5

Legend

- Documented SSO
- Suspected SSO
- WWTP
- Pump Station
- Sewer Lines
- Major Road
- Major Stream
- Credits Catchment Boundary
- CSO Area
- Branch Boundary
- County Boundary

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CMS Inc. Figure 2.3.5_jeffersontown_credit catchment

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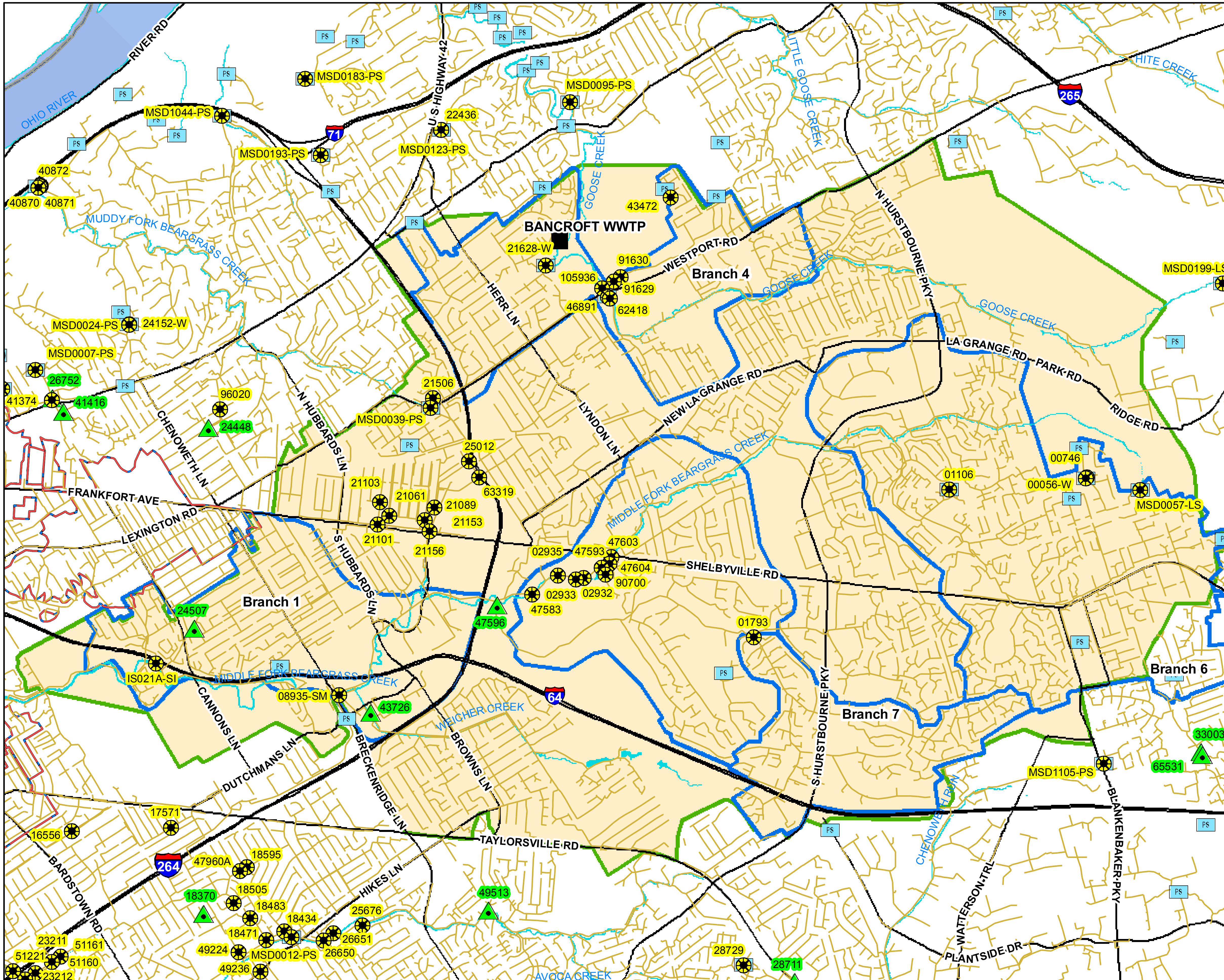
Middle Fork Model Area and Branch Network
Figure 2.3.6



Legend

- Documented SSO
- Suspected SSO
- Pump Station
- Sewer Lines
- Major Road
- Major Stream
- Credits Catchment Boundary
- CSO Area
- Branch Boundary
- County Boundary

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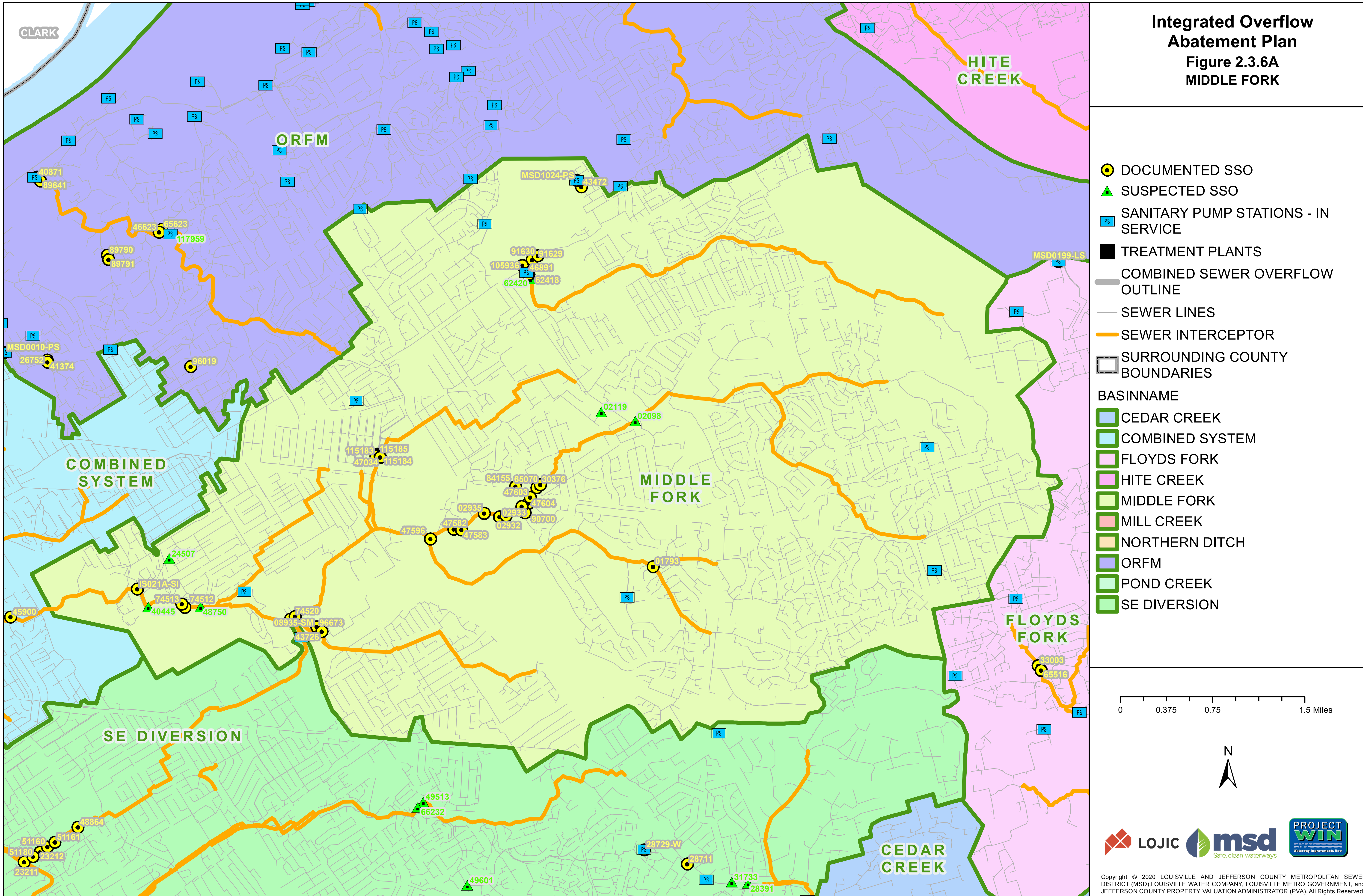
Figure 2.3.6A
MIDDLE FORK



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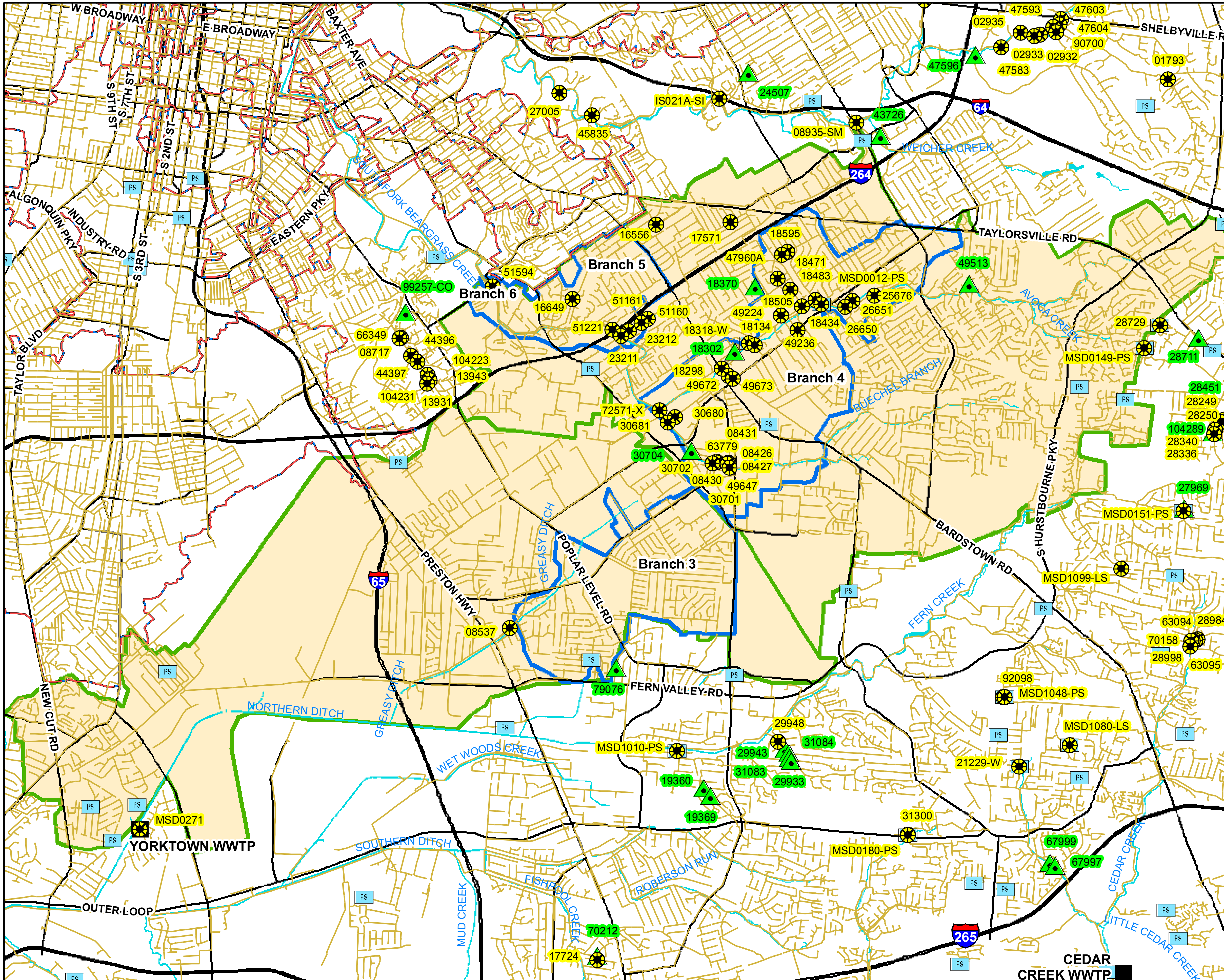
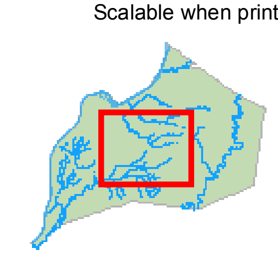
Southeastern Diversion
Model Area and Branch Network
Figure 2.3.7



Legend

- Documented SSO
- Suspected SSO
- Pump Station
- Sewer Lines
- Major Road
- Major Stream
- Credits Catchment Boundary
- CSO Area
- Branch Boundary
- County Boundary

1 inch equals 4,800 feet
Scalable when printed on 11" X 17" paper



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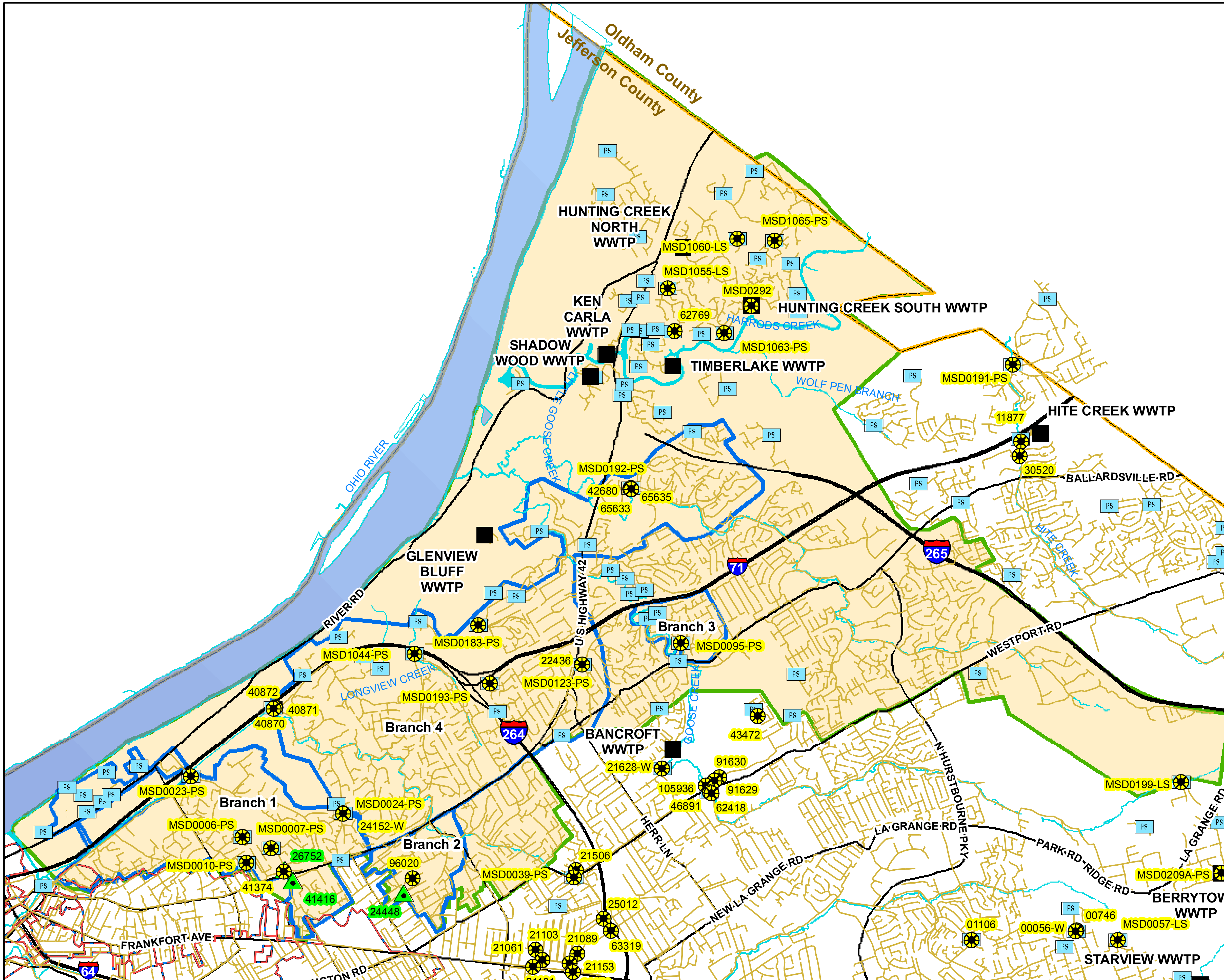
ORFM Model Area and Branch Network
Figure 2.3.8



Legend

- Documented SSO
- Suspected SSO
- Pump Station
- Sewer Lines
- Major Road
- Major Stream
- Credits Catchment Boundary
- CSO Area
- Branch Boundary
- County Boundary

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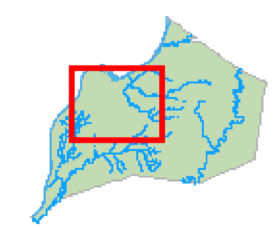
CSS Model Area and Branch Network
Figure 2.3.9

Legend

- Documented SSO
- Suspected SSO
- Pump Station
- Sewer Lines
- Major Road
- Major Stream
- Credits Catchment Boundary
- CSO Area
- Branch Boundary
- County Boundary

1 inch equals 4,800 feet
Scalable when printed on 11" X 17" paper



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Pond Creek Model Area and Branch Network

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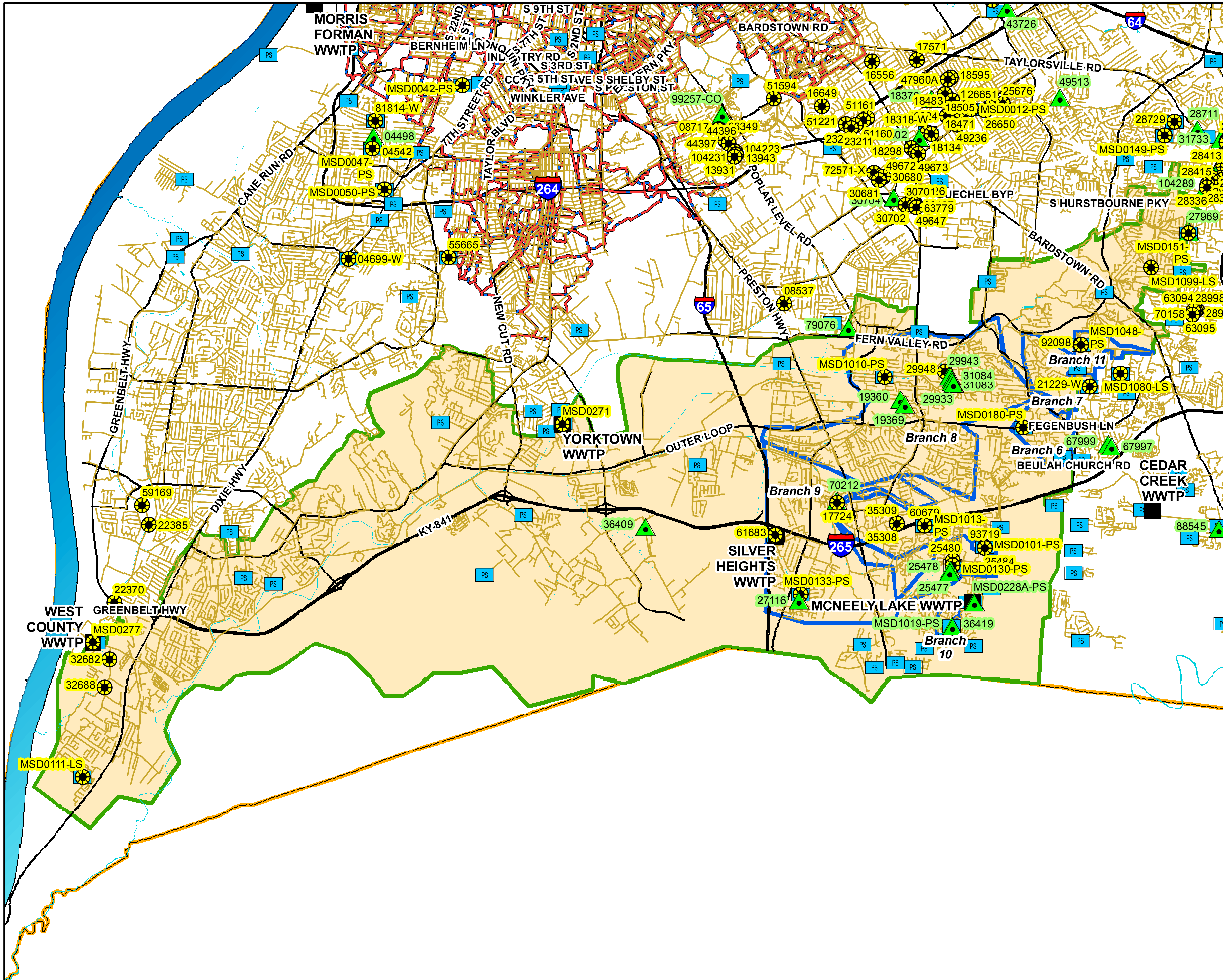

Legend

- Documented SSO
- Suspected SSO
- Pump Station
- WWTP
- Sewer Lines
- Major Road
- Major Stream
- Credits Catchment Boundary
- CSO Area
- Branch Boundary
- County Boundary

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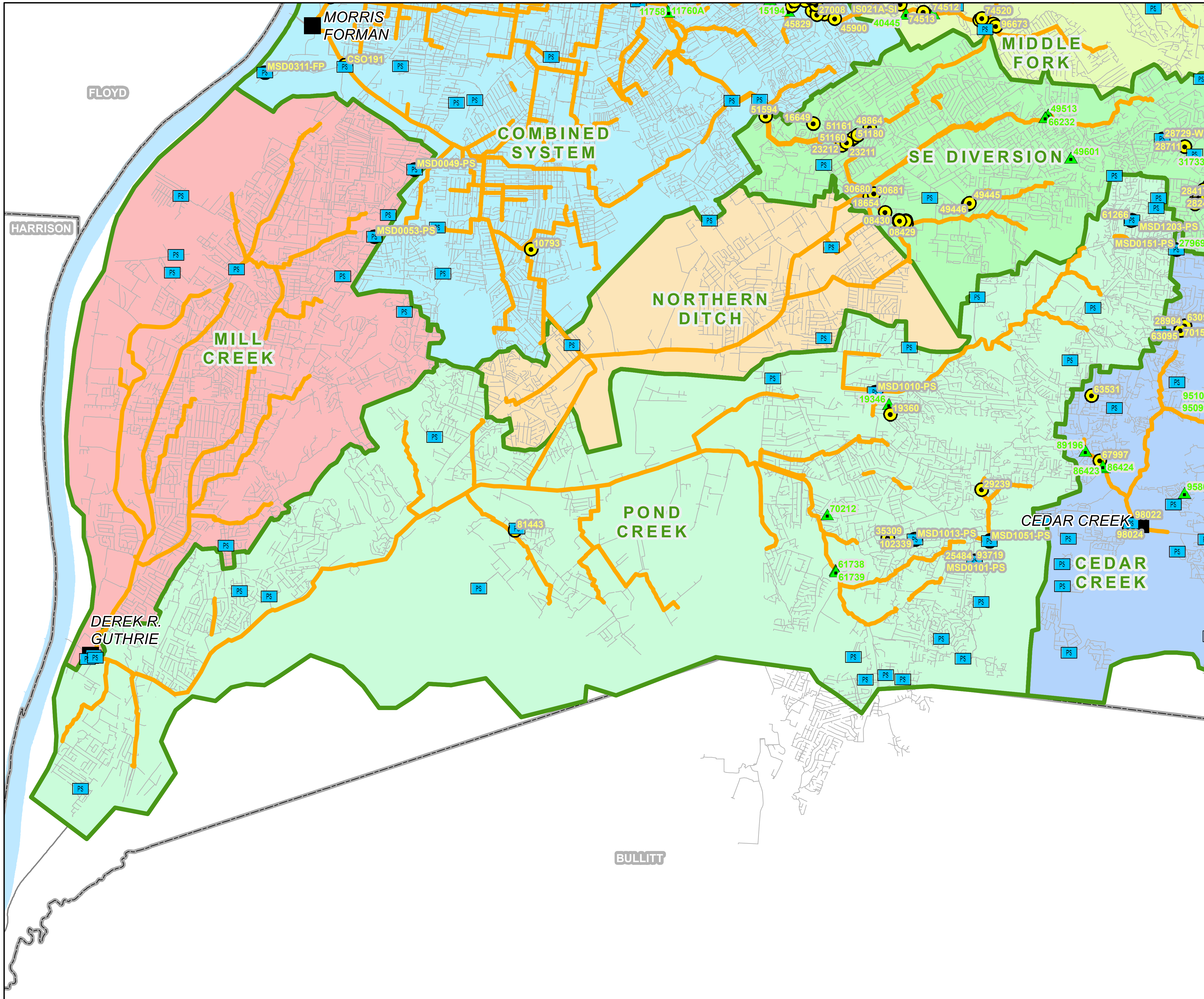
Figure 2.3.10A

POND CREEK



- DOCUMENTED SSO
- SUSPECTED SSO
- SANITARY PUMP STATIONS - IN SERVICE
- TREATMENT PLANTS
- COMBINED SEWER OVERFLOW OUTLINE
- SEWER LINES
- SEWER INTERCEPTOR
- SURROUNDING COUNTY BOUNDARIES

BASINNAME

- CEDAR CREEK
- COMBINED SYSTEM
- FLOYDS FORK
- HITE CREEK
- MIDDLE FORK
- MILL CREEK
- NORTHERN DITCH
- ORFM
- POND CREEK
- SE DIVERSION

0 0.75 1.5 3 Miles

N

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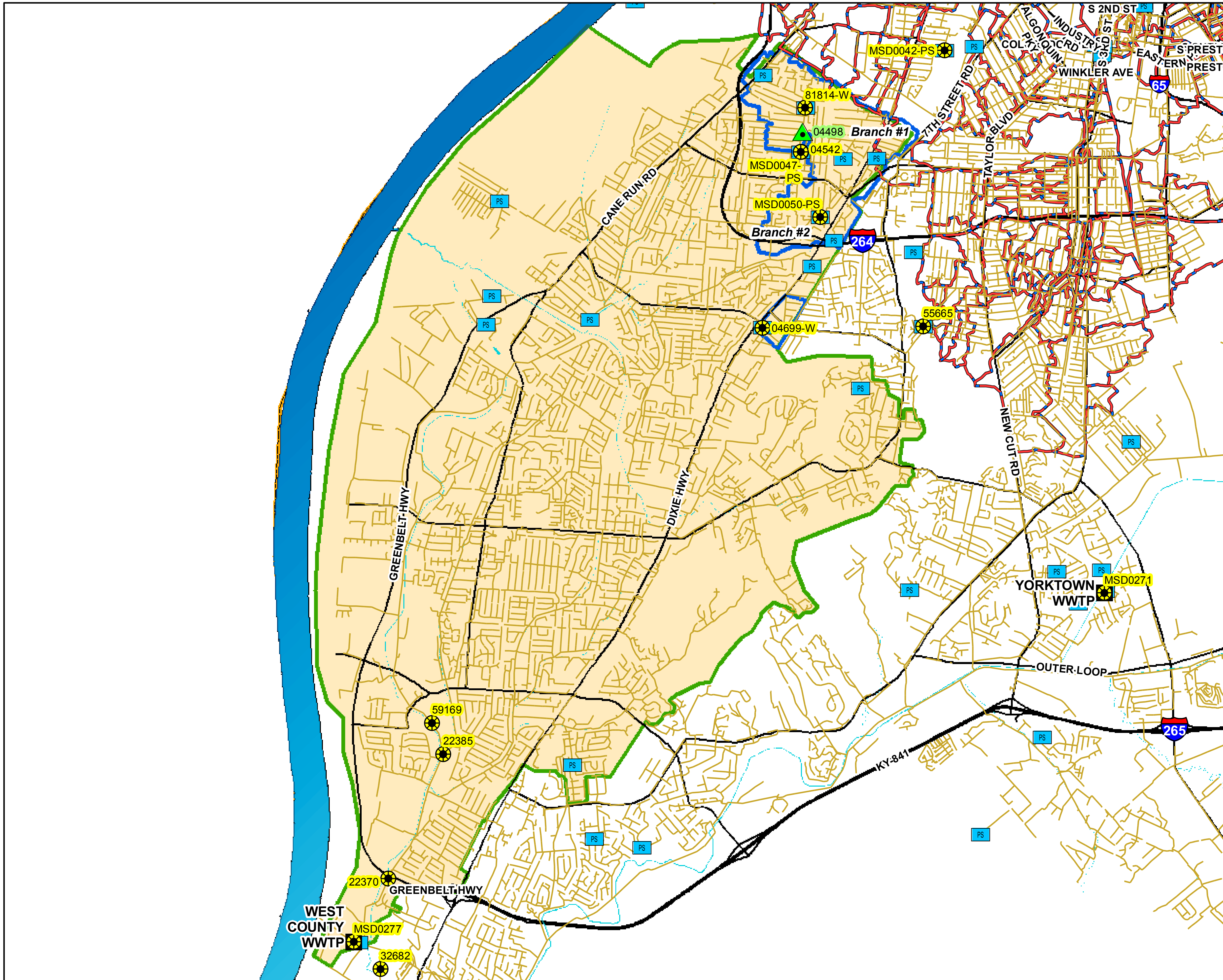

Integrated Overflow Abatement Plan

Vol. 3 - Sanitary Sewer Discharge Plan

Mill Creek Model Area and Branch Network

Figure 2.3.11

Legend

- Documented SSO
- Suspected SSO
- Pump Station
- WWTP
- Sewer Lines
- Major Road
- Major Stream
- Credits Catchment Boundary
- CSO Area
- Branch Boundary
- County Boundary

1 inch = 5,000 feet
Scalable when printed on 11" X 17" paper

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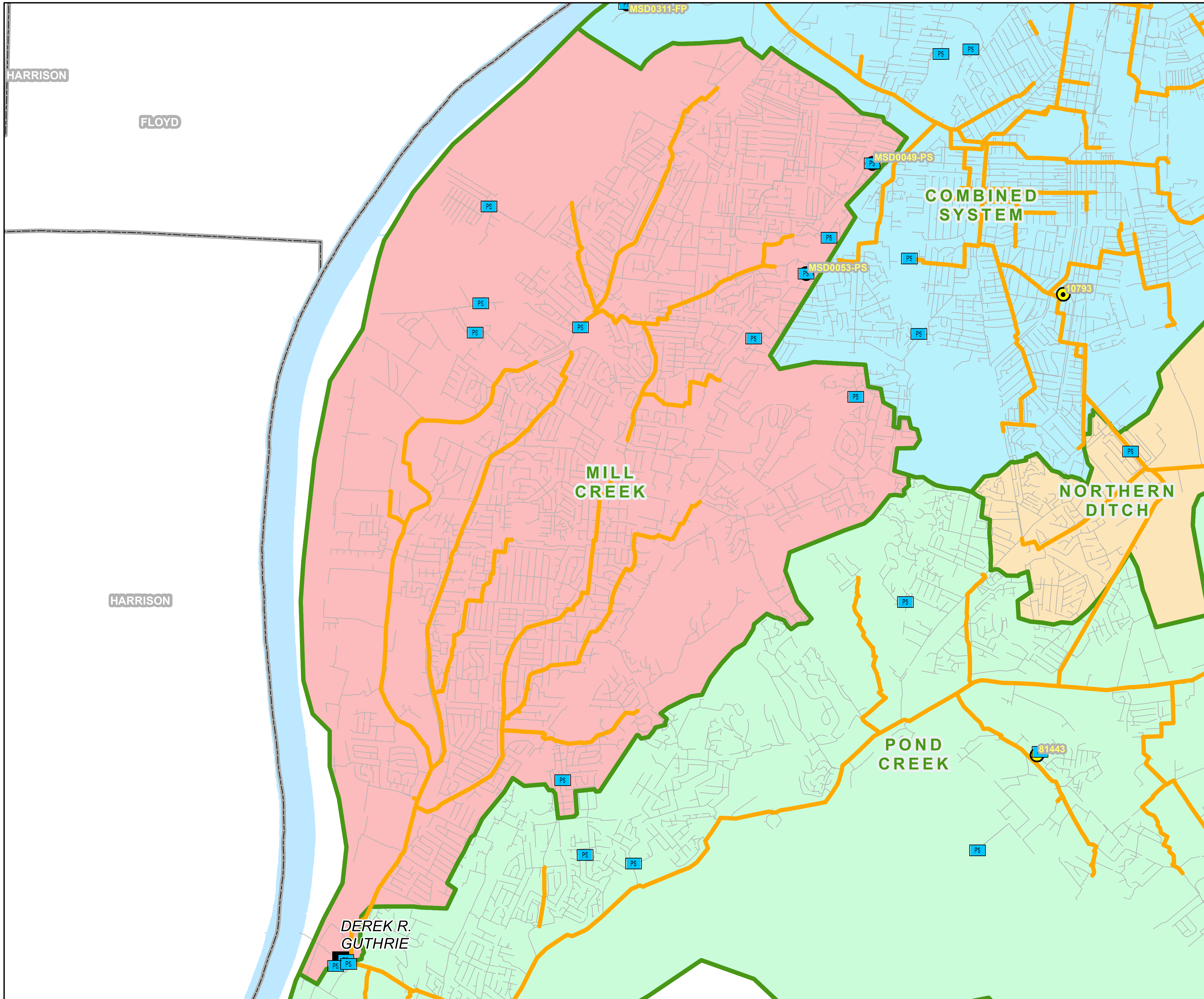
Figure 2.3.11A

MILL CREEK



DOCUMENTED SSO
SUSPECTED SSO
SANITARY PUMP STATIONS - IN SERVICE
TREATMENT PLANTS
COMBINED SEWER OVERFLOW OUTLINE
SEWER LINES
SEWER INTERCEPTOR
SURROUNDING COUNTY BOUNDARIES

BASINNAME
CEDAR CREEK
COMBINED SYSTEM
FLOYDS FORK
HITE CREEK
MIDDLE FORK
MILL CREEK
NORTHERN DITCH
ORFM
POND CREEK
SE DIVERSION

0 0.5 1 2 Miles

N

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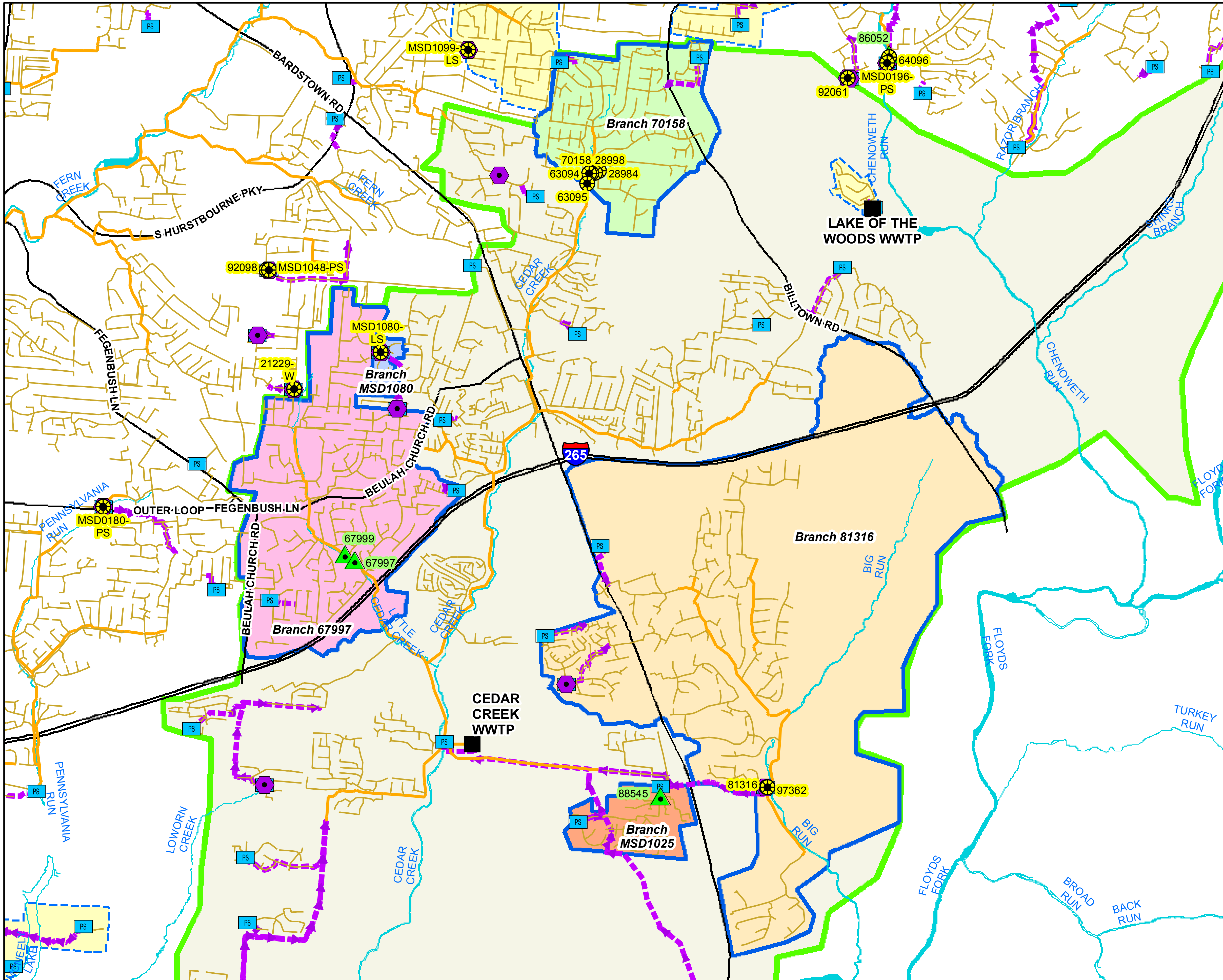
Cedar Creek Sewershed
Branch Network
Figure 2.5.3



Legend

- Documented SSO
- Suspected SSO
- Haul Operation
- WWTP
- Pump Station
- Force Main
- Collector < 12 "
- Interceptor =>12"
- Major Road
- Streams
- CSO Area
- Small WWTP Service Area
- Large WWTP Service Area
- Branch 67997
- Branch 70158
- Branch 81316
- Branch MSD1080
- Branch MSD1025
- County Boundary

1 inch = 2,800 feet
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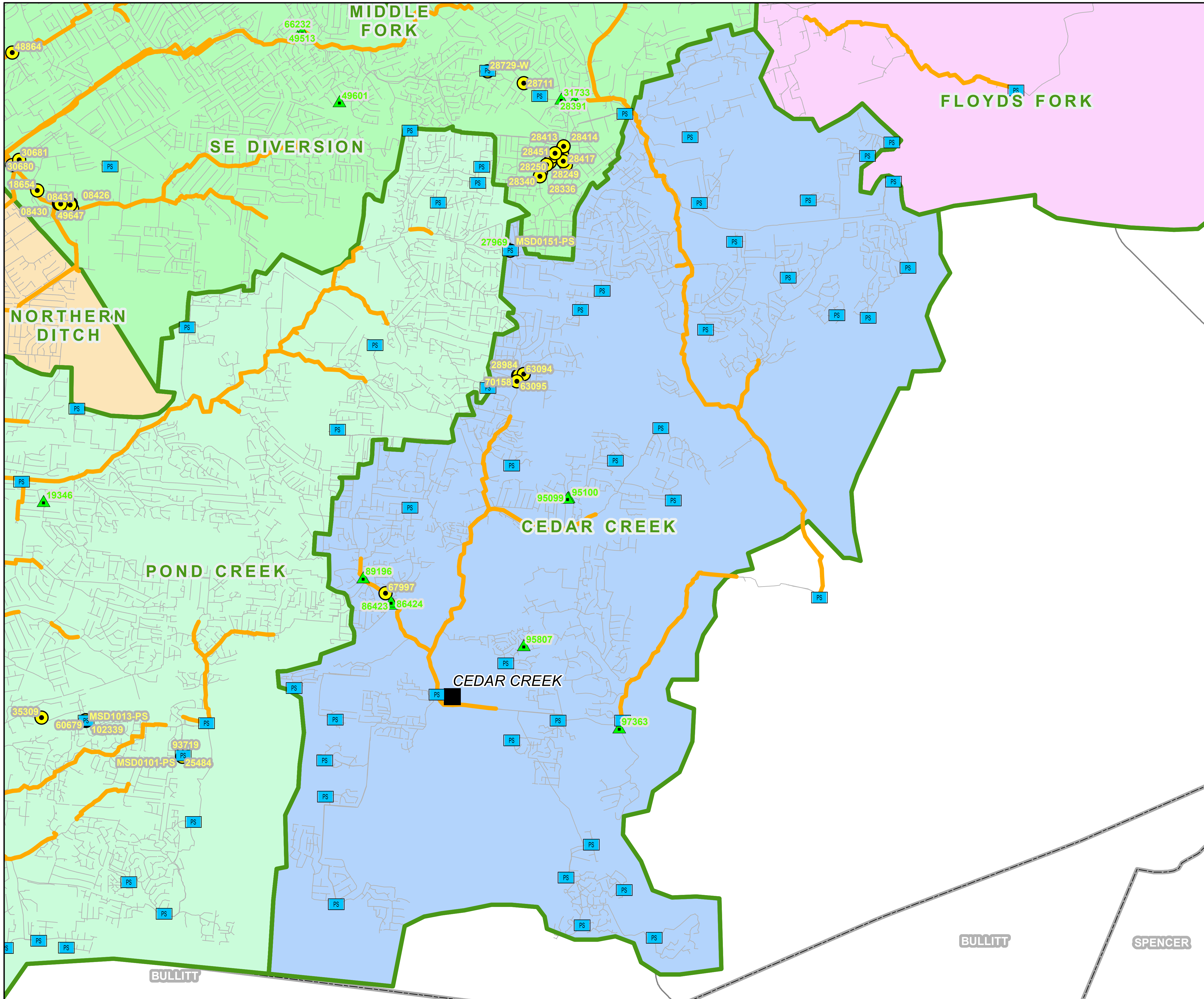
Figure 2.5.3A

CEDAR CREEK



- DOCUMENTED SSO
- SUSPECTED SSO
- SANITARY PUMP STATIONS - IN SERVICE
- TREATMENT PLANTS
- COMBINED SEWER OVERFLOW OUTLINE
- SEWER LINES
- SEWER INTERCEPTOR
- SURROUNDING COUNTY BOUNDARIES

BASINNAME

- CEDAR CREEK
- COMBINED SYSTEM
- FLOYDS FORK
- HITE CREEK
- MIDDLE FORK
- MILL CREEK
- NORTHERN DITCH
- ORFM
- POND CREEK
- SE DIVERSION

0 0.5 1 2 Miles

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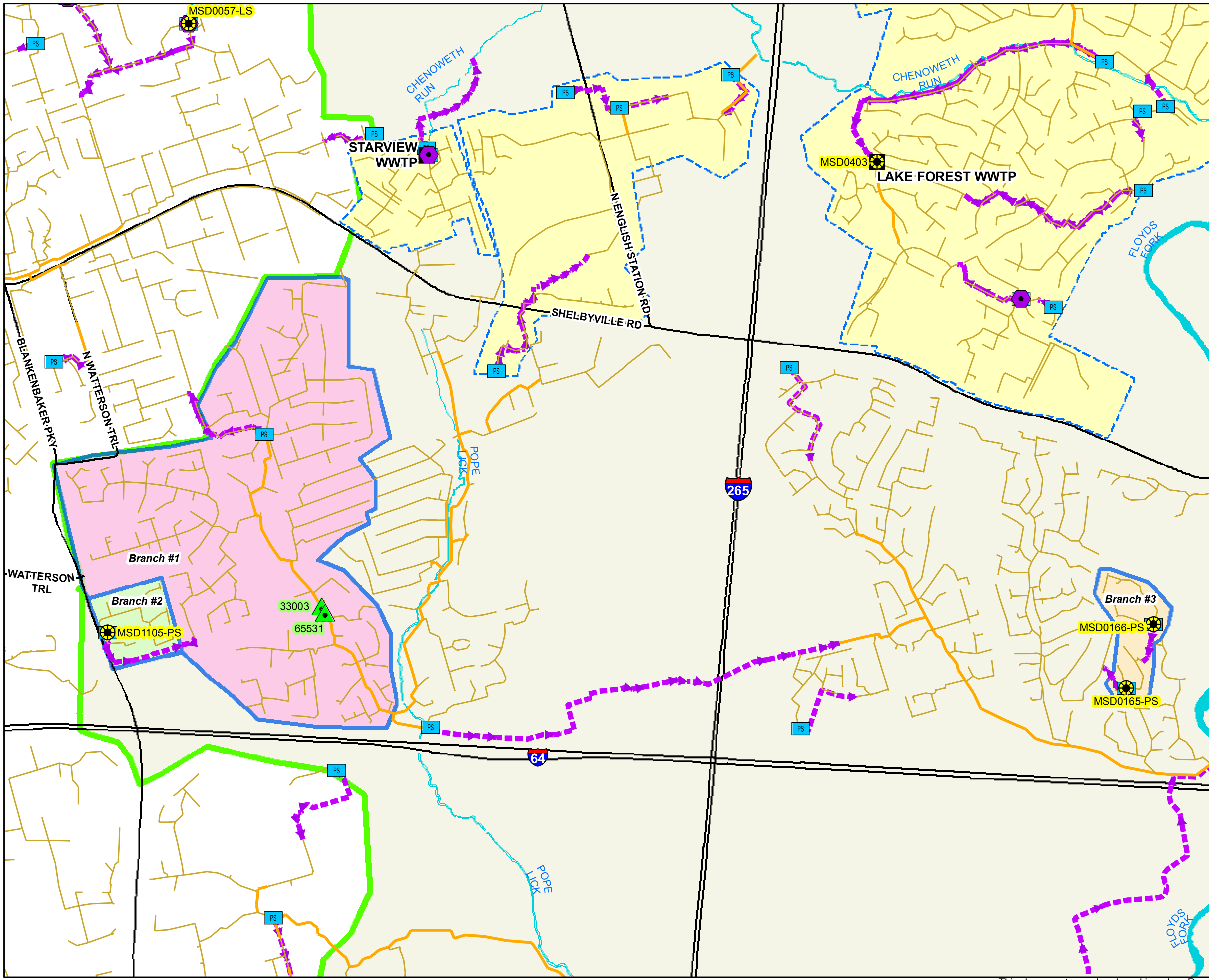
Vol. 3 Sanitary Sewer Discharge Plan

Floyds Fork Sewershed
Branch Network
Figure 2.5.4



Legend

- Documented SSO
- Suspected SSO
- Haul Operation
- WWTP
- Pump Station
- Force Main
- Collector < 12 "
- Interceptor =>12"
- Major Road
- Streams
- CSO Area
- Small WWTP Service Area
- Large WWTP Service Area
- Branch #1
- Branch #2
- Branch #3
- County Boundary

1 inch = 1,600 feet
Scalable when printed on 11" X 17" paper

Some boundaries are uniquely symbolized within the map.

