FINAL COMBINED SEWER OVERFLOW LONG-TERM CONTROL PLAN

EXECUTIVE SUMMARY

INTRODUCTION

On August 12, 2005, the MSD entered into a Consent Decree in Federal Court with the United States Environmental Protection Agency (EPA) and the Kentucky Environmental and Public Protection Cabinet. State government subsequently assigned all state responsibilities under the Consent Decree to the Kentucky Department of Environmental Protection (KDEP).

The Consent Decree was developed in response to an enforcement action taken by EPA and KDEP alleging violations of the Clean Water Act (CWA) primarily related to sewer overflows. One of the requirements of the Consent Decree is the development and submittal of a Combined Sewer Overflow (CSO) Long-Term Control Plan (LTCP).

On December 1, 2008, a draft Amended Consent Decree was released for public comment. The draft Amended Consent Decree addressed alleged violations of the CWA primarily related to wastewater treatment plant (WWTP) performance, record-keeping, and reporting. Public comment closes on the draft Amended Consent Decree on December 31, 2008. It is anticipated that the Amended Consent Decree will be finalized early in 2009.

The Consent Decree amendments were negotiated over several months, and the terms of the draft amendments were known to MSD during the final stages of development of this Integrated Overflow Abatement Plan (IOAP). For the purposes of the IOAP, except where specifically noted otherwise, the term “Consent Decree” will be understood to mean the draft Amended Consent Decree as it was published in the Federal Register on December 1, 2008. Any modifications made to the draft Amended Consent Decree as a result of public comment will be addressed in a revision to the IOAP that will be prepared not later than 60 days after the Amended Consent Decree is finalized, or 60 days after receipt of IOAP review comments from the appropriate regulatory agencies, whichever is later.

Volume 2 of the IOAP is the Final CSO LTCP. Volume 2 presents the proposed plan for compliance in reducing wet weather CSO frequency and volume to levels required by the 1972 CWA and the 1994 CSO Control Policy. The Final CSO LTCP when implemented will accomplish the following objectives:

- Provide that if CSOs occur, they are only the result of a wet weather event;
- Perform modifications to the Ohio River Flood Protection System Infrastructure to provide that discharges only occur during a wet weather event;

- Bring wet weather CSO discharge points into compliance with the technology-based and water-quality-based requirements of the CWA;
- Minimize the impacts of wet weather CSOs on water quality, aquatic biota, and human health.

The Final CSO LTCP details the history of problem areas and presents solutions to bring the combined sewer system (CSS) into compliance. The Final CSO LTCP is organized into four chapters that present a comprehensive overview of MSD, its history of CSS operations, characteristics of the CSS, development of control alternatives, and final recommended programs and projects.

LTCP DOCUMENT ORGANIZATION

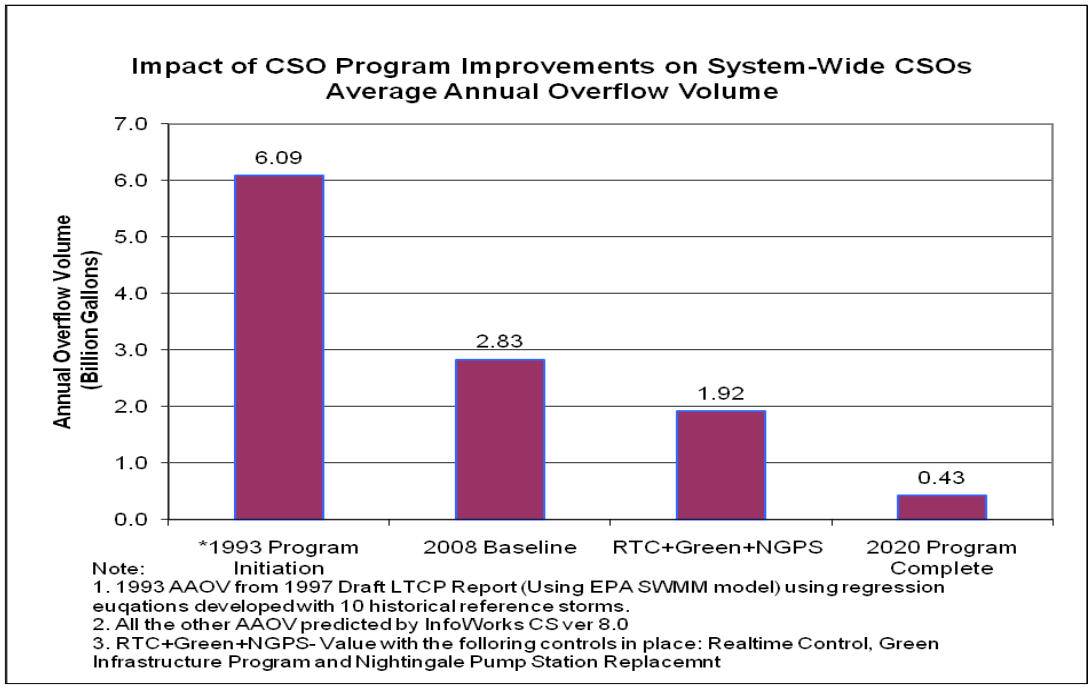
The following is a summary of each chapter:

Chapter 1 Introduction

This chapter provides a description of MSD's past and current sewer system infrastructure, a history of the CSO control policy, and MSD's CSO abatement program initiatives since 1991. Figure ES.1, at the end of the Executive Summary, outlines specific MSD initiatives and lists documents and submittals resulting from these initiatives. This introductory chapter also provides information related to the Final CSO LTCP approach, including public participation efforts, coordination with applicable regulatory agencies, water quality standards, receiving stream classifications, and the existing recreational use and ecological condition of the receiving streams.

Figure ES.2 presents progress of MSDs CSO program since the initial 1993 hydraulic sewer model run by means of the average annual overflow volume (AAOV). The values were predicted utilizing a hydraulic model to calculate a system-wide AAOV with the CSO controls in place at that time, applying an average annual rainfall. The 1993 initial program AAOV was calculated utilizing the EPA-SWMM hydraulic model (Stormwater and Wastewater Management Model) and the subsequent values were calculated using InfoWorks Collection Systems (Infoworks CS) hydraulic model.

FIGURE ES.2 PROJECTED IMPACT OF CSO PROGRAM IMPROVEMENTS



Chapter 2 System Characterization

This chapter presents MSD's CSO abatement efforts resulting from the Early Action Plan, primarily the Nine Minimum Controls (NMC) requirements and provides descriptions of the CSS and flood pump station infrastructure and operations. Additionally, the chapter outlines an overview of the hydraulic and water quality modeling objectives and execution, watershed data and characterization, and recreational use survey and sensitive area results. Figure ES.3 at the end of the Executive Summary provides an overview of the CSS.

Communities with collection systems that contain CSOs were required to implement NMCs by January 1, 1997. Chapter 2 summarizes MSD's initiatives and programs to meet these requirements. MSD continues to enhance components of NMC through present-day.

MSD has the responsibility to operate and maintain an extensive flood protection system infrastructure initiated by the U.S. Army Corp of Engineers (USACE) in the 1950's. In the chapter, a brief description of these facilities and operating requirements is provided. An overview of the CSS infrastructure is presented, with the recommended operational modifications to the flood pump stations and flood control gates. The objective of the modifications is to reduce CSO discharge volumes from the flood pump stations during weather events. The chapter also discusses controls to address dry weather overflows resulting from MSD's compliance with the requirements of the USACE Flood Pump Station operations manual.

Since the inception of software-based hydraulic models, modeling of the CSS has been performed using various rainfall scenarios and model platforms. In the chapter, a detailed description of how the rainfall condition was selected, the software applications, and model results are discussed. For the purpose of the Final CSO LTCP, MSD selected Wallingford InfoWorks CS software, using Jefferson County, KY 2001 typical year rainfall data. This chapter also details a description of the CSS with an overview of physical configurations of MSD's complicated sewer network. As part of the green infrastructure analysis, additional characterizations of the entire CSS are outlined, along with more detailed evaluations of each sewershed with active overflows.

