# HOW WERE THE SOLUTIONS EVALUATED?

The City of Cincinnati and Hamilton County have until December 2012 to submit a Lower Mill Creek Partial Remedy Plan to the Regulators. The timeline displays MSD's comprehensive evaluation of potential "grey" and "sustainable" solutions since the submittal of the Revised Wet Weather Improvement Plan (WWIP) in February 2009.

## 2002

- Interim Partial Consent Decree on Sanitary Sewer Overflows

## 2003

- Evaluation of Combined Sewer Overflows Control Strategies

## 2004

- Global Consent Decree

## 2005

- Biological and Water Quality Study of Mill Creek and Tributaries
- Combined Sewer Overflow Long Term Control Update

## 2006

- Wet Weather Improvement Plan (WWIP) Submittal
- Combined Sewer Overflow Long Term Control Update
- High Rate Chlorination/Dechlorination for Combined Sewer Overflow Disinfection
- Capacity Assurance Program & Combined Sewer Overflow Long Term Control Program

## 2007

- Green Infrastructure Report by City & County

## 2008

- Conceptual Outline for Revised WWIP
- RDII Pilot Study Mill Creek Phase 1
- Wet Weather Improvement Plan (WWIP) Summary Update
- County Pursued Change to ORC 6117
- County Policy Direction: Supports Green/Sustainable Approaches for WWIP
- Conditional Approval - Revised WWIP (June 2009)
- Revised WWIP Submittal
- Geotechnical Report: CSO 217/483 Stream Separation
- Interstate 75 Opportunities Maps
- Coarse Evaluation: CSO 217/483 Stream Separation
- Lower Mill Creek Watershed Coarse Evaluation
- CSO 125 Geotechnical Report

## 2009

- Lick Run Conceptual Report
- Preliminary Survey Report
- Market Analysis of Lick Run Alternative
- South Fairmount CSO #5 Urban Audit Report
- Preliminary Engineering Analysis: Hydrology and Hydraulics Report & Appendices
- Preliminary Property Acquisition Plan for Lick Run Wet Weather Strategy Basis of Design
- Lick Run Daylighting and Urban Revitalization Plan Demographic and Policy Framework
- Judge Approved Consent Decree
- Business Case Evaluation: CSO 10 Source Control
- Denham CSO 10 Geotech Report
- CSO 125 West Fork 60% CDM Design Memo, Tech Specs & Drawings
- BCE: CSO 30 Stream Separation Stage 1
- CSO 30 Data Collection Report
- Hopple Street Interchange ODOT/MSD Coordination
- LMC Coarse Evaluation Community Planning Background Report
- BCE: Clifton CSO 12 Source Control
- Estimate Report: Kings Run CSO 217/483 Stream Separation
- Urban Audit: Denham CSO 10
- Geotechnical Exploration: St. Francis ESP
- Coarse West Fork SWEP
- Alternative Analysis Report: Kings Run CSO 217/483 Stream Separation
- BCE Executive Summary: CSO 125 West Fork Stream Separation
- CSO 125 West Fork Phase I ESA
- CSO 125 West Fork Alternative Screening Evaluation
- Cash Flow Chart - CSO 125 Schedule
- CSOs 127 & 128 West Fork Stream Separation Alternatives Analysis Report
- Revive I-75: Cincinnati Neighborhood of the LMC Valley
- Final Geotechnical Investigation Work Plan
- Final Data Review Report
- Geotechnical Investigation Final Report
- Risk Management
- ESA Investigation Approach Memorandum
- Alternative Analysis Final Report & Preferred Alternative Concept Design
- Environmental Report
- Tunnel Alignment Analysis Facilities Location
- Property Information Report
- Updated Model V. 3.0-4.1
- LMCPR Costing Protocols Presentation