Map Revision
May 07, 2009

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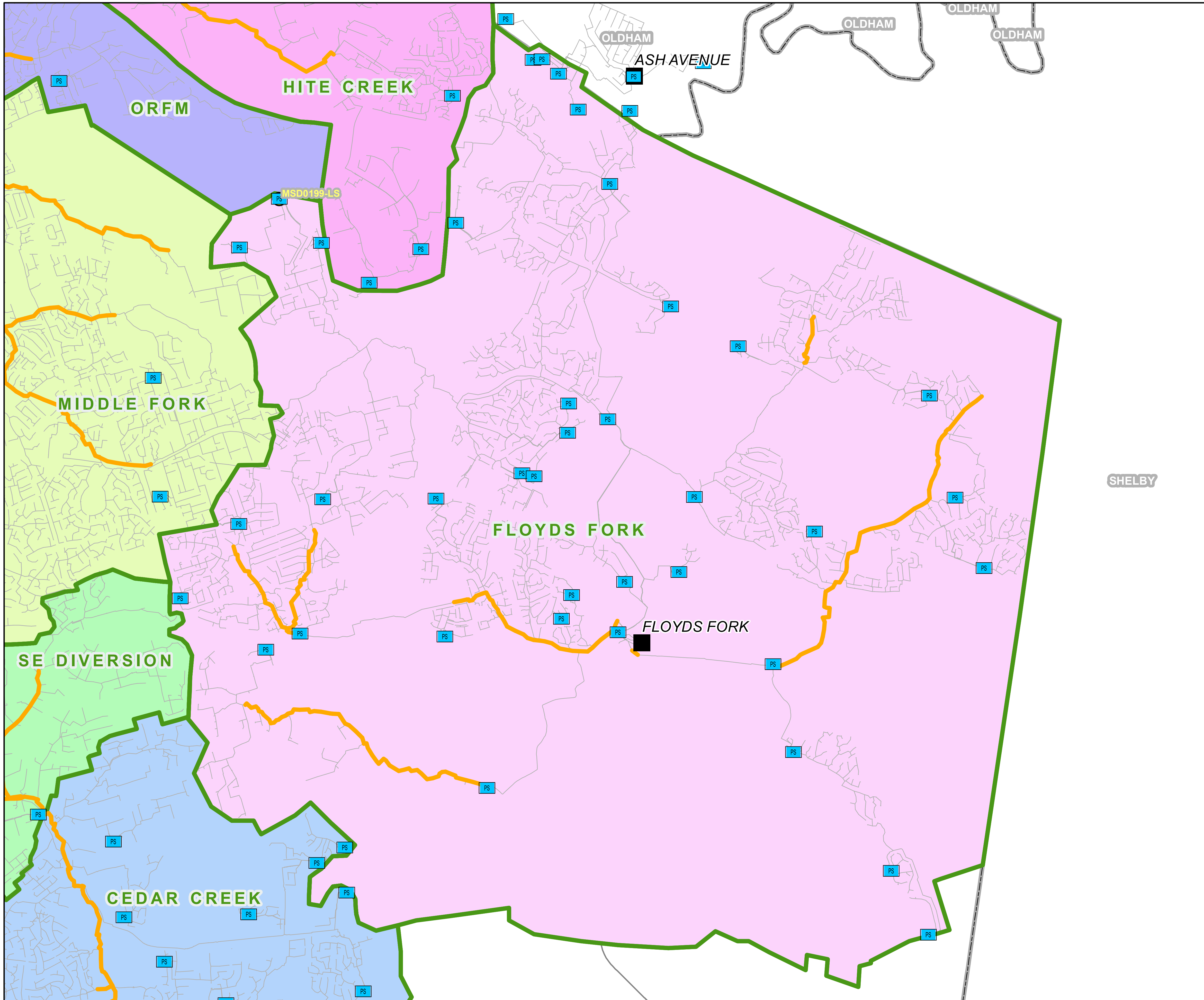
Integrated Overflow Abatement Plan

Figure 2.5.4A

FLOYDS FORK



- DOCUMENTED SSO
- SUSPECTED SSO
- SANITARY PUMP STATIONS - IN SERVICE
- TREATMENT PLANTS
- COMBINED SEWER OVERFLOW OUTLINE
- SEWER LINES
- SEWER INTERCEPTOR
- SURROUNDING COUNTY BOUNDARIES

BASINNAME

- CEDAR CREEK
- COMBINED SYSTEM
- FLOYDS FORK
- HITE CREEK
- MIDDLE FORK
- MILL CREEK
- NORTHERN DITCH
- ORFM
- POND CREEK
- SE DIVERSION

0 0.45 0.9 1.8 Miles

N

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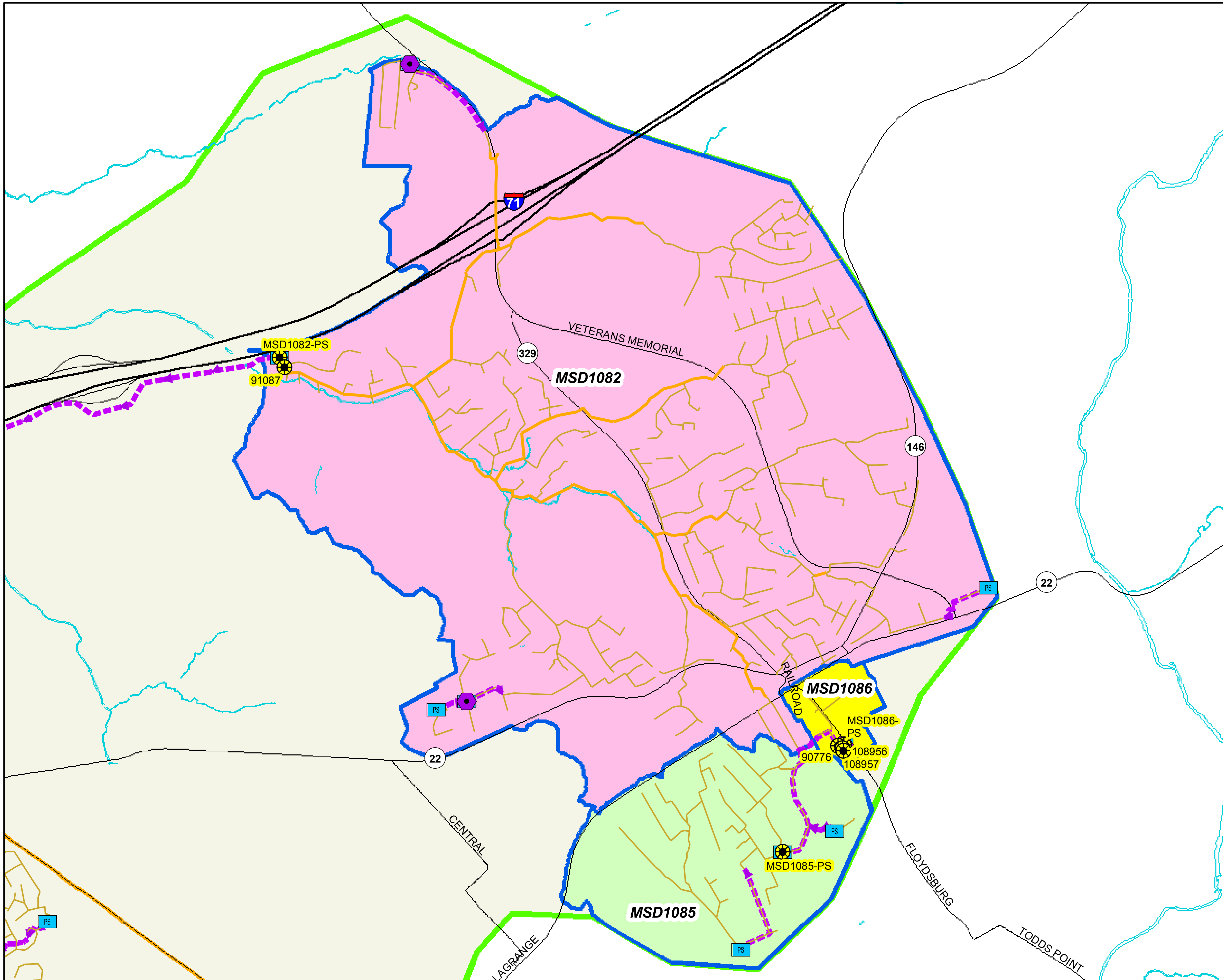
Vol. 3 Sanitary Sewer Discharge Plan

Hite Creek Sewershed
Branch Network
Figure 2.5.5



Legend

- Documented SSO
- Suspected SSO
- Haul Operation
- WWTP
- Pump Station
- Force Main
- Collector < 12 "
- Interceptor =>12"
- Major Road
- Streams
- CSO Area
- Small WWTP Service Area
- Large WWTP Service Area
- Branch MSD1085
- Branch MSD1086
- Branch MSD1082
- County Boundary

1 inch = 1,800 feet
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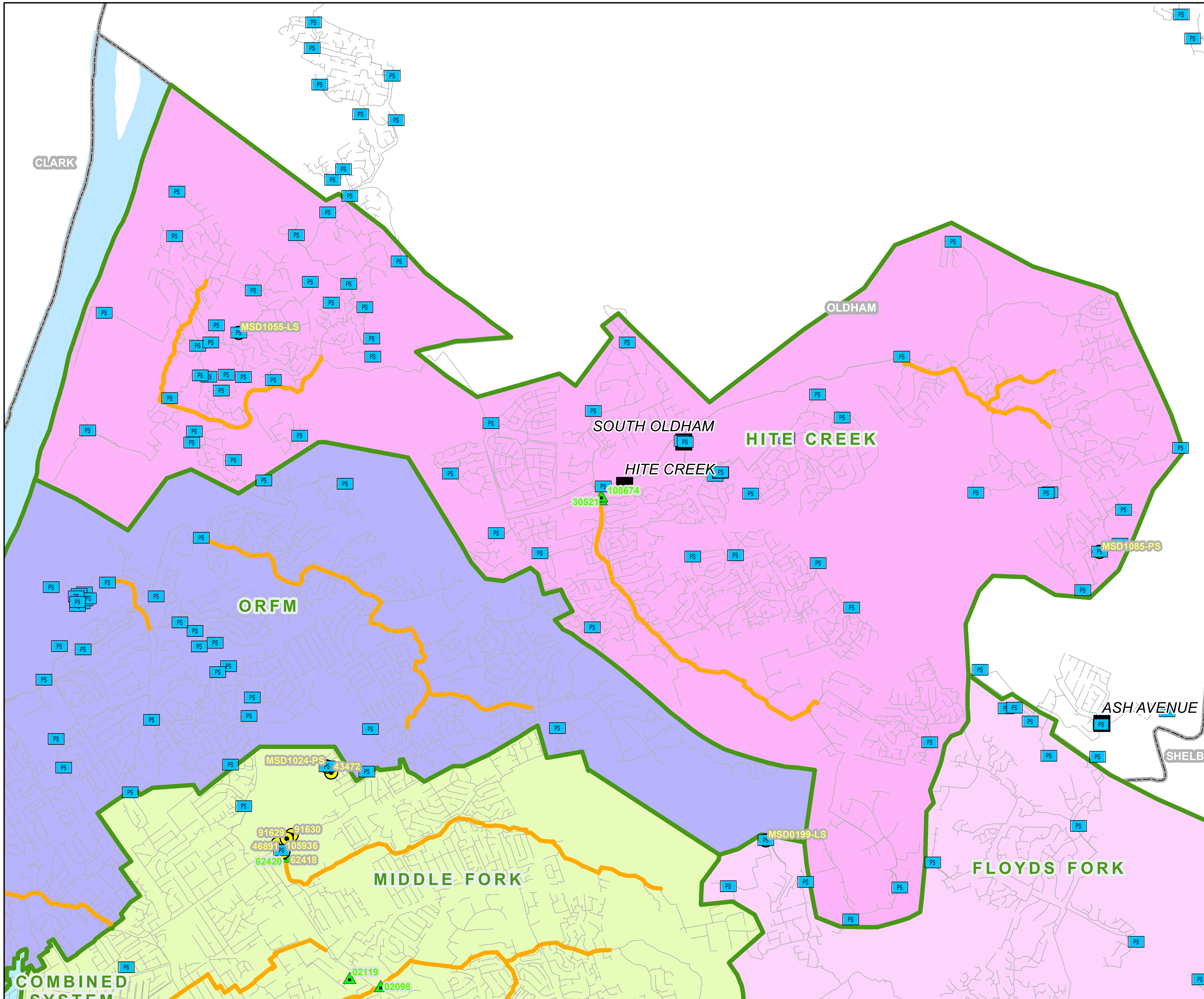
Figure 2.5.5A

HITE CREEK



- DOCUMENTED SSO
- SUSPECTED SSO
- SANITARY PUMP STATIONS - IN SERVICE
- TREATMENT PLANTS
- COMBINED SEWER OVERFLOW OUTLINE
- SEWER LINES
- SEWER INTERCEPTOR
- SURROUNDING COUNTY BOUNDARIES

BASINNAME

- CEDAR CREEK
- COMBINED SYSTEM
- FLOYDS FORK
- HITE CREEK
- MIDDLE FORK
- MILL CREEK
- NORTHERN DITCH
- ORFM
- POND CREEK
- SE DIVERSION

0 0.5 1 2 Miles

N

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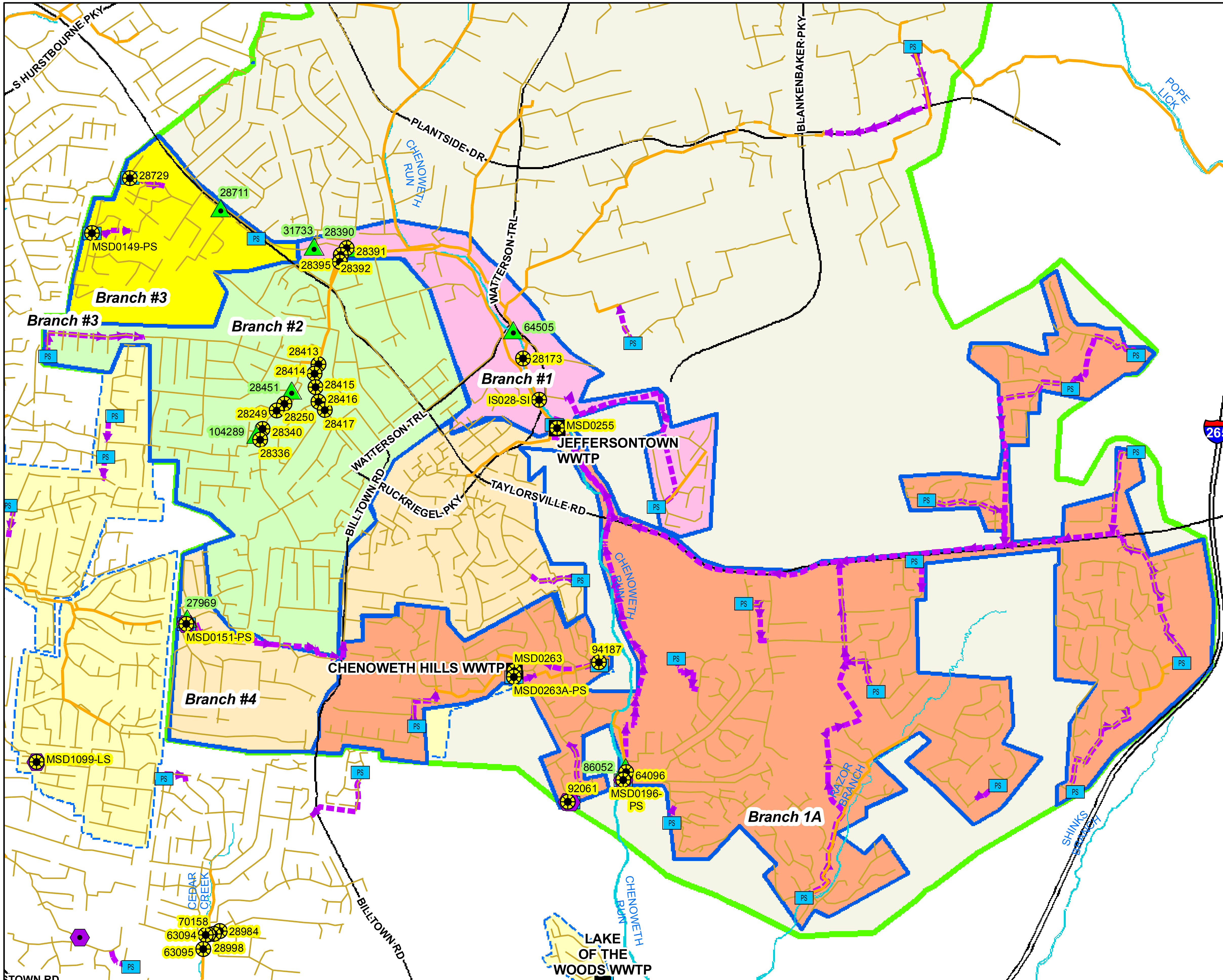
Vol. 3 Sanitary Sewer Discharge Plan

Jeffersontown Sewershed
Branch Network
Figure 2.5.6



Legend

- Documented SSO
- Suspected SSO
- Haul Operation
- WWTP
- Pump Station
- Force Main
- Collector < 12 "
- Interceptor =>12"
- Major Road
- Streams
- CSO Area
- Small WWTP Service Area
- Large WWTP Service Area
- Branch #1
- Branch #2
- Branch #3
- Branch #4
- Branch 1A
- County Boundary

1 inch = 2,000 feet
Scalable when printed on 11" X 17" paper

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CMS Inc. Figure 2.5.6 Jeffersontown_Branch_11x17_size.mxd

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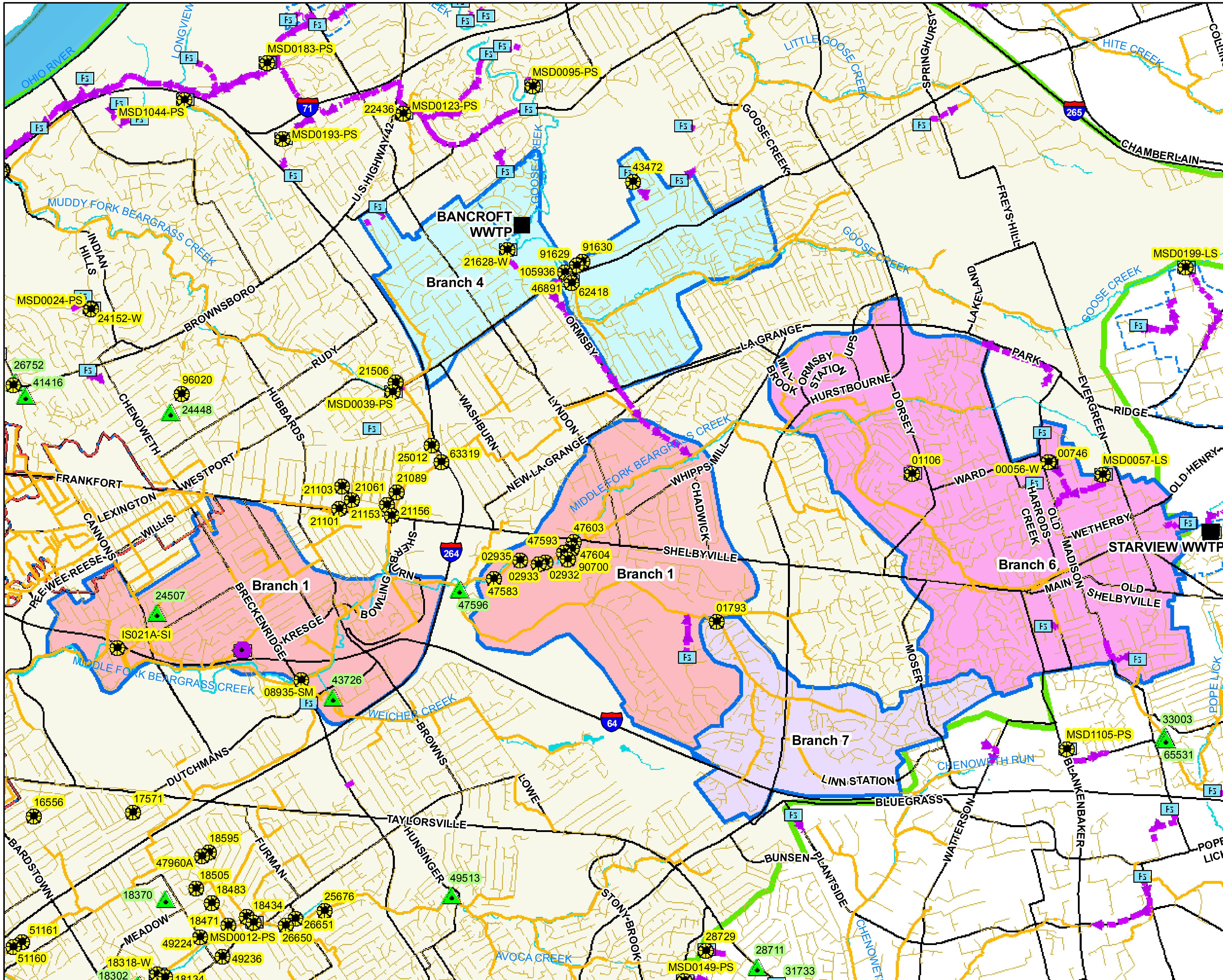


Integrated Overflow Abatement Plan

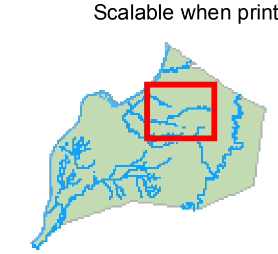
Vol. 3 - Sanitary Sewer Discharge Plan

Morris Forman Sewershed
Middle Fork
Branch Network
Figure 2.5.7

Legend

- Documented SSO
- Suspected SSO
- Haul Operation
- WWTP
- Pump Station
- Force Main
- Collector < 12 "
- Interceptor =>12"
- Streams
- Interstates
- Small WWTP Service Area
- Large WWTP Service Area
- CSO Area
- Branch 1
- Branch 4
- Branch 6
- Branch 7
- County Boundary

1 inch equals 3,600 feet
Scalable when printed on 11" X 17" paper



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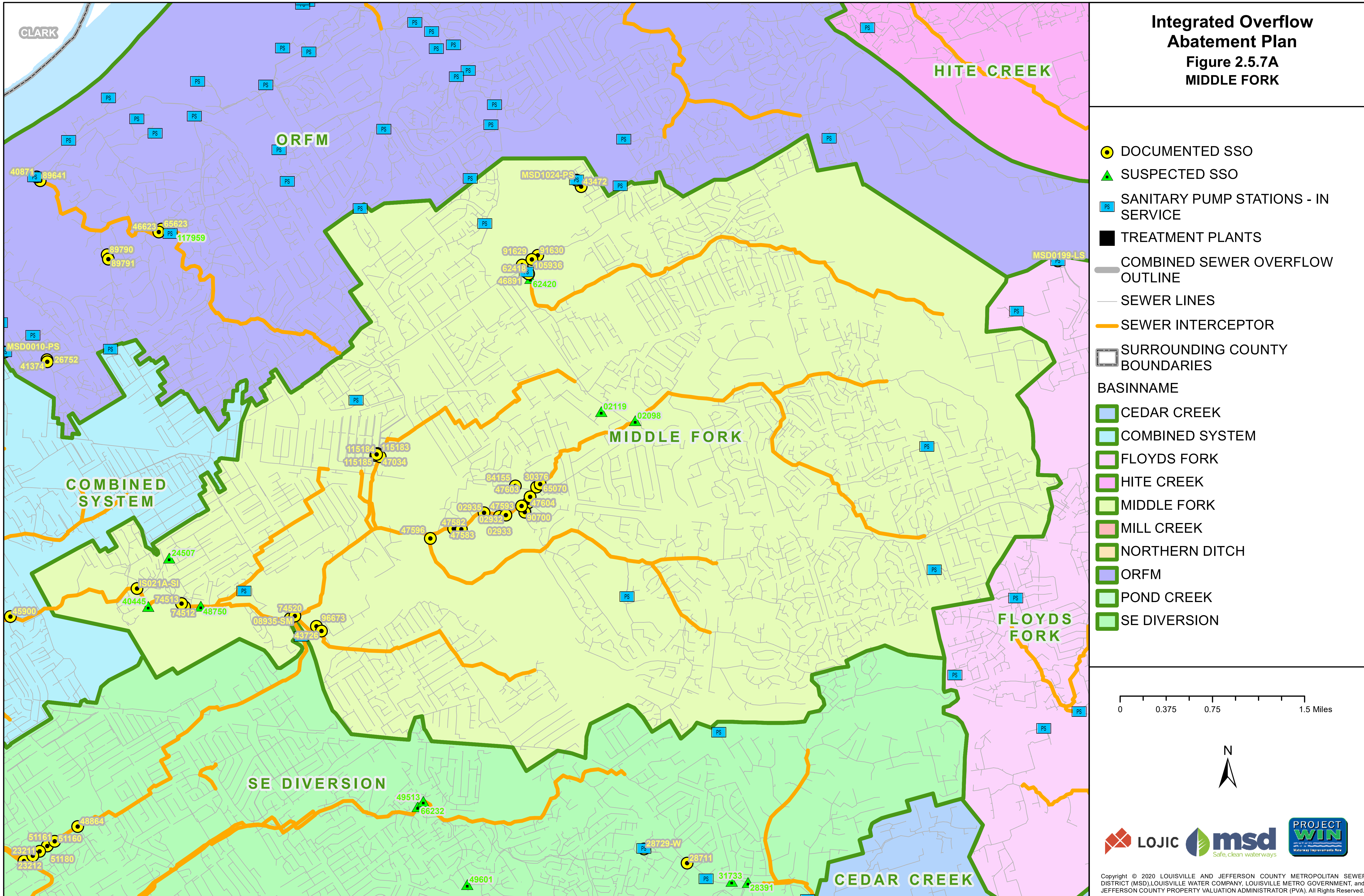

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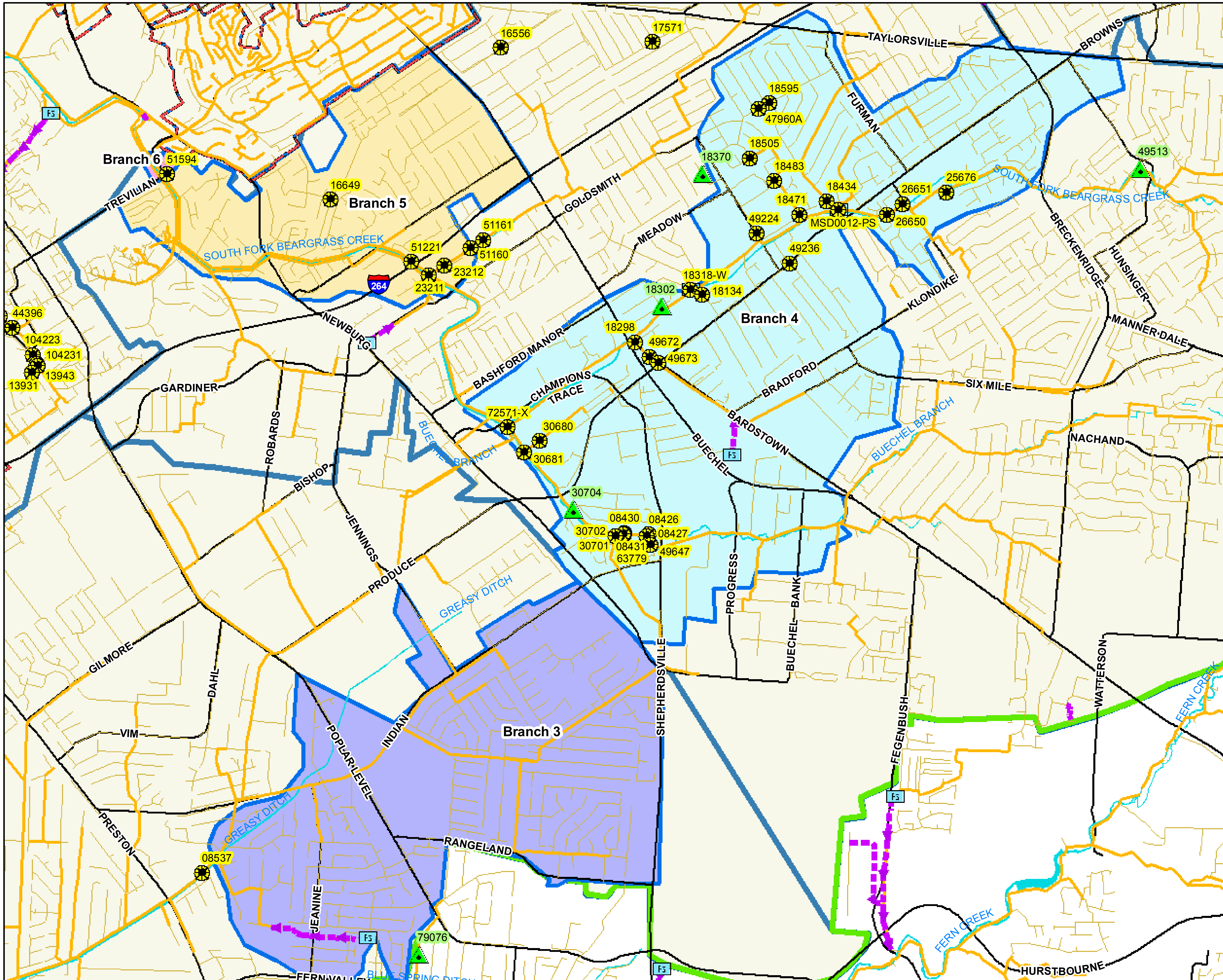

Integrated Overflow Abatement Plan

Vol. 3 - Sanitary Sewer Discharge Plan

Morris Forman Sewershed
Southeast Diversion
Branch Network
Figure 2.5.8

Legend

- Documented SSO
- Suspected SSO
- Haul Operation
- WWTP
- Pump Station
- Force Main
- Collector < 12 "
- Interceptor =>12"
- Streams
- Interstates
- Small WWTP Service Area
- Large WWTP Service Area
- CSO Area
- Branch 3
- Branch 4
- Branch 5
- Branch 6
- County Boundary

1 inch equals 2,350 feet
Scalable when printed on 11" X 17" paper

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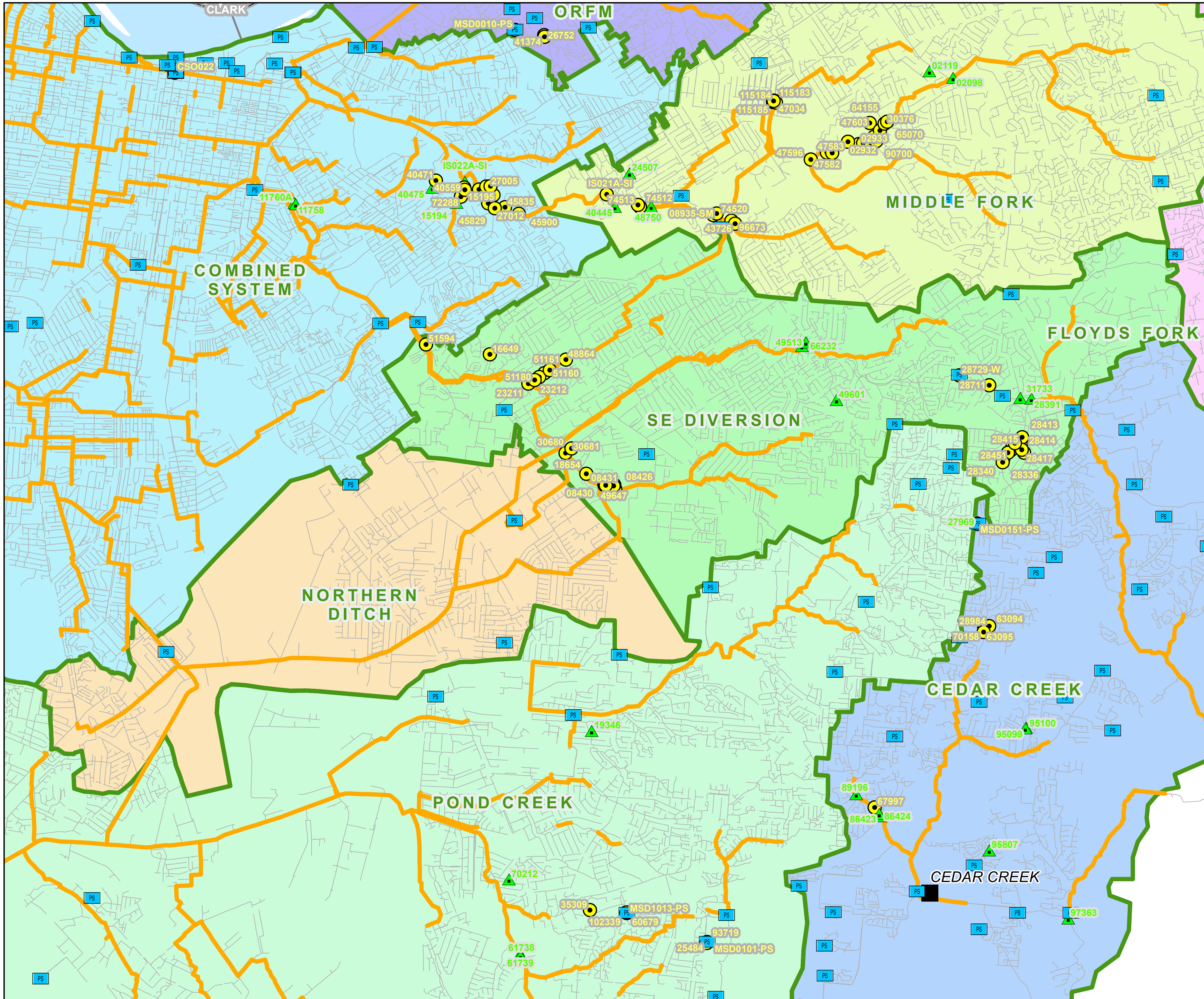

Integrated Overflow Abatement Plan

Figure 2.5.8A

SE DIVERSION / NORTHERN DITCH

DOCUMENTED SSO

SUSPECTED SSO

SANITARY PUMP STATIONS - IN SERVICE

TREATMENT PLANTS

COMBINED SEWER OVERFLOW OUTLINE

SEWER LINES

SEWER INTERCEPTOR

SURROUNDING COUNTY BOUNDARIES

BASINNAME

CEDAR CREEK

COMBINED SYSTEM

FLOYDS FORK

HITE CREEK

MIDDLE FORK

MILL CREEK

NORTHERN DITCH

ORFM

POND CREEK

SE DIVERSION

0 0.5 1 2 Miles

N

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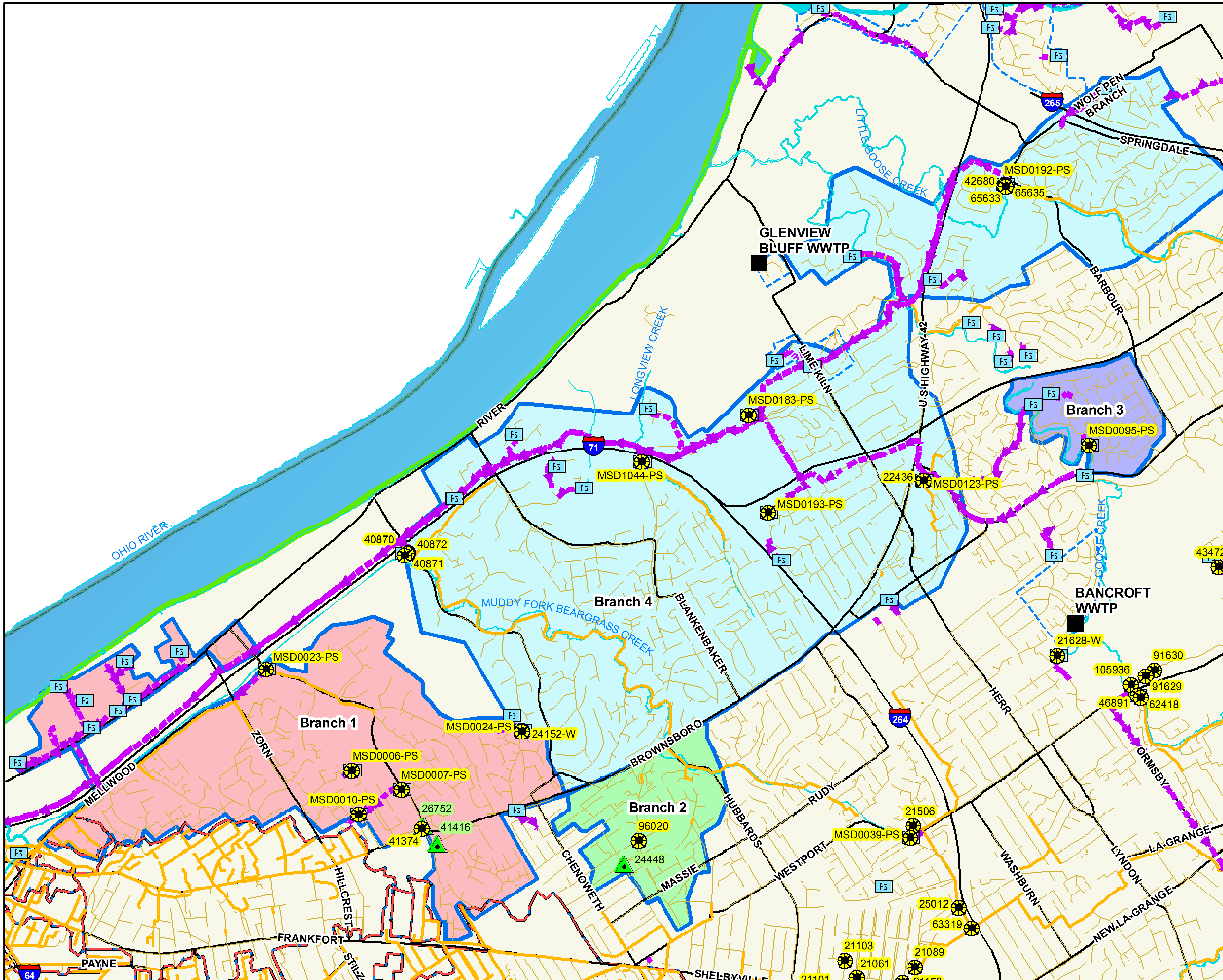
Integrated Overflow Abatement Plan

Vol. 3 - Sanitary Sewer Discharge Plan

Morris Forman Sewershed
ORFM
Branch Network
Figure 2.5.9



Legend

- Documented SSO
- Suspected SSO
- Haul Operation
- WWTP
- Pump Station
- Force Main
- Collector < 12 "
- Interceptor =>12"
- Streams
- Interstates
- Small WWTP Service Area
- Large WWTP Service Area
- CSO Area
- Branch 1
- Branch 2
- Branch 3
- Branch 4
- County Boundary

1 inch equals 2,800 feet
Scalable when printed on 11" X 17" paper

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SDI Inc. Figure 2 5 9 ORFM_Branching.mxd

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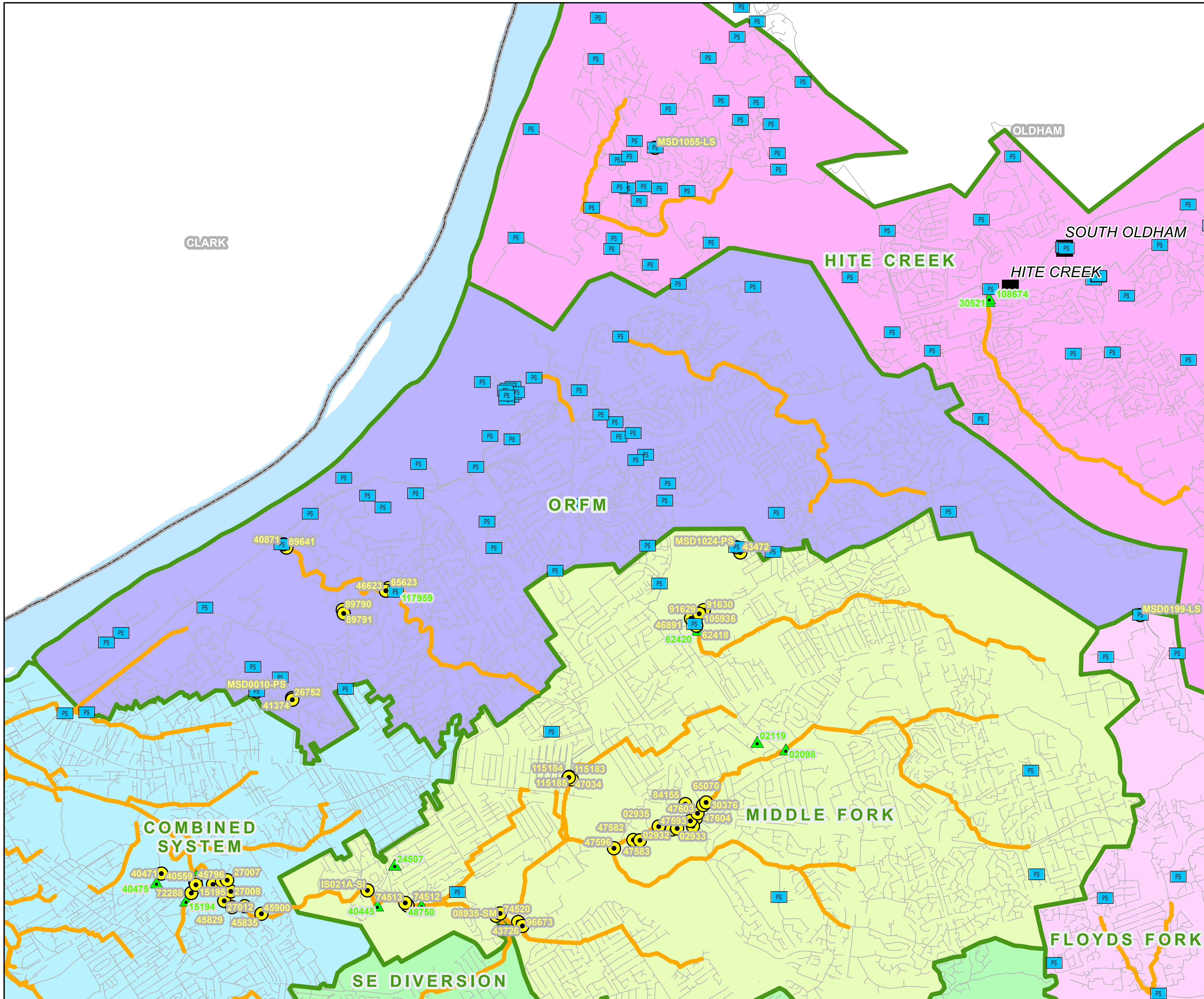
Integrated Overflow Abatement Plan

Figure 2.5.9A

ORFM



- DOCUMENTED SSO
- SUSPECTED SSO
- SANITARY PUMP STATIONS - IN SERVICE
- TREATMENT PLANTS
- COMBINED SEWER OVERFLOW OUTLINE
- SEWER LINES
- SEWER INTERCEPTOR
- SURROUNDING COUNTY BOUNDARIES

BASINNAME

- CEDAR CREEK
- COMBINED SYSTEM
- FLOYDS FORK
- HITE CREEK
- MIDDLE FORK
- MILL CREEK
- NORTHERN DITCH
- ORFM
- POND CREEK
- SE DIVERSION

0 0.5 1 2 Miles

N

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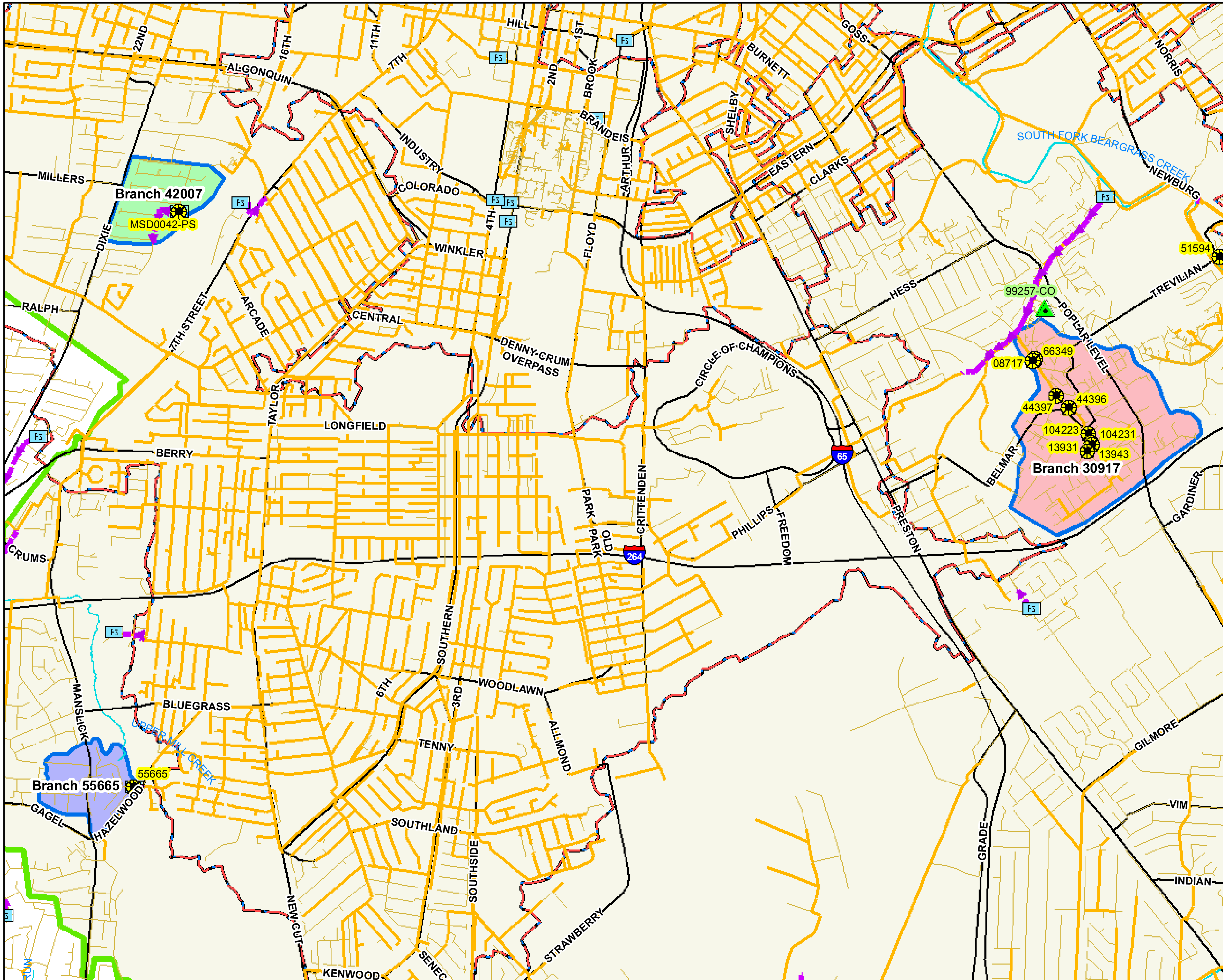
Morris Forman Sewershed
CSS Area
Branch Network
Figure 2.5.10



Legend

- Documented SSO
- Suspected SSO
- Haul Operation
- WWTP
- Pump Station
- Force Main
- Collector < 12 "
- Interceptor =>12"
- Streams
- Interstates
- Small WWTP Service Area
- Large WWTP Service Area
- CSO Area
- Branch 30917
- Branch 42007
- Branch 55665
- County Boundary

1 inch equals 2,400 feet
Scalable when printed on 11" X 17" paper

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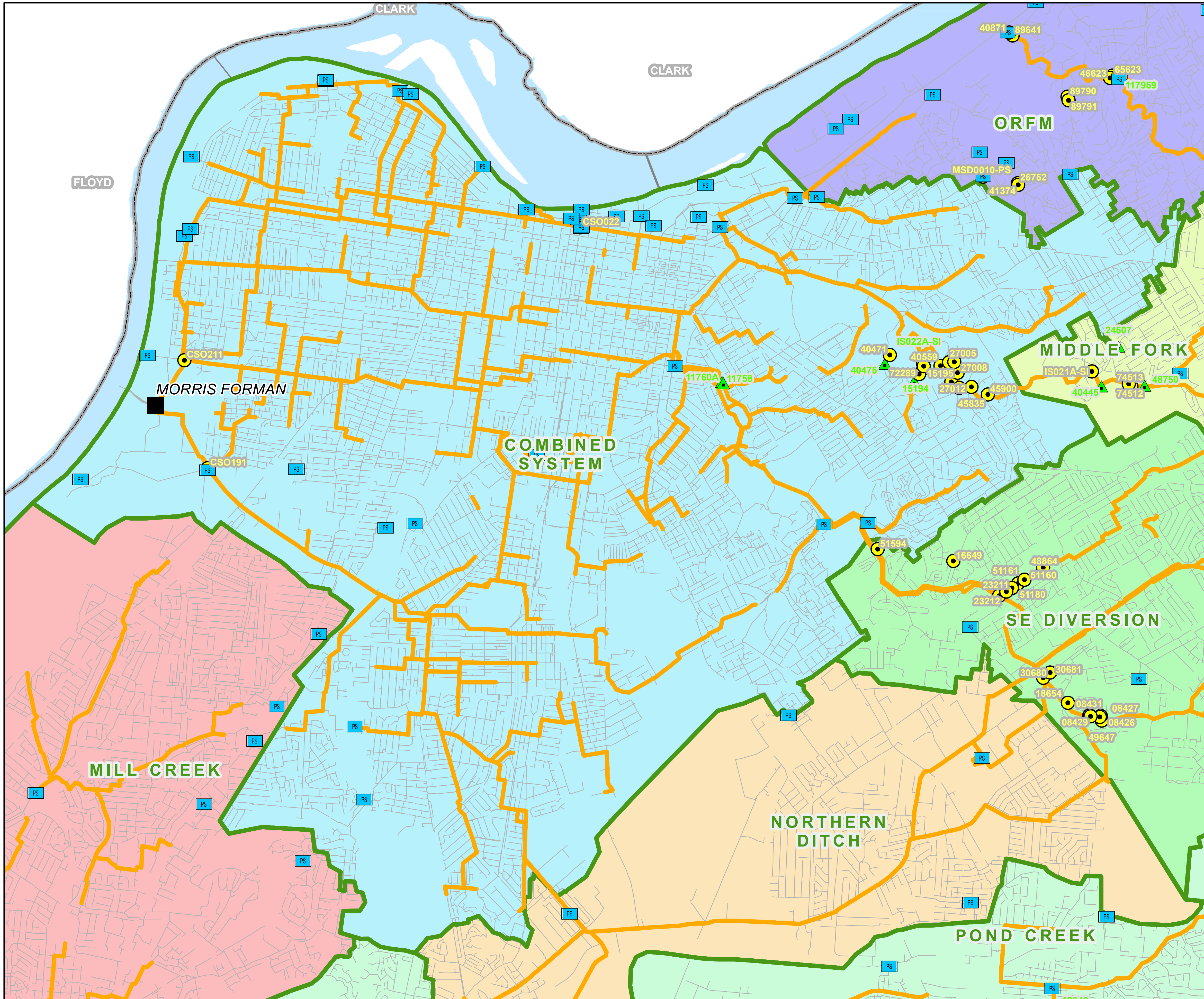
Figure 2.5.10A

