Comments on the Model Recalibration Report, the Hunts Point Model and Tallman Island Model

General Comments

Comment 1: Model Re-calibration Report - Calibration Parameters

The runoff coefficient was the primary parameter used in both site-scale and area-wide calibration efforts. This coefficient is directly related to the type of land use and land cover observed within the drainage area. The land use was represented in the model as pervious and impervious surfaces assigned to subcatchment areas within the system. In the 2007 InfoWorks (IW) Model, the runoff coefficients corresponded only to the perviousness of the drainage area surface and dealt with connectivity through initial infiltration losses. The new recalibrated model was updated to use Directly Connected Impervious Area (DCIA) estimates to assign the runoff coefficient for impervious areas within the subcatchment systems, which accounts for the drainage area's connectivity to the sewer systems.

Overall, the recalibration effort for Hunts Point resulted in a 30% increase in identified impervious cover for the drainage areas that contribute to the combined sewer system when compared to the original 2007 IW model. This increase in impervious area is due to use of Spectral Mixture Analysis (SMA) that used the high resolution imagery provided by the Columbia University to identify pervious areas within the watershed.

Initially the impervious runoff coefficient was assigned a value of 1.0 – which assumes 100% connectivity; however through the site-scale and area-wide scale calibration procedures using the DCIA method- the final runoff coefficient for impervious surfaces was calibrated and ranged between 0.5 and 0.7 for most of the subcatchment areas. The final percentage of the impervious area contributing to the Hunts Point CSO system (total DCIA area provided 6503 acres) was approximately the same as the original 2007 IW model estimated impervious area (6613 acres) as shown in Table 4-5, which implies that recalibration assumes a 30-50% overall loss of runoff from the impervious areas. For urban areas with such a high percentage (approximately 80 % in CSO drainage areas as estimated in Table 4-5) of impervious surfaces, this seems to be a high loss assumption. Please explain why in an urban area such as New York City, 30-50% loss in runoff from impervious areas is realistic.

Response: *First, the comment in paragraph 2 above is an incorrect statement. There was no net 30% increase in impervious cover that contributes to the combined sewer system when compared to the 2007 IW model. The 2007 numbers were derived from available GIS data on building roofs and roadways, and adjusted upward by 10% to account for additional impervious areas including driveways and walkways not available then in the GIS. Impervious cover data recently developed by Columbia University provides an overall measure of impervious cover present in the City without accounting for any flow pathways, and does not provide a direct measure of surfaces that contribute runoff directly to combined sewers. In essence, it simply provides an upper-bound estimate of the impervious surfaces that could generate runoff as a result of rainfall occurring on those surfaces. The method utilized to calculate imperviousness* *in the 2007 models is vastly different from the method used in this recalibration effort. Thus, a direct comparison is not valid.*

Second, DEP believes that the DEC has misinterpreted the DCIA factor of 0.5 and 0.7 to be 30-50% loss of runoff in a watershed like NYC. The DCIA is a parameter derived from an observation of actual runoff reaching the sewer system for a given rainfall, and is defined as the ratio of runoff volume observed to the occurred rainfall volume. The DCIA parameter was calibrated based on site-scale and area-wide observed data and then validated on a basin-wide (WWTP) scale, based on measured inflows to the WWTP. As can be seen from detailed calibration/validation graphics in the report, the correlation between the model and observed runoff data was reasonable for the various drainage areas within New York City.

The DCIA concept is fundamentally similar to the runoff coefficient method used in site-design and large-scale hydrologic studies by practitioners and has been well accepted by regulatory agencies for several decades. Literature values for runoff coefficients can be 30-40% for single family residential areas to 80-90% in commercial/industrial areas in dense urban watersheds. This DCIA coefficient lumps several physical processes including detention of runoff from roof and other impervious areas at individual sites using detention tanks (for example) and connectivity between pervious and impervious areas, into a single model parameter. The values indicated above are well within the literature values for the type of land uses in a dense urban area such as New York City.

Another supporting factor for these values is the percent of right-of-way in the City drainage area. Based on information presented in the DEP's 2010 green infrastructure plan, the ROW (roads and sidewalks) constitutes the impervious area that is in the immediate vicinity of catch basins and therefore are mostly directly connected impervious surfaces (except for depressions in roads that may induce localized ponding, which is accounted for using a depression storage parameter). The overall ROW is about 28% of the total impervious area within the combined sewer drainage area of the City, as seen in the 2010 green infrastructure plan summaries for individual waterbodies. This percentage can vary slightly between different watersheds, but the overall percentage is about 28%. The DCIA for other impervious areas such as roofs, driveways, patios, and walkways (being subjected to detention or connectivity to adjacent pervious areas discussed above) is reduced significantly. Overall DCIA for each subcatchment is the collective representation of connected impervious areas from ROW and individual lots.

Further, DEP finds as shown in the table below that the final DCIA values are in line with runoff coefficients that DEP uses for sewer design. As shown in this table, composite runoff coefficients for residential/commercial/industrial areas vary from 0.4 to 0.85 and can be around 0.2 for large pervious areas such as parks and cemeteries. The magnitude of runoff coefficients utilized in the revised IW model calibrations fall well within the ranges of the design values employed by DEP.

Zoning	C	C Range
R1	*0.40*	
R2	*0.45*	

R3	*0.60*	
R4	*0.70*	
R5	*0.75*	
R6 – R10	*0.85*	*0.70 – 0.85*
All Commercial (C Zoning)	*0.85*	*0.70 – 0.85*
All Industrial (M Zoning)	*0.85*	*0.70 – 0.85*
Parks and Cemeteries	*0.20*	

Further, the calibrated DCIA parameter values (runoff coefficients) are well within similar ranges of values established in the practice literature, as seen in the following reference documents:

(1) R.K. Lindsley & J.B. Franzini (1964) Water Resources Engineering, McGraw Hill, New York.
(2) P.B. Bedient, W.C. Huber, and B.E. Vieux (2008) Hydrology and Floodplain Analysis, 4th Edition, Prentice Hall.
(3) WPCF Manual of Practice No. 9 (1983) Design and Construction of Sanitary and Storm Sewers, Water Environment Federation.
(4) Modern Sewer Design (1980) American Iron and Steel Institute.
(5) G.M. Fair, J.C. Geyer & D.A. Okun (1966) Water and Wastewater Engineering, Volume 1: Water Supply and Wastewater Removal, John Wiley and Sons.
(6) Water Environment Federation Manual of Practice FD-20 & ASCE Manuals and Reports of Engineering Practice No.77 (2000) Design and Construction of Urban Stormwater Management Systems.

It should be noted that the high end runoff coefficients are in fact greater than stated above. For denser urban areas of NYC such as the Newtown Creek Manhattan and North River sewer drainage areas, the Cimp coefficients are greater than 0.8, which is not considered to be unusual. For all other areas of the City, the runoff coefficients are as noted between 0.5 and 0.7 with the majority of coefficients being closer to 0.7 where there are higher population densities as characterized by fewer single family residential lots.