## 2010

- Risk Register
- Utility Review
- Topographic Review
- Transportation Analysis
- Wet Weather Strategy Basis of Design
- Preliminary Geotechnical Exploration Report
- Wet Weather Strategy Community Opportunities Plan
- Phase 1 ESA Report for South Fairmount Neighborhood
- Transportation Analysis Alternatives Development & Refinement Report
- Risk Register Update
- Lick Run Sewer Separation Project Preliminary 30% Design Submittals
  - Sunset Ave. • Wyoming Ave.
  - Harrison Ave. Phase A & B
  - State Ave. • Quebec Rd.
  - Queen City Ave. Phase 1
  - Queen City Ave. Phase 2
  - Queen City Ave. Phase 3
  - Queen City and Cora Ave.
  - Quebec Heights Phases 1&2
  - Grand Ave. • Westwood Ave.
- Enabled Impact Report Interim Project Summary
- Comprehensive Sewershed Flow Monitoring Plan Draft
- Clifton - Burnet Woods Green Infrastructure Modeling
- CSO 12 - Proposed ODOT Retaining Wall
- Kings Run CSO 217/483 Stream Separation Planning Level Modeling Report
- West Fork Alternatives Analysis Report
- Clifton - CSO 12 Phase A 100% Design Package
- Clifton - CSO 12 Outfall at CSX
- Model Validation & Capture Area / Volume Confirmation Tech Memo
- Bloody Run Preliminary Models & SWEP
- Kings Run - CSO 217/483 Preliminary Plan Set
- Ross Run Watershed SWEP
- Geotechnical Study Report
- Clifton - CSO 12 Modeling Report
- Bloody Run Watershed SWEP
- CSO 125 West Fork Surface Water Assessment
- Refined West Fork SWEP
- Biological & Water Quality Monitoring & Bioassessment Plan
- Glenway Woods QHEI/HHEI
- Kings Run - CSO 24 Modeling Report
- Denham - CSO 10 Modeling
- Hydrologic/Hydraulic Model Clifton - CSO 12 Phase A
- 50-scales, CAGIS data, Surveys, Modeling, Specs & Drawings, TV Inspections
- Rapid Run Park 30% Design
- Tunnel System Hydraulics & Operation Report
- Technical Baseline Report
- Tunnel Alignment Analysis & Facility
- Tunnel Workshop
- Revised Concept Design Draft
- Revised Geophysical Alignments
- Geotechnical Data Report
- Technical Baseline Final Report
- EHRT Basis of Design
- MSDGC's Financial Analysis Manual
- Estimate Review Memo
- Green Ultimate Conditions Tech Memo
- Watershed Monitoring & Bioassessment Plan MSDGC Service Area
- Costing Protocol

## 2011

- CSO 5 Value Engineering (VE)
- Community Design Workshop #1 Results
- Hydrologic/Hydraulic Modeling Harrison Avenue Phase A
- USEPA Lick Run Watershed Strategic Integration Plan
- Geotechnical Report Harrison Ave Phase A/B & White St Phase A
- Queen City & Cora Avenues Interim Geotechnical Report
- Phase I ESA Report Update
- Comprehensive Design Report Draft
- Green Temporary Connections Report
- BCE: CSO 5 Sustainable Infrastructure
- Glenway Woods Project Concept Plan Tech Memo
- Wyoming & Minion Avenues Sewer Separation Alternatives Analysis
- Harrison Avenue Sewer Separation Phase A 90% Design
- White Street Sewer Separation Transmittal of CAD files
- Sunset Rapid Run Area Separation 30% Updated Design Package
- White St, Rapid Run Rd, Quebec Rd QCA QHEI
- Voluntary Action Plan Phase 1 Property Assessment
- Sunset Rapid Run Area Separation QHEI/HHEI
- Harrison Avenue Sewer Separation Phase A 90% Design (Refinement)
- Sunset Rapid Run Area Separation Revised QA-QC Plan
- Harrison Avenue Sewer Separation Phase B 30% Design Drawings & Tech
- White Street Sewer Separation 30% Design - Updated
- Quebec Heights Interim Geotechnical Exploration
- White Street Sewer Separation 30% Design Resubmittal
- CDW #2 Results
- CSO 5 Analysis of VE
- Sunset Rapid Run Area Separation 30% Updated Design Modeling Information
- Voluntary Action Plan Phase 2 Assessment
- BCE: West Fork Watershed
- CSO 24 Alternatives Analysis Draft
- LMCPR Preliminary Alternatives Evaluation Preliminary Findings Report
- CSO 10 Alternatives Analysis
- Open House Summary: West Fork
- VE for Mill Creek Tunnel & Pump Station
- Open House Summary: Bloody Run CSO 18 Source Control - Phase 1
- LMCPR System Wide Model Validation Report
- CSO 12 Alternatives Analysis 100% Design Package
- LMC Systems Analysis Mill Creek Updated Model/Report
- Sustainable Projects Tech Memo LMCPR Study
- LMCPR Revised Plan, Project Cost Estimating Protocols
- Bloody Run Watershed Strategic Separation Project
- MSDGC Modeling Guidelines and Standards
- Easement Acquisition Costs Estimating: CSO 217/483
- LMC Watershed LMCPR Water Quality Evaluation
- Rapid Run Park 60% Design
- MSDGC Property Acquisition
- Sustainable Infrastructure Gap Analysis Report & Memo
- Sustainable Watershed Planning Manual for Communities of the Future Draft
- BCE: Bloody Run, CSO 181 Source Control - Phase 1
- LMCPR System Wide Model Restructuring Version 3.2, 4.0.10 & 4.2
- 2011 Flow Monitoring Data Review of Sanitary & Storm Sewers
- Biological & Water Quality Study of Mill Creek & Tributaries - Draft

