Onondaga County Save the Rain Program, Response to CDM Smith's 3rd Party Review of CH2M HILL's Draft SWMM and Update Report

PREPARED FOR: Tom Rhoads/OCWEP

COPY TO: Mike Lannon/OCWEP
Nick Capozza/OCWEP
Matt Marko/CH2M HILL

PREPARED BY: Rita Fordiani/CH2M HILL
Dingfang Liu/CH2M HILL

DATE: November 18, 2013

PROJECT NUMBER: 381098.OC.09.04

This memorandum has been prepared to respond to CDM Smith's 3rd party review of CH2M HILL's Draft Stormwater Management Model (SWMM) and Update Report: *Review of Onondaga County's SWMM Files, Model Updates, Calibration and Green Modeling Approach* (CH2M HILL, January 2013). CDM Smith's review is documented in a memo to Onondaga County (OC) dated November 18, 2013. Please note that pages 1-4 through the bullet referring to dry pipes are more recent CDM review comments initially discussed with CH2M HILL in July 2013. Comments on pages 4-7 starting with the heading "General report comments" are comments previously discussed and adjudicated in the spring of 2013 prior to issuance of the OC ACJ 4th Stipulation 2012 Annual Report (April 2013).

The more recent comments have been categorized as follows:

Comment Category	Number of Comments in Category
No Update Required.	35
Minor SWMM Update – no impact to 2012 ACJ system-wide reporting; change to be made in 2013 SWMM and ACJ Report.	10
Significant SWMM Update – significant influence on model results; update recommended to 2012 ACJ system-wide reporting.	0
TOTAL	**45**

All comments are included in the attached CH2M HILL Comment Review Form (CRF). The CRF provides a response and a final adjudication where needed. CDM's November 18, 2013 memo is also attached for reference. Please let us know if there are additional questions and/or comments.

CH2M HILL Comment Review Form (CRF)			
Project: Onondaga County SWMM Review by CDM Smith			
Date:	11/18/2013		