In essence, the City believes that the runoff coefficients developed during the calibration are representative and produce reasonable replications of the flow data over the three ranges of spatial coverage; site-scale, area-wide, and WWT- scale. The Columbia University data produced a higher estimate of total impervious area in many areas, beyond what was calculated using the 2007 approach that used the ROW data and building footprints plus a ten percent escalation factor to account for driveways and sidewalks. Table 4-5 of the report presents this information.

The overall CSO impervious area from Columbia University remote sensing was larger by a factor of 1.4 times the equivalent area from the 2007 models. The City believes that if the runoff producing impervious area was 1.4 times larger than the 2007 model value, the sewer flow data would have shown higher flows and volumes than were observed in the various metering programs conducted at upland

and in-system scales in the various WWTP drainage areas. DEP is confident that this DCIA approach accurately represents the runoff contributing drainage area, and will conduct some follow up analysis using additional data to be collected during the LTCP2 project. The goal for follow-up analyses will be to further validate the hydrologic and hydraulic parameters developed during this recalibration effort and make minor adjustments at a local watershed scale (individual waterbody drainage areas), as needed and appropriate.

Comment 2: Model Recalibration report – Calibration Parameters

One of the input parameters to define the catchment basin characteristics in InfoWorks CS modeling software is "connectivity (%)". Was a sensitivity analysis performed for this parameter to evaluate how this parameter impacts the calibration of the runoff flow instead of altering the runoff coefficient to account for drainage areas that are not directly connected to the system? Currently, all catchment basins are assigned a 100% "connectivity (%)" value. However, based on the DCIA method described above, the calibrated runoff coefficient shows that the model is currently assuming that impervious areas are only a 50-70% connected to the system within the subcatchment areas. To summarize this comment, why wasn't the "connectivity (%)" value used as calibration parameter instead of the overall runoff coefficient that re-defines the impervious areas at the site (and indirectly the connectivity of the catchment areas in the watershed).

Response: *Effectively a sensitivity analysis was done during the calibration process in which the runoff coefficients (DCIA parameters) were adjusted to arrive at the final values provided in the recalibration report. Varying "C" would result in exactly the same results as varying the % connected, since this value is simply multiplied against the runoff coefficient in the hydrologic calculations in the model. There is no mathematical difference in choosing to enter a value of 0.7 (or 70%) for either runoff coefficient or connectivity. We conducted a sensitivity analysis recently for one of the drainage areas and confirmed that this was true.*

The DEP could have used the percent connectivity, however, it was felt that it would be intuitive to explain the concept of hydraulic connectivity of impervious areas to sewer systems and the use of DCIA similar to runoff coefficient used in sewer design was a more transparent method of establishing the hydrologic parameters and documenting the calibration effort. It should be noted that the calibration values were determined only after conducting three levels of analysis: site-scale, area-wide, and WWTP analysis. At all three levels of the recalibration analysis, the results pointed toward the need to apply a scale-down factor to reduce <u>the remote sensing estimated</u> total impervious surfaces to develop the fraction that represented direct <u>runoff-contributing</u> impervious surfaces.

Similar findings were also observed in the Philadelphia LTCP modeling effort (http://www.phillywatersheds.org/what_were_doing/documents_and_data/cso_long_term_control_plan), in which the DCIA coefficients ranged from 0.5 to 0.9 based on the extensive monitoring performed in a range of smaller sub-basins with varying land-use patterns. The DEP referred to and applied the lessons learned in the Philadelphia study and other standard practice literature (listed previously in this response document) during the recalibration effort.

Comment 3: Model Recalibration Report - Pervious Area Estimates using Columbia University Spectral Mixture Analysis (SMA)

The imagery issues that were described in Section 3.3 (i.e., shadows, water bodies and dry surfaces) can be systemic and can lead to under/over estimations of impervious areas. The report states that the "*uncertainty in impervious estimates and the implications on model results through a sensitivity analysis is discussed in Section 5*". However, Section 5 was not available at the time of this review. Please describe the methods that were used to correct the errors identified above or provide a statistic or prediction on what percentage of imagery errors were observed during calibration efforts.

Response: *The reference to Section 5 is an error. The reference was to Section 4; more specifically to Table 4-6, which presents the sensitivity to CSO overflows in comparing the previous version of the model (2007 version) to the recalibrated version.*

Aside from the IW calibration using the runoff coefficients for the impervious areas, no analytical methods were used to adjust the SMA results. On the other hand, large areas such as wetlands in Gateway National Park were corrected manually during area-wide model calibration through the assignment of pervious-open versus pervious non-open space and assignment of appropriate runoff coefficients.

The DEP's understanding from Columbia University researchers is that there are uncertainties associated with calibration of the spectral densities to identify pervious areas and different analytical methods have different uncertainty ranges. The analytical method used for DEP's data interpretation has an inherent +/- 5% in pervious area classification and this translates to a corresponding +/- 5% variation in impervious areas (calculated as total area minus pervious). The DEP intends to perform a sensitivity analysis as part of the LTCP2 work to understand the potential impacts of this uncertainty on pollutant loading to and the corresponding responses of individual waterbodies to meet applicable water quality standards.

Comments Related to Hunts Point System

Comment 4: Model Recalibration report – Hunts Point CSO Volume Comparison

For site-scale calibration and area-wide calibration, parameters such as depth and velocity were measured at select metering locations; however only comparisons of the simulated and monitored flows at each of these locations were presented to evaluate the model. Please comment on how the model performed for the other calibration parameters (i.e., velocity and depth) at each of these locations or explain why these parameters were not considered during calibration.

Response: *This statement on assessment of calibration solely based on flow volumes is not accurate. The DEP used a weight-of-evidence (WOE) approach to look at different flow characteristics including flow volumes, peak flow rates, and depths. In addition, the WOE approach looks at both event-based and continuous simulation-based modeling results to assess the adequacy of calibration, based on correlations observed at different spatial scales (site, area-wide and WWTP-wide). Correlograms showing the comparison of metered and modeled volumes, flow rates and depths (along with acceptable deviations set forth based on guidelines from international standards developed by the Wastewater Planning User Group, WaPUG, from Europe) and time-series comparisons showing the temporal variations in metered and modeled flows are used as part of the WOE assessment. One additional key calibration criterion was to adjust the parameters on a global (City-wide) basis, so that the lessons learned at the site and area-wide metered areas could be extended to other non-metered portions of the City.*

See figures A.HP.4 through A.HP.8 (for Hunts Point area, for example), all of which show modeled and observed depths and volumes. Further, as the main purpose of this model recalibration was related to the issue of impervious cover and hydrology, DEP decided to focus more on flow rates, volumes, and depths in the form of correlation plots than on other measures such as velocity. The figures also provide a comparison of peak flows between the model predictions and the observed peaks for the specified events. However, this comparison of flow peaks represents one single moment in time within each event, so making adjustments to the model input parameters based solely on this comparison was felt to be somewhat tenuous. Rather, differences in the peak flow comparisons were considered to be less conclusive than volume and depth.

