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Joseph DiMura, P.E.
Director, Bureau of Water Compliance
Division of Water
New York State Department of Environmental Conservation
625 Broadway
Albany, NY 12233- 5500

Re: Comparison of the 2005/2008 CSO Order versus 2011 Modified CSO Order

Dear Mr. DiMura:

This letter summarizes the critical elements and benefits of the proposed 2011 Combined Sewer Overflow (CSO) Order on Consent ("2011 Order") as compared to the 2005 Order and 2008 modification (together, the "2005 Order"). The 2005 Order included, as Exhibit 1, a 2004 memorandum that set forth, among other things, the volumes of CSO capture that DEP projected would result from implementation of elements of the 2005 Order along with other City initiatives to reduce CSOs. This updated memorandum describes the benefits of the 2011 Order, which encompasses a number of new projects that will substitute for less cost-effective projects required under the 2005 Order, adds new projects and milestones, and includes an important new Green Infrastructure program component. Through these projects, DEP will further decrease CSO volumes and improve water quality not only by capturing more combined sewage within the sewer system, but also by using green infrastructure and other source controls to prevent or delay stormwater from entering the sewer system.

As discussed more fully below, this memorandum demonstrates that the 2011 CSO program, even without consideration of the Green Infrastructure component, attains equal if not better performance than the 2005 program. With the new Green Infrastructure component included, the benefits of the 2011 Order are much greater. This trend is consistent with past order modifications which have, in turn, incorporated the latest technologies and practices, resulting in greater CSO reductions.

Prior CSO Requirements and the 2011 Order

DEP first entered into an administrative consent order relating to CSOs in 1992. DEP's obligations were modified in the 2005 Order (and in previous and subsequent modifications that are immaterial to this analysis). Under the 2005 Order, DEP was required to construct multiple combined sewer related facilities, including outfall and sewer improvements, CSO retention facilities,

regulator improvements, in-line storage facilities, storage tanks, tide gates, pumping stations, force mains, and additional separate sewers[1] on a citywide basis between 1992 and 2023, at a cost of billions of dollars.

DEP has continued to evaluate its CSO program since entering into the 2005 Order. Based on our better understanding of pollution reductions required to meet water quality goals, innovative gray infrastructure technology and the water quality benefits of traditional and innovative investments, advances in landside hydraulic modeling, and additional cost/benefit analysis, DEP had requested DEC's authorization to eliminate or defer some of the least cost-effective CSO projects and, in many cases, to construct alternative gray infrastructure projects that were found to provide water quality benefits more cost-effectively. This technical memorandum explains the selection of these new cost effective alternatives in lieu of some previously mandated projects that were included in the 2005 Consent Order. As demonstrated below, these alternative gray infrastructure strategies will attain equivalent CSO reductions and slightly better improvements to water quality.

In addition, the 2011 Order includes a substantial, 20-year citywide commitment to green infrastructure, which refers to retention or detention stormwater source controls designed to lessen the burden on the combined sewer system. Green infrastructure is becoming a widely recognized component of municipal storm water and CSO control programs. The 2011 Order encompasses certain elements of the 2010 New York City Green Infrastructure Plan (2010 GI Plan), in which DEP takes a holistic approach that includes green and gray infrastructure, conservation and other programmatic reduction measures.

In total, the gray projects DEP is committing to construct under the 2011 Consent Order modification are expected to yield similar CSO reduction and improved water quality benefits compared to the 2005 Order, while saving $1.4 billion in public funds.

Improvements in CSO Modeling

In order to compare programs under the 2011 Order with programs under the 2005 Order, it is necessary to assess each based on the same modeling assumptions. Since 2004, methods of calculating overflows have evolved and the landside modeling assumptions that underlie the calculations of CSOs have changed as a result of observed and projected dry weather flows, updated population projections, more advanced hydraulic modeling, and updated impervious data.

Importantly, the CSO calculations included in the 2004 memorandum and the 2005 Order were developed using the RAINMAN model. DEP has since incorporated all available data into a more sophisticated hydraulic model, InfoWorks, which provides for more accurate CSO projections and allows for more flexibility in evaluating various CSO mitigation alternatives than the previous models allowed. DEP now uses the InfoWorks model because it allows for real time hydraulic calculations and provides a more accurate representation of how the combined sewer system will perform under various alternatives. Furthermore, simulations underlying the

[1] Collectively described as "gray infrastructure" projects.

2004 memorandum and the 2005 Order were based on an assumption that all wastewater treatment plants (WWTPs) would be receiving the full design dry weather flow (DDWF). The WWFP flows were based on historical water usage rates adjusted for population projections from the New York City's Office of City Planning extrapolated out to the year 2045. The dry weather flows did not account for ongoing and future water conservation measures. In fact, the observed dry weather flows at the New York City WWTPs are well below their DDWF rated capacities and this trend is anticipated to continue. The overall impacts of water conservation on sanitary dry weather flows will be further evaluated in the development of the future CSO Long Term Control Plans (LTCPs).

