Northern Tampa Bay Phase II Local Technical Peer Review Group (LTPRG)
SWFWMD Tampa Service Office, Hwy 301N, Tampa

Meeting 43

June 3, 2008 - 9:30AM

Summary

The following were in attendance: Don Polmann, Tampa Bay Water; Chris Shea, Tampa Bay Water; Bob Tyson, Tampa Bay Water; **Warren Hogg**, Tampa Bay Water; Jeff Geurink, Tampa Bay Water; Diane Willis, GPI Southeast, Inc.; **Scott Emery**, EHI/Hillsborough County**; Gordon A. Leslie Jr.**, Hillsborough County EPC; Mario Cabana, Hillsborough County WRS; **Dave Slonena**, Pinellas County Utilities; Rich McLean, Pinellas County Utilities; Mark Farrell; WRA; Dominique Brocard, Metcalf & Eddy; **Joe Richards**, Pasco County; Terrie Lee, USGS; Joseph Hughes, USGS; Gregg Jones, Entrix Water Solutions; Mark Rains, USF; Jan McLean, City of Tampa; Gene Heath; **Michael Hancock**, SWFWMD; Maya Burke, SWFWMD; John Emery, SWFWMD; Ron Basso, SWFWMD; Michael Beach, SWFWMD; Ralph Kerr, SWFWMD; Paul Williams, SWFWMD; Darrin Herbst, SWFWMD; April Breton, SWFWMD; Christina Uranowski, SWFWMD; Sandie Will, SWFWMD; Mark Barcelo, SWFWMD. Names in bold are designated representatives for the LTPRG.

This meeting was a joint meeting with the Northern Tampa Bay LTPRG and the pre-application process for the renewal of Tampa Bay Water's Consolidated Permit.

Michael Hancock provided an update on the status of minimum flows and levels development for northern Tampa Bay and other priority water bodies. No lakes or river systems are scheduled to be brought to the Governing Board for approval through June. Work continues on the establishment of minimum flows in the Weeki Wachee River system, and rule development is ongoing for the Lower Alafia River.

The presentation entitled "2008 MFL Update" was postponed, and will likely be presented during the August 2008 meeting.

Dr. Jeff Geurink of Tampa Bay Water gave a presentation on the current status and development of the Integrated Northern Tampa Bay (INTB) model. The INTB is the result of significant cooperation between the Southwest Florida Water Management District and Tampa Bay Water through contributions of staff expertise and financial resources. The INTB model is a hydrologic model of the major surface and ground-water processes within an area encompassing 4,000 square miles, located predominantly north and east of Tampa Bay. The simulation code Integrated Hydrologic Model (IHM) is the foundation on which the INTB model is built. Through the unique integration code of IHM, the surface-water simulation code of HSPF interacts with the ground-water simulation code of MODFLOW to dynamically simulate the major hydrologic processes in a manner which approximates the physical system. For the INTB model, HSPF simulates land processes at a 15-minute time step and surface-water routing through water bodies at a daily time step, while MODFLOW simulates ground-water processes at a daily time step. Surface and ground-water processes are sequentially integrated at a sub-daily time step. Three near-term focus regions of the INTB model include Consolidated Wellfields, Upper Hillsborough, and Springs. Identification of these near-term focus regions informed the calibration process regarding level of effort devoted to calibration relative to other regions.

The conceptual basis for the surface hydrology of the INTB model domain is influenced by the characteristics of rainfall and evapotranspiration (ET) stressors, land use, land cover, and soils, spatial and temporal variability of depth to water table and streamflow, the presence of irrigation flux and pumping or diversions of surface water, and the storage and discharge properties of the water bodies. Annual rainfall varies from 30 to 80 inches with a mean of approximately 52 inches. A majority of the rainfall volume is contributed by convective storms. This characteristic of rainfall requires a relatively high density of rainfall gauges (300) to capture the rainfall volume over the model domain and requires model input of rainfall intensities at a time step of 15-minutes or less to capture the temporal scale of infiltration / runoff processes that is consistent with the physical system. Spatial distribution of rainfall was completed using Thiessen polygons. The Hargreaves method was used to develop a time series of reference ET which is converted to potential ET for input to HSPF. Spatial variability of potential ET is small at annual scales but has greater variability at the daily scale due to local cloud cover. Temporal variability of potential ET is significant from summer to winter months. The average annual actual ET is estimated to be 37 inches or 70% of the average annual rainfall of the region. Spatial variability in actual ET is due to differences in land use or cover, soils, depth to water table, and density of water and wetlands. Temporal variability in actual ET is due to changes in plant phenology, potential ET, antecedent moisture, and depth to water table. Across the INTB model domain, actual ET varies from 15 to 55 inches per year, primarily due to land cover differences. On a long-term basis, one-third of the actual ET is derived from water and wetlands.

The diverse land cover causes very different hydrologic responses for the same rainfall input which requires distinct simulation units to reproduce hydrologic responses. All water bodies (i.e., wetlands, lakes, streams with floodplains) are included in the INTB model to provide necessary volume for storage attenuation of surface runoff, to provide appropriate spatial and temporal contribution to the ET budget, and to provide appropriate magnitude and spatial distribution of flux interaction between water bodies and the ground-water system. Spatial differences in soils result in differences in vadose zone storage, surficial aquifer specific yield, and thickness of the capillary zone which influences integration processes. It is estimated that over 50% of the model domain frequently experiences near-surface (0 to 2 m) depth-to-water table conditions. Streamflow variability ranges from gauged flow which never goes dry, because of upstream spring discharge or relatively high ground-water inflow, to gauged flow being dry for more than 50% of the time. Seasonally, highest streamflow occurs during the summer and lowest streamflow occurs during the spring.