Comment 5: Model Recalibration Report – Hunts Point Volume Comparison

Table 4-6 in the report presents a comparison of the predicted discharged CSO volumes for the Hunts Point WWTP Drainage Area for the October 2007 IW Model and recalibrated June 2012 IW Model using the same precipitation and dry weather flows for the year 2011. The tables lists the Hunts Point CSO discharge volume as 5,912 MG/yr for the 2007 model and 5,634 MG/yr for the 2012 model- indicating that the recalibration resulted in a net 5% decrease in CSO volume estimation for the contributing drainage area for Hunts Point. This is one of the smaller volume differences between the two models for the NYC watershed with differences in overflow volumes estimates ranging from a decrease of 44%

for the 26th Ward drainage area to an increase of 23% for the Newtown Creek drainage areas in the recalibrated model.

In general, it should be noted that using a baseline model with the 2011 hydrologic year simulation is going to provide a conservative estimate of CSO events and total CSO volume. The 2011 hydrologic year was estimated to experience rainfall that was nearly 50% higher than normal. Although the overall WWTP calibration indicates a fairly good match between predicted and observed flow rates into the treatment plant during wet weather events, using the 2011 data may bias the calibration parameters. It may be important to perform calibrations with representative typical average and dry hydrologic years to evaluate how the recalibrated model fits to different levels of CSO and SSO conditions for continuous and event simulations. Using a typical average hydrologic year will also provide a more representative CSO event estimate and total CSO volume, as discharge predictions using 2011 precipitation data are anticipated to be much greater when compared to the system operating under normal conditions.

Response: *DEP agrees that 2011 was a much wetter year with respect to total precipitation, with 55.8 inches in 2011 as compared to 46.3 inches in 2008, (a 33% increase). However, the distribution of the rainfall throughout the year is as critical a factor affecting the total annual volume. The DEP has been using previous versions of the InfoWorks models since 2006 on an annual basis as part of the SPDES consent order requirement; namely, the reporting of percent capture and total nitrogen loadings. The 2011 year was presented in the recalibration report since the annual simulations were performed with recalibrated models for the first time and meaningful comparisons could be made of simulated volumes reported in the 2011 submittal (that used previous 2007 InfoWorks models) for SPDES reporting. Model outputs were processed in a manner similar to the SPDES reporting process and, in general, the model performance (in terms of correlations from visual observations) assessed from time-series and probability plot comparisons of monitored and modeled WWTP inflows were similar for the years from 2006-2010 to those presented in the June 2012 report that used the recalibrated models.*

As part of the LTCP2 Project, the DEP will be performing simulations for the average hydrologic year of 2008 and also a long-term simulation for a 10-year period from 2002 to 2011. In addition, the DEP is in the process of using recalibrated models for Calendar Year 2012 as part of the SPDES reporting submittal due on March 31, 2013. The DEP will assess the sensitivity of models to different climatic inputs during these efforts and determine any need for minor modifications to the calibration strategy documented in the June 2012 recalibration report.

It should be recognized, however, that although 2011 was an outlier year in terms of total rainfall it provided a good test for the model as it contained both large and small events. Large rainfall events, specifically the two events that occurred on August 13 and 27, and September 5-7, that might lead to model bias, were individually examined to assess the ability of the model to reproduce the flows reaching the WWTPs. These events were beneficial to include in the analysis since they did provide large events for which the model goodness of fit could be evaluated. The temporal hydrographs show clearly that the models reproduced the plant inflows fairly well for small, medium and large events during 2011.

Comment 6: Model Recalibration report – Hunts Point CSO Volume Comparison

How were the WWTP pumping operations simulated/setup in the model?

Response: *The WWTP head works are typically represented in the DEP models as pump rating curve, developed to characterize operation of the main pump and the maximum capacity of the WWTP. For simplicity, an Archimedean screw pump type was utilized to represent the pumps at the WWTP in the model. The pump discharge of an Archimedean screw pump is directly related to hydraulic head or upstream water level, i.e., Q = f (h). The relationship between discharge and head in the positive direction is represented as a data table and pumping rates in the model simulated with the real-time control functionality of the model. The pump switch-on level determines when the pump first comes into operation; the pump will continue running until the upstream water level drops below the switch-off level. This type of setup works well to represent variable speed pump stations as a step function. As can be seen in the time-series comparisons of modeled and monitored plant inflows, the calibrated pump curves used in the InfoWorks models are, therefore, reasonable representations of the wet weather operating plans used by the plant operators for the range of storm conditions on a day-to-day basis. Throttling operations to limit the flow to twice the design dry weather flow level are typically represented using the real-time-control (RTC) option in InfoWorks with flow thresholds and the corresponding sluice gate closure levels.*

Comment 7: Model Recalibration report – Hunts Point CSO Volume Comparison

How were the storage areas (reservoir, pond, low ground area) modeled in the model? What are the sources for data collection?

Response: *Only the wet wells at pumps stations or WWTPs are explicitly modeled as storage nodes in the model. Natural ponds and man-made reservoirs (typically in public parks and some golf courses) are not explicitly included. In the absence of their storage or pollutant capture considerations, the runoff or pollutant loads estimated in our models will be conservatively larger for the areas draining to these ponds/reservoirs for a given rain event. One exception to this is in the Wards Island model, where the Van Cortlandt Park natural water system was included for potentially evaluating a daylighting option for the Tibbet's Brook that currently discharges into the combined sewers..*

A two-dimensional representation of road surfaces (low ground areas) was not performed in our recalibration process. A major shift in database organization (to migrate from InfoWorks CS to Integrated Catchment Model that can do the 2-D analysis) and a higher resolution topographic data will be needed to be able to characterize the two-dimensional flow routing behavior on urban landscapes. The DCIA accounts for water volumes that did not reach the sewer system, therefore, the water volumes held in surface depressions or low ground areas are accounted for in the process of determining the fraction of total impervious area directly connected to the sewer system.

Comment 8: Hunts Point Appendix A - Site-Scale Calibration

In Section 3.2, six calibration events and seven validation events were selected for site-scale calibration as presented in Table 3-2a for Hunts Point; however results from only three calibration and three validation events were provided in Appendix A. Please provide the results from the other selected calibration events to show if they fall within the approved calibration criteria or provide rationale on why they are not reported.

Response: *The other events will be included in the revised/final version of the report.*

Comment 9: Hunts Point Appendix A -Site-Scale Calibration

Three flow meters were installed in three different catchment areas within the Hunts Point watershed system and the data was used during the site-scale calibration portion of the total recalibration of the Hunts Point model. The site-scale calibration parameter modifications were then applied to the entire contributing watershed to Hunts Point during the area-wide calibration. Site-scale calibration/ validation used six storm events monitored from October 2009 through December 2009 with three calibration events and three validation events. The results as shown on Figures A.HP. 4, 5 and 6 indicate during the site-scale calibration, there was a variance from the model calibration accepted range for peak flows during the largest flow validation event (i.e. storm event on 11/19/2009). The model under-predicted peak flows at one flow meter location (HP #10) and over-predicted at two other locations (HP #12, HP #16). However, "no changes in the initial calibration parameters were considered necessary to improve model predictions" for any of the metered sites. Please explain why additional calibration was not performed during the site-scale calibration given that the largest storm event indicated a deviance from the accepted range at all of the calibration sites. How does this impact the model's ability to realistically predict CSO discharges that occur during larger flow events?

