

Introduction

When the national financial collapse began in 2008, Detroit's Rouge River Combined Sewer Overflow (CSO) Control Program was well underway. Detroit had already invested more than \$750 million in new infrastructure to capture and treat wet weather discharges to both the Detroit and Rouge Rivers from the sewer system (Table 1) resulting in significant reductions in CSO discharges. The nine Rouge River projects totaled more than \$400 million.

As the economic crisis worsened and the major auto companies that form the economic backbone of the City faced bankruptcy, it became clear that Detroit residents lacked the resources and revenue to complete the CSO program as originally proposed in 1996. In fact, the 28.9% rate of unemployment in the City of Detroit led the nation (July, 2009).

The Detroit Water and Sewerage Department's (DWSD) most immediate problem was the huge cost associated with construction of two major capital improvement projects and the resulting impact on rates to repay bonds and interest. These included \$880 million for the new Upper Rouge CSO Tunnel (URT) and \$300 million for a new outfall at the wastewater treatment plant (WWTP). In accordance with a rate settlement agreement sanctioned by the federal court, Detroit residents were responsible for 83% of the URT costs and about half of the outfall project costs.

Faced with rising unemployment, shrinking household income, continued loss of population and huge revenue shortfalls, the City was compelled to terminate these two projects and attempt to develop a less costly, implementable alternative. The State of Michigan cooperated with the City in the effort which led to cancellation of the contracts and development of a revised CSO Control Program.

This document summarizes the results of DWSD's evaluation of CSO control alternatives and describes an alternative Rouge River CSO Control Program that Detroit is now proceeding to implement. The program represents a creative and viable approach for addressing a complex problem.

Table 1. CSO Projects for the Rouge and Detroit Rivers

Detroit's CSO Projects built or under construction by 2008:		
Hubbell-Southfield Basin (1995)	\$58.9 M	Rouge
Puritan-Fenkell Basin (1996)	\$18.1 M	Rouge
7 Mile Basin (1996)	\$14.9 M	Rouge
In System Storage Gates (1996)	\$3.4 M	Rouge
St. Aubin S&D Facility (1999)	\$19.8 M	Detroit
Leib S&D Facility (1999)	\$33.4 M	Detroit
WWTP Expansion (2000)	\$101.2 M	Rouge/ Detroit
Conner Creek Basin (2001)	\$201.4 M	Detroit
In System Storage Devices (2002)	\$30.8 M	Rouge/ Detroit
Baby Creek S&D Facility (2003)	\$76.1 M	Rouge
Belle Isle Basin (2005)	\$16.1 M	Detroit
Oakwood Basin & Pump Station (2007)	\$168.7 M	Rouge
Oakwood Sewer Improvements #1 (2008)	\$15.0 M	Rouge
Total Cost of Pre-2008 Facilities	\$758 M	
2009 Rouge River capital improvement projects:		
Upper Rouge CSO Storage Tunnel (terminated)	\$880 M	
New WWTP Outfall (DRO-2) (terminated)	\$300 M	
Segment 2 of Oakwood Sewers	\$12 M	
Subtotal for 2009 Facilities	\$1,192 M	
Grand Total	\$1,950 M	



WWTP Expansion



Hubbell-Southfield Basin

Approach

The Southeast Michigan Council of Governments (SEM-COG) has documented that the current economic conditions will be long lasting. In fact, even after the economic recovery occurs, the region is still expected to have fewer jobs in 2025 than in 2000. Between 1970 and 2000, Detroit's population declined by 560,000 (37%). In the last 10 years, it declined by another 124,000. By 2030, Detroit's population is expected to decline by another 119,000.

In the area of the City affected by the URT project, 12% of the parcels are already vacant, without any structures. An additional 6% are abandoned, but contain structures. Based on the forecasted population decline, the amount of vacant land in the tributary area will grow significantly.

Therefore, continuing with a "Business as Usual" approach to sewage collection and treatment systems would be irresponsible and imprudent. Instead, Detroit stepped back to take a more holistic view of its current circumstances to come up with a creative, implementable plan.

The evaluation was tailored to address the regulatory requirements established by MDEQ to ensure that the state's CSO control policies are satisfied and that water quality standards are attained in the Rouge River. The focus of Detroit's study has been to identify and pursue innovative, low cost, environmentally-beneficial solutions to water pollution problems as a substitute for conventional CSO capital improvement projects that are costly to build, operate and maintain.

Objectives

Against the backdrop of staggering unemployment and potential insolvency, the evaluation took a holistic approach to considering multiple outcomes representing various needs. Instead of proposing continued deferral of Rouge River CSO control projects, Detroit's CSO Program has been restructured to meet the following outcomes:

- Initiate implementation immediately to ensure that environmental and water quality benefits are realized as soon as possible.
- Establish a more affordable program that is within Detroit's current financial capability, thus avoiding long delays tied to the City's eventual economic recovery.
- Support the City's financial recovery by acknowledging the demands and limited resources of Detroit's ratepayers. These ratepayers face escalating costs for other essential utilities and infrastructure services such as water, electricity, gas, etc. As a practical matter, the sustainability of the sewer system is dependent on retaining paying customers, so the customers must be able to actually pay for the costs of the CSO projects.
- Design a program that addresses multiple objectives embraced by Federal and State agencies.