COMBINED SYSTEM



- DOCUMENTED SSO
- SUSPECTED SSO
- SANITARY PUMP STATIONS - IN SERVICE
- TREATMENT PLANTS
- COMBINED SEWER OVERFLOW OUTLINE
- SEWER LINES
- SEWER INTERCEPTOR
- SURROUNDING COUNTY BOUNDARIES

BASINNAME

- CEDAR CREEK
- COMBINED SYSTEM
- FLOYDS FORK
- HITE CREEK
- MIDDLE FORK
- MILL CREEK
- NORTHERN DITCH
- ORFM
- POND CREEK
- SE DIVERSION

0 0.5 1 2 Miles

N

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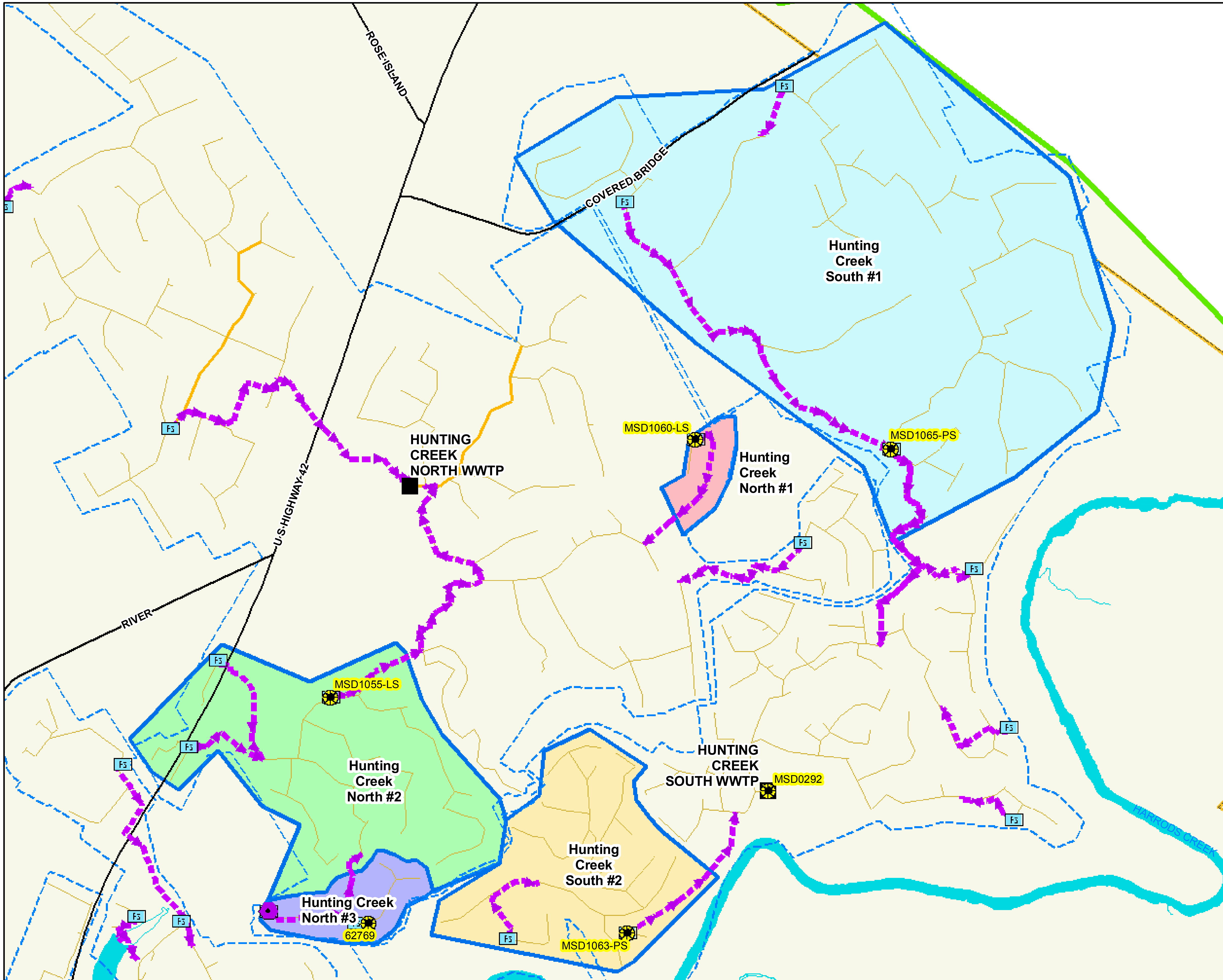
Vol. 3 - Sanitary Sewer Discharge Plan

Morris Forman Sewershed
Small WWTP - Hunting Creek Area
Branch Network
Figure 2.5.11



Legend

- Documented SSO
- Suspected SSO
- Haul Operation
- WWTP
- Pump Station
- Force Main
- Collector < 12 "
- Interceptor =>12"
- Streams
- Interstates
- Small WWTP Service Area
- Large WWTP Service Area
- CSO Area
- Hunting Creek North #1
- Hunting Creek North #2
- Hunting Creek North #3
- Hunting Creek South #1
- Hunting Creek South #2
- County Boundary

1 inch equals 900 feet
Scalable when printed on 11" X 17" paper

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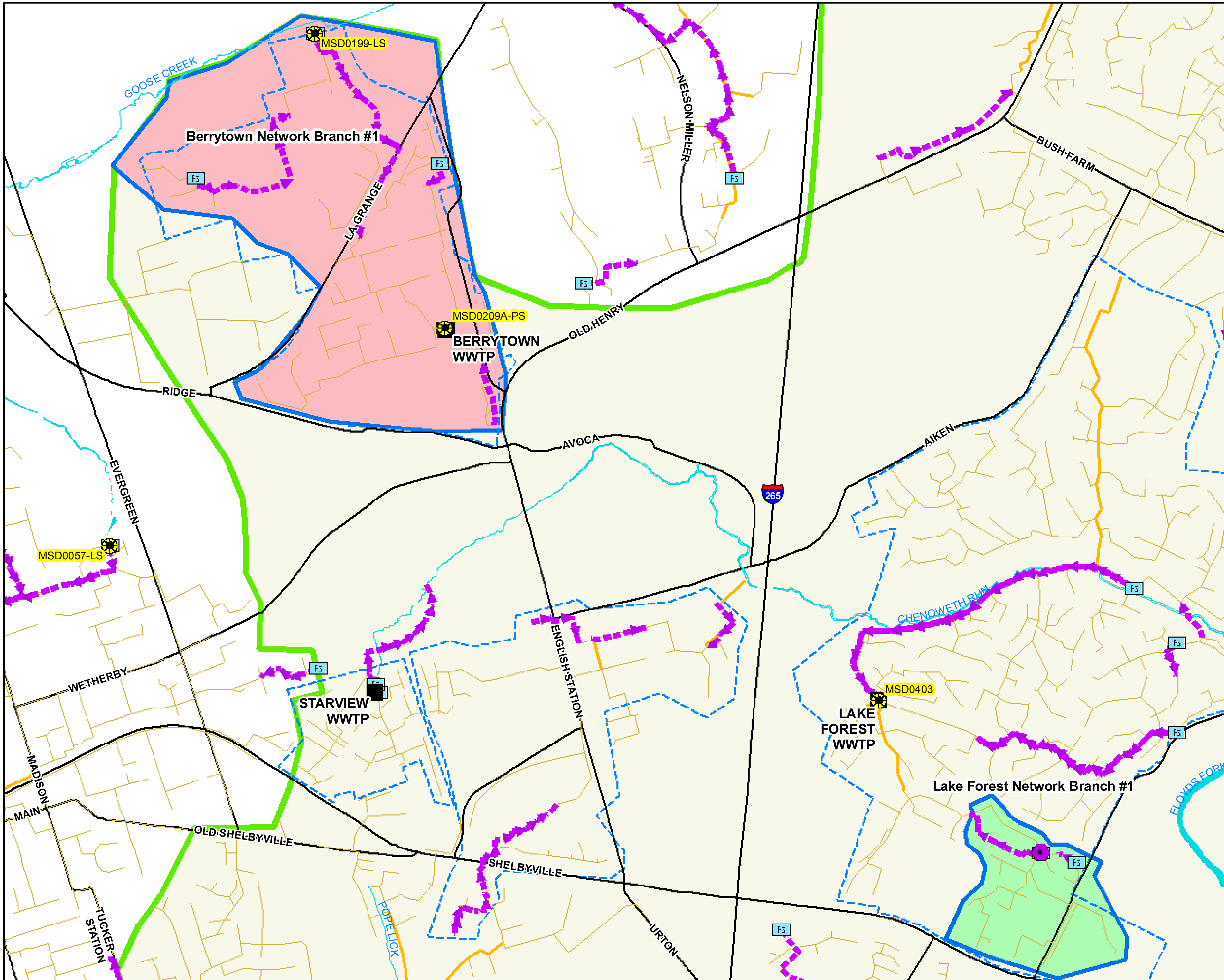
Integrated Overflow Abatement Plan

Vol. 3 - Sanitary Sewer Discharge Plan

Morris Forman Sewershed

Small WWTP - Berrytown and Lake Forest Area Branch Network

Figure 2.5.12



Legend

- Documented SSO
- Suspected SSO
- Haul Operation
- WWTP
- Pump Station
- Force Main
- Collector < 12 "
- Interceptor =>12"
- Streams
- Interstates
- Small WWTP Service Area
- Large WWTP Service Area
- CSO Area
- Berrytown Network Branch #1
- Lake Forest Network Branch #1
- County Boundary

1 inch equals 1,450 feet
Scalable when printed on 11" X 17" paper

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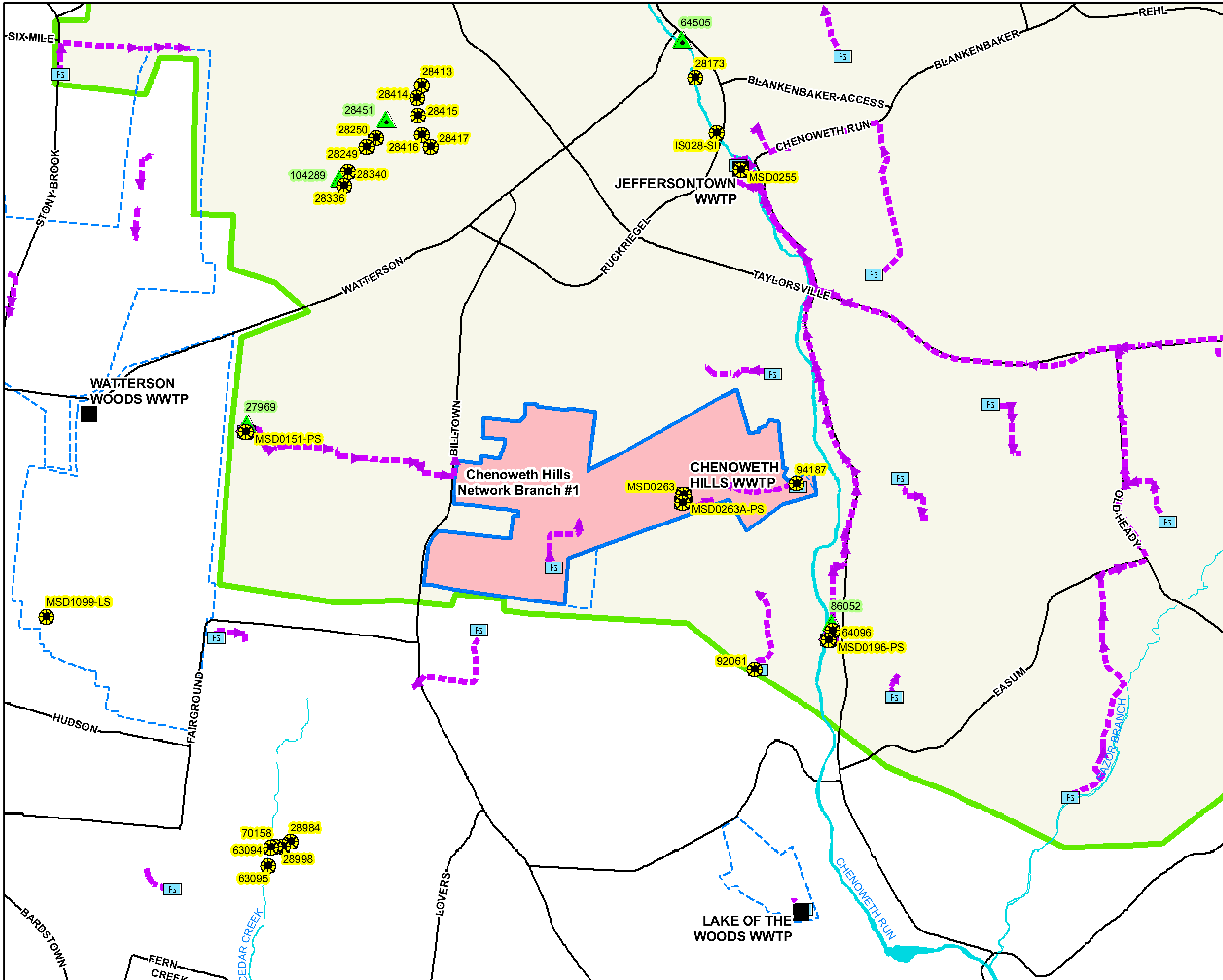

Integrated Overflow Abatement Plan

Vol. 3 - Sanitary Sewer Discharge Plan

Morris Forman Sewershed
Small WWTP - Chenoweth Hills Area
Branch Network
Figure 2.5.13

Legend

- Documented SSO
- Suspected SSO
- Haul Operation
- WWTP
- Pump Station
- Force Main
- Collector < 12 "
- Interceptor =>12"
- Streams
- Interstates
- Small WWTP Service Area
- Large WWTP Service Area
- CSO Area
- Chenoweth Hills Network Branch #1
- County Boundary

1 inch equals 1,500 feet
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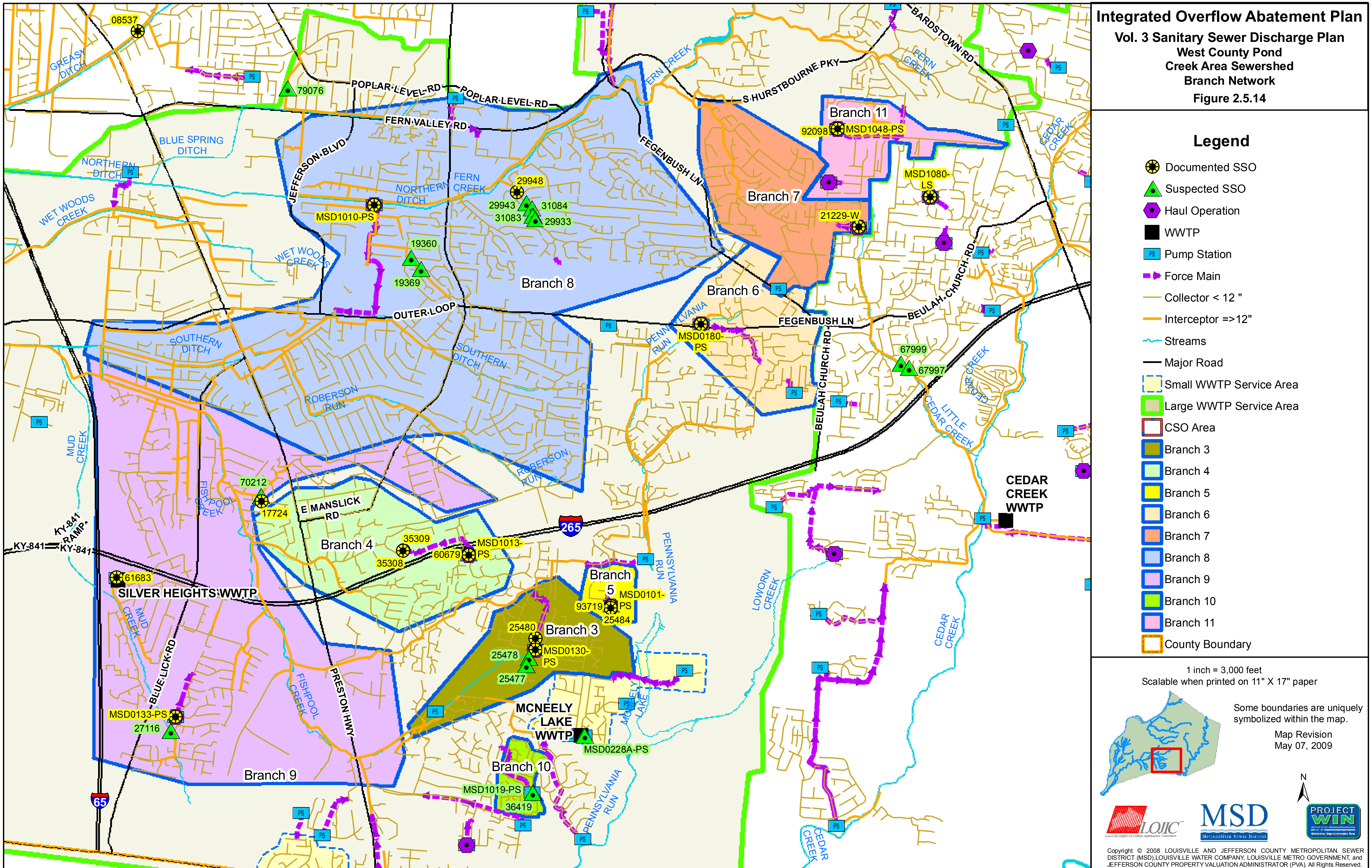

CMS Inc. Figure 2.5.14 West_County_Pond_Creek_Branch_11x17_size.mxd

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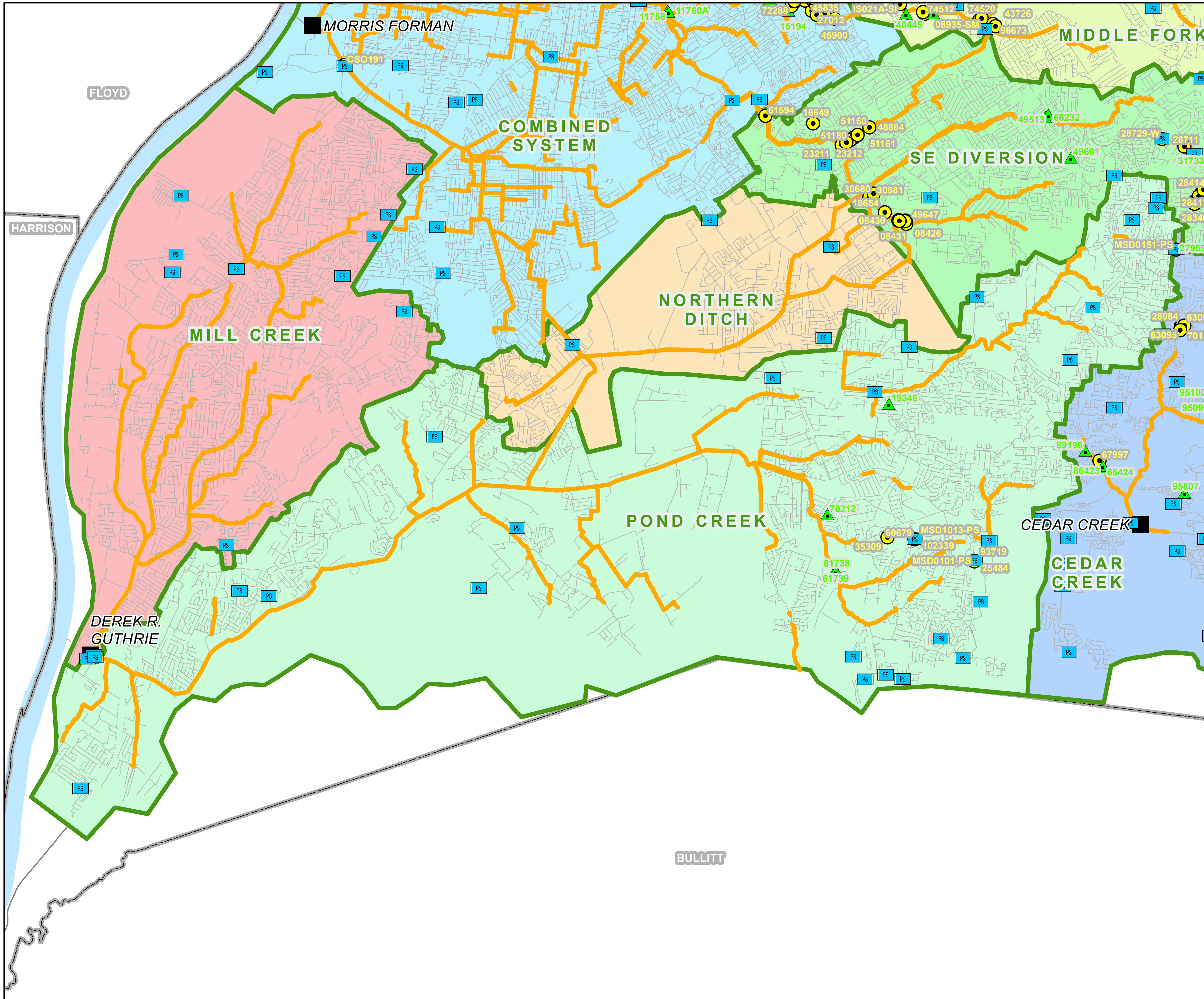

Integrated Overflow Abatement Plan

Figure 2.5.14A

POND CREEK

- DOCUMENTED SSO
- SUSPECTED SSO
- SANITARY PUMP STATIONS - IN SERVICE
- TREATMENT PLANTS
- COMBINED SEWER OVERFLOW OUTLINE
- SEWER LINES
- SEWER INTERCEPTOR
- SURROUNDING COUNTY BOUNDARIES

BASINNAME

- CEDAR CREEK
- COMBINED SYSTEM
- FLOYDS FORK
- HITE CREEK
- MIDDLE FORK
- MILL CREEK
- NORTHERN DITCH
- ORFM
- POND CREEK
- SE DIVERSION

0 0.75 1.5 3 Miles

N

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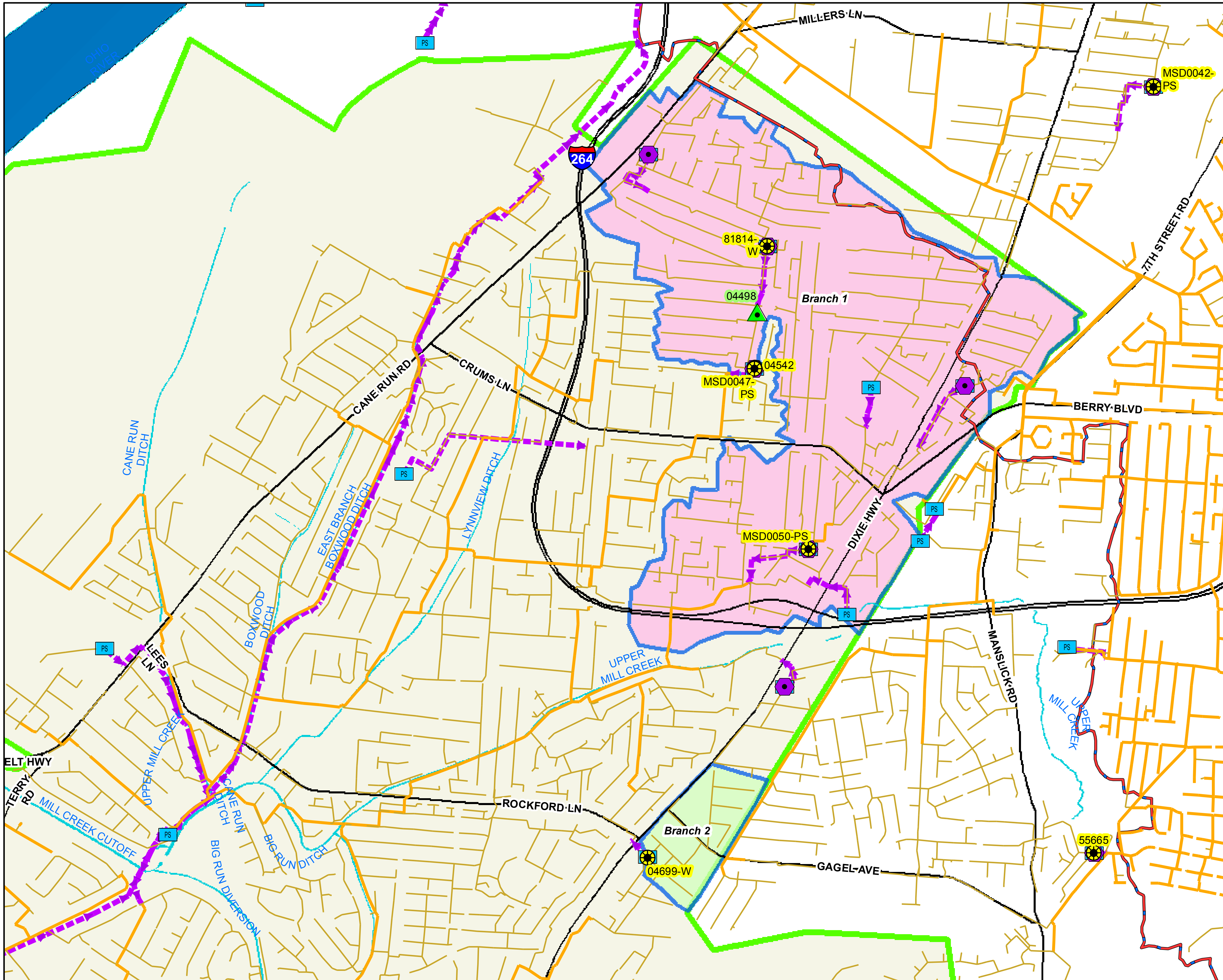
Integrated Overflow Abatement Plan

Vol. 3 Sanitary Sewer Discharge Plan

West County Mill Creek Area Sewershed Branch Network

Figure 2.5.15



Legend

- Documented SSO
- Suspected SSO
- Haul Operation
- WWTP
- Pump Station
- Force Main
- Collector < 12 "
- Interceptor =>12"
- Major Road
- Streams
- CSO Area
- Small WWTP Service Area
- Large WWTP Service Area
- Branch 1
- Branch 2
- County Boundary

1 inch = 1,800 feet
Scalable when printed on 11" X 17" paper

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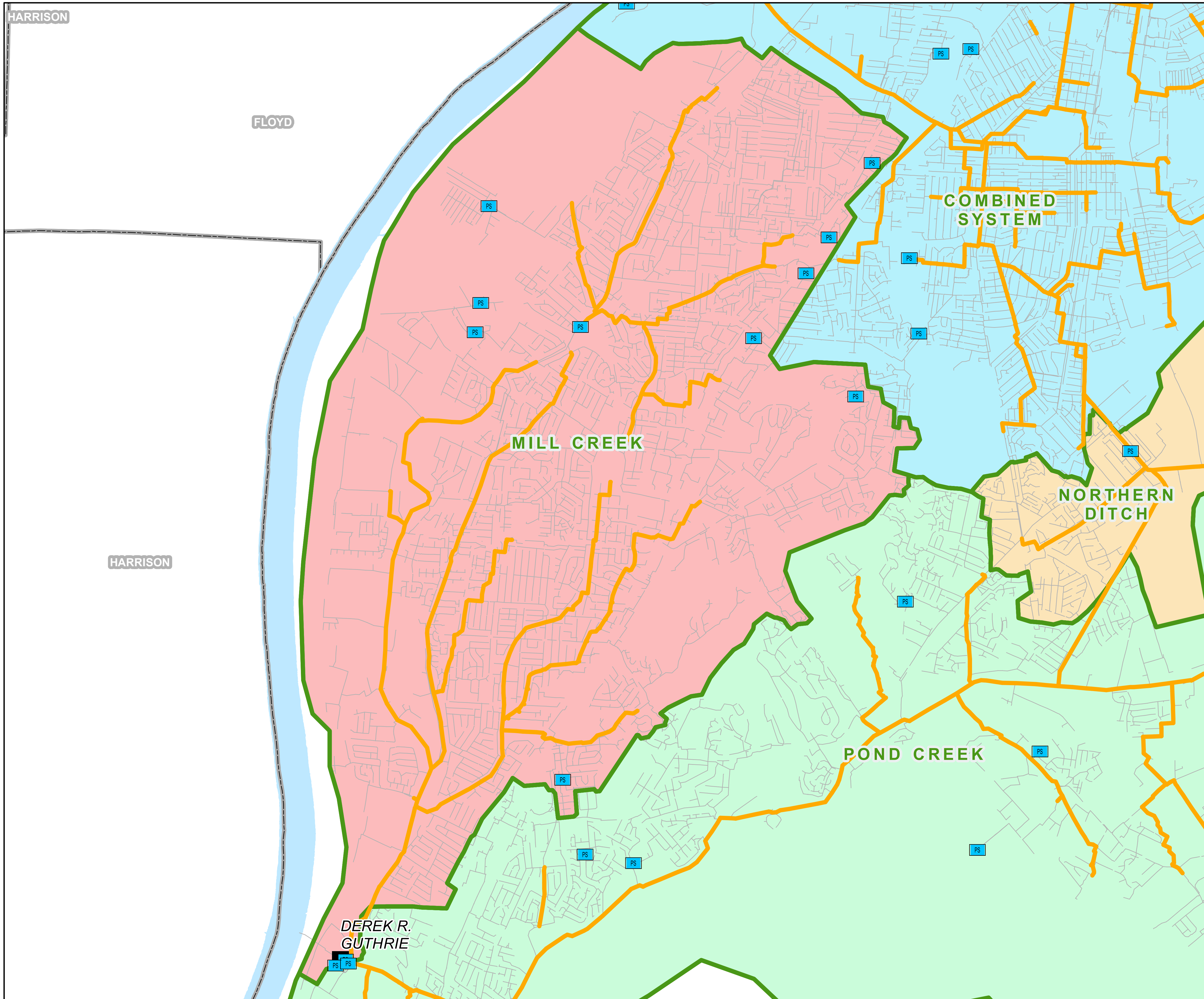

Integrated Overflow Abatement Plan

Figure 2.5.15A

MILL CREEK

- DOCUMENTED SSO
- SUSPECTED SSO
- SANITARY PUMP STATIONS - IN SERVICE
- TREATMENT PLANTS
- COMBINED SEWER OVERFLOW OUTLINE
- SEWER LINES
- SEWER INTERCEPTOR
- SURROUNDING COUNTY BOUNDARIES

BASINNAME

- CEDAR CREEK
- COMBINED SYSTEM
- FLOYDS FORK
- HITE CREEK
- MIDDLE FORK
- MILL CREEK
- NORTHERN DITCH
- ORFM
- POND CREEK
- SE DIVERSION

0 0.5 1 2 Miles

N

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APRIL 30, 2021

2021 IOAP MODIFICATION

VOLUME 3 FINAL SSDP, CHAPTER 3

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FIGURES

APPENDICES

Note: Appendices shown in italic text were not revised for the 2021 IOAP and remain the same as the 2012 IOAP Modification. All appendices have been provided on a separate USB flash drive and are not included in this report.

Chapter 3: DEVELOPMENT AND EVALUATION OF ALTERNATIVES FOR SSO ELIMINATION

Special Note - 2021 Modification: This chapter was initially developed in 2009. The statistical data for the SSO's reported, specifically related to individual SSO volumes and frequency, were derived from the hydraulic models calibrated in 2007. Since then, a more detailed calibration and validation effort has adjusted some of the SSO volumes and frequencies. Modifications made to projects after the 2009 project development based on the updated calibration or other changed conditions are summarized in this chapter. Detailed information regarding project modifications is contained in project modification letters sent at the time of the project change. Copies of the letters are included in Appendix 4.0-1. The Volume 3, Chapter 3 appendices remain the same as those provided with the 2012 IOAP.

Once a clear understanding of the root problems of sanitary sewer overflows (SSOs) is obtained through the system characterization process, it is important to develop a comprehensive set of potential solutions that are effective and acceptable by the public.

Chapter 3 presents the methodologies used to evaluate the various SSO elimination solutions. The chapter defines and discusses strategies and technologies available to control and eliminate unauthorized discharges in the separate sanitary sewer system (SSS). The chapter also provides a summary of the evaluation for each SSO elimination alternative. The evaluation criterion includes feasibility screening, computer modeling, quality control, level of protection, cost estimates, and a benefit-cost analysis.

3.1. THE FINAL SSDP APPROACH

Overall, the Final Sanitary Sewer Discharge Plan (SSDP) approach to SSO elimination is to determine the solution that provides the greatest benefit-cost ratio for each watershed branch. Modeling teams used the Louisville and Jefferson County Metropolitan Sewer District (MSD) Project Cost Estimating Tool and the Benefit-Cost Value Model, both developed specifically for the Integrated Overflow Abatement Plan (IOAP). These tools were used to determine benefit scores, capital costs, long-term operation and maintenance (O&M) costs, and the benefit-cost ratio. The process is discussed in more detail in this section.

3.1.1. SOLUTION DEVELOPMENT OVERVIEW

The major steps in the solution development process are summarized below:

- Models were calibrated and validated (Volume 3, Chapter 2, Section 2.3).
- Where appropriate, rainfall dependent inflow and infiltration (RDI/I) and build-out was applied to the validated models (Volume 3, Chapter 2, Section 2.3.5.7).
- Where appropriate, capital projects were incorporated into the models (Volume 3, Chapter 2, Section 2.3.5.9).
- Input was gathered from public meetings, as well as guidance from the Wet Weather Team (WWT) Stakeholder Group and ground truthing exercises.
- Initial solutions were developed and presented at WWT Stakeholder Group meetings for review and comments.

- Solutions that addressed SSOs and reduced known surcharging under site-specific design conditions were developed using a diverse set of solution technologies.
- Benefits, capital costs, and benefit-cost ratios for each solution were developed at the baseline level of protection (1.82-inch cloudburst storm event).
- The solution with the best benefit-cost ratio was selected for development of the preferred level of protection (Volume 3, Chapter 4).

3.1.2. SSO CONTROL MEASURES AND TECHNOLOGIES

A wide range of technology approaches is available for the development of SSO abatement strategies and alternatives. These approaches are summarized in the following sub-sections.

3.1.2.1. SOURCE CONTROL THROUGH INFILTRATION AND INFLOW (I/I) REDUCTION

Source reduction focuses on preventing wet weather flows through various sources from reaching the sewer. Source reduction was considered for each branch solution. The method and degree of source reduction is described in Volume 3, Chapter 2, Section 2.3.5.7. MSD has embarked on programs to address countywide, private-side, and public-side source reduction. As it pertains to the Final SSDP, a 20-year program was implemented to reduce flows in areas critical to Final SSDP success. The program is outlined in Appendix 3.1.1, I/I Program Documentation. Prior to final project sizing, flow monitoring and model recalibration is performed in areas where significant source reduction efforts were implemented.

Appendix 3.1.1 I/I Program Documentation

Appendix is same as 2012 IOAP Modification and is provided on external USB storage drive.

3.1.2.2. BASEMENT BACKUPS AND SEWER SURCHARGING

Surcharge reduction focuses on the prevention of basement flooding during wet weather. Basement flooding protection was considered and analyzed for all branch solutions using the System Capacity Assurance Plan criterion discussed in Volume 3, Chapter 2, Section 2.5.1. The surcharge criterion was applied to all areas hydraulically connected to a documented or suspected SSO location (known as the "zone of influence") and/or downstream of an SSDP solution. Solutions were then sized accordingly to reduce or eliminate surcharging to the Louisville Metro Sewer Capacity Assurance Plan (SCAP) criterion.

Other basement backup complaints or modeled surcharging not within the SSO zone of influence or downstream of an SSDP solution will be addressed by MSD's Plumbing Modification Program, which is available to all MSD customers, as discussed in Volume 1.Peak Flow Storage Alternatives

A storage solution is an alternative where flow is temporarily stored to eliminate SSOs. This includes inline storage (large diameter pipe(s) built into the sewer system) or offline storage (covered or open storage facilities). Storage alternatives may also include additional pumping capacity, conveyance to and from the storage location, controls, easements, land purchases, odor control, surface treatment, and long-term O&M. Storage solutions developed are then evaluated through a complete "fill-and-empty" cycle in the model, which also includes a secondary storm analysis (as described in Volume 3, Chapter 2, Section 2.3.4).

A significant cost factor in storage is whether the constructed storage facility is open or closed to the environment. Open facilities are generally less expensive, but they present potential problems such as odors and poor aesthetics. Covering the facility, generally by burying, can improve these conditions but significantly increases the cost of the facility.

For any facility, the siting location is critical. Thus, the ground truthing exercises were developed to assist with the siting process. Section 3.1.3.3 describes the ground truthing process in more detail.

3.1.2.3. INCREASED CONVEYANCE CAPACITY

A conveyance solution increases the sewer capacity to eliminate SSOs. The solution may include: increases in pipe size, additional pumping capacity, parallel sewer conveyance, and elimination of bottlenecks. Pure conveyance solutions will usually result in increased flow downstream. In these cases, the increase in flow must be addressed by downstream branches in the system.

While siting is not as critical as storage alternatives, ground truthing is still required to properly cost the improvements for some conveyance solutions (see Section 3.1.3.3 for more detail on ground truthing).

3.1.2.4. FLOW DIVERSION

A diversion solution is an alternative where flow is diverted to other systems or sewersheds to alleviate capacity at the solution location. Generally, a diversion solution will involve gravity solutions, although some pump station improvements may be included.

Diversion alternatives will undoubtedly impact other branches and potentially other watersheds. As a result, solutions will have to account for the additional flows to the impacted branches. Similar to conveyance alternatives, ground truthing is required to properly price diversion alternatives.

3.1.2.5. WATER QUALITY TREATMENT CENTER (WQTC) UPGRADES

In accordance with the 2009 ACD, all WQTCs with the potential to receive additional flow as a result of SSO elimination were evaluated by developing a “Comprehensive Performance Evaluation” (CPE) in accordance with EPA guidance documents called out in the 2009 ACD. The CPE process was originally developed to provide a systematic approach to improving the performance of WQTCs that were not in compliance with discharge standards. In this application it was necessary to conduct an evaluation based on the anticipated performance of the plants in treating the modeled peak wet weather flows. Initial evaluations considered the worst case scenario assuming SSO eliminations were accomplished by increasing conveyance capacity, essentially pushing the entire wet weather flow increase to the WQTC. Final evaluations were refined based on modeled wet weather hydrographs considering the actual SSO elimination projects selected in the Final SSDP.

The 2009 ACD also required CPEs be conducted on the five plants in the Prospect area, and the Lake Forest WQTC. As a result of both sets of requirements, CPEs were developed for the following WQTCs in accordance with the Consent Decree:

- Berrytown WQTC*
- Cedar Creek WQTC
- Chenoweth Hills WQTC*
- Hite Creek WQTC
- Hunting Creek South WQTC*
- Jeffersontown WQTC*
- Ken Carla WQTC*

- Lake Forest WQTC*
- North Hunting Creek WQTC*
- Starview WQTC*
- Timberlake WQTC*

*Eliminated since 2009 IOAP

A more complete description of the CPE process and the resultant Composite Correction Approach WQTC improvement recommendations is contained in Volume 1, Section 4.4. This section in Volume 1 also presents the evaluation of potential collection system modifications compared to WQTC expansions to address wet weather peaks.

CPEs were not developed for the Derek R. Guthrie WQTC (formerly known as the West County Wastewater Treatment Plant) or the Floyds Fork WQTC because both plants are scheduled to undergo significant expansions in the near future. The WQTC expansions will be sized to include any additional wet weather flow peaks anticipated as a result of SSO elimination. In lieu of CPEs, the preliminary design reports for those WQTC expansions are addressed in Volume 1. A CPE was not developed for the Morris Forman WQTC because it serves the combined sewer system and is specifically excluded from the CPE requirement in the Consent Decree.

3.1.3. INITIAL SOLUTIONS

MSD was committed to obtaining WWT Stakeholder Group input throughout the 2009 IOAP development. In particular, MSD solicited WWT Stakeholder Group input before modeled solution development began. To “kick off” the potential solution process, the initial solutions were developed for each modeled branch. The initial solution development phase involved desktop evaluation and simple sizing using existing condition model runs and MSD’s historical work order database.

Initial solutions were presented to the WWT Stakeholder Group in a series of meetings where the Group was engaged in discussions about the initial solutions and their comments or concerns were noted. This information was then considered and included in future modeled solution development. The following sections summarize the initial solution phase, from SSO characterization to the ground truthing process, and provide a general overview of the types and number of initial solutions that were a result of this particular stage of solution development.

This section describes procedures used to develop initial solutions for the 2009 IOAP. The procedure to develop initial solutions is generally followed for updating SSO abatement alternatives based on changed conditions. However, the initial solutions are no longer regularly presented to the WWT Stakeholder Group. The input provided by this group in 2009 informed future decisions regarding the preferences of potential alternatives for consideration.

3.1.3.1. SSO CHARACTERIZATION

Initially, there were 109 SSOs and more than 200 modeled overflow points (MOPs) used to determine the design of initial solution projects. Refer to Volume 3, Chapter 2, Section 2.4.2 for a discussion of the MOP validation process. Many aspects of each area were reviewed before the initial solutions were developed; for example, the source or cause of the SSO(s) was investigated through a review of discharge work orders and, based on initial evaluation, the overflow volume for various levels of protection was reported.

Site conditions for the entire area surrounding the SSOs and MOPs were also investigated and reported for each initial solution. Surrounding land use, apparent utility conflicts, and other aspects that could affect a project were reviewed and documented.

Additionally, capital projects and proposed developments in the area were reviewed and summarized in each initial solution development phase. The initial solutions were developed after investigation of the cause of the SSO, surrounding area land use, apparent utilities, proposed developments, capital projects, and modeling needs. The research was conducted with the objective of integrating the most important characterizations of each project location into the solution alternatives.

3.1.3.2. INITIAL SOLUTION ALTERNATIVES

The initial solution alternatives that were considered included one or more of the available technologies as described in Section 3.1.2. Figure 3.1.1 summarizes the developed solutions. Some of the initial locations were identified as having more than one potential solution and the graph shows the percentage of initial solution options by solution type that may be able to eliminate the SSOs. The pump station elimination, sewer upgrades, force main upgrades, and pump station upgrades could be part of either a conveyance solution or a diversion solution.

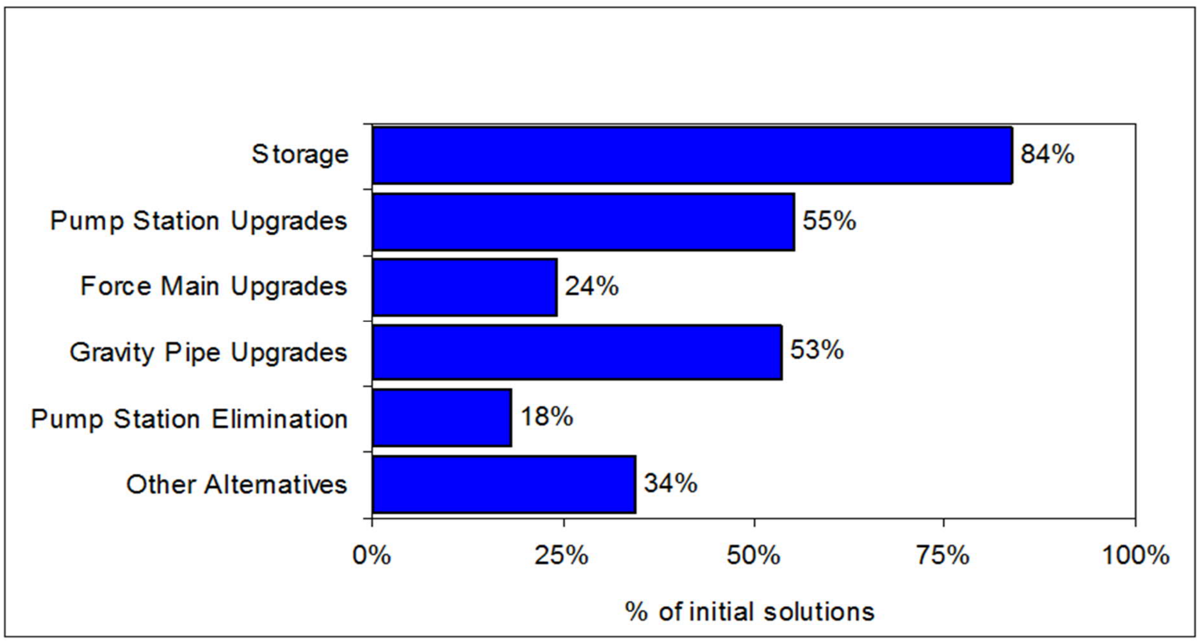

Figure 3.1.1 Summary of Initial Solution Alternatives

Storage Alternatives

More than eighty percent of the initial solution locations displayed potential for storage facilities and inline storage pipes. However, some locations were determined to be unsuitable for storage solutions due to maintenance access and land acquisition concerns.

Conveyance Alternatives

The conveyance alternatives included pump station, force main, and gravity pipe upgrades, pump station eliminations, and diversions. These alternatives were usually more complex requiring sewer pipe upgrades, newly constructed sewer pipe, and/or pump station upgrades. More than eighty percent of the initial solutions displayed potential for conveyance alternatives.

Other Alternatives

Other alternatives included capital project solutions, raising manholes and reducing I/I.

3.1.3.3. GROUND TRUTHING

As mentioned earlier, siting is a critical component of project development. Thus, MSD developed a ground truthing process to consistently evaluate storage, conveyance, and diversion alternatives. Ground truthing collects critical information that could affect cost, such as soil conditions and easements, or, in some cases, prevent the site from being further considered, such as future planned development.

Each modeling team was responsible for ground truthing storage, conveyance, and diversion alternatives considered within the respective watersheds. In some cases, the solution involved alignments in existing rights-of-way or easements, such as pipe upsizing, and ground truthing was not necessary. The following list provides examples of features that were investigated during the ground truthing process:

- Rock depth
- 100-Year floodplain location
- Threatened/endangered species assessment
- Potential utility conflicts
- Required Permits, i.e. Kentucky Department of Environmental Protection (KDEP), U.S. Army Corp of Engineers (USACE), Etc.
- Green space initiatives
- National historic registry
- Development conflicts
- Significant topographical features, i.e. steep slope

Once ground truthing was completed, a recommendation was made labeling the site as either suitable or unsuitable for the particular solution type. Specific ground truthing and significant findings are briefly discussed for each individual watershed (see Section 3.3), and full ground truthing documents along with pictures of the sites are available for review in Appendix 3.1.2.

Appendix 3.1.2 Ground Truthing Documentation
Appendix is same as 2012 IOAP Modification and is provided on external USB storage drive.