Response: *In a generic sense, model calibration/validation is a comprehensive and robust process of selecting the set of coefficients that represent observed conditions. It is not a process of adjusting model coefficients to match each data point. As such there will always be data points that are not fully reproduced. The comparison in this case was for a validation event, and based on the weight of evidence approach utilized throughout this recalibration effort, is only one point of comparison. It must be viewed in context with all other sources of calibration and validation comparison points. Further a global parameter such as the runoff coefficient is well known to vary with differing environmental conditions. Runoff coefficients will not be exactly the same for both low intensity rainfalls and high intensity rainfalls. The goal of the calibration of these City-wide planning level models was to obtain the best set of coefficients that provide a reasonable reproduction of observed conditions.*

Specifically, the DEP selected a combination of small, medium and large-sized events to increase the robustness of model calibration. In addition, the overall goal was to develop parameters from small drainage areas corresponding to 20 site-scale meters, and apply them to unmetered portions of the drainage area and check the correlation between modeled and monitored flows at the area-wide locations and WWTP. In this global parameterization process, the City reviewed the correlations in all the 13 drainage areas concurrently, prior to making adjustments. Based on any future flow metering efforts in individual waterbody drainage areas, the DEP will perform calibration checks and make minor adjustments, for the specific waterbody drainage areas, as necessary.

Also see Response to Comment 4.

Comment 10: Hunts Point Appendix A - Site-Scale Calibration

Were the 2010 census population and associated average dry weather flow (125.3 MGD) used for the site-scale calibration, as these simulations used October- December 2009 precipitation data and would be more representative than the 2000 average DWF (113.8 MGD) and population used in the 2007 IW model?

Response: *No, the 2010 census population and associated average dry weather flow were not used. The DEP typically uses average dry weather flow at the plant and apportions to individual subcatchments based on the population at that local scale, for various modeling efforts including the SPDES consent order reporting requirement on an annual basis. The 2009/2010 average dry weather flows were used for the site-scale calibrations and 2005/2006 data for area-wide calibrations and 2011 data for WWTP inflow calibration. It should also be emphasized that the variance in DWF from 2008, 2009 or 2010 will have minimal significance when calibrating runoff coefficients, especially at sites that are located well upstream in the system.*

Comment 11: Hunts Point Appendix B -Area-Wide Calibration

Figure B.HP.30a through 30c present a Time History Comparison of Measured Data and Calibrated Model Calculations for the January through December 2011 for the Hunts Point WWTP. It appears that the although the model's predicted flow rates at the HP WWTP for large precipitation events (spanning more than 24 hours) match reasonably well to the measured data, the flows observed during a time period immediately after the precipitation stopped for at least a day or two (see 1-2 days past the rainfall events on March 5, March 10, August 14, August 27, September 7, and October 29 as shown on Figures B.H.P 30a-c) appear to be under predicted than what was measured. Please explain why calibration could not be achieved for those times following larger/longer storm events and what could the potential impact be on the model's predictions of CSO discharges immediately after large wet-weather events.

Response: *There are many reasons why the observed flow data at the WWTP does not drop off as fast as the model calculations, including the following.*

- *March events – This may possibly be related to snow melt that could have contributed to these events (note: snowmelt was not modeled explicitly).*
- *August and September events – DEP believes that the slowly falling leg in the data could be attributed to infiltration into the combined sewers which is not modeled explicitly. This infiltration can be present in all seasons (except summer) when high groundwater levels can lead to infiltration of water into the sewer system.*
- *October event – It is not clear why this event appears to have a peak in WWTP flow the day following the rainfall. However, this observation can be seen at some WWTPs and not in others. This is likely due to a localized rainfall event that passed through a portion of the City but was not picked up at the airport rain gauges.*

With respect to the infiltration and snowmelt, DEP believes that from a planning standpoint it is not necessary to include these factors explicitly in the analyses. Snow melt is not considered, nor is the difference between snow and rain precipitation. DEP has not attempted to model snow and snowmelt explicitly in projects. In all WWFP work, any precipitation is treated as rainfall. For the WWTP 2011 *recalibration analyses, the following events were removed from the record as the precipitation fell as snow; Jan 11, Jan 20, and Jan 25-26, for the time-series and probability plot comparisons. The reason is that the modeling algorithms for snowmelt in the U.S. Environmental Protection Agency's Stormwater Management Model (and in the InfoWorks model also) are quite complex and require comprehensive datasets to successfully use them. Most winter storms in the NYC region occur as rainfall, and the DEP believes that the flows and pollutant loads will be overestimated for a handful of events that may have experienced snowfall which is assumed to be rainfall.*

The CSO calculations for any modeled rain events in the winter that actually fall as snow can be considered as over-predictions of CSOs, since water from slowly melting snow will be transferred to the WWTPs for treatment. Similarly, the occurrence of CSOs is dependent on rainfall intensity and volume (which contribute large amounts of runoff into a sewer system) and the system's ability to convey to the WWTP.

Infiltration volumes in comparison to the incoming runoff flows can be quite insignificant and, therefore, are not the primary contributors to CSO volumes. As such, the DEP does not explicitly model infiltration rates on a system-wide basis, other than what is inherently included in measured dry weather flow (i.e., base groundwater infiltration). Infiltration is modeled in some cases where it can make a significant difference in CSO volume capture in CSO retention facilities such as the Flushing Creek tank. Large infiltration volumes entering this tank can take up a portion of the capacity available to store CSO volumes, therefore, the DEP explicitly models this flow rate and the associated system operation procedures in the retention facility.

Comment 12: Hunts Point Appendix B - Area-Wide Scale Calibration

For the Area-Wide Scale Calibration, 14 sites were used in the recalibration of the Hunts Point WWTP model using flow, depth and velocity data from five precipitation events from December 2004 to January 2005. Results of the calibration efforts indicated that four of the metering sites were considered "not adequate for model detailed event calibration" due to "uncertainties in regulator control settings" and did not provide a good data fit to the monitored flow and depths for each of these locations. Please describe these uncertainties in detail and how they impact the meter readings at these selected regulator calibration as rationale for why they should not be further used in calibration.

Response:

- *Two of the metering sites that were evaluated but not focused on during calibration were locations where sensors measured flows in the overflow conduit ("HPCSO28A_BR" and "HPCSO29A_WC").*
- *Location "HPCSO28A_BR" did not contain a sufficient quantity of observed data for comparison purposes. In addition, direct measurement of overflows is prone to instability and not always useful in model calibration.*
- *At locations "HPCSO29A_WC" and "HPR15A_R15", the potential explanation of uncertainties in regulator settings will be revised. The intent of the statement was to indicate that it is recognized that the model is a simplification of reality which can lead to difficulty in exact matching of weir overflows. While the key parameters in the structures are well known and*

represented in the models (e.g., weir crest elevations, lengths, etc.), the actual structures that regulate flow into both of these two outfalls are complex, containing structural columns, walls, etc., that a collection system model cannot replicate (without adding a lot of complexity with diminishing return on the model accuracy). For example, at Site HPCSO29A_WC, the flow meter used at this site was installed in the conduit leading from the regulating structure to the overflow outfall in a relatively large, noisy structure. Within the regulating structure there is a relatively long side flow weir with interior columns along the weirs. This combination of conditions at this particular site may have contributed to the scatter in the data. In situations such as this, it is expected that comparisons of metered versus modeled overflows will at times not result in ideal comparisons.