## 2012

- Quebec Heights 30% DRP Technical Design Memo
- Phase 1 Report Potential Sewer Improvements
- Queen City Ave Sewer Separation Phase 2 Technical Design Memo
- Private Investment Potential UC Economics Center
- Comprehensive Design Report
- Lick Run Percent Effectiveness
- CDW #3 Results
- Lick Run Watershed Master Plan
- Quebec Heights 30% DRP Cost Opinion Summary
- Design Schedule: Sunset Rapid Run Area Separation
- Queen City & Cora Avenues Alternatives Analysis Final Draft
- Quebec Heights HHEI Assessment
- Economic Impacts of Lick Run CSO Mitigation UC Economics Center

## 2013

**December 2012**

- LMCPR Plan Submittal to Regulators
- SSO 700 Final Remedy Plan
- Public Comment Report
- Draft Post-Construction Monitoring Plan
- Draft Watershed Action Plan

## LEGEND

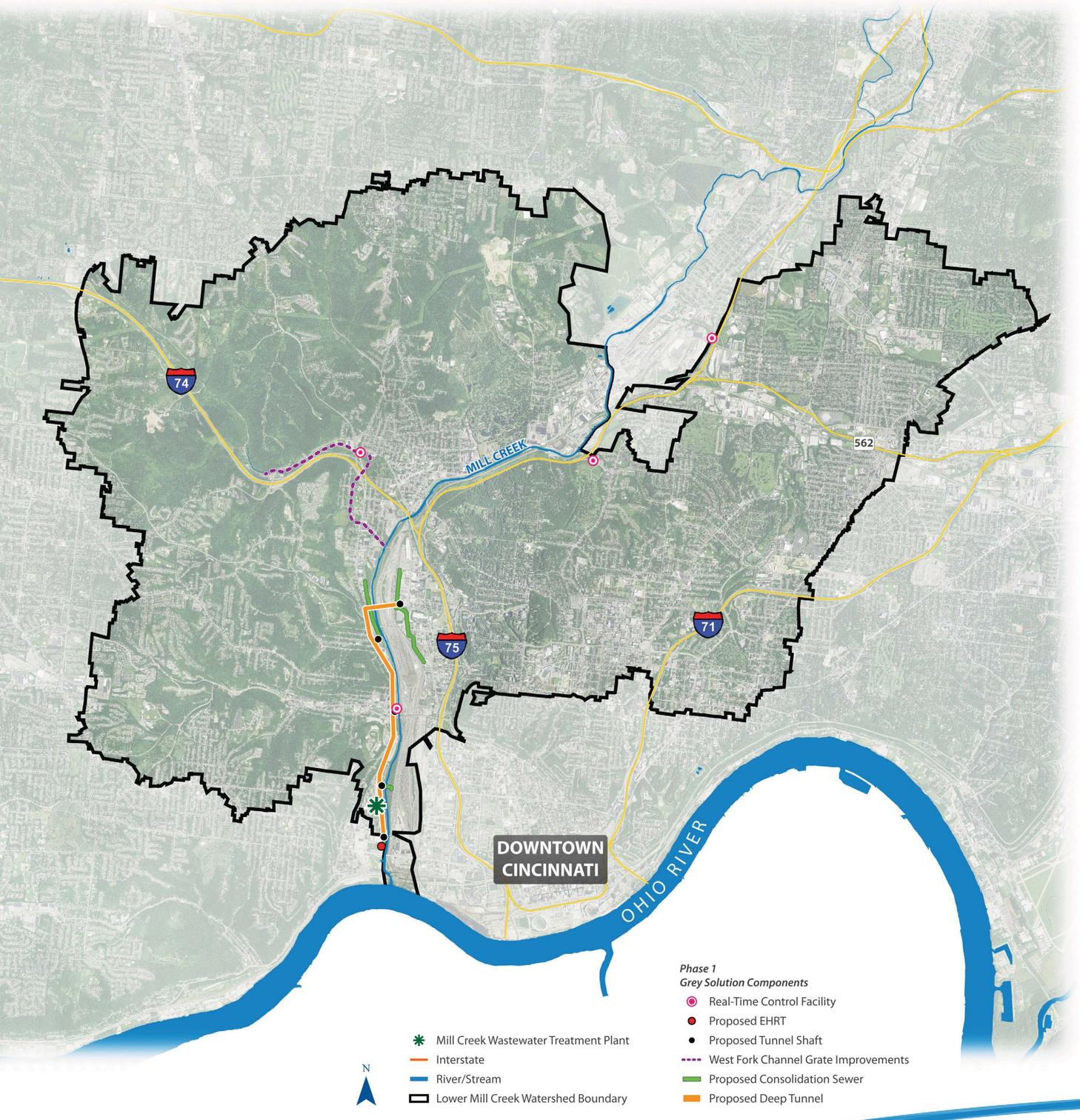
- Lower Mill Creek (LMC) Sustainable Infrastructure
- Lick Run Watershed Sustainable Infrastructure
- Tunnel / Grey Alternative
- Overall Analysis
- Consent Decree Benchmarks

**NOTE:** Documents completed as of June 2012

METROPOLITAN SEWER DISTRICT of greater CINCINNATI