3.2. PROJECT SELECTION ANALYSIS

MSD used a standard benefit-cost ratio process to determine and select the most effective solution for each branch of SSOs for a baseline level of protection. In this case, the 1.82-inch cloudburst storm was utilized as the baseline level of protection. The same process was used to set optimal levels of protection for the selected solutions (described in Volume 3, Chapter 4).

Additionally, several projects were conceptually re-designed using a 2.25-inch cloudburst storm to evaluate if the initial level of control used as the baseline condition created any bias toward a particular technology in selecting a preferred solution from a group of initial competing technologies. The evaluation, detailed in Sections 3.3.5.2, 3.3.9.2, and 3.3.11.2, showed that the initial level of control used as the baseline condition appeared to have no impact on the technology selected. For a full explanation and results of the analysis refer to Appendix 3.2.1.

Appendix 3.2.1 Re-evaluation of Preferred Projects Analysis

Appendix is same as 2012 IOAP Modification and is provided on external USB storage drive.

The MSD Project Cost Estimating Tool and the benefit-cost value model were utilized to develop Final SSDP solution costs and benefits, based on input from the WWT. These planning models are fully described in Volume 1, Section 2.5. The individual components are summarized in the following section.

3.2.1. COST ANALYSIS

A total project capital cost and present worth (including O&M) cost was computed for each solution alternative using the MSD Project Cost Estimating Tool, which uses cost curves based on common parameters obtained from model runs. This includes parameters such as pipe diameters, location (i.e. paved areas versus non-paved) and site conditions (i.e. site dewatering). It also includes costs for easements and land acquisitions, as well as O&M costs for pumping, cleaning and other recurring tasks.

It is important to understand that costs developed at this stage were planning level costs only and included planning level contingencies for the uncertainties at this level. Cost estimates that are more detailed were prepared for selected projects after the optimized solution evaluation stage and are discussed in Volume 3, Chapter 4.

3.2.2. BENEFIT-COST ANALYSIS

The MSD benefit-cost value model was used to consistently calculate benefits for the solution alternatives. Project-specific values, branching, and benefits based on SSO solutions and locations are discussed in this section.

3.2.2.1. PROJECT-SPECIFIC VALUES

The WWT identified community values to be considered during SSO abatement planning. The community values identified were asset protection, customer satisfaction, eco-friendly solutions, economic vitality, environmental enhancement, environmental justice and equity, financial equity, financial stewardship, public health enhancement, public education, and regulatory performance. However, not all of these values were specifically analyzed as part of the benefit-cost analysis. Five project specific values were selected to provide a comprehensive and viable benefit-cost analysis.

Five Project-Specific Core Values

1. Regulatory Performance
2. Public Health Enhancement
3. Asset Protection
4. Environmental Enhancement
5. Eco-Friendly Solutions

To enhance the benefit-cost ratio process, the WWT assigned weighting factors on a zero to ten scale to each of the five values to reflect the degree of importance to the overall control plan impact to the community. The values and assigned weights that were used to score benefits were as follows:

- Public Health 10
- Regulatory Performance 8
- Environmental Enhancement 8
- Asset Protection 6
- Eco-Friendly Solution 6

One module for each of the five core values exists within the benefit-cost analysis tool in addition to a module that summarizes the resulting scores and costs for up to five alternatives per SSO or branch.

Regulatory Performance and Public Health were scored on a 25-point severity-frequency matrix according to SSO volume and frequency. The baseline characteristics of the SSO were initially scored, followed by scoring the remaining overflow/frequency resulting from the proposed solution. The difference in these values was the benefit score, with a higher score indicating a higher reduction in risk, or higher value of benefit. The Asset Protection value was also scored on a 25 point severity-frequency scale (level of protection versus damage impact) to account for reduction in basement flooding by a proposed SSO solution.

The Environmental Enhancement and Eco-Friendly Solution values were scored using several performance metrics that represent a variety of aspects related to the environment or ecosystems, Each of the aspects were scored on a 10-point negative-to-positive scale (-5 to +5). Environmental Enhancement primarily assesses aquatic impact, while Eco-Friendly Solutions assesses broader land/energy impacts of proposed SSO solution alternatives.

3.2.2.2. BENEFITS BASED ON SSO LOCATIONS AND SSO SOLUTIONS

Two values, Regulatory Performance and Public Health Enhancement, are specific to the frequency and magnitude of each individual SSO location. Therefore, benefits are calculated separately for each SSO for both the existing conditions and proposed conditions, after the solution is in place.

The other three values, Eco-Friendly Solutions, Environmental Enhancement and Asset Protection, are specific to the type of solution. Therefore, benefits are calculated by solution and SSOs in the branch receive the same score for both the existing conditions and proposed conditions, after the solution is in place.

3.2.2.3. BRANCHING OR CLUSTERS

As described above, benefits are calculated for each SSO individually at the Regulatory Performance and Public Health levels, and then aggregated for a “cluster” (branch) of SSOs to calculate Asset Protection, Environmental Enhancement, and Eco-Friendly Solutions scores.

Consequently, the net benefit is very much dependent on the number of SSOs in each cluster. Accordingly, net benefits cannot be compared directly from branch to branch. Likewise, benefit-cost ratios cannot be directly compared. Within a branch, however, net benefits can be directly compared and resulting benefit-cost ratios will identify the best solutions.

Table 3.2.1 shows an example of the calculations involved in determining a total benefit score for a cluster of SSOs.

Table 3.2.1 Example Benefit Calculation for One Branch

SSO ID	REGULATORY PERFORMANCE	PUBLIC HEALTH	ASSET PROTECTION	ENVIRONMENTAL ENHANCEMENT	ECO-FRIENDLY SOLUTIONS
MSD0023	12	7	4	4	1
MSD0010	5	2	4	4	1
MSD0007	5	2	4	4	1
26752	5	7	4	4	1
41416	5	5	4	4	1
24472	5	5	4	4	1
41374	0	0	4	4	1
MSD0024	0	2	4	4	1
24152-W	0	0	4	4	1
Sum	*37*	*30*	*36*	*36*	*9*
Weighting Factor	***8***	***10***	***6***	***8***	***6***
Weighted Benefit Score	***296***	***300***	***216***	***288***	***54***
Total Benefit Score	*1154*				

3.2.3. BENEFIT-COST RATIO ANALYSIS

The total weighted benefit-cost ratio can be automatically calculated for alternatives based on the total costs and the weighted benefit scores. Two weighted benefit-cost ratios are calculated; one using capital costs and the other using total present worth costs. Each branch solution has unique benefit-cost ratios for each level of protection. Once the ratios are calculated, the alternatives require further review relative to overall program values and objectives to determine which alternative best fits the overall needs of the community. In addition to the five core values, other values were considered including: Customer Satisfaction, Economic Vitality, Environmental Justice and Equity, Financial Equity, Financial Stewardship, and Public Education.

Benefit-cost Ratio Analysis examples are presented for each individual watershed solution in the following section.

3.3. EVALUATION OF SSO ABATEMENT ALTERNATIVES

The following sections summarize initial solutions considered for each modeled watershed, and the solution feasibility screening that included a thorough investigation of individual properties and sewer alignments in each branch (ground truthing). Additionally, modeled solution analyses including the benefit-cost procedure and the solution technology selected for each branch at the 1.82-inch cloudburst storm level are summarized for each modeled watershed. Appendix 3.1.2 contains the detailed ground truthing documents related to initial solutions. Appendix 3.3.1 contains the detailed cost sheets, benefit-cost analyses, solution maps, and fact sheets for all modeled solutions from 2009. The initial solutions and feasibility screening presented for each area represent the 2009 initial solutions. Previous minor modifications to each of the projects are briefly summarized in this section. For any project where a minor modification was made, a letter detailing the changes was submitted and approved (Appendix 4.0-1).

The benefit-cost analysis tables for each area represent the BCA based on the most recent modification, where applicable. If only a portion of a much larger project was changed, the BCA score was not re-performed because the overall benefits do not change.

Appendix 3.3.1 Preferred Solution Cost Tables, Benefit-Cost Tables, Maps, Fact Sheets

Appendix is same as 2012 IOAP Modification and is provided on external USB storage drive.

3.3.1. CEDAR CREEK ALTERNATIVES

Details on branching and SSO descriptions for Cedar Creek can be found in Volume 3, Chapter 2, Section 2.5.3. The initial solution development process is summarized in detail in Sections 3.1.3 and 3.1.3.3 contains information on the ground truthing procedure.

3.3.1.1. INITIAL SOLUTIONS AND FEASIBILITY SCREENING

Initial solutions were investigated before any baseline conditions (i.e. Capital Projects) or RDI/I reduction were applied; therefore, some preliminary SSOs analyzed in the initial solutions were not considered in the project development phase due to the effects of the baseline conditions or RDI/I reduction. In these cases, the SSO was eliminated and, therefore, is not summarized below.

Branch 70158

This branch includes SSOs caused by a hydraulic bottleneck. The land surrounding the SSOs includes homes that are approximately 100 feet away from the SSO location, which was the former location of the Idlewood WQTC.

The conveyance alternative considered was to build a parallel relief line or increase the existing interceptor size. Initial assessment showed enough room for a construction easement. The first storage alternative considered was to construct a wet weather storage facility near the SSO location. Based on ground truthing, the open land originally considered for the storage facility near the SSO site has development planned. The best location for a storage facility would require additional conveyance downstream approximately 500 feet away. The second storage alternative considered was to construct large pipe in the vicinity of the SSOs to provide inline storage. Ground truthing for inline storage found that 70 percent of the property is in the 100-year floodplain, and the utility conflicts would be minimal.

Branch 81316

This branch includes SSOs caused by insufficient capacity at the Fairmount Road Pump Station to handle upstream flows. The surrounding area is residential but consists of ample open space.

The conveyance alternative considered upgrading the pump station. The first storage alternative considered was to construct a wet weather storage facility onsite. The second storage alternative considered was to construct large pipe in the vicinity of the SSOs to provide inline storage. Ground truthing for inline storage found that 80 percent of the property is in the 100-year floodplain and there is a potential utility conflict with an overhead electrical line.

Branch 67997

This branch includes SSOs caused by insufficient capacity of the interceptor to handle upstream flows during wet weather. The conveyance alternative considered was to increase the existing interceptor pipe size. No storage alternatives were considered for this branch due to lack of available open land. Ground truthing for pipe upgrades found that 90 percent of the property is in the 100-year floodplain and potential utility conflicts may occur with electrical and gas line crossings.

Branch MSD1025

This branch includes an SSO caused by insufficient capacity at the Bardstown Road Pump Station to handle upstream flows. This pump station was not reported as an SSO location until mid-2008; therefore, no initial solutions were developed for this location since it was not known at the time of initial solution development. Solutions, however, were developed later during the solution alternative analysis process discussed below.

Branch MSD1080

This branch includes an SSO caused by insufficient capacity at the Running Fox Pump Station to handle upstream flows. This SSO location was not reported as an SSO until mid-2008; therefore, no initial solutions were developed for the locations since they were not known at the time of initial solution development. Solutions, however, were developed later during the solution alternative analysis process.

3.3.1.2. MODELED SOLUTIONS - BENEFIT COST ANALYSIS

The following section summarizes the solution alternative analysis for each of the branches in Cedar Creek. Based on ground truthing findings and judgments made during the modeling process, some initial solutions identified in the previous section may not have been evaluated. Section 3.2 provides detail on the solution alternative development and selection process. Appendix 3.3.1 contains the detailed cost sheets, benefit-cost analyses, solution maps, and fact sheets for all modeled solutions.

Branch 70158

Based on the benefit-cost analysis, the chosen solution for Cedar Creek Branch 70158 (Idlewood) is Inline Storage. Table 3.3.1 summarizes the solutions considered and the benefit-cost ratios associated with each solution.

Table 3.3.1 Cedar Creek Branch 70158 Solution Alternatives

PROJECT ID	SOLUTION TECHNOLOGY	PROJECT DESCRIPTION	BENEFIT/ COST RATIO (CAPITAL COST)	BENEFIT/ COST RATIO (PRESENT WORTH)
S_CC_CC_70158_M_09A_C	Inline Storage	Inline storage with 955 linear feet (LF) of (84" - 120") pipe to store wet weather peak flow, and upgrade 1,747 LF of (8" - 15") sewer to increase hydraulic capacity during wet weather peak flows.	24.66	31.36
S_CC_CC_70158_M_01_C	Pipe Upgrades	Upsize 8,218 LF of interceptor pipes.	5.76	7.26

Branch 81316

The 2009 chosen solution for Cedar Creek Branch 81316 (Fairmount Rd. PS) was Pump Station Upgrades. The Pump Station Upgrades solution was a capital project known as the Fairmount Rd. Pump Station Expansion Project (E00303) which was planned in 2009 to install three new pumps at Fairmount Rd. Pump Station. The new pumps were sized to accommodate future development per the Cedar Creek Action Plan. In 2010, various alternatives were considered for the elimination of the Jeffersontown WQTC blending, with the final selected alternative being the elimination of the WQTC. In the selected alternative, a portion of the flow from the Jeffersontown WQTC was diverted to the Cedar Creek WQTC. Based on this diversion, the Fairmount Road Pump Station alternative was re-evaluated, and the final selected alternative was to construct a 3.4 MG offline storage basin at the site. No diversion options existed and capacity increases were not possible due to capacity limitations at the WQTC. A minor modification letter explaining the modification was delivered in 2012 (Appendix 4.0-1) and incorporated and approved as part of the 2012 IOAP modification. Table 3.3.2 summarizes the BCA based on the 2012 conditions.

Table 3.3.2 Cedar Creek Branch 81316 Solution Alternatives

PROJECT ID	SOLUTION TECHNOLOGY	PROJECT DESCRIPTION	BENEFIT/ COST RATIO (CAPITAL COST)	BENEFIT/ COST RATIO (PRESENT WORTH)
S_FF_CC_81316_M_03_C	Offline Storage	Construct 3.4 MG of offline storage at Pump Station site	11.11	Not Calculated

Branch 67997

The chosen solution for Cedar Creek Branch 67997(Little Cedar Creek Interceptor) is Pipe Upgrades. As discussed earlier, the only solution considered for this branch was the conveyance alternative. Table 3.3.3 summarizes the solution and the benefit-cost ratio associated with that solution.

Table 3.3.3 Cedar Creek Branch 67997 Solution Alternatives

PROJECT ID	SOLUTION TECHNOLOGY	PROJECT DESCRIPTION	BENEFIT/ COST RATIO (CAPITAL COST)	BENEFIT/ COST RATIO (PRESENT WORTH)
S_CC_CC_67997_M_01_C	Pipe Upgrades	Upsize 3,916 LF with (12" - 21") sewer pipe.	19.06	23.86

Branch MSD1025

Based on the benefit-cost analysis, the chosen solution for Cedar Creek Branch MSD1025 (Bardstown Rd. PS) is Pump Station Upgrades. Table 3.3.4 summarizes the solutions considered and the benefit-cost ratios associated with each solution.

Table 3.3.4 Cedar Creek Branch MSD1025 Solution Alternatives

PROJECT ID	SOLUTION TECHNOLOGY	PROJECT DESCRIPTION	BENEFIT/ COST RATIO (CAPITAL COST)	BENEFIT/ COST RATIO (PRESENT WORTH)
S_CC_CC_MSD1025_S_03_C	PS Upgrades	Increase capacity of the Bardstown Rd PS to handle peak flows of 0.39 MGD	34.40	29.42
S_CC_CC_MSD1025_S_09B_C	Offline Storage	Construct offline covered storage (0.063 MG) at manhole 88545 just upstream of the Bardstown Rd. PS.	28.19	28.52
S_CC_CC_MSD1025_S_09A_C	Inline Storage	Inline storage with 283 LF of 72" pipe to store wet weather peak flow.	12.88	16.50

Branch MSD1080

Based on the benefit-cost analysis, the chosen solution for Cedar Creek Branch MSD1080 (Running Fox PS) is Diversion. Table 3.3.5 summarizes the solutions considered and the benefit-cost ratios associated with each solution.

Table 3.3.5 Cedar Creek Branch MSD1080 Solution Alternatives

PROJECT ID	SOLUTION TECHNOLOGY	PROJECT DESCRIPTION	BENEFIT/ COST RATIO (CAPITAL COST)	BENEFIT/ COST RATIO (PRESENT WORTH)
S_CC_CC_MSD1080_S_01_C	Diversion	Construct 375 LF of 8" gravity sewer to eliminate Running Fox PS.	577.08	659.52
S_CC_CC_MSD1080_S_09A_C	Inline Storage	Inline storage with 400 LF of 60" pipe upstream of Running Fox PS to store wet weather peak flow.	86.72	108.82
S_CC_CC_MSD1080_S_09B_C	Offline Storage	Construct offline covered storage (.015 MG)	44.44	45.57
S_CC_CC_MSD1080_S_03_C	PS Upgrades	Increase the capacity of the Running Fox PS to handle peak flows of 0.4 MGD. Upsize 700 LF of force main to 6".	43.97	38.72

3.3.2. FLOYDS FORK ALTERNATIVES

Details on branching and SSO descriptions for Floyds Fork can be found in Volume 3, Chapter 2, Section 2.5.4. The initial solution development process summarized in detail in Sections 3.1.3 and 3.1.3.3 contains information on the ground truthing procedure.

3.3.2.1. INITIAL SOLUTIONS AND FEASIBILITY SCREENING

Initial solutions were developed before any baseline conditions (i.e. Capital Projects) or RDI/I reduction had been applied; therefore, some preliminary SSOs analyzed in the initial solutions were not considered in the project development phase due to the effects of the baseline conditions or RDI/I reduction. In these cases, the SSO was eliminated by one of the two and therefore is not summarized below.

Branch 1

This branch includes SSOs due to insufficient conveyance capacity and surcharged pipe during wet-weather events. The surrounding area is residential but includes some small open space.

The conveyance alternative considered was to increase the existing interceptor pipe size upstream of the Pope Lick Pump Station. The diversion alternative considered conveying more flow to the Woodland Hills Pump Station, and then on to the Morris Forman WQTC. The first storage alternative considered was to construct a wet weather storage facility in the residential area. The second storage alternative considered was to construct large pipes in the vicinity of the SSOs to provide inline storage.

Branch 2

This branch includes an SSO believed to be caused by a blockage at the Eden Care Pump Station that was cleared on March 18, 2006. The pump station is located in a small residential area.

The conveyance alternative considered was to upgrade the pump station and force main. The first storage alternative considered was to construct a wet weather storage facility near the SSO location but available land near the pump station is limited. The best location for a storage facility would require additional conveyance upstream approximately 600 feet. The second storage alternative considered was to construct large pipe in the vicinity of the SSOs to provide inline storage. Ground truthing for inline storage found that a small drainage ditch with riprap runs parallel to the gravity line and would most likely need to be replaced.

Branch 3

This branch includes SSOs caused by insufficient capacity at both Olde Copper Court and Ashburton Pump Stations to handle upstream flows. The surrounding area is residential with some small wooded areas near the pump stations.

The diversion alternative considered was to divert flow from the Ashburton Pump Station to an alternate gravity system. The first storage alternative considered was to construct a wet weather storage facility near the Olde Copper Court Pump Station. The second storage alternative considered was to construct large pipe in the vicinity of the Olde Copper Court Pump Station to provide inline storage. The third storage alternative considered was to construct large pipe in the woods behind residences near the Ashburton Pump Station to provide inline storage.

Ground truthing identified that a threatened/endangered species assessment is recommended because construction will take place near the wooded area. It also found potential conflicts of force main construction with two electrical lines and one gas main, and gravity sewer construction with an electrical line. Other conflicts with force main construction reveals that it runs along a very steep hill and is located very close to an existing home (would need to be constructed under existing driveway).

3.3.2.2. MODELED SOLUTIONS - BENEFIT COST ANALYSIS

The following section summarizes the solution alternative analysis for each of the branches in Floyds Fork. Based on ground truthing findings and judgments made during the modeling process, some initial solutions identified in the previous section may not have been evaluated. Section 3.2 provides detail on the solution alternative development and selection process. Appendix 3.3.1 contains the detailed cost sheets, benefit-cost analyses, solution maps, and fact sheets for all modeled solutions.

Branch 1

Based on the benefit-cost analysis, the chosen solution for Floyds Fork Branch 1 (Woodland Hills Pump Station) is Diversion. Table 3.3.6 summarizes the solutions considered and the benefit-cost ratios associated with each solution.

Table 3.3.6 Floyds Fork Branch 1 Solution Alternatives

PROJECT ID	SOLUTION TECHNOLOGY	PROJECT DESCRIPTION	BENEFIT/ COST RATIO (CAPITAL COSTS)	BENEFIT/COST RATIO (PRESENT WORTH COSTS)
S_FF_FF_NB01_S_01_C_A	Diversion	Replace the existing overflow and automated gate (to the Woodland Hills PS) with a double barrel overflow that consists of two-15 LF 12" diameter pipes. The upstream invert of the pipes needs to be 2" above the upstream invert of the exiting gravity pipe in manhole 82058. This new invert elevation will allow dry weather flow to gravity drain through the interceptor, but anything greater than dry weather flow will be diverted to the PS by an overflow pipe and reduce the surcharge further down the gravity line.	321.41	92.26
S_FF_FF_NB01_S_09A_C_A	Inline Storage	Inline storage with 400 LF and 110 LF of 48" pipes to store wet weather peak flow.	12.83	16.28
S_FF_FF_NB01_S_03_C_A	Pipe Upgrades	Upsize 1,650 LF of 15" sewer pipe with 18" sewer pipe.	10.84	13.60

Branch 2

The chosen solution for Floyds Fork Branch 2 (Eden Care PS) is Monitoring. The only overflow at this Pump Station occurred on March 18, 2006 and was believed to be caused by a blockage at the Eden Care Pump Station that was cleared on that date. Table 3.3.7 summarizes the solution chosen for Floyds Fork Branch 2.

Table 3.3.7 Floyds Fork Branch 2 Solution Alternatives

PROJECT ID	SOLUTION TECHNOLOGY	PROJECT DESCRIPTION	BENEFIT/ COST RATIO (CAPITAL COSTS)	BENEFIT/COST RATIO (PRESENT WORTH COSTS)
S_FF_FF_NB02_S_13_C	Monitor	Monitor the Eden Care PS during rain events for the next three years according to SORP protocols.	--	--

Branch 3

Based on the benefit-cost analysis, the chosen solution for Floyds Fork Branch 3 (Ashburton PS / Olde Copper PS) is Pipe and Force Main Upgrades (A). Table 3.3.8 summarizes the solutions considered and the benefit-cost ratios associated with each solution.

Table 3.3.8 Floyds Fork Branch 3 Solution Alternatives

PROJECT ID	SOLUTION TECHNOLOGY	PROJECT DESCRIPTION	BENEFIT/ COST RATIO (CAPITAL COSTS)	BENEFIT/COST RATIO (PRESENT WORTH COSTS)
S_FF_FF_NB03_M_01_C_A	Upgrade Force Main & Pipes (A)	Divert flow from Ashburton PS by upgrading 370 LF of force main from 2" to 3" and constructing 115 LF of 8" gravity sewer, also eliminates the SSO at Olde Copper Ct PS.	150.66	161.00
S_FF_FF_NB03_M_03_C_B	Force Main Upgrades	Upgrade 620 LF of force main from 2.5" to 4" at Olde Copper Ct PS and 700 LF of force main from 2" to 3" at Ashburton PS.	111.57	106.61
S_FF_FF_NB03_M_HB_C_C	Upgrade Force Main & Pipes (B)	Eliminate Olde Copper Ct PS, construct 370 LF of 8" gravity sewer to divert flow to another part of the system, upgrade 700 LF of force main from 2" to 3" for Ashburton PS.	86.27	91.31
S_FF_FF_NB03_M_HB_C_B	Inline Storage & Upgrade Force Main (A)	Inline storage with 320 LF of 42" pipe at Olde Copper Ct PS, upgrade 700 LF of force main from 2" to 3" at Ashburton PS.	52.51	59.44
S_FF_FF_NB03_M_HB_C_A	Inline Storage & Upgrade Force Main (B)	Inline storage with 150 LF of 60" pipe at Olde Copper Ct PS, upgrade 700 LF of force main from 2" to 3" at Ashburton PS.	51.19	58.40
S_FF_FF_NB03_M_03_C_A	PS & Force Main Upgrades (A)	Upgrade both pumps at Olde Copper Ct PS for a combined 60 gpm to 100 gpm; upgrade 700 LF of force main from 2" to 3" at the Ashburton PS.	47.82	42.51
S_FF_FF_NB03_M_03_C_C	PS & Force Main Upgrades (B)	Upsize existing wet well from 4' to 8' diameter and pumps at Olde Copper Ct PS for a combined 60 gpm to 90 gpm, upgrade 700 LF of force main from 2" to 3" at Ashburton PS.	27.03	27.73

3.3.3. HITE CREEK ALTERNATIVES

Details on branching and SSO descriptions for Hite Creek can be found in Volume 3, Chapter 2, Section 2.5.5. The initial solution development process is summarized in detail in Sections 3.1.3 and 3.1.3.3 contains information on the ground truthing procedure.

3.3.3.1. INITIAL SOLUTIONS AND FEASIBILITY SCREENING

Initial solutions were investigated before any baseline conditions (i.e. Capital Projects) or RDI/I reduction had been applied; therefore, some preliminary SSOs analyzed in the initial solutions were not considered in the project development phase due to the effects of the baseline conditions or RDI/I reduction. In these cases, the SSO was eliminated by one of the two and, therefore, is not summarized below.

Branch MSD1082

This branch includes SSOs caused by insufficient capacity at the Meadow Stream Pump Station to handle upstream flows. The surrounding area is a mix of single-family residential, multi-family residential, and light industrial. There is ample open space in the area.

The conveyance alternative considered either upsizing the force main or adding a wet weather force main and pump. The first storage alternative considered was to construct a wet weather storage facility in an open area near the SSO locations. The second storage alternative considered was to construct a large pipe in the vicinity of the SSOs to provide inline storage. Ground truthing found that a portion of the pump station property is in the 100-year floodplain but construction would take place outside of the floodplain.

Branch MSD1085

This branch includes an SSO caused by insufficient capacity at the Kavanaugh Road Pump Station to handle upstream flows. The surrounding area is residential with available open space.

The conveyance alternative considered upgrading the pump station. The first storage alternative considered was to construct a wet weather storage facility on residential property. The best location for a storage facility would require additional conveyance downstream approximately 200 feet. The second storage alternative considered was to construct large pipe in the vicinity of the SSO to provide inline storage. Ground truthing found a potential utility conflict with overhead electrical lines.

Branch MSD1086

This branch includes SSOs caused by insufficient capacity at the Floydsburg Road Pump Station to handle upstream flows. The surrounding area is industrial with some residential. There is some open space near the pump station and in a wooded area to the west.

The conveyance alternative considered upgrading the pump station. The storage alternative considered was to construct a wet weather storage facility on developed property. The best location for a storage facility would require additional conveyance downstream approximately 200 feet. Another alternative considered I/I reduction since the area is small (16 properties) and mostly industrial. Ground truthing at the pump station location found that the site is next to an electrical substation and several overhead and underground lines are onsite.

Branches MSD1085/MSD1086

An alternative that would eliminate SSOs at both Floydsburg Road and Kavanaugh Road Pump Stations was also considered. This alternative consisted of eliminating Floydsburg Road and Kavanaugh Road Pump Stations and constructing interceptors to run south to a new pump station site to serve the whole Crestwood area. A force main would be constructed parallel to the Floydsburg Road Interceptor.

3.3.3.2. MODELED SOLUTIONS - BENEFIT COST ANALYSIS

The following section summarizes the solution alternative analysis for each of the branches in Hite Creek. Based on ground truthing findings and judgments made during the modeling process, some initial solutions identified in the previous section may not have been evaluated. Section 3.2 provides detail on the solution alternative development and selection process. Appendix 3.3.1 contains the detailed cost sheets, benefit-cost analyses, solution maps, and fact sheets for all modeled solutions.

Branch MSD1082

Based on the benefit-cost analysis, the chosen solution for Hite Creek Branch MSD1082 (Meadow Stream PS) during the 2009 Final SDDP was Inline Storage.

After the 2009 Final SSDP, MSD received a request from the City of Crestwood to increase the capacity of the station to accommodate growth and to provide partial funding for the project. The new pump station size was evaluated as the baseline condition, and the requested size for the pump station conveyed a 10-year cloudburst event, and no storage was needed. Based on this, the selected alternative is conveyance. A minor modification letter was sent in 2012 (Appendix 4.0-1) and incorporated into and approved as part of the 2012 IOAP modification. Table 3.3.9 summarizes the BCA based on the approved minor modification.

Table 3.3.9 Hite Creek Branch MSD1082 Solution Alternatives

PROJECT ID	SOLUTION TECHNOLOGY	PROJECT DESCRIPTION	BENEFIT/ COST RATIO (CAPITAL COST)	BENEFIT/ COST RATIO (PRESENT WORTH)
S_HC_HC_MSD1082_S_09A_C	PS & FM Upgrades	Upgrades PS and install parallel 18" force main	N/A	N/A

Branch MSD1085

Based on the benefit-cost analysis, the chosen solution for Hite Creek Branch MSD1085 (Kavanaugh Rd. PS) is Pump Station and Force Main Upgrades. Table 3.3.10 summarizes the solutions considered and the benefit-cost ratios associated with each solution.

Table 3.3.10 Hite Creek Branch MSD1085 Solution Alternatives

PROJECT ID	SOLUTION TECHNOLOGY	PROJECT DESCRIPTION	BENEFIT/ COST RATIO (CAPITAL COST)	BENEFIT/ COST RATIO (PRESENT WORTH)
S_HC_HC_MSD1085_S_03_C	PS & Force Main Upgrades	Increase the capacity of the Kavanaugh Rd. PS to handle peak flows of 0.674 MGD and upgrade 2,458 LF of force main.	19.46	19.77
S_HC_HC_MSD1085_S_09A_C	Inline Storage	Inline storage with dual 968 LF, 72" influent PS lines. Additional 2,243 LF of upsized sewer is required.	5.25	6.71

Branch MSD1086

The chosen solution for Hite Creek Branch MSD1086 (Floydsburg Rd. PS) is I/I Reduction. This solution was chosen as the recommended alternative since the contributing area is small and the pump station should have enough capacity based on design calculations. If I/I reduction is deemed unsuccessful in eliminating the SSO, then the next best alternative is Pump Station Upgrades. Table 3.3.11 summarizes the solutions considered and the benefit-cost ratios associated with each solution.

Table 3.3.11 Hite Creek Branch MSD1086 Solution Alternatives

PROJECT ID	SOLUTION TECHNOLOGY	PROJECT DESCRIPTION	BENEFIT/ COST RATIO (CAPITAL COST)	BENEFIT/ COST RATIO (PRESENT WORTH)
S_HC_HC_MSD1086_M_07_C	I/I Reduction	This location is targeted for I/I source control (I/I rehab and private property program).	Cost only for Sanitary Sewer Evaluation Study (SSES) - no benefits calculated	
S_HC_HC_MSD1086_M_03_C	PS & Force Main Upgrades	Upgrade the capacity of the Floydsburg Rd. PS to handle peak flows of 0.30 MGD and upgrade 1,183 LF of force main.	19.78	19.80

Branches MSD1085/MSD1086

The Regional Pump Station alternative was not a favorable solution for Hite Creek Branches MSD1085 and MSD1086 based on the benefit-cost analysis; therefore, no further evaluation occurred for this solution. Table 3.3.12 summarizes the solution considered and the associated benefit-cost ratio.

Table 3.3.12 Hite Creek Regional Pump Station Solution Alternative

PROJECT ID	SOLUTION TECHNOLOGY	PROJECT DESCRIPTION	BENEFIT/ COST RATIO (CAPITAL COST)	BENEFIT/ COST RATIO (PRESENT WORTH)
S_HC_HC_CrestwoodPS_M_13_C	New Regional PS	Eliminate Floydsburg Road PS and Kavanaugh Road PS, construct interceptors to a new regional PS to serve the entire Crestwood area, construct 6,135 LF of force main parallel to Floydsburg Road Interceptor. Additional 6,914 LF of new sewer construction required.	8.14	9.28

3.3.4. JEFFERSONTOWN AREA ALTERNATIVES

Details on branching and SSO descriptions for Jeffersontown are in Volume 3, Chapter 2, Section 2.5.6. The initial solution development process is summarized in detail in Sections 3.1.3 and 3.1.3.3 contains information on the ground truthing procedure.

3.3.4.1. INITIAL SOLUTIONS AND FEASIBILITY SCREENING

Initial solutions were investigated before any baseline conditions (i.e. Capital Projects) or RDI/I reduction had been applied; therefore, some preliminary SSOs analyzed in the initial solutions were not considered in the project development phase due to the effects of the baseline conditions or RDI/I reduction. In these cases, the SSO was eliminated by one of the two and, therefore, is not summarized below.

Branch 1

This branch includes SSOs caused by insufficient capacity of the interceptor, siphon and Jeffersontown WQTC to handle wet weather flows. The surrounding area is a mix of commercial, industrial, residential, and athletic facilities.

Numerous storage, conveyance and diversion alternatives were considered. Most alternatives required the replacement of the interceptor from the Grassland area to the Jeffersontown WQTC. Another alternative considered a pump station or storage facility in the Grassland area.

Ground truthing revealed that 10 percent of the gravity interceptor line from the Grassland area to the Jeffersontown WQTC lies within the 100-year floodplain, has significant steep slopes, and an endangered/threatened species assessment is recommended due to the wooded area. The proposed storage site and the pump station at the Jeffersontown WQTC location lie within the 100-year floodplain and very near Chenoweth Run stream.

Branch 1A

Branch 1A includes the SSOs at the Chippewa and Chenoweth Run Pump Stations, which had previously been considered in the initial alternatives for Branch 4. Both SSOs are caused by insufficient capacity at the pump stations to handle upstream flows. The surrounding area is residential with lot sizes of approximately one acre or less. There is a large undeveloped area to the south of the Chenoweth Run Pump Station.

The conveyance alternative considered upgrading the pump station and the force main. The storage alternative considered was to construct a wet weather storage facility in the area to the south of the SSO locations.

Branch 2

This branch includes SSOs caused by insufficient capacity of the interceptor downstream of Charlane Parkway and Dell Road. The surrounding area is a mix of commercial, single-family, and multi-family residential.

The conveyance alternative considered upsizing the interceptor. The storage alternative considered was to construct a wet weather storage facility in a grassy area east of SSO ID 28391 between the railroad tracks and the sewer. Ground truthing found several utility crossings and a creek located north of the conveyance alternative.

Branch 3

This branch includes SSOs caused by insufficient capacity at the Raintree and Marian Court Pump Stations to handle upstream flows. The surrounding area is a mix of single-family and multi-family residential.

The conveyance alternative considered upgrading the pump stations. The storage alternative considered was to construct a wet weather storage facility at some undeveloped land to the northeast. An additional storage alternative could be under an existing commercial parking lot on Taylorsville Road. A diversion alternative included construction of new pipe to divert flows to an alternate system and eliminate the pump stations. Ground truthing found several utility crossings for the Marian Court Pump Station and Raintree Pump Station diversion alternative.

Branch 4

This branch includes an SSO caused by insufficient capacity at the Monticello Place Pump Station to handle upstream flows. As discussed in the Branch 1A description, several SSO locations initially evaluated in the Branch 4 network are now included in the Branch 1 solutions. The Monticello Pump Station is the only SSO location that remains in Branch 4. The surrounding area is a mix of single-family and multi-family residential.

The conveyance alternative considered upgrading the pump station. The storage alternative considered was to construct a wet weather storage facility to the south of the pump station. A diversion alternative included construction of new pipe to divert flows to an alternate system and eliminate the pump station. Ground truthing for the diversion alternative found one underground utility crossing and a creek located near the site.

3.3.4.2. MODELED SOLUTIONS - BENEFIT COST ANALYSIS

The following section summarizes the solution alternative analysis for each of the branches in Jeffersontown WQTC Branch Network. Based on ground truthing findings and judgments made during the modeling process, some initial solutions identified in the previous section may not have been evaluated. Section 3.2 provides detail on the solution alternative development and selection process. Appendix 3.3.1 contains the detailed cost sheets, benefit-cost analyses, solution maps, and fact sheets for all modeled solutions.

Branch 1

Based on the benefit-cost analysis, the 2009 chosen solution for Jeffersontown Branch 1 (Jeffersontown WQTC) was Offline Storage and Pipe Upgrades as well as a new pump station to be constructed at the Jeffersontown WQTC site. This solution would eliminate the Jeffersontown WQTC. In 2010, three additional alternatives were considered to eliminate blending. Based on this additional analysis, a modification was made to the project. The modified project still eliminates the Jeffersontown WQTC using a pump station and offline storage, but the pump station/offline storage site is moved from the plant site, and a portion of the flow from the plant is diverted to the Cedar Creek sewershed. In 2011, a minor modification letter (Appendix 4.0-1) detailing the benefits was delivered and approved. Table 3.3.13 summarizes the solutions considered and the benefit-cost ratios associated with each solution in the 2011 submittal.

Table 3.3.13 Jeffersontown Branch 1 Solution Alternatives

PROJECT ID	SOLUTION TECHNOLOGY	PROJECT DESCRIPTION	BENEFIT/ COST RATIO (CAPITAL COSTS)	BENEFIT/ COST RATIO (PRESENT WORTH COSTS)
S_JT_JT_NB01_M_01_C_A	Offline Storage, Pipe Upgrades, WQTC Elimination	Upsize the interceptor (6,200 LF) from Grassland to the WQTC. Storage facility (5.7 MG) at the WQTC site and a new PS with capacity of 10 MGD. 32,100 LF of 24" force main constructed to convey flows to the Hikes Lane Interceptor.	14.01	No Present Worth analysis performed
S_JT_JT_NB01_M_01_C_A (Alt1)	Offline Storage, Pipe Upgrades, WQTC Elimination	Upsize the interceptor (6,200 LF) from Grassland to the WQTC. Storage facility (2.3 MG) at the WQTC site and a new PS with capacity of 10 MGD. 32,100 LF of 24" force main constructed to convey flows to the Hikes Lane Interceptor. Conveyance lines to Cedar Creek	14.41	No Present Worth analysis performed
S_JT_JT_NB01_M_01_C_A (Alt2)	WQTC Upgrades, Storage & Pipe Upgrades	Upsize the interceptor (6,200 LF) from Grassland to the WQTC. Storage facility (0.5 MG) at the WQTC site and a new PS with capacity of 10 MGD. 32,100 LF of 24" force main constructed to convey flows to the Hikes Lane Interceptor. Convey Chenoweth Hills WQTC and the pumped zone of Jeffersontown (J'town) to the Billtown Road Interceptor for diversion to Cedar Creek WQTC. Replace/Repair Equipment at Jeffersontown WQTC.	11.89	No Present Worth analysis performed

Table 3.3.13 Jeffersontown Branch 1 Solution Alternatives

PROJECT ID	SOLUTION TECHNOLOGY	PROJECT DESCRIPTION	BENEFIT/ COST RATIO (CAPITAL COSTS)	BENEFIT/ COST RATIO (PRESENT WORTH COSTS)
S_JT_JT_NB01_M_01_C_A (Alt3)	Offline Storage, Pipe Upgrades, WQTC Elimination	Upsize the interceptor (1,240 LF) from Grassland to a new pump station site (Grand Ave). Storage facility (0.8 MG) at the PS site and a new PS with capacity of 10 MGD. Conveyance lines to Cedar Creek. Eliminates Chenoweth Run and Chippewa PS, and Chenoweth Hills WQTC	15.33	No Present Worth analysis performed

Branch 1A

Based on the benefit-cost analysis, the chosen solution in the 2009 Final SSDP for Jeffersontown Branch 1A (Chenoweth Run Pump Station, Chippewa Pump Station and Chenoweth Hills WQTC) was Pump Station and Force Main Upgrades. Each alternative in Branch 1A included the elimination of the Chenoweth Hills WQTC. With the 2011 approved change to the Jefferstown WQTC elimination plan, other alternatives for elimination of the pump stations and WQTC became viable. Based on the alternative analysis, the revised selected alternative was diversion by eliminating each of the pump stations and the WQTC. A minor modification letter was submitted and approved in 2015 (Appendix 4.0-1) summarizing the alternatives. Because the solutions were part of a larger solution for elimination of blending at the Jeffersontown WQTC, no further BCA was performed for Branch 1A.

Branch 2

Based on the benefit-cost analysis, the chosen solution for Jeffersontown Branch 2 (Dell Rd) is Pipe Upgrades. Table 3.3.14 summarizes the solutions considered and the benefit-cost ratios associated with each solution.

Table 3.3.14 Jeffersontown Branch 2 Solution Alternatives

PROJECT ID	SOLUTION TECHNOLOGY	PROJECT DESCRIPTION	BENEFIT/ COST RATIO (CAPITAL COSTS)	BENEFIT/ COST RATIO (PRESENT WORTH COSTS)
S_JT_JT_NB02_M_01_C	Pipe Upgrades	Upsize interceptor downstream of Charlane and Dell Road SSOs with 4,000 LF of (10”-21”) sewer.	25.01	31.35
S_JT_JT_NB02_M_09_C	Offline Storage	Construct underground pumped offline storage facility (0.18 MG) near swimming pool site and storage facility (0.03 MG) at manhole 103647.	12.02	12.55

Branch 3

Based on the benefit-cost analysis, the chosen solution for Jeffersontown Branch 3 (Raintree PS / Marian Ct. PS) is Diversion and Pipe Upgrades. Table 3.3.15 summarizes the solutions considered and the benefit-cost ratios associated with each solution.

Table 3.3.15 Jeffersontown Branch 3 Solution Alternatives

PROJECT ID	SOLUTION TECHNOLOGY	PROJECT DESCRIPTION	BENEFIT/ COST RATIO (CAPITAL COSTS)	BENEFIT/ COST RATIO (PRESENT WORTH COSTS)
S_JT_JT_NB03_M_01_C	Diversion & Pipe Upgrades	Eliminate Marian Ct. and Raintree PSs by installing 455 LF of 8" sewer from Marian Ct. PS and 400 LF of 8" sewer from Raintree PS to divert flows to the Southeast Diversion system, additional 2,675 LF of 15" sewer upgrades is required downstream of the PS diversions.	59.44	72.76
S_JT_JT_NB03_M_09_C	Offline Storage & Pipe Upgrades	Construct underground offline storage facility (0.007 MG) for Marian Ct PS, upgrade 928 LF of force main and pumps for Raintree PS to handle peak flow of 0.63 MGD, additional 2,530 LF of sewer upgrades downstream of the PS is required.	34.31	34.57
S_JT_JT_NB03_M_03_C	PS & Pipe Upgrades	Replace 878 LF of force main at Raintree PS, replace pumps at Marian Ct (to 0.3 MGD) PS and Raintree (to 0.6 MGD) PS, upsize 2,480 LF of gravity sewer downstream of the force main.	33.59	36.94

Branch 4

Based on the benefit-cost analysis, the chosen solution for Jeffersontown Branch 4 (Monticello PS) is Diversion. Table 3.3.16 summarizes the solutions considered and the benefit-cost ratios associated with each solution.

Table 3.3.16 Jeffersontown Branch 4 Solution Alternatives

PROJECT ID	SOLUTION TECHNOLOGY	PROJECT DESCRIPTION	BENEFIT/ COST RATIO (CAPITAL COSTS)	BENEFIT/COST RATIO (PRESENT WORTH COSTS)
S_JT_JT_NB04_M_01_C_C	Diversion	Eliminate Monticello PS by diverting to Derek R. Guthrie WQTC approximately 625 LF of 8" sewer.	39.43	48.90
S_JT_JT_NB04_M_03_C_C	PS Upgrades	Upgrade Monticello PS to handle peak flow of 0.75 MGD.	25.16	19.34
S_JT_JT_NB04_M_09_C_C	Offline Storage	Construct offline storage (0.053 MG) at Monticello PS.	8.83	8.59

3.3.5. MIDDLE FORK ALTERNATIVES

Details on branching and SSO descriptions for Middle Fork can be found in Volume 3, Chapter 2, Section 2.5.7. The initial solution development process is summarized in detail in Sections 3.1.3 and 3.1.3.3 contains information on the ground truthing procedure.

3.3.5.1. INITIAL SOLUTIONS AND FEASIBILITY SCREENING

Initial solutions were investigated before any baseline conditions (i.e. Capital Projects) or RDI/I reduction had been applied; therefore, some preliminary SSOs analyzed in the initial solutions were not considered in the project development phase due to the effects of the baseline conditions or RDI/I reduction. In these cases, the SSO was eliminated by one of the two and, therefore, is not summarized below.

Branch 1

This branch includes SSOs caused by insufficient capacity in the collection system and the Upper Middle Fork Pump Station to handle upstream flows. The surrounding area is mostly commercial and residential with some industrial areas in the vicinity. This Branch has been evaluated with Southeastern Diversion branches to include the costs of the Buechel Basin for various comparative analyses. Initially, alternatives for this area were developed with the review of the Interim SSDP solutions, namely the Hikes Lane Interceptor and Northern Ditch Interceptor.

Ground truthing was performed at six locations in the area. Three of the locations had property in the 100-year floodplain, and three locations showed potential utility conflicts. Ground truthing identified two sites where a threatened/endangered species assessment was recommended. Four sites contained a protected waterway and another location was identified as a potential wetland (hydric soil was found). Several creeks were noted in the areas near the investigated sites.

Branch 4

This branch includes SSOs caused by insufficient capacity at Devondale, Goose Creek and Saurel Road Pump Stations to handle upstream flows. The surrounding area is primarily residential along with a large tract of farmland to the north, and a school to the east.

The conveyance alternative considered upgrading the Goose Creek, Devondale and Saurel Road Pump Stations and force mains. The storage alternative considered was to construct a wet weather storage facility on an undeveloped property adjacent to the pump station on the north and east. Additional storage sites are also available to the east on school property and to the west on undeveloped property.

Ground truthing was performed at four locations, and all had property in the 100-year floodplain. The Saurel Road force main location showed potential utility conflicts and the project could involve construction between existing homes within the easement.

Branch 6

This branch includes SSOs caused by insufficient capacity at Anchor Estates No. 1 and No. 2 Pump Stations, and Vannah Way Pump Station. The surrounding area is single-family residential.

The conveyance alternative considered upgrading the Anchor Estates No. 1, No. 2, and Vannah Way Pump Stations and force mains. The storage alternative considered was to construct large pipe to provide inline storage at Anchor Estates No. 1 and No. 2 Pump Stations. The diversion alternative considered constructing gravity lines to alternate systems to eliminate each of the three pump stations.

Ground truthing was performed at three locations in the area, and a creek was identified at the southern end of the projects. Two locations had property in the 100-year floodplain, and one site had a threatened/endangered species assessment that was recommended. One site identified a protected waterway in the vicinity.

Branch 7

This branch includes an SSO caused by insufficient wet weather capacity in the collection system due to excessive I/I. This SSO location was not reported as an SSO until mid-2008; therefore, no initial solutions were developed for the locations since they were not known at the time of initial solution development. Solutions, however, were developed later during the solution alternative analysis process.

3.3.5.2. MODELED SOLUTIONS - BENEFIT COST ANALYSIS

The following section summarizes the solution alternative analysis for each of the branches in Middle Fork. Based on ground truthing findings and judgments made during the modeling process, some initial solutions identified in the previous section may not have been evaluated. Section 3.2 provides detail on the solution alternative development and selection process. Appendix 3.3.1 contains the detailed cost sheets, benefit-cost analyses, solution maps, and fact sheets for all modeled solutions.

Branch 1

Based on the benefit-cost analysis, the chosen solution for Middle Fork Branch 1 is Offline Storage and Pipe Upgrades (A). This branch is one of the three branches requested to be re-evaluated at the 2.25-inch cloudburst level to ensure the validity of the technology selection approach at the 1.82-inch cloudburst level.

In 2018, MSD began a more detailed review of the conditions of the existing Upper Middle Fork Pump Station and determined it would need either significant rehabilitation to perform reliably at the desired pumping rate or would need to be replaced. Based on this condition, that component of the overall plan was re-evaluated and a larger pump station at the UMFLS was proposed in-lieu of a storage basin at the car wash site. The remainder of the selected technologies, and the overall solution technology, associated with this branch remain the same. Because the general overall plan remains the same, the overall benefits remain the same. Table 3.3.17(A) summarizes the solutions considered for the 1.82-inch cloudburst storm and the benefit-cost ratios associated with each solution. Table 3.3.17(B) summarizes the solutions considered for the 2.25-inch cloudburst storm and the benefit-cost ratios associated with each solution.