Rouge River

Overview of Recommended CSO Program

DWSD's Alternative Rouge River CSO Control Program is designed to restore water quality and protect public health while staying within its financial means by controlling rate increases that will be needed to pay for new projects. The program encompasses a 25-year phased plan that focuses on "Green Infrastructure" solutions along with "right-sized" conventional CSO control facilities ("Grey" projects).

The Green Infrastructure improvements are designed to keep stormwater runoff out of the sewer system as much as possible. This will reduce CSO volumes by an estimated 10% to 20%. This will enable the City to utilize smaller, more cost-effective Grey CSO facilities to store and treat the stormwater that gets into the sewers.

The Green and Grey approach offers many advantages:

- Lower capital and operating costs. Green projects are a fraction of the cost of traditional Grey projects (basins, tunnels, and pump stations).
- Immediate benefit. Green projects can be done NOW without long delays for planning, design, site acquisition, financing and construction so the beneficial impact is immediate.
- "Right-sized" infrastructure. Using Green Infrastructure solutions means that the City's downsizing can be reflected in a smaller, more manageable sewer system.
- Multiple benefits. Green solutions provide benefits that transcend a typical sewer project like carbon reduction, improved aesthetics, and enhanced property values.

The DWSD CSO Plan focuses on maximizing Green projects in the immediate near term. When coupled with the proposed Grey CSO control facilities, the City will control its wet weather discharges as part of the basin-wide effort to restore the Rouge River.

Expected Outcomes/ Environmental Impacts and Benefits

- Because of DWSD's prior investment in CSO control on the Rouge River (> \$400 million since 1995), untreated CSO discharges have already been reduced by 64% from the 1995 volume (from 7.7 billion gallons/year to 2.8 billion gallons/year) as shown in Figure 1. Pollutant loads have been reduced by 40% as shown in Figure 2.
- Massive demographic changes have occurred, and will continue to take place, in the tributary area since the project was first envisioned. These are summarized in Figure 3.

Figure 1. Annual Overflow Volume from Detroit CSOs to Rouge River

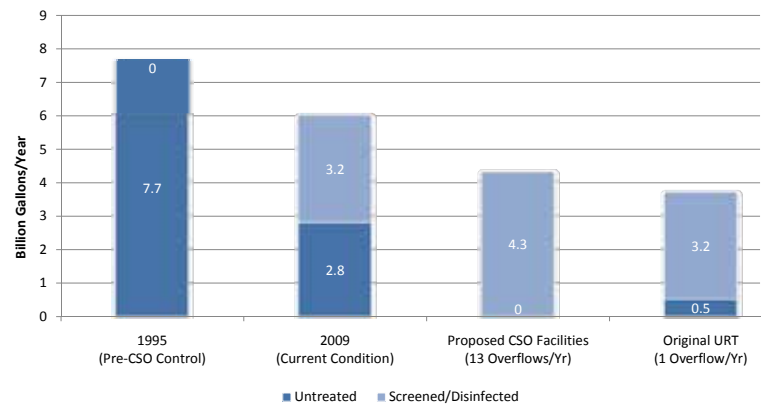
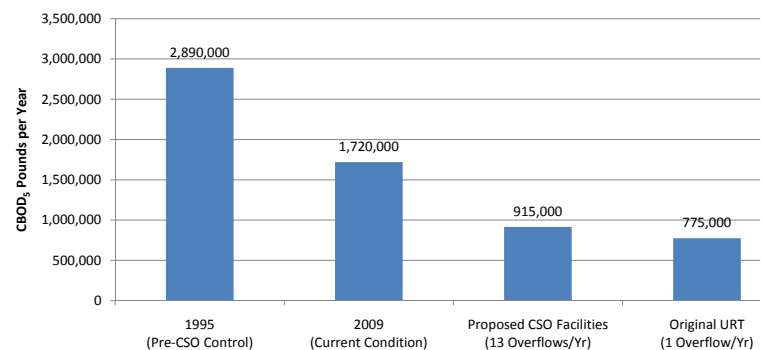


Figure 2. Annual Pollutant Loading to the Rouge River from Detroit CSOs



Note: Values include existing Rouge River CSO facilities as well as the proposed new facilities.