The CSO Control Policy requires consideration and priority ranking of CSO discharges to areas meeting the criteria of sensitive area classification. Using the CSO Policy criteria, all Forks of Beargrass Creek are classified as sensitive, so no prioritization is possible using these criteria. To allow prioritization of CSO discharges, MSD developed a process to rate the ecological condition of each stream reach (defined as length between CSO outfalls). This data was one element used to create the CSO controls implementation schedule. Another requirement of the CSO Control Policy is the protection of public health. In order to assess the potential for human contact with streams receiving CSO discharge, a recreational use survey was conducted on both the Ohio River and Beargrass Creek. The survey results indicate that the Beargrass Creek Middle Fork has the greatest potential for human contact resulting from recreational activities.

This chapter concludes with a discussion of water quality standards, and current water quality conditions of the Ohio River and the three Beargrass Creek Forks: Beargrass Creek Muddy Fork, Beargrass Creek Middle Fork, and Beargrass Creek South Fork. Historic sampling data inclusive of existing CSO impacts are summarized as well as the development of water quality models respective to each receiving stream. The impacts to water quality, primarily through reductions in pathogen concentrations, complete this chapter.

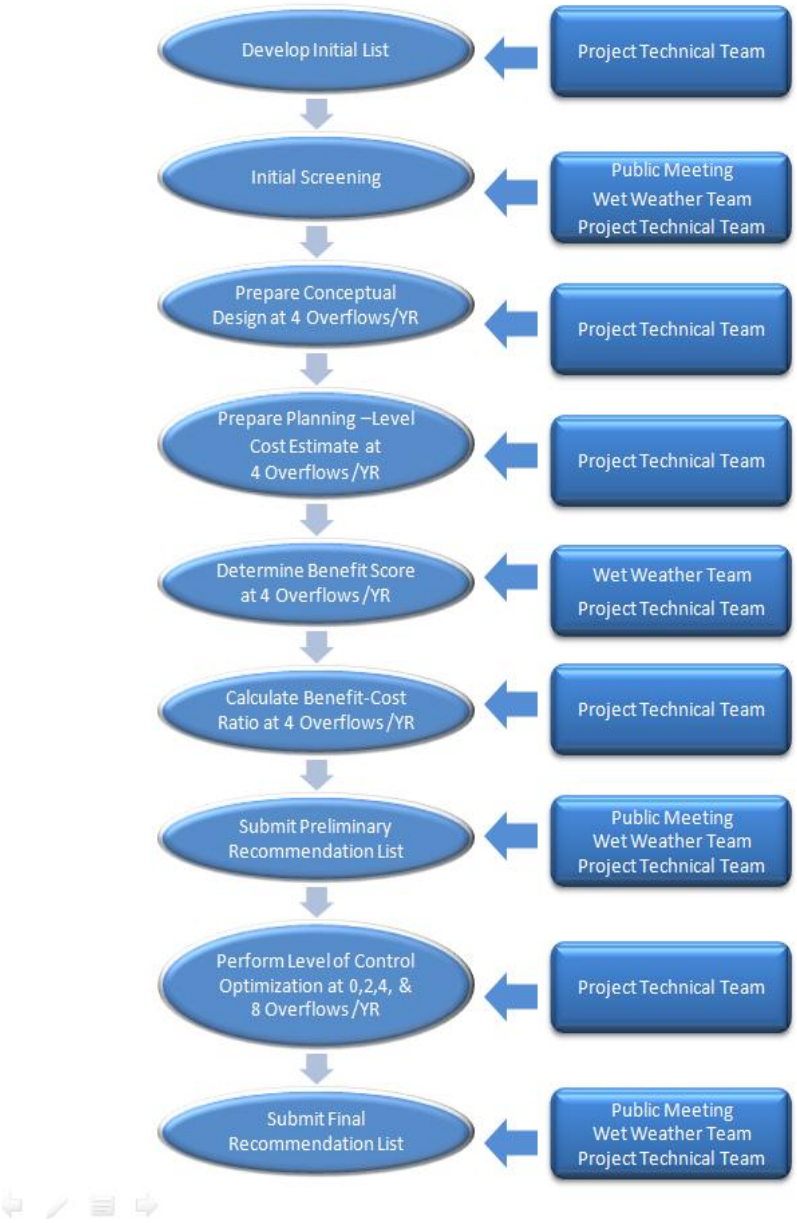
Chapter 3 Development and Evaluation of Alternatives for CSO Control