Table 3.3.17(A) 2009 -Middle Fork Branch 1 – 1.82-Inch Solution Alternatives

PROJECT ID	SOLUTION TECHNOLOGY	PROJECT DESCRIPTION	BENEFIT/ COST RATIO (CAPITAL COST)	BENEFIT/ COST RATIO (PRESENT WORTH)
S_MISF_MF_NB01_M_01_C_A1	Offline Storage & Pipe Upgrades (A)	Construct 30" force main diversion to Hikes Lane Interceptor (10,200 LF), construct Middle Fork Relief Interceptor between Oxmoor Mall and Upper Middle Fork Lift Station (UMFLS), construct 1.6 MG covered facility near Car Wash Site and 17.3 MG facility at Buechel Site. 11,800 LF total new gravity pipe including Relief Interceptor, storage piping, and relief at manhole 15138.	1.14	1.26
S_MISF_MF_NB01_M_01_C_A2	Offline Storage & Pipe Upgrades (B)	Divert UMFLS to Hikes Lane Interceptor using capacity of existing pumps (no Middle Fork Interceptor required). Construct 17.3 MG storage facility at Buechel Site and 3.0 MG covered storage near Oxmoor Mall. 4,750 LF of additional gravity pipe improvements, 10,200 LF of force main.	1.06	1.15

Table 3.3.17(A) 2009 -Middle Fork Branch 1 – 1.82-Inch Solution Alternatives

PROJECT ID	SOLUTION TECHNOLOGY	PROJECT DESCRIPTION	BENEFIT/ COST RATIO (CAPITAL COST)	BENEFIT/ COST RATIO (PRESENT WORTH)
S_MISF_MF_NB01_M_01_C_A3	Offline Storage & Pipe Upgrades (C)	Construct 30" force main diversion to Hikes Lane Interceptor (10,200 LF), construct Middle Fork Relief Interceptor between Oxmoor Mall and UMFLS, construct 3 MG covered facility at Cannons Lane site and 17.3 MG storage facility at Buechel site, 11,800 LF total new gravity pipe including Relief Interceptor, storage piping, and relief at manhole 15138.	1.05	1.16
S_MISF_MF_NB01_M_01_C_B1	PS & Pipe Upgrades with Offline Storage	Divert all necessary flow through UMFLS to Hikes Lane Interceptor by upgrading pumps to convey peak discharge in diversion, construct 20.5 MG storage at Buechel Site, and construct 36" force main diversion to Hikes Lane Interceptor, 11,800 LF total new gravity pipe including Relief Interceptor, storage piping, and relief at manhole 15138., 10,200 LF of force main.	0.84	0.93

Table 3.3.17(B) Middle Fork Branch 1 – 2.25-Inch Solution Alternatives

PROJECT ID	SOLUTION TECHNOLOGY	PROJECT DESCRIPTION	BENEFIT/ COST RATIO (CAPITAL COST)	BENEFIT/ COST RATIO (PRESENT WORTH)
S_MISF_MF_NB01_M_01_B_A1	Offline Storage & Pipe Upgrades (A)	Construct 30" force main diversion to Hikes Lane Interceptor (10,200 LF), construct Middle Fork Relief Interceptor between Oxmoor Mall and Upper Middle Fork Lift Station (UMFLS), construct 7.9 MG covered facility near Car Wash Site and 30.1 MG facility at Buechel Site. 16,900 LF total new gravity pipe including Relief Interceptor, storage piping, and relief at manhole 15138.	0.96	1.07
S_MISF_MF_NB01_M_01_B_B1	PS & Pipe Upgrades with Offline Storage	Divert all necessary flow through UMFLS to Hikes Lane Interceptor by upgrading pumps to convey peak discharge in diversion, construct 57.2 MG storage at Buechel Site, and construct 36" force main diversion to Hikes Lane Interceptor, 16,900 LF total new gravity pipe including Relief Interceptor, storage piping, and relief at manhole 15138., 10,200 LF of force main.	0.95	1.06
S_MISF_MF_NB01_M_01_B_A2	Offline Storage & Pipe Upgrades (B)	Divert UMFLS to Hikes Lane Interceptor using capacity of existing pumps (no Middle Fork Interceptor required). Construct 43.1 MG storage facility at Buechel Site and 8.5 MG covered storage near Oxmoor Mall. 5,900 LF of additional gravity pipe improvements, 10,200 LF of force main.	0.95	1.03

Table 3.3.17(B) Middle Fork Branch 1 – 2.25-Inch Solution Alternatives

PROJECT ID	SOLUTION TECHNOLOGY	PROJECT DESCRIPTION	BENEFIT/ COST RATIO (CAPITAL COST)	BENEFIT/ COST RATIO (PRESENT WORTH)
S_MISF_MF_NB01_M_01_B_A3	Offline Storage & Pipe Upgrades (C)	Construct 30" force main diversion to Hikes Lane Interceptor (10,200 LF), construct Middle Fork Relief Interceptor between Oxmoor Mall and UMFLS, construct 11.3 MG covered facility at Cannons Lane site and 34 MG storage facility at Buechel site, 25,800 LF total new gravity pipe including Relief Interceptor, storage piping, and relief at manhole 15138.	0.74	0.83

As indicated in the table, the Offline Storage and Pipe Upgrades (A) alternative had the best benefit-cost ratio, independent of level of control. It can be noted that the Pump Station and Pipe Upgrades with Offline Storage changed from the worst benefit-cost ratio at the 1.82-inch level to the second best benefit-cost ratio at the 2.25-inch level. The other three alternatives used underground, covered storage which increased in cost significantly at the higher storm level. The Pump Station and Pipe Upgrades with Offline Storage assumed an open, earthen facility which has a lower incremental cost to expand. A detailed evaluation of the odor generating potential was not conducted for this technology screening step, but there is a high potential that depending on the final site selected for the storage facility, the larger facility needed to contain the 2.25-inch rain could exceed the criteria established for uncovered facilities, thus increasing the cost considerably for this alternative.

Branch 4

Based on the benefit-cost analysis, the 2009 Final SSDP chosen solution for Middle Fork Branch 4 (Devondale, Goose Creek, and Saurel Rd. PSs) was Storage and Force Main Upgrades. After 2009, MSD decided to eliminate the Bancroft WQTC, which was near the Devondale Pump Station. Based on this elimination plan, the storage basin was moved to the Bancroft WQTC site, the Devondale Pump Station was eliminated, and a new pump station was constructed at the Bancroft WQTC site. This was one component of a regional solution for the network branch, and the change is consistent with the overall selected solution. A minor modification letter was submitted in 2015 (Appendix 4.0-1), and approval was received in the same year. Table 3.3.18 summarizes the 2009 solutions considered and the benefit-cost ratios associated with each solution.

Table 3.3.18 Middle Fork Branch 4 Solution Alternatives

PROJECT ID	SOLUTION TECHNOLOGY	PROJECT DESCRIPTION	BENEFIT/ COST RATIO (CAPITAL COST)	BENEFIT/ COST RATIO (PRESENT WORTH)
S_MI_MF_NB04_M_03_B_A	Offline Storage, PS & Force Main Upgrades	Construct 0.5 MG covered storage facility near Devondale PS. Upsize 16" portion of force main at Goose Creek PS to 20" force main. Upgrade Goose Creek PS to 7.2 MGD. Replace Saurel Rd 4" force main with 6" force main. Upsize a total of 3,300 LF of force main.	10.78	11.00
S_MI_MF_NB04_M_09B_B	Inline and Offline Storage	Construct offline covered storage at Devondale PS (0.48 MG) and Goose Creek PS (0.19 MG). Inline storage with 72" pipe to store wet weather peak flow at Saurel Road PS.	9.04	9.17
S_MI_MF_NB04_M_03_B	Force Main & PS Upgrades	Upgrade the Devondale PS to handle peak flow of 1.5 MGD, upsize the force main to an 8" force main, and upsize downstream gravity pipes to 12" and 15" (5,710 LF). Upsize the 16" portion of Goose Creek force main to a 20" force main, and upgrade the PS to 7.2 MGD. Upsize 4" Saurel Rd force main to a 6" force main.	8.66	8.71

Branch 6

The chosen solution for Middle Fork Branch 6 (Anchor Estates No. 1 and 2 Pump Stations / Vannah Way Pump Station) is Diversion. This alternative was chosen because it eliminates three pump stations and has the potential for cost sharing with developers planning for new future connections in a currently un-sewered area.

Table 3.3.19 summarizes the solutions considered and the benefit-cost ratios associated with each solution.

Table 3.3.19 Middle Fork Branch 6 Solution Alternatives

PROJECT ID	SOLUTION TECHNOLOGY	PROJECT DESCRIPTION	BENEFIT/ COST RATIO (CAPITAL COST)	BENEFIT/ COST RATIO (PRESENT WORTH)
S_MI_MF_NB06_M_01_C_A	Diversion	Construct 9,790 LF of 8" to 10" diversion gravity pipe to eliminate Anchor Estates No. 1 and No. 2 PSs, and Vannah Way PS. SSES upstream of Anchor Estates No. 2 PS.	20.86	25.39
S_MI_MF_NB06_M_01_C_C	Inline Storage & Diversion (A)	Construct 3,950 LF of 8" diversion gravity pipe to eliminate Vannah Way and Anchor Estates No. 1 PS, and construct 150 LF of 72" pipe at Anchor Estates No. 2 PS to provide inline storage	32.27	39.83
S_MI_MF_NB06_M_09_C	Inline Storage & Diversion (B)	Diversion pipe to eliminate Vannah Way PS, 150 LF of 72" pipe (at Anchor Estates No. 2 PS) and 300 LF of 72" pipe (at Anchor Estates No. 1 PS) to provide inline storage.	27.70	35.43

Table 3.3.19 Middle Fork Branch 6 Solution Alternatives

PROJECT ID	SOLUTION TECHNOLOGY	PROJECT DESCRIPTION	BENEFIT/ COST RATIO (CAPITAL COST)	BENEFIT/ COST RATIO (PRESENT WORTH)
S_MI_MF_NB06_M_01_C_B	PS Upgrades & Diversion	Construct 3,950 LF of 8" diversion gravity pipes to eliminate Vannah Way and Anchor Estates No. 1 PSs, and Anchor Estates No. 2 PS upgrades with flow diverted to Vannah PS diversion.	20.10	23.05
S_MI_MF_NB06_M_03_C	PS Upgrades	Upgrade all PSs, upsize 2,300 LF of force main, upsize 2,300 LF of downstream collector sewers.	5.34	6.11

Branch 7

The chosen solution for Middle Fork Branch 7 is I/I Reduction. This solution was chosen as the recommended alternative based on modeling results. An overflow did not occur at this manhole in the existing conditions model at the 1.82-inch or 2.25-inch cloudburst storm indicating excessive I/I during heavy rainfall is likely the problem. Table 3.3.20 summarizes the solution considered.

Table 3.3.20 Middle Fork Branch 7 Solution Alternatives

PROJECT ID	SOLUTION TECHNOLOGY	PROJECT DESCRIPTION	BENEFIT/ COST RATIO (CAPITAL COST)	BENEFIT/ COST RATIO (PRESENT WORTH)
S_MI_MF_NB07_S_07_C	I/I Reduction	This location is targeted for I/I source control (I/I rehab and private property program).	Cost only for SSES - no benefits calculated.	

3.3.6. SOUTHEASTERN DIVERSION ALTERNATIVES

Details on branching and SSO descriptions for Southeastern Diversion can be found in Volume 3, Chapter 2, Section 2.5.8. The initial solution development process is summarized in detail in Sections 3.1.3 and 3.1.3.3 contains information on the ground truthing procedure.

3.3.6.1. INITIAL SOLUTIONS AND FEASIBILITY SCREENING

Initial solutions were investigated before any baseline conditions (i.e. Capital Projects) or RDI/I reduction had been applied; therefore, some preliminary SSOs analyzed in the initial solutions were not considered in the project development phase due to the effects of the baseline conditions or RDI/I reduction. In these cases, the SSO was eliminated by one of the two and, therefore, is not summarized below.

Branch 3

This branch includes an SSO caused by insufficient capacity of the interceptor to handle upstream flows during wet weather. The surrounding area is a mix of single-family residential, multi-family residential, and light industrial.

The conveyance alternative considered was to upsize the interceptor. The first storage alternative considered was to construct a wet weather storage facility on land at the upper end of the industrial area or behind the school property. The second storage alternative considered was to construct large pipe in the vicinity of the SSOs to provide inline storage.

Ground truthing at the storage location and along the Rustic Way corridor found hydric soil which may classify the area as a potential wetland site. Additionally, the locations were recommended for a threatened/endangered species assessment.

Branch 4

This branch includes an SSO caused by insufficient capacity of the system to handle upstream flows during wet weather. The surrounding area is single-family residential.

The conveyance alternative considered was to construct a relief sewer from the SSO at Alcona Lane to the new Hikes Lane Interceptor. The storage alternative considered was to construct a wet weather storage facility on the school property adjacent to the SSO location.

Ground truthing for the conveyance alternative found the alignment is 100 percent within the 100-year floodplain and a Louisville and Jefferson County Information Consortium (LOJIC) sensitive feature tool identified a protected waterway. A threatened/endangered species assessment was recommended because a portion of the construction would take place adjacent to a stream. Potential utility conflicts identified include water service replacements.

Branch 5

This branch includes an SSO caused by insufficient capacity of the interceptor to handle upstream flows during wet weather. The surrounding area is single-family residential.

The conveyance alternative considered was to upsize the interceptor behind homes on Sutherland Drive. The first storage alternative considered was to construct a wet weather storage facility on the school property to the south of the SSO locations. The second storage alternative considered was to construct large pipe in the vicinity of the SSOs to provide inline storage.

Ground truthing for the conveyance alternative found the property is 45 percent within the 100-year floodplain and a LOJIC sensitive feature tool identified a protected waterway. The Beargrass Creek was identified at the south end of the project.

Branch 6

This branch includes an SSO caused by backwater in the Beargrass Interceptor due to obstructions in the sewer line. No initial solutions were developed for this location. This SSO is targeted for interceptor rehabilitation to remove obstructions in the downstream 42” interceptor.

3.3.6.2. MODELED SOLUTIONS - BENEFIT COST ANALYSIS

The following section summarizes the solution alternative analysis for each of the branches in the Southeastern Diversion area. Based on ground truthing findings and judgments made during the modeling process, some initial solutions identified in the previous section may not have been evaluated. Section 3.2 provides detail on the solution alternative development and selection process. Appendix 3.3.1 contains the detailed cost sheets, benefit-cost analyses, solution maps, and fact sheets for all modeled solutions.

Branch 3

The chosen solution for Southeastern Diversion Branch 3 (Parkview) is I/I Reduction. This solution was chosen as the recommended alternative since the contributing area is small and the interceptor should contain enough capacity based on design calculations. If infiltration reduction is deemed unsuccessful in eliminating the SSO, then the next best alternative is Pipe Upgrades. This solution is more desirable than the storage solution due to the proximity of the nearby school. Table 3.3.21 summarizes the solutions considered and the benefit-cost ratios associated with each solution.

Table 3.3.21 Southeastern Diversion Branch 3 Solution Alternatives

PROJECT ID	SOLUTION TECHNOLOGY	PROJECT DESCRIPTION	BENEFIT/ COST RATIO (CAPITAL COST)	BENEFIT/ COST RATIO (PRESENT WORTH)
S_SD_MF_NB03_S_07_C	I/I Reduction	This location is targeted for I/I source control (I/I rehab and private property program).	Cost only for SSES - no benefits calculated.	
S_SD_MF_NB03_S_09B_C	Offline Storage	Construct offline covered (0.084 MG) storage in open field adjacent to SSO.	22.76	22.88
S_SD_MF_NB03_S_01_C	Pipe Upgrades	Construct 2,394 LF of 10" relief sewer that parallels the existing sewer along Rustic Way.	17.14	21.23
S_SD_MF_NB03_S_09A_C	Inline Storage	Construct 752 LF of 60" sewer from manhole 19320 to 47252 and 497 LF of 42" sewer from manhole 47252 to 27280 to provide inline storage.	10.62	13.48

Branch 4

The solution for the Southeastern Diversion Branch 4 (Klondike) is Pipe Upgrades. This solution involves a 30" gravity interceptor connecting to the Hikes Lane Interceptor where the Jeffersontown Branch 1 24" force main solution connects to the Hikes Lane Interceptor. The Southeastern Diversion Branch 4 solution was priced with a 30" gravity interceptor constructed to the Hikes Lane Interceptor minus the cost of the 24" Jeffersontown force main along the same route. Table 3.3.22 summarizes the solutions considered and the benefit-cost ratios associated with each solution.

Table 3.3.22 Southeastern Diversion Branch 4 Solution Alternatives

PROJECT ID	SOLUTION TECHNOLOGY	PROJECT DESCRIPTION	BENEFIT/ COST RATIO (CAPITAL COST)	BENEFIT/ COST RATIO (PRESENT WORTH)
S_SD_MF_NB04_S_01_C_A	Pipe Upgrades	Construct 2,830 LF of 30" gravity interceptor connecting the Jeffersontown Branch 1 24" force main to the Hikes Lane Interceptor.	6.21	9.11
S_SD_MF_NB04_S_01_C_B	Pipe Upgrades	Construct 2,830 LF of 12" relief interceptor.	3.47	4.35
S_SD_MF_NB04_S_09B_C	Offline Storage	Construct a covered 0.12 MG offline storage facility in the school property adjacent to the SSO.	1.21	1.21

Branch 5

Based on the benefit-cost analysis, the chosen solution for Southeastern Diversion Branch 5 (Sutherland) is Pipe Upgrades. Table 3.3.23 summarizes the solutions considered and the benefit-cost ratios associated with each solution.

Table 3.3.23 Southeastern Diversion Branch 5 Solution Alternatives

PROJECT ID	SOLUTION TECHNOLOGY	PROJECT DESCRIPTION	BENEFIT/ COST RATIO (CAPITAL COST)	BENEFIT/ COST RATIO (PRESENT WORTH)
S_SD_MF_NB05_M_01_C	Pipe Upgrades	Upsize 1,760 LF of gravity pipe from 10" to 15" along rear yards.	20.54	25.22
S_SD_MF_NB05_M_09B_C	Offline Storage	Construct offline covered (0.089 MG) storage in an open field on school property.	18.10	18.10
S_SD_MF_NB05_M_09A_C	Inline Storage	Construct 620 LF of 60" sewer downstream of manhole ID 16649 to provide inline storage.	16.03	20.34

Branch 6

The chosen solution for Southeastern Diversion Branch 6 (BGI) is Pipe Rehab. This is based on findings during the Interceptor Condition Assessment Phase 1. Table 3.3.24 summarizes the solution considered.

Table 3.3.24 Southeastern Diversion Branch 6 Solution Alternatives

PROJECT ID	SOLUTION TECHNOLOGY	PROJECT DESCRIPTION	BENEFIT/ COST RATIO (CAPITAL COST)	BENEFIT/ COST RATIO (PRESENT WORTH)
S_SD_MF_NB06_S_13_C	Pipe Rehab	Heavily clean 2,000 LF of 42” interceptor	Cost only for Maintenance - no benefits calculated.	

3.3.7. OHIO RIVER FORCE MAIN (ORFM) ALTERNATIVES

Details on branching and SSO descriptions for ORFM can be found in Volume 3, Chapter 2, Section 2.5.9. The initial solution development process is summarized in detail in Sections 3.1.3 and 3.1.3.3 contains information on the ground truthing procedure.

3.3.7.1. INITIAL SOLUTIONS AND FEASIBILITY SCREENING

Initial solutions were investigated before any baseline conditions (i.e. Capital Projects) or RDI/I reduction had been applied; therefore, some preliminary SSOs analyzed in the initial solutions were not considered in the project development phase due to the effects of the baseline conditions or RDI/I reduction. In these cases, the SSO was eliminated by one of the two and, therefore, is not summarized below.

Branch 1

This branch includes SSOs caused by insufficient capacity at pump stations in residential neighborhoods to handle upstream flows. Each pump station location was analyzed separately.

Many of the pump stations had available space for onsite storage alternatives. The conveyance alternatives considered would include pump station upgrades as well as pipe upgrades. The diversion alternatives involved elimination of pump stations by constructing new pipe to alternate systems.

Ground truthing was performed at six locations. Four of the locations include property in the 100-year floodplain. Two locations had a threatened/endangered species assessment recommended and two locations found potential utility conflicts with water lines. One location is located 70 percent in a golf course, and another location is located east of a creek. The Mockingbird Pump Station diversion location has potential steep slope and is in a Floodplain Management Ordinance review zone. The Mellwood Pump Station ground truthing noted a protected waterway. The Mellwood Pump Station force main project has numerous water lines to cross at Zorn Avenue.

Branch 2

This branch includes an SSO caused by a hydraulic bottleneck of two 8” pipes flowing into one 8” pipe. The surrounding area is single-family residential.

The conveyance alternative considered was to increase the existing pipe size downstream of the SSO. The storage alternative considered was to construct a wet weather storage facility behind residential lots due to lack of available land.

Branch 3

This branch includes an SSO caused by insufficient capacity at the Derington Court Pump Station to handle upstream flows. The surrounding area is single-family residential.

The conveyance alternative considered upgrading the pump station. The first storage alternative considered was to construct a wet weather storage facility in an area adjacent to the SSO. The second storage alternative considered was to construct large pipe in the vicinity of the SSO to provide inline storage.

Ground truthing at the pump station property found that 10 percent of the property is in the 100-year floodplain and a sensitive feature was identified as a protected waterway southwest of the pump station. Ground truthing for offline storage found that 100 percent of the property is in the 100-year floodplain. A threatened/endangered species assessment was recommended.

Branch 4

This branch includes SSOs caused by insufficient capacity at pump stations in residential neighborhoods to handle upstream flows. Each pump station location was analyzed separately.

The conveyance alternatives considered would include pump station upgrades. The storage alternatives considered offline storage facilities in areas adjacent to the SSOs.

Ground truthing was performed at six locations. Five of the locations had properties in the 100-year floodplain. Two locations had a threatened/endangered species assessment recommended and many stream crossings were found in the area.

3.3.7.2. MODELED SOLUTIONS - BENEFIT COST ANALYSIS

The following section summarizes the solution alternative analysis for each of the branches in ORFM. Based on ground truthing findings and judgments made during the modeling process, some initial solutions identified in the previous section may not have been evaluated. Section 3.2 provides detail on the solution alternative development and selection process. Appendix 3.3.1 contains the detailed cost sheets, benefit-cost analyses, solution maps, and fact sheets for all modeled solutions.

Branch 1

Based on the benefit-cost analysis, the chosen solution for ORFM Branch 1 (Melwood PS, Mockingbird Valley PS, Winton PS is Pump Station and Pipe Upgrades and Diversion. The Winton Avenue Pump Station and Mockingbird Valley Pump Station will be eliminated by the project. Table 3.3.25 summarizes the solutions considered and the benefit-cost ratios associated with each solution.

Table 3.3.25 ORFM Branch 1 Solution Alternatives

PROJECT ID	SOLUTION TECHNOLOGY	PROJECT DESCRIPTION	BENEFIT/ COST RATIO (CAPITAL COST)	BENEFIT/ COST RATIO (PRESENT WORTH)
S_OR_MF_NB01_M_01_C	PS Upgrades, Pipe Upgrades & Diversion	Replace 1,760 LF of gravity sewer flowing into Mockingbird Valley PS, upgrade Mellwood Ave PS to handle peak flow of 2.5 MGD and flood-proof PS, upsize approximately 1,240 LF of 6" force main with 12" force main for Mellwood Ave PS, installation of 400 LF of 8" pipe for Winton PS diversion and 2,210 LF of 15" pipe for Mockingbird Valley PS diversion to alternate systems.	21.11	25.09
S_OR_MF_NB01_M_03_C	PS Upgrades & Pipe Upgrades	Replace 1,890 LF of gravity sewer flowing into Mockingbird Valley PS, upgrade pumps at Mockingbird Valley PS and Winton PS, total PS upgrade at Mellwood Ave PS, upsize 2,000 LF of force main for Mockingbird Valley PS, and upsize 1,240 LF of force main for Mellwood Ave PS.	19.55	22.90
S_OR_MF_NB01_M_09_C	Pipe Upgrades & Storage	Replace 200 LF of gravity sewer flowing into the storage area for Mockingbird Valley PS, divert Winton PS, construct 0.12 MG pumped storage facility at Mockingbird Valley PS, and construct 0.15 MG covered storage facility at Mellwood Ave PS.	14.27	15.38
S_OR_MF_NB01_M_01_C_A	Diversion, Pipe Upgrades & Storage	Replace 685 LF of 10" gravity sewer, construct 875 LF of 12" relief sewer, and 200 LF of 15" relief sewer for Mockingbird Valley PS. Additional upgrade of storage at Mellwood Ave PS to 1 MG (flood-proofed). Installation of 400 LF of 8" pipe for Winton PS diversion and 2,210 LF of 15" pipe for Mockingbird Valley PS diversion to alternate systems.	8.42	9.31

Branch 2

The chosen solution for ORFM Branch 2 (Leland) is Condition Assessment. This solution was chosen because cleaning/flushing has occurred twice since March 2006 (the last documented overflow date) at this location and no additional overflows have been reported since that date. Table 3.3.26 the solutions considered, and the benefit-cost ratios associated with each solution.

Table 3.3.26 ORFM Branch 2 Solution Alternatives

PROJECT ID	SOLUTION TECHNOLOGY	PROJECT DESCRIPTION	BENEFIT/ COST RATIO (CAPITAL COST)	BENEFIT/ COST RATIO (PRESENT WORTH)
S_OR_MF_NB02_S_13_C	Condition Assessment	Perform periodic condition assessment (TVI and Wet Weather Monitoring) for three years to determine if SSO has been eliminated.	--	--
S_OR_MF_NB02_S_01_B	Pipe Upgrades	Construct 325 LF of 8" relief sewer.	85.67	102.80
S_OR_MF_NB02_S_09_B	Offline Storage	Construct offline covered pumped storage (0.048 MG) along the gravity sewer in the rear of homes on Leland Ave.	12.74	11.45

Branch 3

The chosen solution for ORFM Branch 3 (Derington Ct. PS) is I/I Reduction. This solution was chosen as the recommended alternative due to the small contributing area and difficult surrounding conditions (steep slopes and lack of available storage sites). If I/I reduction is deemed unsuccessful in eliminating the SSO, the next best solution will be inline storage (based on Present Worth Benefit Cost ratio). Table 3.3.27 summarizes the solutions considered and the benefit-cost ratios associated with each solution.

Table 3.3.27 ORFM Branch 3 Solution Alternatives

PROJECT ID	SOLUTION TECHNOLOGY	PROJECT DESCRIPTION	BENEFIT/ COST RATIO (CAPITAL COST)	BENEFIT/ COST RATIO (PRESENT WORTH)
S_OR_MF_NB03_S_07_C	I/I Reduction	This location is targeted for I/I source control (I/I rehab and private property program).	Cost only for SSES - no benefits calculated.	
S_OR_MF_NB03_09_C_B	Offline Storage	Construct offline covered storage facility (0.016 MG) between the edge of pavement of Derington Court and the creek.	43.48	20.75
S_OR_MF_NB03_09_C_A	Inline Storage	Install 285 LF of 60" pipe parallel to the 8" gravity upstream of Derington Court PS to provide inline storage.	16.85	21.49
S_OR_MF_NB03_03_C	PS Upgrades	Upsize pumps at Derington Court PS, upsize 460 LF of force main from 4" to 6".	16.24	13.68

Branch 4

Based on the benefit-cost analysis, the 2009 chosen solution for ORFM Branch 4 (ORFM) is Pump Station and Pipe Upgrades and WQTC Elimination. This solution includes the elimination of five Prospect WQTCs. These solutions include the cost for a new Harrods Creek Pump Station but do not include the cost for additional treatment at Hite Creek WQTC. In 2015, MSD analyzed the modification of a small portion of the overall project. The interceptor upstream of the Muddy Fork Pump Station that was initially proposed to be upsized was replaced with an offline storage facility. A cost analysis and BCA was performed on this portion of the project to select this sub- alternative. Because this is only one component of a much larger project, the overall analysis comparing large-scale solutions for ORFM Branch 4 remains unchanged. Table 3.3.28 summarizes the solutions considered and the benefit-cost ratios associated with each solution. A present worth analysis was not performed for these solutions. In 2015, a minor modification letter (Appendix 4.0-1) was submitted, and approval of the modification was received in the same year.

Table 3.3.28 ORFM Branch 4 Solution Alternatives

PROJECT ID	SOLUTION TECHNOLOGY	PROJECT DESCRIPTION	BENEFIT/ COST RATIO (CAPITAL COST)	BENEFIT/ COST RATIO (PRESENT WORTH)
S_OR_MF_NB04_M_03_B_B	PS & Pipe Upgrades, WQTC Elimination	Upsize 8,300 LF of interceptor upstream of Muddy Fork PS. Upgrade pumps at Muddy Fork, Winding Falls/Phoenix Hill PS, and New Market PS. Upsize force main from Muddy Fork PS from 14" to a 24". Construct new 7.2 MGD Harrods Creek PS and 24,000 LF of 24" force main to pump flow to Hite Creek WQTC. The solution includes the elimination of the 5 Prospect WQTCs: Hunting Creek North, Hunting Creek South, Timberlake, Ken Carla, and Shadow Wood.	2.46	No Present Worth Analysis performed
S_OR_MF_NB04_M_01_B_B	Storage & PS Upgrades (A)	Construct covered storage facilities at Barbour Lane PS. Additional upsizing of interceptor upstream of Muddy Fork PS. Upgrade pumps at New Market PS.	1.94	No Present Worth Analysis performed
S_OR_MF_NB04_M_09_B_B2	PS & Force Main Upgrades	Construct additional 18" barrel for the ORFM from Muddy Fork PS to the outfall of the ORFM. This additional barrel would isolate Muddy Fork flow. Additional upsizing of interceptor required upstream of Muddy Fork PS. Upgrade pumps at Muddy Fork and New Market PSs. Upsize force main from Muddy Fork PS from 14" to an 18".	1.45	No Present Worth Analysis performed
S_OR_MF_NB04_M_09_B_B1	Storage & PS Upgrades (B)	Construct covered storage facilities at Muddy Fork PS and Winding Falls/Phoenix Hill PS. Additional upsizing of interceptor upstream of Muddy Fork PS. Upgrade pumps at New Market PS.	1.19	No Present Worth Analysis performed

3.3.8. CSO AREA ALTERNATIVES

Details on branching and SSO descriptions for the CSO area can be found in Volume 3, Chapter 2, Section 2.5.10. The initial solution development process is summarized in detail in Sections 3.1.3 and 3.1.3.3 contain information on the ground truthing procedure.

3.3.8.1. INITIAL SOLUTIONS AND FEASIBILITY SCREENING

Initial solutions were investigated before any baseline conditions (i.e. Capital Projects) or RDI/I reduction had been applied; therefore, some preliminary SSOs analyzed in the initial solutions were not considered in the project development phase due to the effects of the baseline conditions or RDI/I reduction. In these cases, the SSO was eliminated by one of the two and therefore is not summarized.

Branch 30917

This branch includes SSOs caused by insufficient capacity in the collection system in the Camp Taylor neighborhood. The land surrounding the SSOs consists of single-family and multi-family residential.

The first conveyance alternative considered replacing the entire sewer system with approximately 47,000 LF of new sewer pipe. The second conveyance alternative considered building a relief sewer to convey excess wet weather flow from documented SSOs to the downstream interceptor. The storage alternative considered construction of offline storage facilities to store excess wet weather flow. Due to the age and condition of the system, a storage option alone was not viable. Another alternative considered performing an SSES to better define the problem and target the isolated problem area.

Branch 42007

This branch includes an SSO caused most likely by insufficient capacity at the Sonne Avenue Pump Station to handle excess wet weather flow and cross connections in the Sonne Avenue Pump Station area. The surrounding area is residential and industrial and is near electrical utilities.

The conveyance alternative considered upgrading the Sonne Avenue Pump Station to handle excess wet weather flow and convey flow to the downstream combined sewer system. The storage alternative considered construction of an offline storage facility at the adjacent property.

Ground truthing found a potential utility conflict at the pump station location with electrical and gas laterals nearby.

Branch 55665

This branch includes an SSO caused most likely by insufficient capacity at the Hazelwood Pump Station to handle excess wet weather flow. This pump station was not reported as an SSO location until mid-2008; therefore, no initial solutions were developed for this location since it was not known at the time of initial solution development. Solutions, however, were developed later during the solution alternative analysis process.

3.3.8.2. MODELED SOLUTIONS - BENEFIT COST ANALYSIS

The following section summarizes the solution alternative analysis for each of the branches in the CSO area. Based on ground truthing findings and judgments made during the modeling process, some initial solutions identified in the previous section may not have been evaluated. Section 3.2 provides detail on the solution alternative development and selection process. Appendix 3.3.1 contains the detailed cost sheets, benefit-cost analyses, solution maps, and fact sheets for all modeled solutions.

Branch 30917

Based on the benefit-cost analysis, the chosen solution for CSO Branch 30917 (Camp Taylor Neighborhood) is SSES, Rehabilitation, and Replacement. The chosen solution will include a full SSES to target sewers for replacement. In 2012, a minor modification was made to expand the general area of rehabilitation based on SSES results, and some modifications were made to phasing. The modification did not change the overall selected strategy. A minor modification letter was submitted in 2012 (Appendix 4.0-1), and the modification was incorporated and approved as part of the 2012 IOAP modification. Table 3.3.29 summarizes the solutions considered and the benefit-cost ratios associated with each solution.

Table 3.3.29 CSO Branch 30917 Solution Alternatives

PROJECT ID	SOLUTION TECHNOLOGY	PROJECT DESCRIPTION	BENEFIT/ COST RATIO (CAPITAL COST)	BENEFIT/ COST RATIO (PRESENT WORTH)
S_SF_MF_30917_M_09_C	SSES, Sewer Rehabilitation/ Replacement, Offline Storage	Replace and rehabilitate targeted sewer pipe after full SSES of the Camp Taylor area. Construct a pumped 0.02 MG covered storage facility to store excess wet weather flows, additional 3,395 LF of 8" pipe required to convey flow to the facility.	69.19	65.12
S_SF_MF_30917_M_12_A_A	System Replacement	Construct approximately 46,786 LF of new sanitary sewer pipe (8" - 15") to replace existing system.	7.18	9.05

Branch 42007

The chosen solution for CSO Branch 42007 (Sonne PS) is I/I Reduction. This solution was chosen as the recommended alternative due to the small contributing area and the fact that the area is located in the combined sewer system area and likely contains numerous cross connections. If I/I reduction is deemed unsuccessful in eliminating the SSO, the next best alternative is Offline Storage. Table 3.3.30 summarizes the solution and benefit-cost ratio associated with the solution.

Table 3.3.30 CSO Branch 42007 Solution Alternatives

PROJECT ID	SOLUTION TECHNOLOGY	PROJECT DESCRIPTION	BENEFIT/ COST RATIO (CAPITAL COST)	BENEFIT/ COST RATIO (PRESENT WORTH)
S_OR_MF_42007_S_07_C	I/I Reduction	This location is targeted for I/I source control (I/I rehab and private property program)	Cost only for SSES - no benefits calculated.	
S_OR_MF_42007_S_09_C	Offline Storage	Construct offline covered pumped storage facility (0.18 MG) to store excess wet weather flows.	19.53	15.53
S_OR_MF_42007_S_03_C	PS Upgrades	Expand wet well from 6' to 12' diameter at the Sonne PS and upgrade PS to handle peak flow of 1.7 MGD.	9.26	10.12

Branch 55665

The chosen solution for CSO Branch 55665 (Hazelwood PS) is I/I Reduction. This solution was chosen as the recommended alternative due to the small contributing area and the fact that the area is located in the combined sewer system area and most likely contains numerous cross connections. If I/I reduction is deemed unsuccessful in eliminating the SSO, the next best alternative is Offline Storage and Pipe Upgrades. Table 3.3.31 summarizes the solution and the benefit-cost ratio associated with that solution.

Table 3.3.31 CSO Branch 55665 Solution Alternatives

PROJECT ID	SOLUTION TECHNOLOGY	PROJECT DESCRIPTION	BENEFIT/ COST RATIO (CAPITAL COST)	BENEFIT/ COST RATIO (PRESENT WORTH)
S_MC_MF_55665_S_07_C	I/I Reduction	This location is targeted for I/I source control (I/I rehab and private property program).	Cost only for SSES - no benefits calculated.	
S_MC_MF_55665_S_13_C_B	Offline Storage & Pipe Upgrades	Construct offline covered storage facility (0.45 MG) to store excess wet weather flows and upsize 1,858 LF of 8" pipe to (12"-18")	10.98	11.60

3.3.9. SMALL WQTC AREA ALTERNATIVES

Details on branching and SSO descriptions for the Small WQTC areas can be found in Volume 3, Chapter 2, Section 2.5.11. The initial solution development process is summarized in detail in Sections 3.1.3 and 3.1.3.3 contains information on the ground truthing procedure.

3.3.9.1. INITIAL SOLUTIONS AND FEASIBILITY SCREENING

Initial solutions were investigated before any baseline conditions (i.e. Capital Projects) or RDI/I reduction had been applied; therefore, some preliminary SSOs analyzed in the initial solutions were not considered in the project development phase due to the effects of the baseline conditions or RDI/I reduction. In these cases, the SSO was eliminated by one of the two and therefore is not summarized.

Berrytown Branch 1

This branch includes an SSO caused by insufficient capacity at the Lucas Lane Lift Station (LS) to handle upstream flows. With the exception of a few residences, the area surrounding the SSO is mostly open space and is adjacent to Goose Creek.

The conveyance alternative considered upgrading the wet well, pump station, and force main. The storage alternative considered constructing large pipe in the vicinity of the SSOs to provide inline storage. The diversion alternative considered diverting flow to the Morris Forman WQTC through a force main. However, numerous utility lines would need to be avoided.

Ground truthing found a significant topographical feature identified as a drainage ditch that runs the length of the last two gravity sewer pipes upstream of the Lift Station. There are several trees growing above or very near the existing gravity sewer (sewer is currently scheduled to be replaced) potentially making replacement very difficult, and a resident's retaining wall is within ten feet of the proposed construction. The retaining wall would not impede construction of the proposed storage facility and the offline storage alternative would not require replacement of the entire sewer.

Chenoweth Hills Branch 1

This branch initially included an SSO located at the Chenoweth Hills WQTC caused by upstream flows greater than the WQTC capacity. The surrounding area is single-family residential. After initial solutions were investigated, it was found that the Chenoweth Hills WQTC location could be incorporated into the Jeffersontown Branch 1A solution. The SSO addressed by this branch is now the St. Rene Road Pump Station. This pump station was not reported as an SSO location until mid-2008; therefore, no initial solutions were developed for this location since it was not known at the time of initial solution development. Solutions, however, were developed later during the solution alternative analysis process.

Hunting Creek North Branch 1

This branch includes an SSO caused by insufficient capacity at the Riding Ridge Pump Station to handle upstream flows. The surrounding area is primarily residential with wooded and green space.

The conveyance alternative considered upgrading the wet well, pump station, and force main. Storage alternatives included constructing storage facilities in wooded areas near the SSO. Another storage alternative considered was to construct a large pipe in the vicinity of the SSO to provide inline storage. Ground truthing found an overhead electrical line runs near the pump station but is not in the potential area for a storage facility.

Hunting Creek North Branch 2

This branch includes an SSO caused by insufficient capacity at the Gunpowder Pump Station to handle upstream flows. The surrounding area is primarily residential.

The conveyance alternative considered upgrading the wet well, pump station, and force main. The only storage alternative considered was to construct large pipe in the vicinity of the SSO to provide inline storage. Ground truthing at the Gunpowder Pump Station found water and gas mains and an underground electrical line that run parallel to the pump station, but the site was found to be suitable.

Hunting Creek North Branch 3

This branch includes an SSO caused by insufficient capacity at the Fox Harbor No. 1 and No. 2 Pump Stations to handle upstream flows. These SSO locations were not reported as SSOs until mid-2008; therefore, no initial solutions were developed for the locations since they were not known at the time of initial solution development. Solutions, however, were developed later during the solution alternative analysis process.

Hunting Creek South Branch 1

This branch includes an SSO caused by insufficient capacity at the Fairway View Pump Station to handle upstream flows. The surrounding area is mostly residential with some open area and a golf course.

The conveyance alternative considered upgrading the wet well, pump station, and force main. The first storage alternative considered was to construct a wet weather storage facility in a small wooded area. The second storage alternative considered was to construct a large pipe in the vicinity of the SSO to provide inline storage. Ground truthing found the pipe upstream of the SSO intersects with three electrical lines and a gas main.

Hunting Creek South Branch 2

This branch includes an SSO caused by insufficient capacity at the Deep Creek Pump Station to handle upstream flows. The surrounding area is mostly residential with wooded areas in backyards.

The conveyance alternative considered upgrading the wet well and the pump station, and possibly the force main. The first storage alternative considered was to construct a wet weather storage facility in a small wooded area. The second storage alternative considered was to construct large pipe in the vicinity of the SSO to provide inline storage. Another alternative considered building a storage facility at Deep Creek Trail Pump Station and reducing the pumping rate at Deep Creek Pump Station. Ground truthing identified electrical, water, and gas lines as potential utility conflicts.

Lake Forest Branch 1

This branch includes an SSO caused by insufficient capacity at the Lake Forest Pump Station to handle upstream flows. The surrounding area is single-family residential.

The conveyance alternative considered upgrading the wet well, pump station, and force main. The first storage alternative considered was to construct a wet weather storage facility; however, there are no locations available to build a storage facility near the pump station. There is an area near the Worthing Pump Station where volume could be stored to delay pumping to the Lake Forest Pump Station. The second storage alternative considered was to construct large pipe in the vicinity of the SSO to provide inline storage.

3.3.9.2. MODELED SOLUTIONS - BENEFIT COST ANALYSIS

The following section summarizes the solution alternative analysis for each of the branches in Small WQTC areas. Based on ground truthing findings and judgments made during the modeling process, some initial solutions identified in the previous section may not have been evaluated. Section 3.2 provides detail on the solution alternative development and selection process. Appendix 3.3.1 contains the detailed cost sheets, benefit-cost analyses, solution maps, and fact sheets for all modeled solutions.

Berrytown Branch 1

Based on the benefit-cost analysis, the chosen solution in the 2009 SSDP for Berrytown Branch 1 (Lucas Lane PS) was Inline Storage. Based on additional flow monitoring and calibration performed in 2019 and 2020, this project was re-evaluted, and it was determined the SSO would not overflow during a 10-year cloudburst event. Based on this result, the project was eliminated. A minor modification letter will be submitted with the this SSDP modification. The offline and inline storage solution ratios were almost identical, so other values were taken into account such as reduced maintenance costs due to self-flushing pipe (no need to clean).

Chenoweth Hills Branch 1

Based on the benefit-cost analysis, the 2009 chosen solution for Chenoweth Hills Branch 1 (St. Rene Rd. PS) was Inline Storage. In 2010, the Jeffersontown WQTC blending elimination plan was re-analyzed, and the revised solution was to divert a portion of the flow to the Cedar Creek WQTC through a series of gravity interceptors and pump stations. The proposed alternative passed within 700 feet of this pump station, allowing the pump station to be eliminated by gravity.at a lower cost. A minor modification letter was submitted and approval was received in 2015 (Appendix 4.0-1).

Hunting Creek North Branch 1

Based on the benefit-cost analysis, the chosen solution for Hunting Creek North Branch 1 (Riding Ridge PS) is Pump Station Upgrades. Table 3.3.32 summarizes the solutions considered and the benefit-cost ratios associated with each solution.

Table 3.3.32 Hunting Creek North Branch 1 Solution Alternatives

PROJECT ID	SOLUTION TECHNOLOGY	PROJECT DESCRIPTION	BENEFIT/ COST RATIO (CAPITAL COST)	BENEFIT/ COST RATIO (PRESENT WORTH)
S_HC_HN_NB01_S_03_C_A	PS Upgrades	Upgrade Riding Ridge PS to handle peak flow of 0.075 MGD.	66.40	52.02
S_HC_HN_NB01_S_09A_C_A	Inline Storage	Upsize 131 LF of existing 8" sewer to 12", and lower its slope via a drop manhole at its upstream end.	29.65	37.96
S_HC_HN_NB01_S_03_C_B	Force Main Upgrades	Upsize 1,464 LF of force main at Riding Ridge PS from 2" to 2.5".	24.95	24.12

Hunting Creek North Branch 2

Based on the benefit-cost analysis, the chosen solution for Hunting Creek North Branch 2 (Gunpowder PS) is Inline Storage. This branch is one of the three branches requested to be re-evaluated at the 2.25-inch cloudburst level to ensure the validity of the technology selection approach at the 1.82-inch cloudburst level. Table 3.3.33(A) summarizes the solutions considered for the 1.82-inch cloudburst storm and the benefit-cost ratios associated with each solution. Table 3.3.36(B) summarizes the solutions considered for the 2.25-inch cloudburst storm and the benefit-cost ratios associated with each solution.

Table 3.3.33(A) Hunting Creek North Branch 2 - 1.82-Inch Solution Alternatives

PROJECT ID	SOLUTION TECHNOLOGY	PROJECT DESCRIPTION	BENEFIT/ COST RATIO (CAPITAL COST)	BENEFIT/ COST RATIO (PRESENT WORTH)
S_HC_HN_NB02_S_09A_C_B	Inline Storage	Replace 120 LF of 8" with 60" sewer pipe to provide inline storage, 28 LF of additional pipe upgrades required.	61.73	78.71
S_HC_HN_NB02_S_09A_C_A	Inline Storage	Replace 252 LF of 8" with 48" sewer pipe to provide inline storage.	39.75	50.66
S_HC_HN_NB02_S_03_C_A	PS Upgrades	Upgrade both pumps to 155 gpm each, increase wet well to 8 ft diameter, and upsize 3,485 LF of force main to 6" at the Gunpowder PS	8.87	9.09

Table 3.3.36(B) Hunting Creek North Branch 2 - 2.25-Inch Solution Alternatives

PROJECT ID	SOLUTION TECHNOLOGY	PROJECT DESCRIPTION	BENEFIT/ COST RATIO (CAPITAL COST)	BENEFIT/ COST RATIO (PRESENT WORTH)
S_HC_HN_NB02_S_09A_B_B	Inline Storage	Replace 120 LF of 8" (east of the lift station) with 60" sewer pipe as well as replace 148 LF of 8" sewer (west of the lift station) with 60" sewer pipe to provide in-line storage.	46.33	59.15
S_HC_HN_NB02_S_03_B_A	PS Upgrades	Upgrade both pumps to 220 gpm each, increase the wet well to 8 feet in diameter and upsize entire force main to 6" at the Gunpowder PS	11.29	11.62

As indicated Table 3.3.36(B), Inline Storage is the preferred alternative independent of level of control.

Hunting Creek North Branch 3

Based on the benefit-cost analysis, the 2009 chosen solution for Hunting Creek North Branch 3 (Fox Harbor No. 1 and No. 2 PSs) was Inline Storage. Based on additional flow monitoring and calibration performed in 2018 and 2019, this project was re-evaluted, and it was determined the SSO would not overflow during a 10-year cloudburst event. Based on this result, the project was eliminated. A minor modification letter was submitted in 2019 (Appendix 4.0-1), and approval was received in 2020.

Hunting Creek South Branch 1

The chosen solution for Hunting Creek South Branch 1 (Fairway View PS) is Pump Station Upgrades. While Offline Storage had a higher benefit/cost ratio, pump replacement is a lower capital cost and can be accomplished easily with no underground construction that would disrupt the surrounding neighborhood. This is consistent with the community values of customer satisfaction and economic vitality. Table 3.3.34 summarizes the solutions considered and the benefit-cost ratios associated with each solution.

