Peer Review of the Regional Simulation Model (RSM)

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Intersection of Urban Area and the Everglades, looking west from Central Broward County
Source: D.A. Chin

Submitted to

Office of Modeling
South Florida Water Management District
West Palm Beach, Florida

23 September 2005

Executive Summary

The South Florida Water Management District (SFWMD) is developing a new model to simulate regional water movement in South Florida. This model, called the Regional Simulation Model (RSM), is a significant improvement over the currently used South Florida Water Management Model (SFWMM). Key advancements include more efficient computational algorithms, better spatial resolution using irregular triangular cells instead of a regular square grid mesh, more transparency to client users, and an object-oriented programming approach that provides greater flexibility for further model development. There is currently no commercially available model that has all the features planned for the RSM, and this model should be ideally suited for regional simulation of water movement in the mixed agricultural, urban, and natural environment of South Florida. The RSM is capable of simulating a wide variety of hydrologic, hydraulic, and water-resource processes and applying the complex set of operational rules and conditions that are unique to water management in South Florida.

After reviewing the RSM model documentation, supporting references, and the SFWMD responses to a draft of this report, several recommendations for further improvement of the RSM are made in this final report. These recommendations address aspects of the RSM formulation that need to be reassessed, concerns regarding the applicability of the diffusion-wave model formulation in some parts of the water-management system (particularly in coastal areas and canals), suggested improvements in the numerical solution technique, and concerns about the formulation and validity of some hydrologic process modules. There is a particularly urgent need to validate the RSM in South Florida and include results of pending validation studies in the model documentation. As application of the model in South Florida develops, it is anticipated that inefficiency of the numerical-solution algorithms will become a major issue, giving development of more robust solution methods a heightened priority. Coupled application of the management simulation engine (MSE) to the Hydrologic Simulation Engine (HSE) appears very promising but will need to be demonstrated.

Model documentation in its current draft form needs significant improvement in organization and content, particularly in describing model assumptions, numerical solution procedures, model-calibration methods, control of numerical errors, and model-validation techniques and results. Panel discussions with SFWMD staff indicate that a plan has been developed to improve the array of overview materials, technical reference papers, user manuals, implementation application reports, and background material an better organize them into a cohesive RSM Documentation Set. The improved documentation will greatly help to highlight current features of the model and its suitability for application in South Florida.

The SFWMD is proceeding towards the development of a state-of-the-art regional water-management model that will address the needs of its clients adequately. This peer-review component provides an important quality-control step in the development of the RSM. The SFWMD is to be commended for including this formative review in the RSM development process and for responding to the questions raised during the review.

1. Introduction

Both surface water and ground water significantly influence the hydrology of South Florida. Any applicable regional-scale model must be capable of conjunctively simulating both of these hydrologic elements and their interactions. The surface-water component must account for stormwater-management systems in urban areas, crop-management and irrigation practices in agricultural areas, natural hydrologic processes in overland-flow areas, ground-water recharge or discharge, and open-channel flow in the extensive canal network. Performance curves and operational rules for canal hydraulic structures also must be considered. The ground-water component of any regional-scale hydrologic model necessarily must simulate the shallow water table that frequently rises above ground level, highly permeable aquifers, withdrawals for water supply, and seepage into and out of surface waters.

The South Florida Water Management District (SFWMD) has developed the Regional Simulation Model (RSM) to simulate the behavior of the water-management system in South Florida. The RSM is a generic regional-scale model particularly suited for simulation of the managed flow conditions in South Florida. The RSM simulates surface-water and ground-water hydrology, interaction between surface water and ground water, flow regulation at hydraulic structures, canal hydraulics, and management of the connected system. The RSM has two principal components, the Hydrologic Simulation Engine (HSE) and the Management Simulation Engine (MSE). The HSE simulates the natural hydrology, water-control features, water-conveyance systems, and water-storage systems. The MSE component is designed to use the hydrologic-state information generated by the HSE to simulate a variety of water-management options, including those presently being used and others planned for future implementation. The MSE is capable of identifying optimal water-management protocols for meeting various water-allocation and hydrologic-state objectives.

Within the HSE, hydrologic process modules (HPMs) resolve the local surface-water hydrology for each cell (or group of cells) in an irregular mesh that covers the entire model domain. Each HPM is unique to a particular type of area; HPMs have been developed for agricultural, urban, and natural systems. The inclusion of HPMs in the RSM accounts for small-scale hydrologic processes and land-use heterogeneity, without having to use an extremely fine mesh in the regional model that would make computations impractical.

The RSM is a significant improvement over the regional-scale water-management model (SFWMM) currently used by the SFWMD. Computational features of the RSM that make this model different from the SFWMM are: inclusion of object-oriented design concepts; new and more efficient computational approaches; utilization of the latest programming languages, Geographic Information Systems (GIS), and databases; improved spatial resolution using triangular instead of square grid cells; and minimization of hard-coding of hydrologic elements unique to South Florida. Compared to the SFWMM, the RSM is more complex but designed to be more understandable and transparent to users, easier to learn, and more amenable to the development of additional hydrologic modules by client users.

A review of the RSM development is provided in this report. The eight goals of this review were to: (1) assess the scientific soundness of the model; (2) assess the conceptual framework of the model; (3) identify appropriate use of the model; (4) make suggestions for modifications and improvements to the model; (5) assess the model documentation; (6) suggest validation tests for the model; (7) suggest validation tests for the HPMs in the model; and (8) assess the suitability of the model for meeting client goals. This report provides a detailed assessment of the RSM, with each review goal addressed in a separate section.

The assessment described in this report is based on model and support documentation provided to the peer-review panel prior to 22 June 2005, an interactive workshop with SFWMD staff and RSM developers in West Palm Beach on 22-23 June 2005, a helicopter and airboat tour of the SFRSM area, and follow-up correspondence between the model developers, SFWMD staff, and the peer-review panel until 23 September 2005. Draft version 1.3 of this review report was submitted to the SFWMD on 15 July 2005. The SFWMD subsequently reviewed the draft report and provided a response to the Panel on 19 August 2005. The SFWMD staff is to be commended for their thorough and forthright consideration and assessment of Panel recommendations in the draft review report. The Panel evaluated the Draft District Response Document and revised their draft review report to produce this final version. This final report, submitted to the SFWMD on 23 September 2005, reflects responses to Panel questions raised at the interactive workshop and responses to Panel recommendations contained in the Draft District Response Document. This peer-review report is intended to provide formative input to assist the SFWMD in development of the RSM. The comments in this report do not necessarily apply to later versions of the model, documentation, and subsequent applications.

2. Scientific Soundness of Model Approach

The goal of this section is to assess whether proper and sound scientific approaches were used in the development of the RSM, and to verify that there is a self-correcting open process in place for continued assessment of scientific development.

2.1 General

It was difficult to assess conclusively the scientific soundness of the RSM from the vast amount of information provided by the SFWMD. The draft documentation, referred to as the Theory Manual, did not present a complete cohesive description of the model. The current draft of the model documentation does not provide adequate coverage of the equations solved by the model and the numerical techniques used to obtain their solutions. The descriptions of validation examples for the current version of the RSM were insufficient. However, a significant amount of supporting information in the form of journal articles, unpublished papers, online documents, and written responses to both pre-workshop peer-review comments and a draft of this report were provided to the Panel. Based on this information, the Panel has attempted to assess the scientific soundness of the model.

The excellent proposal by the SFWMD to add a figure illustrating the RSM Documentation Set to the inside front cover of all RSM-related documents should help apprise potential client users of all available references and direct users to the correct information source for insight beyond that provided in the Theory Manual. An integrated illustration that identifies the array of published journal papers, unpublished "white" papers, and electronic documents describing the conceptual development, formulation, and use of the RSM will better serve the SFWMD in representing the model formulation to the South Florida scientific community and client users. The interim draft status of the RSM Theory Manual provided to the Panel and the variety of separate reference documents spanning the multi-year model development period, identified for use by the Panel, presented unnecessary review distractions and complications, making it difficult for the Panel to readily assess the model formulation and determine the precise model status. Potential client users likely would suffer the same frustrations given the identical draft of the Theory Manual and collection of RSM reference documents. These shortcomings of the RSM documentation should be corrected upon implementation of both the Panel recommendations for improving the Theory Manual, presented below in the Documentation section and the SFWMD action plan to compile, revise, and illustrate the full RSM Documentation Set. A major improvement in the quality of the RSM Theory Manual will be achieved upon removal of the six journal and white papers reproduced in Appendix C, with pertinent content incorporated directly into appropriate chapters and linked together in the Theory Manual.

2.2 Basic Equations and Formulation

The ground-water component of the RSM assumes that the subsurface geology is isotropic. The validity of this assumption throughout the model domain in all applications of the model is questionable. For example, secondary solution cavities certainly will be oriented in the direction of historical flows, leading to anisotropic hydraulic conductivities and transmissivities. It is recognized that the assumption of isotropy is usually necessary due to lack of data, and might be a reasonable assumption in many applications of the model. However, if anisotropy cannot be incorporated into the model, then the validity and limitations of assuming isotropy should be stated clearly in the Theory Manual. The SFWMD modelers are aware of the potential limitations of assuming isotropic properties and plan to explore the inclusion of anisotropy in a future version of RSM.

The canal seepage watermover is based on the following linear relationship between seepage rate per unit length of the canal, q_l, and the difference between the water-surface elevation in a canal, H_i, and the water table elevation adjacent to the canal, H_m (Equation 2.40 in the Theory Manual):

$$q_l = \frac{k_m p}{\delta}(H_i - H_m)$$

where k_m is the sediment-layer conductivity, p is the perimeter of the canal, and δ is the sediment-layer thickness. This equation is applicable for describing canal seepage only where a sediment layer exists, and only in the case of a very fine grid will the adjacent grid cell provide a reasonable estimate of H_m. In most canals in South Florida, a sediment layer does not exist on the sides of the canal and this is where most of the seepage occurs. In such cases, canal seepage in numerical models is best estimated using a reach transmissivity (Chin, 1991). In the reach transmissivity formulation, canal seepage, q_l, is expressed in the form

$$q_l = \Gamma(H_i - H_m)$$

where Γ is the reach transmissivity, H_i is the water-surface elevation in the canal segment, and H_m is the water-table elevation in the adjacent grid cell. Since the reach transmissivity, Γ, is a function of where H_m is measured, then Γ necessarily must be a function of the grid size.

Coupling of overland and ground-water flow in the RSM currently assumes continuity of head for the overland and ground-water domains, since there is only one head value computed for each waterbody. Other approaches exist to couple surface and subsurface flow, for example by assuming that the head in the overland and subsurface-flow domains can be different in a single finite-difference cell (which is the analogue of a waterbody in the RSM). In that case, the overland and ground-water domains are linked by a fluid-flow term, similar to that currently used in the RSM to link a canal and a cell (see Equation 2.40 of the Theory Manual). The SFWMD modelers could explore the need for modifying the RSM to use this other coupling approach. Coupling the overland and ground-water domains with this linking term, and computing two different head values, can produce simulations in which the overland domain is recharging the ground-water domain, ground water recharges the overland domain, or where there is ponding of surface water on top of an unsaturated zone. The documentation does not provide evidence that such exchange of flow between domains can be as readily simulated with the current head continuity assumption in the RSM. Discussions with the SFWMD modelers indicate that HPMs could be used to allow the simulation of ponding conditions, but that capability has not been demonstrated. Another potential advantage of solving for two head values per waterbody is that different time steps could be used to solve the overland and ground-water flow equations, if needed.

The SFWMD states that part of the reason overland and ground-water head discontinuity was not considered in the RSM development was to maintain compatibility with the previous application of the SFWMM. Progress in RSM development and the SFRSM application appears to be hampered by the constraint to maintain SFWMM compatibility. Moreover, the justification presented in the SFWMD response to Panel concerns about the continuity of overland and ground-water head assumption seems to overemphasize the need for improved computational speed potentially at the expense of RSM generic utility and/or proper replication of potential head differences in the SFRSM application.

The RSM Theory Manual does not discuss explicitly how the RSM accounts for conservation of momentum in the transition between surface and subsurface flow. For example, this should be analyzed in cases where one cell has overland flow and an adjacent cell does not, how is the conservation of momentum considered? The panel understands that there is an option to provide a plot of the transmissivity and the conveyance with water level as input to the RSM. However, the need for such input and its implications should be clarified in the Theory Manual.

Many of the watermovers in the Hydrologic Simulation Engine (HSE) are formulated in terms of the Manning equation, which strictly is applicable only to fully developed turbulent flow. In some cases in the HSE, the Manning equation likely will be used to describe overland flows that are either mixed turbulent-laminar or laminar. In practice, the term "effective roughness parameter for overland flow" is often used, and *N* is substituted for *n* to indicate that the flow is not fully turbulent. Since many of the potential overland-flow applications of the model are not fully turbulent flow, it is recommended that *N* be used instead of *n*. The SFWMD agrees to adopt the Panel recommended terminology and variable notation.

In the formulation of the linear form of Manning's equation, the square root of the energy slope is moved inside the denominator of the matrix coefficient and a minimum value of this slope is required to prevent numerical instabilities. The Panel understands this and agrees that it is a reasonable approach. However, there is concern about the wide range of values for this minimum, which ranges from 10^{-7} to 10^{-13}. This artifact of the linearization process requires an expanded explanation of why that range was chosen and the practical implications of this restriction.

2.3 Diffusion-Wave Approximation

Local and convective acceleration (inertia) terms are neglected in watermover equations that simulate overland and canal flow. These watermovers use a special type of diffusion-wave approach where the volume flux is proportional to the head gradient. Omission of the local acceleration term limits RSM to the simulation of slowly varying transients, and neglecting the convective acceleration term limits the ability of RSM to simulate spatial variability in flow conveyance accurately. The diffusion-wave approach is suited for overland flow in steep to mild slopes, making it compatible for use in most inland flow systems and water bodies in South Florida under most conditions. Exceptions arise where and when inertial effects are significant. Flows in coastal areas influenced by tides cannot be simulated by the diffusion-wave approximation, due to the importance of the local and convective acceleration terms. The Panel recognizes that tides are limited to coastal zones and the time step of one day currently used in the RSM is incompatible with treating tidal stresses. The panel further recognizes that there is a natural check against using diffusion-flow models (such as the RSM) under dynamic conditions where the model is not applicable, since such applications tend to become unstable when the diffusion-wave approximation is violated. Inertial effects in flows through structures also could be significant, depending on the structure-discharge rate, the converging and diverging channel geometry at the structure, and the nonlinear behavior of the structure. This condition is of less concern when inertial effects at structures are incorporated in structure flow equations and in cases where local high-flow velocities have limited effects on regional flows.

The diffusion-wave applicability criteria used in the RSM (Ponce et al., 1978) should be qualified as an extension from one-dimensional to two-dimensional flow. Although the convective and diffusive properties of one-dimensional surface flow are well known, the same is not true for two-dimensional surface flows. For instance, how the diffusivity in one dimension (Ponce, 1989) is resolved in two dimensions is uncertain.

In one-dimensional canal flow, the use of lookup tables in the RSM renders the simulation kinematic and, therefore, not subject to physical diffusion. Any hydrograph diffusion manifested in the simulation would necessarily be a function of grid size (Cunge, 1969). Therefore, an assessment should be made of how the use of lookup tables is reconciled with the diffusion-wave assumption, which has built-in physical diffusion through hysteresis in the rating. This is not likely to be an issue for South Florida applications of the RSM, where the SFWMD does not plan to implement the lookup-table option.

In summary, adopting the diffusion-wave approach for RSM development imposes some limitations on the use of RSM in South Florida. However, this concern must be balanced with experience, which suggests that the diffusion-wave assumption is reasonable for simulating regional overland flows in South Florida under most conditions. Nonetheless, potential client users must be cautioned about limitations of the RSM stemming from the diffusion-wave approximation. The RSM model developers agree with the Panel recommendation to caution potential client users about diffusion-wave assumptions, and the Panel welcomes their proposal to state these clearly under RSM Limitations and Assumptions in the RSM documentation.

2.4 Numerical Methods

The solution of all watermover and waterbody equations in the HSE is integrated into one global matrix as opposed to sub-matrix solutions coupled by boundary fluxes. According to the SFWMD modelers, the Petsc matrix solver used in the model is very efficient in solving the global matrix for current applications. Although it does not appear to be the case currently for regional simulations in South Florida, there is concern that this approach could cause the model to grow too numerically intensive as the mesh size is refined or the size and complexity of the model domain increases. The diagonal dominance of the global matrix likely will be diminished as the number of canal segments increases and a greater number of sophisticated water-control structures are added, potentially requiring an increased number of iterations for convergence. Sixty percent of the processing time in the RSM application to South Florida (SFRSM) is expended in matrix inversion and 40-60 iterations are required for convergence. The numerically intensive computational performance of the SFRSM, which is still under development, appears excessive and is likely a symptom of increasing system complexity and/or linear assumptions made in the RSM. Typically, the factors that increase the computational run times of numerical models are the nonlinear terms, which are not included in the diffusion-wave approximation of the RSM. The SFWMD model developers respond that a global solution requires a very good sparse matrix solver, such as the Petsc solver presently used, and that HPMs are designed to deal with some of the complexities and nonlinearities in the system. The developers indicate that other approaches for dealing with nonlinearities are under consideration, including HSE iterations. The SFWMD action plan also calls for the development of implementation strategies. The Panel views these proposed actions as vital to addressing the numerical solution run-time issue.

The use of an implicit versus explicit numerical solution scheme is a tradeoff that needs to be assessed judiciously. Implicit schemes ($0 < \alpha \leq 1$) are usually unconditionally stable, whereas explicit schemes ($\alpha = 0$) are not. Therefore, if stability is an issue, an implicit scheme is preferred. However, in numerical modeling, stability is usually achieved at the expense of convergence (O'Brien et al., 1950). Once the focus shifts from stability to convergence, an explicit scheme can compete effectively with an implicit scheme. An explicit scheme usually will achieve convergence at the same time as stability, whereas an implicit scheme might be stable throughout a wide range of grid resolutions, while remaining nonconvergent for some subrange. Therefore, it should not be assumed a priori that implicit schemes are altogether better than explicit schemes. The objective in the RSM numerical solution technique should be to seek a balance between stability and convergence, and not to pursue one at the expense of the other. This balance should be obtained through the simultaneous minimization of round-off and truncation errors (O'Brien et al., 1950). The use of a fully-implicit model ($\alpha = 1$) as the default case for numerical solution is justified only when results of sensitivity analysis clearly show improved stability without undue sacrifice of convergence. This problem is not unique to the RSM, and can be found in other widely-used models such as MODFLOW. It is recommended that the tradeoffs between the use of $\alpha = 1$ and that of more convergent values ($\alpha < 1$) continue to be investigated and reported by the RSM developers.

The Panel acknowledges and recognizes that Manning's *n* and α values are not fixed in the RSM code, which is the typical approach used in model design and development. Considerable open discussion occurred in the Interactive Workshop held 22-23 June 2005 during which appropriate and reasonable Manning's *n* values were suggested for wetland sheet-flow conditions in South Florida (refer to Meeting Notes of 2:34 PM June 23, 2005). Interactive Workshop discussion also occurred on the topic of the α weighting factor and its affects on simulation behavior (refer to Meeting Notes of 1:54 PM June 22 and 4:47 PM June 23, 2005), during which time sensitivity testing with the α factor was recommended by the Panel. The Panel did not imply that SFWMD model developers used Manning's $n = 1$ and a weighting factor of $\alpha = 1$ to hide numerical instabilities in the model as suggested in the Draft District Response Document. The greater energy dissipation effects of large resistance values and the wave suppression effects of weighting factors approaching a value of one are well known in engineering practice, as acknowledged in the Draft District Response Document. The Panel's recommendation to the SFWMD model developers was that sensitivity testing on both conditions be conducted so that effects on model results could be investigated, demonstrated, and reported for the benefit of potential client users. Moreover, the observation made in the SFWMD's response summary that structure nonlinear equations are more likely the cause of numerical instabilities than overland flow equations should be discussed and illustrated in the RSM documentation. In the Draft District Response Document, contradictory comments are made regarding the issue of α in controlling stability. One comment indicates that an increase in α had limited success in controlling instability or oscillations as more complicated nonlinear equations were added because the diffusion flux terms were not the source of the instability, while another comment states that the α value was left at almost 1.0 to keep the model non-oscillatory. Some discussion, explanation, and clarification about this are needed in the RSM documentation.

There should be an option in the model to evaluate waterbody mass-balance matrices with updated H values, which does not appear to be possible in the current version of the RSM. As described in Equation 2.47 of the Theory Manual, it appears that matrices A and M on the left-hand side of the equation are evaluated with previous head values at time n, rather than updated values at time n+1. The latter approach has the potential to introduce numerical difficulties in the simulation when the MSE is coupled to the HSE. Undocumented analyses conducted by the RSM developers indicate that the error generated by the use of previous head values was smaller than the discretization error. Their proposed action plan calls for revisiting this issue when addressing rapidly varying diffusion flows and dynamic flows.

2.5 Hydrologic Process Modules

The panel is satisfied that the runoff curve number method is being used in a continuous-simulation mode by adjusting the value of maximum potential retention (S) based on the available soil-moisture storage. While the method's developers did not intend it to be used outside of event modeling (see http://mockus.sdsu.edu), it is correct to state that the method has been extended, by default and by practice, to the continuous simulation arena. The key is to do it carefully and transparently.

The <agimp> module uses the V-notch weir equation to calculate the angle of the V-notch weir to be used in the compound-weir equation. The module should place limitations on the calculated notch angle, since the assumed relationship is not valid for all angles and heads and some weir angles might not be practical. In cases where an impractical V-notch weir is selected by the <agimp> module, a circular orifice might be a better selection. The Panel understands that the SFWMD plans to modify the <agimp> module to check impoundment discharges and select the appropriate discharge structure.

The <unsat> module assumes that evapotranspiration (ET) is zero when the water depth is greater than the root depth (Equation 13). This formulation is questionable since it has been demonstrated that evaporation can still be significant well below the root depth (Chin and Patterson, 2005).

3. Conceptual Framework

The goal of this section is to assess whether the conceptual framework of the model contains all of the important hydrological processes necessary to do regional-scale modeling in South Florida.

In most regional-scale models, it is commonplace for the potential evapotranspiration (PET) to be calculated based on climatic input such as maximum and minimum temperature. The SFWMD should consider incorporating the calculation of PET into the RSM, rather than specifying it as input data, especially since there are fairly simple relationships currently in use to estimate PET. PET might vary temporally in a long-term model application, particularly as land-use changes and ecosystem-restoration practices are implemented. Furthermore, the inclusion of PET calculations in the model would allow the simulation of climate-variability scenarios. If historical PET estimates were derived using different methodologies than those incorporated in the RSM, then it would be appropriate to include the historical PETs as input. In addition, if computation of PET within the model significantly increases the run time or it is desirable to apply a fixed PET to several models, then calculation of the PET outside of the RSM would be justified. The Panel concurs with the SFWMD response to consider PET calculation inside the model as a future enhancement.

The Management Simulation Engine (MSE) is essential for developing management protocols for the complex operations of the main hydraulic structures in South Florida. This well-documented component of the RSM is designed to optimize operation of hydraulic structures to achieve some desired outcome. Given the constraint of a daily time step in the SFRSM implementation, it is problematic to translate the MSE-recommended daily-averaged operation of hydraulic structures to their sub-daily operation. The MSE is still under development and its effectiveness in achieving water-management objectives will need to be demonstrated. Operational features of the hydraulic structures could potentially be modified to incorporate the MSE algorithms, thereby producing a much more efficient water management system in South Florida.

The shear-stress effects of winds on surface flows are not accounted for in the RSM. Slowly varying flows are potentially subject to wind forcing that could cause setup, particularly in sparsely vegetated wetland sloughs, in lakes and reservoirs, and in canal segments between water-control structures. Given that wind forcing is not accounted for in reservoirs and lakes, this omission could be particularly problematic in the SFRSM implementation, as Lake Okeechobee is treated as a reservoir. Wind effects on Florida Bay are an important forcing mechanism, producing backwater effects along the coast. The present conceptual framework of the RSM excludes treatment of wind-stress forcing in all watermovers. The Panel recognizes that the effects of wind stress on regional-scale water surface elevations is likely to be small, and that the RSM provides the same wind stress functionality as the currently used model, the SFWMM. The SFWMD should remain open to including wind stress in the RSM if future experience indicates that such a refinement is necessary.

Conveyance in sloughs traversing overland-flow cells is not accounted for; sloughs are treated simply as surface depressions in the storage-volume relationship of the RSM. Representation of the ridge and slough wetland landscape needs to be factored into the mesh-generation and flow-simulation processes. Similarly, patchiness in vegetation density can lead to heterogeneity and anisotropy in conveyance. The SFWMD plans to conduct research into implementing transmissivity and conveyance as tensors or design detailed HPMs to capture resistance heterogeneity.

The RSM simulates hydrologic responses to a time-varying climate in a static physical system. Although this approach might adequately address a variety of water-management objectives at the present time, historical trends indicate that land use constantly changes as agricultural land is converted to urban use, marshes, or reservoirs. Such land-use changes should be accounted for in future versions of the RSM, in which case the following RSM capabilities would be desirable:

- The land-surface mesh configuration and definition in the HSE of RSM are dynamically adjustable to account for topographic and physical changes during the course of a simulation.

- Physical changes due to natural catastrophic events such as wetland fires and hurricanes are treated by dynamically varying the RSM mesh configuration and applicable parameters.

- Structure, levee, and canal configurations are dynamically adjustable during long-term simulations.

It is relevant to note that there have been a number of the above-mentioned physical changes to the system during the 1965-2000 simulation period.

The SFWMD plan to clarify the purpose and scope of the RSM in the Theory Manual and Fact Sheet should aid in representing the model's capabilities to the South Florida scientific community and client users. According to the Draft District Response Document, the RSM was originally envisioned to simulate hydrologic responses, e.g. changes in water levels and flows, in a static physical configuration, using a time-varying climatologic input (rainfall and ET) and to a limited extent, time-varying structure operating rules over a 36-year simulation period. The fact that the RSM is not a succession model, capable of incorporating dynamic changes in the physical configuration, is an important distinction to note in the Theory Manual and other RSM documentation as appropriate. Moreover, it might be appropriate to recognize that one of the primary purposes of the RSM in the SFRSM application is to conduct regional long-term scenario testing for hydrological and ecological assessment of restoration design and operational system modifications.

4. Use of Model in South Florida

The goal of this section is to identify appropriate use of the RSM in South Florida.

A calibrated and validated version of the RSM should be appropriate for simulating the current water-management system in South Florida. However, considerable work remains to be done at the SFWMD to successfully transition from the SFWMM to the SFRSM. A thoroughly calibrated and validated SFRSM should be more useful than the SFWMM in simulating various alternatives for restoration of the Everglades and for assessing water-supply and flood-control measures in South Florida. This increased utility is due to improved process and hydraulic-structure representations and increased spatial resolution. The success and validity of the RSM in South Florida (SFRSM) will need to be demonstrated in a subsequent peer review planned for 2006, upon full implementation of the SFRSM.

For canals of nearly zero bed slopes, such as those in South Florida, the only way to induce flow is to force a depth gradient mechanically, which might incorporate some inertia. This flow is unsteady, and the Manning equation is not able to account for the unsteadiness and associated convection and diffusion properties of such a wave. There is an urgent need for a theoretical analysis to identify the convective and diffusive properties of such waves and to build the canal model on these premises. Barring this analysis, an alternative is to implement full dynamic-wave modeling in the canals with all the attendant nonlinearities, which will likely impose associated additional data requirements and numerical computations. The RSM model developers propose additional benchmark and field tests to determine if full dynamic-wave capability might become necessary to implement.

The computational domain of the RSM in the SFRSM application includes the tidally dominated mangrove ecotone along the southwest Gulf coast between Cape Sable and Ten Thousand Islands. Use of the RSM in coastal areas is not justified within the context of the diffusion-wave assumption, and the computational domain of the SFRSM should not be publicized as including the tidal transition zone. The SFWMD response to the Panel's objection to inclusion of the coastal mangrove ecotone in the SFRSM domain identified two options for treatment of the boundary interface between overland flow with the tidal transition zone. The two options were to either terminate the SFRSM domain at the boundary interface, which would require development of a suitable boundary condition at the interface, or to extend the SFRSM domain through the tidal transition zone, which requires determination of a suitable boundary condition at the coastline. The option chosen was the extension of the SFRSM domain to include the tidal transition zone. In this approach, erroneous model results in the tidal transition zone must not be published and presentations illustrating the SFRSM domain should not include the mangrove ecotone, as agreed in the Draft District Response Document.

The approach used by the SFWMD to develop the coastal boundary condition in the SFRSM application is unknown and undocumented. One approach to developing the coastal boundary condition could be to subtract tides from a local (NOAA or other) long-term tidal record using either a tidal decomposition technique or a simpler 24-hour running average filter. Whatever approach is used in the SFRSM application to accommodate flow computation up to the overland/tidal boundary interface should be thoroughly documented and restrictions on RSM use in tidal areas should be clearly identified in all model documentation.

5. Modifications and Improvements

The goal of this section is to suggest modifications and future improvements to the RSM, including suggestions for improved computational methods and future model-expansion ideas.

With such a large number of canals in South Florida, and given the long simulation period, both rainfall and ET should be included in the canal water balance. This is simple to implement, and it should improve model accuracy slightly. The necessity of implementing rainfall and ET in the canal water balance certainly increases as the model domain size decreases yielding increased resolution. This is likely in future applications of the generic RSM.

If an objective of the RSM is to simulate the extent of surface flooding, consideration should be given to using a GIS model component to improve spatial resolution of the distribution of water on the land surface. The water-surface elevation calculated for each cell by the RSM could be combined with more detailed sub-cell GIS land-surface elevation coverage to refine estimates of the spatial extent of flooding.

The RSM solves all equations for regional flow simultaneously. The formulation of the surface-water, ground-water, and canal-flow equations into a coupled-matrix solution forces the simulation to be conducted at a unique time step for all waterbodies within the system. Ideally, flow conditions in the most dynamic waterbody should govern the choice of time step. Otherwise, unnecessary flow computations might be carried out for other waterbodies. For instance, ground-water flow solutions are typically required much less frequently (daily stress periods) than surface-water flow solutions (hourly or smaller time steps). Given that reduced computational run time is a high priority issue for RSM development, decoupling the ground-water and surface-water solutions could be advantageous. The RSM model developers assert that, at present, the use of an efficient sparse matrix solver diminishes the impact of excessive computations associated with using a common time step for the overland and ground-water flow equations. However, RSM model developers note that decoupling techniques might be considered should excessive computation times become an issue in the future.

Consideration should be given to making the time step dynamically variable. It is more computationally efficient and accurate to adjust the simulation time step dynamically to closely match the flow conditions. For example, it might make sense to use longer time steps ($\Delta t > 24$ hours) in dry seasons and shorter time steps in wet seasons ($\Delta t < 24$ hours) and during periods of extreme weather, flow, and control events. During the Interactive Workshop, SFWMD model developers stated that dynamic time stepping was used in the RSM before a recent change in the matrix solver. The model developers indicated that dynamic time stepping might need to be re-implemented (refer to Meeting Notes of 5:13 PM June 22, 2005).

Other numerical enhancements to be considered for future development of the RSM include sub-timing and domain decomposition. Sub-timing has been described in Bhallamudi et al. (2003) for subsurface flow and transport simulation. The objective of sub-timing is, for a single global time step, to take smaller time steps for regions of the domain where flow processes are faster (say the surface) and larger time steps for slow flow regions (for example, the subsurface). Domain decomposition is also attractive for large-scale simulations of coupled surface and subsurface flows that potentially require very long simulation times. It consists of splitting the total flow domain into several pieces or sub-domains (sub-watersheds, for example), solving for flow in each sub-domain individually, and then iteratively linking all sub-domains.

Preliminary applications of the RSM in South Florida have focused primarily on two-dimensional ground-water flow. Intended future applications include more three-dimensional models, particularly in certain regions of the aquifer system. The U.S. Department of Defense Groundwater Modeling System (GMS) software http://chl.erdc.usace.army.mil/CHL.aspx?p=s&a=Software!1 is currently used to construct the triangular meshes for the ground-water component of the RSM. As three-dimensional components are constructed in the future, the subsurface characterization will become more challenging. There are new tools in version 6.0 of GMS (released in July 2005) that should work well with the RSM. These tools are associated with the GMS "Horizons" feature, which makes it possible to use user-defined and interpolated surfaces, in the form of triangulated irregular networks (TINs), to create three-dimensional representations of the complex geologic layering present in some parts of the aquifer system. In addition, Horizons includes tools for incorporation of boreholes and hand-sketched cross-sections between boreholes.