- Green Infrastructure projects will reduce stormwater runoff into the sewer system by at least 10% to 20%. But the reductions could be even greater, and discussions are underway within Detroit to pursue additional opportunities beyond those identified in this report. If successful, these could further reduce stormwater flows into the sewer system.
- Early reductions in CSO discharge volume will be achieved from implementing the Green Infrastructure program, with corresponding improvements in Rouge River water quality.
- USEPA explicitly advocates the incorporation of Green Infrastructure into CSO programs and projects. These types of activities are being implemented in many cities across the nation as part of their CSO Control Programs. The State of Michigan has been a strong advocate for advancing “green practices” in many areas including energy production, land use planning and support of low impact development.
- Incorporating Green Infrastructure projects into the CSO program helps ensure that these measures will receive funding and be implemented as an integral component of Detroit’s Long Term CSO Control Plan.
- Green Infrastructure provides direct benefits for CSO control and the means to “right size” the system to reflect current and future population needs.

- The Green Infrastructure projects may create carbon credits that provide additional incentives to expedite implementation.
- Performance predictions for the proposed new conventional CSO projects are based on computer model simulations that have historically over predicted overflow volumes and frequencies. The recommended projects may actually perform much better than predicted by the computer model simulations included in this study.
- As indicated in Table 2 on the following page, the environmental outcomes of the recommended CSO program are similar to what was previously approved by the State of Michigan (the CSO Program as of 2008), but with a capital cost savings of nearly \$625 million.
- The northernmost portion of the Rouge River above 7 Mile Road will be restored to a CSO-free condition quickly because the proposed implementation schedule calls for the first new CSO control facility to be built at the Pembroke outfall.



Figure 3. Population and Employment within Tributary Area

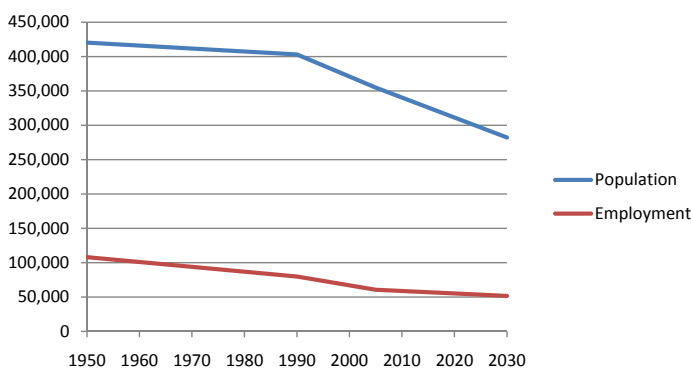


Table 2 shows that there will be no untreated CSO volume to the Rouge River once the recommended facilities are placed in service, and the total discharge volume of treated and untreated CSOs is quite similar to what would have resulted from the much more expensive Upper Rouge CSO Tunnel project. The estimated pollutant loading from the URT and the new CSO facilities are also similar. As a result, the predicted in-stream dissolved oxygen (D.O.) levels during wet weather periods are virtually identical, as shown



in Figure 4. With respect to D.O., the model predicts that compliance with the 5.0 mg/l Water Quality Standard will be achieved by the recommended facilities for all but a few hours each year. For bacteria, all of the discharges from the new CSO facilities will be disinfected so the overall bacteria loading to the Rouge River will be reduced as compared to

the URT which would have had one undisinfected discharge per year. As shown in Figure 5, the E. Coli standard in the Rouge River will still be exceeded during most, if not all, wet weather events due to sources other than Detroit's CSO discharges.

Table 2. Comparison of Original URT and Proposed New CSO Control Facilities

	2008 CSO Program Results for Original URT	2010 CSO Program Results for 9 Proposed New CSO Facilities (First Flush Tanks)
Storage Volume for CSO Flow	215 MG	38 MG
Overflow Frequency	1 event per year	13 events per year
CSO Volume ¹ Untreated	510,000 gallons/year	0 gallons/year
CSO Volume ¹ Screened/Disinfected	0 gallons/year	1,120,000 gallons/year
Pollutant Load (lbs CBOD ₅) ¹	107,000 lbs.	250,000 lbs.
Dissolved Oxygen (> 5.0 mg/l) ²	98.18% of time	98.11% of time
Bacteria Compliance (< 200 #/100 ml Fecal Coliform) ²	0.87%	0.87%
Capital Cost	\$880 million (over 7 years)	\$427 million (over 25 years)
Average Annual Cost for New Upper Rouge Outfall CSO Facilities	\$126 million/year	\$17 million/year

¹The volume and pollutant load values for the new CSO facilities do not include green infrastructure components. It is estimated that green infrastructure will reduce volume by 10% to 20%, with a corresponding decrease in pollutant loading. The values shown in Table 2 are for the 17 "Upper Rouge Outfalls" only, and do not include CSO discharges from DWSD's other Rouge River CSO facilities.

²Compliance data is based on computer simulations of in-stream water quality during wet weather periods.