Comment Number	Reference Page or Sheet No.	Commenter	Review Comment	Responder	Response	Adjudication
RESPONSE TO COMMENTS ON SWMM 3RD PARTY REVIEW						
1	Opening paragraph	Mitchell Heineman/ Ted Burgess	There are several important exclusions in the report that can be addressed through providing additional information. In addition, there are several areas where specific measures may need to be taken to improve the model's benefit and presentation.	Dingfang Liu	If this is in reference to the spring 2013 comments, then this additional information has already been provided in the 2012 ACJ Report. CH2M HILL does not see any new comments which require additional text being added to the 2012 ACJ Report. There are some minor changes that we will make to SWMM 2013 noted below that we will list in the 2013 ACJ Report Appendix as needed.	No update required except as noted below.
2	Computer Model: General	Mitchell Heineman/ Ted Burgess	The model coordinate system is UTM Zone 18 with coordinates in meters, but model length units are in feet. This makes is awkward to compare modeled and measured conduit lengths. State Plane feet would be a more sensible coordinate system unless UTM is the district standard.	Dingfang Liu	The updated model is in the same "default" coordinate system used by the previous model. CH2M HILL will update the coordinate system to New York State Plane feet in the 2013 SWMM and ACJ Report. This change is recommended to match the GIS database as well. No impact on model results.	Minor update: CH2M HILL will make this update in the 2013 SWMM and ACJ Report.
3	Computer Model: General	Mitchell Heineman/ Ted Burgess	Internal documentation lacks identification of coordinate system, vertical datum, authors, data sources, etc.	Dingfang Liu	This information was included in the modeling report. Most of the data are from Mile Square maps. Facility record plans are listed in the modeling report.	No update required.
4	Computer Model: Simulation Options	Mitchell Heineman/ Ted Burgess	Inertial terms were ignored in dynamic wave solution. This may produce inaccuracies in hydraulics and therefore should be compared with full dynamic wave solution condition.	Dingfang Liu	Comparison of model runs with and without inertial terms show small differences. All model runs reported are computed with full dynamic wave solution condition.	No update required.
5	Computer Model: Simulation Options	Mitchell Heineman/ Ted Burgess	Constant evaporation is used which is an unnecessary oversimplification. This overestimates runoff in summer and underestimates it in winter. Large CSO models should use monthly or higher frequency values.	Dingfang Liu	Evaporation will be added to the model according to NOAA's Technical Report NWS 34 entitled *Mean Monthly, Seasonal, and Annual Pan Evaporation for the United States*. Monthly evaporation roughly assumes the shape of a bell curve, totaling nearly 39 inches per year for the city of Syracuse. It was assumed that evaporation only occurs during dry periods.	Minor update: CH2M HILL will make this update in the 2013 SWMM and ACJ Report.
6	Computer Model: Simulation Options	Mitchell Heineman/ Ted Burgess	Have you considered synthetic disaggregation of the long-term hourly precipitation data to the time scale used for calibration (i.e., 15 minutes)?	Dingfang Liu	Historically, all the model simulations used for the ACJ negotiations and capture percentage values stated in the ACJ were based on long-term simulations using hourly rainfall data of the 1991 year. Using shorter time interval precipitation data now would not be comparable with previous results or previously reported ACJ goals/milestones. Using hourly rainfall data for model simulations is an acceptable practice used by many other CSO communities. Therefore, we recommend no change in the precipitation data (a model boundary condition) for long-term simulations. Shorter time interval precipitation data was used to calibrate and validate the model based on flow monitoring data. The facility design and evaluation of system performance evaluations were also based on simulations with shorter time intervals (e.g. 15 min.), and they were used on a case-by-case simulation per OC request.	No update required.
7	Computer Model: Catchments	Mitchell Heineman/ Ted Burgess	Areas okay: avg. 21 ac, min 0.5, max 216.	Dingfang Liu	No response needed.	No update required.
8	Computer Model: Catchments	Mitchell Heineman/ Ted Burgess	Imperviousness okay: weighted average 45%, range 0-100%.	Dingfang Liu	No response needed.	No update required.
9	Computer Model: Catchments	Mitchell Heineman/ Ted Burgess	Width is quite low – average 54 ft/ac, weighted average 33 ft/ac. A typical urban system is 5-10 times higher. Attenuated hydrographs and reduced pervious runoff can be expected.	Dingfang Liu	Large stormwater drainage basins were included to simulate hydraulic conditions in receiving waters. These large sub catchments (several square miles) are delineated based on Streamstat's Basin tool and used its topology computation result for watershed width. For combined sewer subcatchments, the updated model has an average subcatchment width of 115 ft/ac. This translates to sheet flow path length of 378 ft which is acceptable to be used for urban systems (typically less than 500 ft) before flow channelizes.	No update required.
10	Computer Model: Catchments	Mitchell Heineman/ Ted Burgess	Slope okay: area-weighted 1.5%, range 0.1% to 10%.	Dingfang Liu	No response needed.	No update required.
11	Computer Model: Catchments	Mitchell Heineman/ Ted Burgess	Impervious N minor issue: 15 catchments have N=0.017 while remainder have 0.0167.	Dingfang Liu	No response needed.	No update required.

CH2M HILL Comment Review Form (CRF)						
Project: Onondaga County SWMM Review by CDM Smith						
Date:	11/18/2013					