Table 3.3.34 Hunting Creek South Branch 1

PROJECT ID	SOLUTION TECHNOLOGY	PROJECT DESCRIPTION	BENEFIT/ COST RATIO (CAPITAL COST)	BENEFIT/ COST RATIO (PRESENT WORTH)
S_HC_HS_NB01_S_03_C_A	PS Upgrades	Upgrade the three pumps at Fairway View PS to 100, 100, and 120 gpm (previously 88 gpm each).	10.71	10.32
S_HC_HS_NB01_S_09A_C_B	Offline Storage	Construct offline covered storage facility (.0075 MG) upstream of Fairway View PS, upsize additional 175 LF of gravity sewer upstream of the PS.	29.69	33.55
S_HC_HS_NB01_S_13_C_A_	PS & Pipe Upgrades	Upgrade the three pumps to 92 gpm (previously 88 gpm each), upsize 152 LF of gravity sewer upstream of PS from 8" to 24", new pipe entrances at a lower elevation drilled into wet well for larger pipe diameters.	10.25	10.20

Hunting Creek South Branch 2

The chosen solution for Hunting Creek South Branch 2 (Deep Creek PS) is Diversion. During the solution optimization process (discussed in Volume 3, Chapter 4) it was discovered that this pump station could be eliminated with 130 linear feet of 8” pipe connecting to the new Harrods Creek Interceptor, analyzed in Branch 4 of the ORFM model. Therefore, the solutions initially analyzed for this branch are no longer warranted and the Deep Creek Pump Station will be addressed with ORFM Branch 4 solutions. Table 3.3.35 summarizes the solutions previously considered and the benefit-cost ratios associated with each solution.

Table 3.3.35 Hunting Creek South Branch 2 Solution Alternatives

PROJECT ID	SOLUTION TECHNOLOGY	PROJECT DESCRIPTION	BENEFIT/ COST RATIO (CAPITAL COST)	BENEFIT/ COST RATIO (PRESENT WORTH)
See ORFM Branch 4	Diversion	Construct 130 LF of 8” gravity sewer connecting to the new Harrods Creek Interceptor in ORFM Branch 4 to eliminate Deep Creek PS	--	--
S_HC_HS_NB02_S_09A_C_A	Inline Storage	Replace two 8" gravity sewers immediately upstream of the Deep Creek PS with 150 LF of 42" and 170 LF of 30" sewer pipe respectively to provide inline storage.	64.09	80.83
S_HC_HS_NB02_S_13_C_A	PS Upgrades & Inline Storage	Install two new 138 gpm pumps at PS (previously 122 gpm). Replace 150 LF of 8” sewer directly upstream of the PS with 36” pipe to provide inline storage.	22.45	22.75
S_HC_HS_NB02_S_03_C_A	PS Upgrades	Upgrade the Deep Creek PS by installing a 7' diameter wet well and installing new 156 gpm pumps (previously 122 gpm).	7.89	8.79

Lake Forest Branch 1

The chosen solution for Lake Forest Branch 1 (Lake Forest PS) is Monitoring. The Lake Forest Pump Station was upgraded in June 2008. Two new 144 gpm pumps were installed. Table 3.3.36 summarizes the solution chosen for Lake Forest Branch 1.

Table 3.3.36 Lake Forest Branch 1 Solution Alternatives

PROJECT ID	SOLUTION TECHNOLOGY	PROJECT DESCRIPTION	BENEFIT/ COST RATIO (CAPITAL COST)	BENEFIT/ COST RATIO (PRESENT WORTH)
S_FF_LF_NB01_S_13_C_A	Monitor	Monitor the Lake Forest PS during rain events for the next three years according to SORP protocols.	--	--

3.3.10. POND CREEK ALTERNATIVES

Details on branching and SSO descriptions for Pond Creek can be found in Volume 3, Chapter 2, Section 2.5.12. The 2012 SSDP update included a recalibration of the Pond Creek model. This resulted in only one project change, but changed the BCA scores for each project. However, the BCA scores for project technology selection are from the 2009 analysis and the updated values are used for LOC evaluation in Chapter 4. The initial solution development process is summarized in detail in Sections 3.1.3 and 3.1.3.3 contains information on the ground truthing procedure.

3.3.10.1. INITIAL SOLUTIONS AND FEASIBILITY SCREENING

Initial solutions were investigated before any baseline conditions (i.e. Capital Projects) or RDI/I reduction had been applied; therefore, some preliminary SSOs analyzed in the initial solutions were not considered in the project development phase due to the effects of the baseline conditions or RDI/I reduction. In these cases, the SSO was eliminated by one of the two and therefore is not summarized below.

Branch 3

This branch includes SSOs caused by insufficient capacity at the Cooper Chapel Pump Station to handle upstream flows. The surrounding area is single-family residential.

The conveyance alternative considered upgrading the pump station and collection system pipe. The storage alternative considered was to construct an off-site storage facility upstream of the pump station. The diversion alternative considered was to construct a sewer line to an alternate system to eliminate the pump station. Ground truthing at the storage location found that 30 percent of the property is in the 100-year floodplain, and a blue line stream runs through the middle of the open field. This site was not suitable for the project.

Branch 4

This branch includes SSOs caused by insufficient capacity at the Cinderella Pump Station to handle upstream flows and limited interceptor capacity downstream. The surrounding area is single-family residential.

The conveyance alternative considered upgrading the pump station and increasing the capacity of the interceptor. The storage alternative considered was to construct a larger wet well at the pump station or a storage facility at the pump station site.

Branch 5

This branch includes SSOs caused by insufficient capacity at the Lantana Drive Pump Station to handle upstream flows. The surrounding area is single-family residential.

The conveyance alternative considered upgrading the pump station. The first storage alternative considered was to construct a larger wet well at the pump station. The second storage alternative considered was to construct large pipe in the vicinity of the SSOs to provide inline storage.

Branch 6

This branch includes SSOs caused by insufficient capacity at the Government Center Pump Station to handle upstream flows. The surrounding area is mostly single-family residential with some government-owned property.

The conveyance alternative considered upgrading the pump station. The storage alternative considered was to construct underground storage beneath the parking lot at the Government Center.

Branch 7

This branch includes SSOs caused by insufficient capacity at the Avanti Pump Station to handle upstream flows. The surrounding area is primarily residential with some commercial.

The conveyance alternative considered upgrading the pump station and increasing the capacity in the downstream collector sewer. The storage alternative considered was to construct offline storage near the pump station. The diversion alternative considered was to eliminate the pump station and divert all flow to the Cedar Creek WQTC.

Branch 8 / Branch 11

This branch includes SSOs caused by insufficient capacity at the Lea Ann Way Pump Station to handle upstream flows and limited collector sewer capacity upstream of the pump station. Initially, this branch included the SSO at the Edsel Pump Station which is now included in Branch 11. This SSO is most likely caused by excessive I/I in the upstream collection system. The surrounding area is primarily single-family residential.

The conveyance alternative considered was to upgrade the pump stations. The first storage alternative considered constructing larger wet wells at the pump stations. The second storage alternative considered was to construct large pipe in the vicinity of the SSOs to provide inline storage.

Ground truthing found 60 percent of one property near Edsel Pump Station (Branch 11) is in the 100-year floodplain and a creek runs through the center of the wooded area. A threatened/endangered species assessment was recommended for this location. The location was found unsuitable for the solution.

Branch 9

This branch includes SSOs caused by a hydraulic constriction at the I-65 crossing, limited collector sewer capacity, and insufficient capacity at the Caven Avenue Pump Station to handle upstream flows. The surrounding area is mostly single-family residential with some industrial and commercial properties.

The conveyance alternative considered was to upgrade the Caven Avenue Pump Station and upsize the interceptor under I-65 and down the Outer Loop. The storage alternative considered constructing offline storage facilities in open land near the SSO locations.

Ground truthing for one potential storage location found a potential utility conflict with an electrical line. Ground truthing at the Meijer site found 10 percent of the property is in the 100-year floodplain and creeks border the west and north sides of the wooded area. A threatened/endangered species assessment was recommended for this site. A retention basin is located just west of the property. Ground truthing at another site near a nursing home found five percent of the property is in the 100-year floodplain and a threatened/endangered species assessment was recommended for the wooded area. Fishpool Creek and utilities may create conflicts. The site was found unsuitable due to shallow rock and a force main and sewer line located on the property.

Branch 10

This branch includes an SSO caused by insufficient capacity at the Leven Pump Station to handle upstream flows. This SSO location was not reported as an SSO until mid-2008; therefore, no initial solutions were developed for the locations since they were not known at the time of initial solution development. Solutions, however, were developed later during the solution alternative analysis process.

3.3.10.2. MODELED SOLUTIONS - BENEFIT COST ANALYSIS

The following section summarizes the solution alternative analysis for each of the branches in Pond Creek. Based on ground truthing findings and judgments made during the modeling process, some initial solutions identified in the previous section may not have been evaluated. Section 3.2 provides detail on the solution alternative development and selection process. Appendix 3.3.1 contains the detailed cost sheets, benefit-cost analyses, solution maps, and fact sheets for all modeled solutions.

Branch 3

The chosen solution for Pond Creek Branch 3 is Pipe Upgrades. The Charleswood Interceptor Capital Improvement Project specifically eliminates the Cooper Chapel Pump Station. This was the only solution considered at this phase because the project is currently under design. The solution listed in the table is an extension to the Capital Improvement Project due to downstream capacity problems caused by the additional flow. Table 3.3.37 summarizes the solution considered and the benefit-cost ratio associated with the solution.

Table 3.3.37 Pond Creek Branch 3 Solution Alternatives

PROJECT ID	SOLUTION TECHNOLOGY	PROJECT DESCRIPTION	BENEFIT/ COST RATIO (CAPITAL COST)	BENEFIT/ COST RATIO (PRESENT WORTH)
S_PO_WC_PC03_M_01_C	Pipe Upgrades	Upsize additional 1,846 LF of gravity sewer downstream of the Charleswood Interceptor connection to correct capacity problems.	50.30	62.84

Branch 4

The chosen solution for Pond Creek Branch 4 (Cinderella PS) is Diversion. While this does not appear to have the highest benefit/cost ratio, the cost estimates do not reflect the costs likely needed to keep the pump station in service. This pump station is nearly thirty years old and may require continual servicing and upgrades over time. When these costs are fully considered, it is likely that the diversion solution would have the highest benefit/cost ratio. Table 3.3.38 summarizes the solutions considered and the benefit-cost ratios associated with each solution.

Table 3.3.38 Pond Creek Branch 4 Solution Alternatives

PROJECT ID	SOLUTION TECHNOLOGY	PROJECT DESCRIPTION	BENEFIT/ COST RATIO (CAPITAL COST)	BENEFIT/ COST RATIO (PRESENT WORTH)
S_PO_WC_PC04_M_01_C	Diversion	Eliminate Cinderella PS by constructing 2,250 LF of 10" pipe. 208 LF of tunneling under I-265.	17.41	22.14
S_PO_WC_PC04_M_09B_C	Offline Storage	Construct offline covered storage facility at Cinderella PS (0.22 MG).	32.35	32.40
S_PO_WC_PC04_M_0103_C	PS Upgrades	Upgrade pumps at Cinderella PS to 1.5 MGD each (previously 0.5 MGD) and upsize 2,953 LF of force main from 6" to 15". Additional 2,918 LF of sewer improvements required downstream of new force main.	12.94	14.51

Branch 5

The chosen solution for Pond Creek Branch 5 (Lantana PS) is I/I Reduction. This solution was chosen as the recommended alternative due to the small contributing area. If I/I reduction is deemed unsuccessful in eliminating the SSO, the next best alternative is Offline Storage and Pipe Upgrades. Table 3.3.39 summarizes the solutions considered and the benefit-cost ratios associated with each solution.

Table 3.3.39 Pond Creek Branch 5 Solution Alternatives

PROJECT ID	SOLUTION TECHNOLOGY	PROJECT DESCRIPTION	BENEFIT/ COST RATIO (CAPITAL COST)	BENEFIT/ COST RATIO (PRESENT WORTH)
S_PO_WC_PC05_M_07_C	I/I Reduction	This location will be targeted for I/I source control (I/I Rehab and private property program.)	Cost only for SSES - no benefits calculated.	
S_PO_WC_PC05_M_0109B_C	Offline Storage & Pipe Upgrades	Construct offline covered storage facility at Lantana PS (0.08 MG). Additional 241 LF of sewer improvements (10" - 15") required upstream of PS.	71.21	72.58
S_PO_WC_PC05_M_0103_C	PS & Pipe Upgrades	Upgrade Lantana PS to handle peak flow of 1.45 MGD, upgrade or replace 1,345 LF of 8" force main, 3,770 LF of additional conveyance improvements (10" - 27") required upstream of the PS and downstream of force main.	12.53	14.48
S_PO_WC_PC05_M_09A_C	Inline Storage	Install 667 LF of 60" pipe upstream of Lantana PS to provide inline storage.	5.05	6.49

Branch 6

Based on the benefit-cost analysis, the chosen solution for Pond Creek Branch 6 (Government Center PS) is Diversion. The cost estimates for Offline Storage and Pump Station Upgrades do not reflect the costs likely needed to keep the pump station in service. When these costs are fully considered, it is likely that these solutions would have even lower benefit/cost ratios. Table 3.3.40 summarizes the solutions considered and the benefit-cost ratios associated with each solution.

Table 3.3.40 Pond Creek Branch 6 Solution Alternatives

PROJECT ID	SOLUTION TECHNOLOGY	PROJECT DESCRIPTION	BENEFIT/ COST RATIO (CAPITAL COST)	BENEFIT/ COST RATIO (PRESENT WORTH)
S_PO_WC_PC06_M_01_C	Diversion	Eliminate Government Center PS by constructing 1,350 LF of 10" pipe.	35.50	44.91
S_PO_WC_PC06_M_0109B_C	Offline Storage & Pipe Upgrades	Construct offline covered storage facility at Government Center PS (0.31 MG). Additional 220 LF of sewer improvements (10" - 12") required upstream of PS.	21.29	22.17
S_PO_WC_PC06_M_0103_C	PS & Pipe Upgrades	Upgrade pumps at Government Center PS to 2.1 MGD each (previously 1 MGD) and upsize 3,107 LF of force main to 10". Additional 3,032 LF of sewer improvements (10" - 12") required downstream of new force main.	15.38	16.70

Branch 7

Based on the benefit-cost analysis, the chosen solution for Pond Creek Branch 7 (Avanti PS) is Diversion. The cost estimates for Offline Storage and Pump Station Upgrades do not reflect the costs likely needed to keep the pump station in service. When these costs are fully considered, it is likely that these solutions would have even lower benefit/cost ratios. Table 3.3.41 summarizes the solutions considered and the benefit-cost ratios associated with each solution.

Table 3.3.41 Pond Creek Branch 7 Solution Alternatives

PROJECT ID	SOLUTION TECHNOLOGY	PROJECT DESCRIPTION	BENEFIT/ COST RATIO (CAPITAL COST)	BENEFIT/ COST RATIO (PRESENT WORTH)
S_PO_WC_PC07_M_01_C	Diversion	This alternative eliminates Avanti PS by constructing 150 LF of 8" pipe	900.43	1000.48
S_PO_WC_PC07_M_09B_C	Offline Storage	Construct offline covered storage facility at Avanti PS (0.023 MG).	256.76	263.10
S_PO_WC_PC07_M_0103_C	PS & Pipe Upgrades	Upgrade Avanti PS to handle peak flow of 1.8 MGD. Additional 1,886 LF of sewer improvements (10") required downstream of new force main.	16.80	19.52

Branch 8

The 2009 chosen solution for Pond Creek Branch 8 (Lea Ann Way) is Pipe Upgrades. This was the only solution considered because the pumps at the Lea Ann Way Pump Station were being replaced, which will increase the capacity of the pump station to 22 MGD and eliminate the SSO at the Pump Station. The first pump has been replaced and a developer was installing a fourth pump. The second and third pumps were replaced by MSD Operations in September 2008. The Pipe Upgrades solution addresses insufficient pipe capacity in the collection system upstream of the Lea Ann Way Pump Station. Since 2009, MSD also performed an SSES and rehabilitation in the area. Based on some of the SSES work, MSD decided to expand the scope to include the SSES and monitor the results to determine if more improvements were necessary. A minor modification letter was submitted in 2012 (Appendix 4.0-1), and was incorporated and approved as part of the 2012 IOAP modification. Table 3.3.42 summarizes the solution and the benefit-cost ratio associated with that solution.

Table 3.3.42 Pond Creek Branch 8 Solution Alternatives

PROJECT ID	SOLUTION TECHNOLOGY	PROJECT DESCRIPTION	BENEFIT/ COST RATIO (CAPITAL COST)	BENEFIT/ COST RATIO (PRESENT WORTH)
S_PO_WC_PC08_M_01_C	Pipe Upgrades	Upsize 3,255 LF of gravity sewer (12" - 18") upstream of Lea Ann Way PS.	39.74	49.01

Branch 9

Based on the benefit-cost analysis, the 2009 Final SSDP chosen solution for Pond Creek Branch 9 (Caven Ave PS, Outer Loop) was Offline Storage and Pipe Upgrades. In addition to the model recalibration in 2010, a project was added to the Capital Improvement Plan after 2009 to eliminate the Silver Heights WQTC near the Caven Avenue Pump Station, changing the baseline conditions of the model. The change in calibration and baseline conditions eliminated the need for the storage basin behind the Meijer store and changed the preferred solution for Caven Avenue to a pump station elimination. Table 3.3.43 summarizes the 2012 solutions for the Caven Avenue Pump Station SSO considered and the benefit-cost ratios associated with each solution. Two minor modification letters were submitted in 2012 (one to eliminate the Outer Loop Project and one to modify the Caven Ave Project) (Appendix 4.0-1), and the changes were incorporated into and approved as part of the 2012 IOAP modification.

Table 3.3.43 Pond Creek Branch 9 Solution Alternatives

PROJECT ID	SOLUTION TECHNOLOGY	PROJECT DESCRIPTION	BENEFIT/ COST RATIO (CAPITAL COST)	BENEFIT/ COST RATIO (PRESENT WORTH)
S_PO_WC_PC09_M_01_C	Diversion	Construct an 8" interceptor (2530 LF) to divert flow from Caven Avenue PS to the Silver Heights WQTC system. (2-yr solution)	121.54	139.48
S_PO_WC_PC09_M_09B_C1	Offline Storage	Construct offline covered storage facility at Caven Avenue PS (0.21 MG).	36.16	36.26

Branch 10

Based on the benefit-cost analysis, the chosen solution for Pond Creek Branch 10 (Leven PS) is Diversion. The cost estimates for Offline Storage, Inline Storage, and Pump Station Upgrades do not reflect the costs likely needed to keep the pump station in service. When these costs are fully considered, it is likely that these solutions would have even lower benefit/cost ratios. Table 3.3.44 summarizes the solutions considered and the benefit-cost ratios associated with each solution.

Table 3.3.44 Pond Creek Branch 10 Solution Alternatives

PROJECT ID	SOLUTION TECHNOLOGY	PROJECT DESCRIPTION	BENEFIT/ COST RATIO (CAPITAL COST)	BENEFIT/ COST RATIO (PRESENT WORTH)
S_PO_WC_PC10_M_01_C	Diversion	Eliminate Leven PS by constructing 890 LF of 10" pipe.	76.88	95.93
S_PO_WC_PC10_M_09B_C	Offline Storage	Construct offline covered storage facility at Leven PS (0.12 MG).	64.21	65.61
S_PO_WC_PC10_M_03_C	PS Upgrades	Upgrade Leven PS to handle peak flow of 3.42 MGD.	42.87	41.44
S_PO_WC_PC10_M_09A_C	Inline Storage	Install 1,084 LF of 48" pipe upstream of Leven PS to provide inline storage.	14.46	18.51

Branch 11

The chosen solution for Pond Creek Branch 11 (Edsel) is I/I Reduction. This solution was chosen as the recommended alternative based on modeling results. An overflow did not occur at this pump station in the existing conditions model at the 1.82-inch, 2.25-inch, or even 2.60-inch cloudburst storm indicating excessive I/I during heavy rain events is likely the problem rather than insufficient capacity at the pump station. If I/I reduction is deemed unsuccessful in eliminating the SSO, the next best alternative is Offline Storage. Table 3.3.45 summarizes the solutions considered and the benefit-cost ratios associated with each solution.

Table 3.3.45 Pond Creek Branch 11 Solution Alternatives

PROJECT ID	SOLUTION TECHNOLOGY	PROJECT DESCRIPTION	BENEFIT/ COST RATIO (CAPITAL COST)	BENEFIT/ COST RATIO (PRESENT WORTH)
S_PO_WC_PC11_M_07_C	I/I Reduction	This location is targeted for I/I source control (I/I rehab and private property program).	Cost only for SSES - no benefits calculated.	
S_PO_WC_PC11_M_0109B_C	Offline Storage	Construct offline covered storage facility at Edsel PS (0.09 MG). Additional 457 LF of sewer improvements (10" – 12") required upstream of PS.	58.87	62.63
S_PO_WC_PC11_M_0103_C	PS Upgrades	Upgrade Edsel PS to handle peak flow of 0.7 MGD and upsize 3,468 LF of force main to 10". Additional 925 LF of sewer improvements (10" – 12") required.	9.92	10.49
S_PO_WC_PC11_M_0109A_C	Inline Storage	Install 572 LF of 96" pipe upstream of Edsel PS to provide inline storage. Additional 423 LF of sewer improvements (10" - 12") required.	5.41	6.94

3.3.11. MILL CREEK ALTERNATIVES

Details on branching and SSO descriptions for Mill Creek can be found in Volume 3, Chapter 2, Section 2.5.11. The initial solution development process is summarized in detail in Sections 3.1.3 and 3.1.3.3 contain information on the ground truthing procedure.

3.3.11.1. INITIAL SOLUTIONS AND FEASIBILITY SCREENING

Initial solutions were investigated before any baseline conditions (i.e. Capital Projects) or RDI/I reduction had been applied; therefore, some preliminary SSOs analyzed in the initial solutions were not considered in the project development phase due to the effects of the baseline conditions or RDI/I reduction. In these cases, the SSO was eliminated by one of the two and therefore is not summarized below.

Branch 1

This branch includes SSOs caused by insufficient capacity at Pioneer, Fern Lea, and Garrs Lane pump stations to handle upstream flow. The land use in the area is a combination of park, residential, vacant lots, commercial, and industrial. Each pump station location was analyzed separately.

The conveyance alternatives considered pump station upgrades, pump station replacement, pipe upgrades, and pump station eliminations. The storage alternatives considered off-line storage facilities and expansion of pump station wet wells.

Ground truthing was performed at 22 locations in the Shively area. Twelve of the locations had 15 to 100 percent of the property in the 100-year floodplain. All twenty locations were found to have potential utility conflicts including water lines, gas lines, storm drains, and electrical lines. The pipe upgrade solution could affect many residential properties and landscapes.

Branch 2

This branch includes an SSO caused most likely by surface flooding in the East Rockford Pump Station area during wet weather. This pump station was not reported as an SSO location until mid-2008; therefore, no initial solutions were developed for this location since it was not known at the time of initial solution development. Solutions, however, were developed later during the solution alternative analysis process.

3.3.11.2. MODELED SOLUTIONS - BENEFIT COST ANALYSIS

The following section summarizes the solution alternative analysis for each of the branches in Mill Creek. Based on ground truthing findings and judgments made during the modeling process, some initial solutions identified in the previous section may not have been evaluated. Section 3.2 provides detail on the solution alternative development and selection process. Appendix 3.3.1 contains the detailed cost sheets, benefit-cost analyses, solution maps, and fact sheets for all modeled solutions.

Branch 1

The Shively Interceptor Capital Improvement Project specifically eliminates five pump stations: Jacks Lane Pump Station, Pioneer Pump Station, Fern Lea Pump Station, Garrs Lane Pump Station, and City Park Pump Station, three of which are documented SSOs. This project is currently in the preliminary design stage. The solution listed below includes the benefit-cost ratio for the entire project. This branch is one of the three branches requested to be re-evaluated at the 2.25-inch cloudburst level to ensure the validity of the technology selection approach at the 1.82-inch cloudburst level. Table 3.3.46(A) summarizes the solutions considered for the 1.82-inch cloudburst storm and the benefit-cost ratios associated with each solution. Table 3.3.50(B) summarizes the solutions considered for the 2.25-inch cloudburst storm and the benefit-cost ratios associated with each solution.

Table 3.3.46(A) Mill Creek Branch 1 - 1.82-Inch Solution Alternatives

PROJECT ID	SOLUTION TECHNOLOGY	PROJECT DESCRIPTION	BENEFIT/ COST RATIO (CAPITAL COST)	BENEFIT/ COST RATIO (PRESENT WORTH)
S_MC_WC_NB01_M_01_C	Pipe Upgrades	Construct 18,830 LF of new gravity sewers (8" – 18") to eliminate the Jacks Lane, Pioneer, Garrs Lane, Fern Lea, and City Park PSs. This is the Shively Interceptor capital improvement project.	4.11	5.20
S_MC_WC_NB01_M_0109_C	Offline Storage & Pipe Upgrades	Construct new gravity sewers (2,821 LF). Construct seven small offline storage facilities (0.63 MG total) and 3,214 LF of force main.	1.44	1.70

Table 3.3.50(B) Mill Creek Branch 1 – 2.25-Inch Solution Alternatives

PROJECT ID	SOLUTION TECHNOLOGY	PROJECT DESCRIPTION	BENEFIT/ COST RATIO (CAPITAL COST)	BENEFIT/ COST RATIO (PRESENT WORTH)
S_MC_WC_NB01_M_01_B	Pipe Upgrades	Construct 18,830 LF of new gravity sewers (10" – 21") to eliminate the Jacks Lane, Pioneer, Garrs Lane, Fern Lea, and City Park PSs.	5.27	6.68
S_MC_WC_NB01_M_0109_B	Offline Storage & Pipe Upgrades	Construct new gravity sewers (2,821 LF). Construct seven small offline storage facilities (0.74 MG total) and 3,214 LF of force main.	1.41	1.66

As indicated in Table 3.3.50(b), the pipe upgrades accomplished by expanding the Shively Interceptor Project has the highest benefit-cost ratio, independent of level of control. Costs are fairly similar for both technologies at each level of evaluation; however, the benefit scores are significantly lower for the Offline Storage solution due to storage facility construction in residential neighborhoods and lower impact in reducing overflow volumes during larger storm events.

Branch 2

The chosen solution for Mill Creek Branch 2 (East Rockford) is Pump Station Replacement and Relocation. No modeling was used to identify this solution. It is the only solution considered for this branch because the problem is due to street surface flooding. Table 3.3.47 summarizes the solution.

Table 3.3.47 Mill Creek Branch 2 Solution Alternatives

PROJECT ID	SOLUTION TECHNOLOGY	PROJECT DESCRIPTION
S_MC_WC_NB02_S_03_C	PS replacement and relocation	Relocate and replace East Rockford PS at 300 gpm. 150 LF of 4" force main will be replaced. Additional 150 LF of 10" gravity improvements required to relocate PS.

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APRIL 30, 2021

2021 IOAP MODIFICATION

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APPENDICES

Note: Appendices shown in italic text were not revised for the 2021 IOAP and remain the same as the 2012 IOAP Modification. All appendices have been provided on a separate USB flash drive and are not included in this report.

Chapter 4: SELECTION OF FINAL SANITARY SEWER DISCHARGE PLAN

Special Note – 2021 Modification: This chapter was initially developed in 2009. This chapter generally describes the procedures used to select the level of control, prioritize projects, and develop the Final SSDP. An overview describing SSDP progress to date and modifications made is provided at the beginning of this chapter. Items discussing procedure are unchanged, as is overall statistical information developed for the 2009 SSDP. Other items throughout this chapter related to project modifications are revised where relevant.

The Final Sanitary Sewer Discharge Plan (SSDP) approach to sanitary sewer overflow (SSO) elimination is based upon identifying the solution that provides the highest benefit-cost ratio for each modeled watershed branch. As presented in Chapter 3, Louisville, and Jefferson County Metropolitan Sewer District (MSD) developed a solution development process. The following is a summary of the Final SSDP solution development process.

- Solutions were developed that eliminated SSOs and known surcharging under site-specific levels of protection using a diverse set of solution technologies.
- Benefits, capital costs, and benefit-cost ratios were developed for each solution at the baseline level of protection (1.82-inch cloudburst storm event).
- The solution with the best benefit-cost ratio was selected for further development and analysis of the preferred level of protection.

Chapter 4 summarizes the final steps in the solution development process. The Chapter discusses the optimized level of protection evaluations and the resulting list of selected projects. Additionally, the chapter reviews the Integrated Overflow Abatement Plan (IOAP) public involvement process. The chapter ends by discussing the process used for tracking and determining success of the Final SSDP projects.

In the 2009 Final SSDP there were 49 total projects. Eight projects were split into multiple phases, creating a total of 60 Final SSDP projects. As part of the adaptive management methodology, projects are modified based on improved calibration, changed physical conditions, or the evaluation of other alternatives. The modification of projects provides an improved final project better aligned with previously determined community values. Since the 2009 Final SSDP, 14 projects have been modified (each Camp Taylor phase is considered modified) and 3 projects have been eliminated. As of December 31, 2020, 47 projects have been certified completed (including the six Interim SSDP projects), and 16 projects remain to be constructed. Twelve of the projects were certified complete 1 year or more ahead of the 2009 schedule.

Table 4.0-1 summarizes the 60 Final SSDP and six Interim SSDP projects from 2009, listing any changes to each project, the certified date if the project has been completed, and the revised schedule if the project is remaining. A copy of minor modification letters can be found in Appendix 4.0.1 and a copy of certification letters can be found in Appendix 4.0.2 A map showing the competed and remaining SSDP projects and their associated SSOs can be found in Appendix 4.0.3

Appendix 4.1.1 Minor Modification Letters

Appendix 4.1.2 Certification Letters

Appendix 4.1.3 SSO Mitigation Status

These are new appendices that were added for the 2021 IOAP Modification and are provided on external USB drive.

Table 4.1.1 Summary of Final SSDP Project Modifications

	FINAL SSDP PROJECT NAME AND IOAP ID	RECEIVING STREAM	2009 SSO(S) ELIMINATED & LEVEL OF PROTECTION	2009 TECH AND SIZE	2009 COST ESTIMATE	2009 FINISH DATE	2012 SSO(S) ELIMINATED & LEVEL OF PROTECTION	2012 TECH AND SIZE	2012 COST ESTIMATE	2012 FINISH DATE	MODIFICATION APPROVAL YEAR AND DESCRIPTION	2021 SSO(S) ELIMINATED & APPROVED LEVEL OF PROTECTION	2021 TECH AND SIZE	2021 COST ESTIMATE	2021 COMPLETION SCHEDULE DATE OR CERTIFIED YEAR
CEDAR CREEK AREA															
1	Running Fox PS Elimination *S_CC_CC_MSD1080_S_01-C*	Little Cedar Creek	2-yr, 3-hr storm for MSD1080-LS	Flow Diversion	$99,000	2023	No change	Flow Diversion	$59,700	2023	No change	2-yr, 3-hr storm for MSD1080-LS	Flow Diversion	$59,700	2010
2	Fairmount Rd PS Off-line Storage *S_FF_CC_81316_M_03_C_A*	Big Run	N/A	N/A	N/A	N/A	2-yr, 3-hr storm for 81316, 97362	Off-Line Storage	$13,439,000	2015	2012. Project added to send the flows from eliminated Jeffersontown WQTC to the Cedar Creek WQTC.	2-yr, 3-hr storm for 81316, 97362	Off-Line Storage	$14,753,500	2015
3	Idlewood Inline Storage *S_CC_CC_70158_M_09A_C*	Cedar Creek	2-yr, 3-hr storm for 28998, 28984, 63094, 63095, 70158	Inline Storage	$2,921,000	2023	No change	Inline Storage	$2,317,000	2023	2021.Revised completion date to December 31, 2025.	2-yr, 3-hr storm for 28998, 28984, 63094, 63095, 70158	Inline Storage	$4,087,400	2025
4	Bardstown Rd PS Improvements *S_CC_CC_MSD1025_S_03_B*	Big Run	5-yr, 3-hr storm for 88545	PS Upgrade	$401,000	2021	No change	PS Upgrade	$401,000	2021	2021.Revised completion date to December 31, 2030.	5-yr, 3-hr storm for 88545	PS Upgrade	$3,400,000	2030
5	Little Cedar Creek Interceptor Improvements *S_CC_CC_67997_M_01_C*	Little Cedar Creek	2-yr, 3-hr storm for 67997, 67999, 86423, 86424, 89195, 89196, 89197	Pipe Upgrades	$2,921,000	2024	No Change	Pipe Upgrades	$2,921,000	2024	2021.Revised completion date to December 31, 2025. Future. Modeling on-going, project may be eliminated.	2-yr, 3-hr storm for 67997, 67999, 86423, 86424, 89195, 89196, 89197	Pipe Upgrades	$2,400,000	2025
HITE CREEK AREA															
6	Floydsburg Rd SSES, Rehabilitation and PS Upgrade *S_HC_HC_MSD1086_M_07_C_A*	Floyds Fork, South Fork Harrods Creek	2-yr, 3-hr for MSD1086-PS, 90776, 108956, 108957, 108958	I/I Reduction	$59,000	2016	No change	I/I Reduction	$59,000	2010	No change	2-yr, 3-hr for MSD1086-PS, 90776, 108956, 108957, 108958	I/I Reduction	$50,200	2010
7	Meadow Stream PS & Force Main Upgrade *S_HC_HC_MSD1082_S_09A_C*	Floyds Fork	2-yr, 3-hr storm for 91087, MSD1082-PS	0.5 MG Storage Basin	$1,198,000	2010	10-yr, 3-hr storm for 91087, MSD1082-PS	3.89 MGD PS, new 18-inch FM	$1,011,900	2012	2012. Project changed from small storage basin to PS upgrade and new FM due to capacity needs of Crestwood. Changed LOC from 1.82 inch to 2.6 inch.	10-yr, 3-hr storm for 91087, MSD1082-PS	3.89 MGD PS, new 18-inch FM	$1,011,900	2012
8	Kavanaugh Rd PS Improvements *S_HC_HC_MSD1085_S_03_A*	Hite Creek	10-yr, 3-hr storm for MSD1085-PS	PS & FM Upgrades	$1,729,000	2024	No change	PS & FM Upgrades	$1,729,000	2024	2021.Revised completion date to December 31, 2025.	10-yr, 3-hr storm for MSD1085-PS	PS & FM Upgrades	$4,300,000	2025
FLOYDS FORK AREA															
9	Woodland Hills PS Diversion *S_FF_FF_NB01_S_01_C_A*	Pope Lick	2-yr, 3-hr storm for 33003, 65531	Flow Diversion	$21,000	2011	No change	Flow Diversion	$19,400	2011	No change	2-yr, 3-hr storm for 33003, 65531	Flow Diversion	$19,400	2010
10	Eden Care PS SSO Investigation *S_FF_FF_NB02_S_13_C*	Floyds Fork	N/A storm for Eden Care PS (MSD1105-PS)	Monitoring	N/A	2012	N/A	Monitor	N/A	2012	2012. One overflow documented at this location. MSD cleaned sewers in the vicinity and had no documented overflows for more than 3 years.	N/A	Monitoring Complete	N/A	2012

Table 4.1.1 Summary of Final SSDP Project Modifications

	FINAL SSDP PROJECT NAME AND IOAP ID	RECEIVING STREAM	2009 SSO(S) ELIMINATED & LEVEL OF PROTECTION	2009 TECH AND SIZE	2009 COST ESTIMATE	2009 FINISH DATE	2012 SSO(S) ELIMINATED & LEVEL OF PROTECTION	2012 TECH AND SIZE	2012 COST ESTIMATE	2012 FINISH DATE	MODIFICATION APPROVAL YEAR AND DESCRIPTION	2021 SSO(S) ELIMINATED & APPROVED LEVEL OF PROTECTION	2021 TECH AND SIZE	2021 COST ESTIMATE	2021 COMPLETION SCHEDULE DATE OR CERTIFIED YEAR
11	Ashburton PS Improvements and Diversion *S_FF_FF_NB03_M_01_C_A*	Floyds Fork	2-yr, 3-hr storm for Olde Copper Court PS (MSD0165-PS), Ashburton PS (MSD0166-PS)	FM & Pipes Upgrade	$168,000	2021	No change	FM & Pipes Upgrade	$30,300	2009	No change	2-yr, 3-hr storm for Olde Copper Court PS (MSD0165-PS), Ashburton PS (MSD0166-PS)	FM & Pipes Upgrade	$30,300	2009
JEFFERSONTOWN AREA															
12	Jeffersontown WQTC Elimination *S_JT_NB01_M_01_C_A*	Chenoweth Run	2-yr, 3-hr storm for 28390, 28391, 28392, 28395, 28551, 31733, Jeffersontown WQTC (28173, 64505, MSD0255, ISO28-SI)	Offline Storage, Pipe Upgrades, WQTC Eliminations	$28,386,000	2015	No change	Offline Storage, Pipe Upgrades, WQTC Eliminations	$38,773,700	2015	2010. Modified elimination plan to move new PS to Municipal Yard and divert portion of service area to Cedar Creek WQTC.	2-yr, 3-hr storm for 28390, 28391, 28392, 28395, 28551, 31733, Jeffersontown WQTC (28173, 64505, MSD0255, ISO28-SI)	Offline Storage, Pipe Upgrades, WQTC Eliminations	$38,773,700	2015
13	Chenoweth Hills WQTC Elimination and PS Improvements *S_JT_JT_NB01A_M_03_C*	Chenoweth Run	2-yr, 3-hr storm for Chenoweth Run PS (MSD0196-PS, 86052, 64096), Chenoweth WQTC PS (MSD0263A-PS), Chenoweth Hills WQTC (MSD0263)	Flow Diversion, WQTC Eliminations	$3,749,000	2015	No change	Flow Diversion, WQTC Eliminations	$3,749,000	2015	2015. Eliminated Pump Stations and WQTC via gravity to Cedar Creek.	2-yr, 3-hr storm for Chenoweth Run PS (MSD0196-PS, 86052, 64096), Chenoweth WQTC PS (MSD0263A-PS), Chenoweth Hills WQTC (MSD0263)	Flow Diversion, WQTC Eliminations	$3,011,700	2015
14	Dell Rd & Charlane Parkway Interceptor *S_JT_JT_NB02_M_01_C*	Beatty Brook	2-yr, 3-hr storm Charlane Pkwy (28250, 28249, 28340, 28336, 104289,) Dell Rd (28413, 28414, 28415, 28416, 28417)	Pipe Upgrades	$1,347,000	2022	No Change	Pipe Upgrades	$1,347,000	2022	2021.Revised completion date to December 31, 2030.	2-yr, 3-hr storm Charlane Pkwy (28250, 28249, 28340, 28336, 104289,) Dell Rd (28413, 28414, 28415, 28416, 28417)	Pipe Upgrades	$8,800,000	2030
15	Raintree and Marian Court PS Eliminations Phase 1 *S_JT_JT_NB03_M_01_C*	Beatty Brook	2-yr, 3-hr storm for Marian Ct PS (28729), Raintree PS (MSD0149-PS)	Flow Diversion	$371,000	2021	2-yr, 3-hr storm for Marian Ct PS (28729), Raintree PS (MSD0149-PS)	Flow Diversion	$371,000	2021	2021.Revised completion date to December 31, 2025.	2-yr, 3-hr storm for Marian Ct PS (28729), Raintree PS (MSD0149-PS)	Flow Diversion	$165,700	2025
16	Raintree and Marian Court PS Eliminations Phase 2 *S_JT_JT_NB03_M_01_C*		2-yr, 3-hr storm for 28719, 28711	Pipe Upgrades	$1,062,000	2021	2-yr, 3-hr storm for 28719, 28711	Pipe Upgrades	Cost combined with Phase 1	2021	2021.Revised completion date to December 31, 2030. Future: Lag in schedule allows flow monitoring for Phase 1 PS eliminations.	2-yr, 3-hr storm for 28719, 28711	Pipe Upgrades	$1,800,000	2030
17	Monticello PS Elimination *S_JT_JT_NB04_M_01_A*	Fern Creek	10-yr, 3-hr storm for Monticello Place PS (MSD0151-PS, 27969)	Flow Diversion	$304,000	2022	10-yr, 3-hr storm for Monticello Place PS (MSD0151-PS, 27969)	Flow Diversion	$207,000	2022	2021.Revised completion date to December 31, 2025. Future: Flow monitoring and calibration underway – project may not be necessary.	10-yr, 3-hr storm for Monticello Place PS (MSD0151-PS, 27969)	Flow Diversion	$464,000	2025

Table 4.1.1 Summary of Final SSDP Project Modifications

	FINAL SSDP PROJECT NAME AND IOAP ID	RECEIVING STREAM	2009 SSO(S) ELIMINATED & LEVEL OF PROTECTION	2009 TECH AND SIZE	2009 COST ESTIMATE	2009 FINISH DATE	2012 SSO(S) ELIMINATED & LEVEL OF PROTECTION	2012 TECH AND SIZE	2012 COST ESTIMATE	2012 FINISH DATE	MODIFICATION APPROVAL YEAR AND DESCRIPTION	2021 SSO(S) ELIMINATED & APPROVED LEVEL OF PROTECTION	2021 TECH AND SIZE	2021 COST ESTIMATE	2021 COMPLETION SCHEDULE DATE OR CERTIFIED YEAR
MIDDLE FORK AREA															
18	Middle Fork Relief Interceptor, Wet Weather Storage, Upper Middle Fork LS Diversion Phase 1: Buechel Basin *S_MISF_MF_NB01_M_01_C_A1*	Middle Fork Beargrass Creek	2-yr, 3-hr storm for 02932, 02932, 02933, 02935, 08537, 23211, 23212, 27005, 51221, 51160, 51161, 45835, 47583, 47593, 47596, 47603, 47604, 90700, IS021A-SI, 08935-SM	Storage Basin	$15,170,000	2023	No Change	Storage Basin	$33,684,200	2013	No Change	2-yr, 3-hr storm for 02932, 02932, 02933, 02935, 08537, 23211, 23212, 27005, 51221, 51160, 51161, 45835, 47583, 47593, 47596, 47603, 47604, 90700, IS021A-SI, 08935-SM	Storage Basin	$33,684,200	2013
19	Middle Fork Relief Interceptor, Wet Weather Storage, Upper Middle Fork LS Diversion Phase 2: UMFLS & Relief Interceptor *S_MISF_MF_NB01_M_01_C_A1*			1.6 MG Offline Storage, PS & FM Upgrades	$19,889,000	2023	No Change	1.6 MG Offline Storage at UMFLS, PS & FM Upgrades	$19,889,000	2023	2018. Replaced offline storage at UMFLS with new 30 MGD PS at UMF Site. 2021.Revised completion date to December 31, 2030.		New 30 MGD PS, Pipe & FM Upgrades	$86,408,000	2030
20	Goose Creek PS Improvements and Wet Weather Storage Phase 1: Devondale PS *S_MI_MF_NB04_M_03_B*	Goose Creek	5-yr, 3-hr storm 46891, 62418, 91629, 91630, 10593, 43472, 21628-W	Offline Storage, PS & FM Upgrades	$2,775,000	2023	No Change	Offline Storage, PS & FM Upgrades	$2,775,000	2016	2015. Combined project with Bancroft WQTC elimination. Moved storage and PS to Bancroft site instead of Devondale PS	5-yr, 3-hr storm 46891, 62418, 91629, 91630, 10593, 43472, 21628-W	Offline Storage, PS & FM Upgrades	$5,242,800	2016
21	Goose Creek PS Improvements and Wet Weather Storage Phase 2: Goose Creek PS Improvement *S_MI_MF_NB04_M_03_B*			PS & FM Upgrades	$1,676,000	2023	No Change	PS & FM Upgrades	$1,676,000	2023	2021.Revised completion date to December 31, 2035.		PS & FM Upgrades	$6,978,600	2035
22	Anchor Estates PS Elimination Phase 1: Anchor PS Elimination *S_MI_MF_NB06_M_01_A_A_1*	Middle Fork Beargrass Creek	10-yr, 3-hr storm for 0056-W, 00746, MSD0057-LS	Flow Diversion	$66,000	2016	No Change	Flow Diversion	$66,000	2016	No Change	10-yr, 3-hr storm for 0056-W, 00746, MSD0057-LS	Flow Diversion	$83,200	2016
23	Anchor Estates PS Elimination Phase 2: Vannah Way PS Elim. *S_MI_MF_NB06_M_01_A_A_1*		10-yr, 3-hr storm for 01106	, Flow Diversion	$2,275,000	2011	No Change	, Flow Diversion	$3,878,900	2011	No Change	10-yr, 3-hr storm for 01106	, Flow Diversion	$3,878,900	2011
24	Hurstbourne I/I Investigation & Rehabilitation *S_MI_MF_NB07_S_07_C*	Hurstbourne Creek	2-yr, 3-hr storm for 01793	I/I Reduction	$569,000	2011	No Change	I/I Reduction	$773,200	2011	No Change	2-yr, 3-hr storm for 01793	I/I Reduction	$773,200	2011
SOUTHEASTERN DIVERSION AREA															
25	Parkview Estates I/I Investigation & Rehabilitation *S_SD_MF_NB03_S_07_C*	South Fork Beargrass Creek	2-yr, 3-hr storm for 47250	I/I Reduction	$302,000	2011	No Change	I/I Reduction	$29,600	2011	No Change	2-yr, 3-hr storm for 47250	I/I Reduction	$29,600	2011
26	Klondike Interceptor *S_SD_MF_NB04_S_01_B_A*	South Fork Beargrass Creek	5-yr, 3-hr storm for 25676, 26650, 26651	Pipe Upgrades	$666,000	2014	No Change	Pipe Upgrades	$2,231,000	2014	No Change	5-yr, 3-hr storm for 25676, 26650, 26651	Pipe Upgrades	$2,231,000	2014
27	Sutherland Interceptor *S_SD_MF_NB05_M_01_A*	South Fork Beargrass Creek	10-yr, 3-hr storm for 16649	Pipe Upgrades	$623,000	2023	10-yr, 3-hr storm for 16649	Pipe Upgrades	$623,000	2023	2021.Revised completion date to December 31, 2030.	10-yr, 3-hr storm for 16649	Pipe Upgrades	$1,065,300	2030
28	Beargrass Interceptor Rehabilitation Phase 2 *S_SD_MF_NB06_S_13_C*	South Fork Beargrass Creek	2-yr, 3-hr storm for 51594	Pipe Rehabilitation	$59,000	2010	2-yr, 3-hr storm for 51594	Pipe Rehabilitation	$29,700	2010	No Change	2-yr, 3-hr storm for 51594	Pipe Rehabilitation	$29,700	2010
POND CREEK AREA															