Figure 4. Main Branch Rouge River Simulated DO concentrations during Wet Weather Periods vs. Water Quality Standard (5.0 mg/l)

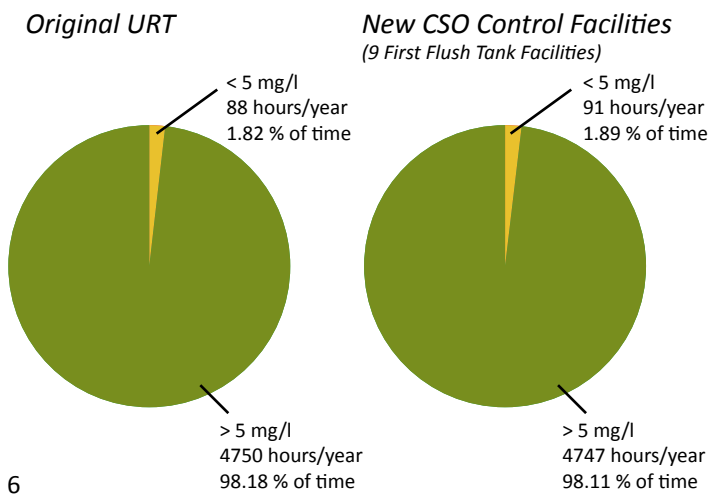
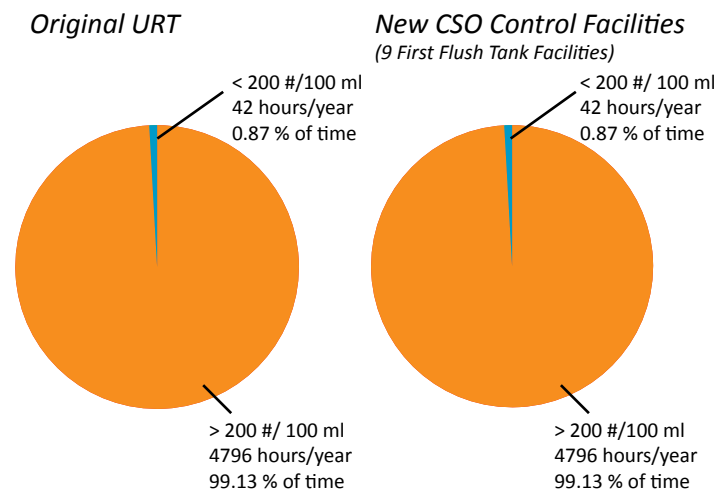


Figure 5. Main Branch Rouge River Simulated Bacteria levels during Wet Weather Periods vs. Fecal Coliform target level (200/100 ml)



Proposed Projects

DWSD's recommended CSO program for the Rouge River includes both Green and Grey projects.

Recommended Green Infrastructure projects

1. Disconnect residential and municipal downspouts.
2. Demolish and remove vacant structures and replace with pervious land cover.
3. Use bioswales and tree trenches along roadways and parking lots to intercept runoff and reduce stormwater inputs.
4. Plant trees for uptake and evapotranspiration along roadways and open spaces.
5. Implement activities on municipally-owned properties, focusing on managing stormwater runoff in under-utilized parks.

It is anticipated that the Green Infrastructure projects will be implemented as a cooperative endeavor with multiple City agencies and departments, as well as private and non-profit stakeholders. A \$50 million budget has been established to fund Green Infrastructure projects from sewer revenues as an integral component of the CSO Control Program. For the first 10 years (2010 – 2019), the recommended budget for Green projects as part of DWSD's sewer system Capital Improvement Program (CIP) is \$3 million/year, plus an additional \$2 million/year for the following 10 years (2020 – 2029).



Vacant Home Demolition/Revegetation



Parking Lot Bioswale



Downspout Disconnection



Tree Planting

Recommended conventional (Grey) CSO control projects

In addition to completing the Oakwood CSO Basin and Pump Station, DWSD proposes to undertake the following new CSO control projects within the Rouge River Watershed as shown in Figure 6.

1. Complete the Oakwood District Sewer Improvement Program (3 construction contracts totaling \$59 million).
2. Install remedial improvements at the Baby Creek Screening and Disinfection (S&D) Facility including disinfection feed system renovations, new mechanical mixers, and emergency bypass channel (\$2 million).
3. Complete the Total Residual Chlorine Minimization and In-Stream Assessment program for three Rouge River CSO Control Facilities (\$1 million).
4. Initiate improvements at the Hubbell-Southfield CSO Basin to maintain its operational effectiveness (\$3 million).
5. Modify two Lower Rouge Outfalls to eliminate existing CSO discharges (\$1 million):
 - Carbon Outfall elimination
 - Fort St. East Outfall diversion to Oakwood Basin
6. Re-invest in existing CSO Control Facilities on a phased basis over the 25 year program to ensure their continued structural integrity and operational viability as they approach their design life expectancies (\$40 million).
7. Eliminate the Glenhurst Outfall by constructing flow control devices and a new pump station to direct flow to the Oakwood Northwest Interceptor (\$3 million).
8. Construct a Pilot Project to demonstrate the effectiveness of First Flush capture tanks in conjunction with disposable nets and innovative upstream disinfection injection systems at the Pembroke outfall (\$24 million). A schematic drawing of the new CSO control technology is shown in Figure 7.