The very nature of South Florida and the complexity of the RSM make this application a classic example of a highly parameterized system. A new parameter-estimation algorithm called SVD-Assist (Single Value Decomposition – Assist) is available to work with highly parameterized systems. Applications of this algorithm have shown remarkable success. SVD-Assist is able to calibrate systems with thousands of parameters in a stable relatively quick fashion. The algorithm can be accessed in the most recent version of the parameter estimation utility PEST (http://www.sspa.com/pest/).

In calibrating the ground-water model, the hydraulic conductivity (K) array is broken into multiple polygons, resulting in abrupt discontinuities in the K values along the polygon boundaries. This method of dividing the K array into subsections seems arbitrary. This is a problem because the original interpolation for K values was performed across the entire model domain. If the RSM developers wish to use a zonal approach, they should first divide the area into polygons and then perform interpolation on a zone-by-zone basis, using only the K point data within each zone. At that step, the multipliers could be applied to zones without violating the integrity of the original interpolation. Another approach to consider is the "pilot point" method in which the modeler defines a series of points in the model area where the K values are allowed to vary during the parameter estimation process. An interpolation algorithm is used at each step to interpolate the K values in the remainder of the grid. Assuming the K values in an aquifer vary continuously, the pilot point method is a simple and convenient way to parameterize a model. If the purpose of the model zonation used by the RSM developers is simply to obtain a low residual rather than to represent specific geologic features, the pilot point method would seem appropriate. This method can be constrained within zones and therefore the interpolation of pilot points can be performed on a zone-by-zone basis during the parameter estimation process. The PEST parameter-estimation program provides a number of tools for performing pilot-point-based parameter estimation.

The eXtensible Model Data Format (XMDF) and Application Programming Interface (API) (http://www.wes.army.mil/ITL/XMDF/) could be used to replace the NetCDF portion of the RSM input/output file format. Based on current experience with XMDF, it is likely that this would result in much smaller file sizes than the currently used NetCDF data format. It would be easy to test this assertion by simply downloading the XMDF library and implementing some function calls in the RSM code. Sample source code is provided in the XMDF documentation.

6. Documentation

The goal of this section is to make suggestions about the model documentation, including whether the level of detail is sufficient, and whether the conceptual framework is clear.

6.1 Organization and Content

The primary documentation for the RSM model is the Theory Manual, which is currently organized into three sections: Introduction, HSE Theory and Concepts, and MSE Theory and Concepts. In addition to the Bibliography, there are three appendices: Appendix A: Regional Simulation Model Philosophy, Appendix B: Governing Equations Using the Traditional Approach, and Appendix C: Selected Publications for Further Reading. The panel recommends the following modifications to the layout of the Theory Manual:

- A “Purpose and Scope” section should be added to the documentation, wherein limitations and restrictions on use of the model, imposed by assumptions in the model formulation, are identified. Potential users should be advised of the types of analyses that can be appropriately conducted with the model and cautioned about inappropriate uses. The SFWMD acknowledges the need for a “Purpose and Scope” section and will incorporate one into the RSM Theory Manual.

- Descriptions of the HSE and HPM should be in separate chapters. The SFWMD agrees that the importance of HPMs warrants their treatment in a separate chapter rather than in an appendix. The discussion of HPMs in chapter 2 (HSE Theory and Concepts) of the Theory Manual will be limited to their conceptual framework and interaction with other HSE objects.

- Appendix A (Regional Simulation Model Philosophy), particularly A.2 (Scope of the RSM), should be included in Chapter 1 (Introduction). The SFWMD intends to remove this material entirely or retain it in Appendix A.

- Appendix B (Governing Equations Using the Traditional Approach) should be part of Chapter 2 (Hydrologic Simulation Engine Theory and Concepts). The SFWMD feels that discussion of the traditional approach is not vital and intends to remove it entirely or retain it only in Appendix B.

- Reference papers should be listed as references rather than reproduced in entirety in the Appendix. The Theory Manual suffers significantly by having technical papers describing critical aspects and concepts related to RSM development summarily attached as report appendices. Concepts vital to documenting the model formulation, guiding use of the model, and investigating potential numerical errors should be excerpted and incorporated directly into the Theory Manual for emphasis, continuity and clarity. The SFWMD agrees with Panel recommendation that refereed journal papers C.1, C.2, C.3, and C.4 should not be appendices in the Theory Manual, but that instead appropriate content should be incorporated into separate chapters in the manual.

  In naming the "References" section, it should be noted that there is a difference between "Bibliography" and "References." "Bibliography" is a list of published works that are related to the topic, but not necessarily quoted in the text. "References" is the list of published works that have been specifically referred to in the text. The Theory Manual would be expected to have only a list of references. If a bibliography is deemed necessary, it should be contained in a separate appendix. The SFWMD agrees that "Bibliography" should be changed to "References".

- The HPM white paper (Appendix C.5) should be assimilated into the main body of the Theory Manual as a separate chapter. According to Draft District Response Document, Appendix C.5 will be incorporated as a separate chapter in the Theory Manual.

- The MSE white paper (Appendix C.6) should be assimilated into the main body of the Theory Manual as a separate chapter. The SFWMD agrees with the Panel recommendation to incorporate Appendix C.6 into the Theory Manual as a separate chapter.

  In the MSE white paper, it should be noted that the models used for comparative analyses with the RSM were not developed with the same purpose and scope as the RSM. Most of the models listed in Tables 1 and 2 of the MSE white paper can be classified as hydrodynamic-simulation models rather than hydrologic-management models. Although these other models are capable of simulating all or part of the South Florida ecosystem, they might not be as efficient and easy to use for water management as the RSM since the main purpose for their development was quite different.

- Uniform document standards should be applied to all parts of the Theory Manual. This would include using the same word processor for all parts of the document. The LaTex typesetting program is clearly superior to other programs when used for large, high-technical-content documents such as the Theory Manual. The SFWMD intends to use uniform document standards in developing future versions of the Theory Manual and the document set supporting the RSM.

- A list of symbols with units of measure would significantly improve the Theory Manual. Defined variables could be limited to those used in equations. The SFWMD intends to add a list of symbols and variables used in the equations to the Theory Manual.

- Consistent terminology should be used throughout the Theory Manual and supporting documentation. A glossary would make the Theory Manual easier to understand and unambiguous. The SFWMD agrees to add a glossary and an index to the Theory Manual.

- A consistent set of units should be used throughout the Theory Manual, either "English units" (which should properly be called U.S. Customary units) or "metric units" (which should properly be called SI units). If both systems are used in the RSM, the Fact Sheet should state so. Both systems of units should be used if the model is going to be applied outside of South Florida. According to the SFWMD, "SI" and "U.S. Customary" units will be used throughout the documentation.

The Panel commends the SFWMD for developing plans to reorganize the Theory Manual in response to most of the above recommendations. Furthermore, the SFWMD has proposed a RSM document set that should provide adequate supporting information for users to understand the formulation and application of the model.

6.2 Hydrologic Process Modules

Many of the equations used as a basis for the HPMs are heuristic and have not been validated in the field. Although this does not rule out using these equations, the lack of validation and references to validation studies should be made clear in the documentation. In general, HPM validation experiments should be reported in the section where the basis of the HPM is described.

Many of the parameter values suggested for use in the HPMs are presented without references describing the contexts in which the parameters were derived. All tabular presentations of suggested parameter values should have a "References" column.

6.2.1 <unsat>

This HPM uses different equations depending on the elevation of the water table relative to ground surface. Whereas the equations appear to be reasonable approximations to reality, the documentation and assigned variable names indicate that "water depth" is being compared to "surface elevation". Variable names and document terminology should be changed to differentiate between depth and elevation.

6.2.2 <layer5>

The symbols Θ_{cap} and Ew are both used to represent the extractable water in the soil column. To avoid confusion, one or the other variable should be used.

6.2.3 <prr>

The suggested values for the maximum infiltration rate, K_{0inf}, in Table 4 of the HPM white paper are off by at least an order of magnitude. The results of Chin and Patterson (2005) for Miami-Dade could be used as one reference for estimating this parameter.

Several parameters given as "typical values" in Table 4 of the HPM white paper depend on local conditions within individual cells; guidance should be provided for selecting these variables. Specifically, the variable Lmax depends on depth to the water table and soil type, and the variables CKOL, CKIF, and CKBF depend on local surface and subsurface conditions. Guidance in selecting these variables, preferably based on their functional relationship to other variables, should be presented in the documentation.

6.2.4 <pumpedditch>

The documentation states that a "throwout" pump can remove water from a farm at a rate as high as six inches per day. Expressing maximum pumping rates in terms of inches per day is questionable; m^3/s or cfs seems to be more appropriate. This doubt is reinforced in Table 6, where the pump rates for wsPump and fcPump are expressed in m^3/s.

6.2.5 <agimp>

The NRCS curve number method is given as a basis for calculating the runoff (Q) from the 25-year 3-day rainfall amount (r25y3d), with the available soil storage denoted by S. The documentation further states that S is determined from the soil series. In South Florida, S is sometimes taken to be a function of the depth to the water table, not a function of the soil series.

6.2.6 <mbrcell>

The documentation provides a range of values and a typical value for the time of concentration (3600 seconds, typically) and the water content at field capacity (20 cm, typically). Both of these values depend on local conditions and cell dimensions, and are best expressed as functional relationships. Specifically, the time of concentration could be given as a function of cell dimension and ground slope, and the water content at field capacity could be given as a function of the depth to the water table.

6.3 Need for Additional Materials

The current draft version of the Theory Manual asserts that a challenge in modeling complex hydrologic systems is to maintain an acceptable level of numerical error. However, no guidance is given on what is an acceptable level of numerical error and where to expect error in applying the RSM. In addition, there is no clear statement on the sources of numerical error in the RSM. Identification of suspicious numerical behavior and manifestations of numerical error in RSM simulations should be provided in the documentation. Any numerical errors specific to the RSM theory assumptions should be identified and their manifestations in model simulations should be discussed. Consolidation of error analyses stemming from the RSM conceptual formulation and development—presented in various papers by Lal (1998, 1998a, 2000)—into a single document on “Guidelines for Managing Numerical Error” as proposed by the SFWMD will be a highly beneficial contribution to the RSM Documentation Set. Error is common to all numerical models, model implementations, and simulation designs, to some extent. Presentation of guidelines for controlling model behavior and illustration of erroneous numerical artifacts should help alleviate mistakes in judgment by RSM users. A well crafted set of sensitivity analyses demonstrating the effects of parameter ranges on model results also can be beneficial in helping client users to minimize the potential for erroneous simulations. A single document or chapter specifically discussing model uncertainty and numerical error will represent a vast improvement to the RSM documentation.

All of the assumptions used to develop the RSM to simulate regional flow in South Florida should be clearly stated and justified. Model limitations that arise from neglect of the inertia terms, and the consequences of these limitations in operational water management and restoration planning, must be clearly identified and discussed. Since one motivation for developing the RSM is the absence of other models with similar capabilities, clearly stated model assumptions and limitations will facilitate comparative evaluations with other physically based, spatially distributed models. For example, MODHMS or MIKE-SHE can simulate variably saturated flow using Richard’s equation, which is not currently planned for RSM.

Additional documentation is needed to describe the validation of the RSM. Currently available validation examples in South Florida should be described in sufficient detail to allow users of the RSM to reproduce the same results. Reproducing all documented examples builds model confidence and identifies any irregularities that might result from using different computer platforms. The documentation of validation examples also should be sufficient to allow users of other physically based, spatially distributed models to simulate these scenarios for comparative purposes and to build confidence in the RSM.

The numerical techniques used in the RSM need to be documented in significantly more detail. Specifically, it should be clearly stated how the different matrices are assembled for the waterbody mass-balance equation.

Since the RSM is generic and potentially useful in regions that are similar to South Florida, a description of the main hydrological features of South Florida would be helpful in the Theory Manual. Such a description should be supported by figures showing the main areas in South Florida (Lake Okeechobee, Everglades agricultural area, water conservation areas, Everglades National Park, and urban areas), the main canals and control structures, and a short description of the geology. References should be made to other documents that present more details about the system, to allow the interested reader to get more information without lengthening the Theory Manual. Unique characteristics of the South Florida area that are particularly relevant to the RSM and that could be described in the Theory Manual are: (1) the competing objectives for water use (flood control, water supply, water quality, and environmental protection); (2) the extremely mild-gradient topography; (3) the proximity of extensive wetlands and urban areas, which correspond to very different hydrologic regimes; (4) the presence of the low-permeability layer, muck, overlying the bedrock in the water conservation areas and Everglades National Park; (5) the nature of the aquifer which is extremely permeable near the coast, and (6) the potential for salt-water intrusion which cannot be simulated at regional scale.

In defining the applicability of the RSM, there must be identification of what is considered "generic" model code. If the RSM code without South Florida regional modeling features constitutes the generic RSM, then those features should not be documented in the RSM Theory Manual but should be documented in the SFRSM and NSRSM implementation reports instead, as suggested in the SFWMD's response summary to the Panel. However, as the SFWMD response further indicates, it would remain beneficial to identify the important hydrologic characteristics of South Florida in the RSM Theory Manual to demonstrate the potential suitability of the RSM to simulate other water bodies. In the same section of the Theory Manual, there should be a discussion of the object-oriented feature and its advantages in tailoring the generic RSM to simulate dissimilar water bodies.

Detailed editorial comments on the RSM documentation submitted by the Panel to the SFWMD prior to 22 June 2005 are presented in Appendix II. It is recommended that the manual be reviewed by a competent technical editor to resolve problems with language, grammar, and consistency of scientific terminology.

7. Validation of Regional Simulation Model

The goal of this section is to suggest additional tests to validate the RSM.

There are three types of error in modeling: (1) numerical error caused by round off and/or truncation, (2) physical error attributed to inaccurate parameter estimation, and (3) error that is traceable to limited or poor-quality data. RSM calibration and validation examples should identify these three sources of error. Numerical error can be minimized by a judicious choice of grid resolution and time step and physical error can be minimized by the proper choice of parameter values, while data-quality error usually can be assessed only qualitatively. However, the importance of data-quality error cannot be overemphasized. Full model validation requires explicit separation of error; otherwise, one could be calibrating numerical errors against physical and/or data-quality errors. The validation procedure should take into account the following considerations: (1) to the extent possible, eliminate numerical error; (2) calibrate physical parameters to acceptable values; and (3) if necessary, assess the quality of measured input data.

The Panel is reassured that the SFWMD will make every effort to distinguish between the three types of error which arise in mathematical modeling. First, numerical errors should be minimized; second, physical errors should be investigated, identified, and corrected; and third, data-quality errors should be acknowledged and, to the extent possible, resolved. As the SFWMD has adroitly recognized, disregarding this triad results in bad modeling practice.

The issue of calibrating physical parameters to acceptable values is controversial. One group of individuals with expertise in this area would argue that the constraints on the physical parameters should be limited to realistic values. This allows modelers to determine the parameter values that best fit the observed data. These optimal parameters can be compared to realistic parameter ranges in order to assess the conceptual validity of the model. Another group of experts would argue that physical parameter ranges should not be constrained in order to enforce the conceptual basis of the model. In this case, extreme and often unrealistic values of the optimal parameters would serve as an indication that conceptual problems might exist in the model. To accommodate both of these views, a model could have the option of either specifying acceptable ranges of physical parameters or not constraining these parameters at all. The modeler would then interpret the estimated physical parameters accordingly. The Panel recognizes that the inclusion of tools and techniques to constrain model parameters to acceptable ranges is currently part of the long-term RSM development strategy, and the current version of the RSM provides features that are similar to this recommendation.

The diffusion-wave approach of the RSM is a single-equation solution for one unknown in which a simplified flow velocity term is incorporated into the continuity equation. Flows are computed in terms of change in head; flow velocities or discharges are not computed directly. In this approach, the Manning equation for overland or canal flow becomes a calibration term for computed water levels. Derived flow velocities are a result of this water-level calibration, rather than being calibrated directly as in the case of unsteady-flow models. This could cast doubt on the validity of using RSM flow results to define transport rates for future work, when it is planned to extend the model with water-quality process modules (WQPMs) to address water-quality restoration issues.

Although model calibration using stage (water level) data alone is common engineering practice, it does not guarantee fully accurate model calibration. Stage data typically are used for model calibration simply because of their ready availability. However, different mass transports can result from the same water level, and if velocity or discharge data are available—either as discrete values or explicit ranges—they should be factored into the model calibration process. Such a two-variable approach is required to achieve credible mass transport results for use in addressing water quality problems. Both stage and flow velocity (or discharge) are dependent variables in the governing equations (mass and momentum conservation). Therefore, in a dynamic flow model that simultaneously solves these governing equations, stage and velocity can be concurrently assessed and employed in the calibration process. This is not the case with a diffusion-wave model, in which the lone dependent variable is water level. Given this model-calibration limitation, caution must be exercised in using mass transport results from a diffusion-wave model to compute constituent concentrations for water quality analyses.

The behavior of surface flow is nonlinear or quasi-linear, implying that flow parameters might vary throughout the range of possible flow conditions. A clear example of this is demonstrated in diffusion-wave routing in a natural channel, where the Muskingum-Cunge parameters vary not only with stage, but also with rate-of-change in stage. Conventional parameter estimation approaches will miss the peaks and valleys of the flow variability. A three-stage parameter calibration (low, average, and high) might be more appropriate in the RSM to account for the inherent nonlinearity of surface-flow behavior. The Panel is reassured that the SFWMD will implement a three-stage parameter calibration to better simulate the nonlinearities inherent in the physical process.

Systematic benchmarking should be used to ensure that modifications to the RSM code do not introduce errors in the solution. Verification examples are needed to show that the RSM can reproduce results from analytical solutions or other numerical models. Consideration should be given to incorporating nine HSE verification examples in the Theory Manual: three examples for surface flow, three examples for subsurface flow and three examples for coupled surface and subsurface flow. Documenting more verification examples as the model evolves should be a priority.

Tests should be done to demonstrate the significance of errors introduced by using the HSE solution from the previous time step to compute water balances in model cells. These demonstrations should resolve accuracy issues and answer questions such as whether the time lag constrains the HSE time step. In addition, sensitivity tests should be conducted to determine the effect of this time lag in RSM applications.

Validation of the RSM requires applying the model to a particular area, calibrating the model, and then comparing predicted and simulated hydrologic variables. As of the time of this panel review, validation of the RSM has not been accomplished and documented. A RSM implementation to current conditions in South Florida (SFRSM) and a RSM application to historic conditions (natural system) in South Florida (NSRSM) will be documented and submitted for peer review in the near future. The outcomes of these forthcoming peer reviews will be a key basis for assessing the validity of the RSM.

8. Validation of Hydrologic Process Modules

The goal of this section is to suggest tests for the HPM approach to simulating local hydrology, and to make recommendations for improvement or expansion of the approach.

Very limited evidence is presented to validate the documented HPMs. For example, there is no evidence that the hydrology of agricultural areas in south Miami-Dade County can be described accurately by any of the HPMs identified in the RSM documentation. Addition of validation results, either directly or by reference, into the model documentation would justify application of the HPMs.

The validity of the HPMs should be assessed by conducting more studies like that of Chin and Patterson (2005) at various locations within the RSM application area in South Florida. Such studies address the quantitative relationships between hydrologic variables and these relationships can be included either as new HPMs or adapted to existing HPMs.

9. Suitability for Meeting Client Goals

The goal of this section is to evaluate whether the model is suitable for meeting client goals.

The three groups of RSM clients are: (1) internal (SFWMD) modelers; (2) SFWMD users of the model (e.g. water-supply permitting, operations, interagency teams); and (3) non-SFWMD users, including consultants, public utilities, environmental groups, and the agricultural industry. In order for the model to be used correctly, all clients expect clear statements on the model assumptions and unambiguous statements regarding what the model does and does not simulate. It should be made clear in the documentation that the intended use of the RSM is evaluation of long-term effects of management decisions that impact conflicting water-control issues such as flood protection, water supply, water quality, irrigation, and ecosystem conservation and restoration. Clients expect that all equations solved or used in the model be included in the documentation and written in such a way that a user/client knows exactly how each input parameter is incorporated into the model. More work needs to be done on addressing client needs in the documentation.

In order to make the model more user-friendly, a graphical user interface (GUI) is essential, and systematic tutorials covering simple and potentially complex model applications would be useful for most clients. The SFWMD is currently developing a GUI to support application of the RSM.

The infrastructure and atmosphere of cooperation at the SFWMD appears to be such that the goals of SFWMD modelers and users of the model will be met. The solicitation of input from SFWMD users by modelers, and a concerted attempt to address these issues appears to be in place.

The goals of non-SFWMD users of the model are diverse, and are likely to depend on their particular applications of the model. Most non-SFWMD users likely will desire a well documented, scientifically sound, validated, and user-friendly model. More work needs to be done in these areas for the RSM to meet these anticipated non-SFWMD client goals.

10. Conclusions and Recommendations

The SFWMD is to be commended for its effort to develop a state-of-the-art regional-scale water-management model for South Florida. The Regional Simulation Model (RSM) is a significant improvement over the currently used South Florida Water Management Model (SFWMM). The object-oriented approach in the RSM makes it easier to maintain and improve, capable of simulating a wider variety of processes, and capable of incorporating a more complex set of water-management rules. The unstructured grid capability of the RSM provides increased spatial resolution that should lead to more accurate simulation results. The extensible property of the RSM over the SFWMM should increase the model's longevity by readily facilitating the addition of new features over the lifetime of its use.

Some key panel recommendations for improving the RSM and its documentation are as follows:

- The validity of the RSM assumption that subsurface geology is isotropic throughout the model domain should be clearly stated.

- The canal-seepage watermover should include the reach transmissivity in addition to the sediment-layer conductivity. The fact that bottom-sediment layers have minimal effect on canal leakage and sediment layers rarely exist on the sides of canals should be recognized.

- The diffusion-wave approach used by the RSM is not applicable over the entire South Florida domain. Specifically, flows in coastal areas influenced by tides cannot be simulated using the diffusion-wave approximation and simulation of certain flow conditions in low-gradient highly regulated canals could be inaccurate using a diffusion-wave model.

- The numerically intensive computational performance of the RSM applications appears to be excessive. The computational advantage of the diffusion-wave approach might be outweighed by the numerical intensity of the global-matrix solution of the RSM. Alternative sub-matrix solutions should be considered in the future if computation time becomes more of an issue.

- Use of an explicit numerical scheme should be considered in addition to a fully implicit scheme.

- Computation of potential evapotranspiration should be considered for inclusion in the RSM.

- The effects of wind-stress forcing on large open-water bodies should be considered within the generic RSM even though their treatment might not be required in a regional-scale application such as the SFRSM.

- Conveyance in sloughs should be treated explicitly to avoid losing it in the storage-volume relationship.

- Consideration should be given to incorporating rainfall and ET in the canal water balance.

- To improve model run times and efficiency, consideration should be given to partially decoupling the surface-water and ground-water solutions to allow different time steps to be used in these components. In addition, consideration should be given to re-implementing dynamic time stepping in the RSM.

- Recent developments in GMS, PEST, and XMDF software could be used to improve RSM efficiency.

- The model documentation needs significant improvement in organization and content. Several specific recommendations are provided in the Documentation section of this report.

- Model assumptions, numerical methods, model calibration, numerical errors, and model validation should be more fully explained in the RSM documentation and presented in a cohesive fashion in the Theory Manual.

- Local studies need to be performed and documented to validate the hydrologic process modules.

- The current model and documentation need further improvement to more adequately address and fulfill client goals and expectations.

The SFWMD has made a commendable effort to develop and document the RSM. Inclusion of a peer-review component in the RSM development process provides important quality-control and continuous-improvement assurances that can be expected to generate unbiased technical advice on model development. The RSM is on track to become a state-of-the-art, essential, and scientifically defensible tool for water management in South Florida. The peer-review panel anticipates that the recommendations contained in this report will be given serious consideration by the SFWMD to achieve this goal.

APPENDIX I: References

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APPENDIX II: Preliminary and Editorial Comments on RSM Documentation

The attached documentation includes all comments on the RSM documentation reviewed by the panel in advance of the Interactive Workshop on 22-23 June 2005. These comments include most of the editorial comments on the RSM documentation, and some of the substantive comments that are the focus of this report. SFWMD responses to these pre-workshop comments, delivered to the Panel on 14 July 2005, are also shown.

#	Author	Document	Comment Location	Comment	Goal	Response	who	Response continuation
26	Dracup	0 - General Comments	2	In the formulation of the linear form of Manning's equation, the authors move the square root of the energy slope into the denominator of the matrix coefficient. They state that a small, minimum value of this slope is required to prevent instabilities. I buy this, and I think this is a reasonable approach, but the wide range of values for this minimum that they propose concerns me - ranging from 10-7 to 10-13.	1	The range 10^{-7} to 10^{-13} is an artifact of the linearization process as described and the sparse solver more than pure hydraulics. The *K* used for linearization has a singularity that was avoided using the small tolerances. The higher value 10^{7} was at the more stable end of the range because the values resulting after division are smaller. But with this all slopes less than 10^{7} are lost in the sense that a Darcian type of flow will be used instead of Manning type of flow (with $(s_h)^{0.5}$) as a result. This may or may not be bad for certain areas in the Everglades where there may not be strict turbulent flow. However, it will not follow the strict Mannings equation. The range of slopes described here is used to describe the range for which the strict Mannings form is to be used. The lower value 10-13 selected is the lowest value one can use without the sparse solver crashing due to the large value of K selected.	amwl	
27	Dracup	0 - General Comments	3	Finally, the authors don't mention the matrix solver that they use to invert the enormous matrix they create - and what the tolerances are in this (probably iterative) solution. Perhaps this is in an appendix; I'll look more carefully for that.	1	The matrix solver used is called PetSc developed by the Argonne National Lab. The maximum of two tolerances is used by default. Convergence is detected at iteration *k* if $\|r_k\| < \max(rtol * \|b\|_2, atol)$, where rtol = 10-5 and atol = 10-50 .	amwl	
28	Dracup	0 - General Comments	1	The transition between subsurface and overland flow. In the stage-volume relationship for a cell, a continuous transition from subsurface flow to overland flow is presented. I can see that this will work well for mass conservation. I could not find, however, an equivalent description for how the momentum equation is handled around this same transition. That is, as the water level rises or falls relative to the soil surface - either temporally or spatially - it isn't clear how the momentum equation handles transitions between the different formulations of the momentum equation. [It should be noted that the authors have essentially solved a simplified form of the momentum equation for each of the three flow domains - subsurface, overland, and canal - that they are considering]. For example, if one cell has overland flow, and the downstream cell doesn't, how does the momentum solver handle it?	1	The transition of the momentum equation between surface and subsurface flows is not handled as delicately for a number of reasons. The momentum equation essentially reduces to a friction term and a gravity term for diffusion flow. This equation applies for the momentum transfer across two water bodies, and the average cell value (or the segment value) of friction and gravity terms between the two water bodies is used without serious consideration given to the discontinuity at the surface. If one is ponded and the other is dry, the conditions given by (15) of Lal, et al (2005) or (2.23) is used to activate the water mover. Beyond that, a gradually changing transmissivity from subsurface flow to surface flow as in wetlands is simulated using a "lookup table". The reason for the serious need of the SV converter for mass balance is that mass balance is important for the type of applications the model is to be used. It is also important in the way the model is designed to handle perfect mass balance without having to carry out iterations within the same timestep. (cont)	amwl	This is a basic difference between RSM and MODFLOW as described at some later point where in MODFLOW, one has to carry out iterations in order to maintain mass balance. The second reason for not having an SV type function for momentum is that momentum balance is not that critical locally, especially at the local surface/subsurface interfaces of regional models, because imbalances in the momentum equation normally do not get accumulated to create massive momentum balance errors. This is because of the nonlinear dissipation behavior of the Mannings equation DH $\propto$ V2. This is particularly true when the cells are large. The worst result of this approximation is a small error in head and the velocity.
31	Ponce	02- Chapter 2	Page 16, paragraph 1	You may want to replace "water storage and conveyance" with "water conveyance and storage." In channels, conveyance is of first order, while storage is of second order. In reservoirs, there is no conveyance.	1			
32	Ponce	02- Chapter 2	Page 18, Section 2.2, paragraph 2	"without regard to the type of discretization." In reality, overland flow, groundwater flow, and canal flow have different characteristics celerities and diffusivities under unsteady flow. How can all these physical characteristics be reconciled under one time step and space step? Please clarify to help justify the above statement.	1	The discretization is determined by the model user. But if the user is careful enough to select discretizations that can carry all the wave in both space and time, the model should carry all the signals. If a small discretization suitable for the subsurface flow is used as a common discretization, with a short temporal discretization needed for the surface flow problem as well, the model will carry most frequencies and wave numbers of the spectrum. If the model is designed only for the longer discretizations, the short disturbances will drop out as suggested. What frequencies can be carried by a discretization are given by Lal (2000). A single discretization for all wave characterizations may look inefficient depending on the problem. The advantage of a single discretization comes because there is no need for coupling separate modules. The final proof of the pudding ought to be in eating, and the experiment to find which approach is better is still considered to be not over.	amwl	
33	Ponce	02- Chapter 2	Page 20	Is Eq. 2.2 correct with respect to dV? Reference to it on Page 22 differs from it.	1	has to be corrected	amwl	
71	Schaffranek	0 - General Comments	64	Would simulations of flow in a canal reach schematized as a sequentially connected sequence of segments with flow solution by the canal watermover and alternatively schematized as a sequence of equilateral triangles aligned along adjacent sides with flow solution by the overland watermover yield identical results?	1	It gives the exact same result, if the triangular cells are developed by dividing the rectangular cells in half.		
72	Schaffranek	0 - General Comments	65	Is the implicit solution within the HSE of the RSM iterative? If so, how many iterations are typically required to achieve convergence? What are the convergence tests?	1	The implicit solution within RSM uses iterations within the sparse solver, as would any sparse solver based on optimization methods. However unlike some Priessman scheme models, the matrix is based on the conditions at the beginning of the time step and not iterated. The reason for coming to use this simplification has to do with a number of experiments that showed that the difference with and without iterations is within the first order error. Iterations were used at the beginning of the development process because it is standard practice. If future experiments show there is a need for this because there is a gain in accuracy for a reasonable price to pay, iterations will be introduced. This seems unlikely for overland and groundwater flow alone.		

Note: any comment with a blank response will be addressed in the District's response to this panel's findings, scheduled for August, 2005.