With regard to overall flows that include wet weather contributions, the more recent simulations used in the InfoWorks model continue to be based on the 1988 rainfall conditions that represent a typical year in accordance with the EPA CSO Policy so that we can compare model runs to earlier predictions using the same modeling assumptions. However, whether or not the 1988 rainfall conditions remain representative of current and projected rainfall conditions will be reevaluated as part of the future CSO LTCPs to ensure that the model assumptions account for potential impacts of climate change.

Table 1 below shows a comparison of the assumptions used to conduct the technical analyses associated with the 2004 memorandum versus those used in more recent CSO Waterbody Watershed Facility Plan (WWFP) analyses. The first column of Table 1 shows the modeling assumptions used to assess the volume reductions of the 2005 Order and the second column shows the assumptions that were used in development of the CSO WWFPs.

Table 1 – Summary of Prior Modeling Assumptions

	2004 Technical Memorandum of 2005 CSO Order	**2011 Technical Memorandum**
Rainfall Conditions	1988	1988
Tide Data	Not Applicable	1988
Dry Weather Flows (MGD)	1,805	1,482
Wet Weather Flows (MGD)	3,790	3,690
Landside Model	RAINMAN	InfoWorks

Comparison of Construction Projects Proposed under Different Scenarios

The projects required under three different CSO scenarios and associated costs are presented in **Table 2**. The first scenario lists all the projects that were required in the 2005 Order and were included in the 2004 Technical Memorandum; the second scenario lists all the projects and assumptions that were included in the 2010 GI Plan; and the last column contains all the gray infrastructure that has been incorporated into Appendix A of the 2011 Order in conjunction with a 10% application rate of green infrastructure throughout New York City. The difference in the underlying gray costs between the 2005 Order and the 2010 GI Plan is associated with substitution projects that were proposed in lieu of the more expensive CSO Tanks and Wet Weather Expansions. The difference in the underlying gray costs between the 2010 GI Plan and the 2011 Order is associated with additional CSO controls that were negotiated with the DEC

after issuance of the 2010 GI Plan along with other water quality related projects such as environmental dredging and in-stream aeration that were included in the CSO WWFPs but weren't used in the 2010 GI Plan cost evaluation because there was no associated CSO reduction for these projects. The projected costs for green infrastructure, which include costs that are expected to be borne by both public and private entities, are based on the preliminary estimates from the 2010 GI Plan. It should be noted that the 2010 GI Plan estimated the costs and benefits of a 10% application rate across each combined sewer watershed, except for East River and Open Waters, while the 2011 Modified CSO Order requires that the City attain a 10% application rate as a citywide target; therefore it provides for flexibility in the LTCPs for DEP to adjust the amount of green infrastructure in particular watersheds depending upon water quality impairments, implementation opportunities, and overall cost-effectiveness.

Table 2 - Summary of CSO Reduction Projects

	Capital Element	2005 CSO Order White Paper[(1)]	2010 GI Plan	2011 CSO Order
JAMAICA TRIBUTARIES		**$1,421**	**$912**	**$941**
	Expand JAM WPCP Wet Weather Capacity	X		
	Meadowmere and Warnerville Sewers and Pump Station	X	X	X
	High Level Sewer Separation - Laurelton and Springfield Blvd.	X	X	X
	Regulator 3 and 14 Improvements, Interceptor Improvements		X	X
	Bending Weirs			X
	Regulator 2 Automation	X	X	X
JAMAICA BAY		**$777**	**$169**	**$379**
	Combined Sewer Cleaning	X	X	X
	Expand 26th Ward Wet Weather Capacity	X		
	Fresh Creek High Level Storm Sewers			X
	Spring Creek Tank Improvements	X	X	X
	Fresh Creek Parallel Interceptor		X	
	26th Ward Headworks Stabilization			X
	Shellbank Destratification Facility	X		X
	Hendrix Creek Dredging	X		X
PAERDEGAT BASIN		**$381**	**$387**	**$397**
	Paerdegat Basin CSO Retention Facility	X	X	X
	Paerdegat Basin Dredging			X
BRONX RIVER		**$52**	**$20**	**$52**
	Hunts Point New Headworks Pumps	X	X	X
	Floatables Control Bronx River	X		X
WESTCHESTER CREEK		**$360**	**$46**	**$141**
	Storage Tank at HP-014 (12 MG lockout tank)	X		
	Hunts Point New Headworks Pumps	X	X	X
	Regulator Modification HP-014 (raise weir)		X	X
	Pugsley Creek parallel sewer			X
HUTCHINSON RIVER		**$303**	**$3**	**$3**
	4 MG flow-through tank at HP-023	X		
	3 MG flow-through tank at HP-024	X		
	Hunts Point New Headworks Pumps	X	X	X
NEWTOWN CREEK		**$630**	**$236**	**$323**