9. After the Pembroke Pilot Project has completed a performance evaluation to confirm the feasibility of the technology to achieve the desired level of CSO control, construct 8 additional facilities using the same technology (First Flush capture with screening by disposable nets and an in-pipe chemical disinfection system) to control the discharges from the remaining 15 uncontrolled CSO outfalls to the Rouge River between Warren Avenue and 7 Mile Road (\$403 million).
10. Upgrade the WWTP by constructing a new Rouge River Outfall (RRO-2) with the capability to chlorinate and dechlorinate primary effluent to eliminate the existing undisinfected Rouge River Outfall (RRO-1). This project will include improvements at the WWTP to provide flow control including gates, regulators, hydraulic structures, and instrumentation and control, plus a new outfall conduit (\$130 million).

The total construction cost for these recommended conventional CSO control facilities is \$668 million (2009 dollars).

Figure 6. Recommended CSO Control Program Projects

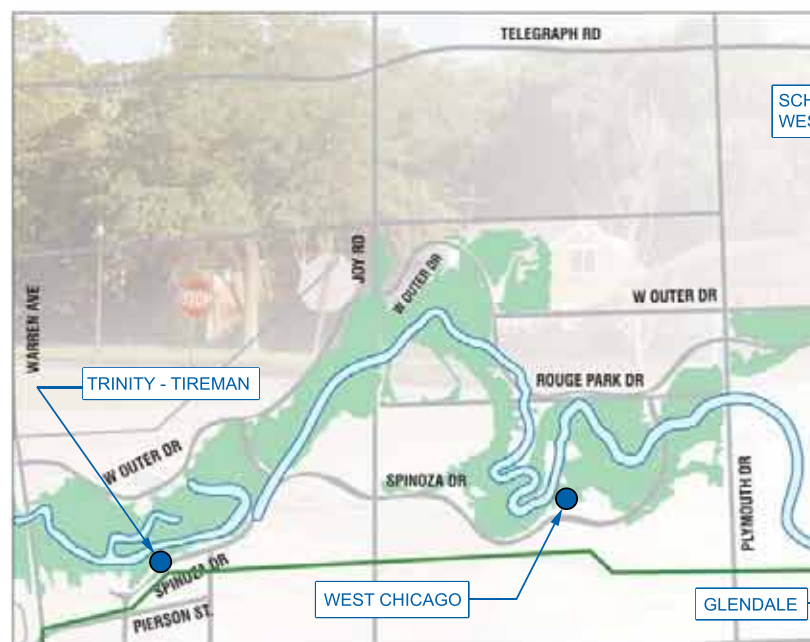
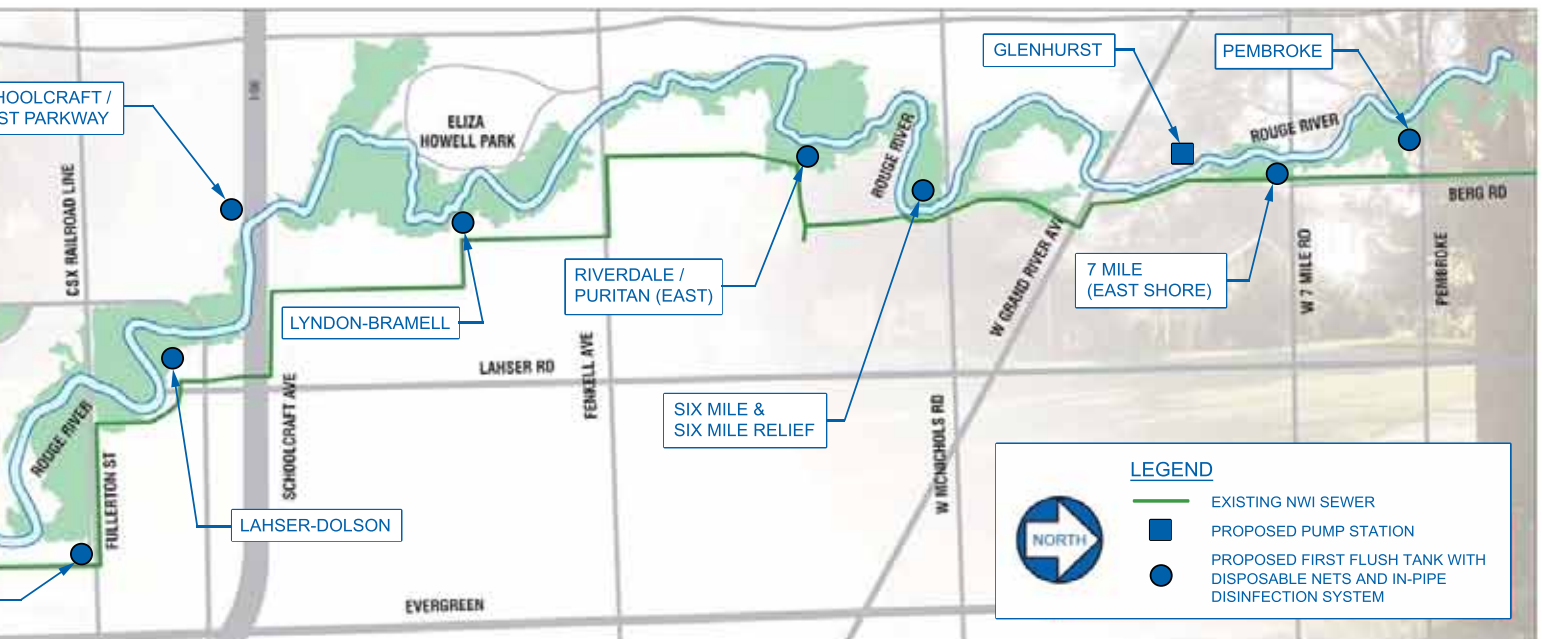
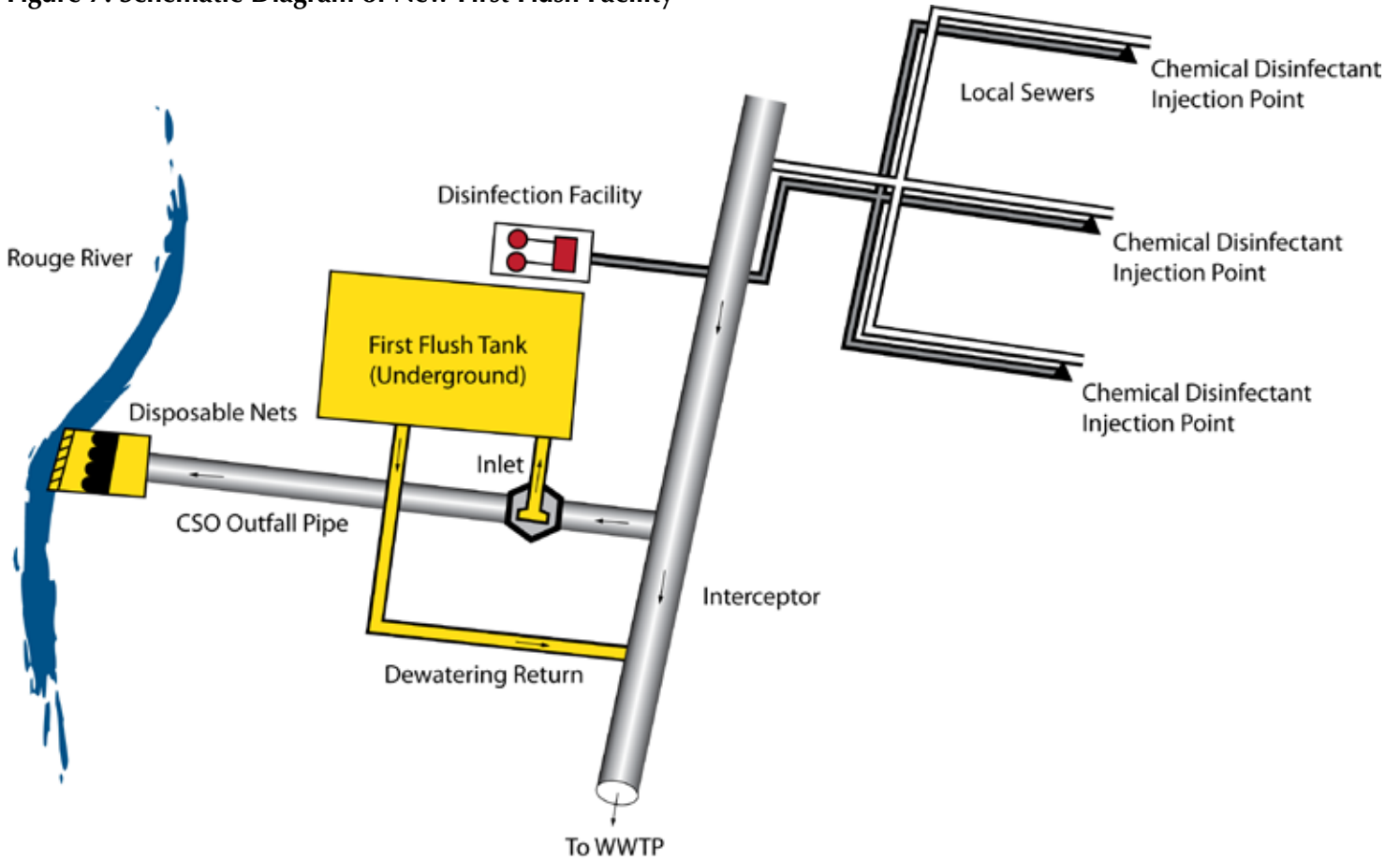


Figure 7. Schematic Diagram of New First Flush Facility



Phased Implementation

Current economic forecasts indicate that Detroit’s financial problems may persist for many years, and this could be problematic as DWSD attempts to complete the CSO program. To ensure that the control program is fiscally feasible, DWSD needs to segment its CSO program into five, 5-year phases as shown in Figure 8. This will spread out the cost and mitigate the impact on ratepayers.