#	Author	Document	Comment Location	Comment	Goal	Response	who	Response continuation
73	Therrien	01 - Chapter 1	13	In section 1.2, it is stated that SFRSM must be both flexible and adaptable. However, there are limits on the number of elements to use and the input and output time intervals (these limits are listed in the **fact sheet**), which seems to contradict the need for flexibility and adaptability. Why are such limits imposed?	1	the SFRSM fact sheet refers to one implementation of the RSM--each implementation can choose different time intervals, units, etc. Once we have a separate fact sheet for RSM, the difference will be more obvious, and we will more clearly delineate what details need to be in the two different fact sheets	pef	
74	Therrien	01 - Chapter 1	15	On page 12, I am not sure what is meant by a limited error analysis.	1	What was meant by "limited error analysis" was an error analysis due to boundary disturbances only. Numerical errors due to a variety of stresses such as well pumping, rainfall were studied by Lal (2000) for problems such as MODFLOW. In the case of RSM, the testing was limited to errors due to boundary disturbances.		
75	Therrien	01 - Chapter 1	18b	There is a mention of lake flow simulation but I did not find a description in the manual of the way it is done. Is it different from overland flow? Are different equations used, allowing for vertical surface flow components?	1	Lake simulation is very different from overland flow simulation. Lakes are considered as individual water bodies and are not discretized any further. For one layer models, lake seepage to and from neighboring cells is simulated using watermovers considering the aquifer transmissivity and the length of the interface. Each of these watermovers move water from the same lake waterbody to various cell waterbodies. Each of the waterbodies consider the cell transmissivity and the length of the cell wall for the calculation. Water from the lake to other waterbodies can take place with the use of structure and shunt water movers that will be discussed in the user manual.		
76	Therrien	01 - Chapter 1	18d	How are the reservoirs and large water bodies interacting with aquifers?	1	see #75		
77	Therrien	02- Chapter 2	21	The stage volume relationship applies to all waterbodies, surface and subsurface (section 2.4.1). I am not sure if this suggests that a given waterbody in the model can switch to be overland or subsurface depending on the water level, and that the transmissivity adjusts accordingly? Figure 2.3 seems to suggest that but I do not think that it is what HSE does.	1	Watermovers for surface flow and subsurface flow gets activated and deactivated depending on the water level. Transmissivity values are also variable within the range.		
90	Dracup	0 - General Comments	2	The spatial scale of the model isn't altogether clear in the document, but perhaps this is something that will be adjusted depending on the application. I think it is important, however, for the authors to discuss the spatial structure that is lost within grid cells. For example, in an overland flow situation, there will be patchiness in the density of vegetation, leading to preferential flow paths through the system. How this heterogeneity is aggregated to the grid scale isn't clear in the document as presented. If a uniform Manning's n is used, for example, is it set based on observed averages in velocity of flow versus energy slope? Or is it an average based on the bottom/vegetation characteristics? If it is the latter, the flow will likely be underestimated for a given energy slope, due to the fact that flow will preferentially select 'short circuits' with less flow resistance.	2	Selection of finite-cell cell sizes that can be many miles long is unavoidable when carrying out finite volume formulations. A number of parameters are designed to capture the lost spatial structures resulting from the selection of cells of such finite dimensions. The first such parameter described here is the SV converter. It can capture the storage behavior of a cell as a function of water level. There are two other parameters that describe the flow resistance above and below ground. These are conveyance and transmissivity. Currently they are scalar parameters as opposed to tensor parameters and therefore can only describe isotropic behaviors. Conveyance is a property describing surface flow behaviors and transmissivity is a property describing subsurface flow behaviors. Currently the generic transmissivity and conveyance properties vary with the spatial location and depth. What is missing from these parameters in RSM for now is anisotropy. Mannings equation gives only one way to explain flow resistance. In the future, both of these can be tensors.		
95	Dracup	0 - General Comments	3	Along these same lines, I think it would be valuable for the authors to be more specific about the limitations of the 'diffusion' solution (friction-pressure momentum balance, really) that they are applying. One example of such a limitation is the spatial heterogeneity described in (2) above. Perhaps a more important one is the timescale of the events that they intend to resolve. With this formulation, they will not be able to address events with short timescales - which would be associated with large accelerations. There should be a scaling estimate for what timescale of events they could reasonably resolve with this approach.	3	Limitations of not being able to simulate spatial heterogeneity described by Dracup (90) will apply not only to diffusion flow but also to full dynamic flow. Limitations of the diffusion flow approach have already been described at different places. They may have to be restated.		
96	Dracup	0 - General Comments	4	Finally, it seems that the model does not consider "channel" flow in caverns. Are there not major conduits through south Florida - I believe that you could essentially have channel flow in large caverns in the subsurface along with traditional flow through porous media and overland flow. It seems that these subsurface conduits could be simply parameterized like pipe flow, but I would be interested in hearing the authors thoughts on this.	3	There have been a number of occasions where the aquifer had caverns. Karst hydrology is an emerging discipline. Physically based regional models such as RSM are based on governing equations derived after making the continuum assumption, where the properties are assumed to remain the same even when the size of the control volume changes. One way of capturing the karstness is using parameters describing anisotropy. RSM is not there yet. The karstic behaviors that exist in the system model can be captured now only using isotropic parameters in the model.		

#	Author	Document	Comment Location	Comment	Goal	Response	who	Response continuation
114	Schaffranek	0 - General Comments	62	The RSM solves all equations for regional flow simultaneously. Formulation of the surface-water, groundwater, and canal flow equations for coupled simultaneous matrix solution forces the simulation to be conducted at a unique time step for all flow components within the system. Flow conditions in the most dynamic component of the system will govern the chosen time step. Thus, unnecessary flow computations will be carried out in the other systems, e.g., groundwater flow solutions are typically required much less frequently (daily stress periods) than surface-water flow solutions (hourly or smaller time steps). Isn't this coupled approach more inefficient than decoupled solution?	4	It is true that the flow conditions in the most dynamic process will govern the time step. As described earlier, a different way of explaining this same argument is to say that the system consist of spatial and temporal disturbances of varying scales in the solution, and the model developer has the responsibility to select the spatial and temporal discretizations necessary to capture as much of the solution as accurately as possible. The developers also considered the fact that spatial and temporal scales of the disturbances are connected through the governing equations (Lal, 2000). Earlier models were mostly decoupled, and two different time discretizations (or space discretizations) could be used to capture the disturbances resulting from various governing equations in each model. Algorithms were developed to couple these modules later. MODFLOW and BRANCH models coupled to create MODBRANCH is an example. In these cases, the time steps for each model were different, but the coupling had to be done iteratively. (cont)		With RSM, the coupling is carried out internal to the model, and the sparse solver is extremely efficient in carrying it out. The efficiency loss due to an over-discretization is compensated by the solution speed of the solver itself during the coupling. The ultimate solution of this problem however depends on all these parameters mentioned.
115	Schaffranek	0 - General Comments	63	Is the computational time step in the RSM dynamically variable during the simulation? If not, could it be? It would seem to be more computationally efficient and perhaps even improve the overall accuracy of the simulation to adjust the time step to more closely match the current flow conditions, e.g., longer time steps (?t > 24 hours) in dry seasons and shorter time steps in wet seasons (?t < 24 hours) and during periods of extreme weather, flow, and control events.	4	The time steps in the model were considered to be dynamic for a long time as suggested. However these conditions were found to be not the same any more with modern solvers, and the time steps are fixed now. When an early solver SLAP by the Lawrence Livermore Lab was used, the model started to become unstable with large time steps, and the model had to use smaller time steps to make it stable. With PetSc, the model is stable without any time step adjustments, and there were mechanisms internal to PetSc that can speed the run during dry periods without manually having to do it. Modern solvers have a number of features that can see how fast conditions change in a system, and carry out a minimum amount of calculations between one tim step and the next. PetSc has many of these capabilities.		
78	Therrien	02- Chapter 2	26	Why are 2 conditions, equations (2.35) and (2.36), used?	1	These equations are from MODFLOW. Based on the two values of the transmissivity, simple averaging, harmonic averaging and a variety of averaging methods have various implications. The type of averaging also depends on the type pf function used to describe the variation of the property within the cell.		
79	Therrien	02- Chapter 2	28	I would like to know what equation 2.40 looks like for uncoupled, loosely coupled, implicit or explicit discretizations.	1	Equation 2.40 is a governing equation describing the seepage rate. Whether there is a numerical model or not, this equation exist and it is valid. Regardless of whether there are numerical artifacts such as coupled, uncoupled, implicit etc, this equation is still the same. The difference is in the way this equation is handled in each. In the case of RSM, this is solved simultaneously with all others.		
34	Ponce	02- Chapter 2	Page 21, paragraph 1	The neglect of inertia terms renders the resulting "diffusion flow" unable to circulate. As long as 2-D convection is the primary mechanism being modeled, this may be an expedient assumption. Is 2-D circulation unimportant in all RSM applications?	1	This question brings a value to the seldom used equation (4) of Lal (1998c) which has a vorticity term. Even if 2-D depth averaged shallow water equations can simulate vorticity in the horizontal plane and therefore circulation, dropping of the $V \times \omega$ where $\omega = \nabla \times V$ eliminates this possibility. There are a number of other references as suggested brings us to the same point. Considering the friction and gravity dominated system in most of the Everglades, the need to model vorticity may be small, assuming that the depths are also uniform. In any case, vorticity creation in a horizontal plane is suppressed by the assumption, and should be admitted as such.	amwl	
35	Ponce	02- Chapter 2	Page 21, paragraph 2	The 1-D diffusion flow (wave) applicability criteria may be applicable to the modeled conditions. What is required is a long-period wave or event. Seasonal variations would be certainly covered; rapid changes involving changes occurring in a few days may not.	1	This is true. Lal (2000) shows that anything smaller than a 4 day period is the most that will be lost in the middle of the Everglades.	amwl	
80	Therrien	05 - Appendix A	35	On page 58, a mass balance error of < 10% is assumed reasonable. However, using the control volume ensures local conservation of mass and the mass balance error should be of the same order of the residual of the matrix equation, much less than 10%. Are errors of 10% commonly computed?	1	see #29	pef	
81	Therrien	07 - Appendices C.1 to C.4	36	I would like to know how accurate are the methods and results described in the papers of Appendix C compared to the current version of the model. Are the procedures in C.2 available in the model?	1	The current version of the model in fully implicit form has numerical error behaviors very similar to the MODFLOW model error behaviors. So all the equations of Lal (2000) for fully implicit conditions can be applied to the RSM model. Since the analytical expressions for error were obtained for rectangular problems, the RSM has to be applied with an approximation such as $\Delta x = \sqrt{\Delta A}$ for triangular meshes with aspect ratios equal to 1.0.	amwl	
82	Therrien	12 - Appendix C.5	39	Equations should be checked for consistency of units.	1	agreed; this will take some time	ef	
83	Therrien	13 - Appendix C.6	46	On page 2, last paragraph, there is a mention of seamless integration and later uncoupling. It seems that integration and uncoupling are contradictory here.	1	This can be reworded. The seamless integration refers to the user/modeler perspective, the mse tools are integrated with the hse application. Mse specifications are provided in the same manner as hse (via xml) and the suite of mse tools are always available in the rsm. The decoupling referred only to the internal information processing between hse/mse.	jcp	
84	Therrien	14 - SFRSM Fact Sheet	59	During our visit to the district, I would like to discuss the items listed in the general assumptions to find out more about the rationale for the choices made.	1	no comment	pef	

#	Author	Document	Comment Location	Comment	Goal	Response	who	Response continuation
85	Therrien	0 - General Comments	6	Although the reading material provides a very good overview of the general characteristics of RSM (both HSE and MSE), and I feel that the model has unique simulations capabilities, I still have several questions on the details of the governing equations and numerical methods used. It is still not clear how the model compares or relates to other coupled surface and subsurface flow model I am familiar with.	1	Comparison with other models was the primary verification method during the early days of development. However, the strategy changed to comparison with analytical methods because of a number of bad experiences. The first experience was during the comparison with the UNET model. Here I found that when the Froude number of the particular example was close to 1, and there were already severe problems with UNET. The RSM did not have the same problems close to Fr=1. The conclusion was that it is better to compare with analytical solutions instead of numerical models that may have diffrent behaviors. The second experience was with the Pinder and Sauer (1978) example used in MODBRANCH model (Swain and Wexler, 1993). Two groups simultaneously found the comparison to be difficult. The MODNET contractors (Ray Walton, West Consultants, SFWMD contract) found that the results of the two models do not agree well. I found the same problem, not being able to compare RSM results with any of the results. The only way to solve these problems and eliminate numerical artifacts of the comparison is to use analytical solu		Swain, E. D. and Wexler, E. J. (1993). A coupled Surface Water and Groundwater model for simulation of stream-aquifer interaction,USGS, Open file report 92-138
336	Chin	0 - General Comments	1	To be consistent with USGS terminology change groundwater" to "ground water"	9	SFWMD standard is groundwater	pef	
337	Chin	0 - General Comments	2	Do not use italics in figure captions	9	using LaTeX default for now--will defer to Technical Editor	pef	
338	Chin	0 - General Comments	3	When two words are used as adjectives, insert a hyphen between the two words, e.g. "water supply deliveries" should be "water-supply deliveries". Widespread corrections necessary.	9	some terms in common usage at SFWMD are not hyphenated-- water supply is a good example	pef	
339	Chin	0 - General Comments	4	Be consistent in describing the area as "South Florida" or "south Florida"	9	see #357	pef	
340	Chin	0 - General Comments	5	If RSM is a generic code that can be applied anywhere, and South Florida characteristics are not "hard wired" into the code, then the RSM is itself not a "model" but a "code", i.e. RSC.	9	good point, but it is probably too late to change!	pef	
341	Chin	0 - General Comments	6	The document was obviously written in TeX. Open quotations are not coded in correctly, " should be ``.	9	global replace of " with either \textacutedbl or \textgravedbl seems like lots of extra work--will defer to tech editor	pef	
354	Jones	0 - General Comments	General comment	As a member of the peer review panel, it is my understanding that deliverable #1 due on June 12th is a preliminary set of questions and editorial comments relative to the RSM Theory Manual. I have read through some of the comments submitted by the other panelists and my overall impression of the documentation is similar to what has been expressed thus far. First of all, I am sympathetic to the SFWMD in that they truly have a unique and complex hydrologic system to manage. I applaud your efforts in developing a new suite of tools customized to your special needs. I also applaud the object-oriented, modular, and open-ended approach to the software design. I look forward to the visit later this month and to sharing time with the rest of the panel discussing the model and documentation.	9	no comment	pef	
355	Jones	0 - General Comments		I was a little disappointed that this review did not include a review of the source code, file formats, integration with external data sources, and pre- and post-processing tools. Due to my background, this is the area where I feel that that I could have made the biggest contribution. Perhaps this will be covered in a future peer review.	9	source code and additional XML information is provided on the web site, but was not included in this part I peer review	pef	
36	Ponce	02- Chapter 2	Page 22, section 2.4.1, equation 2.13	Replace partial derivative ? for total derivative d (for consistency with text immediately below and Figure 2.4)	1	yes	amwl	
86	Therrien	0 - General Comments	6a	How is groundwater flow simulated? Some parts of the manual mention that 2D flow is simulated and others parts mention that it can be 2D or 3D. It is not clear what equation(s) can be solved in the model. For example, is Richards' equation solved?	1	In SFRSM, groundwater flow is simulated in 2-D. In SFRSM, Richards equations are not solved. The equations solved in RSM for 2-D and 3-D saturated groundwater flow conditions are the same equations solved in MODFLOW. Both confined and unconfined flow can be simulated using RSM.		
87	Therrien	0 - General Comments	6b	For the case where the aquifer is unconfined, it appears that the governing equation is based on the Dupuit approximation (horizontal flow) with the transmissivity being the product of hydraulic conductivity and hydraulic head in the aquifer. That approach is the cause of the main problem with MODFLOW, where simulations can lead to drying up of finite difference cells (head falls below the bottom of the aquifer) that become inactive. Rewetting capabilities exist in MODFLOW but they generally do not work very well. I would like to know if a similar approach is used here. Note that solving Richards' equation is more involved numerically and requires more data, but the drying/wetting problem is not an issue.	1	Since a single layer groundwater model is used for most RSM applications, the issue of dry cells is not yet a major problem. However for future 3d application of RSM, dry cells can be a problem. The solutions to this problem for now are the same solutions provided in MODFLOW.		
88	Therrien	0 - General Comments	6c	There is a mention of a limestone aquifer in the region, but no mention of capabilities of the model to simulate flow in fractured rock formations. Is an equivalent porous medium approach used for the subsurface?	1			
68	Schaffranek	01 - Chapter 1	7	In the first full paragraph on page 11, the statement is made "Inertia terms in the shallow water equations are neglected, and the solution to the governing equations is obtained using a single global matrix." The location of this sentence, occurring after identification of a number of physically based models, appears to apply to all these models as well, not just the RSM. This same text appears on page 3 in the paper (Lal, et al., 2005) reproduced in Appendix C.3. The potential misrepresentation presented by this text needs to be corrected.	1	agreed.	amwl	

#	Author	Document	Comment Location	Comment	Goal	Response	who	Response continuation
69	Schaffranek	01 - Chapter 1	11	The comment on page 13 asserts that one challenge in modeling complex hydrologic systems is to maintain "…an acceptable level of numerical errors". What is an acceptable level of numerical errors in the SFRSM? What are typical numerical errors in the HSE of the RSM? What are sources of numerical errors in the RSM? Questions of this type will immediately arise in the mind of the reader, yet no prior explanation or description of numerical errors is initially presented in the RSM Theory Manual. Sources of some numerical errors are subsequently identified on page 15 of the Manual, but numerical, computational, and model errors are largely discussed in reports reproduced in Appendix C.2 and C.3. Identification of typical invalid numerical behavior and manifestations of numerical errors in RSM simulations should be provided in the RSM Theory Manual at the first mention of the topic as on page 13 (reference citations to applicable published papers also should be made and provided). Any numerical errors specific to the RSM theory assumptions should be clearly identified and their manifestations in model simulations discussed in the main body of RSM Theory Manual.	1	Numerical errors exist in all numerical models. The way they are handled in RSM is by providing guidelines for the selection of the time step and the cell size, and establishing relationships between the discretizations and the numerical error. To give an example from MODFLOW, Figures 2, 3, 4 of Lal (2000) show that the equations describing numerical error in MODFLOW are accurate. Similarly Figure 5 of Lal (2005) shows that the same numerical error formulation is valid for RSM as well. Both these analyses show that the numerical errors of MODFLOW and RSM are approximately the same for $\alpha = 1$ conditions if the cell sizes are the same. Any discussion of error on RSM is equally valid for MODFLOW or any other numerical model as well. Error analysis with both MODFLOW and RSM show that the error in simulating a certain fourier component of the solution increases with increasing cell size and the time step as expected. See Fig (4) of Lal (2000) for the MODFLOW example. (cont.)	amwl	From the plot it can be shown that the only way to keep the numerical error below 100% as in the example of spatial discretization $\Phi = 0.4$ (in the same figure) is to keep β less than 10. The error in simulating a certain fourier component of the solution increases with increasing cell size and the time step. See Fig (4) of Lal (2000) for a MODFLOW example. Unfortunately there is a limit to how small β or the discretizations can get. Lal (1998a) eq (39) shows that the run time becomes extremely large when the discretization becomes small. This brings the idea of compromise between the error and the run time. Once the spatial mesh is determined, the size of the spatial disturbance that is possible on the mesh (say with a 5% accuracy) is known as a result. The time step should be selected to support the same solution in the time dimension, and the accuracy of the solution is given by equations in the paper.
89	Therrien	0 - General Comments	6f	Are overland and subsurface flow equations discretized with the same control volumes (or meshes) or with different meshes?	1	Yes		
106	Therrien	01 - Chapter 1	12	In figure 1.2, is it of importance that the SFWMM extends beyond land to the east, while the SFRSM has slightly different boundaries (figure 1.3)?	3	no--just pretty pictures; change in resolution is more important to note	pef	
107	Therrien	01 - Chapter 1	17a	How does Lake Okeechobee interact with the other hydrological features of the region?	3	Lake Okeechobee can interact with other hydrological features in a number of ways. Some of these are implementation features that will be discussed in other places. The primary way the lake communicates with other features is through structures and through seepage. Rainfall and ET can also be calculated over the lake.	pef	
108	Therrien	01 - Chapter 1	17b	Do the extreme weather patterns of rain events refer to hurricanes? What is the impact of these extreme patterns on the choice of model?	3	The term extreme weather pattern is used for dry events and wet events. Rainfall due to hurricanes is considered in the model, but only the daily values are considered by the model. These values are not as extreme as some of the peak values reached during the hurricanes.	pef	
91	Schaffranek	01 - Chapter 1	2	On page 7, justification of the need to simulate canal seepage and sheet flow in two (x-y) dimensions is attributed to a reference citation (Lin, 2003) identified as a 2003 personal communication in the Bibliography on page 54. Has a formal paper been published to fully support this conclusion? If not, seek other justification or design a set of carefully crafted numerical examples to illustrate need.	2	Steve Lin was an employee at the District for over 30 years. He was an early user of the predecessor to the SFWMM model called the regional routing model. The regional routing model was also called the "pot" model where South Florida was simulated by assuming it to be consisting of large regional pots, and writing mass balance equations between the pots. The conservation areas were the most obvious regional blocks. Each block or pot had one state variable. My question to Steve at the time was about the reasons behind the need to move to a new model beyond the pot model. The new model SFWMM was a more physically based model based on governing equations that are PDEs. The answer was that the seepage in the canals was extremely high, which made the pot model practically meaningless without having a mechanism to simulate the seepage. The assumption of zero water loss in the canals in the pot model during conveyance between water bodies was extremely exaggerated. The SFWMM model could simulate seepage better (SFWMM Primer).		
92	Schaffranek	01 - Chapter 1	10	On page 13 the need for long-term regional simulations of 35-40 years is identified as being imperative to assessing south Florida water demands. It is also noted that "…land use constantly changes as agricultural land is converted to urban use, marshes or reservoirs, …". Are such changes able to be accommodated by the RSM within the context of south Florida regional simulations? Is the land surface mesh definition and configuration in the HSE of RSM dynamically adjustable to account for physical and topographic changes during the course of numerical simulation? In similar context, are physical changes due to natural catastrophic events such as wetland fires and tropical storms that alter the landscape able to be treated by dynamically varying the RSM mesh configuration and applicable parameters and coefficients? How about structure, levee, and canal modifications?	2	The 35-40 year climatic record has to be considered simply as a climatic record available for testing a given configuration of the model. As it is, the model land use is considered static, along with topography, parameters and structures. A test with the 35-40 year record was used with SFWMM to study the behavior various static model configurations and scenarios under the past climatic record. Results of some of the simulations for the actual climatic records can be used for calibration when the structure operations and other system properties are known. SFRSM calibration is still under way. How the 35-40 year record could be used effectively will be known later.		
93	Schaffranek	01 - Chapter 1	12	Does the statement on page 14 that the RSM can treat "ponds or small water bodies residing within meshes but in full interaction" mean ponds or small water bodies wholly contained within a discrete mesh element? Clarify.	2	Most of the lake information was presented in the user manual, and not repeated in the "Theory manual". The reason for this was that with the OO formulation, details of lake behaviors appear to be simple enough to be presented as implementation details. Ponds can reside inside cells or outside cells. If ponds reside outside cells, they are considered as individual waterbodies with their own stage-volume curves and watermovers. These water bodies are connected to the adjacent cells using seepage watermovers. If the pond is small, it can reside inside the waterbody. In this case, the pond area is subtracted from the cell area, and the pond is considered as an individual waterbody no different from the previous case. The only exception here is that the seepage is between the lake and its home cell only.		

#	Author	Document	Comment Location	Comment	Goal	Response	who	Response continuation
101	Schaffranek	01 - Chapter 1	4	How is extension of the computational domain of the SFRSM (identified in figure 1.3 on page 10) over the spatial extent of the SFWMM (identified in figure 1.2 on page to include the tidally dominated mangrove ecotone along the southwest Gulf coast between Cape Sable and Ten Thousand Islands justified within the context of the diffusion flow assumption of the RSM? The same computational domain also is defined in figure 1 of the SFRSM Implementation Fact Sheet.	3	The SFRSM domain was extended to the coastline after considering two opposing considerations. On one hand it is true that the diffusion flow formulation of the RSM model is based on depth averaged shallow water flow equations without the inertia terms. As a result, RSM cannot simulate the inertia effects that are dominant in the tidal zones. It can only simulate the effects of both friction and gravity terms. The result of the extended area in the tidal zone is mainly dropping out of the inertia effects from the depth averaged equations. As long as the results of the tidal zone are dropped out from RSM, and as long as any nonlinear effects of tidal solution on the long term water levels are small, all what the boundary extension would do is to provide a seamless boundary condition for the rest of the model. In this proposition, the assumption is that nonlinear effects of the inertia terms in the tidal zone do not fundamentally alter the true water levels at the land boundary (not the ocean boundary) of the tidal zone. (cont)	amwl	If this assumption is valid, the current boundary is ok, as long as the results of the tidal zone are thrown out. If this assumption is extremely wrong, it is necessary to find a suitable bc for the diffusion flow based regional model somewhere at the end of the tidal zone. I am not sure if the work on the tidal model is complete at this time to be used as an alternative boundary condition applied at the rim of the tidal boundary. The opposing view as partially discussed above is to stop the model at the land end of the tidal zone and provide an appropriate bc at the boundary. Unfortunately, availability of data or information at such a boundary is uncertain. This avenue however has to be pursued after checking the progress of USGS work. The third approach was to use a uniform flow bc at the rim of the tidal zone, assuming that overland flow leaves the model domain subjected to uniform flow conditions.
102	Schaffranek	01 - Chapter 1	5	Figure 1.2 shows Lake Okeechobee to be included in the SFWMM, yet it does not appear to be included in the SFRSM according to Figure 1.3, is this correct? If so, why is it not included? If it is included, are lake affects treated? Wind fetch?	3	this is an implementation issue--Ken Tarboton discussed this in his presentation--slides 20-23, and in the minutes @11:40 AM but details aren't given	pef	
109	Therrien	01 - Chapter 1	17c	The aquifers are not described.	3	will address in manual--has been flagged	pef	
110	Therrien	01 - Chapter 1	17d	Be more precise concerning the considerable groundwater and overland flow interaction, because that interaction occurs in several other areas.	3	will address in manual--has been flagged	pef	
111	Therrien	01 - Chapter 1	17e	What is meant by sheet flow and how does it differ from overland flow?	3	Sheet flow is also overland flow. Flows over sloughs are considered as sheet flow. Sheet flow may be not as turbulent as regular overland flow.	amwl	
112	Therrien	12 - Appendix C.5	40	Are typical value in Table 1 for South Florida?	3	This implementation was developed for a watershed in Sri Lanka.	ef	
116	Therrien	0 - General Comments	6d	What type of coupling is used between the various flow domains (for example, between overland and groundwater)? Is a fully coupled approach used or is an iterative approach used (see Panday and Huyakorn (2004) for a discussion of the various coupling approaches possible between domains)? From my own experience with coupled surface and subsurface flow models, I found that the type of coupling used in the model can influence the performance and I would like more information on it. I am also wondering if accounting for HPMs explicitly during a simulation causes numerical difficulties. Perhaps a flowchart of RSM for a typical simulation could help visualize how coupling is performed. The same comment about coupling applies when MSE is used.	4	The regional components of RSM connecting horizontal flow are fully coupled, and there is no iteration between various modules. The only coupling used is for HPMs which contain vertical or local flows. HPMs are considered to be explicit and the coupling itself is explicit. For many of the South Florida conditions, explicitness of HPMs have been found to be adequate as experienced with the SFWMM as well. This is because the water table is much closer to the ground in South Florida, and HPM activities are relatively fast when compared to regional activities.		
117	Therrien	0 - General Comments	6e	How are non-linearities in the governing equations handled numerically? Again, my own experience with coupled surface/subsurface models has been with non-linear equations and the choice of the method of solution can be crucial to avoid convergence problems.	4	Nonlinearities in the governing equations are always linearized. The key is to find the best way to linearize them.		
123	Jones	01 - Chapter 1		I felt this chapter did a good job at outlining the history of model development leading up to the RSM model, giving an overview of the design requirements and a summary of the unique challenges related to modeling in South Florida.	5	will propose a separate background document of the history of modeling in south Florida, which would be on a less frequent update cycle but usable for all modeling in south Florida	pef	
162	Therrien	01 - Chapter 1	8	Figure 1.1 is difficult to understand without more comments in the text. Perhaps another figure, showing an analogy to a real system, would help relate the abstract concepts (watermovers, waterbodies, filters etc.) to real entities.	5	agreed! will address in manual--has been flagged	pef	
163	Therrien	01 - Chapter 1	9	At the bottom of page 6, last 2 paragraphs, there are references to other manuals and documents. I think that a list of all pertinent documents, with a brief description, could help the reader decide if the other documents are of immediate interest. The web site address should also be provided.	5	the inside front cover of the manuals will list the complete document set, which was discussed in Fulton slides during workshop; agreed that there should be more references to other documents throughout the RSM Theory Manual	pef	
164	Therrien	01 - Chapter 1	10	I suggest presenting the main characteristics of South Florida (geography, topography, geology, hydrology natural and man-made) before current section 1.1. Such a description would inform on the model capabilities required and would help put in perspective the need for modifying SFWMM. A few figures to support this description would help a lot. I would also move current section 1.3 after that description to indicate the required model features.	5	see #123	pef	
165	Therrien	01 - Chapter 1	11	In section 1.1, it is not clear if the SFWMM is still used.	5	will address in manual--has been flagged	pef	
166	Therrien	01 - Chapter 1	14	On page 11, it should be stated how RSM differs from the models enumerated.	5	will address in manual--has been flagged	pef	
167	Therrien	01 - Chapter 1	17	The list of special features in section 1.3 could be more detailed. For example items #107-111	5	will address in manual--has been flagged	pef	
168	Therrien	01 - Chapter 1	18	On page 13, the list of RSM capabilities is too long and the items are not placed in a logical fashion. I suggest splitting the list along several topics (for example, equations solved, numerical methods, OO concepts etc.). I also have the following comments and questions (see also #75-76)	5	will address in manual--has been flagged	pef	
169	Therrien	01 - Chapter 1	18a	Do arbitrary water bodies refer to their shape or nature (lake, stream, etc.)?	5	This refers to arbitrariness in shape.	amwl	
170	Therrien	01 - Chapter 1	18c	The notion of a fully integrated model should be defined because it might not have the same meaning for everyone.	5	will address in manual--has been flagged	pef	
171	Therrien	02- Chapter 2	19	Section 2.3 presents the finite volume method (control volume is also used in the text). I suggest presenting a very simple, physically-based, illustrative example of the method before introducing waterbodies and watermovers. A simple 1D flow example, with a central cell and 2 neighbors, could be used to show the integration of the governing equation for the central cell, highlighting mass stored in the cell (waterbody) and fluid flux with the neighbors (watermovers).	5	The term stage-volume was used in the OO design because of the obvious need for a stage-volume relationship in relatively flat wetland type conditions. It is also used in layered flow when there is a head instead of a stage. The word SV converter or curve was extensively used throughout the model by the time 3-D groundwater flow modeling was developed. As a result, the same terms was used as an object name, even when the terminology was not in line with what is used in standard hydrogeology.	amwl	

#	Author	Document	Comment Location	Comment	Goal	Response	who	Response continuation
245	Schaffranek	01 - Chapter 1	1	The role and interaction of hydrologic process modules (HPMs) in the RSM structure are not discussed in the text on page 5 or identified in flowchart of figure 1.1, even though HPMs are defined as a principal component of the RSM in the figure caption. Explain.	7	figure was replaced at the last minute without update of the caption. Has been flagged	pef	
258	Chin	01 - Chapter 1	1. Page 4, third paragraph	"Modflow" to "MODFLOW"	9	will address in manual--has been flagged	pef	
259	Chin	01 - Chapter 1	2. Page 5, third paragraph	change "man-made structures" to "human-made structures" (two occurrences)	9	will consider changing this--has been flagged	pef	
260	Chin	01 - Chapter 1	3. Page 9, first paragraph	change "began engineering a replacement model which could accommodate the goals" to "began developing a replacement model which could accomplish the goals"	9	will address in manual--has been flagged	pef	
261	Chin	01 - Chapter 1	4. Page 9, fourth paragraph	change "has allowed us to acheive a level" to has allowed the achievement of a level"	9	will address in manual--has been flagged	pef	
262	Chin	01 - Chapter 1	5. Page 11, second paragraph	change "MikeSHE/Mike11 based on Abbott et al. (1986a) and Abbott et al. (1986b)" to "MIKE SHE/MIKE 11 (Abbott et al., 1986a; 1986b)	9	will address in manual--has been flagged	pef	
263	Chin	01 - Chapter 1	6. Page 11, second paragraph	change "Richards' Equation" to "Richards' equation"	9	will address in manual--has been flagged	pef	
264	Chin	01 - Chapter 1	7. Page 12, first paragraph	change "language(XML)" to "language (XML)"	9	will address in manual--has been flagged	pef	
265	Chin	01 - Chapter 1	8. Page 12, second paragraph	change "We conducted a limited error analysis to ensure" to "A limited error analysis was conducted to ensure"	9	will address in manual--has been flagged	pef	
266	Chin	01 - Chapter 1	9. Page 12, third paragraph	change "The accuracy of the model was verified" to "The model was verified"	9	will address in manual--has been flagged	pef	
267	Chin	01 - Chapter 1	10. Page 12. last bullet	change "rapidly expanding urban areas and agricultural sectors" to rapidly expanding urban and agricultural areas"	9	no; urban areas are rapidly expanding; existing agricultural sectors impact wetlands. Will switch them to clarify	pef	
268	Chin	01 - Chapter 1	11. Page 13, last bullet	The wording "used to simulate overland flow, canal flow, lake flow or any combination of them" is misleading since lake flows are not actually calculated. Perhaps it would be better to refer to "lake inflows/outflows".	9			
269	Chin	01 - Chapter 1	12. Page 14, second bullet	change "Manning equations" to "Manning equation"	9	will address in manual--has been flagged	pef	
342	Jones	01 - Chapter 1		No specific editorial comments.	9	no response	pef	
37	Ponce	02- Chapter 2	Page 24, section 2.4.4	Eqs. 2-19 and 2-20 are only valid for rectangular channels. How about trapezoidal channels?	1	the equations take too much space and are ugly, so we use a simpler example; the model does handle trapezoidal channels	amwl	
38	Ponce	02- Chapter 2	Page 26, section 2.5.1	Does the model issue a warning when Stol is activated? (Equation 2.24)	1	no, too many instances	amwl	
39	Ponce	02- Chapter 2	Page 31, section 2.5.5, paragraph 2	Which method is used in the structure flow water mover? Lookup tables or regression equations? Why?	1	Lookup table is popular. Some other equation templates are also used within the MSE. All these are options that one can choose from. Regression hasn't been used much yet. The structure equations only give the maximum capacity. Actual discharge is decided by the MSE. Many of these might change in the future depending on how the MSE evolves.	amwl	
40	Ponce	02- Chapter 2	Page 34, section 2.6.2, bullet 1	Do you mean "precipitation-runoff transform"? Usually the conversion of precipitation to runoff is not considered routing (an exception to this would be the Cascade of Linear Reservoirs).	1			
41	Ponce	02- Chapter 2	Page 39, section 2.8, paragraph 1	What is the reason for going fully implicit (a = 1) in order to avoid the iteration? Slightly off-centered (a = 0.6) can be more accurate for all wavelengths.	1	Fully implicit was used because it gave the most stable looking model results. For most of the benchmarks, a weighting of 0.5 was adequate. But as the problem size became larger, the weighting values had to be pushed towards 1.0, and finally ended in 1.0. The second reason was that as new components were added, modification of the code was easier with 1.0 and cumbersome with values other than 1.0.	amwl	
42	Ponce	02- Chapter 2	Page 39, section 2.8, paragraph 3	Are there sensitivity tests available showing the benefits of a = 1 as opposed to a = 0.6-0.8?	1	About 8 years ago, some of the tests were carried out when there was no clear idea if the whole thing was going to work out. Unfortunately, some of the results were lost.	amwl	
43	Ponce	02- Chapter 2	Page 40, section 2.8.1, paragraph 1	How is Equation 2.49 (average water velocity in a cell) reconciled with unsteady flow?	1	Eq (2.49) is an interpolation equation for flow velocity at the center when the discharges across the three walls are known. This is part of the numerical solution. Except for the discretization error (as a result of the interpolation), this is a good estimate for 2-D velocity. In diffusion flow, velocity is not solved independently but directly calculated from the head solution. The question then is how closely is the v in diffusion model comparing with v in the dynamic model. If we consider the condition of validity of diffusion and dynamic flow conditions to be based on wave speeds and decay rates (Ponce, 1978), then the error is in h or in u or v must be within bound that follow the above stated criterion. The answer to this question is available for diffusion flow. It can be shown that the numerical errors for h and q are within the same order of magnitude as shown in eq (22) of Lal (2000).	amwl	
44	Ponce	05 - Appendix A	Page 58, paragraph 1, number 8	How was the value 10% maximum error in mass conservation determined?	1	see #29	pef	