- *The discussion on page B.HP-4 for location "HPR15_Com" explaining the uncertainty in regulator control settings was a typo and will be corrected in the final version. This meter comparison is adequate for calibration purposes.*

Comment 13: Hunts Point Appendix B -Area-Wide Calibration Parameters

Section 4.3 of the recalibration report indicates that parameters such as pipe roughness, local sediment levels, and throttling conditions at the plants were also used as calibration parameters. However, there was no detailed discussion for Hunts Point WWTP. Please explain if the calibration to any hydraulic parameters was performed for this site. The only parameter that appeared to be modified throughout the calibration process was runoff coefficients.

Additionally, the final area-wide calibration parameters (i.e., runoff coefficients), provided in Table B.HP.3, are exactly the same as the site-scale calibration runoff coefficients (these were values used as the initial inputs for area-wide calibration) presented in Table 3-4 of the NYC InfoWorks City-wide Model Recalibration report. It is anticipated that with data provided from 14 additional meters and the WWTP flows the calibration parameters would have to be at least slightly modified from the initial input parameters during the area-wide analysis. Please clarify if modifications to the hydrologic parameters were required during the area-wide calibration or describe other parameter changes that were performed during the area-wide calibration?

If modifications were made to the calibration parameters during area-wide calibrations (i.e., final runoff-coefficients), were they re-evaluated at the site-scale calibration level to see if the predicted flows and depths still provided a generally good match with the measured data at these locations? If so, did they improve the model's ability to predict larger flows observed during the 11/19/09 event (see Comment 4)?

Response: *The City's Weight of Evidence (WOE) approach to calibration involved simultaneous review of site-scale, area-wide and WWTP comparisons of monitored and modeled flows, depths and volumes and adjustment of parameters in a global sense to achieve the hydrologic and hydraulic calibrations. Runoff coefficients were varied based on the fraction of single family homes in each drainage area and also based on the density of urbanization (e.g., Manhattan versus Queens/Brooklyn). It should also be recognized that the calibration/validation efforts focused on globalization of hydrology model* *parameters on a system-wide basis so that the parameters developed from site-scale effort can be applied to unmetered portions of the drainage areas.*

Sensitivity analyses were conducted in the 2007 calibration efforts on the effect of pipe roughness coefficients on area-wide comparisons performed then. Dry weather flows, plant throttling operations and some local sediment buildup played a much bigger role in matching the modeled flows and depths, as key hydraulic model parameters. As such, each of these were modified according to the period of simulation, plant inflow records and the operation rules used by the staff at the plant/retention facility that involved throttling. Local sediments, mostly in interceptor sewers and in some combined sewers, were updated using the latest available results from field inspections, if any. Based on a range of site-scale, area-wide and WWTP-based comparisons performed during model calibration and validation, the calibrated hydrology parameters played a bigger role in achieving good correlations between modeled and monitored flows and depths, once the sediments, dry weather flow and throttling operations were defined in accordance with our available documentation from field and plant operation staff.

The final/revised version of the recalibration report will include a table of initial parameters in the site-scale calibration process so that the changes can be compared.

Comment 14: Hunts Point Appendix A/B - Runoff Coefficients for Drainage Areas not updated using DCIA method

Approximately 30% of the drainage basin for Hunts Point did not include updates to the pervious and impervious areas using the revised DCIA modeling method. Please explain how the hydrologic parameters (not updated using the DCIA method) for these areas were selected and if they were modified during calibration, particularly the impervious runoff coefficient which ranges from 0.4 to 1.0 depending on the subcatchment area.

Response: *HP subcatchments that represent separately sewered areas were not subjected to the DCIA revised hydrologic methodology. These areas include separate and direct drainage areas, for which no calibration data was available. Previous calibration parameters from the 2007 model versions were retained for these particular subcatchments due to the nature of their hydrologic inputs (i.e., RDII versus surface runoff). Parameters for these subcatchments utilize a fixed runoff coefficient that represents the estimated RDII contribution from the separately sewered areas, and the infiltration and depression storage parameters for separate/direct drainage areas that discharge into the waterways directly.*

The DEP will update the parameterization in direct and separate drainage areas in LTCP2 to be consistent with the methodology used and documented in the 2012 recalibration report. This work will be performed on a waterbody-by-waterbody basis as we undertake individual LTCPs between now and 2017.

Comment 15: Hunts Point - Additional hydrologic factors

Please explain how snowmelt flow was considered and simulated and if any of the calibration events include snowmelt periods.

Response: *DEP has not attempted to model snow and snowmelt explicitly in our projects. In all WWFP work, all precipitation is treated as rainfall. For the WWTP 2011 recalibration analyses, the following events were removed from the record as the precipitation fell as snow; Jan 11, Jan 20, and Jan 25-26, for the time-series and probability plot comparisons. The reason is that the modeling algorithms for snowmelt in the U.S. Environmental Protection Agency's Stormwater Management Model (and in the InfoWorks model also) are quite complex and require comprehensive datasets to successfully use them. Most winter storms in the NYC region occur as rainfall, and the DEP believes that the flows and pollutant loads will be overestimated for a handful of events that may have experienced snowfall which is assumed to be rainfall.*

Comment 16: Hunts Point - Additional hydrologic factors

Please explain if groundwater was considered in the simulations. Are there any significant interactions between the groundwater and surface waters within the watershed that should be taken into account as well?

Response: *Groundwater effects where applicable were included with dry weather flow estimates as base flows. The DEP has not attempted to explicitly model the variations in groundwater and associated variation in infiltration rates on a seasonal basis. Model algorithms in the U.S.EPA Stormwater Management Model (and in InfoWorks also) are quite complex and will require significant amount of groundwater level data to be able to successfully apply them. There was no separate modeling of ground water infiltration. For the large storm events in September and October, it appears that there were some possible interactions with an elevated ground water table that resulted in additional infiltration or inflow into the sewer system that was not captured in the model. Groundwater infiltration is included in all modeling simulations as a component of the base dry weather flow, although RD I/I is not. In most storm events occurring in this sewershed, combined flows are dominated by direct runoff, not infiltration.*

Comments Related to Tallman Island System

Comment 4: Model Recalibration Report – Tallman Island CSO Volume Comparison

Table 4-6 in the report presents a comparison of the predicted discharged CSO volumes for the Tallman Island WWTP Drainage Area for the October 2007 IW Model and recalibrated June 2012 IW Model using the same precipitation and dry weather flows for the year 2011. The tables lists the Tallman Island CSO discharge volume as 3,266 MG/yr for the 2007 model and 3,478 MG/yr for the 2012 model- indicating that the recalibration resulted in a net 6% increase in CSO volume estimation for the contributing drainage area for Tallman Island. This is one of the smaller volume differences between the two models for the NYC watershed with differences in overflow volumes estimates ranging from a decrease of 44% for the 26th Ward drainage area to an increase of 23% for the Newtown Creek drainage areas in the recalibrated model.