Segmenting also allows DWSD to undertake other needed improvements within the sewer system. This includes continued expenditures at the wastewater treatment plant to maintain compliance with NPDES permit limits, and re-investment in existing CSO facilities, many of which will approach or surpass their expected design life in the near future.

EPA’s criteria for financial hardship are expected to be exceeded in Detroit for the foreseeable future due to the continued economic decline that has been forecast. This is reflected in a continued decline in household income levels and compounded by increases in the cost of various utility services. These factors make it essential that the recommended CSO control program be implemented gradually over an extended period of time. DWSD will re-examine the CSO program at five-year intervals to assess the progress being made and to confirm the ability of the system to incur the program costs. In summary, schedule adjustments and/or program modifications can then be incorporated based on actual conditions.

Unlike any time in our history, there is a great deal of uncertainty regarding several issues that could have profound effects on the optimal path for this project. These include the “bottoming out” of the economic slide, the rate of re-

covery in the City, the financial solvency of the City, and the rate at which existing flows can be removed from the system. Therefore, it is critical to plan for possible mid-course corrections based on how these various issues unfold.

Figure 8. Proposed Project Phases by Five-year Increments

Phase I: 2010-2014 = \$125 M	
Oakwood Sewer Segments 2 & 3	\$44 M
Baby Creek Remedial Improvements	\$2 M
Carbon/Fort St. Outfall Elimination	\$1 M
Hubbell-Southfield Basin Re-investment	\$3 M
TRC Minimization & In-Stream Evaluations	\$1 M
Task 1 Gate Renovation/Rehabilitation	\$5 M
Pembroke Pilot Project (First Flush Tank)	\$24 M
New Rouge River Outfall (RRO-2) Segment 1	\$30 M
Green Infrastructure Phase I	\$15 M

Phase II: 2015-2019 = \$178 M	
Oakwood Sewers Segment 4	\$15 M
New Rouge River Outfall (RRO-2) Segment 2	\$100 M
Re-investment in Existing Facilities	\$10 M
Glenhurst Outfall Elimination	\$3 M
7 Mile East First Flush Tank Facility	\$17 M
Puritan/Riverdale First Flush Tank Facility	\$18 M
Green Infrastructure Phase II	\$15 M

Phase III: 2020-2024 = \$179 M	
Lyndon/Brammell First Flush Tank Facility	\$39 M
Lahser/Dolson First Flush Tank Facility	\$44 M
Schoolcraft/W. Parkway Flow Diversion	\$6 M
W. Chicago First Flush Tank Facility	\$70 M
Re-investment in Existing Facilities	\$10 M
Green Infrastructure Phase III	\$10 M

Phase IV: 2025-2029 = \$175 M	
Plymouth/W. Chicago Flow Diversion	\$18 M
Glendale First Flush Tank Facility	\$30 M
Trinity/Tireman First Flush Tank Facility	\$50 M
Warren Flow Diversion	\$6 M
Detroit River CSO Outfall Control Facility	\$51 M
Re-investment in Existing Facilities	\$10 M
Green Infrastructure Phase IV	\$10 M

Phase V: 2030-2034 = \$175 M	
6 Mile First Flush Tank Facility	\$102 M
Detroit River CSO Outfall Control Facility	\$63 M
Re-investment in Existing Facilities	\$10 M