Comment Number	Reference Page or Sheet No.	Commenter	Review Comment	Responder	Response	Adjudication
12	Computer Model: Catchments	Mitchell Heineman/ Ted Burgess	Pervious N: 45 catchments have N=0.35; remainder have N=0.04. 0.35 is extremely high and likely produces negligible runoff from pervious area. 0.04 is low for remaining areas, so sharply peaked hydrographs are to be expected in conditions where pervious area runoff occurs.	Dingfang Liu	Subcatchment pervious N values are based on SWMM suggested values for land types: e.g. 0.4 is for wooded areas and 0.15 is for short prairie grass. The N values were set to 0.15 by default and adjusted during the calibration process. In general, the curve shapes of runoff hydrographs are less sensitive to the N value than subcatchment width and infiltration parameters, therefore, future calibration adjustments will be limited to width and infiltration parameters only. CH2M HILL will update the default to 0.15 in the 2013 SWMM.	Minor update: CH2M HILL will make this update in the 2013 SWMM and ACJ Report.
13	Computer Model: Catchments	Mitchell Heineman/ Ted Burgess	Impervious depression storage averages 0.02", ranging from 0.006 to 0.1". It is unlikely that the field data supports this wide range, but the impact on results is minor. A single value of 0.05 in usually adequate.	Dingfang Liu	Maintained parameters in previous model since it is not a sensitive parameter.	No update required.
14	Computer Model: Catchments	Mitchell Heineman/ Ted Burgess	Pervious depression storage ranges from 0.1" to 0.25", averaging 0.12". It is unlikely that data supports this differentiation. A single value of 0.1" is adequate unless differentiation can be justified.	Dingfang Liu	Maintained parameters in previous model since it is not sensitive parameter.	No update required.
15	Computer Model: Catchments	Mitchell Heineman/ Ted Burgess	Impervious area without depression storage: 30% in eight catchments, 25% all others. This results in a minor impact on results. The differentiation should be documented or adjusted so all match. 25% is standard.	Dingfang Liu	Maintained parameters in previous model since it is not sensitive parameter.	No update required.
16	Computer Model: Catchments	Mitchell Heineman/ Ted Burgess	Impervious to pervious routing option selected for all catchments is okay. Routing coefficient ranges from 0 to 90%, area-weighted average effective imperviousness 30%, which is reasonable. E.g. a calibrated SWMM model for Albany NY indicates effective imperviousness of 32%, although Troy NY was calibrated to 13%.	Dingfang Liu	See report section 4 for calibration detail.	No update required.
17	Computer Model: Catchments	Mitchell Heineman/ Ted Burgess	Green-Ampt suction head varies from 3.0 to 8.3 inches (loam/silt loam) which is acceptable.	Dingfang Liu	No response needed.	No update required.
18	Computer Model: Catchments	Mitchell Heineman/ Ted Burgess	Soil hydraulic conductivity ranges from 0.005 in/h (very tight clay) to 1.64 in/h (loamy sand), averaging 0.35 in/h. Soil survey indicates most area soils are gravelly/silty loams. Tight clays may overestimate runoff, but area average appears reasonable.	Dingfang Liu	No response needed.	No update required.
19	Computer Model: Catchments	Mitchell Heineman/ Ted Burgess	Initial moisture deficit set to 32% throughout which is typical for loamy sand.	Dingfang Liu	No response needed.	No update required.
20	Computer Model: Nodes	Mitchell Heineman/ Ted Burgess	Node 336 has no ponding area which means any flood leaves model domain.	Dingfang Liu	The default ponding area of 5,000 square feet will be added to this node.	Minor update: CH2M HILL will make this update in the 2013 SWMM and ACJ Report.
21	Computer Model: Nodes	Mitchell Heineman/ Ted Burgess	Five pressure nodes specified which is acceptable.	Dingfang Liu	No response needed.	No update required.
22	Computer Model: Nodes	Mitchell Heineman/ Ted Burgess	Surface ponding 5000 ft^2 throughout which is acceptable.	Dingfang Liu	No response needed.	No update required.
23	Computer Model: Nodes	Mitchell Heineman/ Ted Burgess	Inverts from 350 to 730 ft which is acceptable.	Dingfang Liu	No response needed.	No update required.
24	Computer Model: Nodes	Mitchell Heineman/ Ted Burgess	Manhole depths from 6 to 30 ft, averaging 13 ft, which is acceptable, but seems a bit deep.	Dingfang Liu	No response needed.	No update required.
25	Computer Model: Nodes	Mitchell Heineman/ Ted Burgess	Metro_LowLift wet well at WWTP has only 24 ft^2 cross-sectional area. This results in extreme fluctuations of pump rate to the WWTP outfall and rapid cycling of the WWTP pumps.	Dingfang Liu	The fluctuations are mainly due to its effective volume. The cross-section area will be increased to 2400 ft^2 and pump start increased from 6 to 12 ft. depth to approximate the available effective volume at METRO and improve computation.	Minor update: CH2M HILL will make this update in the 2013 SWMM and ACJ Report.
26	Computer Model: Nodes	Mitchell Heineman/ Ted Burgess	Storage junction areas range from 24 ft^2 at Metro_LowLift to 3600 ft^2 at Disinfection Tank plus 22,000 ft^2 at Liverpool_Tank (1 MG at 6 ft depth) which are acceptable.	Dingfang Liu	No response needed.	No update required.