# WHAT'S A GREY SOLUTION FOR PHASE 1?

MSD is required to control a significant volume in the Lower Mill Creek by 2018. The City and County have until December 2012 to submit a Lower Mill Creek Partial Remedy plan to the Regulators. This "grey" solution controls up to 2 billion gallons of combined sewer overflows (CSOs).




## Summary of Phase 1 Grey Solution

- Real-time control (RTC) facilities (CSOs 005, 125, 482, and 487)
- West Fork Channel grate modifications
- Deep tunnel (25 feet in diameter, 15,300 feet in length)
- Consolidation sewers (varying diameter, 10,400 feet in length)
- Deep tunnel pump station (84 million gallons per day)
- Enhanced high-rate treatment (EHRT) facility (84 million gallons per day)

*A look inside a tunnel*

*Example EHRT*

*Example RTC facilities*

## Phase 1 Grey Solution Benefits

- Significant reduction in CSO volume
- Fewer assumptions in modeled results
- Higher degree of operational flexibility for interceptor maintenance
- Flexibility to incorporate various solutions for Carthage and SSO 700
- Provides bacteria reduction

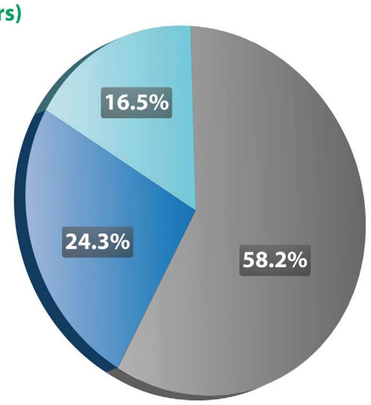
## Summary of Capital Costs (2006 dollars)