	36" relief sewer from St Nicholas weir to Morgan Ave Interceptor	X		
	Raise weir and enlarge sluice gate opening on Reg-B1	X		
	Throttling facility on Kent Ave Interceptor	X	X	X
	9 MG tank at Outfall NCB-015 (Regulator B1)	X		
	In-line inflatable Dam NCB-06	X	X	X
	Plant Expansion to 700 MGD	X	X	X
	Floatables Controls (NCB-015, NCB-083, NCQ-077)			X
	Dutch Kills Relief Sewer		X	
	Bending Weirs (NCB-015, NCB-083)		X	X
	Instream Aeration	X		X
EAST RIVER AND OPEN WATERS		**$536**	**$801**	**$776**
Inner Harbor	Gowanus Pump Station Improvement & Force-main		X	X
	Gowanus Flushing Tunnel Upgrade			X
	Dredging Gowanus Canal			X
	Bending weir at Reg. RH-02		X	X
	In-line inflatable dam at RH-20	X	X	X
	Regulator Improvements/ Automation	X	X	X
Outer Harbor	Avenue V PS @ 80 MGD + New Force Mains	X	X	X
	Bowery Bay Headworks Improvements	X	X	X
	Tallman Island Wet Weather Conveyance	X	X	X
	Wards Island Wet Weather Optimization		X	
	Throttling Facility at PR	X	X	X
	Hannah Street Diversion Sewer		X	X
	Regulator Improvements/ Automation	X	X	X
	Inline Storage	X		
	Alley Creek CSO Facility, Outfall, Sewer Improvements	X	X	X
FLUSHING BAY & CREEK		**$349**	**$361**	**$415**
	Flushing Creek CSO Facility: 28 MG flow-through on TI-010	X	X	X
	Flushing Bay Low Level Diversion Sewer			X
	Regulator Improvements (or bending weirs)		X	X
	Dredging Flushing Bay			X
SUBTOTAL FOR GRAY		**$4,809**	**$2,935**	**$3,427[4]**
CITYWIDE IMPLEMENTATION OF GREEN INFRASTRUCTURE		**$0**	**$2,426[2][3]**	**$2,426[2][3]**
	10% Green Infrastructure Application Rate		X	X
	GI Demonstration in Newtown Creek			X
	GI Demonstration in Bronx River			X
	GI Demonstration in Jamaica Bay			X
	GI Grant Program		X	X
TOTAL FOR GREEN + GRAY		**$4,809**	**$5,361**	**$5,853**

(1) The costs for the 2005 CSO Order include about $2.3B in projects that the DEP has proposed to eliminate and replace with more cost effective CSO reduction projects.

(2) These costs are from the 2010 GI Plan and include $900M that was projected to be incurred by private entities. These costs will be refined during the development of the LTCPs using information from the demonstration projects.

(3) These costs for Green Infrastructure are projected to be incurred over 20 years and DEP is prepared to spend $187 million by 2015 to advance these green strategies. The costs do not reflect other elements of the holistic GI Plan, including investments in operational efficiency and water conservation

(4) The 2011 order includes about $600M in substitution projects along with some other water quality related projects that aren't directly related to CSO reduction but include dredging, aeration, and floatables control.

Comparison of Projected CSO Reductions under the 2005 and 2011 Orders

In order to compare these scenarios on an equivalent basis, it is necessary to use the calibrated InfoWorks model for each scenario and to use the same set of assumptions including 1988 rainfall conditions, sanitary flows used in development of the WWFPs, same tidal conditions, and the 1988 rainfall conditions. These assumptions are likely to be refined as part of the development of the CSO LTCPs but are used to compare all scenarios on an equivalent basis and demonstrate the cost effectiveness of the proposed elements that will be included in the 2011 Modified CSO Order.

As noted in **Table 3**, the estimate of annual overflow under the Baseline 2045 simulation is 29,965 MG/yr. This is reduced to 21,535 MG/yr. under the 2005 Order. The CSO volume under full build-out of the gray infrastructure component of the 2011 Order is 21,514 MG/yr. These results demonstrate that the gray components of the 2011 Order provide more cost effective CSO reductions than those required by the 2005 CSO Order and will attain equivalent, if not better, water quality improvements, even in those few waterbodies that project a slight increase in the CSO discharges.