This chapter discusses the process to identify and validate solutions that achieve the objectives of the Final CSO LTCP. The programs and technologies available for CSO abatement are discussed in detail. Programmatic-based alternatives include solutions such as source control (a Green Infrastructure Program), and technology-based solutions such as storage either within the existing collection system or in new off-line basins.

This chapter also provides the methodology for assessing and comparing the value of the solutions considered. The primary decision guide is a benefit-cost analysis, using tools such as project-specific values, a standardized cost-estimating tool, and stream ecological reach ratings. Additional decision parameters include CSS operation and maintenance considerations, plus opportunities for infrastructure investment that optimizes CSS wet weather operation. The chapter also presents the approach toward structuring solutions and the process of solution evaluation and ranking. Figure ES.4 is a flow chart of the sequential CSO Control Alternative Process, including the associated inter-active community and technical teams.

The evaluation process considered 136 technology-based gray infrastructure projects comprehensive to the entire CSS. As a result of the decision process, 19 preferred solutions were selected to proceed to the optimization process to develop final recommended projects that represent the recommended solutions. In addition, the Green Infrastructure Program and demonstration projects are considered in the final suite of CSO controls.

FIGURE ES.4 CSO CONTROL ALTERNATIVE PROCESS



Chapter 4 Final Selection of the Recommended Plan

This chapter presents the level of control optimization process and subsequent final programs and technologies recommended to achieve the objectives of the Final CSO LTCP. These include the following CSO controls:

- Implementation of 19 Green Demonstration Projects and a Green Infrastructure Program, to reduce wet weather flow to the sewer collection system and increase potential for stormwater infiltration into the ground;
- Completion of a collection system real-time control (RTC) program to maximize in-line storage;
- Flow re-direction among sewersheds to optimize CSS wet weather operations;
- Construction of 23 technology-based gray infrastructure solutions to eliminate, store, or treat wet weather CSOs to performance levels determined by knee of the curve analyses, which results in a 96 percent reduction in CSO capture of flows entering the CSS;
- Five flood pump station modification projects to prevent dry weather CSO discharges; and
- Improvement in receiving water quality through CSO volume reduction; however, significant non-point source loading (non-CSO discharges) on all streams result in periods of non-attainment of water quality standards established by the CWA.

FINAL RECOMMENDED PROJECTS

Tables ES.1 and ES.2, at the end of the Executive Summary, list the Final Recommended Green Demonstration Projects and the Green Infrastructure Program, respectively. MSD anticipates the green demonstration projects to be initiated early in the Final CSO LTCP implementation schedule in order to assess source control performance and the impact, if any, to sizing gray solutions. Table ES.3 lists the Final Recommended Gray Infrastructure Projects, and Table ES.4 lists the Final Recommended Flood Pump Station Projects.

Figure ES.5 at the end of the Executive Summary summarizes the Final CSO LTCP implementation schedule, inclusive of the comprehensive Green Infrastructure Program. These projects are sequenced-based applying the ecological characterization criteria, CSS system operating requirements, constructability, and cash flow required to meet the Consent Decree Final CSO LTCP compliance date of December 31, 2020. The capital cost, in 2008 dollars, to implement the Final CSO LTCP is $320 million, allocated as follows:

- Green Infrastructure Program $ 47 million
- Gray Infrastructure Program $ 270 million
- Flood Pump Station Modifications $ 3 million

As depicted in Table ES.5 completion of the elements recommended in this Final CSO LTCP results in increase of percent capture of combined sewage volume from a modeled 2008 baseline of 75 percent CSS capture, to a predicted level of 96 percent CSS capture.