CH2M HILL Comment Review Form (CRF)						
Project: Onondaga County SWMM Review by CDM Smith						
Date:	11/18/2013					
Comment Number	**Reference Page or Sheet No.**	**Commenter**	**Review Comment**	**Responder**	**Response**	**Adjudication**
27	Computer Model: Conduits	Mitchell Heineman/ Ted Burgess	Seven pipes have N less than or equal to 0.003 which is unreasonable	Dingfang Liu	Manual pipe lengthenings and associated N values were included in the previous model where very short pipe lengths existed. SWMM5 can make these adjustments automatically for computational ease; therefore, these pipe lengths will be adjusted to their actual pipe lengths and N values.	Minor update: CH2M HILL will make this update in the 2013 SWMM and ACJ Report.
28	Computer Model: Conduits	Mitchell Heineman/ Ted Burgess	All other pipes have N greater than or equal to 0.015 and less than or equal to 0.02. This likely overestimates head losses. Many pipes are probably closer to 0.013.	Dingfang Liu	Many pipes are old pipes. Incorporating the knowledge of the County's operational personnel, larger roughness coefficients were used to account for pipe age and sediment conditions.	No update required.
29	Computer Model: Conduits	Mitchell Heineman/ Ted Burgess	Long force mains would be better represented using Hazen-Williams head loss. Using an N value equal to 0.015 for existing mains is probably high for force mains in decent condition.	Dingfang Liu	Many pipes are old pipes. Incorporating the knowledge of the County's operational personnel, larger roughness coefficients were used to account for pipe age and sediment conditions.	No update required.
30	Computer Model: Conduits	Mitchell Heineman/ Ted Burgess	Open channel segment N is equal to 0.025 which is acceptable.	Dingfang Liu	No response needed.	No update required.
31	Computer Model: Conduits	Mitchell Heineman/ Ted Burgess	160 pipes have been assigned an apparent minimum length of 50 feet, but N was not adjusted to maintain head loss equivalence. Probably only a minor impact to the results.	Dingfang Liu	No response needed.	No update required.
32	Computer Model: Conduits	Mitchell Heineman/ Ted Burgess	Pipes 372 and 373 at WWTP have flow constraints of 150 and 90 mgd. No apparent impact in a large storm. Do these constraints represent influent gates that are controlled to maintain flow?	Dingfang Liu	Yes. The flows are controlled to avoid exceeding WWTP hydraulic capacity. The model setups are based on METRO Wet Weather Standard Operating Procedure (SOP).	No update required.
33	Computer Model: Conduits	Mitchell Heineman/ Ted Burgess	130 pipes listed as “Vertical Ellipse” are probably egg-shaped. Conveyance is probably slightly underestimated as a result.	Dingfang Liu	Information based on existing GIS database.	Minor update: CH2M HILL will work with County staff to see if better information is available. Any changes will be reflected in future SWMM and ACJ Reports as the information is made available.
34	Computer Model: Conduits	Mitchell Heineman/ Ted Burgess	22 consecutive pipes in Midland Ave have exit loss coefficients between 3 and 5. These values were apparently entered in error (same as conduit width). These cause excessive head loss in this area.	Dingfang Liu	All pipe exit loss coefficients will be set to 0. This change represents a negligible impact on the results.	Minor update: CH2M HILL will make this update in the 2013 SWMM and ACJ Report.
35	Computer Model: Pumps	Mitchell Heineman/ Ted Burgess	Metro_low_lift cycles constantly equal to 1500 startups in a 6 hour simulation. Simulated flows are very erratic. This can be corrected by adjusting the wet well cross-sectional area to 1000 ft². Whether or not 1000 ft² is more realistic, it’s unlikely the flow rate fluctuates as it does in the base model.	Dingfang Liu	See response to #25.	No additional update required.
36	Computer Model: Pumps	Mitchell Heineman/ Ted Burgess	Midland Influent PS standby pump operates under normal conditions. Is this correct?	Dingfang Liu	Pump operation was based on as-built plans and wet weather SOP.	No update required.
37	Computer Model: Weirs	Mitchell Heineman/ Ted Burgess	Most weirs have a C equal to 3.3, which is acceptable. 039_weir and MST_weir have C equal to 0.5 which is likely a default used in error. These produce higher upstream hydraulic grade lines than are likely to occur, and may simulate excessive flooding.	Dingfang Liu	All weir headloss coefficients will be set to 3.3. This update represents a negligible impact on the results.	Minor update: CH2M HILL will make this update in the 2013 SWMM and ACJ Report.
38	Computer Model: Simulated Conditions	Mitchell Heineman/ Ted Burgess	A seven-hour, 1.56” storm (5/26/91) was simulated. Its peak hour depth was 0.43 in. It was approximately a 1-year 6-hour event with a 2-month 1-hour peak.	Dingfang Liu	No response needed.	No update required.
39	Computer Model: Simulated Conditions	Mitchell Heineman/ Ted Burgess	Flooding at 41 junctions seems quite high.	Dingfang Liu	Most of the pipe invert elevations are interpreted from LIDAR DEM associated with some degree of inaccuracy which could result in inaccurate manhole depths (invert to rim) and subsequently cause overtopping during the peak of a rain storm. However, the flows overtopping the manhole remain in the system by checking the "allow ponding" option.	No update required.