In general, it should be noted that using a baseline model with the 2011 hydrologic year simulation is going to provide a conservative estimate of CSO events and total CSO volume. The 2011 hydrologic year was estimated to experience rainfall that was nearly 50% higher than normal. Although the overall WWTP calibration indicates a fairly good match between predicted and observed flow rates into the treatment plant during wet weather events, using the 2011 data may bias the calibration parameters. It may be important to perform calibrations with representative typical average and dry hydrologic years to evaluate how the recalibrated model fits to different levels of CSO and SSO conditions for continuous and event simulations. Using a typical average hydrologic year will also provide a more representative CSO event estimate and total CSO volume, as discharge predictions using 2011 precipitation data are anticipated to be much greater when compared to the system operating under normal conditions.

Response: *DEP agrees that 2011 was a much wetter year with respect to total precipitation, with 55.8 inches in 2011 as compared to 46.3 inches in 2008, (a 33% increase). However, the distribution of the rainfall throughout the year is as critical a factor affecting the total annual volume. The DEP has been using previous versions of the InfoWorks models since 2006 on an annual basis as part of the SPDES consent order requirement; namely, the reporting of percent capture and total nitrogen loadings. The 2011 year was presented in the recalibration report since the annual simulations were performed with recalibrated models for the first time and meaningful comparisons could be made of simulated volumes reported in the 2011 submittal (that used previous 2007 InfoWorks models) for SPDES reporting. Model outputs were processed in a manner similar to the SPDES reporting process and, in general, the model performance (in terms of correlations from visual observations) assessed from time-series and probability plot comparisons of monitored and modeled WWTP inflows were similar for the years from 2006-2010 to those presented in the June 2012 report that used the recalibrated models.*

As part of the LTCP2 Project, the DEP will be performing simulations for the average hydrologic year of 2008 and also a long-term simulation for a 10-year period from 2002 to 2011. In addition, the DEP is in the process of using recalibrated models for Calendar Year 2012 as part of the SPDES reporting submittal due on March 31, 2013. The DEP will assess the sensitivity of models to different climatic inputs during *these efforts and determine any need for minor modifications to the calibration strategy documented in the June 2012 recalibration report.*

It should be recognized, however, that although 2011 was an outlier year in terms of total rainfall it provided a good test for the model as it contained both large and small events. Large rainfall events, specifically the two events that occurred on August 13 and 27, and September 5-7, that might lead to model bias, were individually examined to assess the ability of the model to reproduce the flows reaching the WWTPs. These events were beneficial to include in the analysis since they did provide large events for which the model goodness of fit could be evaluated. The temporal hydrographs show clearly that the models reproduced the plant inflows fairly well for small, medium and large events during 2011.

Comment 5: Model Recalibration Report – Tallman Island CSO Volume Comparison

How were the WWTP pumping operations simulated/setup in the model?

Response: *The WWTP head works are typically represented in the DEP models as pump rating curve, developed to characterize operation of the main pump and the maximum capacity of the WWTP. For simplicity, an Archimedean screw pump type was utilized to represent the pumps at the WWTP in the model. The pump discharge of an Archimedean screw pump is directly related to hydraulic head or upstream water level, i.e., $Q = f(h)$. The relationship between discharge and head in the positive direction is represented as a data table and pumping rates in the model simulated with the real-time control functionality of the model. The pump switch-on level determines when the pump first comes into operation; the pump will continue running until the upstream water level drops below the switch-off level. This type of setup works well to represent variable speed pump stations as a step function. As can be seen in the time-series comparisons of modeled and monitored plant inflows, the calibrated pump curves used in the InfoWorks models are, therefore, reasonable representations of the wet weather operating plans used by the plant operators for the range of storm conditions on a day-to-day basis. Throttling operations to limit the flow to twice the design dry weather flow level are typically represented using the real-time-control (RTC) option in InfoWorks with flow thresholds and the corresponding sluice gate closure levels.*

Comment 6: Tallman Island Appendix A - Site-Scale Calibration

Three flow meters were installed in three different catchment areas within the Tallman Island watershed system and the data was used during the site-scale calibration portion of the total recalibration of the Tallman Island model. The site-scale calibration parameter modifications were then applied to the entire contributing watershed to Tallman Island during the area-wide calibration. Although the model indicated that the entire watershed had an average impervious services of about 77% (average of all sub-catchments as calculated from the model input), two of the three meter sites used in the site-scale calibration, TI#2 and TI#3, had impervious surfaces which were estimated at only 30% and 53%, respectively. Additionally, a large portion of the subcatchment of meter site TI#3 is identified to contribute to sanitary and storm sewer conveyance systems and not combined sewer systems. Please provide an explanation of why these three site-scale meter sites were selected to be used as representative points within the TI system if they have a much lower impervious area percentage when compared to the sub-catchments system-wide. How does using the metering sites data from "more pervious" sub-catchments impact the calibration results when these calibration parameters are then applied area-wide? How were the calibrated parameters from sub-catchments that only contribute to separate sanitary and storm sewers used for watershed areas that contribute to combined sewers or were these results only applied to sub-catchments that contributed to separate conveyance lines?

Response: *The 20 sites for site-scale monitoring were selected not only to spread out over different WWTP drainage areas geographically, but also with the purpose of representing the variation of the City's drainage basin characteristics such as imperviousness, population density, and land uses, etc. Final selections were also based on site amenability for flow monitoring. In this case, the 3 sites were not selected to exclusively represent the Tallman Island system, but they were a part of the integrated monitoring program to guide the development of a general approach towards the calibration of the City's models.*

A large portion of the drainage area in Site 2 is open space pervious area, but it is part of the combined drainage system, i.e., runoff generated from the pervious surface after the infiltration capacity is fulfilled can be conveyed into the combined drainage system. In model calibration, pervious open surfaces, pervious non-open surfaces and impervious surfaces were represented separately with parameters developed to suit their surface types regardless of the type of the drainage system to which they discharge.

Comment 7: Tallman Island Appendix A - Site-Scale Calibration

Were the 2010 census population and associated average dry weather flow (125.3 MGD) used for the site-scale calibration, as these simulations used October- December 2009 precipitation data and would be more representative than the 2000 average DWF (113.8 MGD) and population used in the 2007 IW model?

Response: *No, the 2010 census population and associated average dry weather flow were not used. The DEP typically uses average dry weather flow at the plant and apportions to individual subcatchments based on the population at that local scale, for various modeling efforts including the SPDES consent order reporting requirement on an annual basis. The 2009/2010 average dry weather flows were used for the site-scale calibrations and 2005/2006 data for area-wide calibrations and 2011 data for WWTP inflow calibration. It should also be emphasized that the variance in DWF from 2008, 2009 or 2010 will have minimal significance when calibrating runoff coefficients, especially at sites that are located well upstream in the system.*

Comment 8: Tallman Island Appendix A - Site-Scale Calibration

The three meter sites used in site-scale calibration all show multiple validation events that are well outside of the acceptable criteria for volume, flow, and depth for various storm events evaluated. If good calibration cannot be reproducible through validation can this calibration be actually deemed "satisfactory" as many of these validation events imply that the site-scale calibrated flows were under-predicted compared to the observed data for these locations?