Deep Tunnel
**$312,671,000**

Deep Tunnel Pump Station and EHRT
**$135,811,000**

Consolidation Sewers
**$88,927,000**

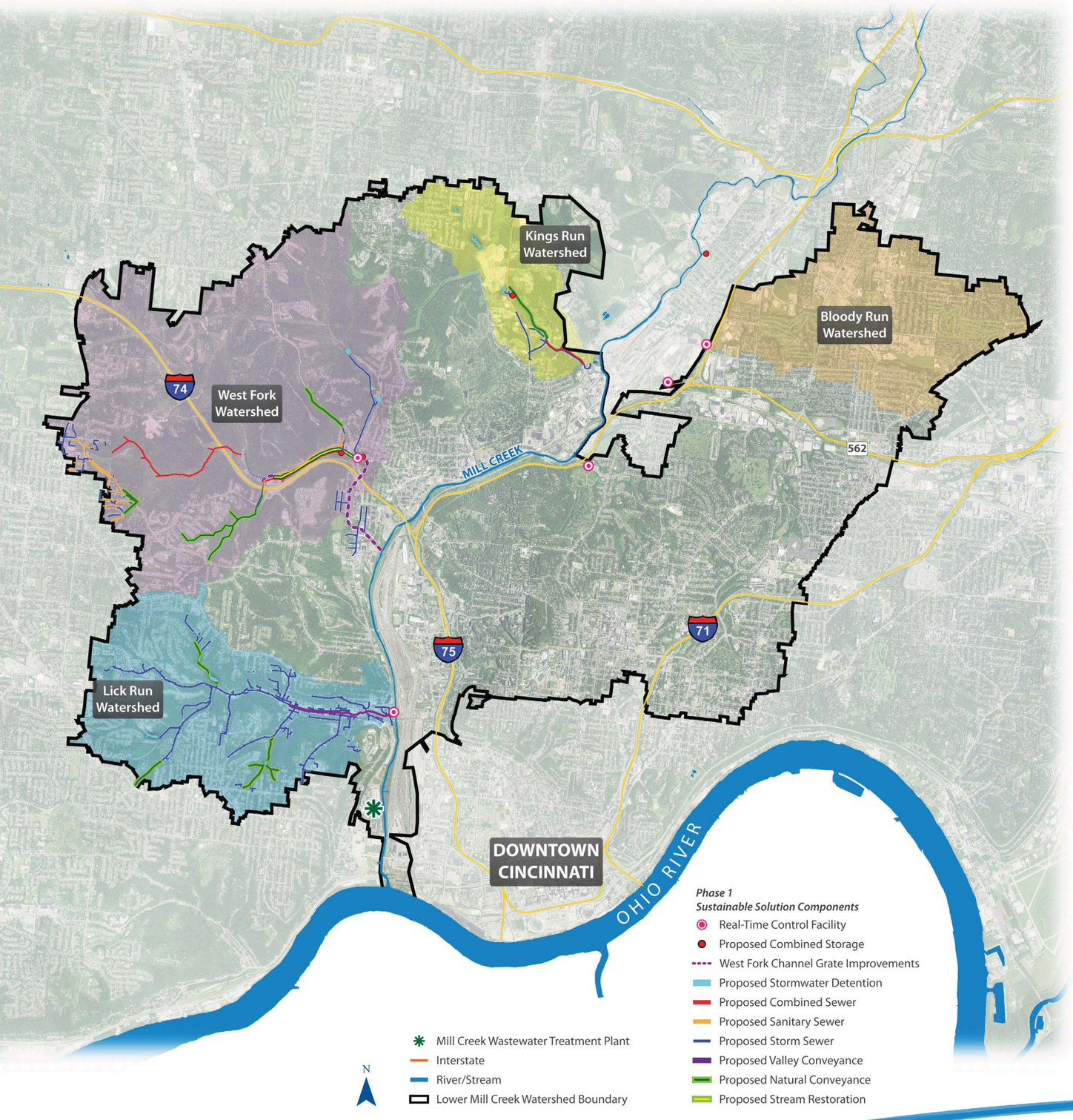
**Total = $537,409,000**




METROPOLITAN SEWER DISTRICT of greater CINCINNATI

# WHAT'S A SUSTAINABLE SOLUTION FOR PHASE 1?

MSD is required to control a significant volume in the Lower Mill Creek by 2018. The City and County have until December 2012 to submit a Lower Mill Creek Partial Remedy plan to the Regulators. A "sustainable" solution focuses on removing stormwater from the combined sewer system to control up to 2 billion gallons of combined sewer overflows (CSOs).




## Summary of Phase 1 Sustainable Solution

- Real-time control (RTC) facilities (CSOs 005, 125, 181, 482, and 487)
- West Fork Channel grate modifications
- Sustainable Infrastructure projects (Lick Run, West Fork, and Kings Run watersheds)
- Combined storage facilities (CSOs 125, 130, 217, and 488)

*Examples of Sustainable Infrastructure*

*Sewer Separation*

*Stormwater Detention Basin*

*Naturalized Channel*

*Stream Restoration*