TABLE ES.5

PERCENT CAPTURE OF COMBINED SEWAGE

	No Control (2008 Baseline)	Final CSO LTCP
Volume of combined sewage collected in the CSS during precipitation events million gallons (MG)	11,369	11,369
Volume of combined sewage captured and treated (MG)	8,536	10,944
Percent of volume captured and treated	75%	96%
Volume of remaining CSOs (MG)	2,833	425
Percent of CSO volume	25%	4%

The success of this Final CSO LTCP in meeting Consent Decree compliance requirements will be measured incrementally as the plan is implemented and also at plan completion in December 2020:

1. The performance of the comprehensive MSD's Green Infrastructure Program will be measured repeatedly to determine if source reduction goals are being achieved.
2. Since engineering design of gray infrastructure projects will parallel reporting of green performance, any impact to gray solutions performance requirements will be integrated, including design characteristics, to incorporate future modifications.
3. The performance of both green technologies and gray technologies will be an on-going process under the Post Construction Compliance Monitoring Program.
4. As performance metrics are established and data collected, any modifications to the plan will be managed through adaptive management techniques to modify controls as necessary to bring operation of the CSS into compliance the CWA and CSO Control Policy requirements.

TABLE ES.1

FINAL RECOMMENDED GREEN DEMONSTRATION PROJECT LIST

Project Name	Watershed	CSO Controlled	Technology	Gallons Removed Annual (MG)	Capital (2008 Dollars)
MSD Main Office Parking Lot Bioswale	Ohio River	CSO053	Biofiltration Technique	0.88 MG	$80,000
Seventh and Cedar Green Parking Lot	Ohio River	CSO053	Biofiltration Technique	1.1 MG	$96,000
Second and Broadway Green Parking Lot	Ohio River	CSO 181 and CSO118	Biofiltration Technique	1.1 MG	$96,000
Third and Ormsby Biofiltration Swales	Ohio River	CSO198	Biofiltration Technique	0.53 MG	$ 48,000
Sixth and Muhammad Ali Green Parking Lot	Ohio River	CSO022	Biofiltration Swale	1.1 MG	$96,000
Sixth and Broadway Rain Garden	Ohio River	CSO028	Rain Garden	0.53 MG	$48,000
Additional Rain Garden Site	TBD	TBD	Rain Garden	0.53 MG	$48,000
Additional Rain Garden Site	TBD	TBD	Rain Garden	0.53 MG	$48,000
Additional Rain Garden Site	TBD	TBD	Rain Garden	0.53 MG	$48,000
Additional Rain Garden Site	TBD	TBD	Rain Garden	0.53 MG	$48,000
Seventeenth and W Hill Permeable Alley	Ohio River	CSO015	Permeable Alley	1.74 MG	$279,000
Seventh and Market Permeable Alley	Ohio River	CSO053	Permeable Alley	0.97 MG	$155,000
Campbell and Main Permeable Alley	South Fork	CSO121	Permeable Alley	0.41 MG	$65,000
Twelfth and Jefferson Green Street	Ohio River	CSO208	Green Street	0.53 MG	$48,000
I-264 Off-Ramp Dry Well	Middle Fork	CSO189	Dry Well	0.15 MG	$30,000
I-264 On-Ramp Dry Well	Ohio River	CSO019	Dry Well	0.15 MG	$30,000
I-264 and Gibson Dry Well	Ohio River	CSO191	Dry Well	0.6 MG	$120,000
Russell Lee Drive Dry Well	Ohio River	CSO191	Dry Well	0.15 MG	$30,000
JFK Montessori Area Dry Well	Ohio River	CSO191	Dry Well	0.3 MG	$60,000

TABLE ES.2

GREEN INFRASTRUCTURE PROGRAM INITIATIVE (FIRST 6 YEARS)