Response: *Model calibration/validation is a process of selecting the set of coefficients that represent observed conditions. It is not a process of adjusting model coefficients to match each data point. As such there will always be data points that are not fully reproduced. Further a global parameter such as the runoff coefficient is well known to vary with differing environmental conditions. Runoff coefficients will not be exactly the same for both low intensity rainfalls and high intensity rainfalls. The goal of the calibration of these City-wide planning level models was to obtain the best set of coefficients that provide a reasonable reproduction of observed conditions.*

The DEP used a weight-of-evidence (WOE) approach to look at different flow characteristics including flow volumes, peak flow rates, and depths. In addition, the WOE approach looks at both event-based and continuous simulation-based modeling results to assess the adequacy of calibration, based on correlations observed at different spatial scales (site, area-wide and WWTP-wide). Correlograms showing the comparison of metered and modeled volumes, flow rates and depths and time-series comparisons showing the temporal variations in metered and modeled flows are used as part of the WOE assessment. One additional key calibration criterion was to adjust the parameters on a global (City-wide) basis, so that the lessons learned at the site and area-wide metered areas can be extended to other non-metered portions of the City.

Comment 9: Tallman Island Appendix A - Site-Scale Calibration

It is noted on Appendix A, page A.TI.2 that "With respect to peak flow rates and water depths, the model is within or closer to the accepted criteria for most events, but under-calculated peak flow rates for the 11/19/09, 10/24/09 and 12/23/09 storms, possibly due to the difference between the actual rainfall in the local area and the rainfall data used in the model." Please explain why the rainfall distribution was not adjusted to better represent the actual rainfall within the local area and how does this impact the model's ability to predict overflows if you are calibrating to data that may not be best representative of the actual area conditions. This point of local and regional rainfall differences was also brought up in the area-wide calibration (see Comment 12) as part of the rationale for why several different calibration locations did not match with observed data.

Response: *As described in Section 2.2.2, for site-scale calibration, radar rainfall data covering the entire City drainage area were used. These data are in a spatial resolution of 0.62 miles by 0.62 miles (1km by 1km) grid size and a temporal resolution of 5 minutes. The data were calibrated by the vendor using point gage data from NOAA stations and local gage data of other sources (from DEP, Weather Underground, etc.) that are available near the City area. The size of the radar grids is similar to the size of the site-scale sites within the Tallman Island Drainage area. Thus, variation in rainfall finer than the spatial resolution available of 1 km by 1 km was not possible. The statement referring to potential differences in rainfall data was intended to refer to the level of accuracy that the model prediction can achieve using the best data available. During site-scale and area-wide model calibration for the City's models, sensitivity analyses on various rainfall data were conducted when necessary to evaluate differences in model results (also see responses to Comments 11 and 12).*

Comment 10: Tallman Island Appendix B -Area-Wide Calibration using data collected in 2005

Area-wide calibration of the Tallman Island model was performed through several steps: 1) calibration using data collected in 2005 at six meters which were originally used to calibration the 2007 IW model; 2) calibration using data collected during June/July 2008 from five supplemental meters; 3) calibration using data collected in the operational records during 2010 at the Flushing Creek CSO Retention Facility; and 4) calibration using data collected in operational records during 2011 for the Tallman Island WWRP.

Based on Figure B.TI.1, the majority of the meters used in the first phase of the area-wide calibration, which uses data collected in 2005 for the original 2007 IW model, are not within sub-catchment areas that contribute to combined sewer systems. The majority of runoff within these sub-catchments used in area-wide calibration for Tallman Island is actually routed to separate sewer or direct drainage. Please explain if it is appropriate to apply calibration parameter results that were fitted for sanitary and storm sewers to combined sewers and if this potentially biases the the model's ability to truly predict CSO overflows.

It was mentioned that at calibration meter site TI-M9, the area was "served by seepage pits, from which excess wet weather flows were routed to nearby combined sewers". Please explain how these excess flows were monitored at this site and how were these flows accounted for during the calibration as this subcatchment contributes to a separate sewer conveyance system. At Metering Station TI-M9, a runoff coefficient of 0.033 was used for the impervious surfaces which also seem extremely low. Please elaborate on how these areas were modeled using a lower runoff coefficient and how the calibrated data was used.

Meter Site TI-M2 initially showed over-estimated flows when compared to observed data. Appendix A indicates that approximately 11 inches of sediment was added to this location to reduce the flow rate to achieve better calibration. Please explain the source of this 11 inch of sediment depth at this location (i.e., was this measured or recorded from field observation or is sediment depth used as a calibration parameter?).

Response: *In the 2005 monitoring, M6A and M6B both measured combined sewer flows as well as M2 that was in the White Stone interceptor. M9 and M12 were installed in sanitary sewers, although the sewers connect to combined sewer eventually at downstream locations. Data showed RDII responses in these upstream separate sewer subcatchments. Parameters developed here were only used to model RDII from separate sewer subcatchments*

Eleven inches were measured in the recent sediment survey (2010-2011) at a section of the interceptor upstream of Meter TI-M2 near Regulator R-10A. For model calibration purpose, this was used as the sediment in the regulator chamber of R-10A where no actual measurement was available.

Comment 11: Tallman Island Appendix B -Area-Wide Calibration using data collected in 2008

Additional water depth data was collected at five supplemental locations in June/July 2008; however, these locations are not identified on the figure to assess what type of conveyance system they are representative of. No flow data was available for these locations monitored in 2008 and calibration was achieved through evaluating water depth at these meter sites. Typically, flow data in conjunction with water depth is used for calibration and it was unclear if using the "water depth" as the only calibration parameter was appropriate.

Overall the calibrated water depths at the five sites were either observed as over-predicted or satisfactory. The main rationale for not achieving a good calibration was that an average sediment depth was applied to the model using 2011 DEP sediment data and may be an overestimate of the existing conditions during 2008. Additionally, the report suggested that the local rainfall pattern was likely different than the precipitation distribution used in the model from the monitoring station (see Comment 9, above). Meter specific comments are provided below on assumptions made in the model.

Meter Site TI-Site7 was placed at the section of the Flushing Interceptor that sags (due to settling). The model significantly over-predicts water depths at this location during calibration; however, there is a note that "grease had been building up on the ceiling of the sagged sewers that could further block sewer cross-sectional area"- it was not indicated whether this was accounted for in the model and if this was contributing to the over-prediction compared to the observed water depth.

Modeling under-predicted the results for water depth at metering Sites TI-Site4 and TI-Site5 when compared to observed data. The report indicates that "the observed sedimentation at Regulator R-10A was not used, even though sediments had been used in the earlier calibration to 2005 monitoring data, because additional sediment would cause further under-prediction of calculated depths for the 2008 events." Please explain how increasing the sediment would decrease the depth at this location and why it is appropriate to omit observed sediment data.