CH2M HILL Comment Review Form (CRF)	
Project: Onondaga County SWMM Review by CDM Smith	
Date: 11/18/2013	

Comment Number	Reference Page or Sheet No.	Commenter	Review Comment	Responder	Response	Adjudication
40	Computer Model: Simulated Conditions	Mitchell Heineman/ Ted Burgess	Flooding exceeds 30 minutes at 32 locations, and results in more than 2 ft of pooled water at nine locations.	Dingfang Liu	See response to #39.	No update required.
41	Computer Model: Simulated Conditions	Mitchell Heineman/ Ted Burgess	Liverpool tank appears underutilized. While MIS619 fills with over 3 MG, Liverpool has about 0.1 MG in the same storm (3 MG capacity).	Dingfang Liu	Tank invert and volume are based on record plan, "Liverpool Pump Station Improvements" dated January 2004. It should be noted that the service area tributary to the Liverpool PS is a separated sanitary sewershed. The storage was designed for emergency relief purposes. MIS 619 is storage tank at Midland RTF which is a combined sewer treatment facility and accepts flow from a large combined sewer area.	No update required.
42	Computer Model: Simulated Conditions	Mitchell Heineman/ Ted Burgess	21 conduits have Vmax between 15 and 25 ft/s which is very high.	Dingfang Liu	Very small percentage of pipes (< 0.9%) have high Vmax during the peak of the storm. High velocities result from high surcharge in the sewer network and relatively low stage in the receiving water.	No update required.
43	Computer Model: Simulated Conditions	Mitchell Heineman/ Ted Burgess	LeyFM1, LiverpoolFM1, Westside_FM1, 063-08-F, and 9277 flooded through most of simulation.	Dingfang Liu	These are forcemain manholes added to allow use of "conduit" for forcemain simulations and presentation purposes. Each manhole has 300 feet of surcharge allowed to simulate pressure conditions; therefore, it should not be interpreted as manhole flooding. For clarity, CH2M HILL will set the ponding area of these manholes to 0 in the 2013 SWMM.	Minor update: CH2M HILL will make this update in the 2013 SWMM and ACJ Report.
44	Computer Model: Simulated Conditions	Mitchell Heineman/ Ted Burgess	Negligible flow enters 007-Stor pump station. Are there misdirected catchment(s) upstream?	Dingfang Liu	Subcatchment areas are based on Mile Square maps. This PS has a very small capacity; therefore, the drainage area appeared reasonable.	No update required.
45	Computer Model: Simulated Conditions	Mitchell Heineman/ Ted Burgess	135 (out of 1800) dry pipes at peak of storm seems high considering that 26 junctions are simultaneously flooded.	Dingfang Liu	Most of the dry pipes are located at upstream ends of the model network where wet weather tributary area has been separated out. A dry weather base flow has been allocated to upstream end nodes.	No update required.

Camp Dresser & McKee/C&S Engineers, Inc.
A Joint Venture
Salina Industrial Power Park, One General Motors Drive
Syracuse, New York 13206 - Ph: 315/434-3200 - Fx: 315/463-5100

MEMO TO:	**Tom Rhoads, Commissioner, OCDWEP**
CC:	**Mike Lannon, OCDWEP** **Nick Capozza, OCDWEP** **Bob Palladine, CDM/C&S** **Chris Schmidt, CDM/C&S** **Matt Marko, CH2M HILL** **Rita Fordiani, CH2M HILL** **Dingfang Liu, CH2M HILL**
FROM:	**Bob Kukenberger, CDM/C&S**
SUBJECT:	**Onondaga County SWMM Review**
RE:	**Draft SWMM and Update Report**
DATE:	**November 18, 2013**

As requested, Mitch Heineman and Ted Burgess, both of CDM Smith, conducted a review of the Draft SWMM Update Report and the computer model. Attached is the memorandum summarizing the comments prepared by Mitch and Ted.

Please let us know if you or other members of the team have any questions regarding these comments. The review team will finalize the comment memorandum once the additional information is reviewed and any questions have been addressed.

Thank you.