Table 3 – Comparison of Scenarios Using Standardized Modeling Assumptions

Waterbody	Baseline	2005 Order	2011 Order (Gray Only)
Alley Creek	502	258	258
Bergen & Thurston Basins	1,983	1,150	839
Bronx River	940	548	607
Coney Island Creek	301	42	42
East River & Open Waters	16,154	13,095	13,459
Flushing Bay	2,187	2,186	1,825
Flushing Creek	2,395	1,394	1,394
Gowanus Canal	404	239	261
Hutchinson River	436	268	400
Jamaica Bay & Tributaries	606	273	359
Newtown Creek	1,472	1,124	1,260
Paerdegat Basin	1,833	555	555
Westchester Creek	751	402	254
Total CSO MGY	**29,965**	**21,535**	**21,514**
Cost Effectiveness ($/Gallon CSO Reduced)		**$0.57**	**$0.41**

Furthermore, preliminary analysis of green infrastructure indicate that it could reduce CSO volumes by approximately 1.5 BG/year after 20 years and other programmatic controls such as water conservation and an enhanced sewer maintenance programs could further reduce CSO volumes by approximately 1.7 BG/year and over 500 MG/year, respectively. As set forth in the 2011 Order, DEP will continue to refine its modeling of the green infrastructure program in order to determine how best to allocate the 10% green infrastructure application rate requirement of the Order on a waterbody-specific basis. A critical component for future modeling and evaluations of green infrastructure includes the design, construction and monitoring of demonstration projects in the Bronx River, Jamaica Bay and Newtown Creek watersheds. These demonstration

projects are specifically required under the 2011 Order, and will allow DEP to obtain pre- and post-construction flow monitoring, and to update the InfoWorks Model in LTCPs and by the 2016 deadline for providing a green infrastructure-CSO reduction methodology.

As DEP develops its CSO LTCPs, it will continue to identify cost-effective applications for green infrastructure and opportunities within specific watersheds. Implementation opportunities will also be influenced by impervious cover, soil conditions, anticipated development, ongoing and future roadwork projects, and the like. Further, during the development of the LTCPs, DEP will assess the CSO reduction benefits produced by placement of green infrastructure within catchment areas based on total amount of CSO by outfall, overflow frequency by outfall, location of opportunities within the catchment areas and other criteria to find the most cost-effective way to reduce CSOs.

Development of the CSO LTCP

The proposed gray elements of this Modified 2011 CSO Order as included in the approved WWFPs, together with DEP's ongoing efforts to optimize the City's wet weather capabilities, and in conjunction with the anticipated CSO reduction from the 10% citywide green infrastructure application rate will be incorporated into the CSO LTCPs baseline conditions. In addition, the new CSO LTCPs will re-evaluate projected sanitary flows to account for water conservation, typical rainfall conditions to address climate change, and may refine models based on best available information. The new baseline will be used to evaluate further CSO controls to achieve applicable water quality standards in accordance with the 1994 EPA CSO Control Policy.

Where waterbody specific standards do not support the Section 101(a)(2) goals of the Clean Water Act or where the recommended level of CSO control does not achieve the current standards, the LTCP shall include a Use Attainability Analysis that will address the waterbodies "Highest Attainable Use" pursuant to the 2001 EPA Guidance on Coordinating CSO LTCPs with Water Quality Standards Review. Development of the LTCPs and determination of a waterbodies highest attainable use during any UAA will involve a robust public participation process and must be completed before the State will consider adjusting any Water Quality Standard, waterbody classification or developing any site specific criteria. The dates associated with the submittal of the Waterbody specific CSO LTCPs and the final City-wide LTCP are shown below on **Table 4.**

Table 4 – CSO LTCP Submittal Dates

Long Term Control Plans	Milestone Date
Alley Creek	June 2013
Coney Island	June 2014
Hutchinson River	Sept 2014

Flushing Creek	Dec 2014
Gowanus Canal	June 2015
Bronx River	June 2015
Jamaica Bay and Jamaica Tributaries	June 2016
Westchester Creek	June 2016
Flushing Bay	June 2017
Newtown Creek	June 2017
East River, Open Waters, and City-Wide	Dec 2017

Conclusion

The foregoing analysis demonstrates that the 2011 Modified CSO Order represents a substantial improvement over the 2005 Order. Even without consideration of the green infrastructure components, the project substitutions of the 2011 Order result in equal if not greater reductions in CSO volumes compared to the 2005 Order. Moreover, additional gray infrastructure projects, such as dredging, aeration, and floatables control will result in additional water quality improvements beyond CSO volume reductions. Finally, the green infrastructure component of the 2011 Order will provide additional reductions in CSO volume along with other social economic benefits including increased green space. The program set forth in the 2011 Order represents a forward looking approach to CSO control that reflects a recently developed understanding of the benefits of green infrastructure. The combination of green infrastructure and cost-effective gray infrastructure will not only improve water quality but has many other benefits to the community and the environment.

Sincerely:

Vincent Sapienza, PE
Deputy Commissioner