## Phase 1 Sustainable Solution Benefits

- Significant reduction in CSO volume
- Surface improvements and increased public acceptance
- Opportunities to leverage private/public funding
- Construction jobs available for local workforce & SBEs
- Less purchased energy
- Adaptable to future water quality needs
- Ability to capture more flow by adding separation areas
- Brownfield remediation and repurposing of land for source control
- Reduction in rain water and natural drainage volume to wastewater treatment plant
- Provides the greatest reduction in peak bacteria levels in Mill Creek
- Returns more base flow to the hydromodified Mill Creek

## Summary of Capital Costs (2006 dollars)

Lick Run Watershed
**$195,449,000**

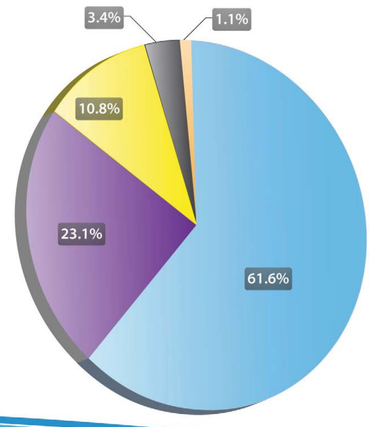
CSO 488 Storage
**$10,651,000**

West Fork Watershed
**$73,503,100**

Bloody Run Watershed
**$3,421,000**

Kings Run Watershed
**$34,423,000**

**Total = $317,447,000**

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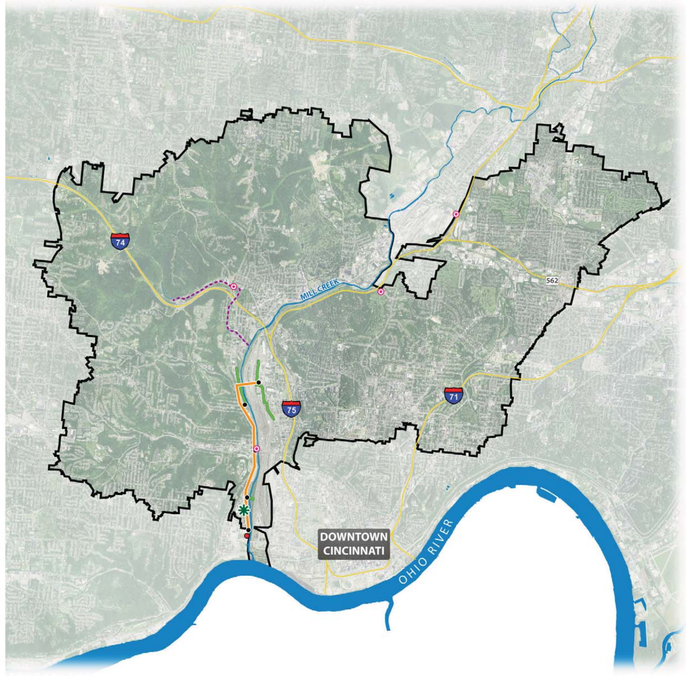
# HOW DO THE POTENTIAL SOLUTIONS COMPARE?