Impervious Surface and Best Management Practice (BMP) Type	Implementation Level over a 15-year Planning Horizon	Estimated Stormwater Reduction over a 15-year Planning Horizon	Annual Cost
Public Roofs			
Extensive Vegetated Roofs	7%	21,326,704	$427,000
Tray System Vegetated Roofs	3%	5,624,625	$112,000
Commercial Roofs			
Extensive Vegetated Roofs	1%	4,375,836	$88,000
Tray System Vegetated Roofs	1%	2,692,822	$54,000
Industrial Roof			
Extensive Vegetated Roofs	1%	6,532,083	$131,000
Tray System Vegetated Roofs	1%	4,019,743	$80,000
Single Family Residential Roofs			
Downspout Disconnection	10%	123,792,136	$386,000
Rain Barrel Program	N/A	0	$165,000
Local Roads			
Green Street	1%	245,900,715	$3,070,000
Urban Reforestation	14,000 trees	11,200,000	$224,000
Highways			
Biofiltration	0.5%	10,691,335	$7,000
Alleys			
Type A Alley (porous strip)	5%	11,885,294	$238,000
Type B Alley (porous entire width)	5%	11,885,294	$238,000
Public Parking/Driveways			
Biofiltration	5%	305,541,071	$191,000
Commercial Parking/Driveways			
Biofiltration	1%	84,097,514	$52,000
Industrial Parking/Driveway			
Biofiltration	0.5%	44,716,333	$28,000
Single Family Residential Property			
Biofiltration	0.5%	52,034,648	$32,000
Subtotal		**946,316,153 gallons**	**$5,523,000**
Technical Support			**$276,000**
TOTAL			**$5,799,000**
Green Infrastructure Program Cost to MSD per Gallon Removed			**$0.09**

TABLE ES.3

FINAL RECOMMENDED GRAY INFRASTRUCTURE PROJECT LIST

Project Name and Project ID	Watershed	CSOs Controlled	Technology	Size (MG)	Capital Cost (2008 Dollars)	Completion Date
CSO108 Dam Modification **L_SO_MF_108_S_09A**	South Fork	CSO108	In-Line Storage	NA	$150,000	12/31/2010
CSO123 Downspout Disconnection **L_MI_MF_123_S_08**	Middle Fork	CSO123	Sewer Separation	NA	$315,000	12/31/2011
Adams Street Storage Basin **L_OR_MF_172_S_09B**	Ohio River	CSO172	Off-Line Storage	0.12	$983,000	12/31/2012
Story Avenue and Main Street Storage Basin **L_OR_MF_020_S_09B**	Ohio River	CSO020	Off-Line Storage	0.13	$1,580,000	12/31/2013
CSO206 Sewer Separation **L_MI_MF_206_S_08**	Middle Fork	CSO206	Sewer Separation	NA	$3,842,000	12/31/2013
Paddy's Run Wet Weather Treatment Facility **L_OR_MF_015_M_13**	Ohio River	CSO015, CSO191	Hybrid Technologies	50 mgd	$24,940,000	12/31/2014
I-64 and Grinstead Drive Storage Basin **L_MI_MF_127_M 09B**	Middle Fork	CSO127, CSO125, CSO126, CSO166	Off-Line Storage	2.74	$12,950,000	12/31/2014
CSO058 Sewer Separation **L_OR_MF_058_S_08**	Ohio River	CSO058	Sewer Separation	N/A	$1,361,000	12/31/2014
CSO140 Sewer Separation **L_MI_MF_140_S_08**	Middle Fork	CSO140	Sewer Separation	N/A	$3,150,000	12/31/2015
CSO093 Sewer Separation **L_SO_MF_093_S_08**	South Fork	CSO093	Sewer Separation	N/A	$952,000	12/31/2015
CSO160 Sewer Separation **L_OR_MF_160_S_08**	Ohio River	CSO160	Sewer Separation	N/A	$237,000	12/31/2015
Nightingale Pump Station Replacement **L_SO_MF_018_S_03**	South Fork	CSO018	Pump Station Expansion	60 mgd	$15,710,000	12/31/2016