#	Author	Document	Comment Location	Comment	Goal	Response	who	Response continuation
45	Ponce	06 - Appendix B	Page 61	The Saint Venant equations are the equations of water continuity and momentum in one dimension, not in two dimensions. Referring to the 2-D system, Cunge mentions that "This system of three equations is analogous to the system derived by de Saint Venant for the flow in one spatial dimension." (See Cunge, J. A., 1975, "Two-dimensional modeling of flood plains," Chapter 17 in Unsteady Flow in Open Channels, K Mahmood and V. Yevjevich, Water Resources Publications). The system in question is properly referred to as the "the system of depth-integrated (two-dimensional) equations for unsteady shallow water flow." It is incorrect to say that this system is "commonly referred to as the Saint Venant equations." However, repeated incorrect usage converts to correct usage (by definition of "usage").	1	We need to just say "depth averaged equations for unsteady shallow water flow" as opposed to "commonly referred to St Venant equations.."	amwl	
46	Ponce	06 - Appendix B	Page 62, paragraph 2	A diffusion flow formulation does away with circulation in two-dimensional depth-averaged flow (Ponce and Yabusaki, 1980, Modeling circulation in depth-averaged flow," ASCE Journal of the Hydraulics Division, 107, HY11). Therefore, the approximation is only good for 2-D convection-dominated flows. Is this condition applicable to all cases where the RSM will be applied? A warning is appropriate to caution other users of the model, who may try to apply the model to sites where the 2-D flows are not necessarily convection-dominated.	1	Some of the same material has been discussed in (Ponce 34). According to (4) of Lal (1998c) which has the components of the complete depth averaged equation, the diffusion flow assumption clearly requires the nullification of $\nabla \times V$, or the vorticity terms. This means there is no possibility for the model to simulate vorticity in the z plane. But this does not eliminate the possibility of having irrotational circulations. An example of irrotational rotation is demonstrated in the case where there are easterly winds in the southern half of the Everglades and westerly winds in the northern half making a rotation in a confined flow domain. This is possible even now with RSM. What is not possible is true vorticity or rotational flow occurring mainly due to wall shear. This is associated with $\frac{\partial (uvh)}{\partial y}$ type cross terms in the momentum equation. (cont)	amwl	In the Everglades, the horizontal boundary layer thickness itself is probably a few feet wide at most when compared with the size of a cell, and even if vorticity terms are present in the model, a huge eddy circulation may be numerically challenging. The final thought on this is that one should recognize that RSM is not capable of simulating vorticity in the horizontal plane because of the diffusion assumption. Even if a full equation model had been used, it is doubtful if the large cell sizes used would allow circulations of huge magnitude at such low depths.
47	Ponce	08 - Appendix C.1	Page 2, Introduction, paragraph 2, last sentence	The crucial question is whether a 2-D diffusion-flow model retains the same (or similar) convective and diffusive properties of its 1-D diffusion-wave counterpart. What is your answer to this question?	1	If we consider (4) of Lal (1998c) to be capturing the 2-D momentum equations, the difference between a 1-D equation and the 2-D equation for the sake of this argument is primarily the term associated with vorticity. The other terms are a gradient driven term, a friction driven term and a local acceleration term. Considering the dominance of the first two terms, it seems that the difference between the remaining 2-D equation and the 1-D equation is the direction of the 2-D model. This implies that convective diffusive properties of the remaining 2-D equation are not different between the 1-D and 2-D equations once the mainly the vorticity terms are dropped out.	amwl	
48	Ponce	08 - Appendix C.1	Page 2, Introduction, paragraph 3	Ponce et al.'s 1978 analysis is strictly valid only for 1-D flow. The extension to 2-D flow is plausible, but it needs to be qualified.	1	Ponce (1978) is valid only for 1-D flow. Its extension to 2-D full equations might have some additional terms. Unless a complete analysis is carried out, it is not clear what the terms are like. But considering that horizontal vorticity is not a key issue even in the deepest part of the Everglades, this issue may not have a very high priority.	amwl	
49	Ponce	08 - Appendix C.1	Page 5, paragraph 1	The strategy of recovering some of the convective inertia through the use of E instead of H may be unwise. Ponce (1990) [Ponce, V. M., 1990, Generalized diffusion wave equation with inertial effects, Water Resources Research, 26, No. 5] has demonstrated that in 1-D flow, the full dynamic diffusivity (including all inertia terms) is closer to the kinematic hydraulic diffusivity (neglecting all inertia terms) than the convective-only (partial inertia) model.	1	I was similarly advised by others, and decided to settle on the current formulation.	amwl	
50	Ponce	09 - Appendix C.2	Page 8, Introduction, paragraph 1	The statement "Various unconditionally stable numerical methods using implicit or other methods have made it possible for modelers to use almost any discretization with computer models" is too strong and possibly misleading. While fully implicit methods generally feature unconditional stability, this is usually at the expense of reduced convergence, i.e, loss of accuracy. To mention the unconditional stability without saying anything about accuracy implies that the strategy is one of stability "at all cost," which is self-defeating.	1	The statement was put together after observing some of the wrong practices in industry where discretization was not analyzed or understood in light of the speeds of disturbance, and yet the solution did not show apparent defects for the user to recognize a problem. Since modern solvers solved many problems, the user never saw the loss of accuracy in order to cast any shadow of suspicion. For some time, "stability at all cost" was the motto in certain user applications. This was the reason for the statement.	amwl	
51	Ponce	09 - Appendix C.2	Page 9, paragraph 1	Replace "are arbitrarily chosen" with "are usually arbitrarily chosen." In some diffusion-flow formulations, the space and time follow the Courant convergence law (See Ponce, 1989, Chapter 9, "Engineering Hydrology, Principles and Practices.")	1	Courant and other criterions are useful in explicit schemes. But in implicit schemes, these guidelines are not available, and sometimes arbitrarily chosen.	amwl	
52	Ponce	09 - Appendix C.2	Page 13, paragraph 1	Three discretizations per half sine wave appears very coarse. The error < 4.5% in what? Stage?	1	It is true that 3 discretizations per sine looks good. But that is only as far as the representation of a continuous function using digital values is concerned. When the computations are over, the solution may have larger errors. The error in what? It can be in the representation of the solution in space or in time.	amwl	
53	Ponce	09 - Appendix C.2	Page 16	All methods that solve many grid points at-a-time are implicit. So, there is no semi-implicit. There is implicit and fully implicit, the latter to show that the functions and/or derivatives are being taken at the advanced time step.	1	True. The term "semi-implicit" has been used in the past too to explain α between 0 and 1. But if they were not explicit, they are implicit.	amwl	
54	Ponce	10 - Appendix C.3	Page 5, Governing equations, paragraph 1	Replace "non-inertia form of the Saint Venant equation" with "the non-inertia form of the Saint Venant equations"	1	yes	amwl	
55	Ponce	10 - Appendix C.3	Page 6	In 1-D unsteady flow, the convective celerity is given by Seddon's law, for laminar, mixed, and turbulent flow. How is Seddon's law represented in 2-D unsteady flow? Is the adopted value of Manning's n turbulent, or is it its laminar-equivalent?	1	RSM model only considers 2-D diffusion flow at this time, and therefore the representation of 2-D unsteady (dynamic) flow in Seddon's law was not investigated. But to the extent numerical solutions are applicable, the wave speeds of the diffusion flow have to be close to the analytical values obtained by Ponce in various papers. The Mannings value used in the model are somewhat larger than the values commonly used for fully developed turbulent flow. Wetland conditions, various vegetation types and microtopographic conditions have pushed the Mannings values higher than most Mannings values developed for deep rivers.	amwl	
56	Ponce	10 - Appendix C.3	Page 7, paragraph 2	When friction slope Sn reaches values as low as 10-7 and lower, the applicability of the diffusion flow assumption may not be guaranteed.	1	Yes. Then, the diffusion flow becomes linear diffusion flow as a Darcian flow, with a constant K value as opposed to the nonlinear K value, and the flow becomes closer to groundwater flow than surface water flow.	amwl	

#	Author	Document	Comment Location	Comment	Goal	Response	who	Response continuation
57	Ponce	10 - Appendix C.3	Page 9, last line	Is the defined stage-volume (SV) relationship unique? If so, it contradicts the principle of (dynamic or diffusive) unsteady flow, rendering the simulated flow kinematic. Please explain in a better way.	1	SV relationship does not affect dynamic or diffusion flow when the free water surface is above ground because then the gradient of the function becomes 1.0 as opposed to s_c. The SV relationship is important only when the water surface is within the microtopography. At that point, surely the wave speeds are affected. The SV relationship is always unique for a given location, and varies from place to place.	amwl	
58	Ponce	10 - Appendix C.3	Page 10, paragraph 2	Explain the cost to be paid when the a weighting factor is raised to a = 1 when "nonlinearities are severe and the model shows signs of instability."	1	α = 1.0 does not cost anything. It is the cheapest. However nonlinearities are costly. They slow the matrix operations while increasing errors and instabilities.	amwl	
59	Ponce	10 - Appendix C.3	Page 12, paragraph 3	If the water movers (and the water bodies) conserve mass, why is it necessary to track mass balance of the system?	1	Water movers and waterbodies are tracked not for computational reasons but to carry out water budget calculations during post processing.	amwl	
60	Ponce	10 - Appendix C.3	Page 20, paragraph 2	The hydraulic diffusivity of overland flow is likely to be different from that of groundwater flow. How is the mesh size reconciled for this difference? In other words, a resolution (or discretization) that is accurate for overland flow may not have the same accuracy for groundwater flow. Please explain how do you handle this different accuracy response (i.e., convergence response, based on suitable amplitude and phase portraits).	1	The reason for carrying out error analysis was to find out the relationship between the discretization, numerical error taking into account the diffusivity of the medium. Diffusivity come into the picture because the matching between spatial and temporal discretizations depend on the diffusivity. As long as the user designs a discretization that can carry the solution accurately in both space and time, the solution will survive regardless of the medium. If a single discretization is to be used, one has to be careful that it does not drop solution components that are important to the user. Different solution components also have different error levels depending on the discretization.	amwl	
61	Ponce	13 - Appendix C.6	Page 37, paragraph 2	Question the use of the word "arguably" in this context. Argumentative; value judgment. Is there a need to defend MIKE SHE here?	1	Agreed, there is no need to defend MIKE SHE, rather, was attempting to convey that other models do implement advanced management processing, that the mse implementation represents an advance in the state-of-the-art.	jcp	
62	Ponce	14 - SFRSM Fact Sheet	Page 1, Section	What are the main components of SFRSM?	1	see #73	pef	
63	Ponce	06 - Appendix B	2.	Need to establish a better link between the traditional equations (the differential equations of Appendix B) and the equations used in the OO model (look-up tables, regression). Are the latter based on the former? If not, how is the relevancy of the traditional equations justified?	1	The traditional equations are presented only for historical interest. But it is not different from the OO presentation.	amwl	
64	Ponce	0 - General Comments	4.	The so-called "diffusion equations" calculate hydrograph diffusion, in either 1-D or 2-D. True (physical) hydrograph diffusion can only be produced by an unsteady loop in the rating curve. Disregarding the loop by using a static look-up table renders the simulation kinematic, i.e., not subject to physical diffusion. Then, any hydrograph diffusion represented in the simulation would necessarily be a function of the grid size. Please explain how extensive is the use of look-up tables in the model, and what is the effect, if any, on the calculated hydrograph diffusion.	1	This is a valid argument. The idea of a lookup table for conveyance with the slope raised to the power 1 or 0.5 would mean flow of a certain restricted kind more closely related to kinematic waves. Under such shallow conditions, the use of the definition of "diffusion" itself becomes questionable. In large rivers, this would be a different case. Lookup tables have not been used in applications yet. But I can see them useful when the flow is not quite surface flow or subsurface flow but some kind of localized stream flow where there may not be a good analytical relationship developed from raw data, and only a lookup table is possible.	amwl	
65	Ponce	06 - Appendix B	5.	How was the threshold value d in Eq. B.16 determined? How often is it reached? What does the model do when the threshold value is reached?	1	see #26		
66	Ponce	0 - General Comments	6.	The model uses the NRCS curve number method as the infiltration model. However, the latter is strictly applicable only to event (short-term) modeling. In practice, the AMC feature of the curve number method helps it account for the natural variability of infiltration response. There is no such thing as a fixed "curve number," or a constant "maximum potential retention (S)." Thus, a curve number obtained through calibration may not be applicable in the validation phase, unless the two events being used (for calibration and validation) happen to have similar AMC characteristics. This is a tough problem, and one which not many people are fully aware of.	1	The user can decide the type of HPMs used in a model application. The curve number method was used in one of the HPMs as a way to approximate local processes, when there are no other local hydrologic parameters are available to be used.	amwl	
736	Schaffranek	01 - Chapter 1	3	Add NSM, first defined on page 7, and SFRSM and NSRSM, defined on page 9, to the Acronyms list.	9	will address in manual--has been flagged	pef	
737	Schaffranek	01 - Chapter 1	6	Could not find the reference citation (Solomantine, 1996) on page 9 in the 1996 ASCE Journal of Hydraulic Engineering as indicated in the Bibliography on page 55.	9	see #759	pef	
738	Schaffranek	01 - Chapter 1	8	The reference citation (Shen et al., 1997) appearing on page 11 is not in the 1997 ASCE Journal of Hydraulic Engineering as indicated in the Bibliography on page 55.	9	see #759	pef	
739	Schaffranek	01 - Chapter 1	9	The reference (Senarath et al., 2001) cited on page 12 is insufficiently identified in the Bibliography on page 55, no publication source is given for this abstract.	9	see #759	pef	
1	Chin	02- Chapter 2	2. Page 18, Section 2.2, second paragraph	The second sentence states that "The governing equations used in the formulation are based on the Reynolds transport theorem." This is not strictly true, since the Reynolds transport theorem is simply a means of transforming an equation based on a Lagrangian reference frame to the same equation in an Eulerian reference frame. Therefore, the Theory Manual should more correctly state "The governing equations used in the formulation are based on the continuity equation".	1	According to Chow and Maidment in Applied Hydrology, ans many other texts, "a consistent mechanism needed for developing hydrologic models is provided by the Reynolds transport theorem". Prior to 1970's development of various governing equations was based on mass balance and other conservation laws applied on small control volumes on a one-by-one basis. The control volume size was then limited (in the sense of calculus) to zero to obtain differential equations. The Reynolds transport theorem allows for a more elegant way to apply conservation laws using a consistent generic mathematical form without regard to the material type. With this form, it is possible to obtain the integral form of the equation, and even the differential form of the equation. The RT theorem eliminates the need to specify the conservation of "what" and make it possible to write mathematical principle. In RSM, the numerical model is built around conservation laws applicable to many physical processes, and the RT theorem is at the root of the model. (cont)	amwl	Unfortunately according to the way it happened in history, there was Gauss's theorem and Stokes theorem first, and RT theorem came much later in the attempt to make all derivations consistent. The attempt here with the RSM is to take one more step and make the conceptualization consistent with a generic mathematical form. Even if it appears as if the RT theorem transforms a theorem based on the Lagrangian frame of reference to an Eulerian, the intent of the RT theorem is to describe conservation laws written for a constant mass (called a system) to a constant fixed control volume. I found a good description of this in Panton (1994).
2	Chin	02- Chapter 2	5. Page 20, Section 2.3.1	Change "The first term in Equation 2.2 represents storage in the control volumes" to "The first term in Equation 2.2 represents the rate of change of storage in the control volumes".	1	Yes, will correct	amwl	
3	Chin	02- Chapter 2	7. Page 21, Equation 2.3	"E" and "V" are really the same vector, I would recommend using "V" for both. If this is done, Equation 2.2 should also use "V" instead of "E".	1	correct.	amwl	

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#	Author	Document	Comment Location	Comment	Goal	Response	who	Response continuation
4	Chin	02- Chapter 2	8. Page 21, sentence before Equation 2.5	change "explained" to "estimated". It would also be useful to cite a reference for Equations 2.6 and 2.7.	1	sounds better	amwl	
5	Chin	02- Chapter 2	9. Equations 2.10 to 2.12 are incorrect	the integral sign (over cv) on the RHS of these equations needs to be removed.	1	yes	amwl	
6	Chin	02- Chapter 2	12. Page 22, second sentence after Equation 2.13	the phrase "becomes 1 for overland flow and sc for groundwater flow" needs modification to define sc. Care should be taken not to define "sc" simply as the storage coefficient , but as the specific yield.	1	The idea of SV function started for unconfined flow first, but later extended to include confined aquifers and multi-layered configurations. But a single term "storage coefficient" was used to to call all these objects. The variable s_c was also used generically in the OO formulation. Functionally, this captures specific yield or storage coefficient depending on the application. The manual has to be changed to account for this.	amwl	
7	Chin	02- Chapter 2	13. Page 24, Equations 2.16 to 2.18	consideration should be given to using fsv^-1 instead of introducing a new function fvs.	1	The meaning of inverse here is not a reciprocal but an inverse function mapping.	amwl	
8	Chin	02- Chapter 2	14. Page 26, Equations 2.23 and 2.24	The meaning of Tmn should be stated, for example "Tmn is the flow per unit width per unit slope, which is effectively a transmissivity".	1	correct	amwl	
9	Chin	02- Chapter 2	15. Page 27, Equation 2.27	It is not obvious where Equation 2.27 comes from, or what is the basis for its derivation. e.g. is it the slope in the direction normal to jk? This should be addressed in the text.	1	Unfortunately it is not obvious where this came from. But one has to see equations (4) and (5) of Lal (1998a) in which K is described using $\frac{h^{5/3}}{n\sqrt{s_r}}$, the way to calculate s_r is as $\sqrt{s_1^2 + s_2^2}$ as long as s_1 and s_2 are in two perpendicular directions. s_r here is the magnitude of the maximum slope at the wall *r*.	amwl	
10	Chin	02- Chapter 2	16. Page 27, second to last sentence	the statement "flow across section r adds water to cell n and removes water from cell m" does not follow Figure 2.6. Switch "m" and "n".	1	Will address in manual (fig. 2.6)		
11	Chin	02- Chapter 2	17. Page 28, Equations 2.30 to 2.33	Explain where the additional term on the RHS of each of these equations comes from.	1	Equations 2.20-2.33 are intended to represent lines in the computer code meaning that the new value is equal to the old value plus a term. The arrow implies that the variable in the left hand side is to be replaced with the value of the expression on the right hand side. The manual may have to explain the use of the arrow.	amwl	
12	Chin	02- Chapter 2	18. Page 30, Equation 2.30	Is there a "Delta L" missing from this equation? Comparing Equations 2.38 and 2.34, does Tr have different units in these equations?	1	Delta L is missing	amwl	
13	Chin	02- Chapter 2	19. Page 30, Equation 2.39	Exponent should be "2/3" instead of "5/3".	1	For canal flow, this is 2/3 because there is already an A_m outside. The comment is correct.	amwl	
14	Chin	02- Chapter 2	23. Page 39, Section 2.8	State explicitly whether taking M^n+1 = M^n has any impact on model accuracy	1	Making M^{n+1} to be the same as M^n was found to be a good approximation during the early part of development where a couple of iterative cycles were used to update M^{n+1} with the correct value. During the period, it was found that the error generated by this assumption was smaller than the discretization error (first order error), and therefore could be neglected. As an alternative to the iteration, it was decided to carry out a thorough error analysis with rapidly varying flows (high frequency components) in the solution, and understand the behavior of the error before making a decision. The error analysis showed that the model error without iteration was the range that can also be determined analytically for linear problems. It was determined that even if iterations were added to improve the nonlinear behavior of the diffusion flow model for example, the numerical error will still be within the first order range. (cont)	amwl	Further studying of this is planned with rapidly varying diffusion flows and dynamic flows. These are the types of flows where flow variations are going to be rapid and the iteration are going to be significant. With the results of this study, it will be easy to check how adding dynamic terms compare with adding iterations to nonlinear diffusion flow.
15	Chin	02- Chapter 2	24. Page 40, first sentence	If you know H^n and Delta H why not take H^n+1 = H^n + Delta H instead of H^n+1 = fvs(V^n+A \Delta H)?	1			
25	Dracup	02- Chapter 2	1	It wasn't clear to me why the authors interpolated the energy slope laterally across a cell face in addition to between point's m and n (the centers of the two adjoining cells). See equation 2.27.	1	In eq (7) of Lal (1998c), $K = \frac{1}{n_b} h^{\lambda+1} S_n^{\lambda-1}$, the variable S_n is the maximum slope of the energy grade line at the wall. Eq (2.27) is the way to obtain this at the middle of the wall as described in **Chin 9** as well, which is $\sqrt{s_1^2 + s_2^2}$	amwl	
67	Ponce	0 - General Comments	7.	Need to better explain the determination of the Manning friction coefficient under various vegetative and other terrain (land use) conditions. If the Manning value is going to be large (greater than 0.3), it is probably out of the fully-developed, turbulent-flow regime already, and may be in the mixed laminar-turbulent regime. In this case, it is more appropriate to refer to the friction coefficient as the "equivalent Manning roughness." The latter is sometimes denoted as N to indicate that it is not the fully-developed, turbulent-flow value. What is the model's sensitivity to the chosen value of Manning friction?	1	The Manning friction values used in the Everglades have always been high, sometimes getting close to 1, according to the SFWMM model calibrations. The high values have been justified in thick vegetations in the Everglades consisting of sawgrass, cattail, etc. For some vegetation types, the Manning values were described as functions of depth with Manning value becoming less as the depth increases. It is true that a better term to use here is the equivalent Manning roughness. The most sensitive parameter in the Everglades is ET. The second most sensitive parameters is Mannings roughness. The sensitivity to Mannings coefficient is higher when the water velocity is high.	amwl	

#	Author	Document	Comment Location	Comment	Goal	Response	who	Response continuation
98	Ponce	06 - Appendix B	Page 65, section B.4, paragraph 1	Is a correction being used to account of the fact that neither rainfall nor ET are being input to the canals? With so many canals in South Florida, is this effect negligible?	3	Will address in response doc. <1% of land surface in FL is canal top elevs.	Ken	
99	Ponce	08 - Appendix C.1	Page 14, paragraph 2	What is the basis for the choice (assumption) of Manning n = 1 for the given case? What is the sensitivity of the results to variation in n?	3	This test was selected after considering the sheet flow problem in the Everglades. The size of the domain, depth of water and the Mannings values were similar to those used in the SFWMM. This test was used first to verify the SFWMM during its peer review and verify if a circular patch of water remains circular after a given time.	amwl	
100	Ponce	12 - Appendix C.5	Page 27, Table 7	What is the s attribute of agimp? Abstraction in the NRCS runoff method? Is it the potential storage (abstraction), commonly referred to as (capital) S? if so, the CN corresponding to S = 0.85 m is CN = 23. This value appears to be too low. Is this a good (central) value for South Florida?	3	The value for S in table 7 will be adjusted to reflect better values for South Florida	ef	
142	Ponce	02- Chapter 2	Page 22, section 2.4, paragraph 1	A stage-volume relationship implies the existence of a unique rating curve. In general, unsteady flow rating curves are not unique. The manual needs to state here that the unique rating assumption is "approximately" consistent with the diffusion flow assumption.	5	With kinematic waves, there will be a unique rating curve. But SV curves can be used with unsteady curves as well, in which case there won't be a unique rating curve. Regardless of the SV curve, there won't be a unique rating curve whenever diffusion waves are used.	amwl	
143	Ponce	02- Chapter 2	Page 26, section 2.5.1	Define Tmn	5	see #8	pef	
144	Ponce	02- Chapter 2	Page 26, section 2.5.1	Question the usage of "If" at the beginning of the sentence. What other equations are used, besides the Manning equation?	5	will change to "when"--has been flagged	pef	
145	Ponce	06 - Appendix B	Page 64, section B.3, paragraph 1	For completeness, the definition of "internal boundary condition" is missing.	5	internal boundary condition is described on the next page; we either need to define both in the opening paragraph, or make subsections for external and internal so that internal stands out more--has been flagged	pef	
146	Ponce	06 - Appendix B	Page 65, section B.4, paragraph 1	The Saint Venant equations are not commonly referred to as "depth-averaged." Replace "Gradually varied 1-D unsteady flow is explained using the depth averaged equations commonly referred to as Saint Venant equations" with "Gradually varied unsteady 1-D flow is commonly described using the equations of water continuity and momentum attributed to Saint Venant"	5	agreed	amwl	
147	Ponce	06 - Appendix B	Page 66, paragraph 1	Is the last sentence needed? The first sentence of Appendix B states "The PDEs... are not directly used in the RSM." The last sentence says "The finite volume method is not directly based on this differential form..." This appears to be redundant. Need to more clearly explain the tie between the PDE's, needed to check accuracy, and the finite-volume method, needed for the OO modeling. Maybe this explanation belongs in Chapter 2.	5	The first sentence "The PDE form of the equations are not directly used in RSM" was meant to say that only the "Reynolds transport theorem form was directly used or modeled in RSM". It is true that the last sentence is redundant. The relationship between the PDE and the RSM is that both can be derived beginning from the Reynolds Transport theorem.	amwl	
148	Ponce	08 - Appendix C.1	Page 2, Introduction, paragraph 2	Liggett and Woolhiser (1967) and the other authors cited here used the 1-D overland flow equations, not the 2-D equations. It is best here to replace "The earliest 2-D models" with "The earliest models"	5	paper already published--parts that are added into Theory Manual will incorporate these suggestions	pef	
149	Ponce	08 - Appendix C.1	Page 5, Governing Equations, paragraph 1	Question the name "Saint Venant equations" to refer to the depth-integrated 2-D shallow-water equations.	5	paper already published--parts that are added into Theory Manual will incorporate these suggestions	pef	
150	Ponce	09 - Appendix C.2	Page 14, paragraph 1	Eq. 9 is not clear.	5	paper already published--parts that are added into Theory Manual will incorporate these suggestions	pef	
172	Therrien	02- Chapter 2	20	Although the stage volume relationship applies for the subsurface, the name is confusing because stage is not used to describe groundwater levels.	5	will address in manual--has been flagged, plus we have noted the need for a glossary of terms, where we would define "stage" to mean either surface water or groundwater head	pef	
173	Therrien	02- Chapter 2	23	Figure 2.6 does not show control volumes 1 and 2 (page 26).	5	Lal? I don't see any reference to control volumes 1 and 2, but it has been flagged in the manual to update the graphic	pef	
174	Therrien	02- Chapter 2	24	Figure 2.6 shows nodes and cells but at that point in the manual, it is not clear what nodes and cells are.	5	will address by expanding figure caption and image of figure 2.2--has been flagged	pef	
94	Schaffranek	02- Chapter 2	27	Are canal segments treated as prismatic channels?	2			
103	Schaffranek	02- Chapter 2	16	In the last page 21 paragraph, what is meant by "under the deep sections"? Is the meaning "for deep locations in the Everglades wetlands"?	3	yes; locations in Everglades where water depths are relatively deep		
104	Schaffranek	02- Chapter 2	22	Change the last sentence on page 26 starting at the definition of Stol to read "a small lower-limit slope for the energy grade line used to prevent division by zero in the calculation of Tmn.	3			
105	Schaffranek	02- Chapter 2	23	Change the first sentence on page 27 that reads "A value of 10-13 to 10-7 is used in the Everglades because these slopes are below typically observed slopes except in deep pools of water." to "A lower-limit slope in the range of 10-13 to 10-7 is reasonable for Everglades wetlands."	3			