Memorandum

To: *Robert Kukenberger, P.E.*

From: *Mitch Heineman*

Date: *July 11, 2013*

Subject: *Onondaga County SWMM Review*

CDM Smith has reviewed CH2M HILL's Onondaga County SWMM file and summary report, "Review of Onondaga County's SWMM Files Model Updates, Calibration and Green Modeling Approach." The modeling in the file and described in the report is generally sound, and is reasonably in line with current practice. However, there are several important exclusions in the report that can be addressed through providing additional information. In addition, there are several areas where specific measures may need to be taken to improve the model's benefit and presentation.

Computer Model

- General
  - The model coordinate system is UTM Zone 18 with coordinates in meters, but model length units are in feet. This makes is awkward to compare modeled and measured conduit lengths. State Plane feet would be a more sensible coordinate system unless UTM is the district standard
  - Internal documentation lacks identification of coordinate system, vertical datum, authors, data sources, etc…

- Simulation options
  - Inertial terms were ignored in dynamic wave solution. This may produce inaccuracies in hydraulics and therefore should be compared with full dynamic wave solution condition.
  - Constant evaporation is used which is an unnecessary oversimplification. This overestimates runoff in summer and underestimates it in winter. Large CSO models should use monthly or higher frequency values
  - Have you considered synthetic disaggregation of the long-term hourly precipitation data to the time scale used for calibration (i.e. 15 minutes)?

- Catchments (excluding three catchments over 1000 acres for modeling brooks)
  - Areas okay: avg. 21 ac, min 0.5, max 216

- Imperviousness okay: weighted average 45%, range 0-100%
- Width is quite low – average 54 ft/ac, weighted average 33 ft/ac. A typical urban system is 5-10 times higher. Attenuated hydrographs and reduced pervious runoff can be expected.
- Slope okay: area-weighted 1.5%, range 0.1% to 10%
- Impervious N minor issue: 15 catchments have N=0.017 while remainder have 0.0167.
- Pervious N: 45 catchments have N=0.35; remainder have N=0.04. 0.35 is extremely high and likely produces negligible runoff from pervious area. 0.04 is low for remaining areas, so sharply peaked hydrographs are to be expected in conditions where pervious area runoff occurs.
- Impervious depression storage averages 0.02", ranging from 0.006 to 0.1". It is unlikely that the field data supports this wide range, but the impact on results is minor. A single value of 0.05 in usually adequate.
- Pervious depression storage ranges from 0.1" to 0.25", averaging 0.12". It is unlikely that data supports this differentiation. A single value of 0.1" is adequate unless differentiation can be justified.
- Impervious area without depression storage: 30% in eight catchments, 25% all others. This results in a minor impact on results. The differentiation should be documented or adjusted so all match. 25% is standard
- Impervious to pervious routing option selected for all catchments is okay. Routing coefficient ranges from 0 to 90%, area-weighted average effective imperviousness 30%, which is reasonable. E.g. a calibrated SWMM model for Albany NY indicates effective imperviousness of 32%, although Troy NY was calibrated to 13%
- Green-Ampt suction head varies from 3.0 to 8.3 inches (loam/silt loam) which is acceptable
- Soil hydraulic conductivity ranges from 0.005 in/h (very tight clay) to 1.64 in/h (loamy sand), averaging 0.35 in/h. Soil survey indicates most area soils are gravelly/silty loams. Tight clays may overestimate runoff, but area average appears reasonable.
- Initial moisture deficit set to 32% throughout which is typical for loamy sand.

- Nodes
  - Node 336 has no ponding area which means any flood leaves model domain
  - Five pressure nodes specified which is acceptable
  - Surface ponding 5000 ft^2 throughout which is acceptable
  - Inverts from 350 to 730 ft which is acceptable
  - Manhole depths from 6 to 30 ft, averaging 13 ft, which is acceptable, but seems a bit deep

- Metro_LowLift wet well at WWTP has only 24 ft^2 cross-sectional area. This results in extreme fluctuations of pump rate to the WWTP outfall and rapid cycling of the WWTP pumps.
- Storage junction areas range from 24 ft^2 at Metro_LowLift to 3600 ft^2 at DisinfectionTank plus 22,000 ft^2 at Liverpool_Tank (1 MG at 6 ft depth) which are acceptable