Table 4.1.1 Summary of Final SSDP Project Modifications

#	FINAL SSDP PROJECT NAME AND IOAP ID	RECEIVING STREAM	2009 SSO(S) ELIMINATED & LEVEL OF PROTECTION	2009 TECH AND SIZE	2009 COST ESTIMATE	2009 FINISH DATE	2012 SSO(S) ELIMINATED & LEVEL OF PROTECTION	2012 TECH AND SIZE	2012 COST ESTIMATE	2012 FINISH DATE	MODIFICATION APPROVAL YEAR AND DESCRIPTION	2021 SSO(S) ELIMINATED & APPROVED LEVEL OF PROTECTION	2021 TECH AND SIZE	2021 COST ESTIMATE	2021 COMPLETION SCHEDULE DATE OR CERTIFIED YEAR
29	Charleswood Interceptor Extension *S_PO_WC_PC03_M_01_C*	Fishpool Creek	2-yr, 3-hr storm 25477, 25478, 25480, MSD0130-PS	Pipe Upgrades	$886,000	2015	2-yr, 3-hr storm 25477, 25478, 25480, MSD0130-PS	Pipe Upgrades	$1,213,400	2015	No Change	2-yr, 3-hr storm 25477, 25478, 25480, MSD0130-PS	Pipe Upgrades	$1,213,400	2015
30	Cinderella PS Elimination *S_PO_WC_PC04_M_01_C*	Fishpool Creek	2-yr, 3-hr storm 60679, MSD1013-PS, 35309	Flow Diversion	$3,395,000	2025	2-yr, 3-hr storm 60679, MSD1013-PS, 35309	Flow Diversion	$1,500,000	2025	2021.Revised completion date to December 31, 2025.	2-yr, 3-hr storm 60679, MSD1013-PS, 35309	Flow Diversion	$1,500,000	2025
31	Lantana PS I/I Investigation & Rehabilitation *S_PO_WC_PC05_M_07_C*	Pennsylvania Run	2-yr, 3-hr storm 25484, 93719, MSD0101-PS	I/I Reduction	$21.000	2011	2-yr, 3-hr storm 25484, 93719, MSD0101-PS	Investigation Complete	$164,000	2011	No Change	2-yr, 3-hr storm 25484, 93719, MSD0101-PS	Investigation Complete	$164,000	2011
32	Government Center PS Elimination *S_PO_WC_PC06_M_01_C*	Pennsylvania Run	10-yr, 3-hr storm for MSD0180-PS	Flow Diversion	$1,909,000	2011	10-yr, 3-hr storm for MSD0180-PS	Flow Diversion	$353,600	2011	No Change	10-yr, 3-hr storm for MSD0180-PS	Flow Diversion	$353,600	2011
33	Avanti PS Elimination *S_PO_WC_PC07_M_01_A*	Little Cedar Creek	2-yr, 3-hr storm for 21229-W	Flow Diversion	$32,000	2009	2-yr, 3-hr storm for 21229-W	Flow Diversion	$32,000	2009	No Change	2-yr, 3-hr storm for 21229-W	Flow Diversion	$32,000	2009
34	Lea Ann Way System Improvements *S_PO_WC_PC08_M_01_C*	Fern Creek	2-yr, 3-hr storm 19360, 19369, 29933, 29948, 29943, 31083, 31084, 79076, MSD1010-PS	Pipe Upgrades	$987,000	2015	2-yr, 3-hr storm 19360, 19369, 29933, 29948, 29943, 31083, 31084, 79076, MSD1010-PS	Pipe Upgrades	$4,863,900	2015	2012. Combined SSES projects and performed additional sewer inspection and rehabilitation.	2-yr, 3-hr storm 19360, 19369, 29933, 29948, 29943, 31083, 31084, 79076, MSD1010-PS	Pipe Upgrades	$4,863,900	2015
35	Caven Ave PS Elimination & Offline Storage Phase 1: Caven Ave PS Elimination *S_PO_WC_PC09_M_09B_C*	Fishpool Creek	2-yr, 3-hr storm for 27116, MSD0133-PS	Offline Storage	$1,672,000	2016	2-yr, 3-hr storm for 27116, MSD0133-PS	Flow Diversion	$2,923,000	2016	2012. Elimination of nearby WQTC allowed for PS elimination instead of offline storage.	2-yr, 3-hr storm for 27116, MSD0133-PS	Flow Diversion	$2,923,000	2016
E	Caven Ave PS Elimination & Offline Storage Phase 2: Outer Loop Storage *S_PO_WC_PC09_M_09B_C*		2-yr, 3-hr storm for 70212, 17724	Offline Storage	Cost combined with Phase 1	N/A	2-yr, 3-hr storm for 70212, 17724	Project Eliminated	N/A	N/A	2012. Project eliminated due to new flow monitoring and model re-calibration.	2-yr, 3-hr storm for 70212, 17724	Project Eliminated	N/A	N/A
36	Leven PS Elimination *S_PO_WC_PC10_M_01_C*	Pennsylvania Run	2-yr, 3-hr storm for 36419, MSD1019-PS	Flow Diversion	$352,000	2022	2-yr, 3-hr storm for 36419, MSD1019-PS	Flow Diversion	$352,000	2022	2021.Revised completion date to December 31, 2025.	2-yr, 3-hr storm for 36419, MSD1019-PS	Flow Diversion	$720,000	2025
37	Edsel PS I/I Investigation & Rehabilitation *S_PO_WC_PC11_M_07_C*	Fern Creek	2-yr, 3-hr storm for 92098, MSD1048-PS	I/I Reduction	$389,000	2011	2-yr, 3-hr storm for 92098, MSD1048-PS	I/I Reduction	$1,289.800	2011	No Change	2-yr, 3-hr storm for 92098, MSD1048-PS	I/I Reduction	$1,289.800	2011
OHIIO RIVER FORCE MAIN (ORFM) AREA															
38	Mellwood System Improvements, PS Eliminations, Phase 1: Mellwood PS *S_OR_MF_NB01_M_01_B*	Muddy Fork Beargrass Creek	5-yr, 3-hr storm 26752, 41374, 41416, MSD0007-PS, MSD0010-PS, 24472, MSD0023-PS, 24152-W, MSD0024-PS	PS Replacement	$2,369,000	2012	5-yr, 3-hr storm 26752, 41374, 41416, MSD0007-PS, MSD0010-PS, 24472, MSD0023-PS, 24152-W, MSD0024-PS	Flow Diversion, PS and Pipe Upgrades	$2,369,000	2012	No Change	5-yr, 3-hr storm 26752, 41374, 41416, MSD0007-PS, MSD0010-PS, 24472, MSD0023-PS, 24152-W, MSD0024-PS	PS Replacement	$3,275,800	2012
39	Mellwood System Improvements, PS Eliminations, Phase 2: Mockingbird Valley & Winton PS *S_OR_MF_NB01_M_01_B*			Flow Diversion, PS and Pipe Upgrades	$1,302,000	2024		Flow Diversion, PS and Pipe Upgrades	$1,302,000	2024	2021.Revised completion date to December 31, 2030.		Flow Diversion, PS and Pipe Upgrades	$2,516,100	2030

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40	Leland Road SSO Investigation *S_OR_MF_NB02_A_13_C*	Cherrywood Creek	N/A storm for 96020	Condition Assessment	N/A	N/A	N/A	Condition Assessment	N/A	N/A	2012. One overflow documented at this location. MSD cleaned sewers in the vicinity and had no documented overflows for more than 3 years.	N/A	Assessment Completed	N/A	2012
41	Derington Ct. PS I/I Investigation & Rehabilitation *S_OR_MF_NB03_S_07_C*	Goose Creek	2-yr, 3-hr storm for MSD0095-PS	I/I Reduction	$290,000	2012	2-yr, 3-hr storm for MSD0095-PS	I/I Reduction	N/A	2012	No Change	2-yr, 3-hr storm for MSD0095-PS	I/I Reduction	Included in FY12 I/I Budget	2012
42	Prospect WQTC Elimination, Harrods Creek PS, ORFM System Improvements Phase 1: WQTC Eliminations *S_OR_MF_NB04_M_3_B_B*	Little Goose Creek	5-yr, 3-hr storm 40870, 40871, 40872, 42680, 65633, 65635, 22436, MSD0123-PS, MSD1044-PS, MSD0183-PS, MSD0192-PS, MSD0193-PS, MSD1063-PS, MSD0292	WQTC Elimination	$34,062,000	2015	5-yr, 3-hr storm 40870, 40871, 40872, 42680, 65633, 65635, 22436, MSD0123-PS, MSD1044-PS, MSD0183-PS, MSD0192-PS, MSD0193-PS, MSD1063-PS, MSD0292	WQTC Elimination	$34,062,000	2015	No Change	5-yr, 3-hr storm 40870, 40871, 40872, 42680, 65633, 65635, 22436, MSD0123-PS, MSD1044-PS, MSD0183-PS, MSD0192-PS, MSD0193-PS, MSD1063-PS, MSD0292	WQTC Elimination	$1,941,900	2015
43	Prospect WQTC Elimination, Harrods Creek PS, ORFM System Improvements Phase 2: HCPS & FM *S_OR_MF_NB04_M_3_B_B*	Little Goose Creek		PS and Pipe Upgrades		2015		PS and Pipe Upgrades		2015	No Change		PS and Pipe Upgrades		2015
44	Prospect WQTC Elimination, Harrods Creek PS, ORFM System Improvements Phase 3: ORFM System Improvements *S_OR_MF_NB04_M_3_B_B*	Little Goose Creek		Flow Diversion, PS and Pipe Upgrades		2016		Flow Diversion, PS and Pipe Upgrades		2016	2015. Replaced Muddy Fork Interceptor Upsizing with Muddy Fork Offline Storage Basin		Flow Diversion, PS Upgrade, Offline Storage Basin		2016
MILL CREEK AREA															
45	Shively Interceptor *S_MC_WC_NB01_M_01_A*	Lynnview Ditch	10-yr, 3-hr storm 04498, 04542, 81814-W, MSD0047-PS, MSD0050-PS	Pipe Upgrades	$19,034,000	2012	10-yr, 3-hr storm 04498, 04542, 81814-W, MSD0047-PS, MSD0050-PS	Pipe Upgrades	$11,473,500	2012	No Change	10-yr, 3-hr storm 04498, 04542, 81814-W, MSD0047-PS, MSD0050-PS	Pipe Upgrades	$11,473,500	2012
46	East Rockford PS Relocation *S_MC_WC_NB02_S_03_C*	Mill Creek	2-yr, 3-hr storm for 04699-W	PS Replacement and Relocation	$1,488,000	2012	2-yr, 3-hr storm for 04699-W	PS Replacement and Relocation	$541,300	2012	No Change	2-yr, 3-hr storm for 04699-W	PS Replacement and Relocation	$541,300	2012
SMALL WQTC AREA															
E	Lucas Lane PS Inline Storage *S_FF_NB01_S_09A_C_A*	Goose Creek	2-yr, 3-hr storm for MSD0199-LS	Inline Storage	$261,000	2021	2-yr, 3-hr storm for MSD0199-LS	Inline Storage	$320,000	2021	2021. Project eliminated due to more detailed model calibration.	2-yr, 3-hr storm for MSD0199-LS	Project Eliminated	N/A	N/A
47	Riding Ridge PS Improvements *S_HC_HN_NB02_S_03_C_A*	Harrods Creek	2-yr, 3-hr storm for MSD1060-LS	PS Upgrades	$31,000	2014	2-yr, 3-hr storm for MSD1060-LS	PS Upgrades	$31,000	2014	No Change	2-yr, 3-hr storm for MSD1060-LS	PS Upgrades	$19,200	2014
48	Gunpowder PS Inline Storage *S_HC_HN_NB02_S_09A_C_B*	Harrods Creek	2-yr, 3-hr storm for MSD1055-LS	Inline Storage	$251,000	2021	2-yr, 3-hr storm for MSD1055-LS	Inline Storage	$251,000	2021	2021.Revised completion date to December 31, 2025.	2-yr, 3-hr storm for MSD1055-LS	Inline Storage	$800,000	2025
E	Fox Harbor Inline Storage *S_HC_HN_NB03_S_09A_A_A*	Harrods Creek	10-yr, 3-hr storm for 62769	Inline Storage	$468,000	2021	10-yr, 3-hr storm for 62769	Inline Storage	$468,000	2021	2019. Project eliminated due to more detailed model calibration.	10-yr, 3-hr storm for 62769	Project Eliminated	N/A	N/A
49	Fairway View PS Improvements *S_FF_LF_NB01_S_03_C_A*	Harrods Creek	2-yr, 3-hr storm for MSD1065-PS	PS Upgrades	$101,000	2014	2-yr, 3-hr storm for MSD1065-PS	PS Upgrades	$101,000	2014	No Change	2-yr, 3-hr storm for MSD1065-PS	PS Upgrades	$359,500	2014

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50	Lake Forest PS SSO Investigation *S_FF_LF_NB01_S_13_C_A*	Chenoweth Run	N/A storm for MSD1169-LS	Monitor	$650,000	2012	N/A storm for MSD1169-LS	Monitor	$650,000	2012	No Change	N/A storm for MSD1169-LS	Monitor	$650,500	2012
51	St. Rene Rd PS Inline Storage *S_FF_CH_NB01_S_09A_C_A*	Chenoweth Run	2-yr, 3-hr storm for 94187	Inline Storage	$43,000	2014	2-yr, 3-hr storm for 94187	Inline Storage	$43,000	2014	2015. Project changed to PS Elimination	2-yr, 3-hr storm for 94187	Flow Diversion	Included in Jeffersontown WQTC Elimination	2014
COMBINED SEWER SYSTEM AREA															
52	Sonne PS I/I Investigation *S_OR_MF_42007_S_07_C*	Paddy Run	2-yr, 3-hr storm for MSD0042-PS	I/I Reduction	$281,000	2011	2-yr, 3-hr storm for MSD0042-PS	I/I Reduction	$846,500	2011	No Change	2-yr, 3-hr storm for MSD0042-PS	I/I Reduction	$846,500	2011
53	Camp Taylor System Improvements, Phase 1: SSES *S_SF_MF_30917_M_09_A*			SSES				SSES		2011			SSES	$12,367,100	2011
54	Camp Taylor System Improvements, Phase 2: Replace & Rehabilitate Sewers *S_SF_MF_30917_M_09_A*	Muddy Fork Beargrass Creek	10-yr, 3-hr storm 08717, 13931, 13943, 36763, 44396, 44397, 66349, 104223, 104231	Sewer Replacement & Rehabilitation	$37,927,000	2014	10-yr, 3-hr storm 08717, 13931, 13943, 36763, 44396, 44397, 66349, 104223, 104231	Sewer Replacement & Rehabilitation		2017	2012. Modification combined Phases 2 & 3 and expanded overall area	10-yr, 3-hr storm 08717, 13931, 13943, 36763, 44396, 44397, 66349, 104223, 104231	Sewer Replacement & Rehabilitation	$29,345,500	2013
55	Camp Taylor System Improvements, Phase 3: Replace & Rehabilitate Sewers *S_SF_MF_30917_M_09_A*			Sewer Replacement & Rehabilitation											2017
56	Camp Taylor System Improvements, Phase 4: Offline Storage *S_SF_MF_30917_M_09_A*			Offline Storage				Offline Storage		2024	2021.Revised completion date to December 31, 2035. Future: Monitoring on-going – project may not be necessary		Offline Storage	$23,972,300	2035
57	Hazelwood PS I/I Investigation & Rehabilitation *S_MC_MF_55665_S_07_C*	Manslick Branch	2-yr, 3-hr storm for 55665	I/I Reduction	$184,000	2011	2-yr, 3-hr storm for 55665	I/I Reduction	$382,000	2011	No Change	2-yr, 3-hr storm for 55665	I/I Reduction	$382,100	2011
INTERIM SSDP															
1	Hikes Lane Interceptor and Highgate Springs	South Fork Beargrass Creek and Wedgewood Ditch	2-yr, 3-hr storm for 18134, 18298, 18302, 18483, 18595, 49224, 49236, 49672, 49673, MSD0012-PS	New Sewer	$23,183,000	2012	N/A	N/A	N/A	N/A	N/A	N/A	N/A	$13,821,500	2012
2	Southeastern Diversion Structure & Interceptor	South Fork Beargrass Creek	8426, 8427, 8430, 8431, 18654, 30680, 30681, 30701, 30702, 30704, 49647, 63779, 72571-X	Diversion Structure	$1,906,000	2012	N/A	N/A	N/A	N/A	N/A	N/A	N/A	$8,589,600	2012
3	Northern Ditch Diversion Interceptor	Northern Ditch	MSD0271	New Sewer	$21,639,000	2011	N/A	N/A	N/A	N/A	N/A	N/A	N/A	$14,104,600	2011
4	Sinking Fork Relief Sewer	Middle Fork Beargrass Creek, Upper Sinking Fork	21103, 25012, 63319	New Sewer	$1,741,000	2010	N/A	N/A	N/A	N/A	N/A	N/A	N/A	$1,437,300	2009

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5	Beechwood Village Sanitary Sewer Replacement	Upper Sinking Fork	2-yr, 3-hr storm for 21061, 21089, 21101, 21153, 21156	Sewer Replacement, Rehab	$12,519,000	2011	N/A	N/A	N/A	N/A	N/A	N/A	N/A	$7,982,100	2010
6	Derek R. Guthrie WQTC	Ohio River, Black Pond Creek, Alvey Ditch, Mendora Branch, Mill Creek	10-yr, 3-hr storm for wet weather SSOs	100 MGD High Rate Treatment Facility	$122,000,000	2012	N/A	N/A	N/A	N/A	N/A	N/A	N/A	$96,358,900	2012

Note: As part of the 2021 IOAP Modification, MSD is requesting elimination of the Lucas Lane PS Inline Storage IOAP Project No. S_FF_BT_NB01_S_09A_C_A. The original project, developed in 2009, was based on one overflow event that occurred in 2006 without a cause identified. In 2008 and 2009, flow was hauled from the pump station. The 2008 event implied a capacity-related issue and the 2009 event was linked to a power failure. While there are limited details on the specifics of the single 2006 overflow and the two subsequent annual hauling operations, it is possible that the overflows were caused by a mechanical issue and not a capacity issue. At the time of the original calibration, no flow monitoring data was available at the site and the model was calibrated conservatively to account for the potential of capacity issues at the station. Since the original project was developed, in addition to updated calibration to best available data, MSD has monitored the pump station site and no overflows have occurred since 2009. While there have been multiple rainfall events that would have exceeded the 2, 5, and 10-year levels of control, a review of records since 2009 does not reveal any observed overflows or hauling operations at Lucas Lane. Furthermore, pump station drawdown tests were performed at the station to determine the actual pumping capacity. Pump runtimes were reviewed during dry weather and wet weather periods, and these values were used to update the hydraulic model. Based on the revised calibration and updated model, the existing pump station does not result in an overflow for up to a 10-year cloudburst event. Because historical data upstream of the pump station does not show any overflows for over 11 years, and because the modeled data does not result in overflows during a 2-, 5-, or 10-year cloudburst event, the proposed inline storage project is not necessary.

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4.1. FINAL PROJECT SELECTION

As detailed in Chapter 3, MSD used a standard benefit-cost ratio process to determine and select the most effective solution (referred to as the preferred solution). The same process was used to set optimal levels of protection for the selected solutions. The following section revisits the preferred solution process.

4.1.1. PREFERRED SOLUTIONS

During the development of SSO elimination strategies and alternatives, a wide range of technology approaches were considered for the baseline level of protection. The approaches included the following:

- Source control through infiltration and inflow (I/I) reduction
- Reduced surcharging in systems hydraulically connected to SSOs and solutions
- A wide variety of conventional constructed facilities commonly referred to as gray infrastructure, including:
    - Peak flow storage (constructed storage tanks, or oversized pipes providing “in-line” storage)
    - Increased conveyance capacity (increased pipe sizes, parallel relief sewers, new or expanded pump stations)
    - Flow diversions to other portions of the system that have available capacity
    - Expanded wastewater treatment capacity (provided at existing regional treatment facilities or provided remotely as high-rate wet weather treatment facilities)

Table 4.1.1 recaps the preferred solution technology list developed for the baseline level of protection. Projects are listed by the eleven model areas. The solution listed in Table 4.1.1 represents the most recent preferred solution, including any modifications.

Table 4.1.1 Summary of Preferred Solutions

SSDP RECOMMENDED PROJECT NAME/LOCATION	REGION AND BRANCH ID	SSO(S) ADDRESSED	TECHNOLOGY
Cedar Creek Area			
Idlewood Inline Storage	Cedar Creek - 70158	28998, 28984, 63094, 63095, 70158	Inline Storage
Fairmount Rd. Pump Station Offline Storage	Cedar Creek - 81316	Fairmount Road Pump Station (PS) (81316 & 97362)	Offline Storage
Little Cedar Creek Interceptor Improvements	Cedar Creek - 67997	67997, 67999, 86423, 89195, 89197	Pipe Upgrades
Bardstown Rd. PS Improvements	Cedar Creek - MSD1025	88545	PS Upgrades
Running Fox PS Elimination	Cedar Creek – MSD1080	Running Fox PS (MSD1080-LS)	Diversion
Hite Creek Area			
Meadow Stream PS & Force Main Upgrade	Hite Creek - MSD1082	Meadow Steam PS (91087 & MSD1082-PS)	PS Upgrade
Floydsburg Rd. I/I Investigation & Rehabilitation	Hite Creek - MSD1086	Floydsburg Road (MSD1086-PS, 90776, 108956, 108957, 108958)	I/I Reduction
Kavanaugh Rd. PS Improvements	Hite Creek - MSD1085	Kavanaugh Road (MSD1085-PS)	PS & Force Main Upgrades
Floyds Fork Area			
Woodland Hills PS Diversion	Floyds Fork - NB01	33003, 65531	Diversion
Eden Care PS SSO Investigation	Floyds Fork - NB02	Eden Care PS (MSD1105-PS)	Monitor
Ashburton PS Improvements & Diversion	Floyds Fork - NB03	Olde Copper Court PS (MSD0165-PS), Ashburton PS (MSD0166-PS)	Upgrade Force Main & Pipes
Jeffersontown Area			
Jeffersontown WQTC Elimination	Jeffersontown - NB01	28390, 28391, 28392, 28395, 31733, Jeffersontown WQTC (28173 & 64505 & MSD0255 & IS028-SI)	Offline Storage, Pipe Upgrades, WQTC Eliminations
Chenoweth Hills WQTC Elimination, Chenoweth Run and Chippewa PS Elimination	Jeffersontown - NB01A	Chenoweth Run PS (MSD0196-PS & 86052 & 64096), Chippewa PS (92061), Chenoweth Hills WQTC PS (MSD0263A-PS), Chenoweth Hills WQTC (MSD0263)	Diversion, WQTC Eliminations
Dell Rd and Charlane Pkwy Interceptor Improvements	Jeffersontown - NB02	Charlane Pkwy (28250, 28249, 28340, 28336, 104289), Dell Rd. (28413, 28414, 28415, 28416, 28417)	Pipe Upgrades

Table 4.1.1 Summary of Preferred Solutions

SSDP RECOMMENDED PROJECT NAME/LOCATION	REGION AND BRANCH ID	SSO(S) ADDRESSED	TECHNOLOGY
Raintree & Marian Ct PS Eliminations (*represents two projects in Final SSDP)*	Jeffersontown - NB03	28719, 28711, Marian Ct. PS (28729), Raintree PS (MSD0149-PS)	Diversion, Pipe Upgrades
Monticello PS Elimination	Jeffersontown - NB04	Monticello Place PS (MSD0151-PS & 27969)	Diversion
Middle Fork Area			
Middle Fork Relief Interceptor, Wet Weather Storage, and UMFLS Diversion (*represents 2 Final SSDP projects)*	Middle Fork - MF01	02932, 02933, 02935, 08537, 23211, 23212, 27005, 45835, 47583, 47593, 47596, 47603, 47604, 51221, 51160, 51161, 90700, IS021A-SI, Middle Fork at Breckenridge (08935-SM)	Offline Storage & Pipe Upgrades
Goose Creek PS Improvements & Wet Weather Storage *(represents 2 Final SSDP projects)*	Middle Fork - MF04	Devondale PS (21628-W), Goose Creek PS (46891 & 62418 & 91629 & 91630 & 105936), Saurel PS (43472)	Offline Storage, PS & Force Main Upgrades
Anchor Estates PS Eliminations (*represents 2 Final SSDP projects)*	Middle Fork - MF06	Vannah PS (01106), Anchor Estates #1 PS (00746 & 00056-W), Anchor Estates #2 PS (MSD0057-LS)	Inline Storage & Diversion
Hurstbourne I/I Investigation & Rehabilitation	Middle Fork – MF07	01793	I/I Reduction
Southeastern Diversion Area			
Parkview Estates I/I Investigation & Rehabilitation	Southeastern Diversion – NB03	47250	I/I Reduction
Klondike Interceptor	Southeastern Diversion – NB04	25676 (Alcona), 26650, 26651	Pipe Upgrades
Sutherland Interceptor	Southeastern Diversion – NB05	Sutherland (16649)	Pipe Upgrades
Beargrass Interceptor Rehab Ph. 2	Southeastern Diversion – NB06	51594	Pipe Rehab
Pond Creek Area			
Charleswood Interceptor Extension	Pond Creek - PC03	25477, 25478, Cooper Chapel PS (25480 & MSD0130-PS)	Pipe Upgrades
Cinderella PS Elimination	Pond Creek - PC04	Cinderella PS (60679 & MSD1013-PS), 35309	Diversion
Lantana PS I/I Investigation & Rehabilitation	Pond Creek - PC05	Lantana Drive #1 PS (25484 & 93719 & MSD0101-PS)	I/I Reduction
Government Center PS Elimination	Pond Creek - PC06	Government Center PS (MSD0180-PS)	Diversion
Avanti PS Elimination	Pond Creek - PC07	Avanti PS (21229-W)	Diversion

Table 4.1.1 Summary of Preferred Solutions

SSDP RECOMMENDED PROJECT NAME/LOCATION	REGION AND BRANCH ID	SSO(S) ADDRESSED	TECHNOLOGY
Lea Ann Way System Improvements	Pond Creek - PC08	19360, 19369, 29933, 29948, 29943, 31083, 31084, 79076, Lea Ann Way PS (MSD1010-PS)	Pipe Upgrades
Caven Ave Pump Station Elimination (*represents 2 Final SSDP projects of which one was subsequently eliminated)*	Pond Creek - PC09	27116, 70212, 17724, Caven Ave PS (MSD0133-PS)	Diversion, Project Eliminated
Leven PS Elimination	Pond Creek - PC10	Leven PS (36419 & MSD1019-PS)	Diversion
Edsel PS I/I Investigation & Rehabilitation	Pond Creek - PC11	Edsel PS (92098 & MSD1048-PS)	I/I Reduction
ORFM Area			
Mellwood System Improvements & PS Eliminations (*represents 2 Final SSDP projects)*	ORFM - NB01	26752, 41374, 41416, Mockingbird Valley PS (MSD0007-PS), Winton PS (MSD0010-PS), Mellwood Avenue PS (24472 & MSD0023-PS), Canoe Lane PS (24152-W & MSD0024-PS)	PS Upgrades, Pipe Upgrades & Diversion
Leland Rd. SSO Investigation	ORFM - NB02	96020	Condition Assessment
Derington Ct. PS I/I Investigation & Rehab	ORFM - NB03	Derington Court PS (MSD0095-PS)	I/I Reduction
Prospect WQTC Eliminations, Harrods Creek PS, and ORFM System Improvements (*represents 3 Final SSDP projects)*	ORFM - NB04 (Prospect)	40870, 40871, 40872, Barbour Lane PS (42680 & 65633 & 65635), West Goose Creek PS (22436 & MSD0123-PS), Phoenix Hill PS (MSD1044-PS), Glenview Hills PS (MSD0183-PS), Barbour Lane PS (MSD0192-PS), New Market PS (MSD0193-PS), Deep Creek PS (MSD1063-PS), Hunting Creek South WQTC (MSD0292)	PS and Pipe Upgrades, Diversion, WQTC eliminations
Mill Creek Area			
Shively Interceptor	Mill Creek - NB01	04498, 04542, Pioneer PS (81814-W), Fern Lea PS (MSD0047-PS), Garr's Lane PS (MSD0050-PS)	Pipe Upgrades
East Rockford PS Relocation	Mill Creek - NB02	East Rockford PS (04699-W)	PS Replacement and Relocation
Small WQTC Area			
Lucas Ln. PS Inline Storage	Berrytown - NB01	Lucas Lane PS (MSD0199-LS)	Project Eliminated
Riding Ridge PS Improvements	Hunting Creek North - NB01	Riding Ridge PS (MSD1060-LS)	PS Upgrades
Gunpowder PS Inline Storage	Hunting Creek North - NB02	Gunpowder PS (MSD1055-LS)	Inline Storage

Table 4.1.1 Summary of Preferred Solutions

SSDP RECOMMENDED PROJECT NAME/LOCATION	REGION AND BRANCH ID	SSO(S) ADDRESSED	TECHNOLOGY
Fox Harbor Inline Storage	Hunting Creek North - NB03	Fox Harbor #1 and #2 PS (62769)	Project Eliminated
Fairway View PS Improvements	Hunting Creek South - NB01	Fairway View PS (MSD1065-PS)	PS Upgrades
Lake Forest PS SSO Investigation	Lake Forest - NB01	Lake Forest PS (MSD1169-LS)	Monitor
St. Rene Rd. PS Elimination	Chenoweth Hills - CH01	94187	Diversion
CSS Area			
Sonne PS I/I Investigation & Rehabilitation	CSO - 42007	Sonne Avenue PS (MSD0042-PS)	I/I Reduction
Camp Taylor System Improvements *(represents 4 Final SSDP projects)*	CSO - 30917	08717, 13931, 13943, 39763, 44396, 44397, 66349, 104223, 104231	SSES, Sewer Rehabilitation & Replacement, Offline Storage
Hazelwood PS I/I Investigation & Rehabilitation	CSO - 55665	Hazelwood PS (55665)	I/I Reduction

Legend: LS –Lift station, PS – Pump Station, CSO – Combined Sewer Overflow, SSO – Sanitary Sewer Overflow, CSS- Combined Sewer System, WQTC – Water Quality Treatment Center, SSES – Sanitary Sewer Evaluation Study, I/I – Inflow and Infiltration, UMFLS – Upper Middle Fork Lift Station, ORFM – Ohio River Force Main

4.1.2. LEVEL OF PROTECTION EVALUATION

The IOAP sets the minimum level of protection at a 1.82-inch cloudburst storm event, and the maximum level of protection evaluated at a 2.60-inch cloudburst storm event. A 1.82-inch cloudburst storm is equivalent to a 3-hour, high-intensity event with a 50 percent probability of occurring in a given year. MSD selected this level of protection to be consistent with the cities of Atlanta, Cincinnati, and Knoxville who also use a 50 percent probability (often referred to as a two-year recurrence interval design storm) as the minimum protection level for SSOs.

For solution optimization, the starting point is the preferred solution and a baseline level of protection set at a 1.82-inch cloudburst storm. The solution is then analyzed at a 2.25-inch cloudburst and 2.60-inch cloudburst (if needed) storm level to compare benefit-cost ratios for the modeled branch. The method implemented involves analyzing the same solution determined at the 1.82-inch cloudburst level and modifying the solution to capture flows and prevent SSOs during the higher-intensity cloudburst storm events.

Costs and benefits are re-evaluated, and a new benefit-cost ratio is determined for that solution. The following rules apply to the re-evaluated results:

- If the 2.25-inch cloudburst benefit-cost ratio does not exceed the 1.82-inch cloudburst benefit-cost ratio then the level of protection chosen for that particular solution is the 1.82-inch cloudburst storm level.
- If the 2.25-inch cloudburst benefit-cost ratio does exceed the 1.82-inch cloudburst benefit-cost ratio then the same process is repeated at the 2.60-inch cloudburst storm level.
- If the 2.60-inch cloudburst benefit-cost ratio does not exceed the 2.25-inch cloudburst benefit-cost ratio then the level of protection chosen for that particular solution is the 2.25-inch cloudburst storm level.
- If the 2.60-inch cloudburst benefit-cost ratio does exceed the 2.25-inch cloudburst benefit-cost ratio then the level of protection chosen for that particular solution is the 2.60-inch cloudburst storm level and no further evaluation is performed.

This approach to determine the optimal level of protection means that solutions to address an individual SSO location may be designed to protect against larger storms if that will yield a higher benefit-cost ratio in the analysis of project alternatives.

Additionally, three projects were chosen to examine the above approach by evaluating the 2.60-inch cloudburst event where all three levels of control had not been previously developed. The projects subject to this further evaluation are Klondike Interceptor, Middle Fork Relief Interceptor, and the Shively Interceptor. The results presented in Table 4.1-2 illustrate that the evaluation rules presented above are appropriate and identify the level of protection with the highest benefit-cost ratio.

Table 4.1.2 Summary of Level of Protection Evaluation

Table 4.1-2 cites the modeled area, lists the SSOs that are controlled, summarizes the design level of protection evaluation process for each modeled branch, and highlights the ultimate design level of protection for that particular branch. Projects are listed by modeled area. Level of Protection costs and benefit-cost detailed evaluation tables for each modeled branch are available in Appendix 4.1.1. The final project list in Table 4.1.2 is used for analysis of Level of Protection. The Present Worth B/C ratio values listed are based on the most recent modification, where applicable. If Level of Protection was not re-evaluated, the 2009 values are listed. If a project modification was made, a letter summarizing the changes was submitted and approved for each project.

Appendix 4.1.1 Optimized Solution Cost Estimates and Benefit-Cost Analyses

Appendix 4.1.2 Final SSDP Project Cost Estimates

Appendices are same as the 2012 IOAP Modification and are provided on an external USB storage drive.

Table 4.1.2 Summary of Level of Protection Evaluation

SSDP RECOMMENDED PROJECT NAME/LOCATION	SSO(S) ADDRESSED	TECHNOLOGY	LEVEL OF PROTECTION	PRESENT WORTH BENEFIT-COST RATIO
Cedar Creek Area				
Idlewood Inline Storage	28998, 28984, 63094, 63095, 70158	Inline Storage	1.82-inch	31.36
			2.25-inch	27.11
Fairmount Rd. PS Offline Storage	Fairmount Road PS (81316 & 97362)	Offline Storage	1.82-inch	11.11
			2.25-inch	9.31
			2.60-inch	8.09
Little Cedar Creek Interceptor Improvements	67997, 67999, 86423, 89195, 89197	Pipe Upgrades	1.82-inch	23.86
			2.25-inch	17.43
Bardstown Rd. PS Improvements	88545	PS Upgrades	1.82-inch	29.42
			2.25-inch	46.50
			2.60-inch	33.85
Running Fox PS Elimination	MSD1080-LS	Diversion	1.82-inch	659.52
			2.25-inch	118.87
Hite Creek Area				
Meadow Stream PS & FM Upgrades	Meadow Steam PS (91087 & MSD1082-PS)	PS & Force Main Upgrades		
			2.60-inch	N/A
Floydsburg Rd. I/I Investigation & Rehabilitation	Floydsburg Road (MSD1086-PS, 90776, 108956, 108957, 108958)	I/I Reduction	Sewer System Evaluation Study (SSES)/Rehab	
Kavanaugh Rd. PS Improvements	Kavanaugh Road (MSD1085-PS)	PS & Force Main Upgrades	1.82-inch	19.77
			2.25-inch	20.23
			2.60-inch	21.09

Table 4.1.2 Summary of Level of Protection Evaluation

SSDP RECOMMENDED PROJECT NAME/LOCATION	SSO(S) ADDRESSED	TECHNOLOGY	LEVEL OF PROTECTION	PRESENT WORTH BENEFIT-COST RATIO
Floyds Fork Area				
Woodland Hills PS Diversion	33003, 65531	Diversion	1.82-inch	92.26
			2.25-inch	17.75
			2.60-inch	15.45
Eden Care PS SSO Investigation	Eden Care PS (MSD1105-PS)	Monitoring	Monitoring	
Ashburton PS Improvements & Diversion	Olde Copper Court PS (MSD0165-PS), Ashburton PS (MSD0166-PS)	Upgrade Force Main & Pipes	1.82-inch	161.00
			2.25-inch	82.24
Jeffersontown Area				
Jeffersontown WQTC Elimination	28390, 28391, 28392, 28395, 31733, Jeffersontown WQTC (28173 & 64505 & MSD0255 & IS028-SI)	Offline Storage, Pipe Upgrades, WQTC Elimination	1.82-inch	5.23
			2.25-inch	5.09
Chenoweth Hills WQTC Elimination, Chenoweth Run and Chippewa PS Elimination	Chenoweth Run PS (MSD0196-PS & 86052 & 64096), Chippewa PS (92061), Chenoweth Hills WQTC PS (MSD0263A-PS), Chenoweth Hills WQTC (MSD0263)	PS & Force Main Upgrades, WQTC Elimination	1.82-inch	20.05
			2.25-inch	17.94
Dell Rd and Charlane Pkwy Interceptor Improvements	Charlane Pkwy (28250, 28249, 28340, 28336, 104289), Dell Rd. (28413, 28414, 28415, 28416, 28417)	Pipe Upgrades	1.82-inch	31.34
			2.25-inch	26.28
Raintree & Marian Ct. PS Eliminations (*represents two projects in Final SSDP)*	28719, 28711, Marian Court PS (28729), Raintree PS (MSD0149-PS)	Diversion, Pipe Upgrades	1.82-inch	72.76
			2.25-inch	51.97
Monticello PS Elimination	Monticello Place PS (MSD0151-PS & 27969)	Diversion	1.82-inch	48.90
			2.25-inch	63.24
			2.60-inch	65.85
Middle Fork Area				
Middle Fork Relief Interceptor, Wet Weather Storage, and UMFLS Diversion (*represents two projects in Final SSDP)*	02932, 02933, 02935, 08537, 23211, 23212, 27005, 45835, 47583, 47593, 47596, 47603, 47604, 51221, 51160, 51161, 90700, IS021A-SI, Middle Fork at Breckenridge (08935-SM)	Offline Storage & Pipe Upgrades	1.82-inch	1.26
			2.25-inch	1.07
			2.60-inch	0.90

Table 4.1.2 Summary of Level of Protection Evaluation

SSDP RECOMMENDED PROJECT NAME/LOCATION	SSO(S) ADDRESSED	TECHNOLOGY	LEVEL OF PROTECTION	PRESENT WORTH BENEFIT-COST RATIO
Goose Creek PS Improvements & Wet Weather Storage *(represents two projects in Final SSDP)*	Devondale PS (21628-W), Goose Creek PS (46891 & 62418 & 91629 & 91630 & 105936), Saurel PS (43472)	Offline Storage, PS & Force Main Upgrades	2.25-inch	11.00
			2.60-inch	6.84
Anchor Estates PS Eliminations *(represents two projects in Final SSDP)*	Vannah PS (01106), Anchor Estates #1 PS (00746 & 00056-W), Anchor Estates #2 PS (MSD0057-LS)	Diversion	1.82-inch	25.39
			2.25-inch	29.55
			2.60-inch	31.14
Hurstbourne I/I Investigation & Rehabilitation	01793	I/I Reduction	SSES/Rehab	
Southeastern Diversion Area				
Parkview Estates I/I Investigation & Rehabilitation	47250	I/I Reduction	SSES/Rehab	
Klondike Interceptor	Alcona (25676), 25560, 25561	Pipe Upgrades	1.82-inch	9.11
			2.25-inch	9.11
			2.60-inch	7.02
Sutherland Interceptor	Sutherland (16649)	Pipe Upgrades	1.82-inch	25.22
			2.25-inch	31.98
			2.60-inch	32.71
Beargrass Interceptor Rehab Phase 2	51594	Sewer Rehab	Rehabilitation	
Pond Creek Area				
Charleswood Interceptor Extension	25477, 25478, Cooper Chapel PS (25480 & MSD0130-PS)	Pipe Upgrades	1.82-inch	62.84
			2.25-inch	7.14
Cinderella PS Elimination	Cinderella PS (60679 & MSD1013-PS), 35309	Diversion	1.82-inch	43.86
			2.25-inch	38.20
Lantana PS I/I Investigation & Rehabilitation	Lantana Drive #1 PS (25484 & 93719 & MSD0101-PS)	I/I Reduction	SSES/Rehab	
Government Center PS Elimination	Government Center PS (MSD0180-PS)	Diversion	1.82-inch	50.05
			2.25-inch	48.01

Table 4.1.2 Summary of Level of Protection Evaluation

SSDP RECOMMENDED PROJECT NAME/LOCATION	SSO(S) ADDRESSED	TECHNOLOGY	LEVEL OF PROTECTION	PRESENT WORTH BENEFIT-COST RATIO
Avanti PS Elimination	Avanti PS (21229-W)	Diversion	1.82-inch	1448.28
			2.25-inch	1448.28
			2.60-inch	1448.28
Lea Ann Way System Improvements	19360, 19369, 29933, 29948, 29943, 31083, 31084, 79076, Lea Ann Way PS (MSD1010-PS)	Pipe Upgrades	1.82-inch	49.01
			2.25-inch	5.63
Caven Ave Elimination *(represents two Final SSDP projects. The 2nd project was eliminated after additional flow monitoring)*	27116, 70212, 17724, Caven Ave PS (MSD0133-PS)	Offline Storage & Pipe Upgrades	1.82-inch	139.48
			2.25-inch	155.40
			2-60-inch	158.27
Leven PS Elimination	Leven PS (36419 & MSD1019-PS)	Diversion	1.82-inch	152.13
			2.25-inch	74.72
Edsel PS I/I Investigation & Rehabilitation	Edsel PS (92098 & MSD1048-PS)	I/I Reduction	SSES/Rehab	
ORFM Area				
Mellwood System Improvements & PS Eliminations *(represents two projects in Final SSDP)*	26752, 41374, 41416, Mockingbird Valley PS (MSD0007-PS), Winton PS (MSD0010-PS), Mellwood Avenue PS (24472 & MSD0023-PS), Canoe Lane PS (24152-W & MSD0024-PS)	PS Upgrades, Pipe Upgrades & Diversion	1.82-inch	25.09
			2.25-inch	26.97
			2.60-inch	26.09
Leland Rd. SSO Investigation	96020	Condition Assessment	Condition Assessment	
Derington Ct. PS I/I Investigation & Rehabilitation	Derington Court PS (MSD0095-PS)	I/I Reduction	SSES/Rehab	
Prospect WQTC Eliminations, Harrods Creek PS, and ORFM System Improvements *(represents three projects in Final SSDP)*	40870, 40871, 40872, Barbour Lane PS (42680 & 65633 & 65635), West Goose Creek PS (22436 & MSD0123-PS), Phoenix Hill PS (MSD1044-PS), Glenview Hills PS (MSD0183-PS), Barbour Lane PS (MSD0192-PS), New Market PS (MSD0193-PS), Deep Creek PS (MSD1063-PS), Hunting Creek South WQTC (MSD0292)	PS and Pipe Upgrades, Diversion, WQTC eliminations	2.25-inch	1.69
			2.60-inch	0.99

Table 4.1.2 Summary of Level of Protection Evaluation

SSDP RECOMMENDED PROJECT NAME/LOCATION	SSO(S) ADDRESSED	TECHNOLOGY	LEVEL OF PROTECTION	PRESENT WORTH BENEFIT-COST RATIO
Mill Creek Area				
Shively Interceptor	04498, 04542, Pioneer PS (81814-W), Fern Lea PS (MSD0047-PS), Garr's Lane PS (MSD0050-PS)	Pipe Upgrades	1.82-inch	5.20
			2.25-inch	6.68
			2.60-inch	6.70
East Rockford PS Relocation	East Rockford PS (04699-W)	PS Replacement and Relocation	PS Relocation	
Small WQTC Area				
Lucas Ln. PS Inline Storage	Lucas Lane PS (MSD0199-LS)	Project Eliminated	1.82-inch	N/A
			2.25-inch	N/A
Riding Ridge PS Improvements	Riding Ridge PS (MSD1060-LS)	PS Upgrades	1.82-inch	52.02
			2.25-inch	19.61
Gunpowder PS Inline Storage	Gunpowder PS (MSD1055-LS)	Inline Storage	1.82-inch	78.71
			2.25-inch	59.15
Fox Harbor Inline Storage	Fox Harbor #1 and #2 PS (62769)	Project Eliminated	1.82-inch	N/A
			2.25-inch	N/A
			2.60-inch	N/A
Fairway View PS Improvements	Fairway View PS (MSD1065-PS)	PS Upgrades	1.82-inch	10.32
			2.25-inch	7.64
Lake Forest PS SSO Investigation	Lake Forest PS (MSD1169-LS)	Monitoring	Monitoring	
St. Rene Rd. PS Elimination	94187	Inline Storage	1.82-inch	212.00
			2.25-inch	97.68

Table 4.1.2 Summary of Level of Protection Evaluation

SSDP RECOMMENDED PROJECT NAME/LOCATION	SSO(S) ADDRESSED	TECHNOLOGY	LEVEL OF PROTECTION	PRESENT WORTH BENEFIT-COST RATIO
CSS Area				
Sonne PS I/I Investigation & Rehabilitation	Sonne Avenue PS (MSD0042-PS)	I/I Reduction	SSES/Rehab	
Camp Taylor System Improvements (*represents four projects in Final SSDP)*	08717, 13931, 13943, 36763, 44396, 44397, 66349, 104223, 104231	SSES, Sewer Rehabilitation & Replacement, Offline Storage	1.82-inch	65.12
			2.25-inch	67.63
			2.60-inch	68.47
Hazelwood PS I/I Investigation & Rehabilitation	Hazelwood PS (55665)	I/I Reduction	SSES/Rehab	

Legend: LS –Lift station, PS – Pump Station, CSO – Combined Sewer Overflow, SSO – Sanitary Sewer Overflow, CSS- Combined Sewer System, WQTC – Water Quality Treatment Center, SSES – Sanitary Sewer Evaluation Study, I/I – Inflow and Infiltration, UMFLS – Upper Middle Fork Lift Station, ORFM – Ohio River Force Main

4.1.2.1. LEVEL OF PROTECTION EVALUATION RESULTS

2021 Update: The “knee-of-the-curve" analysis discussed in this section was performed for the 2009 Final SSDP utilizing data available at that time. Because there are no major changes to the overall SSDP, the general conclusions stated in this chapter should still be relevant.

The level of protection evaluation presented in Table 4.1.2 was assessed by an analysis referred to as the "knee-of-the-curve” analysis. A knee-of-the-curve analysis typically involves estimating costs for a range of design levels, then comparing performance (benefits) versus cost and identifying the point of diminishing returns. For the Final SSDP, the knee-of-the-curve analysis focused on a comparison of total benefits versus total capital costs at various levels of protection.

The Final SSDP optimization process did not calculate the total capital costs and benefits for each preferred technology at all levels of protection. Total capital costs and benefits were calculated for 35 preferred technologies at a level of protection corresponding to the 1.82-inch and 2.25-inch cloudburst storms. Cost and benefits were calculated for several of the preferred technologies at the 1.52-inch and 2.60-inch levels of protection (recall the 2.60-inch level was not calculated if the 1.82-inch benefit-cost ratio was higher than the 2.25-inch benefit-cost ratio). Costs and benefits for all other preferred technologies at the 1.52-inch and 2.60-inch levels were estimated by extrapolation of the 1.82-inch or 2.25-inch level-of-protection values. All costs reflect the more detailed budget-level cost estimates prepared for the preferred alternatives.

Figure 4.1.1 shows a curve of total benefits as a function of total capital cost for each level of protection. This figure also shows a single point above the curve denoting the total benefits (26,800) and total capital cost ($169 million, 2008 dollars) for the recommended projects (not including Interim SSDP projects). The figure illustrates a typical knee of the curve response, with the point of inflection representing the point of diminishing returns. As depicted, beyond the 1.82-inch level of protection, additional capital expenditures result in a much slower increase in total benefits. The single point corresponding to the recommended projects lies just at the knee of the curve, demonstrating that the program maximizes benefits to the community with a controlled cost.

Figure 4.1.2 shows a curve of average project benefit-cost ratio versus total capital cost for each level of protection. There is a single point representing the average benefit-cost ratio (94) and total capital cost ($169 million, 2008 dollars) for the recommended projects. This curve is plotted in a format to illustrate optimization of the benefit-cost ratio. This figure shows that the maximum average benefit-cost ratio occurs around the 1.82-inch cloudburst storm and benefit-cost ratios decline significantly beyond a 1.82-inch level of protection. The single point shows that the recommended projects are at the highest benefit-cost ratio, again demonstrating that the program maximizes benefits to the community.

Figure 4.1.3 shows a Benefit-Cost curve of three projects (Klondike Interceptor, Middle Fork Relief Interceptor, and Shively Interceptor) at all three levels of evaluation. Based on the evaluation of the three projects selected, the assumptions regarding benefit-cost trends appear to be valid. In two of the three cases, the benefit-cost score for the 2.25-inch cloudburst storm alternative is equal to or less than the score for the 1.82-inch cloudburst storm. In both of these cases the benefit-cost scores for the 2.60-inch cloudburst storm are less than that of the 2.25-inch cloudburst storm. In one case, the benefit-cost score for the 2.25-inch cloudburst storm is greater than the 1.82-inch cloudburst storm, and in this case the 2.60-inch cloudburst storm benefit/cost score is slightly greater than the 2.25-inch cloudburst storm, and this is the level of protection that was selected. For a full explanation and results of the analysis refer to Appendix 4.1.3.

Appendix 4.1.3 Evaluation of All Levels of Protection Analysis

This appendix is the same as 2012 IOAP Modification and is provided on external USB storage drive.