Response: *See Figure B.TI.1 in the revised Appendix B for 2008 monitoring locations. As mentioned in the report, velocity measurements were taken at the meters during 2008 monitoring, but they were in very poor quality. As a result, the flow data were not usable either for model calibration. In an effort to utilize as much historical data as possible, the depth data were used in the model calibration to supplement the 2005 data.*

Radar rainfall in the same resolution as was used for the site-scale calibration was used for the 2008 events calibrations. See responses to Comment 9. During model calibration, sensitivity runs were conducted using hourly rainfall data available at the LGA NOAA gage. Results using radar rainfall data appeared to show better matches to monitored data in most of the cases; occasionally results using LGA data showed better agreements with the monitored data. This confirmed the existence of model uncertainty due to the accuracy of data used, and is part of the model accuracy.

Grease build up was found during interceptor surveying and cleaning in 2011;, it was unclear whether this condition also existed in 2008, and was therefore not included in the model simulation.

Sediment was observed in the interceptor immediately downstream of regulator R-10A during interceptor inspection in 2010; no data was available for sediment condition within the regulator chamber. For events in 2005, the comparison of modeled and monitored data indicated that sediment could exist within the regulator chamber, and therefore a similar level of sediment in the interceptor was applied to the regulator chamber as a calibration parameter. For the 2008 events, however, applying *sediment in the regulator chamber would have resulted in "further under-prediction" in comparison to the monitored depths. This is because regulator R-10A is located upstream of Site 4 and Site 5. An increased sediment level at R-10A would have caused more overflow at that location and would have resulted in less flow entering the interceptor. Modeled depth at Sites 4 and Site 5 would have decreased along with the flow decrease in the interceptor, resulting in "further under-prediction". Thus, no sediment was applied for the 2008 event calibrations.*

Comment 12: Tallman Island Appendix B - Area-Wide Scale Calibration Flushing Creek CSO Retention Facility

Figure B.TI.1c which shows a schematic of the facility was not provided.

The model was calibrated using several points from within the Flushing Creek CSO Retention Facility to evaluate the predicted water depth in the facility. The calibration used two sets of precipitation data (collected from La Guardia Airport (LGA) and John F. Kennedy (JFK) Airport, respectively). Overall there was a fairly good match between observed data and modeled data for this facility within the system. However, when a deviance was observed the JFK modeled results aligned more with the observed data. Why was LGA monitoring site selected as the precipitation data source for Tallman Island final simulation when JFK showed better calibration alignment at this facility?

As mentioned in Comment 9, it was observed that the local precipitation was different than the LGA regional data used. Was the JFK precipitation data used to evaluate any of the other area-wide calibration meters (i.e, 2005, 2008) or the site-scale meters to see if this data set would be more applicable and resolve some of the calibration discrepancies that were observed in the earlier stages of calibration?

In general, it appears that the model was over-estimating the overflow occurring at the Flushing Creek CSO Retention Facility when compared to the existing records kept by the DEP- particularly during months that do not have large volumes of overflows at the facility. So if the modeled flows are consistently higher than the actual recorded/measured flows, can this be considered a good calibration?

Response: *The Schematic of the Facility will be added in the revised Appendix B as Figure B.TI.1b*

For the majority of the Tallman Island drainage areas, the LGA station is closer than JFK station. As the drainage area to the Flushing Creek CSO facility is located on the south portion of the TI drainage area, the distance to LGA and JFK stations are similar. This could be the reason that the results using JFK rainfall appeared to be more aligned with the observed data for some events. This also depends on the size of rain cells during individual storms, and the direction and speed at which they pass the area. For 2005 and 2008 simulations, radar rainfall is available (described in responses to comment 9). Radar data has a higher resolution both spatially and temporally in comparison to either of the point gage data. For the final 2011 simulation, sensitivity runs using both JFK and LGA were conducted. Results from the two runs were very similar, with LGA results slightly better for some events, and therefore LGA was used as the final run in the report.

The comparisons at retention facilities were only used as a validation check. Some of the issues with comparing flows at the CSO facilities to the modeled flow is that at Flushing Bay CSO Facility, only the flow that goes through the CSO tank is monitored, not the entire flow, a portion of which bypasses the tank and is then discharged through TI-010 along with the overflow from the CSO tank. As can be seen in Figure B.TI.26, out of the four 2011 events reviewed, three of them showed fairly good agreement with the monitored data. The data, however, appeared to have gaps which could also be an indication that the estimated CSO volume from the data could be low for some events. Additional analyses will be conducted as part of the ongoing PCM work and the LTCP2 work to assess the data validity and to further refine the model estimates where appropriate.

Comment 13: Tallman Island Appendix B- Area-Wide Scale Calibration Alley Creek CSO Retention Facility

No calibration was performed for the Alley Creek CSO Retention Facility which became operational on March 11, 2011. Is operational information for this facility available? Was this facility modeled similarly to the Flushing Creek CSO Retention Facility as a single node?

The model appears to be over-predicting the overflows at the Alley Creek CSO Retention Facility when compared to existing records. So if the modeled flows are consistently higher than the actual recorded/measured flows, can this be considered a good calibration?

Response: *Also see Comment 12. The comparisons at retention facilities were only used as a validation check. Additional analyses will be conducted as part of the ongoing PCM work and the LTCP2 work to assess the data validity and to further refine the model estimates where appropriate.*

Comment 14: Tallman Island - Additional hydrologic factors

Please explain how snowmelt flow was considered and simulated and if any of the calibration events include snowmelt periods.

Response: *DEP has not attempted to model snow and snowmelt explicitly in our projects. In all WWFP work, all precipitation is treated as rainfall. For the WWTP 2011 recalibration analyses, the following events were removed from the record as the precipitation fell as snow; Jan 11, Jan 20, and Jan 25-26, for the time-series and probability plot comparisons. The reason is that the modeling algorithms for snowmelt in the U.S. Environmental Protection Agency's Stormwater Management Model (and in the InfoWorks model also) are quite complex and require comprehensive datasets to successfully use them. Most winter storms in the NYC region occur as rainfall, and the DEP believes that the flows and pollutant loads will be overestimated for a handful of events that may have experienced snowfall which is assumed to be rainfall.*

Comment 15: Tallman Island - Additional hydrologic factors

Please explain if groundwater was considered in the simulations. Are there any significant interactions between the groundwater and surface waters within the watershed that should be taken into account as well?

Response: *Groundwater effects where applicable were included with dry weather flow estimates as base flows. The DEP has not attempted to explicitly model the variations in groundwater and associated variation in infiltration rates on a seasonal basis. Model algorithms in the U.S.EPA Stormwater Management Model (and in InfoWorks also) are quite complex and will require significant amount of groundwater level data to be able to successfully apply them. There was no separate modeling of ground water infiltration, except for the ground water infiltration captured at Flushing Creek Retention CSO Facility and Alley Creek CSO Retention Facility. For the two tanks, constant infiltration rates were estimated based on data from the Monthly Monitoring Reports, and modeled as inflows.*

For the large storm events in September and October, it appears that there were some possible interactions with an elevated ground water table that resulted in additional infiltration or inflow into the sewer system that was not captured in the model. Groundwater infiltration is included in all modeling simulations as a component of the base dry weather flow, although RD I/I is not. In most storm events occurring in this sewershed, combined flows are dominated by direct runoff, not infiltration.