- Conduits
  - Seven pipes have N less than or equal to 0.003 which is unreasonable
  - All other pipes have N greater than or equal to 0.015 and less than or equal to 0.02. This likely overestimates head losses. Many pipes are probably closer to 0.013.
  - Long force mains would be better represented using Hazen-Williams head loss. Using an N value equal to 0.015 for existing mains is probably high for force mains in decent condition.
  - Open channel segment N is equal to 0.025 which is acceptable
  - 160 pipes have been assigned an apparent minimum length of 50 feet, but N was not adjusted to maintain head loss equivalence. Probably only a minor impact to the results.
  - Pipes 372 and 373 at WWTP have flow constraints of 150 and 90 mgd. No apparent impact in a large storm. Do these constraints represent influent gates that are controlled to maintain flow?
  - 130 pipes listed as "Vertical Ellipse" are probably egg-shaped. Conveyance is probably slightly underestimated as a result.
  - 22 consecutive pipes in Midland Ave have exit loss coefficients between 3 and 5. These values were apparently entered in error (same as conduit width). These cause excessive head loss in this area.

- Pumps
  - Metro_low_lift cycles constantly equal to 1500 startups in a 6 hour simulation. Simulated flows are very erratic. This can be corrected by adjusting the wet well cross-sectional area to 1000 ft^2. Whether or not 1000 ft^2 is more realistic, it's unlikely the flow rate fluctuates as it does in the base model.
  - Midland Influent PS standby pump operates under normal conditions. Is this correct?

- Orifices – all acceptable.
- Weirs
  - Most weirs have a C equal to 3.3, which is acceptable. 039_weir and MST_weir have C equal to 0.5 which is likely a default used in error. These produce higher upstream hydraulic grade lines than are likely to occur, and may simulate excessive flooding.

- Simulated conditions

- A seven-hour, 1.56” storm (5/26/91) was simulated. Its peak hour depth was 0.43 in. It was approximately a 1-year 6-hour event with a 2-month 1-hour peak.
- Flooding at 41 junctions seems quite high.
- Flooding exceeds 30 minutes at 32 locations, and results in more than 2 ft of pooled water at nine locations
- Liverpool tank appears underutilized. While MIS619 fills with over 3 MG, Liverpool has about 0.1 MG in the same storm (3 MG capacity).
- 21 conduits have Vmax between 15 and 25 ft/s which is very high
- LeyFM1, LiverpoolFM1, Westside_FM1, 063-08-F, and 9277 flooded through most of simulation
- Negligible flow enters 007-Stor pump station. Are there misdirected catchment(s) upstream?
- 135 (out of 1800) dry pipes at peak of storm seems high considering that 26 junctions are simultaneously flooded

General report comments

- Calibration
  - add plots for depth and velocity to the flow plots presented
  - statistical summaries should be presented indicating percent error along with calibration targets and explanations of why calibration might deviate from targets
  - scatterplots should summarize calibration over multiple storms demonstrating the correlation between observed and simulated depth, velocity, peak discharge, and volume
  - observed and simulated dry weather flows should be presented
- Figures
  - The numerous 11x17 fold out figures are unwieldy and interrupt the text. Some can be more effectively presented on 8.5x11 sheets (e.g. pipe profiles 3-2 and 3-3).
  - Several present information with limited value and can be omitted (e.g. Figure 3-11, impervious surface map).
- Appendices
  - Appendix A appears to include an incomplete listing of the “previous existing condition” model input data. Since the original model was substantially rebuilt, could this be eliminated?
  - Appendix B presents real-time control rules for the updated model. The value of this section could be enhanced by descriptive comments, such as provided for the “previous” model in Table 2-4

- Appendix C presents USDA NRCS tables of soil properties for Onondaga County. It does not appear the soil types are referenced or discussed in the report, so is there a value in presenting this information?

Section-specific report comments:

Section 1 – no comments

Section 2

- This section makes a valid case that the previous model's architecture does not align with contemporary modeling practice.
- Figure 2-1 superimposes the model network on the full pipe network, making it very difficult to visually distinguish the modeled pipes from the actual system. In addition, the legend is hard to read, and service areas should be labeled directly on the map
- Figure 2-3 should show the approximate hydraulic grade line the authors believe would be valid, as the text indicates that the simulated hydraulic grade line is too low.
- The x-axis (Subcatchment Numbers) in Figure 2-4 is confusing as currently presented. Perhaps this graphic could be better if drawn as a box and whisker chart showing minimum, maximum, and mean areas for the three principal basins
- Section 2.1.3 characterizes SWMM type 1 and 2 pumps as "ideal," presumably meaning they are not specified as dynamic head curves. This is somewhat misleading; as these pump types can offer realistic representations in cases where pump rate depends only on wet well conditions.
- Section 2.2.1 indicates that to assess LID, greater hydrologic detail than exists in the "previous" model is needed. This is inaccurate, as the explicit SWMM LID components are designed to apply multiple LID units within a single subcatchment.
- Section 2.2.3 states that the Green-Ampt infiltration model is superior to the Horton model, and that the Horton model ignores hydraulic conductivity. While the Green-Ampt model has a stronger physical basis, both methods have been used with success in many studies. The Horton model does not ignore hydraulic conductivity, and the Green-Ampt model is not "…dependent on groundwater hydrology…"
- Section 2.2.5 indicates that radar rainfall estimates will provide better calibration results. This is not necessarily true. Except during intense summer storms, rainfall spatial variability in the Northeast can usually be adequately captured using approximately one rain gage per 10 square miles.