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#	Author	Document	Comment Location	Comment	Goal	Response	who	Response continuation
113	Schaffranek	02- Chapter 2	13	On page 20, the first line of the second paragraph states that "…control volumes are represented by triangular prisms or objects of any other shape, depending on the water body type and discretization used." Does this mean any shape object (square, rectangular, irregular polygons, etc.) for any water body type? Does the HSE code accommodate an unstructured mesh of variable types of elements? If so, within every water body type? Also, if so, how does this pass limitations of the circumcenter method, e.g. acute triangles, identified at the bottom of page 28?	4	overland flow waterbody requires triangles; other types (e.g., canal waterbody) can have other shapes; this has been flagged for clarification in the manual	pef	
124	Jones	02- Chapter 2		Good overall introduction to the HSE. Some parts could have used more explanation. I think this chapter should be combined with Appendix C.3 and C.5 (and perhaps parts of C1).	5	requested panel to provide suggestions on what parts to move forward, what parts to drop	pef	
125	Jones	02- Chapter 2	Page 22	The derivation at the beginning of section 2.4.1 was a little difficult to follow. Could benefit from additional explanation/discussion.	5			
126	Jones	02- Chapter 2	Page 33, paragraph 3	"They are computed separately for each cell with a new land use type." New relative to what? Confusing.	5	will address in manual--has been flagged	pef	
127	Jones	02- Chapter 2	Page 34	This section lists four simple HPMs. A code "layer1nsm", "layer5", etc. is included in brackets after each type name. These codes are not explained until Appendix C.5. A similar set of codes is listed in the next section. Since this section is just a very brief summary, the codes seem out of place here.	5	will address in manual--has been flagged	pef	
128	Jones	02- Chapter 2	Page 40	Figure 2.13 could use more explanation.	5			
151	Ponce	10 - Appendix C.3	Page 2, Introduction	To compare the rate of increase of computing power with the rate of increase in complexity of other hydrologic system and water management issues is to compare apples and oranges. Better to say it this way - "While the computing power has continued to increase steadily, the complexity of the hydrologic system and the related management issues have also continued to grow".	5	paper already published--parts that are added into Theory Manual will incorporate these suggestions	pef	
152	Ponce	10 - Appendix C.3	Page 5, paragraph 1	What is meant by "micro-hydrologic features"?	5	paper already published--parts that are added into Theory Manual will incorporate these suggestions	pef	
153	Ponce	12 - Appendix C.5	General comment	This paper contains some important concepts which are not detailed in the main body of the Theory Manual. You may want to consider eventually placing some of this material within the main body of the Theory Manual.	5	see #124	pef	
160	Schaffranek	02- Chapter 2	26	In Figure 2.8 on page 30, is the matrix definition part intended to represent the canal submatrix as figure 2.7 does for overland flow or is it intended to illustrate canal flow calculations as the caption states, or both? Either this figure needs to be divided into two figures or the information the figure is intended to convey needs more description and discussion in the text, or both.	5			
175	Therrien	02- Chapter 2	25	In section 2.5.1.1., I am not sure what is meant by mixed flow.	5	As explained in the same section, two adjacent cells use different types of flow equations in mixed flow.	amwl	
176	Therrien	02- Chapter 2	27	In section 2.5, it should be clear that segments refer to canals only (I guessed it when reading section 2.5.3) and that cells refer only to overland or subsurface.	5	has been flagged to replace all "segment" with "canal segment waterbody"	pef	
177	Therrien	02- Chapter 2	30	Figure 2.12 is a good example that relates concepts in the model to a field example and I like that figure. Similar examples or figures should be used more often in the manual.	5	good idea--especiallyat the start of section 2.4 on page 22	pef	
178	Therrien	02- Chapter 2	31	The weighted implicit method (section 2.8) should be defined exactly. In general, implicit time weighting corresponds to a value of alpha equal to 1.0 in equation 2.47, which does not correspond with the term implicit method used here.	5	Has been flagged	pef	
179	Therrien	02- Chapter 2	32	Figure 2.13 is difficult to understand.	5	agreed! will address in manual--has been flagged	pef	
180	Therrien	02- Chapter 2	33	The flowchart in figure 2.14 is informative and could be modified to answer some of my comments above (show if other loops exist for non-linearity, show where convergence checks are made). However, I find that the label for the 3rd box, horizontal flow, is confusing because it suggests that only 2D flow is simulated, while I thought that the model has 3D capabilities.	5	agreed! will address in manual--has been flagged	pef	
181	Therrien	03 - Chapter 3	34	I find that chapter 3 (MSE) is rather abstract and would benefit from a few real examples to complement the description of supervisors, assessors and filters. From reading that chapter, I find it difficult to understand which situations are better handled with only assessors or with supervisors and assessors.	5	agreed--MSE is still under development, so we haven't concluded which way is better yet	pef	
182	Therrien	12 - Appendix C.5	37	Appendix C.5 has been written with a different word processor than the theory manual and it is not as easy to read. For example, equations and variables are not written with different fonts and they tend to blend with the text. I prefer the style used in the theory manuel (I assume it is Latex).	5	requested panel to provide recommendations regarding LaTeX vs. MS Word for production of documents; SFWMD will be setting standards before 10/05 and panel's experiences would be welcomed	pef	
183	Therrien	12 - Appendix C.5	41	The concept of the hub is clearly defined, but I am still not sure when it is preferable to use a hub as opposed to independent HPMs.	5	The Hub is preferred for two situations: 1) when a large area has a single water source (irrigation or urban consumptive use) and/or a single discharge. The Hub allows the HMPs that overlay each mesh cell to interact with the regional mesh at two selected locations. 2) where there distinctly different land-use types and consequently different local hydrology within a mesh cell. The Hub can be used to represent this complex hydrology. It is simpler and more flexible to construct a single Hub with multiple simple HPMs than it is to construct a unique HPM that has the necessary features.	ef	
184	Therrien	12 - Appendix C.5	42	The example in section 8 should be presented in more detail. There is missing information on the physical set up (for example, input parameters describing material properties) that makes it difficult to assess. For example, rainfall is not shown.	5	Greater detail will be added to the example in Section 8.	ef	
185	Therrien	13 - Appendix C.6	44	On page 2, the first paragraph is too broad is scope (for example, references to electrical or mechanical engineering). I would also not use the expression overwhelming proliferation, which sounds negative.	5	As in previous comment, overwhelming is removed.	jcp	
186	Therrien	13 - Appendix C.6	45	In the introduction, I think that an example of some hydraulic structures could be given. I would describe exactly the context in South Florida with respect to hydraulic structures, to provide justification for building the MSE.	5	This is a good suggestion. Section 3, which provides a model implementation and demonstration of hse/mse applied to hydraulic structures, was partially intended to address this concern.	jcp	

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270	Chin	02- Chapter 2	1. Page 17	capitalize first word in list (1-7)	9	defer to technical editor	pef	
271	Chin	02- Chapter 2	3. Page 18, Section 2.2, second paragraph	Delete the sentence that begins with "Parts of the surface integral"	9	has been flagged in manual	pef	
272	Chin	02- Chapter 2	4. Page 19, Section 2.3	replace "E = flux vector; n = unit normal vector" by "E = velocity vector; n = unit normal vector pointing out of the control volume".	1			
273	Chin	02- Chapter 2	6. Page 21, first line	change "of the St. Venant equations" to "or the St. Venant equations"	9	has been flagged	pef	
274	Chin	02- Chapter 2	10. Page 22, first sentence after Equation 2.12	change "Ao = plan area of the waterbody" to "Ao = reference plan area of the waterbody"	9			
275	Chin	02- Chapter 2	11. Page 22, first sentence after Equation 2.12	remove the phrase "that applies to any of the control volumes"	9			
276	Chin	02- Chapter 2	20. Page 31, first sentence after Equation 2.40	change "km = sediment layer conductivity" to "kv = sediment layer hydraulic conductivity"	9	has been flagged	pef	
277	Chin	02- Chapter 2	21. Page 31, Section 2.5.5, first sentence	change ";" to "."	9	has been flagged	pef	
278	Chin	02- Chapter 2	22. Page 37, Equation 2.44	remove the "dot" on RHS	9	has been flagged	pef	
279	Chin	02- Chapter 2	25. Page 40, last sentence	change "/cite" to "\cite" to correct the TeX formatting	9	has been flagged	pef	
154	Ponce	14 - SFRSM Fact Sheet	Page 2, item 15	Replace "English units" with "U.S. customary units" [SI units have been used in the papers. Is there a conflict here? Or, are both systems being used?]	5	the RSM can handle English or SI units; the default is SI. See p. 33 of HSE User Manual. The fact sheet describes the units chosen for the SFRSM implementation of the RSM.	pef	
155	Ponce	14 - SFRSM Fact Sheet		Suggest collecting all positives at the beginning, and all negatives at the end. Emphasize positives and deemphasize negatives.	5	the "negatives" are constraints within the current "SFRSM 2005" project deadline. Most of them are intended to be removed as we progress. We will probably group the general assumptions into categories that better the scope of this phase of the SFRSM project.	pef	
156	Ponce	07 - Appendices C.1 to C.4	1.	The main body of the manual consists of 56 pages. The remainder consists of Appendices A, B, and C. In particular, Appendix C consists of six (6) documents, the first four of which are published (or to be published) papers. I believe Appendices C.5 and C.6 contain information which should be part of the main body of the manual. It is okay to place published work in the appendix, but unpublished work, particularly if it relates directly to the subject matter, should be placed within the main body. This may require a major restructuring of the manual chapters.	5	see #124, #129	pef	
157	Ponce	07 - Appendices C.1 to C.4	2.	Published papers to be placed in an appendix (in this case, C.1 to C.4) should be in the original, published form. The proper permissions should be secured from the publishers.	5	see #120	pef	
158	Ponce	0 - General Comments	1.	Avoid jumping over details of equations. If the manual is to be used by practitioners (consultants and others), they need to be able to see the various steps leading to the solution, within reason, of course.	5	traditional approach equations were moved to Appendix B because they are background info; please specify if there are places where we jumped too far (such as comment #125) too fast; potential audience was detailed in Fulton slides during workshop	pef	
159	Ponce	0 - General Comments	3.	Need to be consistent on the system of units. Appendix C.5 contains SI units, while the Fact Sheet states that "all input and output data will be created in English units"	5	see #154	pef	
232	Ponce	12 - Appendix C.5	Page 2	Is the used approximation, which neglects the inertia terms, named "diffusive wave" or "diffusion wave" or "diffusion flow"? Be consistent throughout the report (Theory Manual).	7			
233	Ponce	12 - Appendix C.5	Page 9, section 3.3, paragraph 1	"explicit solution for convenience and stability" Rationale is not clear, aren't explicit solutions conditionally stable?	7			
234	Ponce	12 - Appendix C.5	Page 9, section 4, bullet 4	Replace "deterministic lumped parameter conceptual model" with "deterministic lumped-parameter conceptual model". Is the model is classified as deterministic, it cannot be conceptual; these are mutually exclusive terms. If it has components of both, then it is classified as deterministic-conceptual.	7			
235	Ponce	12 - Appendix C.5	Page 13, paragraph 1	Replace "vegetation specific reference vegetation PET correction coefficient" with "vegetation-specific reference-vegetation PET correction coefficient." Don't vegetation-specific and reference-vegetation contradict each other? Please clarify.	7	1) editorial change will be made, 2) concerning coefficients used to adjust PET values to estimate actual evapotranspiration--this comment was also made during the general comments on the model, and will be addressed by adding the following text to the Section 2 Governing Equations: The driving forces for the HPMs are rainfall and potential evapotranspiration. The rainfall is input for each cell based on a Theissen polygon estimation of local rainfall from daily rainfall data collected at 300+ gages distributed around south Florida (SFWMD, 2004a). The rainfall data are saved in a binary file that is accessed by the mesh cell to determine the daily rainfall. Daily values of potential evapotransporation (PET) are provided to each mesh cell interpolated from theissen polygon of the daily PET values at 60+ stations (SFWMD, 2004b). The daily PET values are estimated using a temperature-based method for approximating solar radiation that was calibrated to the actual ET for wetland vegetation reference-land cover. (cont)	ef	To estimate actual ET for each HPM, either crop PET-correction coefficients or cover-vegetation PET-correction coefficients are applied to the PET developed for the wetland-vegetation, reference-land cover PET. Typically, daily reference-crop PET values are available for a well-watered short grass crop (FAO, 1990), but it is felt that PET from a wetland reference-vegetation such as a mixed emergent macrophyte cover would be more appropriate for South Florida. (3 references will be added)

#	Author	Document	Comment Location	Comment	Goal	Response	who	Response continuation
236	Ponce	12 - Appendix C.5	Page 17, first sentence	How is Imax determined?	7	Lmax is computed using Eqn 50, which will be moved from the example into the <prr> HPM chapter.	ef	
237	Ponce	12 - Appendix C.5	Page 29, Table 8	What is the time duration of the depth attributes of the imperv HPM? One day? One time interval?	7	The attributes <imperv> described in Table 8 are continuous. The storages are filled by rain and emptied by evaporation. A water budget is maintained for each storage	ef	
238	Ponce	12 - Appendix C.5	Page 30, paragraph 2	How do you justify using the event-based NRCS runoff (curve number) method for hydrologic abstraction in continuous modeling? I know that this has been done in the past, but, is it generally justified?	7	The curve number method is used for estimating the volume of runoff from any single storm event. If the available watershed storage and initial abstraction are estimated in a reasonable manner, the continuous record may be broken down into a sequence of individual events. This method provides a means to use the accumulated knowledge of curve number values for different land-use and land cover types to estimate runoff. HPMs are designed to produce the one and only best method for modeling local hydrology, but also to provide comparable methods for modeling the same hydrology. The <mbrcell> HPM provides a means of implementing a CN method for local hydrology.	ef	
239	Ponce	12 - Appendix C.5	Page 31, paragraph 1	How was Eq. 44 determined? How was the constant 0.5 in Eq. 44 determined?	7			
240	Ponce	12 - Appendix C.5	Page 31, Table 9	How is time of concentration determined?	7			
241	Ponce	12 - Appendix C.5	Page 37, paragraph 2	The sentence "The urban developments receive water from offsite public water supply wells (PWS), are self-served or have both where landscape irrigation comes from a local source." is ackward. Better state as "The urban developments receive water either from offsite public water-supply wells (PWS), or are self-served, or from both (PWS and self-served) in the case where landscape irrigation comes from a local source" I hope I have not changed the meaning. Please verify.	7	agreed--sounds better; will address in manual--has been flagged	pef	
242	Ponce	12 - Appendix C.5	Page 39, Fgure 16	What is the temporal dimension of ET and runoff? Per day? Per year?	7	The temporal dimension of ET and Runoff is annual. The figure will be changed.	ef	
243	Ponce	12 - Appendix C.5	Page 40, paragraph 3	There is a danger of excessive reliance of NRCS runoff curve number to model conditions for which the model is known not to perform. NRCS is a design tool, not a continuous simulation tool. Its use in continuous simulation, for lack of a better or more convenient method, should be performed with extreme caution.	7	see #243	ef	
244	Ponce	12 - Appendix C.5	Page 41, paragraph 2	Equation 50 is dimensional, with the units of Lmax, 1000 and 10 given in inches. For usage in the metric system, the quantity 1000 and 10 need to be converted to the proper units (2540 and 25.4 for centimeters; 25.4 and 0.254 in meters). Please confirm that this is the case in this application.	7	The HPMs were originally developed in their native units (in, ft or m). In the conversion to a single scale the equation will be converted to 25.4 and 0.254 so S is in meters. The pre-processor will be used to provide those users that prefer to use local units to convert to metric for the xml input files.	ef	
356	Ponce	01 - Chapter 1	Page 4, paragraph 1	Question the usage of words such as "leveraged" and "overwhelming".	9	has been flagged for technical editor	pef	
740	Schaffranek	02- Chapter 2	14	In the last sentence of the second paragraph on page 20, change "are" to "is".	9	has been flagged	pef	
741	Schaffranek	02- Chapter 2	15	In the first sentence of the last paragraph on page 21, change first "conditions" to "factors", "have made" to "make", "possible" to "acceptable" or "reasonable", and "in south Florida" to "models of the south Florida Everglades".	9	has been flagged	pef	
742	Schaffranek	02- Chapter 2	17	Change the sentence in the last page 21 paragraph that reads "Diffusion assumption can also becomes weak in deep canals of RSM for the same reason." to "The diffusion assumption of the RSM also is weak in deep canals for the same reason."	9	has been flagged	pef	
743	Schaffranek	02- Chapter 2	18	In the last sentence on page 21, add "in simulations of the south Florida Everglades" after "of interest" and change "irrelevant, as long as the accuracy of the long period solution components can be maintained" to "neglected, as long as the solution accuracy for long period components is not compromised".	9	has been flagged	pef	
744	Schaffranek	02- Chapter 2	19	On page 23, change "When the ground level is assumed horizontal" to "When the ground surface is assumed horizontal".	9	has been flagged	pef	
745	Schaffranek	02- Chapter 2	20	On page 24, change "flat ground" to "a horizontal ground surface".	9	has been flagged	pef	
746	Schaffranek	02- Chapter 2	21	In sentence on page 25 beginning, "Hydrologic process modules (HPMs)" all words should be first letter capital as on page 33.	9	has been flagged	pef	
747	Schaffranek	02- Chapter 2	24	In the first sentence of section 2.5.1.1 on page 29, add "surface" after "ground" and change "flow takes place between them" to "flow occurs between the cells".	9	has been flagged	pef	
748	Schaffranek	02- Chapter 2	25	In section 2.5.1.1, hyphenate "inter-block" and change "filled up by the" to "representing".	9	has been flagged	pef	
749	Schaffranek	02- Chapter 2	28	At the top of page 31, hyphenate "cross-sectional".	9	has been flagged	pef	
750	Schaffranek	02- Chapter 2	29	In section 2.5.5 on page 31, change "is not easy for most of the structures" to "is difficult for most types of structures used in the Everglades".	9	has been flagged	pef	
751	Schaffranek	02- Chapter 2	30	In the second paragraph of section 2.5.5, change "differential equations with structure equations" to "differential equations for structures".	9	has been flagged	pef	
752	Schaffranek	02- Chapter 2	31	Add PWS, defined on page 34, to Acronyms list.	9	has been flagged	pef	
753	Schaffranek	02- Chapter 2	32	In the first full paragraph on page 37, insert "land" after "impervious" in the sentence that begins "The Hub allows runoff…".	9	has been flagged	pef	
754	Schaffranek	02- Chapter 2	33	In second paragraph on page 39, change matrix "P" to "M" and hyphenate "one-thousand".	9	has been flagged	pef	
755	Schaffranek	02- Chapter 2	34	At the bottom of page 40, correct Latex "/citePutti:1996" to "Putti (1996)" and add reference in Bibliography.	9	has been flagged	pef	
756	Schaffranek	02- Chapter 2	35	Add WQPM and EPM, defined on page 41, to Acronyms list.	9	has been flagged	pef	
129	Jones	03 - Chapter 3		Good introduction to the MSE, but I found Appendix C.6 to be more helpful. I recommend combining this chapter with Appendix C.6.	5	requested panel to provide suggestions on what parts to move forward, what parts to drop	pef	

Note: any comment with a blank response will be addressed in the District's response to this panel's findings, scheduled for August, 2005.

#	Author	Document	Comment Location	Comment	Goal	Response	who	Response continuation
130	Jones	03 - Chapter 3	Page 44, paragraph 2	This paragraph was not particularly helpful. Could have been explained in more detail.	5	not sure which paragraph is being referred to; maybe a figure is needed for section 3.2?	pef	
131	Jones	03 - Chapter 3	Page 45, Figure 3.2	This figure is not helpful. First of all the figure is blurry. Second, the accompanying text did not explain it well. Three pages later on page 48, the components of the figure were finally described.	5	will address in manual--has been flagged	pef	
132	Jones	03 - Chapter 3	Page 46, Figure 3.3	Figure is blurry.	5	will address in manual--has been flagged	pef	
133	Jones	03 - Chapter 3	Page 47, Figure 3.4	Overall figure is blurry. The leftmost image in the figure is mostly black and difficult to read.	5	will address in manual--has been flagged	pef	
187	Therrien	13 - Appendix C.6	47	The last sentence of the 1st paragraph on page 3 is not clear.	5	Referring to: "Given a well defined interface between the two, this approach enables multiple information processing algorithms to execute in parallel, with higher levels of the hierarchical management able to synthesize the individual results which are best suited to the managerial objectives." This can be changed for clarification. The primary idea was to recognize that careful design of the supervisor/controller interfaces, and controller/watermover interfaces enables multiple controllers/supervisors to run in parallel, with the ability to dynamically change control charateristics.	jcp	
280	Chin	03 - Chapter 3	1.	Readable and informative	9	no comment	pef	
281	Chin	03 - Chapter 3	2.	Fix grammatical changes suggested by Ponce	9	see Ponce comments	pef	
357	Ponce	01 - Chapter 1	Page 4	Is "south Florida" correct? Or, should it be "South Florida?" (several instances, no consistency).	9	south Florida is correct; we are not consistent--this has been flagged	pef	
358	Ponce	01 - Chapter 1	Page 5, paragraph 2	Question the word "developing;" it should be "has developed."	9	we'll never stop tweaking…:-) has been flagged for technical editor	pef	
359	Ponce	01 - Chapter 1	Page 5, paragraph 3	Note about future developments of the model should not be placed in parenthesis; state in a sentence by itself.	9	will address in manual--has been flagged	pef	
360	Ponce	01 - Chapter 1	Page 5, Figure 1.1	t missing in "managemen"	9	will address in manual--has been flagged	pef	
361	Ponce	01 - Chapter 1	Page 5, Figure 1.1	Where is HPM in the figure?	9	will address in manual--has been flagged	pef	
362	Ponce	01 - Chapter 1	Page 6, paragraph 3	Replace "Chapter two" with "Chapter 2"	9	will address in manual--has been flagged	pef	
363	Ponce	01 - Chapter 1	Page 6, paragraph 4	Replace "Chapter three presents" with "Chapter 3 presents" (no consistency in this paragraph)	9	will address in manual--has been flagged	pef	
364	Ponce	01 - Chapter 1	Page 6, paragraph 5	Question the use of the word "traditionally" in this context.	9			
365	Ponce	01 - Chapter 1	Page 7, paragraph 1	Question the use of the word "always;" too strong.	9	will address in manual--has been flagged	pef	
366	Ponce	01 - Chapter 1	Page 7, paragraph 1	Replace "sheet flow have to be" with "sheet flow would have to be"	9	will address in manual--has been flagged	pef	
367	Ponce	01 - Chapter 1	Page 7, paragraph 2	No need to mention "slow" in here; it is understood.	9	will address in manual--has been flagged	pef	
368	Ponce	01 - Chapter 1	Page 9, paragraph 1	Question the use of "Seeing."	9	will address in manual--has been flagged	pef	
369	Ponce	01 - Chapter 1	Page 9, paragraph 1	Question the use of "currently under development." It obsoletes the phrase when the model is finished. Unless the model is being planned to be under development for a long time.	9	see #358! Has been flagged	pef	
757	Schaffranek	03 - Chapter 3	36	On page 47, define LP since this is the first occurrence.	9	has been flagged	pef	
758	Schaffranek	03 - Chapter 3	37	Add MIMO, defined on page 49, to Acronyms list.	9	has been flagged	pef	
759	Schaffranek	04 - Bibliography	38	References (Senarath et al., 2001), (Shen et al., 1997), and (Solomantine, 1996) need corrected.	9	will address in manual--has been flagged	pef	
29	Jones	05 - Appendix A	Page 58, item 8	"Check if the overall mass balance conditions in the model are within reasonable (<10%) limits." 10% seems a little high to me.	1	This comment (8) was made in the middle of the uncertainty (6) and accuracy (7) discussion of Appendix A. The 10% was a rule of thumb intended for the comparison of SFRSM model results with observed data, considering the quality of the discharge data in the SFWMD databases. For areas where good data is available, the number could be much smaller. The 10% does not refer to numerical error in simulated head or overall model error. These are variable, and Lal (2000) should be used as a guide, as mentioned in #5.	amwl	
370	Ponce	01 - Chapter 1	Page 9, paragraph 3	No need for the phrase "Without these three building blocks, RSM could not meet the needs of south Florida"	9	will address in manual--has been flagged	pef	
188	Therrien	13 - Appendix C.6	48	Appendix C.6 uses numbered references (for example on page 3), which is not consistent with the other parts of the manual. Also, the table caption is located below, compared to above the table in other sections of the manual.	5	Agreed.	jcp	
371	Ponce	01 - Chapter 1	Page 9, paragraph 4	Use of first person pronoun "us" should be discouraged.	9	see #261	pef	
372	Ponce	01 - Chapter 1	Page 9, paragraph 4	No need to mention that OO is outside of the expertise of many hydrologists.	9	will address in manual--has been flagged	pef	
373	Ponce	01 - Chapter 1	Page 11, paragraph 2	Define or better explain "lookup tables." This is very important, because they are critical to the modeling accuracy.	9	"lookup" defined in dictionary .com as "a procedure in which a table of values stored in a computer is searched until a specified value is found"	pef	
374	Ponce	01 - Chapter 1	Page 11, paragraph 3	Replace "discretizations for integrated modeling approach" for "discretizations for the integrated modeling approach"	9	will address in manual--has been flagged	pef	
375	Ponce	01 - Chapter 1	Page 12, paragraph 1	Replace "language(XML)" with "language (XML)"	9	see #264	pef	
376	Ponce	01 - Chapter 1	Page 12, paragraph 2	Use of first person pronoun "we" should be discouraged.	9	see #265	pef	
377	Ponce	01 - Chapter 1	Page 12, paragraph 3	Replace "Lal, 2001." with "(Lal, 2001)."	9	will address in manual--has been flagged	pef	
378	Ponce	01 - Chapter 1	Page 13, paragraph 1	Question the use of the word "tremendous' here. Overstated.	9	tremendous idea; has been flagged	pef	

#	Author	Document	Comment Location	Comment	Goal	Response	who	Response continuation
379	Ponce	01 - Chapter 1	Page 13, paragraph 2	"better" repeated too often. Use "enhanced" or "improved" instead.	9	will address in manual--has been flagged	pef	
380	Ponce	01 - Chapter 1	Page 14, bullet 11	Replace "water level difference based" for "water-level-difference-based"	9	will address in manual--has been flagged	pef	
381	Ponce	01 - Chapter 1	Page 14, section 1.4	Replace "sub-surface" with "subsurface"	9	will address in manual--has been flagged	pef	
382	Ponce	01 - Chapter 1	Page 14, section 1.4	Replace "essential to make progress" with "essential to enable progress"	9	will address in manual--has been flagged	pef	
383	Ponce	01 - Chapter 1	Page 15, paragraph 3	delete two instances of "also"	9	will address in manual--has been flagged	pef	
384	Ponce	01 - Chapter 1	Page 15, paragraph 5	Replace "difficult conditions" with "trying conditions" or "challenging conditions"	9	will address in manual--has been flagged	pef	
385	Ponce	01 - Chapter 1	Page 15, paragraph 5	Replace "see Appendix C for additional references with details regarding some of this research" for "see Appendix C for additional references"	9	will address in manual--has been flagged	pef	
386	Ponce	02- Chapter 2	Page 16; paragraph 2	Replace "sophisticated set of rules" with "predetermined set of rules." (Overstated)	9	has been flagged	pef	
387	Ponce	02- Chapter 2	Page 16; paragraph 3	Replace "high level abstractions" with "high-level abstractions"	9	has been flagged	pef	
388	Ponce	02- Chapter 2	Page 17, paragraph 1, bullet 3	Replace "complicated" with "complex"	9	has been flagged	pef	
389	Ponce	02- Chapter 2	Page 17, last paragraph, into Page 18	"important" repeated three times; please reword.	9	has been flagged	pef	
760	Schaffranek	05 - Appendix A	39	Reference citation to "Abbott (1982)" on page 58 is not listed in the Bibliography.	9	should have been Abbott & Cunge, 1982; has been flagged	pef	
761	Schaffranek	05 - Appendix A	40	At the bottom of page 58, correct mistype of "hydrologic".	9	has been flagged	pef	
16	Chin	06 - Appendix B	1. General comment	I am not convinced of the necessity of having an appendix that covers equations that are not used in the RSM	1	Will Consider (App. B/Traditional Approach)	pef	
17	Chin	06 - Appendix B	4. Page 61, Equation B.2	A term accounting for the infiltration rate is missing	1			
18	Chin	06 - Appendix B	6. Page 62, sentence before Equation B.5	Change "without the source term to produce the following vector momentum equation" to "without the source term to produce the following vector equation". The combination of the momentum equation and the continuity equation does not produce a momentum equation.	1			
19	Chin	06 - Appendix B	7. Page 62, second sentence after Equation B.5	The statement that "Equation B.5 can be integrated along a streamline to obtain the commonly-used energy equation." is not correct, this is a common misconception. This is what is done to produce the Bernoulli equation, which is not the energy equation. The energy equation is derived from the first law of thermodynamics, and cannot be derived from the momentum equation.	1	The reviewer comment is partly true and not completely true. As shown in incompressible flow by Panton (1984), p-124, section 5.10, The equation that governs kinetic energy is not an independent law but is derived from the momentum equation. At a later point in the paragraph, The thermal energy equation is obtained by subtracting the mechanical energy equation from the thermal energy equation. What was presented in (4) of Lal (1998c) was the vector form of the momentum equation as derived similar to eq 12.3.4 of Panton (1984), page 316 instead of two scalar forms of the same equation. As in the case where the momentum equation integrates to Bernoullis equation along a straight line when the flow is irrotational, eq (4) of Lal (1998c) also becomes Bernoulli when the flow is irrotational and there is no friction. The purpose of this whole exercise was (in historic terms now, considering that this attempt failed) to see if the diffusion flow solution could be enhanced (cont)	amwl	by adding convective acceleration terms masquerading as $V^2/2$ to the formulation. Unfortunately it was found to be not only inaccurate, but also numerically unstable. The reviewers of ASCE first pointed this out, and the effort was abandoned. However the vector equation was left in the manuscript. The formulation used in RSM is a simple diffusion flow formulation where this term is absent along with the vorticity terms, which means that both local and convective acceleration terms are dropped out of the equation. After these terms are dropped out, the remaining equation is a force balance equation between gravity and friction terms which also can be presented in the standard energy equation format. In conclusion it has to be pointed out that the form of the diffusion equation used in RSM is simple and has been used by many others. The intent of the paragraph was to obtain a kinetic energy equation that looks like the energy equation along the flow.
20	Chin	06 - Appendix B	9. Page 62, Equation B.6	Comment, this is actually the definition of Sf. Equation B.6 (a definition equation) results because the simplifications in the momentum equation leading to Equation B.6 are the same as the assumptions involved in approximating the boundary shear stress (in the momentum equation) equal to gamma x R x Sf.	1	True. The attempt here was to evaluate terms associated with the diffusion flow model in various ways.	amwl	
21	Chin	06 - Appendix B	10. Page 63, Equations B.7 and B.8	It should be made clear that Equations B.7 and B.8 are linearized approximations to the Manning equation.	1	true	amwl	
22	Chin	06 - Appendix B	11. Page 63, first line after Equation B.12	I would strongly discourage using defining sc as the storage coefficient. In ground-water hydrology the storage coefficient generally implies a confined aquifer, which is not the case here. The more correct term would be the specific yield.	1	see #6	amwl	
23	Chin	06 - Appendix B	12. Page 63, Section B.2, first sentence	This statement is not strictly correct. A suggested modification is as follows - "For ground-water flow, combining the continuity equation with Darcy's law, applying the Dupuit-Forcheimer approximation, and assuming that the formation is isotropic, the governing equation is given by (B.12)..."	1	the suggested change is good	amwl	
390	Ponce	02- Chapter 2	Page 18, Section 2.2, paragraph 3	"those who may not be familiar with OO methods". This phrase is condescending. Reword or eliminate.	9	has been flagged	pef	

#	Author	Document	Comment Location	Comment	Goal	Response	who	Response continuation
391	Ponce	02- Chapter 2	Page 19, Section 2.3, paragraph 1	Replace "Reynolds transport theorem" for "The Reynolds transport theorem"	9	has been flagged	pef	
392	Ponce	02- Chapter 2	Page 20, Figure 2.3	Move "groundwater" to the left so that the "r" can be better seen.	9	has been flagged	pef	
393	Ponce	02- Chapter 2	Page 21, paragraph 1	Replace "The bottom shear stress can be explained" with "The bottom shear stress can be expressed"	9	has been flagged	pef	
70	Schaffranek	06 - Appendix B	46	At the bottom of page 65, change "three" to "two" in sentence that reads "After neglecting the first three terms contributing to inertia effects, ".	1			
394	Ponce	02- Chapter 2	Page 23, section 2.4.2, paragraph 1	Replace "described next." with" described below."	9	has been flagged	pef	
395	Ponce	02- Chapter 2	Page 25, paragraph 1	Replace "pure sources" with "sources"	9	has been flagged	pef	
396	Ponce	02- Chapter 2	Page 25, paragraph 2	Replace "gradient driven" with "gradient-driven"	9	has been flagged	pef	
397	Ponce	02- Chapter 2	Page 25, last line	Replace "current diffusion flow formulation" with "diffusion flow formulation"	9	has been flagged	pef	
282	Chin	06 - Appendix B	2. Page 61, Section B.1, second sentence	Change "It is presented" to "They are presented"	9	has been flagged	pef	
283	Chin	06 - Appendix B	3. Page 61, Equations B.1 and B.2	Add equal signs when defining variables	9	has been flagged	pef	
284	Chin	06 - Appendix B	5. Page 62, first paragraph	Change "These aspects are dealt in local hydrologic" to "These aspects are dealt with in local hydrologic"	9	has been flagged	pef	
285	Chin	06 - Appendix B	8. Page 62, next sentence after the above sentence	put commas in and modify as follows - "The first term in (B.5), which is the local acceleration term, and the second term, which is the convective acceleration term, account for inertia effects."	9	has been flagged	pef	
286	Chin	06 - Appendix B	13. Page 64, Section B.3, first sentence	Change "specified at infinity as in the case of Theies problem" to "specified at infinity, as in the case of Theis problem"	9	will address in manual--has been flagged	pef	
287	Chin	06 - Appendix B	14. Page 64, Section B.3 second paragraph, first sentence	Change "type of the problem," to "type of the problem to be solved,"	9	has been flagged	pef	
288	Chin	06 - Appendix B	15. Page 64, Section B.3 second paragraph, third sentence	Change "If the boundary conditions type selected is not the proper type, the resulting solution will lack in well-posedness" to "If the boundary condition type selected is not the proper type, the resulting solution will lack well-posedness"	9	has been flagged	pef	
289	Chin	06 - Appendix B	16. Page 64, Section B.3 fourth paragraph, first sentence	Change "water water" to "water"	9	has been flagged	pef	
290	Chin	06 - Appendix B	17. Page 64, Section B.3 fourth paragraph	Change "control point" to "control section"	9	has been flagged	pef	
291	Chin	06 - Appendix B	18. Page 64, last sentence	Change "bounfary" to "boundary"	9	see #343	pef	
292	Chin	06 - Appendix B	19. Page 65, Section B.4, first sentence	Change "depth averaged" to "cross-section averaged"	9	has been flagged	pef	
293	Chin	06 - Appendix B	20. Page 65, sentence continuation after Equation B.14	Change "water level; beta" to "water level; and beta". In the following sentence, change "three" to "two".	9	has been flagged	pef	