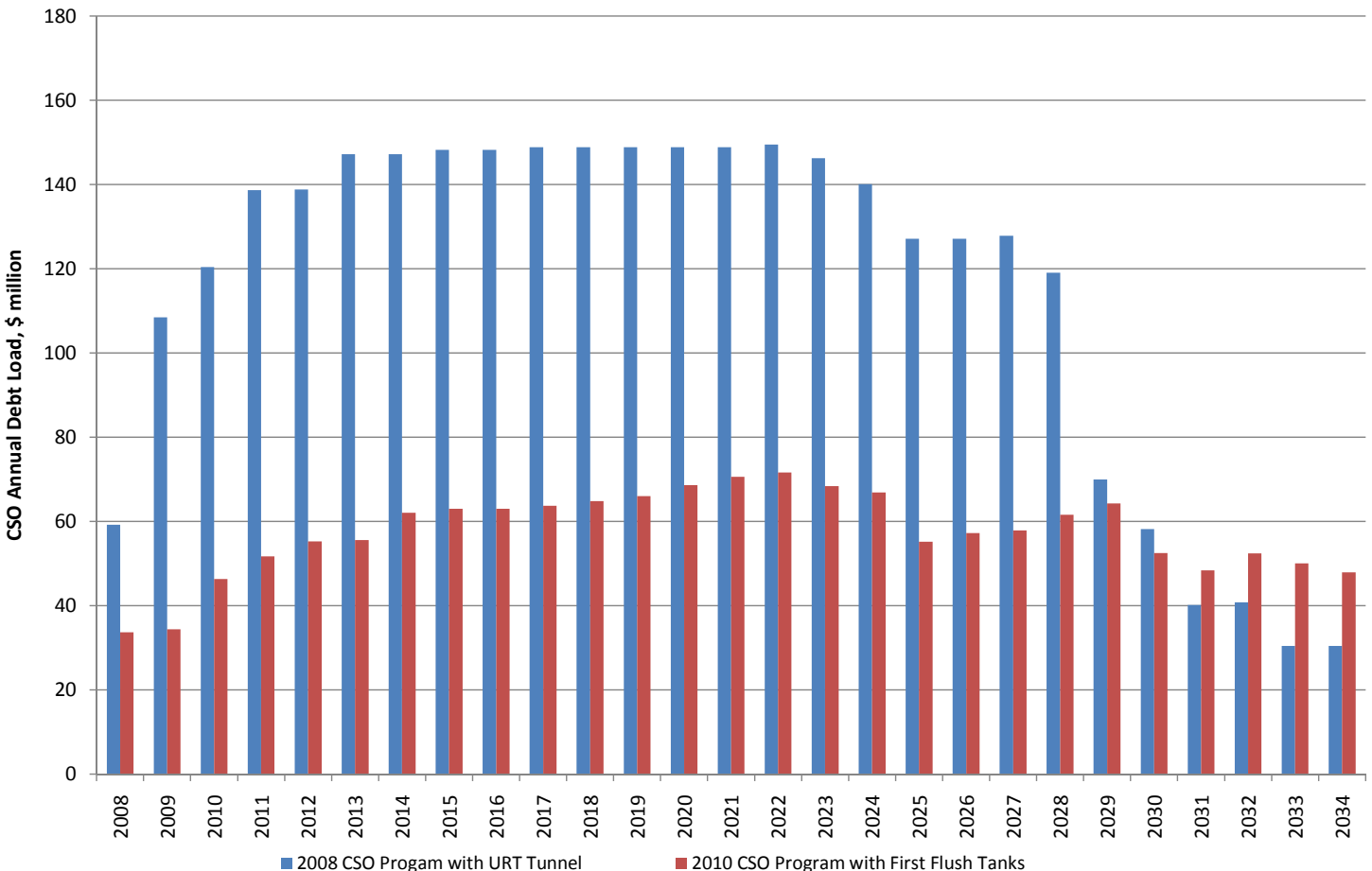
Note: Grouping of projects in Phases III through V is preliminary and subject to change.

Financial Commitments/ Affordability

The new DWSD CSO Control Program encompasses \$668 million in new spending for CSO controls on the Rouge River and \$114 million for CSO control projects along the Detroit River. In addition, Detroit is committed to a \$50 million investment in Green projects starting in 2010 for a total CSO program budget of \$832 million over the 25 year planning period. By spreading the cost of the program over a 25 year time period as shown in Figure 9, the CSO

program debt payments, including principal and interest for the ongoing CSO projects and the new CSO facilities, will average about \$57 million per year. This is expected to be a manageable level of spending for DWSD based on economic forecasts. By contrast, the previously approved plan would have resulted in an annual debt payment averaging more than \$115 million per year. The CSO plan expenditures will be leveraged as much as possible by taking advantage of low interest loans, grants, support from foundations, and private parties (e.g. utilities supporting Green projects in exchange for carbon credits).

Figure 9. Comparison of Cost Per Year for 2008 URT and 2010 First Flush Tank CSO Program



Note: Costs include payments for pre-2008 CSO facilities plus new CSO facilities.

Conclusion/ Next Steps

Detroit has opted to press forward instead of postponing its CSO projects until economic conditions sufficiently improve. The holistic review of relevant circumstances and desired outcomes has led to a reduced expenditure for “bricks and mortar” that would have added to a system in need of right-sizing to reflect new realities. But, opportunities for major benefits beyond addressing CSO are available as a result of Detroit’s commitment to pursue Green Infrastructure and to institutionalize this by funding implementation as part of DWSD’s Long Term CSO Control Program.

We thank the Michigan Department of Environmental Quality for cooperating in the termination of the construction contracts for the original URT and DRO-2 projects, and for recognizing the potential cost savings and environmental benefits associated with a major redesign of the CSO control program.

DWSD is already moving forward with planning efforts for immediate implementation of the Green Infrastructure projects. This includes coordination with other City

Departments, networking with foundations and private stakeholders, pursuing a change to the Detroit City Code regarding disconnection of downspouts, public education programs, and prioritization of properties for “clean & green” activities. In addition, Detroit is designing several Phase I conventional CSO facilities including the Pembroke Pilot Project which will demonstrate the feasibility of the proposed new control technology. MDEQ is in the process of issuing a modification to DWSD’s NPDES discharge permit which will establish the approved compliance schedules for the revised CSO control program.



For more information about the Detroit Water and Sewerage Department’s Alternative Rouge River CSO Control Program, contact:

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