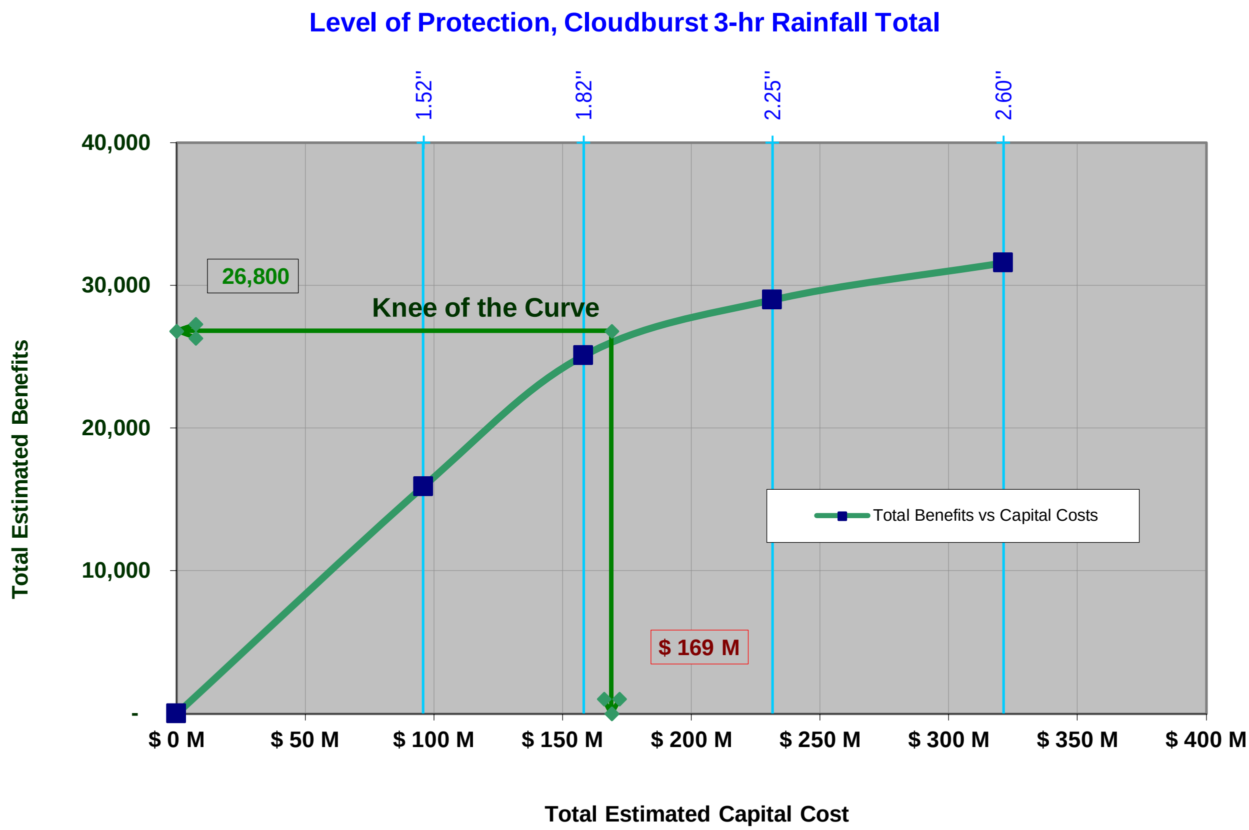


Figure 4.1.1 SSDP Project Optimization: Total Benefits Versus Total Capital Cost (2008 Dollars & 2009 SSDP Projects)

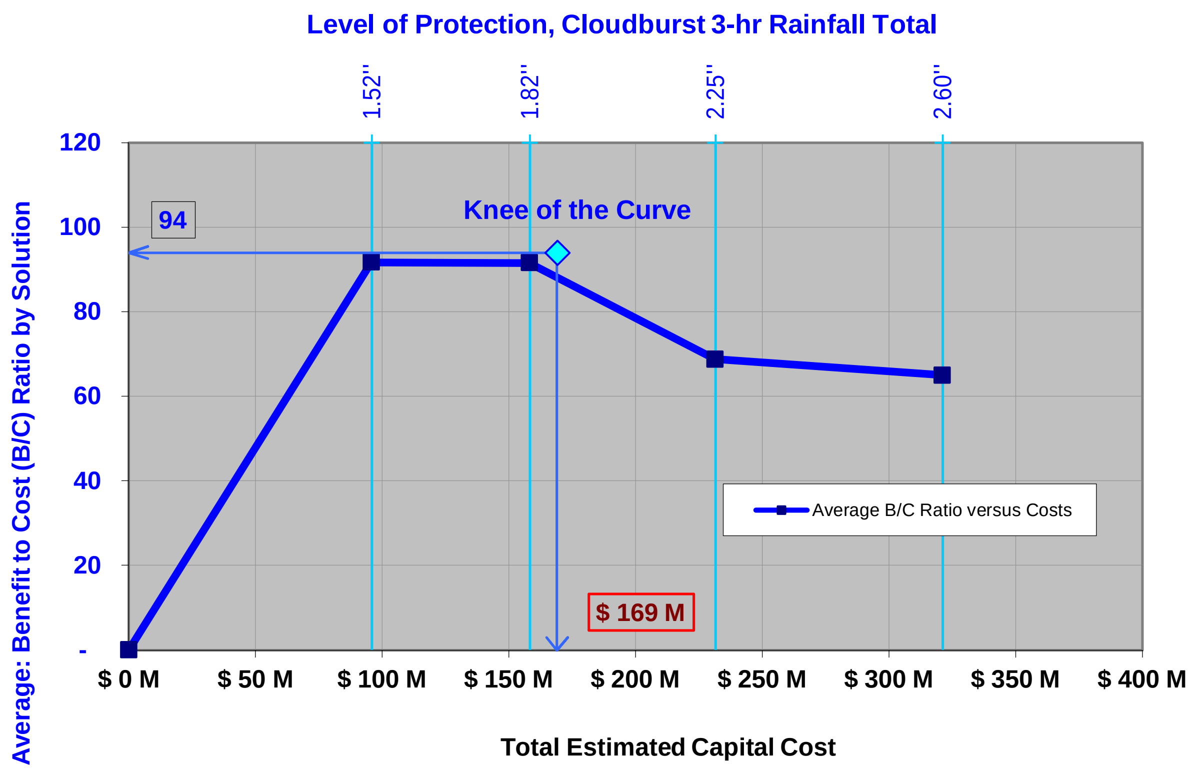


Figure 4.1.2 SSDP Project Optimization: Average B/C Ratio Versus Total Capital Cost (2008 Dollars & 2009 SSDP Suite of Projects)

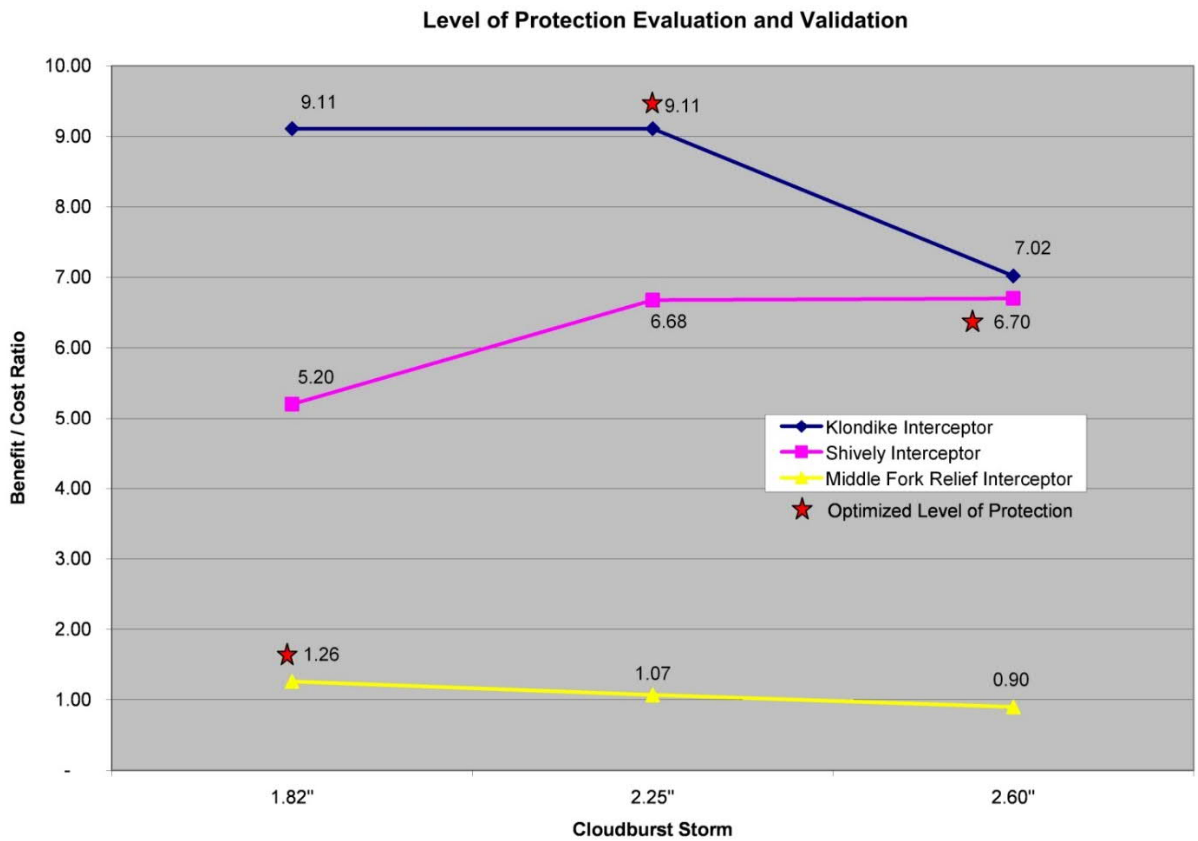


Figure 4.1.3 SSDP Level of Protection Evaluation (2009 SSDP Projects)

4.1.3. FINAL SSDP PROJECTS

Driven by the values-based benefit-cost analysis discussed in Chapter 3, the IOAP seeks to present a balanced mix of "green infrastructure" and "gray" solutions to prevent and control SSOs. Since green infrastructure generally is intended to reduce stormwater runoff, it is not directly applicable to flow reduction in a separate

4.1.4. FINAL SSDP PROJECTS

Driven by the values-based benefit-cost analysis discussed in Chapter 3, the IOAP seeks to present a balanced mix of "green infrastructure" and "gray" solutions to prevent and control SSOs. Since green infrastructure generally is intended to reduce stormwater runoff, it is not directly applicable to flow reduction in a separate sanitary sewer system (SSS). The equivalent to green infrastructure in the Final SSDP includes controlling I/I, using techniques such as disconnecting building laterals, downspouts, sump pumps, and foundation drains that are a direct source of I/I. Gray solutions include options such as storage, diversion, treatment, and conveyance/transport.

The final projects selected for eliminating SSOs also include a mixture of source control (including I/I reduction efforts), wet weather storage, system diversion, conveyance/transport, and basement flooding protection. This mix of control options for SSO locations reflects the benefit-cost analysis and site-specific considerations. Consistent with the Final CSO Long-Term Control Plan (LTCP), the Final SSDP project alternatives are designed to be built around MSD's existing infrastructure, which may include large diameter pipes and water quality treatment centers (WQTC) and draw on synergistic benefits from other MSD projects.

Overall, the 57 Final SSDP projects include 44 gray infrastructure projects, 10 I/I reduction projects, and three SSO investigation projects. The Interim SSDP includes six gray infrastructure projects not included in the SSDP project list.

The gray infrastructure projects, including the six Interim SSDP projects, are divided into a combination of the following categories, (some projects fall into more than one category):

- 23 conveyance capacity upgrades
- 8 storage projects, inline and offline, many with pipe upgrades as well
- Upgrades or replacements to 12 pump stations
- Elimination of 18 pump stations
- Elimination of 6 small WQTCs, including 5 in the Prospect area
- Elimination of 1 regional WQTC
- Expansion of a WQTC

The site-specific level of protection as determined by the value-based benefit-cost analysis resulted in the following for the 57 Final SSDP gray infrastructure projects:

- 17 projects eliminate SSOs up to the 1.82-inch cloudburst storm
- 14 projects eliminate SSOs up to the 2.25-inch cloudburst storm
- 13 projects eliminate SSOs up to the 2.60-inch cloudburst storm
- 9 projects for SSES/rehabilitation to reduce I/I
- 1 project for PS relocation to reduce I/I
- 1 project for condition assessment study
- 2 projects for monitoring studies

Table 4.1.3 represents the final projects chosen for eliminating SSOs at the selected site-specific level of protection. The table includes a list of projects, SSOs controlled by that project, chosen level of protection, capital costs, and scheduled project completion year. In total, there are 214 documented, suspected, and modeled SSOs addressed by the 63 projects (57 Final SSDP and 6 Interim SSDP) listed in Table 4.0.1. This number includes SSOs eliminated by the Interim SSDP projects. Projects are listed by modeled area.

4.1.4.1. FINAL SSDP PROJECT FACT SHEETS AND MAPS

Project fact sheets for the Final SSDP projects detailing project specifics are available at the end of this chapter. Only the fact sheets associated with the most recent modification for each project are included Each fact sheet includes a project description for the abatement solution, associated capital cost and associated benefit-cost ratio, and lists SSOs addressed by the project solution.

Detailed project maps for each Final SSDP project specify project location and type of solution. Maps also are located at the end of this chapter behind each respective project fact sheet. Please note: The general representation of the overflow abatement solutions is for preliminary planning purposes only. Alignments and locations may be altered or refined during the design phase.

Table 4.1.3 List of Final SSDP Projects

SSDP RECOMMENDED PROJECT NAME/LOCATION	SSO(S) ADDRESSED	TECHNOLOGY	LEVEL OF PROTECTION	PRESENT WORTH BENEFIT-COST RATIO	CAPITAL COST $[1]	ANNUAL O&M DOLLARS[2]	SCHEDULED COMPLETION YEAR OR COMPLETED YEAR
Cedar Creek Area							
Idlewood Inline Storage	28998, 28984, 63094, 63095, 70158	Inline Storage	1.82-inch	31.36	$2,317,000	$2,800	2025
Fairmount Rd. PS Offline Storage Basin	Fairmount Road PS (81316 & 97362)	PS Upgrades	2.60-inch	33.29	$874,000	$0	2016
Little Cedar Creek Interceptor Improvements	67997, 67999, 86423, 89195, 89197	Pipe Upgrades	1.82-inch	23.86	$1,875,000	$21,800	2025
Bardstown Rd. PS Improvements	88545	PS Upgrades	2.25-inch	46.50	$281,000	$400	2030
Running Fox PS Elimination	MSD1080-LS	Diversion	1.82-inch	659.52	$96,000	$100	2010
Hite Creek Area							
Meadow Stream PS & FM Upgrades	Meadow Steam PS (91087 & MSD1082-PS)	PS & Force Main Upgrades	1.82-inch	13.77	$974,000	$13,000	2012
Floydsburg Rd. I/I Investigation & Rehabilitation	Floydsburg Road (MSD1086-PS, 90776, 108956, 108957, 108958)	I/I Reduction	1.82-inch	--	$57,000	$0	2010
Kavanaugh Rd. PS Improvements	Kavanaugh Rd (MSD1085-PS)	PS & Force Main Upgrades	2.60-inch	21.09	$1,110,000	$1,400	2025
Floyds Fork Area							
Woodland Hills PS Diversion	33003, 65531	Diversion	1.82-inch	92.26	$20,000	$100	2011
Eden Care PS SSO Investigation	Eden Care PS (MSD1105-PS)	Monitor	Monitor	--	--	--	2012
Ashburton PS Improvements & Diversion	Olde Copper Court PS (MSD0165-PS), Ashburton PS (MSD0166-PS)	Upgrade Force Main & Pipes	1.82-inch	161.00	$118,000	$100	2009

[1] Costs based on 2009 values and projects. Updated estimates for remaining projects are in the executive summary.
[2] Annual O&M costs are from 2009.

Table 4.1.3 List of Final SSDP Projects

SSDP RECOMMENDED PROJECT NAME/LOCATION	SSO(S) ADDRESSED	TECHNOLOGY	LEVEL OF PROTECTION	PRESENT WORTH BENEFIT-COST RATIO	CAPITAL COST $[1]	ANNUAL O&M DOLLARS[2]	SCHEDULED COMPLETION YEAR OR COMPLETED YEAR
Jeffersontown Area							
Jeffersontown WQTC Elimination	28390, 28391, 28392, 28395, 31733, Jeffersontown WQTC (28173 & 64505 & MSD0255 & IS028-SI)	Offline Storage, Pipe Upgrades, WQTC Elimination	1.82-inch	5.23	$23,737,000	$28,500	2015
Chenoweth Hills WQTC Elimination, Chenoweth Run and Chippewa PS Elimination	Chenoweth Run PS (MSD0196-PS & 86052 & 64096), Chippewa PS (92061), Chenoweth Hills WQTC PS (MSD0263A-PS), Chenoweth Hills WQTC (MSD0263)	PS & Force Main Upgrades, WQTC Elimination	1.82-inch	20.05	$3,140,000	$43,800	2014
Dell Rd and Charlane Pkwy Interceptor Improvements	Charlane Pkwy (28250, 28249, 28340, 28336, 104289), Dell Rd. (28413, 28414, 28415, 28416, 28417)	Pipe Upgrades	1.82-inch	31.34	$917,0003	$1,900	2030
Raintree & Marian Ct PS Eliminations *(represents two projects in Final SSDP)*	28719, 28711, Marian Court PS (28729), Raintree PS (MSD0149-PS)	Diversion, Pipe Upgrades	1.82-inch	72.76	$1,005,000	$1,000	2025,2030
Monticello PS Elimination	Monticello Place PS (MSD0151-PS & 27969)	Diversion	2.60-inch	65.85	$207,000	$300	2025
Middle Fork Area							
Middle Fork Relief Interceptor, Wet Weather Storage, and Upper Middle Fork LS Diversion *(represents two projects in Final SSDP)*	02932, 02933, 02935, 08537, 23211, 23212, 27005, 51221, 51160, 51161, 45835, 47583, 47593, 47596, 47603, 47604, 90700, IS021A-SI, Middle Fork at Breckenridge (08935-SM)	Offline Storage & Pipe Upgrades	1.82-inch	1.26	$26,627,000	$18,700	2013, 2030
Goose Creek PS Improvements & Wet Weather Storage *(represents two projects in Final SSDP)*	Devondale PS (21628-W), Goose Creek PS (46891 & 62418 & 91629 & 91630 & 105936), Saurel PS (43472)	Offline Storage, PS & Force Main Upgrades	2.25-inch	11.00	$2,844,000	$2,100	2016, 2035

[3] Detailed cost evaluations are included in Appendix 4.1.2

Table 4.1.3 List of Final SSDP Projects

SSDP RECOMMENDED PROJECT NAME/LOCATION	SSO(S) ADDRESSED	TECHNOLOGY	LEVEL OF PROTECTION	PRESENT WORTH BENEFIT-COST RATIO	CAPITAL COST $[1]	ANNUAL O&M DOLLARS[2]	SCHEDULED COMPLETION YEAR OR COMPLETED YEAR
Anchor Estates PS Eliminations *(represents two projects in Final SSDP)*	Vannah PS (01106), Anchor Estates #1 PS (00746 & 00056-W), Anchor Estates #2 PS (MSD0057-LS)	Diversion	2.60-inch	31.14	$1,909,000	$51,200	2011, 2016
Hurstbourne I/I Investigation & Rehabilitation	01793	I/I Reduction	1.82-inch	--	$536,000	$0	2011
Southeastern Diversion Area							
Parkview Estates I/I Investigation & Rehabilitation	47250	I/I Reduction	1.82-inch	--	$285,000	$0	2011
Klondike Interceptor	25676 (Alcona), 26650, 26651	Pipe Upgrades	2.25-inch	9.11	$558,000	$2,200	2014
Sutherland Interceptor	Sutherland (16649)	Pipe Upgrades	2.60-inch	32.71	$412,000	$900	2030
Beargrass Interceptor Rehab Ph. 2	51594	Pipe Rehab	1.82-inch	--	$57,000	$0	2010
Pond Creek Area							
Charleswood Interceptor Extension	25477, 25478, Cooper Chapel PS (25480 & MSD0130-PS)	Pipe Upgrades	1.82-inch	62.84	$603,000	$900	2015
Cinderella PS Elimination	Cinderella PS (60679 & MSD1013-PS), 35309	Diversion	1.82-inch	43.86	$2,205,000[4]	$100	2025
Lantana PS I/I Investigation & Rehabilitation	Lantana Drive #1 PS (25484 & 93719 & MSD0101-PS)	I/I Reduction	1.82-inch	--	$20,000	$100	2011
Government Center PS Elimination	Government Center PS (MSD0180-PS)	Diversion	1.82-inch	50.05	$1,225,000	$100	2011
Avanti PS Elimination	Avanti PS (21229-W)	Diversion	2.60-inch	1448.28	$31,000	$200	2009

[4] Detailed cost evaluations are included in Appendix 4.1.2

Table 4.1.3 List of Final SSDP Projects

SSDP RECOMMENDED PROJECT NAME/LOCATION	SSO(S) ADDRESSED	TECHNOLOGY	LEVEL OF PROTECTION	PRESENT WORTH BENEFIT-COST RATIO	CAPITAL COST $[1]	ANNUAL O&M DOLLARS[2]	SCHEDULED COMPLETION YEAR OR COMPLETED YEAR
Lea Ann Way System Improvements	19360, 19369, 29933, 29948, 29943, 31083, 31084, 79076, Lea Ann Way PS (MSD1010-PS)	Pipe Upgrades	1.82-inch	49.01	$827,000	$1,600	2015
Caven Ave PS Elimination *(represents two projects in Final SSDP with one subsequently eliminated)*	27116, 70212, 17724, Caven Ave PS (MSD0133-PS)	Diversion	1.82-inch	7.08	$6,084,000	$100	2016
Leven PS Elimination	Leven PS (36419 & MSD1019-PS)	Diversion	1.82-inch	152.13	$376,000	$100	2025
Edsel PS I/I Investigation & Rehabilitation	Edsel PS (92098 & MSD1048-PS)	I/I Reduction	1.82-inch	--	$367,000	$0	2011
ORFM Area							
Mellwood System Improvements & PS Eliminations *(represents two projects in Final SSDP)*	26752, 41374, 41416, Mockingbird Valley PS (MSD0007-PS), Winton PS (MSD0010-PS), Mellwood Avenue PS (24472 & MSD0023-PS), Canoe Lane PS (24152-W & MSD0024-PS)	PS Upgrades, Pipe Upgrades & Diversion	2.25-inch	26.97	$3,055,0005	$2,100	2012, 2030
Leland Rd. SSO Investigation	96020	Condition Assessment	Monitor	--	--	--	2012
Derington Ct. PS I/I Investigation & Rehabilitation	Derington Court PS (MSD0095-PS)	I/I Reduction	1.82-inch	--	$265,000	$700	2012

[5] Detailed cost evaluations are included in Appendix 4.1.2

Table 4.1.3 List of Final SSDP Projects

SSDP RECOMMENDED PROJECT NAME/LOCATION	SSO(S) ADDRESSED	TECHNOLOGY	LEVEL OF PROTECTION	PRESENT WORTH BENEFIT-COST RATIO	CAPITAL COST $[1]	ANNUAL O&M DOLLARS[2]	SCHEDULED COMPLETION YEAR OR COMPLETED YEAR
Prospect WQTC Eliminations, Harrods Creek PS, and ORFM System Improvements *(represents three projects in Final SSDP)*	40870, 40871, 40872, Barbour Lane PS (42680 & 65633 & 65635), West Goose Creek PS (22436 & MSD0123-PS), Phoenix Hill PS (MSD1044-PS), Glenview Hills PS (MSD0183-PS), Barbour Lane PS (MSD0192-PS), New Market PS (MSD0193-PS), Deep Creek PS (MSD1063-PS), Hunting Creek South WQTC (MSD0292)	PS and Pipe Upgrades, Diversion, WQTC eliminations	2.25-inch	1.69	$34,062,000	$78,300	2015, 2016
Mill Creek Area							
Shively Interceptor	04498, 04542, Pioneer PS (81814-W), Fern Lea PS (MSD0047-PS), Garr's Lane PS (MSD0050-PS)	Pipe Upgrades	2.60-inch	6.70	$16,419,000	$11,400	2012
East Rockford PS Relocation	East Rockford PS (04699-W)	PS Replacement and Relocation	1.82-inch	----	$1,044,000	$9,300	2012
Small WQTC Area							
Riding Ridge PS Improvements	Riding Ridge PS (MSD1060-LS)	PS Upgrades	1.82-inch	52.02	$27,000	$100	2014
Gunpowder PS Inline Storage	Gunpowder PS (MSD1055-LS)	Inline Storage	1.82-inch	78.71	$176,000	$9,700	2025
Fairway View PS Improvements	Fairway View PS (MSD1065-PS)	PS Upgrades	1.82-inch	10.32	$87,000	$300	2014
Lake Forest PS SSO Investigation	Lake Forest PS (MSD1169-LS)	Monitor	Monitor	--	--	--	2012
St. Rene Rd. PS Elimination	94187	Inline Storage	1.82-inch	212.00	$30,000	$400	2014
CSS Area							
Sonne PS I/I Investigation & Rehabilitation	Sonne Avenue PS (MSD0042-PS)	I/I Reduction	1.82-inch	--	$265,000	$11,600	2011

Table 4.1.3 List of Final SSDP Projects

SSDP RECOMMENDED PROJECT NAME/LOCATION	SSO(S) ADDRESSED	TECHNOLOGY	LEVEL OF PROTECTION	PRESENT WORTH BENEFIT-COST RATIO	CAPITAL COST $[1]	ANNUAL O&M DOLLARS[2]	SCHEDULED COMPLETION YEAR OR COMPLETED YEAR
Camp Taylor System Improvements *(represents four projects in Final SSDP)*	08717, 13931, 13943, 36763, 44396, 44397, 66349, 104223, 104231	SSES, Sewer Rehabilitation & Replacement, Offline Storage	2.60-inch	68.47	$28,279,000	$0	2011, 2013, 2017, 2035
Hazelwood PS I/I Investigation & Rehabilitation	Hazelwood PS (55665)	I/I Reduction	1.82-inch	--	$173,000	$1,400	2011

4.2. DEVELOPMENT OF RECOMMENDED PLAN

4.2.1. PRIORITIZATION OF PROJECTS

As a guiding principle, MSD's IOAP is being developed based on front-end consideration of source control and green infrastructure. Overall, this means that traditional gray infrastructure in the IOAP are sized after considering both the anticipated flow-reduction benefits of programmatic and site-specific green infrastructure solutions (in the Final LTCP), and source control including reduction of private sources of I/I (in the Final SSDP). Prior to the final design of gray solutions, the actual flow reduction performance will be documented and compared against the estimated targets. The final sizing of the gray solutions will then be based on documented performance of the green infrastructure or other source control solutions previously implemented.

Several green infrastructure and source control solutions in the IOAP were implemented early in the program to allow data to be gathered on the flow reduction benefits. The following list represents the general order of priority that was used to set the implementation schedule for the Final SSDP projects, in descending order:

- Interim SSDP projects and milestones from previously approved submittals
- "Enabling projects" required to implement Consent Decree or milestone projects
- Source control solutions (especially targeted I/I reduction locations)
- Downstream projects that need to be constructed to capture additional flow when smaller upstream projects are constructed (for example, the Buechel Basin is required prior to constructing the Upper Middle Fork Relief Sewer)
- Capital Improvement Projects already under design that address SSOs, as discussed in Chapter 2, Section 2.3.5.9 (i.e., Shively Interceptor)
- Remaining projects rank-ordered based on benefit-cost ratio and scheduled to assist with cash flow leveling

As part of the 2021 Final SSDP development, projects were prioritized again following the same general guidelines. However, the following additional guidelines, based on information gathered over the implementation of the project, were also considered:

- Projects that were downstream of other projects were given a lower priority to allow for flow monitoring and other evaluation of the impact of the upstream changes on the system.
- Projects were organized to allow MSD to use its existing flow monitoring network to provide ample flow monitoring in detailed areas.

The Final SSDP project implementation schedule is represented. Eight Final SSDP projects have been divided into multiple construction phases and are reflected in multiple fact sheets and maps at the end of the chapter. Multiple cost estimates representing these projects are also in Appendix 4.1.2.

This phasing approach was implemented to accommodate various construction schedules occurring in one project or to allow for components of one project (if vastly different) to be constructed at different times.

The eight Final SSDP projects that are divided into multiple phases are:

- Middle Fork Relief Interceptor, Wet Weather Storage, and Upper Middle Fork Lift Station Diversion

- Camp Taylor System Improvements
- Prospect WQTC Eliminations, Harrods Creek Pump Station, and Ohio River Force Main System Improvements
- Mellwood System Improvements and Pump Station Eliminations
- Anchor Estates Pump Station Eliminations
- Outer Loop and Caven Avenue Wet Weather Storage
- Raintree and Marian Court Pump Station Eliminations
- Goose Creek Pump Station Improvements and Wet Weather Storage

4.3. PUBLIC INVOLVEMENT

As stated in the Consent Decree, one requirement for public involvement is for the Wet Weather Team (WWT) to assist in developing the plan to involve the public in planning, prioritization, and selection of projects. This section recaps the public involvement process throughout the development of the Final SSDP projects.

Early in the IOAP development stage, the WWT, including the WWT Stakeholder Group and the technical team, developed a risk-management approach to evaluating and prioritizing alternative approaches to SSO control. This process was based on managing the risks to a set of community values identified by the WWT Stakeholder Group. The process of identifying, evaluating, and prioritizing projects was a highly interactive process involving all members of the WWT. The interactive process, with the essential engagement of the WWT Stakeholder Group, was critical to the success of the Final SSDP because it created a well-documented and transparent process to consider a wide range of community concerns. This process used a benefit-cost approach with performance measures that had complete buy-in from the WWT Stakeholder Group. Details of the approach and public involvement are presented in Volume 1.

A review of the steps of the values-based decision-making process is as follows:

- WWT Stakeholder Group defined values and relative weights for the values;
- The technical team developed draft performance measures and scales based on the “focus areas” or objectives WWT Stakeholder Group identified for the values;
- WWT Stakeholder Group reviewed and helped refine the performance measurement scales;
- The technical team used the performance scales to evaluate alternatives; and
- WWT Stakeholder Group reviewed the results and refined scoring considerations.

4.4. ENVIRONMENTAL BENEFITS OF RECOMMENDED PROGRAM

Environmental benefits, in addition to the public health benefits of SSO reduction, are a critical measure for selecting and optimizing solutions to eliminate SSOs and basement backups. This section describes the environmental benefits of SSO elimination.

4.4.1. DETERMINING ENVIRONMENTAL BENEFITS

Five Project-Specific Values with Required Environmental Benefits

1. Regulatory Performance
2. Public Health Enhancement
3. Asset Protection
4. Environmental Enhancement
5. Eco-Friendly Solutions

Through the stakeholder process, a list of values most vital to the community, as well as the means to measure them, was identified and refined. The WWT Stakeholder Group ultimately identified five project-specific values and associated performance criteria that were selected to be evaluated during the benefit-cost analysis. All of the criteria included environmental benefit.

The benefit-cost analysis tool was important because it provided the means to track and rate the diverse environmental benefits of each solution. It also included cost contingencies for properly designing, installing, and maintaining the environmental benefits inherent to the proposed solutions. The benefit-cost analysis tool also provided standards through a list of criteria that could not be violated (fatal flaws) regardless of any cost advantage.

Table 4.4.1 provides an overview of how the Final SSDP performs with respect to these five values. Under some values, such as Regulatory Performance, the Final SSDP will provide complete compliance for all rainfall events at or less than the defined level of protection.

Table 4.4.1 SSDP Project-specific Values with Environmental Benefits

CRITERIA		SSDP DISTINGUISHING ATTRIBUTE
Regulatory Performance	Eliminating Overflows	No overflows at or below the defined level of protection at known or suspected SSO locations.
Public Health	Eliminating or Reducing Overflow Volume	No overflows at or below defined level of protection at known or suspected SSO locations.
		Overflow volumes may be reduced above the defined level of protection at known and suspected SSOs.
Asset Protection	Eliminating or reducing surcharging and basement back-ups	No basement back-ups at or below the defined level of protection within zone of influence of known or suspected SSO locations.
		Surcharging reduced above the defined level of protection within zone of influence of known or suspected SSO locations.
Environmental Enhancement	Aquatic and Terrestrial Habitat Protection	No solution will, in any way, impact the aquatic and terrestrial habitat of endangered species.
	Aesthetics – Solids and Floatables	All solutions will reduce floatables by 1) eliminating overflows, and thus floatables, at or below the defined level of protections and 2) reducing overflow volumes above the defined level of protections, in particular first-flush floatables.
	Aesthetics – Odor and Air Emissions	No solution will create odors occasionally affecting more than 20 customers. All storage solutions near customers will be required to install and maintain odor-control equipment.
	Dissolved Oxygen Impacts	All solutions will provide intermittent improvement of in-stream dissolved oxygen.
	Downstream Impacts	All solutions will provide intermittent improvement of in-stream BOD and nutrient loads.
	Stream Flow Impacts (Peak flows)	All solutions will provide intermittent reduction of stream peak flows.
	Stream Flow Impacts/ Dry Weather Flow	No solution will impact dry weather flow.

Table 4.4.1 SSDP Project-specific Values with Environmental Benefits

CRITERIA		SSDP DISTINGUISHING ATTRIBUTE
Eco-Friendly Solutions	Non-Renewable Energy Consumption	No solution will require energy greater than secondary treatment. All conveyance solutions and many storage solutions will rely on gravity and will require no energy except for periodic O&M measures.
	Use of Natural Systems	No solutions will permanently displace more than 5 acres of wetlands or 50% of locally available green space. Most conveyance solutions will replace existing features and will have no permanent displacement of wetlands or green areas.
	Multiple-Use Facilities	No solution will impact recreational opportunities. In fact, many solutions will provide new recreational opportunities.
	Source Control of sub watershed pollutant loads	By elimination of overflows at known, suspected and new SSOs, there will be complete source control at or below the defined level of protection. There will be some source control above the defined level of protection, particularly of the first-flush contaminants.
	Non-Obtrusive Construction Techniques	All RDII reduction will be done with the latest non-obtrusive techniques such as in-situ lining and repairs. There will also be opportunities for non-obtrusive pipe work such as directional drilling. Given the nature of the solutions, there will be limited opportunities for non-obtrusive construction techniques for gray projects such as storage sites. BMPs will be required for all construction projects.
	Consistent Land Use	All features will be consistent with neighborhood or adjacent land use. Most conveyance solutions will be underground using existing right of ways.
	Impermeable Surfaces	Most conveyance solutions and many storage solutions, especially underground storage, will result in no change in impervious areas. All other solutions will include stormwater management features.
	LEEDS Performance	Most systems use gravity for energy. There will be opportunities for LEEDS in pumps controls and lighting.

4.4.2. MEASURING AND MODELING ENVIRONMENTAL BENEFITS

Elimination of SSOs and basement backups clearly provide environmental benefits as a whole. Based on water quality data from 2005-2007 normalized by rainfall annually, over 290 million gallons (MG) of overflows could potentially be removed by implementing the Final SSDP. On average, this would annually remove 100 tons of biochemical oxygen demand (BOD)5 and 200 tons of suspended solids from local waterways. In addition, the improvements to the Jeffersontown WQTC and elimination of the Prospect WQTCs would reduce nutrient loads in the respective watersheds.

Under the Final SSDP, there is no specific program to measure and model the benefits of SSO reduction on the environment. In the next section, the elimination of SSOs and basement backups as the key measurement of success are discussed. Moreover, other programs will capture the benefits and evaluate the overall improvements of modeled areas. For example, the Beargrass Creek Total Maximum Daily Load (TMDL) program will use reduced SSO events and volumes as well as positive impacts from the Final CSO LTCP to predict in-stream improvements.

4.5. MEASURES OF SUCCESS

This section provides an overview of known, documented SSO locations and the associated project that addresses the SSO, as well as a detailed discussion of the performance goals that will be used to measure the success of each Final SSDP project. The measures of success are a means to demonstrate compliance with the Consent Decree requirements and to quantify the benefits achieved from SSO elimination projects. Each project's performance goals should be tailored to site-specific situations. A review of the Final SSDP projects after completion will evaluate how well the project accomplished the performance goals that were established before the project began. Appendix 4.5.1 lists the known, documented SSOs, the associated project that addresses the SSO (including Final SSD and, Interim SSDP), levels of protection and project completion dates. The detailed fact sheets provided in 2012 for each documented SSO are provided in Appendix 4.5.1. The SSO fact sheets provide additional information such as a map of the SSO location, a background and history of the SSO location, downstream land use, receiving stream, and the overflow volume summary for the past five years. The fact sheets were not updated for the 2021 IOAP as they remain representative of SSO information.at the beginning of the program.

Appendix 4.5.1 SSO Fact Sheets

This appendix is the same as 2012 IOAP Modification and is provided on an external USB storage drive.

The four performance goals to be tracked under the Final SSDP include:

1. No Wet Weather, Capacity-Related SSOs under the Selected Level of Protection
2. No Wet Weather, Capacity-Related Basement Backups under the Selected Level of Protection
3. Sufficient Treatment Capacity under the Selected Level of Protection
4. Project Flow Monitoring Performed and Documented

It is worth noting that Goal One is the only goal specifically required by the Consent Decree. Goals Two through Four are in response to WWT Stakeholder Group requests and/or Kentucky Department of Environmental Protection (KDEP) Permit and regulatory requirements. Additionally, an overriding success measure and initial goal identified by MSD already met is that the plan is cost-effective for MSD ratepayers as presented in Figure 4.1.2. The next section provides an overview of the measure of success for each performance goal.

4.5.1. GOAL ONE: NO WET WEATHER, CAPACITY-RELATED SSOS UNDER THE SELECTED LEVEL OF PROTECTION

Since the main premise of the Consent Decree is to prevent unauthorized discharges, the goal of the Final SSDP is to eliminate capacity related SSOs under the site-specific levels of protection. To demonstrate the success of the Consent Decree premise, monitoring of the SSOs will be implemented. MSD will follow Sewer Overflow Response Protocol (SORP) guidelines to monitor SSOs.

Key to the monitoring is determining the magnitude of the rainfall, how significant the rainfall event was, and did the event exceed the level of protection for the appropriate area. MSD developed a rain-tracking tool called MSD-NET RainTrack that utilizes MSD's rain gauge network, radar data, and various software to determine the rainfall frequency for any area within the MSD collection system. Figure 4.5.1 is an example of the tool output displaying the rainfall frequency for various durations and rainfall distributions for a significant September 2006 storm in the Pond Creek watershed.

Storm Classification Report by Area

Louisville and Jefferson County
Metropolitan Sewer District

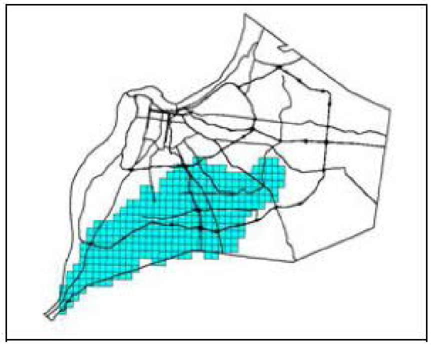
Run Time: 10:49:31 AM
Run Date: 9/24/2008

Area

POND CREEK WS

Start Time 9/22/06

End Time 9/25/06



24 hr	Start 9/22/2006 4:20:00 PM	End 9/23/2006 4:20:00 PM	Rain Total 4.98058736	
Standard	**Low Frequency**	**Low Value**	**High Frequency**	**High Value**
Atlas 14	10 Year	4.52	25 Year	5.43
Bulletin 71	10 Year	4.22	25 Year	5.22
TP-40	10 Year	4.5	25 Year	5.2

48 hr	Start 9/22/2006 3:30:00 AM	End 9/24/2006 3:30:00 AM	Rain Total 6.28185032	
Standard	**Low Frequency**	**Low Value**	**High Frequency**	**High Value**
Atlas 14	10 Year	5.3	25 Year	6.33
Bulletin 71	25 Year	5.58	50 Year	6.52
TP-40	25 Year	6.1	50 Year	6.4

Figure 4.5.1 Example of Output from MSD Rain-Tracking Tool

In addition to the rain-tracking tool, the hydraulic models can provide insight into the magnitude of the storm. The Post Construction Compliance Monitoring Plan, (Volume 1, Section 6.5) discusses how the hydraulic models will be maintained. The models will be re-calibrated on a regular basis and will be modified to reflect changes in collection systems, Final SSDP improvements, and rainfall-derived infiltration and inflow (RDI/I) reduction measures. Additionally, calibrated models can be used to determine if specific significant storms created watershed conditions that exceed the levels of protection.

Once a solution has been constructed and a significant storm has been monitored, MSD can measure the success of that solution. If the measure is successful for two consecutive significant storm events, then the solution is deemed successful relative to Goal One.

If the measure is unsuccessful under one significant (defined level of protection) storm event, MSD will utilize its adaptive management process to improve the project. For example, these improvements could include additional storage or targeted RDI/I-reduction measures upstream of the solution.

4.5.2. GOAL TWO: NO WET WEATHER, CAPACITY-RELATED BASEMENT BACKUPS UNDER THE SELECTED DESIGN LEVEL

A second goal for measuring the success of Final SSDP projects is to ensure basement flooding does not occur in the pre-remediated surcharge zone of influence under the level of protection and after the projects are complete. This is not a Consent Decree requirement, but rather a priority identified by the Wet Weather Stakeholder Group.

Success will be measured in the same manner as Goal One, except that the measurement will be for basement flooding in the zone of influence of known or suspected SSOs. If no basement backups due to capacity are reported for two consecutive significant storm events (defined level of protection or greater), then the solution is deemed to be successful relative to Goal Two.

If the measure is unsuccessful under one significant (defined level of protection) storm event, MSD will utilize their adaptive management process to improve the project. For example, these improvements could include additional storage or targeted RDI/I-reduction measures upstream of the solution.

4.5.3. GOAL THREE: SUFFICIENT TREATMENT CAPACITY UNDER THE SELECTED LEVEL OF PROTECTION

A third goal for measuring success of Final SSDP projects is to prevent WQTCs from exceeding wet weather capacity, which could potentially cause basement backups and SSOs in the upstream system and at the WQTC. The System Capacity Assurance Plan (SCAP) provides standards and details how the capacity of a WQTC is established, updated, and used for project evaluations. The SCAP is available on MSD's website under the Project WIN public repository at http://www.msdlouky.org/projectwin/docs.htm.

Success will be measured in the same manner as Goal One and Goal Two, except that the measurement will be for bypasses or violations at the WQTC. If no capacity related bypasses or violations are reported for two consecutive significant storm events (defined level of protection or greater), then WQTC improvements are deemed to be successful relative to Goal Three.

If the measure is unsuccessful under one significant (defined level of protection) storm event, MSD will utilize its adaptive management process to improve the project. For example, these improvements could include additional storage or targeted RDI/I-reduction measures upstream of the WQTC or additional WQTC improvements.

4.5.4. GOAL FOUR: PROJECT FLOW MONITORING PERFORMED AND DOCUMENTED

Flow monitoring related to the Final SSDP will build upon the pre-established Post Construction Compliance Monitoring program. Pre-construction data will be compared to the post-construction data to evaluate the effectiveness of improvements. Success will be measured in two ways. First, the flow monitoring will be used to determine if projected RDI/I reduction efforts (refer to Appendix 2.3.4) utilized in solution development has been achieved. Second, downstream solutions must be successful, as measured by Goal One. Ultimately, data provided by flow monitoring will dictate success of the project.

Table 4.5.1 provides an overview of the specific requirements for each goal, type, the characteristics of success, and the specific feature that is successful.

Table 4.5.1 Final SSDP Measures of Success

	Goal	Measurement	Location of Measurement	Event Triggering Measurement	Program Responsible for Measurement	Agency Requiring Measurement	Characteristics of Success	Successful Feature
1	**No Capacity Related Overflows under the Level of Protection**	Overflow, or lack thereof, at known, suspected or new SSO location	By solution (branch)	Large rainfall event near or above level of protection for solution area (branch)	SORP	Consent Decree	Two or more periods with rainfall at or above design conditions with NO overflows at known, suspected or new SSO locations within branch	Solution
2	**No Capacity Related Basement Back-ups under the Level of Protection**	Basement back-ups, or lack thereof, in zone of influence upstream of known, suspected or new SSOs	By solution (branch)		SORP	WWT Stakeholder Group	Two or more periods with rainfall at or above design conditions with NO basement back-ups within zone of influence of overflows at known, suspected or new SSO locations	Downstream Solution
3	**Sufficient Treatment Capacity under the Level of Protection**	Bypass or inadequate treatment, or lack thereof, at WQTCs in separate sewer system	By WQTC	Large rainfall event near or above cloudburst conditions for collection-system area	SCAP/CMOM	KDEP	Two or more periods with rainfall at or above 2-year cloudburst design conditions with NO bypasses or WQTC violations	WQTC
4	**Project Flow Monitoring Performed and Documented**	Reduction of projected RDI/I used in Hydraulic Modeling (1)	By any solution requiring RDI/I reduction as part of technology (2)	Any large storm (comparison based on control basin)	Post Construction Compliance Monitoring Plan, (See Volume 1, Section 6.5)	WWT Stakeholder Group requirement for RDI/I reduction as first part of any solution	Two or more periods with rainfall where RDI/I is reduced at or above requirement listed in RDI/I reduction memorandum	Downstream Solutions success eliminates the need for additional monitoring
4	**Project Flow Monitoring Performed and Documented**	Overflow, or lack thereof, at downstream known, suspected, or new SSO locations	By solution (branch)	Large rainfall event near or above level of protection for solution area (branch)	SORP	WWT Stakeholder Group requirement for RDI/I reduction as first part of any solution	Two or more periods with rainfall at or above level of protection with NO overflows at downstream known, suspected, or new SSO locations	

Legend: CMOM - Capacity, Management, Operations, and Maintenance

Notes:

1. These RDI/I reduction rates are listed in RDI/I-reduction memorandum (Appendix 2.3.4).
2. These solutions are listed in I/I program memorandum (Appendix 3.1.1)

4.5.5. BENEFITS OF THE MEASURES OF SUCCESS

The measures of success are a means to show compliance and benefits achieved from projects undertaken. Meeting these performance goals has many potential benefits including improved water quality, reducing negative impacts on public health, fewer impacts on receiving waters, and legal compliance. These measures are also a means to provide documented project results and verification that the benefit-cost analyses and risk management approach used to choose targeted deficiencies, levels of protection, and project scheduling were effective. The success measures encompass a flexibility to consider site-specific and project-specific values in an effort to find cost-effective means to reduce SSOs. Communication, collaboration, data tracking, documentation, and trend monitoring will be instrumental in achieving these success measures. Operational data from the Capacity, Management, Operations, and Maintenance (CMOM) and SORP may also be useful to incorporate into projects.

4.5.6. ADDITIONAL PERFORMANCE GOALS

In addition to the performance goals described in the previous section, projects will follow standard MSD business practices. Performance goals for sewer construction and acceptance testing will be based on MSD standard specifications and the Inspector Guidance Manual. The Flow Monitoring Field Operations Program (CMOM Section 2.2.6) provides data to support specific project needs such as watershed hydraulic modeling and calibration. The Water Quality Monitoring Program (CMOM Section 2.1.11) is a well-established program that uses a watershed management approach with routine water quality monitoring, investigative water quality monitoring, and water quality monitoring for spill impact. The Contingency Plan for Sewer and Treatment Systems Programs (CMOM Section 2.1.12) has its own performance goals for emergency response, public notification, agency notification, planning and water quality monitoring. Documentation and policies for emergency issues that could result in unauthorized discharges are detailed in the SORP section of the contingency plan. Additional green solution benefits and detailed monitoring procedures are found in Volume 1 of the IOAP.

4.5.7. NEW SSO LOCATIONS

It is anticipated that new SSO locations will be found over time. As a result, existing solutions will be modified to address new SSO locations. New SSOs could be a result of the following:

- Structural deficiencies that cause a loss of downstream capacity over time which may result in an overflow upstream of the structural deficiency. These structural deficiencies could include sewer collapses, the loss of efficiency at pump stations, blockages, or root intrusions.
- Increases in RDI/I due to long-term deterioration of the sewer system.
- Increases in flow through private property connections, such as illicitly connected sump pumps. During wet weather, the increased flow could result in an overflow in the area adjacent or downstream of the connections.

These new locations will be addressed on a case-by-case basis through MSD's adaptive management process (e.g., new SSOs will be added to the SORP investigation list and monitored. If necessary, hydraulic models will be validated to the new SSOs and used to develop solutions). SSOs that are not capacity-related will be addressed through the Gravity Preventative Maintenance and Continuing Sanitary Sewer Assessment (CSSA) Programs.

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On the front cover:
Goose Creek

Safe, clean waterways

700 West Liberty Street
Louisville, KY 40203-1911
LouisvilleMSD.org
Customer Relations
502.540.6000

PROJECT WIN
Waterway Improvements Now