#	Author	Document	Comment Location	Comment	Goal	Response	who	Response continuation
294	Chin	06 - Appendix B	21. Page 65, last sentence	Change "can be expressed in the following form using Manning's equations" to "can be approximated using the following form of the Manning equation"	9	has been flagged	pef	
295	Chin	06 - Appendix B	22. Page 66, sentence before Equation B.17	Remove the word "now".	9	has been flagged	pef	
296	Chin	06 - Appendix B	23. Page 66 Equation B.17	Change "qae" to "qint" to be consistent with Equation B.13.	9	has been flagged	pef	
343	Jones	06 - Appendix B	Page 64. last paragraph	"bounfary" should be "boundary"	9	will address in manual--has been flagged	pef	
398	Ponce	02- Chapter 2	page 31, section 2.5.6	Replace "(Equation 2.21)" with "Equation 2.21"	9	has been flagged	pef	
399	Ponce	02- Chapter 2	Page 32	Replace "The case" with "For the case"	9	has been flagged	pef	
400	Ponce	02- Chapter 2	Page 37, paragraph 2	Replace "landuse" for land-use	9	has been flagged	pef	
401	Ponce	02- Chapter 2	Page 39, section 2.8, paragraph 2	Replace "one thousand cell discretization" with "one-thousand cell discretization" or "a discretization of one thousand cells"	9	has been flagged	pef	
402	Ponce	02- Chapter 2	Page 39, section 2.8, paragraph 3	Replace "values used;a" with "values used; a"	9	has been flagged	pef	
403	Ponce	02- Chapter 2	Page 40, paragraph 2	Replace "involved mainly for" with "involved for"	9	has been flagged	pef	
404	Ponce	02- Chapter 2	Page 40, section 2.8.1	delete "/cite"	9	has been flagged	pef	
405	Ponce	02- Chapter 2	Page 41, paragraph 2	Replace "EPMs are being developed to simulate landscape and habitat" with "EPMs simulate landscape and habitat"	9	these are still under development--will clarify	pef	
406	Ponce	03 - Chapter 3	Page 42, paragraph 1	Replace "water resource management schemes" with "water-resource-management schemes"	9	defer to technical editor	pef	
407	Ponce	03 - Chapter 3	Page 42, paragraph 1	Delete "carefully designed and". It is redundant.	9	has been flagged	pef	
408	Ponce	03 - Chapter 3	Page 42, paragraph 2	Replace "water resource control schemes" with "water-resource-control schemes"	9	defer to technical editor	pef	
409	Ponce	03 - Chapter 3	Page 42, paragraph 2	Replace "water resource management feature" with "water-resource-management feature"	9	defer to technical editor	pef	
410	Ponce	03 - Chapter 3	Page 43, section 3.1, bullet 2	Replace "alternative resource control strategies" with "alternative resource-control strategies"	9	has been flagged	pef	
411	Ponce	03 - Chapter 3	Page 43, section 3.1, paragraph 3, bullet 1	Replace "water resource reallocation" with "water-resource reallocation"	9	defer to technical editor	pef	
412	Ponce	03 - Chapter 3	Page 47, Figure 3.4 caption	Replace "M SE" with "MSE"	9	has been flagged	pef	
413	Ponce	03 - Chapter 3	Page 50, section 3.3.2, paragraph 3:	Replace "Related to the assessors are MSE filters." with "MSE filters are related to the assessors."	9	has been flagged	pef	
414	Ponce	03 - Chapter 3	Page 50, seciton 3.3.2, paragraph 3	Replace "from the users perspective" with "from the user's perpective"	9	has been flagged	pef	
762	Schaffranek	06 - Appendix B	41	In the second sentence on page 62, insert "with" after "dealt".	9	has been flagged	pef	
763	Schaffranek	06 - Appendix B	42	On page 62, change format of the "Kadlec and Knight (1996)" reference citation to "(Kadlec and Knight ,1996)".	9	has been flagged	pef	
764	Schaffranek	06 - Appendix B	43	In line after equation (B.9) on page 63, change "ds" to "dn" in sentence that begins "A value of …".	9	has been flagged	pef	
765	Schaffranek	06 - Appendix B	44	In line after equation (B.10) on page 63, change "expresses" to "expressed".	9	has been flagged	pef	
766	Schaffranek	06 - Appendix B	45	On page 64 in the fourth paragraph, delete the first "as" in the sentence that reads "The two components of water velocities can also be used as at…".	9	has been flagged	pef	
767	Schaffranek	06 - Appendix B	47	At the bottom of page 65 and top of page 66, use non-possessive form to reference the Manning equation and coefficient to be consistent with prior usage, e.g., see page 62.	9	has been flagged	pef	
768	Schaffranek	06 - Appendix B	48	At the bottom of page 65, change "using Manning's equations" to "using the Manning equation".	9	has been flagged	pef	
415	Ponce	03 - Chapter 3	Page 50, section 3.3.2, paragraph 3	Replace "(first-in, first-out)" with (first in, first out)"	9	left as is--checked www.dictionary.com	pef	
189	Therrien	13 - Appendix C.6	49	On page 4, I am not sure what is meant exactly by "partially available features" and "disjoint functional overlaps".	5	The 'partially available' is described in the individual sections of each feature, for example under Arbitrary Control: The feature is partially implemented if the model restricts the expression of control algorithms to a set of rules, or limits the inputs to a restricted set hydraulic and temporal variables. Disjoint functional overlap simply means that not all of the models have the same functional capabilities.	jcp	

#	Author	Document	Comment Location	Comment	Goal	Response	who	Response continuation
141	Jones	07 - Appendices C.1 to C.4		As for the documentation, I thought it was well-written overall. It was fairly easy to read, with certain exceptions noted in my review sections below. I did have some concerns about the organization and structure of the documents. The documentation consists primarily of three chapters with a series of articles included in the Appendix. As I was reading the three chapters there were many instances where I felt that more explanation and detail was needed. Much of this was provided later in the articles in the Appendix. Furthermore, there was considerable amount of redundant information between the chapters and the Appendix. I would suggest taking sections C1, C3, C5, and C6 in the Appendix and integrating them into the main body of the manual. The other sections could be left in the Appendix.	5	requested panel to provide suggestions on what parts to move forward, what parts to drop	pef	
416	Ponce	03 - Chapter 3	Page 51, section 3.4.1, paragraph 2, bullet 1	Replace "rulecurves" with "rule curves"	9	has been flagged	pef	
417	Ponce	03 - Chapter 3	Page 51, section 3.4.1, paragraph 2, bullet 2	Replace "Piecewise linear transfer function" with "Piecewise-linear transfer function"	9	has been flagged	pef	
776	Schaffranek	07 - Appendices C.1 to C.4	49	Published papers were read for verifying theory development in the RSM Theory Manual. Any questions are reflected in above review comments.	5	see #120	pef	
418	Ponce	03 - Chapter 3	Page 51, section 3.4.1, paragraph 2, bullet 6	Replace "finite state machine" with "finite-state machine"	9	left as is--checked www.dictionary.com	pef	
419	Ponce	05 - Appendix A	Page 57, paragraph 1, 3rd sentence	Avoid starting a sentence with "And"	9	will address in manual--has been flagged	pef	
420	Ponce	05 - Appendix A	Page 57, paragraph 2	Replace "Numerous articles" with "Several articles"	9	agreed	pef	
421	Ponce	05 - Appendix A	Page 57, paragraph 2	Replace "should also be consulted prior to the application" with "provide the bakground documentation for the application"	9	agreed	pef	
118	Chin	08 - Appendix C.1	1	I have looked closely at Appendix C.1 and compared it to the published paper. The text is not exactly the same. To be efficient in reviewing the Theory Manual, I would strongly recommend that the published version of the paper (rather than an earlier version of the paper) be included in Appendix C.1. The same should be done for Appendices C.2 and C.3.	5	see #120	pef	
119	Chin	08 - Appendix C.1	2	I have read Appendix C.1, which was published about 7 years ago, obviously when the RSM was in early stages of development. This paper documents the relative advantage of the circumcenter method versus the line integral method in calculating cell-boundary fluxes. In today's model, this is no longer an issue, since the circumcenter method has been adopted in the RSM. The benchmark examples used to demonstrate the relative advantages of the circumcenter method were very simplistic, and maybe not representative of the types of applications being envisioned for today's model. Nevertheless, including Appendix C.1 (published version) is justified since it provides additional details to equations presented in the main chapters of the Theory Manual.	5	see #124	pef	
120	Chin	08 - Appendix C.1	3	I am in the process of securing the published versions of Appendices C.2 and C.3, so that I do not have to look at (possibly) earlier versions.	5	checked with attorneys and we have a green light to use the copyrighted journal articles in the appendix, unless we decide to take parts out and put them in the main body instead	pef	
134	Jones	08 - Appendix C.1		Good overview of model. It would have been nice to have a copy of the published paper with the figures integrated with the text. The same is true for each of the previously published papers.	5	see #120	pef	
422	Ponce	05 - Appendix A	Page 57, paragraph 2	Replace "numerous operational alternatives" with "many operational alternatives"	9	agreed	pef	
423	Ponce	05 - Appendix A	Page 57, paragraph 2	Replace "any other model" with "other models" (Overstated).	9	has been flagged	pef	
424	Ponce	05 - Appendix A	Page 57, paragraph 3	Reword "One should be very careful..." Perhaps "Users should be very careful..." will do.	9	has been flagged	pef	
425	Ponce	05 - Appendix A	Page 57, paragraph 4	Replace "does not say anything" with "says little" (Overstated)	9	has been flagged	pef	
426	Ponce	05 - Appendix A	Page 58, paragraph 1, number 4	Replace "well- posed" with "well-posed"	9	has been flagged	pef	
427	Ponce	05 - Appendix A	Page 58, paragraph 2	Reword "One should consider..."	9	has been flagged	pef	
428	Ponce	05 - Appendix A	Page 58, paragraph 3	Replace "hydlorogic" with "hydrologic" (Typo)	9	has been flagged	pef	
429	Ponce	05 - Appendix A	page 59, section A.2, number 1	Replace "a variety of hydrologic models to understand the underlying" with "a variety of hydrologic models to describe the underlying"	9	has been flagged	pef	
430	Ponce	05 - Appendix A	Page 59, section A.2, number 2	Delete "in the model structure" (unnecessary)	9	has been flagged	pef	
431	Ponce	05 - Appendix A	Page 59, section A.2, number 2	Replace "without having to abandon the entire model" with "without becoming obsolecent"	9	has been flagged	pef	
432	Ponce	05 - Appendix A	Page 60, number 6	Replace "Even if a certain amount of this is inevitable" with "Even is a certain amount of this practice is inevitable"	9	has been flagged	pef	
433	Ponce	05 - Appendix A	Page 60, number 6	Replace "Anyone" with "Other parties" or "Third parties"	9	has been flagged	pef	
434	Ponce	05 - Appendix A	Page 60, number 6	Replace "should be allowed and even encouraged to do so" with "can do so"	9	has been flagged	pef	
435	Ponce	05 - Appendix A	Page 60, number 8	Replace "Non personal" with "Non-personal"	9	has been flagged	pef	

#	Author	Document	Comment Location	Comment	Goal	Response	who	Response continuation
436	Ponce	05 - Appendix A	Page 60, number 8	Replace "the use of scientific method falling to the original authors" with "the credit for the development of a scientific method falling to the original authors"	9	has been flagged	pef	
437	Ponce	05 - Appendix A	Page 60, number 8	In this paragraph, you may want to use the word "open source." This is a commonly used term to denote the fact that the source code is open to anybody willing to participate.	9	has been flagged	pef	
438	Ponce	06 - Appendix B	Page 61	Question the use of the title "Governing Equations Using the Traditional Approach." Prefer "Governing Equations in Partial Differential Form" or "Governing Equations of Hydromechanics."	9	has been flagged	pef	
439	Ponce	06 - Appendix B	Page 63, paragraph 1	Replace "conveyance can be expresses" with "conveyance can be expressed"	9	has been flagged	pef	
440	Ponce	06 - Appendix B	Page 63, paragraph 2	Replace "sub-surface" with "subsurface"	9	has been flagged	pef	
441	Ponce	06 - Appendix B	Page 63, paragraph 2	Replace "using many of the methods used to solve parabolic equations" with "using methods applicable to parabolic equations"	9	has been flagged	pef	
442	Ponce	06 - Appendix B	Page 63, section B.2, paragraph 1	Replace "object oriented" with "object-oriented"	9	has been flagged	pef	
443	Ponce	06 - Appendix B	Page 64, section B.3, paragraph 1	Do not start sentence with "Unless". Reword.	9	has been flagged	pef	
444	Ponce	06 - Appendix B	Page 64, section B.3, paragraph 1	Replace "Theies" with "Theis" (misspelling).	9	has been flagged	pef	
445	Ponce	06 - Appendix B	Page 64, section B.3, paragraph 3	Replace "sub-critical" with "subcritical"	9	has been flagged	pef	
446	Ponce	06 - Appendix B	Page 64, section B.3, paragraph 3	Last sentence is awkward; rephrase and/or clarify.	9	has been flagged	pef	
447	Ponce	06 - Appendix B	Page 64, section B.3, paragraph 4	Replace "shallow water water models" with "shallow-water models"	9	has been flagged	pef	
448	Ponce	06 - Appendix B	Page 64, section B.3, paragraph 4	Replace "can also be used as at" with "can also be used at"	9	has been flagged	pef	
449	Ponce	06 - Appendix B	Page 64, section B.3, paragraph 4	Replace "specified head" with "specified-head" or "head-specified"	9	has been flagged	pef	
450	Ponce	06 - Appendix B	Page 64, section B.3, paragraph 5	Replace "the governing equation used is nonlinear parabolic" with "the system of governing equations is nonlinear and parabolic"	9	has been flagged	pef	
451	Ponce	06 - Appendix B	Page 64, section B.3, paragraph 4	Replace "ground water" "groundwater"	9	has been flagged	pef	
452	Ponce	06 - Appendix B	Page 64, section B.3, paragraph 5	The correct spelling for Neuman is "Neumann" However, the incorrect spelling has been used in groundwater.	9	okay	pef	
453	Ponce	06 - Appendix B	Page 65, section B.3, paragraph 5	Replace "mixed type" with "mixed-type"	9	has been flagged	pef	
454	Ponce	06 - Appendix B	Page 65, section B.3, paragraph 5	Replace semi-pervious" with "semipervious"	9	has been flagged	pef	
455	Ponce	08 - Appendix C.1	Page 1, Title	Replace "A weighted implicit finite volume model for overland flow" with "A weighted-implicit finite-volume model for overland flow"	9	paper already published--parts that are added into Theory Manual will incorporate these suggestions	pef	
456	Ponce	08 - Appendix C.1	Page 1, Abstract	Replace "A weighted implicit finite volume model for overland flow" with "A weighted-implicit finite-volume model for overland flow"	9	paper already published--parts that are added into Theory Manual will incorporate these suggestions	pef	
457	Ponce	08 - Appendix C.1	Page 1, Abstract	Replace "two dimensional diffusion flow" for "two-dimensional diffusion flow" (Two instances in this paragraph).	9	paper already published--parts that are added into Theory Manual will incorporate these suggestions	pef	
458	Ponce	08 - Appendix C.1	Page 1, Abstract	Replace "the implicit formulation makes the model stable and run faster" with "The implicit formulation makes the model stable and enables it to run faster"	9	paper already published--parts that are added into Theory Manual will incorporate these suggestions	pef	
459	Ponce	08 - Appendix C.1	Page 1, Abstract	Replace "conjugate gradient" with "conjugate-gradient" (also all other instances)	9	paper already published--parts that are added into Theory Manual will incorporate these suggestions	pef	
460	Ponce	08 - Appendix C.1	Page 1, Abstract	Replace "that had known solutions" with "for which solutions are available"	9	paper already published--parts that are added into Theory Manual will incorporate these suggestions	pef	
461	Ponce	08 - Appendix C.1	Page 1, Abstract	Replace "weighted implicit methods" for "weighted-implicit methods" (As opposed to forward-implicit methods)	9	paper already published--parts that are added into Theory Manual will incorporate these suggestions	pef	
462	Ponce	08 - Appendix C.1	Page 1, Abstract	Replace "The method is to be used" with "The method will be used"	9	paper already published--parts that are added into Theory Manual will incorporate these suggestions	pef	
463	Ponce	08 - Appendix C.1	Page 1, Abstract	Replace "local and regional modeling problems in South Florida" with "local and regional flow modeling in South Florida"	9	paper already published--parts that are added into Theory Manual will incorporate these suggestions	pef	
464	Ponce	08 - Appendix C.1	Page 1, Introduction	Replace "large scale" with "large-scale"	9	paper already published--parts that are added into Theory Manual will incorporate these suggestions	pef	
465	Ponce	08 - Appendix C.1	Page 2, Introduction, paragraph 1	Replace "The features" with "Features"	9	paper already published--parts that are added into Theory Manual will incorporate these suggestions	pef	
466	Ponce	08 - Appendix C.1	Page 2, Introduction, paragraph 2	Replace "finite element" with "finite-element" and "finite volume" with "final-volume"	9	paper already published--parts that are added into Theory Manual will incorporate these suggestions	pef	

#	Author	Document	Comment Location	Comment	Goal	Response	who	Response continuation
467	Ponce	08 - Appendix C.1	Page 2, Introduction, paragraph 2	Replace "the inertia term is negligible" with "the inertia terms are negligible" (Under an Eulerian frame, there are two types of inertia - local and convective)	9	paper already published--parts that are added into Theory Manual will incorporate these suggestions	pef	
121	Chin	09 - Appendix C.2	1	Reviewed the published version of this paper. Include this version in the Theory Manual.	5	see #120	pef	
468	Ponce	08 - Appendix C.1	Page 3, Introduction, paragraph 2	Suggest using the adjective "finite-volume" throughout, rather than "finite volume" (Many references)	9	paper already published--parts that are added into Theory Manual will incorporate these suggestions	pef	
297	Chin	09 - Appendix C.2	2	This is an interesting and relevant paper that discusses the relationship between numerical errors (in 1-D and 2-D wave propagation problems) and spatial and temporal discretization. These results are particularly useful if the forcing function is sinusoidal. This paper provides a basis for the RSM error analysis performed in Appendix C.3.	9	no comment	pef	
344	Jones	09 - Appendix C.2		No specific editorial comments.	9	no comment	pef	
469	Ponce	08 - Appendix C.1	Page 3, Introduction, paragraph 3	Suggest using the adjective "weighted-implicit" throughout, rather than "weighted implicit" (Many references)	9	paper already published--parts that are added into Theory Manual will incorporate these suggestions	pef	
470	Ponce	08 - Appendix C.1	Page 4, Introduction, paragraph 1	Suggest using the adjective "conjugate-gradient" throughout, rather than "conjugate gradient" (Many references)	9	paper already published--parts that are added into Theory Manual will incorporate these suggestions	pef	
471	Ponce	08 - Appendix C.1	Page 5, Introduction, paragraph 2	Replace "both long and short term simulations" with "both long- and short-term simulations"	9	paper already published--parts that are added into Theory Manual will incorporate these suggestions	pef	
472	Ponce	08 - Appendix C.1	Page 5, Introduction, paragraph 2	Replace "some results shown at low resolutions" with "some results shown at low grid resolution"	9	paper already published--parts that are added into Theory Manual will incorporate these suggestions	pef	
473	Ponce	08 - Appendix C.1	Page 5, paragraph 1	Replace "The first term is neglected in slowly varying flow" with "The first two terms are neglected in slowly varying flow"	9	paper already published--parts that are added into Theory Manual will incorporate these suggestions	pef	
474	Ponce	08 - Appendix C.1	Page 6, paragraph 2	"When the velocity head is included, H is replaced with E as explained earlier" Ditto the above comment.	9	paper already published--parts that are added into Theory Manual will incorporate these suggestions	pef	
475	Ponce	08 - Appendix C.1	Page 6, paragraph 2, last line	Replace "using many of the methods" with "with many of the methods"	9	paper already published--parts that are added into Theory Manual will incorporate these suggestions	pef	
476	Ponce	08 - Appendix C.1	Page 7, paragraph 1	Replace "free surface diffusion flow or ground water flow" with "free-surface diffusion flow or groundwater flow"	9	paper already published--parts that are added into Theory Manual will incorporate these suggestions	pef	
477	Ponce	08 - Appendix C.1	Page 8, paragraph 2	"Replace low-order mixed finite element method" with "low-order mixed finite-element method" (Many instances of finite element as adjective, with no hyphen)	9	paper already published--parts that are added into Theory Manual will incorporate these suggestions	pef	
478	Ponce	08 - Appendix C.1	Page 11, paragraph 3	Reword sentence to avoid starting with "If"	9	paper already published--parts that are added into Theory Manual will incorporate these suggestions	pef	
479	Ponce	08 - Appendix C.1	Page 11, paragraph 3, last sentence	Avoid the usage of "explained later"	9	paper already published--parts that are added into Theory Manual will incorporate these suggestions	pef	
480	Ponce	08 - Appendix C.1	Page 12, paragraph 1	Replace "0 and 1 for explicit and implicit problems" with "0 and 1 for explicit and implicit problems, respectively"	9	paper already published--parts that are added into Theory Manual will incorporate these suggestions	pef	
481	Ponce	08 - Appendix C.1	Page 13, paragraph 1	Replace "with the choicen sparse solver" with "with the chosen sparse solver"	9	paper already published--parts that are added into Theory Manual will incorporate these suggestions	pef	
482	Ponce	08 - Appendix C.1	Page 13, paragraph 1	Replace "re-run the code due to non-convergence" with "rerun the code due to nonconvergence"	9	paper already published--parts that are added into Theory Manual will incorporate these suggestions	pef	
483	Ponce	08 - Appendix C.1	Page 13, paragraph 2	Replace "Active research" with "Research" or "Current research"	9	paper already published--parts that are added into Theory Manual will incorporate these suggestions	pef	
484	Ponce	08 - Appendix C.1	Page 13, paragraph 2	Replace "transient flow activities" with "transient flow phenomena"	9	paper already published--parts that are added into Theory Manual will incorporate these suggestions	pef	
485	Ponce	08 - Appendix C.1	Page 13, paragraph 3	Replace "numerical error and stability analysis" with "stability and convergence analysis"	9	paper already published--parts that are added into Theory Manual will incorporate these suggestions	pef	
486	Ponce	08 - Appendix C.1	Page 15, paragraph 1	Replace "solve (30) accurately" with "solve Eq. 30 accurately" (This is only a matter of style)	9	paper already published--parts that are added into Theory Manual will incorporate these suggestions	pef	
487	Ponce	08 - Appendix C.1	Page 15, paragraph 3	Replace "spatial and temporal discretizations" with "spatial and temporal discretization"	9	paper already published--parts that are added into Theory Manual will incorporate these suggestions	pef	
488	Ponce	08 - Appendix C.1	Page 15, paragraph 3	Replace "wave length" with "wavelength" (Twice)	9	paper already published--parts that are added into Theory Manual will incorporate these suggestions	pef	
489	Ponce	08 - Appendix C.1	Page 15, paragraph 3	Replace "spatial and temporal resolutions" with "spatial and temporal resolution"	9	paper already published--parts that are added into Theory Manual will incorporate these suggestions	pef	
490	Ponce	08 - Appendix C.1	Page 17, paragraph 2	Avoid the use of "explained later"; use instead "explained in the next section"	9	paper already published--parts that are added into Theory Manual will incorporate these suggestions	pef	
491	Ponce	08 - Appendix C.1	Page 18, paragraph 1	Do not use italic font for units such as m3/s.	9	paper already published--parts that are added into Theory Manual will incorporate these suggestions	pef	

#	Author	Document	Comment Location	Comment	Goal	Response	who	Response continuation
492	Ponce	08 - Appendix C.1	Page 18, paragraph 2	Replace "current model" with "present model"	9	paper already published--parts that are added into Theory Manual will incorporate these suggestions	pef	
493	Ponce	08 - Appendix C.1	Page 19, paragraph 1	Replace "current model" with "present model"	9	paper already published--parts that are added into Theory Manual will incorporate these suggestions	pef	
494	Ponce	08 - Appendix C.1	Page 20, paragraph 2	Replace "much finer spatial resolutions and larger time steps otherwise possible" with "much finer spatial resolution and larger time steps"	9	paper already published--parts that are added into Theory Manual will incorporate these suggestions	pef	
495	Ponce	09 - Appendix C.2	Page 6, Abstract,last line	Replace "in in" with "in"	9	paper already published--parts that are added into Theory Manual will incorporate these suggestions	pef	
496	Ponce	09 - Appendix C.2	Page 6, Abstract,last line	Replace "finite difference model" with "finite-difference model"	9	paper already published--parts that are added into Theory Manual will incorporate these suggestions	pef	
497	Ponce	09 - Appendix C.2	Page 7, Introduction, paragraph 1	Ackward phrasing "increased recently due to the increased need". Reword.	9	paper already published--parts that are added into Theory Manual will incorporate these suggestions	pef	
498	Ponce	09 - Appendix C.2	Page 7, Introduction, paragraph 1	Replace "The current study" with "This study" or "The present study"	9	paper already published--parts that are added into Theory Manual will incorporate these suggestions	pef	
499	Ponce	09 - Appendix C.2	Page 7, Introduction; paragraph 2	Replace "rainfall, and evapotranspiration" with "rainfall and evapotranspiration"	9	paper already published--parts that are added into Theory Manual will incorporate these suggestions	pef	
500	Ponce	09 - Appendix C.2	Page 8, Introduction, paragraph 1	The statement "compiled many of the basis developments" is weak. Prefer "have described many of the basic principles"	9	paper already published--parts that are added into Theory Manual will incorporate these suggestions	pef	
501	Ponce	09 - Appendix C.2	Page 9, paragraph 3	Replace "two dimensional" with "Two-dimensional"	9	paper already published--parts that are added into Theory Manual will incorporate these suggestions	pef	
502	Ponce	09 - Appendix C.2	Page 10, paragraph 1	Replace "St Venant equations." with "St. Venant equations" (no period at the end, before a reference)	9	paper already published--parts that are added into Theory Manual will incorporate these suggestions	pef	
503	Ponce	09 - Appendix C.2	Page 10, paragraph 1	Replace "Manning's" with "Manning"	9	paper already published--parts that are added into Theory Manual will incorporate these suggestions	pef	
504	Ponce	09 - Appendix C.2	Page 10, paragraph 1	Replace "weighted implicit finite volume formulation" with "weighted-implicit finite-volume formulation"	9	paper already published--parts that are added into Theory Manual will incorporate these suggestions	pef	
505	Ponce	09 - Appendix C.2	Page 10, paragraph 1	Replace "semi-implicit" with "implicit" (There are implicit and fully implicit schemes; the term semi-implicit is redundant).	9	paper already published--parts that are added into Theory Manual will incorporate these suggestions	pef	
506	Ponce	09 - Appendix C.2	Page 11, paragraph 1	Replace "explicit and the implicit methods are obtained by using a = 0 and 1.0" with "explicit and implicit schemes are obtained by using a = 0 and a = 1, respectively"	9	paper already published--parts that are added into Theory Manual will incorporate these suggestions	pef	
507	Ponce	09 - Appendix C.2	Page 11, paragraph 2	Replace "explaining" with "describing"	9	paper already published--parts that are added into Theory Manual will incorporate these suggestions	pef	
508	Ponce	09 - Appendix C.2	Page 11, paragraph 2	Replace "current paper" with "present paper"	9	paper already published--parts that are added into Theory Manual will incorporate these suggestions	pef	
509	Ponce	09 - Appendix C.2	Page 12, paragraph 1	Replace "numerical approximations for derivatives, etc" with "numerical approximations for derivatives and other terms"	9	paper already published--parts that are added into Theory Manual will incorporate these suggestions	pef	
510	Ponce	09 - Appendix C.2	Page 12, paragraph 2	Replace "maximum percentage" with "maximum-percentage"	9	paper already published--parts that are added into Theory Manual will incorporate these suggestions	pef	
122	Chin	10 - Appendix C.3	1	Reviewed published version of this paper. Include this version in the Theory Manual.	5	see #120	pef	
135	Jones	10 - Appendix C.3		Good overview of RSM model, but a lot of material to put into a single paper.	5	requested panel to provide suggestions on what parts to move forward, what parts to drop	pef	
136	Jones	10 - Appendix C.3	Page 16, first paragraph	Discussion on pseudo-cells was not clear.	5	paper already published--parts that are added into Theory Manual will incorporate these suggestions	pef	
137	Jones	10 - Appendix C.3	Page 36, Figure 3	There is an empty box to the right of the single control box. What does this box represent?	5	flexibility to add more watermover types	pef	
511	Ponce	09 - Appendix C.2	Page 13, paragraph 1	Replace "Quantity f" with "the quantity f"	9	paper already published--parts that are added into Theory Manual will incorporate these suggestions	pef	
512	Ponce	09 - Appendix C.2	Page 13, paragraph 2	Replace "sinusoidal water level variation" with "sinuosidal water-level variation"	9	paper already published--parts that are added into Theory Manual will incorporate these suggestions	pef	
205	Chin	10 - Appendix C.3	2	Well written and informative. Contains much of the material presented in Chapter 2 of the Theory Manual, in a clear concise form. The Model Error section was useful in confirming the computational-error theory presented in Appendix C.2. The Model Verification section provided needed assurance of the validity of the RSM, and demonstrated its applicability to a particular area in South Florida.	6	this may be relocated to the Benchmarks and Testing Manual	pef	
298	Chin	10 - Appendix C.3	3	Page 256, XML data entry of "5.9 12.6" should be "5.9 25.2".	9	paper already published--parts that are added into Theory Manual will incorporate these suggestions	pef	
513	Ponce	09 - Appendix C.2	Page 13, paragraph 2	Replace "problems respectively" with "problems, respectively"	9	paper already published--parts that are added into Theory Manual will incorporate these suggestions	pef	