MSD is required to control a significant volume in the Lower Mill Creek by 2018. The City and County have until December 2012 to submit a Lower Mill Creek Partial Remedy plan to the Regulators. MSD developed performance metrics to compare the grey solutions and the sustainable solutions to overarching goals. A grey and a sustainable solution are compared below.

## Grey Solution




**LEGEND**
- Mill Creek Wastewater Treatment Plant
- Interstate
- River/Stream
- Lower Mill Creek Watershed Boundary

*Phase 1 Grey Solution Components*
- Real-Time Control Facility
- Proposed EHRT
- Proposed Tunnel Shaft
- West Fork Channel Grate Improvements
- Proposed Deep Tunnel
- Proposed Consolidation Sewer

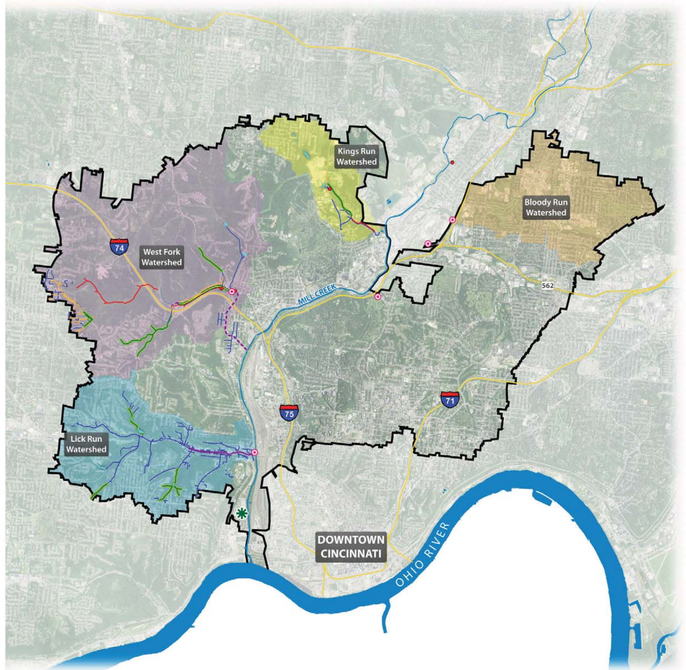
### BENEFITS
- Significant reduction in CSO volume
- Fewer assumptions in modeled results
- Higher degree of operational flexibility for interceptor maintenance
- Flexibility to incorporate various solutions for Carthage and SSO 700
- Provides bacteria reduction

### RISKS
- Long-term solution not adaptable
- Future NPDES regulations
- Potential large cost variance
- Complex construction methods
- Limited local construction participation
- Higher energy demand & cost
- Larger carbon footprint

**Total Capital Cost** (2006 dollars) **$537,409,000** »

**Cost per Gallon**[1] **$0.24**

## Sustainable Solution




**LEGEND**
- Mill Creek Wastewater Treatment Plant
- Interstate
- River/Stream
- Lower Mill Creek Watershed Boundary

*Phase 1 Sustainable Solution Components*
- Real-Time Control Facility
- Proposed Combined Storage
- West Fork Channel Grate Improvements
- Proposed Sanitary Sewer
- Proposed Stormwater Detention
- Proposed Combined Sewer
- Proposed Storm Sewer
- Proposed Natural Conveyance
- Proposed Stream Restoration
- Proposed Valley Conveyance

### BENEFITS
- Significant reduction in CSO volume
- Surface improvements & increased public acceptance
- Opportunities to leverage private/public funding
- Construction jobs available for local workforce & SBEs
- Less purchased energy
- Adaptable to future water quality needs
- Ability to capture more flow by adding separation areas
- Brownfield remediation and repurposing of land for source control
- Reduction in rain water and natural drainage volume to WWTP
- Greatest reduction in peak bacteria levels in Mill Creek
- Returns more base flow to the hydromodified Mill Creek