TABLE ES.3

FINAL RECOMMENDED GRAY INFRASTRUCTURE PROJECT LIST

Project Name and Project ID	Watershed	CSOs Controlled	Technology	Size (MG)	Capital Cost (2008 Dollars)	Completion Date
Story Avenue and Spring Street Storage Basin L_SO_MF_130_S_09B	South Fork	CSO130	Off-Line Storage	0.01	$1,077,000	12/31/2016
Logan Street and Breckinridge Street Storage Basin L_SO_MF_092_M_09B	South Fork	CSO092,CSO 113, CSO152, CSO091, CSO146, CSO179, CSO149, CSO117, and 11 Sneads Branch Relief Sewer CSOs	Off-Line Storage	11.83	$30,320,000	12/31/2017
Calvary - Creekside Storage Basin L_SO_MF_097_M_09B	South Fork	CSO097, CSO106, CSO110, CSO111, CSO137, CSO148, and CSO151	Off-Line Storage	3.46	$13,720,000	12/31/2017
18th and Northwestern Pky. Storage Basin L_SO_MF_190_S_09B	Ohio River	CSO190	Off-Line Storage	1.31	$4,514,000	12/31/2017
Clifton Heights Storage Basin L_MU_MF_154_M_09B	Muddy Fork	CSO154, CSO132 and CSO167	Off-Line Storage	6.55	$13,870,000	12/31/2018
Algonquin Parkway Storage Basin L_OR_MF_211_M_13	Ohio River	CSO211, CSO016, and CSO210	Hybrid Technologies	4.84	$17,300,000	12/31/2018
Southwestern Parkway Storage Basin L_OR_MF_105_M_13	Ohio River	CSO105, CSO104, and CSO189	Hybrid Technologies	5.08	$17,620,000	12/31/2018
Portland Wharf Storage Basin L_OR_MF_019_S_13	Ohio River	CSO019	Hybrid Technologies	6.37	$20,000,000	12/31/2019

TABLE ES.3

FINAL RECOMMENDED GRAY INFRASTRUCTURE PROJECT LIST

Project Name and Project ID	Watershed	CSOs Controlled	Technology	Size (MG)	Capital Cost (2008 Dollars)	Completion Date
13th Street and Rowan Street Storage Basin L_OR_MF_155_M_09B	Ohio River	CSO155, CSO022, CSO023, CSO050, CSO051, CSO052, CSO053, CSO054, CSO055, CSO056, CSO150, CSO156, CSO208, and Central Relief Drain (CRD)	Off-Line Storage	14.44	$49,680,000	12/31/2020
Lexington Road and Payne Street Storage Basin L_SO_MF_083_M_09B	South Fork	CSO083, CSO084, CSO118, CSO119, CSO120, CSO121, CSO141, CSO153 & CSO082	Off-Line Storage	7.31	$25,200,000	12/31/2020
Beargrass Creek Parallel Interceptor L_SO_MF_097_M_13	South Fork	Calvary-Creekside Storage Basin to Starkey Pumping Plant	Miscellaneous	NA	$10,900,000	12/31/2020

TABLE ES.4

FINAL RECOMMENDED FLOOD PUMP STATION PROJECT LIST

Project Name	Watershed	CSO Controlled	Technology	Size (MG)	Capital Cost (2008 Dollars)	Completion Date
27th Street Flood Pump Station **L_OR_MF_019_S_03_A_A**	Ohio River	CSO019	Flow Control	N/A	$476,000	06/30/2012
34th Street Flood Pump Station **L_OR_MF_019_S_03_A_B**	Ohio River	CSO019	Flow Control	N/A	$541,000	12/31/2012
Shawnee Flood Pump Station **L_OR_MF_189_S_03_A_A**	Ohio River	CSO104, CSO105, CSO189	Flow Control	N/A	$411,000	06/30/2013
4th Street Flood Pump Station **L_OR_MF_022_S_03_A_A**	Ohio River	CSO022,CSO023	Flow Control	N/A	$944,000	12/31/2013
17th Street Flood Pump Station **L_OR_MF_190_S_03_A_A**	Ohio River	CSO190	Flow Control	N/A	$625,000	12/31/2014