#	Author	Document	Comment Location	Comment	Goal	Response	who	Response continuation
514	Ponce	09 - Appendix C.2	Page 15 and 16	Replace "explicit, implicit, and semi-explicit" with "explicit, implicit, and fully implicit"	9	paper already published--parts that are added into Theory Manual will incorporate these suggestions	pef	
515	Ponce	09 - Appendix C.2	Page 19, paragraph 1	Replace "measured as the (numerical value - analytical value) is small" with "measured as the numerical minus the analytical value is small"	9	paper already published--parts that are added into Theory Manual will incorporate these suggestions	pef	
516	Ponce	09 - Appendix C.2	Page 19	Replace "water level subsidence" with "water-level subsidence"	9	paper already published--parts that are added into Theory Manual will incorporate these suggestions	pef	
517	Ponce	09 - Appendix C.2	Page 19, paragraph 1, last line	Delete "in the paper"	9	paper already published--parts that are added into Theory Manual will incorporate these suggestions	pef	
518	Ponce	09 - Appendix C.2	Page 24, paragraph 1	Replace "time lag error" with "time-lag error"	9	paper already published--parts that are added into Theory Manual will incorporate these suggestions	pef	
519	Ponce	09 - Appendix C.2	Page 25, paragraph 1	Replace "in head for for a given frequency" with "in head for a given frequency"	9	paper already published--parts that are added into Theory Manual will incorporate these suggestions	pef	
520	Ponce	09 - Appendix C.2	Page 26, paragraph 1	Replace "steady state" with "steady-state"	9	paper already published--parts that are added into Theory Manual will incorporate these suggestions	pef	
521	Ponce	09 - Appendix C.2	Page 26, paragraph 1	Replace "Thiem" with "The Thiem"	9	paper already published--parts that are added into Theory Manual will incorporate these suggestions	pef	
522	Ponce	09 - Appendix C.2	Page 28, paragraph 2	Replace "(rainfall - evapotranspiration)" with "rainfall minus evapotranspiration" Avoid algebra in text.	9	paper already published--parts that are added into Theory Manual will incorporate these suggestions	pef	
523	Ponce	09 - Appendix C.2	Page 29, last paragraph	Replace "two one dimensional rainfall patterns" with "two one-dimensional rainfall patterns"	9	paper already published--parts that are added into Theory Manual will incorporate these suggestions	pef	
524	Ponce	09 - Appendix C.2	Page 30, paragraph 1	Replace "source induced flow condition" with "source-induced flow condition".	9	paper already published--parts that are added into Theory Manual will incorporate these suggestions	pef	
525	Ponce	09 - Appendix C.2	Page 31	Do not use italics for units.	9	paper already published--parts that are added into Theory Manual will incorporate these suggestions	pef	
526	Ponce	09 - Appendix C.2	Page 31, paragraph 2	Replace "14 day intervals" with "14-day intervals"	9	paper already published--parts that are added into Theory Manual will incorporate these suggestions	pef	
527	Ponce	09 - Appendix C.2	Page 32, paragraph 2	Replace "rain driven water level fluctuations" with "rain-driven water-level fluctuations"	9	paper already published--parts that are added into Theory Manual will incorporate these suggestions	pef	
528	Ponce	09 - Appendix C.2	Page 32, paragraph 2	Replace "driving forces of hydrology" with "driving forces"	9	paper already published--parts that are added into Theory Manual will incorporate these suggestions	pef	
529	Ponce	09 - Appendix C.2	Page 34, paragraph 2	Replace "spatial discretizations" with "spatial discretization" The word "discretization" applies to the entire grid, in either 1-D or 2-D.	9	paper already published--parts that are added into Theory Manual will incorporate these suggestions	pef	
530	Ponce	10 - Appendix C.3	Page 1, Abstract, paragraph 1	Replace "super fast computers" with "super-fast computers"	9	paper already published--parts that are added into Theory Manual will incorporate these suggestions	pef	
531	Ponce	10 - Appendix C.3	Page 1, Abstract, paragraph 2	Replace "object oriented" with "object-oriented" (Many other instances of this same problem with hyphenation).	9	paper already published--parts that are added into Theory Manual will incorporate these suggestions	pef	
532	Ponce	10 - Appendix C.3	Page 2, Introduction, paragraph 2	Avoid the use of the first person pronoun "us"	9	paper already published--parts that are added into Theory Manual will incorporate these suggestions	pef	
533	Ponce	10 - Appendix C.3	Page 3, Introduction, paragraph 2	Replace "Richard's Equation" with "Richard's equation"	9	paper already published--parts that are added into Theory Manual will incorporate these suggestions	pef	
534	Ponce	10 - Appendix C.3	Page 5, Governing equations, paragraph 1	Replace "finite volume method" with "finite-volume method" (Many instances)	9	paper already published--parts that are added into Theory Manual will incorporate these suggestions	pef	
535	Ponce	10 - Appendix C.3	Page 5, Governing equations, paragraph 2	May consider replacing the name "pseudo cells" with "subgrid cells" (this is only a suggestion)	9	paper already published--parts that are added into Theory Manual will incorporate these suggestions	pef	
536	Ponce	10 - Appendix C.3	Page 7, paragraph 1, last line	Replace "in to" with "into"	9	paper already published--parts that are added into Theory Manual will incorporate these suggestions	pef	
537	Ponce	10 - Appendix C.3	Page 7, paragraph 2	Standardize the spelling of St. Venant (Either Saint Venant of St. Venant) throughout the reports and papers.	9	paper already published--parts that are added into Theory Manual will incorporate these suggestions	pef	
538	Ponce	10 - Appendix C.3	Page 8, paragraph 2, last line	Replace "is provided under the object design" with "is provided under the section on object design"	9	paper already published--parts that are added into Theory Manual will incorporate these suggestions	pef	
539	Ponce	10 - Appendix C.3	Page 8, last section, title	Replace "THE IMPLICIT FINITE VOLUME METHOD" with "THE IMPLICIT FINITE-VOLUME METHOD" (Many other instances of the same hyphenation problem)	9	paper already published--parts that are added into Theory Manual will incorporate these suggestions	pef	

#	Author	Document	Comment Location	Comment	Goal	Response	who	Response continuation
97	Jones	11 - Appendix C.4	Page 14, last sentence of top paragraph	"Considering that the discretization is crude, the discrepancy has more to do with the numerical error." If that is the case, why not simply use a more refined mesh? It appears that the grid resolution was rather coarse.	3	This was a test to see if the analytical solutions derived in the paper are applicable to relatively short channels. The analytical solutions were derived assuming the canals to be infinitely long. The test showed that the analytical and numerical model results match reasonably well. The small difference between the results can be due to a number of factors. I was speculating based on my past experience that the difference is more likely be due to the crude discretization rather than the shortness of the canal. Of course the truth of this could be verified by taking finer discretizations. Considering the length and the focus in the paper, and the closeness of the results already obtained, this was not pursued.	amwl	
299	Chin	11 - Appendix C.4	1	I have read Appendix C.4 as a reviewer for Water Resources Research and have provided written comments to the Editor, which will be shortly forwarded to Dr. Lal for consideration and possible modification of this paper. I anticipate an improved paper will be forthcoming. It is probably not appropriate for me to repeat these comments here.	9	thank you	amwl	
345	Jones	11 - Appendix C.4		I assume this is an unpublished paper. I could not find a corresponding reference in the bibliography.	9	yes, in review--is in the Bibliography midway through page 54	pef	
346	Jones	11 - Appendix C.4		Interesting approach to determine aquifer parameters. I can certainly understand how traditional parameter estimation would be difficult with the RSM applied to the complex conditions of South Florida.	9	no comment	pef	
347	Jones	11 - Appendix C.4	Page 2, near end of paragraph 1	"…canal seepage parameters is important in necessary in order to…" I assume you meant to say "…canal seepage parameters is necessary in order to…"	9	paper is in review; these changes will be considered	pef	
348	Jones	11 - Appendix C.4	Page 18, last paragraph	"effificncy" should be "efficiency"	9	paper is in review; these changes will be considered	pef	
540	Ponce	10 - Appendix C.3	Page 9, paragraph 1	Replace "lake related regional flows" with "lake-related regional flows"	9	paper already published--parts that are added into Theory Manual will incorporate these suggestions	pef	
541	Ponce	10 - Appendix C.3	Page 13, paragraph 1	Replace "described in the paper by Lal (1998a)" with "described by Lal (1998a)."	9	paper already published--parts that are added into Theory Manual will incorporate these suggestions	pef	
542	Ponce	10 - Appendix C.3	Page 14, paragraph 2	Replace "Canal seepage water mover" with "Canal-seepage water mover" (Many instances)	9	paper already published--parts that are added into Theory Manual will incorporate these suggestions	pef	
543	Ponce	10 - Appendix C.3	Page 14, paragraph 2	Replace "linearization" with "linearization:"	9	paper already published--parts that are added into Theory Manual will incorporate these suggestions	pef	
544	Ponce	10 - Appendix C.3	Page 15, last line	Replace However" with "However,"	9	paper already published--parts that are added into Theory Manual will incorporate these suggestions	pef	
545	Ponce	10 - Appendix C.3	Page 16, paragraph 2	When used as a compound adjective, the phrase "pseudo cell" requires hyphenation, as in "pseudo-cell models"	9	paper already published--parts that are added into Theory Manual will incorporate these suggestions	pef	
546	Ponce	10 - Appendix C.3	Page 17, paragraph 1	Replace "bc" with "boundary condition" (several instances)	9	paper already published--parts that are added into Theory Manual will incorporate these suggestions	pef	
547	Ponce	10 - Appendix C.3	Page 18, paragraph 3	Replace "oscillation free" with "oscillation-free"	9	paper already published--parts that are added into Theory Manual will incorporate these suggestions	pef	
548	Ponce	10 - Appendix C.3	Page 18, paragraph 4	Replace "model error control" with "model-error control"	9	paper already published--parts that are added into Theory Manual will incorporate these suggestions	pef	
549	Ponce	10 - Appendix C.3	Page 19, paragraph 1	No italics associated with units, as in km.	9	paper already published--parts that are added into Theory Manual will incorporate these suggestions	pef	
550	Ponce	10 - Appendix C.3	Page 21, paragraph 1	Replace "current model" with "present model"	9	paper already published--parts that are added into Theory Manual will incorporate these suggestions	pef	
551	Ponce	10 - Appendix C.3	Page 21, paragraph 3	Replace "human influences" with "anthropogenic influences"	9	paper already published--parts that are added into Theory Manual will incorporate these suggestions	pef	
552	Ponce	10 - Appendix C.3	Page 22, paragraph 1	No italics associated with units, as in m3/s (many instances)	9	paper already published--parts that are added into Theory Manual will incorporate these suggestions	pef	
553	Ponce	10 - Appendix C.3	Page 25, paragraph 1	Replace "Sri-Lanka (3200) cells, Lal et al., (2004)" with "Sri-Lanka (3200) cells (Lal et al., 2004)"	9	paper already published--parts that are added into Theory Manual will incorporate these suggestions	pef	
554	Ponce	10 - Appendix C.3	Page 25, Summary and Conclusions	Replace "An implicit finite volume method, a high-speed sparse solver, and the object oriented design approach" with "An implicit finite-volume method, a high-speed sparse solver, and an object-oriented design approach"	9	paper already published--parts that are added into Theory Manual will incorporate these suggestions	pef	
555	Ponce	10 - Appendix C.3	Page 25, Summary and Conclusions	Replace "one simple computational algorithm" with "one computational algorithm"	9	paper already published--parts that are added into Theory Manual will incorporate these suggestions	pef	
556	Ponce	10 - Appendix C.3	Page 25, Summary and Conclusions	Replace "are extremely useful in designing suitable model discretizations with know numerical error limits" with "are very useful in the design of model discretization following established numerical error limits"	9	paper already published--parts that are added into Theory Manual will incorporate these suggestions	pef	
557	Ponce	11 - Appendix C.4	Page 1, title	Replace "PARAMATERS... WATER LEVEL" with "PARAMETERS... WATER-LEVEL"	9	paper is in review; these changes will be considered	pef	

#	Author	Document	Comment Location	Comment	Goal	Response	who	Response continuation
558	Ponce	11 - Appendix C.4	Page 1, Abstract	Replace "water level disturbance" with "water-level disturbances"	9	paper is in review; these changes will be considered	pef	
559	Ponce	11 - Appendix C.4	Page 1, Abstract	Replace "water management system" with "water-management system"	9	paper is in review; these changes will be considered	pef	
560	Ponce	11 - Appendix C.4	Page 1, Abstract, paragraph 2, 2nd sentence	"Which" is awkward here. Reword.	9	paper is in review; these changes will be considered	pef	
561	Ponce	11 - Appendix C.4	Page 1, Abstract, paragraph 2	Replace "noisy or questionable" with "either noisy or questionable"	9	paper is in review; these changes will be considered	pef	
562	Ponce	11 - Appendix C.4	Page 2, Introduction	Replace "management of the hydrology" with "management of the water resource"	9	paper is in review; these changes will be considered	pef	
563	Ponce	11 - Appendix C.4	Page 2, Introduction	Sentence "Any future restoration of natural areas could be accomplished only by..." is overstated. Reword and deemphasize. Suggest "Future restoration of natural areas is best accomplished by ..."	9	paper is in review; these changes will be considered	pef	
564	Ponce	11 - Appendix C.4	Page 2, Introduction	"Replace "base flow" with "baseflow"	9	paper is in review; these changes will be considered	pef	
565	Ponce	11 - Appendix C.4	Page 2, Introduction	Replace "manuscript" with "study" or "paper"	9	paper is in review; these changes will be considered	pef	
566	Ponce	11 - Appendix C.4	Page 2, Introduction, paragraph 2	Awkward wording, "simple" repeated twice. Reword. Do not use "complicated" here. Instead use "complex"	9	paper is in review; these changes will be considered	pef	
567	Ponce	11 - Appendix C.4	Page 3, paragraph 1	Replace "cause and effect relationships" with "cause-and-effect relationships"	9	paper is in review; these changes will be considered	pef	
568	Ponce	11 - Appendix C.4	Page 3, paragraph 2	Several instances such as "under-determined" and "under determined". The correct spelling is "underdetermined" (although this word not in the dictionary; overdetermined is, though; so "underdetermined" appears to be appropriate).	9	paper is in review; these changes will be considered	pef	
569	Ponce	11 - Appendix C.4	Page 4, paragraph 1	Replace "These approaches however require" with "These approaches, however, require" or better yet "However, these approaches require"	9	paper is in review; these changes will be considered	pef	
570	Ponce	11 - Appendix C.4	Page 4, paragraph 2	Replace "Hydrogeology" with "hydrogeology" What beginning? Reword. Prefer "has remained a challenge"	9	paper is in review; these changes will be considered	pef	
571	Ponce	11 - Appendix C.4	Page 4, paragraph 2	Replace "flow meter" "flow-meter"	9	paper is in review; these changes will be considered	pef	
572	Ponce	11 - Appendix C.4	Page 4, paragraph 2	Replace "steady state solutions" with "steady-state solutions"	9	paper is in review; these changes will be considered	pef	
573	Ponce	11 - Appendix C.4	Page 4, paragraph2	Replace "Chin (1991) for example" with "For example, Chin (1991)"	9	paper is in review; these changes will be considered	pef	
574	Ponce	11 - Appendix C.4	Page 4, paragraph 2, last sentence	Replace "steady state assumption" with "steady-state assumption"	9	paper is in review; these changes will be considered	pef	
575	Ponce	11 - Appendix C.4	Page 5, paragraph 1	leakance, replace for leakiness, or leakage (many instances)	9	paper is in review; these changes will be considered	pef	
576	Ponce	11 - Appendix C.4	Page 5, paragraph 2	Replace "south Florida" with "South Florida" (many instances)	9	paper is in review; these changes will be considered	pef	
577	Ponce	11 - Appendix C.4	Page 6, paragraph 1	Replace "targetted" with "targeted" (twice)	9	paper is in review; these changes will be considered	pef	
578	Ponce	11 - Appendix C.4	Page 6, paragraph 2	Replace "High frequency disturbances" with "High-frequency disturbances"	9	paper is in review; these changes will be considered	pef	
579	Ponce	11 - Appendix C.4	Page 6, paragraph 2	Replace "close to th canal" with "close to the canal"	9	paper is in review; these changes will be considered	pef	
580	Ponce	11 - Appendix C.4	Page 6, paragraph 2	Replace "low frequency disturbances" with "low-frequency disturbances"	9	paper is in review; these changes will be considered	pef	
581	Ponce	11 - Appendix C.4	Page 6, paragraph 2	Replace "far field investigations" with "far-field investigations"	9	paper is in review; these changes will be considered	pef	
582	Ponce	11 - Appendix C.4	Page 6, paragraph 2	Replace "water level differences" with "water-level differences" (many instances)	9	paper is in review; these changes will be considered	pef	
583	Ponce	11 - Appendix C.4	Page 8, paragraph 1	Replace "inhomogenuity" with "inhomogeneity"	9	paper is in review; these changes will be considered	pef	
584	Ponce	11 - Appendix C.4	Page 9, paragrapg 1	Replace "aquifer properties can be plotted on a map to show the heterogenuity" with "aquifer properties that can be plotted on a map to show the heterogeneity"	9	paper is in review; these changes will be considered	pef	
585	Ponce	11 - Appendix C.4	Page 9, paragraph 3	Replace "1.0 hr" with "1-hr"	9	paper is in review; these changes will be considered	pef	

#	Author	Document	Comment Location	Comment	Goal	Response	who	Response continuation
586	Ponce	11 - Appendix C.4	Page 9, paragraph 3	Do not use italics for units.	9	paper is in review; these changes will be considered	pef	
587	Ponce	11 - Appendix C.4	Page 9, paragraph 3	Replace "least square method" with "least-square method"	9	paper is in review; these changes will be considered	pef	
588	Ponce	11 - Appendix C.4	Page 10, paragraph 2	Replace "sediment conductance parameter" with "sediment-conductance parameter"	9	paper is in review; these changes will be considered	pef	
589	Ponce	11 - Appendix C.4	Page 12, paragraph 3	Replace "100 m and 1hr respectively" with "100 m and 1 hr, respectively"	9	paper is in review; these changes will be considered	pef	
590	Ponce	11 - Appendix C.4	Page 12, paragraph 3	Replace "16 hrs" with "16 hr"	9	paper is in review; these changes will be considered	pef	
591	Ponce	11 - Appendix C.4	Page 13, paragraph 2	Replace "Hrs" with "hr"	9	paper is in review; these changes will be considered	pef	
592	Ponce	11 - Appendix C.4	Page 15, paragraph 2	Replace "top 1/3 rd." with "top one-third"	9	paper is in review; these changes will be considered	pef	
593	Ponce	11 - Appendix C.4	Page 15, paragraph 2	Replace "bottom 2/3 rd." with "bottom two-thirds"	9	paper is in review; these changes will be considered	pef	
594	Ponce	11 - Appendix C.4	Page 15, paragraph 2	Replace "Ft" with "Ft."	9	paper is in review; these changes will be considered	pef	
595	Ponce	11 - Appendix C.4	Page 15, paragraph 3	Replace "Tp = 48 Hrs" with "Tp = 48 hr"	9	paper is in review; these changes will be considered	pef	
596	Ponce	11 - Appendix C.4	Page 15, paragraph 3	Replace "48 Hr" with "48-hr"	9	paper is in review; these changes will be considered	pef	
597	Ponce	11 - Appendix C.4	Page 15, paragraph 3	Replace "south Florida" with "South Florida"	9	paper is in review; these changes will be considered	pef	
598	Ponce	11 - Appendix C.4	Page 17, paragraph 3	Replace "T = 4.49ms/s" with "T = 4.49 m3/s"	9	paper is in review; these changes will be considered	pef	
24	Chin	12 - Appendix C.5	2. Page 3, after Equation (1)	Change to "where St is the volumetric storage in the HPM at step t, Pt is the precipitation, ETt is the evapotranspiration…". Change of wording recommended since it is not necessary to define St and St-1 separately once St has been defined.	9	will address in manual--has been flagged	pef	
190	Therrien	13 - Appendix C.6	50	On page 6, PID should be defined.	5	has been flagged	pef	
599	Ponce	11 - Appendix C.4	Page 18, paragraph 4	Replace "effificncy" with "efficiency"	9	paper is in review; these changes will be considered	pef	
191	Therrien	13 - Appendix C.6	51	Assessors (A) are not shown in figure 1.	5	This is represented as "Assess", this will be changed to be consistent with Assessors.	jcp	
138	Jones	12 - Appendix C.5		This paper was very helpful in understanding HPMs. As mentioned above, I think it would be a good idea to integrate this paper with Chapter 2 in the Theory Manual.	5	see #124	pef	
600	Ponce	11 - Appendix C.4	Page 18, paragraph 4	Replace "single layer" with "single-layer" (several instances)	9	paper is in review; these changes will be considered	pef	
192	Therrien	13 - Appendix C.6	52	A real example would help understand figures 1 and 2.	5	Section 3 was intended to fulfill this need. Though the model of section 3 didn't explicitly refer to figures 1&2, perhaps it should.	jcp	
193	Therrien	13 - Appendix C.6	53	Figure 2 tries to convey too much information and is difficult to understand. It is not clear from the figure that controllers can operate independently of supervisors.	5	A valid criticism. Need to review ways to simplify the expression of the control scheme.	jcp	
194	Therrien	13 - Appendix C.6	54	Page 13, what is user defined state machine?	5	Refers to a 'finite state machine': A finite state machine (FSM) or finite automaton is a model of behaviour composed of states, transitions and actions. A state stores information about the past, i.e. it reflects the input changes from the system start to the present moment. A transition indicates a state change and is described by a condition that would need to be fulfilled to enable the transition. An action is a description of an activity that is to be performed at a given moment. Essentially, it is an information processing algorithm which can be expressed in a flow chart, and thereby easily coded into a software module.	jcp	
207	Chin	12 - Appendix C.5	13. Page 13, Equation (12)	Change "P + CellDelta + hpmInflow" to "addwater"	7	will address in manual--has been flagged	pef	
208	Chin	12 - Appendix C.5	14. Page 13, sentence after Equation (12)	Change "The water in the unsaturated soil is determined by the amount of available water. Kc is the PET correction coefficient, The vegetation…" to "where Xthres is the wilting point, Kc is the PET correction coefficient, and the vegetation…"	7	will address in manual--has been flagged	pef	
209	Chin	12 - Appendix C.5	15. Paragraph before Equation (13), second sentence	The statement "When the wtdepth is less than the surface elevation…" is a bit confusing. The basic problem is comparing a depth with an elevation. Maybe using "When the water-surface elevation is less than the ground-surface elevation…" would be much clearer. If such a change is adopted, there are several similar changes that would need to be made; especially when the variable name has includes "depth", even though the variable is an elevation.	7	The text and Figure 5. will be modified to clearly show that the unsaturated zone is determined by the depth to the water table and when the water table is less than zero, the water table is above ground surface.	ef	

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210	Chin	12 - Appendix C.5	16. Page 13, Equation (13), last line	Remove " 0 wtdepth > Rd"	7	The equation will be modified to reflect that above ground surface the wtdepth is compared to -Pd. The last line of the equation is necessary to state that Kc = 0 when the wtdepth is greater than root depth regardless of water content.	ef	
211	Chin	12 - Appendix C.5	19. Page 14, Section 4.3, first paragraph, fourth sentence	This sentence begins with "Extractable water (theta_cap) is the". Since "Ew" was used previously to represent the extractable water, the same variable should be used throughout, i.e. Ew or theta_cap.	7	The text will be modified to reflect the use of extractable water equals field capacity (FC) minus wilting point (WP): Ew = FC – WP. Throughout the text, the terminology for field capacity and wilting point will be revised.	ef	
212	Chin	12 - Appendix C.5	21. Page 18, Equations (20) and (22)	It appears that Equations (20) and (22) are heuristic and without supporting data. This should be made clear in the text.	7			
213	Chin	12 - Appendix C.5	22. Page 19, Table 4	Add a "References" column. Several of the "Typical values" in Table 4 should be reconsidered, specifically - (1) "K0inf" equal to 0,4 m/s is incorrect; (2) "Lmax" equal to 1.3 m is very misleading since this will depend on the depth of the water table and the soil type; (3) "CKOL", "CKIF", and "CKBF" could vary significantly depending on surface and subsurface conditions, more specific guidance in selecting these variables (based on their functional relationship to other parameters) would be helpful.	7	A reference column will be added to table 4. The implementation of <prr> is being reviewed	ef	
214	Chin	12 - Appendix C.5	23. Page 22, Equation (26)	It seems to me that the "minus" sign before "Upflux" should be changed to a "plus" sign.	7			
215	Chin	12 - Appendix C.5	24. Page 22, third paragraph from the bottom	Sentence beginning with "The amount of percolation is determined by soil water" should be changed to "The amount of deep percolation is determined by soil water". The reason for this suggestion is that "percolation" refers generally to flow through any portion of the soil while "deep percolation" generally refers to flow below the root zone.	7	agreed; will address in manual--has been flagged	pef	
216	Chin	12 - Appendix C.5	25. Page 22, third paragraph from the bottom, last sentence	The "wedge of water" mentioned here should be described in more detail, such as how the wedge dimensions are related to the soil characteristics.	7	The text will be modified to: "Soil water upflux from the water table into the root zone is modeled as a wedge of water extending from the water table up one meter into the root zone such that the water content in the root zone can not fall below the water content described by the wedge. The wedge decreases linearly from saturated water content at the water table to zero a meter above the water table."	ef	
217	Chin	12 - Appendix C.5	27. Page 24, fifth row	this sentence states that "throwout pump that can remove the water from the farm at a rate as high as six inches per day". Expressing maximum pumping rates in terms of inches per day seems questionable; m^3/s seems to be more appropriate. This doubt is reinforced in Table 6, where the pump rates for wsPump and fcPump are expressed in m^3/s.	7	The information discussing the characteristics of the flood control and water supply pumps is based on the drainage design characteristics used to size the pumps. The (in/day) pumpage makes the pump size independent of area. A pre-processor is used to convert the design pump rate into the model input dimensions. The attribute values in the table are the required metric for the model (m3/s). This text will be added to page 24.	ef	
218	Chin	12 - Appendix C.5	28. Page 24, Table 6	Several definitions seem incorrect, specifically - (1) for "fcPumpoff" change "water supply pump turn-on" to "collector ditch turn-off"; (2) for "fcPumpOn" change "water supply pump turn-on" to "collector ditch turn-on"; (3) for "fcPumpoff" change "Trigger elevation for water supply pump turn-on" to "Trigger elevation for water supply pump turn-off"; (4) for "maxLevel" change "Trigger elevation for water supply pump turn-on" to "Trigger elevation for pump turn-on"; and (5) for "minLevel" change "Trigger elevation for water supply pump turn-on" to "Trigger elevation for pump turn-off".	7	The attribute definitions in lines 7-12 in Table 6 need to be changed--has been flagged in white paper	ef	
219	Chin	12 - Appendix C.5	30. Page 25, second line after Equation (29)	"The value of S is determined from the soil series" is questionable. According to SFWMD (2000), "The value of S is determined from the depth to the water table".	7	The following method will be incorporated in the code for calculating S based on water table depth: This method was developed from the absorption curve of sandy soils in the Taylor Creek area (Speir et.al., 1960). The relationship between watershed storage and water table is given by the following equations: S = 0.60 (DWT) , 0.0 < DWT <0.5; S = 0.30 + 1.00 (DWT-0.5) , 0.5<DWT<1.0 ; S = 0.80 + 1.35 (DWT-1.0) , 1.0<DWT<2.0 ; S = 2.15 + 1.55 (DWT-2.0) , 2.0<DWT<3.0 ; where S = watershed storage, inches DWT = depth to water table, feet.	ef	
220	Chin	12 - Appendix C.5	31. Page 26, Equations (30) to (33)	These equations are not dimensionally homogeneous; the units of the variables in these equations must be given in the text.	7	The units and description of the variables and coefficients will be added to the document.	ef	
221	Chin	12 - Appendix C.5	33. Page 26, after Equation (32)	The text states that Equation (32) is used to calculate the angle of the V-notch weir. Limitations on the calculated value of this angle must be stated.	7	The following language will be included in the document and the source code will be modified. The devices shall incorporate dimensions no smaller than 6 square inches of cross sectional area, two inches minimum dimension, and 20 degrees for "V" notches.	ef	
222	Chin	12 - Appendix C.5	35. Page 27, Table 7	Add reference column. The "Typical value" of 5.2 m for r253d is obviously incorrect.	7	see #309	ef	
223	Chin	12 - Appendix C.5	40. Page 30, first sentence after Equation (40)	Change to "Where Sy is specific yield, Fld_cap is field capacity (= maximum soil water storage in unsaturated zone) uns is water…"	7	will address in manual--has been flagged	pef	
224	Chin	12 - Appendix C.5	41. Page 30, Equation (42)	Provide specific justification for including "uns" in Equation (42), since this is not the standard form of Equation (42).	7	The intent of this equation is to adjust for the changes in the watershed storage, S, in the continuous model. The primary change is an adjustment for the antecedent moisture content of the soil. Typically, the CN values is changed resulting in a new value of S. In this HPM, excess rainfall is reduced as the amount of water in the unsaturated zone increases. The <mbrcell> HPM is not a preferred HPM, it is undergoing additional calibration and testing.	ef	
225	Chin	12 - Appendix C.5	42. Page 31, sentence before Equation (43)	it would be nice to add a reference for derivation of Equation (43). The equation itself is okay.	7			

#	Author	Document	Comment Location	Comment	Goal	Response	who	Response continuation
226	Chin	12 - Appendix C.5	44. Page 31, Table 9	Add "References" column. Would be better to add a function for estimating the time of concentration, rather than just a typical value of 3600 seconds. Similarly, the water content at field capacity is better estimated by a function (where the field capacity in meters is related to the depth to the water table and soil type) instead of a typical value of 0.2 m.	7	see #309; The time of concentration is currently intended to be an input value that is provided to the model as a typical value for a specific land use type. A pre-processing package can be used to develop the site-specific values for input into the model input XML. It is not intended that the model calculate TOC internally. The value of FC is provided on a ft/ft or m/m basis and after the water table elevation is determined at each time that thickness of unsaturated soil is determined the actual available soil water content is determined. This text will be added to the document.	ef	
227	Chin	12 - Appendix C.5	45. Page 32, Table 10	Is there a "Suggested Range" and "Typical Value" for "septic"?	7	The septic tank attribute is binary, on or off indicating whether the return flow for urban consumptive use goes to the home cell or some other water body. This text will be added to the document.	ef	
228	Chin	12 - Appendix C.5	49. Page 38, Section 8.1.1	Is the duration of the applied rainfall mentioned anywhere? Are the head boundary conditions mentioned anywhere (the no-runoff result would indicate a uniform head on boundaries 2-3 and 14-15).	7	Section 8 will be revised to provide more details on the example. Several tests were applied to the benchmark to evaluate the performance of the <prr> HPM. In the editing for space some of the details were inadvertently deleted. This will be revised.	ef	
229	Chin	12 - Appendix C.5	50. Page 40, third paragraph	A brief explanation or reference to explain how the curve number method can be used to estimate "Imax" would be useful here.	7			
230	Chin	12 - Appendix C.5	51. Page 40, fourth paragraph	the term "base flow" may not be appropriate for the stage hydrograph. Perhaps "base stage hydrograph" would be better.	7	will address in manual--has been flagged	pef	
231	Chin	12 - Appendix C.5	52. Page 41, Equation (50)	Some suggestion or reference of how to estimate CN for a given land area in South Florida should be added below this equation.	7	A reference will be provided for typical CN values for South Florida	ef	
601	Ponce	11 - Appendix C.4	Page 19, paragraph 1	Replace 0.8 days" with "18 d"	9	paper is in review; these changes will be considered	pef	
602	Ponce	11 - Appendix C.4	Page 19, paragraph 2, last sentence	Replace "1 day" with "1 d"	9	paper is in review; these changes will be considered	pef	
603	Ponce	11 - Appendix C.4	Page 19, paragraph 3	Replace "many gages are spatially spread" with "many gages spatially spread"	9	paper is in review; these changes will be considered	pef	
604	Ponce	11 - Appendix C.4	Page 19, paragraph 4	Replace "0.1m2/s" with "0.1 m2/s"	9	paper is in review; these changes will be considered	pef	
605	Ponce	11 - Appendix C.4	Page 20, paragraph 1	Replace "78 day" with "78 d"	9	paper is in review; these changes will be considered	pef	
606	Ponce	11 - Appendix C.4	Page 21, paragraph 3	Replace "Using the test it was able to demonstrate" with "This test was used to demonstrate"	9	paper is in review; these changes will be considered	pef	
607	Ponce	11 - Appendix C.4	Page 21, paragraph 4, sentence 2	Replace "calibation" with "calibration"	9	paper is in review; these changes will be considered	pef	
608	Ponce	11 - Appendix C.4	Table 5	Replace "Ampl based" with "amplitude-based"	9	paper is in review; these changes will be considered	pef	
609	Ponce	11 - Appendix C.4	Table 5	Replace "Storage coeff" with "Storage coefficient"	9	paper is in review; these changes will be considered	pef	
610	Ponce	11 - Appendix C.4	Table 5	Replace "Coeff of leakage (sediment)" with "sediment-leakage coefficient"	9	paper is in review; these changes will be considered	pef	
611	Ponce	11 - Appendix C.4	Table 5	Replace "Coeff of leakage (aquifer)" with "aquifer-leakage coefficient"	9	paper is in review; these changes will be considered	pef	
612	Ponce	11 - Appendix C.4	Table 5	Replace "effi ciency based" with "efficiency-based"	9	paper is in review; these changes will be considered	pef	
613	Ponce	11 - Appendix C.4	Figure 2	Replace "semiperveous" with "semipervious"	9	paper is in review; these changes will be considered	pef	
246	Schaffranek	12 - Appendix C.5	50	Should the recharge term (Recjt) in equations (1) and (4) include the "j" subscript since it only applies to the homecell or is a summation sign (?) missing?	7	will address in manual--has been flagged to remove j	pef	
247	Schaffranek	12 - Appendix C.5	51	How significant is the error introduced by using the HSE from the previous time step to compute water balance in the HPM? How does time lag constrain the HSE time step? Have sensitivity tests been conducted to determine the effect of this time lag in SFRSM simulations?	7			
248	Schaffranek	12 - Appendix C.5	52	On page 8 the last sentence in the first paragraph reads "To simulate such areas without unduly complicated arrangements of mesh cells or watermovers, a hub is used." How complex can a mesh or arrangement of watermovers be before the solution is degraded? What guidelines govern the choice of mesh and watermover complexities?	7	This sentence will be dropped; it has caused too much confusion. The topic of what components (nonlinear, small scale, unique) of hydrology should be placed in Hubs and which components (regional, generic, linear) should be placed in the water movers is discussed elsewhere in the document.	ef	
249	Schaffranek	12 - Appendix C.5	54	Does the assumption on the bottom of page 11 that "(AET) from open ponded water is greater than the ET from the vegetation" mean at same site?	7	The text will be modified to indicate that "The model default is that the actual evapotranspiration of flooded sites will be higher than the AET at the same site when it is not flooded as shown in Fig. 4. Based on the input values, it is possible to model s site where the AET under flooded conditions is lower than the now flooded land at the same site. Land cover types with very high AET, such as sugar cane, cattail or *E. melaleuca*, are not likely to have higher AET when flooded."	ef	
250	Schaffranek	12 - Appendix C.5	56	Change the summation limit in equation (16) from "3" to "5".	7	Actually, the summation should be changed from 0-3 to 3-4 because there is no ET from layer 5.	ef	

Note: any comment with a blank response will be addressed in the District's response to this panel's findings, scheduled for August, 2005.