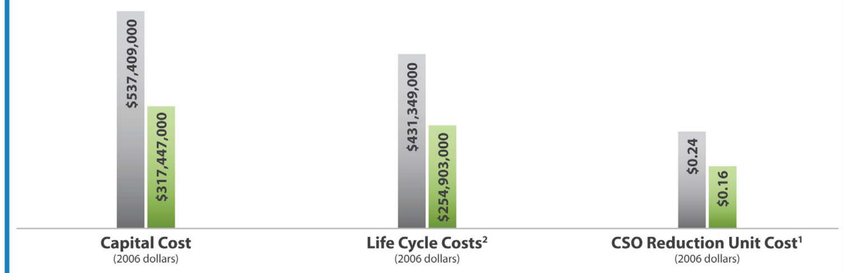
### RISKS
- Additional assumptions for modeling
- Potential future stormwater regulations

**Total Capital Cost** (2006 dollars) **$317,447,000** »

**Cost per Gallon**[1] **$0.16**

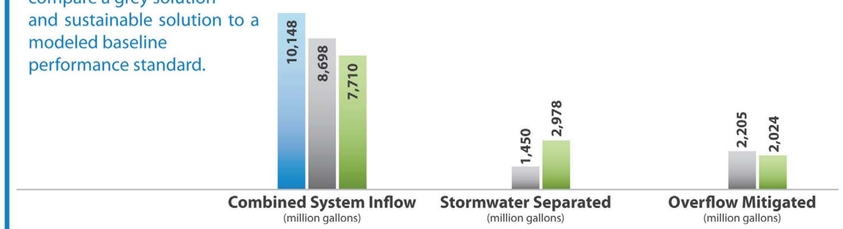
**LEGEND** Baseline Model 3.2 | Grey Solution | Sustainable Solution

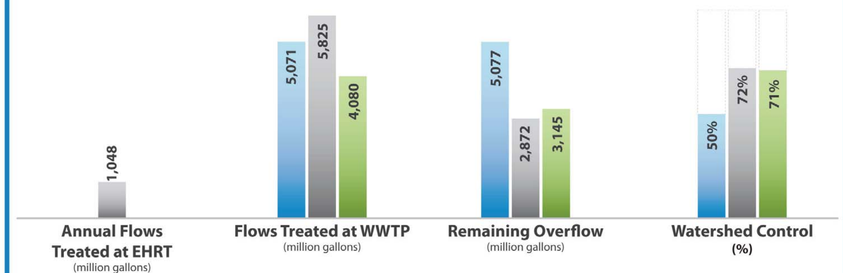
## Phase 1 Cost Comparison

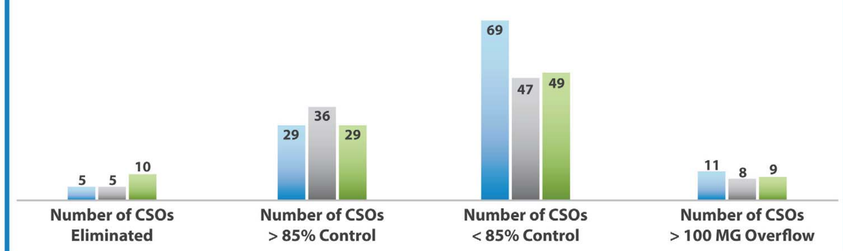



## Phase 1 Performance Metrics

Phase 1 performance metrics compare a grey solution and sustainable solution to a modeled baseline performance standard.




[1] Cost per gallon refers to the CSO reduction unit cost of a solution. This planning-level metric is calculated by dividing capital cost (in 2006 dollars) by the estimated annual CSO reduction (in gallons). Potential Phase 1 costs per gallon include the 4 completed real-time control (RTC) facilities.

[2] Life cycle costs are reported in terms of present worth (in 2006 dollars) using an analysis period of 25 years and a discount rate of 4.2%

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