Section 3

- How are snow processes addressed in the model?

- Section 3.2.2.1 indicates that Manning's n of 0.015 was used for most closed conduits. A value of 0.013 might be a more appropriate default except where there are known hydraulic constraints.
- Section 3.2.2.2 indicates that all 20 simulated pumps have fixed flow rates. This seems unlikely, especially for the larger pumps. This can yield model results with hundreds of pump activations/deactivations per day.
- Figure 3-5 presents a 1-year storm Onondaga Creek hydraulic profile, similar to Figure 2-3. However, the axis legends are illegible, the graphic has a substantially different look, and the upstream water level appears similar to that shown in Figure 2-3. This contradicts the argument presented in Section 2 that the lack of upstream flow in the "previous" model was a serious flaw.
- Figure 3-6 is difficult to read
- Figures 3-7 and 3-8 should be consolidated into a single figure and shown in conjunction with the modeled urban area.
- Imperviousness estimation is described in Section 3.3.3, but not summarized. The estimates used should be compared with the NLCD 2006 (National Land Cover Database) percent developed imperviousness dataset, which estimates imperviousness on a 30 m pixel grid. Significant differences between the modeled estimates and NLCD should be assessed.
- A methodology for characterizing soil infiltration parameters is discussed in Section 3.3.5, but no specifics are presented as to how it was implemented. As most urban soils are not assigned texture classes, it is not clear how the information in Table 3-12 and Appendix C was used. Furthermore, the Green-Ampt method only uses two of the five parameters presented in Table 3-12 (conductivity and suction head).
- Section 3.3.6 indicates that unit hydrographs were developed, but provides no details of their parameterization.
- Section 3 does not describe how dry weather flows were assessed and allocated. This issue is only briefly addressed in Section 4.4.
- Section 3 does not describe any methodology to account for seasonality in base flows in the sewer system. This can be an important component of collection system behavior in the New York area, as dry weather flows in winter/spring are typically much higher than those in summer/fall. Long-term data from the wastewater treatment plant should be assessed to identify whether/how to account for seasonal dry weather flow variation.

Section 4

- Section 4.2 identifies calibration storms, but several storms listed in Table 4-1 last less than one hour and/or have accumulation less than 0.5 inches. Such events are usually of limited value for collection system model calibration.

- Sections 4.1 through 4.3 discuss calibration of the model to flow metering data from summer 2004 and summer/fall 2009, but Figures 4-7 through 4-9 present calibration plots from spring 2011.
- The good replication of multi-day baseflow recession evident in Figures 4-7 was achieved using unit hydrographs, but no discussion is presented as to how the unit hydrograph characteristics were allocated across the year. As SWMM allows specification of different unit hydrograph parameters for each month, it is important that observations from one season be used appropriately in another season.
- The discussion of calibration is very limited. Calibration results should present averages and ranges for calibrated parameters, as well as a qualitative discussion of findings.
- There is no assessment of the model's performance on a long-term basis, such as comparison of daily average flows at the WWTP over a year
- There is no assessment of system performance in a large storm. Simulated flooding in a large event should be compared with anecdotal reports and system understanding to validate the model's performance.
- There is no presentation of model results demonstrating that there is low continuity error, no unexplained flooding, and a sensible overall water balance.

Section 5

- The threshold for identifying wet weather in the percent capture analysis is only briefly explained. It would be helpful to report the number of hours identified as wet weather over the typical year simulation and compare it with precipitation statistics.
- Is use of 1991 as the representative year worth re-assessing at this time?
- There is no discussion of flooding in either the new or previous model in the typical year simulation. It should be stated how much, if any, flooding is simulated.

Section 6

- This section summarizes SWMM's capabilities. It does not present any information about the Onondaga County sewer system.

cc: Ted Burgess
Chris Schmidt