The surface-water system is discretized separately for land and water / wetland processes which are compatible with HSPF. The entire domain is discretized into 172 basins. Within each basin, up to five land segments or hydrologic response units have been identified based on a generalized land use or cover classification. Within each basin, water bodies have been placed into one of three types of routing reaches. All isolated wetlands and lakes are put into the conditionally-connected reach of the basin while all streams, lakes, and wetlands that are connected to the stream network are put into either the connected reach of the basin or into a routing reach. Routing reaches are used to represent the main collector streams and rivers. Water levels in isolated wetlands and lakes must reach a pop-off threshold before discharge can occur. By separating conditionally-connected from connected water bodies, storage attenuation and discharge timing are more appropriately simulated when compared to observed streamflow discharge. The grid cells of MODFLOW are intersected with the land segments and reaches of HSPF to create IHM land fragments and water-body fragments which are used to dynamically transfer flux and storage between HSPF and MODFLOW through aggregation and disaggregation processes. Land fluxes are routed to reaches which route the water from inland reaches to coastal reaches through a reservoir routing process.

The ground-water flow system is divided into three hydraulically distinct yet connected units. The surficial aquifer system (SAS) is the top-most unit, composed of unconsolidated sand, silt, clay, and organic matter, which has storage coefficient on the order of 0.10. The primary function of the SAS is to provide storage to the upper Floridan aquifer system (UFAS) located below; the low hydraulic conductivity of the SAS promotes mostly vertical flow between the surficial and Floridan systems. Underneath the northern two-thirds of the SAS, the intermediate confining unit (ICU) forms a semi-confined barrier to vertical flow between the SAS and the UFAS. Underneath the southern one-third of the SAS, the intermediate aquifer system (IAS) is present with low hydraulic conductivity relative to that of the UFAS. The UFAS is the production aquifer for the region with relatively large hydraulic conductivities, especially upgradient of spring discharge locations. For most of the INTB model domain, the UFAS is semi-confined with storage coefficient on the order of 1e-3. However in the springs region (north) of the model, evidence suggests that the UFAS is unconfined with storage coefficient similar to the SAS. Inter-aquifer head data, lithologic data, and aquifer performance tests results provide evidence that the SAS and UFAS interchange flow under varying degrees. Large head differences and low leakance values indicate the SAS and UFAS are poorly inter-connected in some parts of the domain and the flow exchange is always downward. Over most of the domain, relatively good inter-connection is evident with flow being downward except in coastal areas and along major segments of rivers. Thickness of the SAS varies spatially. Generally, the ICU / IAS thickens and the top of the UFAS dips from north to south.

The aquifer system is descritized vertically into three layers, SAS, ICU / IAS, UFAS, and spatially into grid cells varying from one-quarter mile on a side in the center of the grid up to one mile on a side at the edge of the grid. Ground-water pumping is a significant part of the water budget (2.7 inches per year). Boundary conditions for the SAS include no-flow on all sides (due to low hydraulic conductivity) and constant head in the Gulf of Mexico and Tampa Bay to simulate upward discharge from the UFAS. The eastern and northern boundary condition of the UFAS is also no flow which is aligned with a hydrologic barrier in the aquifer. The southern and southeastern boundary condition is represented by a head-dependent flux boundary. A constant head condition is set in the southwest to represent equivalent freshwater head. Contours of the UFAS potentiometric surface provide valuable information about locations of relatively low and high transmissivity and transitions in transmissivity and indicate locations of recharge and discharge and regionally significant mounds in the flow system.

Calibration of the INTB model is nearing completion as of June 2008. Calibration of the model is being performed iteratively using manual methods and a numerical tool called Parameter ESTimation or PEST. The manual calibration period spans from 1989 through 1998. Model parameters are manually modified, in an iterative manner, to move toward reproducing observed responses in SAS and UFAS heads, inter-aquifer heads, streamflow, spring flow, and ET. However, regionally consistent parameterization has also been an objective of the calibration process. The PEST calibration period is limited to years 1996 and 1997 due to numerical computing limits. Shape and orientation of parameter zones are changed manually for PEST runs while PEST modifies the magnitude of the zone during numerical processing. Calibration alternates between manual and PEST modes. The final version of the model will be the result of manual adjustments to the PEST parameter results. Calibration targets include quantitative observations and qualitative information. Parameter sensitivity and uncertainty has been quantified for the model results available at this time which indicates acceptable results with minor exceptions that will be addressed before calibration is completed.

Draft results of the calibration were presented. Dr. Geurink felt that the results indicated good agreement with the observations of heads, streamflow, spring flow, and target ET. Based on goodness of agreement between the simulated and observed UFAS contours, Dr. Geurink felt that the flow system of the UFAS is well characterized by the integrated model. Error statistics at well locations indicate the model captures the dynamic behavior of the SAS and UFAS at dry, normal, and wet conditions and this behavior is consistent across the model regions. Dynamic conditions of spring flow are well characterized. Spring flow is slightly under simulated at some locations. Dynamic conditions of streamflow are also well characterized. Generally, streamflow volume is under simulated by less than 10%. Simulated actual ET agrees well with target ET. Dr. Geurink explained that the results presented are draft with simulated conditions expected to improve in some areas.

The next regular LTPRG meeting is scheduled for 9:30 AM on August 5, 2008 at SWFWMD's Tampa Service Office.

AGENDA

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1. April meeting follow-up

2. Miscellaneous updates
   - Lake MFL Update

3. 2008 MFL update (Michael Hancock, SWFWMD)

4. Conceptual Basis and Calibration of the Integrated Northern Tampa Bay Model (Jeff Geurink, TBW and Ron Basso, SWFWMD)

5. Issues for next Meeting – August 5, 2008