#	Author	Document	Comment Location	Comment	Goal	Response	who	Response continuation
251	Schaffranek	12 - Appendix C.5	57	Upper limits for TOF, TIF, and TG in equations (1 , (20), and (22) cannot be one as defined by limit ranges on page 18 and in Table 4 on page 19.	7	The implementation of <prr> is being reviewed	ef	
252	Schaffranek	12 - Appendix C.5	58	On page 26, Q is defined as "discharge rate" which is dimensionally inconsistent with equations (31), (32), and (33). Equation (33) is dimensionally inconsistent.	7	see #220	ef	
253	Schaffranek	12 - Appendix C.5	59	In the last sentence of the third paragraph on page 26 "Equation 34" should read as "Equation 33".	7	see #317; should be 31; has been flagged	pef	
195	Therrien	13 - Appendix C.6	55	I like the example FCL shown on page 17. It really helps understand the feature described. An example of supervisor (section 2.5) would also help.	5	Agreed.	jcp	
196	Therrien	13 - Appendix C.6	56	Section 2.5.2, variables maxflow and mincost should be defined. Is arc a graph theory term or does it refer to a mesh feature?	5	Maxflow and mincost are standard flow optimization algorithms. Can add references to maxflow and mincost algorithms ([28, 29]), didn't want to explain them in the text. Arc is a graph theory term, refers to the connection between two nodes in the graph. In the rsm context, it has a one-to-one correspondence with a canal segment in the hse.	jcp	
300	Chin	12 - Appendix C.5	1. Page 2, third paragraph	Change "Huyahorn" to "Huyakorn". Also misspelled in References section on Page 43.	9	will address in manual--has been flagged	pef	
301	Chin	12 - Appendix C.5	3. Page 4, Figure 1	Change "HPM" to "Hub"	9			
302	Chin	12 - Appendix C.5	4. Page 5, paragraph after Equation (4), second-to-last sentence	Change "includes" to "included".	9	will address in manual--has been flagged	pef	
303	Chin	12 - Appendix C.5	5. Page 5, last paragraph, second sentence	Change "Water bodies" to "water bodies"	9	will address in manual--has been flagged	pef	
304	Chin	12 - Appendix C.5	6. Page 7, Section 3.1, first sentence	Change "native" to "natural"	9	will address in manual--has been flagged	pef	
305	Chin	12 - Appendix C.5	7. Page 10, first paragraph	Change "Evaporation (Evap) occurs from the Intso at the rate" to "Evaporation (Evap) occurs from the interception storage (Intso) at the rate".	9	will address in manual--has been flagged	pef	
306	Chin	12 - Appendix C.5	8. Page 10, sentence before Equation (6)	Change "(7)" to "(6)".	9	will address in manual--has been flagged	pef	
307	Chin	12 - Appendix C.5	9. Page 10, Equation (6)	"Kc" is introduced here, but not defined until later on. Define "Kc" here.	9			
308	Chin	12 - Appendix C.5	10. Page 11, first sentence	Change "Where" to "where".	9	will address in manual--has been flagged	pef	
309	Chin	12 - Appendix C.5	11. Page 12, Table 1	Add "References" column (at right) and fill in as appropriate.	9	It was recommended by the Panel that a reference be provided for the values used in the attribute tables for HPM. This will be done but can not be completed immediately.	ef	
310	Chin	12 - Appendix C.5	12. Page 13, sentence before Equation (12)	Change "Ew is the extractable water between field capacity and wilting point" to "Ew is the extractable water equal to the difference between field capacity and wilting point"	9	will address in manual--has been flagged	pef	
311	Chin	12 - Appendix C.5	17. Page 14, Table 2	Add "References" column (at right) and fill in as appropriate.	9	see #309	ef	
312	Chin	12 - Appendix C.5	18. Page 14, second sentence	Change "length" to "height"	9	will address in manual--has been flagged	pef	
313	Chin	12 - Appendix C.5	20. Page 16, Table 3	Add "References" column (at right) and fill in as appropriate.	9	see #309	ef	
314	Chin	12 - Appendix C.5	26. Page 22, second paragraph from the bottom	Change "The crop information includes crop correction coefficients for wetland" to "The crop information includes crop coefficients for wetland".	9	will address in manual--has been flagged	pef	
315	Chin	12 - Appendix C.5	29. Page 25, Section 5.3, second paragraph	Change "store the first inch" to "detain the first inch".	9	will address in manual--has been flagged	pef	
316	Chin	12 - Appendix C.5	32. Page 26, sentence before Equation (33)	Change "following equation" to "following compound-weir equation".	9	will address in manual--has been flagged	pef	
317	Chin	12 - Appendix C.5	34. Page 26, second paragraph from the bottom	Change "Equation 34" to "Equation 31".	9	will address in manual--has been flagged	pef	

#	Author	Document	Comment Location	Comment	Goal	Response	who	Response continuation
318	Chin	12 - Appendix C.5	36. Page 28, last paragraph	"undirectly connected impervious area" is not standard terminology, "non-directly connected impervious area" is more standard. This should at least be mentioned.	9	A quick search indicates that “undirectly connected impervious” should be changed to “unconnected impervious area” rather than “non-directly connected impervious area”	ef	
319	Chin	12 - Appendix C.5	37. Page 29, Table 8	Add "References" column.	9	see #309	ef	
320	Chin	12 - Appendix C.5	38. Page 29, Section 6.2, first paragraph	Change "South Florid Water" to "South Florida Water"	9	will address in manual--has been flagged	pef	
321	Chin	12 - Appendix C.5	39. Page 30, second paragraph	Given the history of the CN method, change " method was developed to determine the volume" to "method was developed to indicate the volume".	9	will address in manual--has been flagged	pef	
322	Chin	12 - Appendix C.5	43. Page 31, sentence after Equation (46)	Replace "depths" by "elevations"	9	Eqn 46 needs to be modified to the following: $K_c = \begin{cases} K_{veg} & z - h > D_{shallow} \\ \frac{[(z-h) - D_{deep}]}{[D_{deep} - D_{shal}]} * K_{veg} & D_{shall} > z-h > D_{deep} \\ 0 & z-h < D_{deep} \end{cases}$	ef	
323	Chin	12 - Appendix C.5	46. Page 34, first paragraph, fourth sentence	should read "The water-quality discharge from the pond…"	9	will address in manual--has been flagged	pef	
324	Chin	12 - Appendix C.5	47. Page 34, Table 11	Add "References" column.	9	see #309	ef	
325	Chin	12 - Appendix C.5	48. Page 38, Section 8.1.1	Given previous syntax, the title of this section should be "<prr> HPM"	9	will address in manual--has been flagged	pef	
349	Jones	12 - Appendix C.5	Page 4, second paragraph	“…explicitly define progression…” should be “…explicitly defined progression…”	9	will address in manual--has been flagged	pef	
350	Jones	12 - Appendix C.5	Page 5, end of fourth paragraph	“…the processes includes in the…” should be “…the processes included in the…”	9	see #302; will address in manual--has been flagged	pef	
351	Jones	12 - Appendix C.5	Page 24, near end of first paragraph	There is a reference to “Table 9” that should be a reference “Table 6”.	9	will address in manual--has been flagged; also there is no table 5, renumber all	pef	
352	Jones	12 - Appendix C.5	Page 29, middle of page	Change “…South Florid Water…” to “…South Florida Water…”	9	see #320	pef	
614	Ponce	11 - Appendix C.4	Figure 4	Replace "sediment conductivity parameter" with "sediment-conductivity parameter"	9	paper is in review; these changes will be considered	pef	
615	Ponce	11 - Appendix C.4	Figure 9	Replace "m^3/s" with "m3/s" (delete ^)	9	paper is in review; these changes will be considered	pef	
616	Ponce	12 - Appendix C.5	Page 1, Abstract	Word "regional" in the first line is redundant.	9	sentence was reworded but left in the concept, since HPMs are needed to bridge the gap bwtween regional-scale and local-scale	pef	
617	Ponce	12 - Appendix C.5	Page 1, Abstract	Replace "surface water" with "surface-water"	9	following District standard--has been flagged for technical editor	pef	
618	Ponce	12 - Appendix C.5	Page 1, Abstract	Replace "additional functionality is required" with "additional functionality is envisioned"	9	see #144	pef	
619	Ponce	12 - Appendix C.5	Page 1, Abstract	Replace "There are Hubs" with "In addition, there are Hubs"	9	will address in manual--has been flagged	pef	
620	Ponce	12 - Appendix C.5	Page 2	Review and apply consistent spelling of "south Florida" throughout.	9	see #357	pef	
621	Ponce	12 - Appendix C.5	Page 3, paragraph 1	Avoid the use of the first-person pronoun "we"	9	will address in manual--has been flagged	pef	
622	Ponce	12 - Appendix C.5	Page 4, paragraph 2	Replace "explicitly define" with "explicitly defined"	9	will address in manual--has been flagged	pef	
623	Ponce	12 - Appendix C.5	Page 5, paragraph 1	Replace "right hand side" with "right-hand side"	9	will address in manual--has been flagged	pef	
624	Ponce	12 - Appendix C.5	Page 5, paragraph 4	Replace "local detention storage components" with "local detention-storage components"	9	will address in manual--has been flagged	pef	
625	Ponce	12 - Appendix C.5	Page 7, paragraph 2	Replace "landuse" with "land-use" (several instances)	9	following District standard	pef	
626	Ponce	12 - Appendix C.5	Page 7, section 3.1, paragraph 1	Replace "surface water management systems" with "surface-water management systems"	9	see #617	pef	
627	Ponce	12 - Appendix C.5	Page 8, section 3.2, paragraph 3	Replace "process specific HPMs" with "process-specific HPMs"	9	will address in manual--has been flagged	pef	

#	Author	Document	Comment Location	Comment	Goal	Response	who	Response continuation
628	Ponce	12 - Appendix C.5	Page 9, section 4, bullet 1	Replace "high water table soils" with "high-water-table soils"	9	will address in manual--has been flagged	pef	
629	Ponce	12 - Appendix C.5	Page 9, section 4, bullet 4	Replace "where is apportioned" with "where it is apportioned"	9	will address in manual--has been flagged	pef	
630	Ponce	12 - Appendix C.5	Page 11, paragraph 1	Replace "dry season ET budgets" with "dry-season ET budgets"	9	will address in manual--has been flagged	pef	
631	Ponce	12 - Appendix C.5	Page 11, paragraph 2	Replace "generic crop correction factor" with "generic crop-correction factor"	9	will address in manual--has been flagged	pef	
632	Ponce	12 - Appendix C.5	Page 11, paragraph 2	Replace "reference crop potential evapotranspiration" with "reference-crop potential evapotranspiration"	9	will address in manual--has been flagged	pef	
633	Ponce	12 - Appendix C.5	Page 11, Figure 4	Replace "Water table Elevation" with "Water-table elevation"	9	defer to technical editor	pef	
634	Ponce	12 - Appendix C.5	Page 12, Section 4.2	Replace "except it considers" with "except that it considers"	9	will address in manual--has been flagged	pef	
635	Ponce	12 - Appendix C.5	Page 18, paragraph 5	Replace "lower zone storage" with "lower-zone storage"	9	will address in manual--has been flagged	pef	
636	Ponce	12 - Appendix C.5	Page 18, paragraph 6	Replace "upper zone storage" with "upper-zone storage"	9	will address in manual--has been flagged	pef	
637	Ponce	12 - Appendix C.5	Page 18, last line	Replace "root zone threshold value" with "root-zone threshold value"	9	will address in manual--has been flagged	pef	
638	Ponce	12 - Appendix C.5	Page 20, section 5.1, paragraph 2	Replace "soil moisture accounting" with "soil-moisture accounting"	9	will address in manual--has been flagged	pef	
639	Ponce	12 - Appendix C.5	Page 29, section 6.2, paragraph 1	Replace "South Florid Water Management Model" with "South Florida Water Management Model"	9	see #320	pef	
640	Ponce	12 - Appendix C.5	Page 36, section 7.1, paragraph 2	Replace "is described above in Section 5.1" with "was described in Section 5.1"	9	defer to technical editor	pef	
641	Ponce	12 - Appendix C.5	Page 37, paragraph 3	Replace "water storage capacity" with "water-storage capacity"	9	will address in manual--has been flagged	pef	
642	Ponce	12 - Appendix C.5	Page 38, paragraph 1	Replace "ignored" with "neglected." Provide additional justification for the statement "infiltration is assumed to be complete within a day."	9	The word "*ignored*" will be replaced with "neglected". The following text will be added: "The surface soils of South Florida are typically poorly graded sands or fine sands with infiltration rates greater than 20 inches per day. Except in the locations where the surface soil is hydrophobic, the soil is not infiltration-limited and surface runoff only occurs when soil water storage capacity is exceeded."	ef	
769	Schaffranek	12 - Appendix C.5	53	On page 11, "where" in the first sentence should be lower case and there should be a period instead of a comma between "type" and "KW" in the last sentence of the same paragraph.	9	will address in manual--has been flagged	pef	
770	Schaffranek	12 - Appendix C.5	55	Delete "in the" in the last line of page 14.	9	will address in manual--has been flagged	pef	
30	Jones	13 - Appendix C.6	Page 4, Table 1	There is a reference here to the HEC-RAS model. HEC-RAS is a 1-D river routing model. Then in Table 2 on page 5, it lists indicates that the HEC model can do coupled surface water/ground water interaction. HEC-RAS certainly cannot. Then I noticed that the legend below the table caption says "HEC – HEC HMS". HMS is a watershed runoff model. Once again, it does not do coupled ground water/surface water modeling. Then I noticed that in the appendix to the article (pages 46-48), it discusses a suite of HEC models including HMS, RAS, and RESSIM. This makes a little more sense, although I wouldn't classify any of these as a ground water model. The early references are confusing and incomplete. Perhaps the early references should simply say "HEC" or "HEC Suite".	1	Agreed, should change to HEC	jcp	
643	Ponce	12 - Appendix C.5	Page 38, paragraph 1	Replace "soil water storage" with "soil-water storage"	9	will address in manual--has been flagged	pef	
197	Therrien	13 - Appendix C.6	**57**	On page 24, I think that the structure (node) object is different from the nodes in figure 7. Also, do segments on that page refer to canals?	5	Correct. The structure (node) objects on page 24 refer to the structures depicted in figure 8 (S1, S2, etc..), the nodes of figure 7 are HSE canal segment boundaries. The segments are portions of the HSE canal network. A group of segments represents a canal, a group of canals represents a WCU.	jcp	
139	Jones	13 - Appendix C.6		Good overview of MSE. Could be integrated with Chapter 3 in the Theory Manual.	5	see #129	pef	
140	Jones	13 - Appendix C.6	Page 5, paragraph entitled "Metadata Input"	I am not sure I would agree on the definition of "metadata". In my experience, this term is used to describe header information associated with data objects that provides supplementary information about the data (i.e., "data about data"). There are federal and ISO metadata standards. Metadata can be included in XML, but I wouldn't call it a type of metadata input.	5	jcp: Semantics. Consider: Metadata (Greek: meta-+data "information") means data about data. While this definition is commonly offered, it is also commonly not helpful. Metadata is more properly called ontology or schema when it is structured into a hierarchical arrangements. Both terms describe "what exists" for some purpose or to enable some action. In this context, it seems appropriate to express: A prime example would be the use of the Extensible Markup Language (XML) employed by the RSM. pef: metadata describes content, quality, condition, limitations, source of data; will address in manual--has been flagged	jcp pef	

#	Author	Document	Comment Location	Comment	Goal	Response	who	Response continuation
161	Schaffranek	13 - Appendix C.6	60	On page 4 of Appendix C.6, the reader also should be cautioned that the models used for comparative analyses with the RSM were not developed with the same purpose and scope in mind as the RSM, i.e., long-term (30+ year) regional simulation in a closely coupled aquifer/wetland/canal flow system that is extensively managed, frequently structurally modified, and undergoing an extensive engineering restoration. In fact, most of the models listed in Tables 1 and 2 and Appendix A on page 44 can be classified as hydrodynamic-simulation models rather than hydrologic-management models due to the fact that the purpose and scope driving the original model development was quite different than that of the RSM. Naturally, although these models are capable of simulating part or the whole of the south Florida ecosystem, they might not be as efficient and easy to operate for management purposes as the RSM because the main driving force behind their development was quite different.	5	Excellent point. This will be added.	jcp	
198	Therrien	14 - SFRSM Fact Sheet	58	My main comment about the quick facts is that it contains information about the model application and assumptions that does not seem to be in the manual (but I think should be in the manual).	5	see #73	pef	
199	Therrien	0 - General Comments	2	I would like to have a better idea of the intended audience for the manual. Is it aimed mainly at potentia users of the manual, or is it also aimed at developers (programmers)? What are the levels of knowledge of hydrology (surface or groundwater) and programming skills expected?	5	see Fulton slides	pef	
200	Therrien	0 - General Comments	3	In relation to comment 2, I assumed when reading the manual (correctly or not) that the main audience will be mainly model users, who should have a solid background in physical hydrology, but perhaps not so much in object-oriented (OO) programming. If it is the case, I think that the manual should put emphasis first on the hydrological processes and then on the OO concepts. For example, chapter 2 of the manual presents the HSE theory and concepts but I find that the presentation focuses a lot on OO concepts and to a lesser extent on physical processes. A reader not so familiar with OO will probably have to read more than section 2 to get a precise idea of all physical processes simulated in HSE, and numerical methods of solution (by reading for example Appendix B and papers in Appendices C). As a university professor, I observe that undergraduate and graduate students trained in hydrological sciences usually do not have a good (or any at all) knowledge of object-oriented programming. The only programming experience they have is usually with non OO languages, which are quite different in	5	we should include more "object" type figures throughout the manuals to introduce these concepts more clearly--this is flagged to be added later	pef	
201	Therrien	0 - General Comments	4	A requirement of RSM is that it must simulate all important hydrological processes to do regional scale modeling in South Florida. Not being very familiar with the hydrology of South Florida, I find that the information provided on the physical system to model (i.e. South Florida) is not described in enough detail to allow me to comment on the fulfillment of that requirement. There is some background presented in section 1.1 of the manual, and a list of features presented in section 1.3. That list clearly shows that canals and control structures are a main feature of South Florida but it remains somewhat vague, in my opinion, on the natural surface and subsurface flow characteristics for the region. For example, there is a mention that highly pervious aquifers (that I assume deep) are connected to superficial aquifers but I did not find much more information in the documents as to the nature of these different aquifers. Unless we can assume that the reader is very familiar with the hydrology of South Florida, I think that the description of the hydrological characteristics needs to be expanded.	5	see #123; also covered during tour and Obeysekera and Tarboton slides	pef	
202	Therrien	0 - General Comments	5	A, Adding a series of papers in Appendix C is a good idea if the reader wants more information on a given topic. However, the papers should not replace description of theory in the manual, unless it is clearly stated that the model follows exactly the theory presented in a given paper. I do not feel that it is the case at the moment. For example, some of these papers have been published in 1998 or 2000 and I assume that RSM has evolved a lot since and that the model may have significant differences compared to the original papers. B. Another example is paper C.2, which presents the only theory I have seen on estimation of numerical errors, which seems to be part of RSM. C. I also suggest presenting the papers in the original published format or at least indicate the name of the journal, the pages and the date of publication.	5	A. see #124; B. benchmarks, numerical estimation of errors, and validation tests will all be in a separate Benchmarks and Testing Manual; C. see #120	pef	
203	Therrien	0 - General Comments	7a	The notion of a fully integrated model is used consistently but it should be clearly defined because it might not have the same meaning for everyone (could be physical or numerical).	5	see #170	pef	
204	Therrien	0 - General Comments	7c	The notion of implicit formulation is also used, but I am not sure that it only refers to the time weighting used for solution of the equations, which is the common meaning in modeling.	5	subset of #773; see #178	pef	
206	Therrien	01 - Chapter 1	16	On page 12, there is mention of tests against MODFLOW and stream-aquifer interactions. I assume that many more verification examples are used to check the code and I would like to see a list or table or verification examples for RSM (or HSE).	6	this was discussed during Lal's Testing talk (slide 9), but is not in the meeting notes; it is also covered in Appendix C.1; it may also be part of the Benchmarks and Testing Manual--has been flagged to make this clearer	pef	
254	Therrien	02- Chapter 2	22	It is not clear what is meant by HPMs being uncoupled or loosely coupled with head (page 25).	7			
255	Therrien	02- Chapter 2	29	More detail should be given on the method of coupling HPMs to overland and subsurface equations (perhaps with a flowchart).	7			
256	Therrien	12 - Appendix C.5	38	There are numerous HPMs described in the appendix and it becomes overwhelming to differentiate between them and to visualize situations where one HPm is more suitable than another. I suggest having a table of content for the appendix, and also providing a summary table of the main features of all HPMs. I am also wondering why such a large number of HPMs have been designed, since it seems that a general HPM could be designed and could be used for several situations.	7	The table that was presented at the Panel workshop that describe the HPM types and instances and the table that indicated the preferred application of HPMs to different land use types will be placed in the document. Additional text will be added discussing the preferred HPM implementation with the flexibility to implement other HPMs depending on the objectives of the application and desires of the client. The are occasions when we wish to simulate the local hydrology a specific way to match previous work.	ef	
257	Therrien	12 - Appendix C.5	43	In the future work, there is mention of additional HPMs. A clear summary of all HPMs will be absolutely necessary, otherwise the reader will not know which HPM is better suited for his/her needs.	7			

#	Author	Document	Comment Location	Comment	Goal	Response	who	Response continuation
772	Therrien	0 - General Comments	1	The documentation reviewed provides a very good overview of the main features of RSM, as well as the challenges for the model developers. The inclusion of HPMs in HSE makes it very flexible for simulating a variety of surface hydrologic processes and distinguishes RSM from similar numerical models. The Management Simulation Engine (MSE) is also very impressive and it reflects the complexity of managing control structures in South Florida. Coupling the MSE with the HSE makes RSM a unique model, because most coupled surface/subsurface flow models that I am aware of offer no or limited capabilities for managing control structures. This coupling is one of the main strengths of RSM. I am quite impressed with the model capabilities and with the developments made to this day.	9	no comment	pef	
326	Chin	13 - Appendix C.6	1	This paper is clear, polished, and very well written.	9	no comment	pef	
327	Chin	13 - Appendix C.6	2	The paper (Section 2.1) refers to "pseudocells" in the context of HPMs. More use of the term "pseudocell" in the HPM white paper would complement this discussion.	9	"pseudocell" is the old term for "HPM"; this one was overlooked	pef	
328	Chin	13 - Appendix C.6	3. Page 19, Section 2.5, second paragraph	Change "Kolmorogorov" to "Kolmogorov"	9	Agreed.	jcp	
353	Jones	13 - Appendix C.6	Page 8, bottom of paragraph 1	Change "it's" to "its".	9	Agreed.	jcp	
644	Ponce	12 - Appendix C.5	Page 42, section 10, paragraph 1	Replace "more functionality is necessary" with "more functionality becomes necessary"	9	will address in manual--has been flagged	pef	
645	Ponce	13 - Appendix C.6	Page 1, Abstract	Replace "water resource control schemes" with "water-resource control schemes"	9	Agreed.	jcp	
646	Ponce	13 - Appendix C.6	Page 2, Introduction, paragraph 1	Suggest replacing or remove the word "overwhelming". It is a value judgment, and does not belong in this document.	9	Agreed.	jcp	
647	Ponce	13 - Appendix C.6	Page 2, Introduction, paragraph 2	Suggest rewording of the phrase "This is not to say"	9	Agreed.	jcp	
648	Ponce	13 - Appendix C.6	Page 3, Introduction, paragraph 1	Replace "well defined interface" with "well defined interface"	9	well-defined interface	jcp	
649	Ponce	13 - Appendix C.6	Page 3, Introduction, paragraph 2	Last sentence is awkward. Please rephrase.	9	Agreed.	jcp	
650	Ponce	13 - Appendix C.6	Page 3, section 1.1, paragraph 1	Delete first word "Even"	9	Agreed.	jcp	
651	Ponce	13 - Appendix C.6	Page 3, section 1.1, paragraph 1	Avoid usage of first-person pronoun "we" (many instances)	9	Agreed.	jcp	
652	Ponce	13 - Appendix C.6	Page 3, section 1, bullet 2	Replace "&" with "and"	9	Agreed.	jcp	
653	Ponce	13 - Appendix C.6	Page 3, section 1	Replace "appendix 7" with "Appendix 7"	9	Agreed.	jcp	
654	Ponce	13 - Appendix C.6	Page 4, paragraph 1	Replace "capabilities" with "capabilities,"	9	Agreed.	jcp	
655	Ponce	13 - Appendix C.6	Page 4, paragraph 1	Replace "ground water and stream flow" with "groundwater and streamflow"	9	Agreed.	jcp	
656	Ponce	13 - Appendix C.6	Page 4, paragraph 1	Replace "stream conveyance models" with "stream-conveyance models"	9	Agreed.	jcp	
657	Ponce	13 - Appendix C.6	Page 4, paragraph 1	Suggest replacing or removing the phrase "not to argue for superiority" This phrase is confrontational, does not belong here.	9	The intent was to defuse a confrontational perception that a comparison of models would naturally arise. Can be changed.	jcp	
658	Ponce	13 - Appendix C.6	Page 5, paragraph 2	Replace "pragmatics of applying finite difference formulations" with "the pragmatics of finite-difference formulations"	9	Agreed.	jcp	
659	Ponce	13 - Appendix C.6	Page 6, paragraph 5	Replace "closed loop feedback controller" with "closed-loop feedback controller"	9	Agreed.	jcp	
660	Ponce	13 - Appendix C.6	Page 6, paragraph 5	Replace "it's target value" with "its target value" (Many instances of the contraction "it's" instead of the possessive "its". Replace all)	9	Agreed.	jcp	
661	Ponce	13 - Appendix C.6	Page 8, paragraph 1	Replace "section, one may refer to the citations for more detail" with "section. More details can be found in the aforementioned citations."	9	Agreed.	jcp	
662	Ponce	13 - Appendix C.6	Page 8, section 2.1, paragraph 1	Replace "piecewise linear canal segments" with "piecewise-linear canal segments"	9	Agreed.	jcp	
663	Ponce	13 - Appendix C.6	Page 8, section 2.1, paragraph 1	Replace "ET and rain function" with "ET and rainfall function"	9	Agreed.	jcp	
664	Ponce	13 - Appendix C.6	Page 8, section 2.1, paragraph 2	Replace "semi-implicit finite volume approximation of the diffusion flow transport equations" with"semi-implicit finite-volume approximation of the diffusion-flow transport equations"	9	Agreed.	jcp	

#	Author	Document	Comment Location	Comment	Goal	Response	who	Response continuation
665	Ponce	13 - Appendix C.6	Page 9, section 2.2, paragraph 1	Replace "water control structures" with "water-control structures" (Many instances throughout)	9	Agreed.	jcp	
666	Ponce	13 - Appendix C.6	Page 10, paragraph 2	Replace "uniform data monitor interface" with "uniform data-monitor interface"	9	Agreed.	jcp	
667	Ponce	13 - Appendix C.6	Page 10, paragraph 2	Replace "complex water management policies" with "complex water-management policies"	9	Agreed.	jcp	
668	Ponce	13 - Appendix C.6	Page 11, section 2.3 title	Replace "Assessors & Filters" with "Assessors and Filters"	9	Agreed.	jcp	
669	Ponce	13 - Appendix C.6	Page 11, section 2.3, paragraph 1	Replace "supply & demand" with "supply and demand"	9	Agreed.	jcp	
670	Ponce	13 - Appendix C.6	Page 11, section 2.3, paragraph 2	Replace "Related to the assessors, are MSE filters" with "MSE filters are related to the assessors"	9	Agreed.	jcp	
671	Ponce	13 - Appendix C.6	Page 13, paragraph 3	Replace "flexible, data-driven specification, which is easily modified providing a level of plug-and-play ..." with "flexible, data-driven specification, which can be readily modified." (Delete last part of this sentence; argumentative; value judgment; not needed)	9	Agreed.	jcp	
672	Ponce	13 - Appendix C.6	Page 13, secton 2.4, paragraph 2, bullet 1	Replace "One & two dimensional rulecurves" with "One- and two-dimensional rule curves" (The word "rulecurve" is not in the dictionary. The preferred spelling should be rule curve). Replace "rulecurve" with "rule curve" throughout, unless willing to invent a new word, or if common usage (in the field) can be demonstrated.	9	Agreed.	jcp	
673	Ponce	13 - Appendix C.6	Page 13, secton 2.4, paragraph 2, bullet 6	Replace "User defined finite state machine" with "User-defined finite-state machine"	9	Agreed.	jcp	
674	Ponce	13 - Appendix C.6	Page 14, paragraph 1	Replace "[20]" with "Ref. [20]" or "Reference [20]"	9	Agreed.	jcp	
675	Ponce	13 - Appendix C.6	Page 14, section 2.4.1, title	Replace "One & two dimensional rulecurves" with "One- and two-dimensional rule curves"	9	Agreed.	jcp	
676	Ponce	13 - Appendix C.6	Page 14, section 2.4.2, title	Replace "Piecewise linear transfer function" with "Piecewise-linear transfer function"	9	Agreed.	jcp	
677	Ponce	13 - Appendix C.6	Page 15, section 2.4.4, paragraph 3	Replace "closed loop" with "closed-loop"	9	Agreed.	jcp	
678	Ponce	13 - Appendix C.6	Page 16, section 2.4.5, paragraph 1	Replace "doesn't" with "does not"	9	Agreed.	jcp	
679	Ponce	13 - Appendix C.6	Page 18, section 2.4.6, title	Replace "User defined finite state machine" with "User-defined finite-state machine"	9	Agreed.	jcp	
680	Ponce	13 - Appendix C.6	Page 18, section 2.4.6, paragraph 1	Replace "it's" with "its"	9	Agreed.	jcp	
681	Ponce	13 - Appendix C.6	Page 18, section 2.4.6, paragraph 2	Replace "user defined" with "user-defined"	9	Agreed.	jcp	
682	Ponce	13 - Appendix C.6	Page 20, paragraph 4, bullet 2	Replace "User defined finite state machine" with "User-defined finite-state machine"	9	Agreed.	jcp	
683	Ponce	13 - Appendix C.6	Page 20, paragraph 5	Replace "User defined controller" with "User-defined controller"	9	Agreed.	jcp	
684	Ponce	13 - Appendix C.6	Page 20, last sentence	Reword to avoid "allows one to define." Prefer "allows the definition of"	9	Agreed.	jcp	
685	Ponce	13 - Appendix C.6	Page 21, section 2.5.1, paragraph 1	Replace "mixed integer" with "mixed integer"	9	Agreed.	jcp	
686	Ponce	13 - Appendix C.6	Page 21, section 2.5.2, paragraph 2	Replace "it's" with "its"	9	Agreed.	jcp	
687	Ponce	13 - Appendix C.6	Page 22, section 2.5.3, paragraph 1	Replace "water resource management" with "water-resource management"	9	Agreed.	jcp	
688	Ponce	13 - Appendix C.6	Page 23, section 2.6, paragraph 2	Replace "it's" with "its"	9	Agreed.	jcp	
689	Ponce	13 - Appendix C.6	Page 24, paragraph 3	Replace "representation facilitating" with "representation, facilitating	9	Agreed.	jcp	
690	Ponce	13 - Appendix C.6	Page 28, section 3, paragraph 1	Avoid use of first-person pronoun "we"	9	Agreed.	jcp	
691	Ponce	13 - Appendix C.6	Page 28, section 3, paragraph 1	Replace "rain event" with "rainfall event"	9	Agreed.	jcp	
692	Ponce	13 - Appendix C.6	Page 30, paragraph 1	Replace "piecewise linear transfer functions" with "piecewise-linear transfer functions"	9	Agreed.	jcp	

#	Author	Document	Comment Location	Comment	Goal	Response	who	Response continuation
693	Ponce	13 - Appendix C.6	Page 30, paragraph 1	Replace "User defined (C++) finite state machine module" with "User-defined (C++) finite-state machine module"	9	Agreed.	jcp	
694	Ponce	13 - Appendix C.6	Page 30, paragraph 2	Replace "User defined C++ module" with "User-defined C++ module"	9	Agreed.	jcp	
695	Ponce	13 - Appendix C.6	Page 32, paragraph 1	Replace "three day moving window" with "three-day moving window"	9	Agreed.	jcp	
696	Ponce	13 - Appendix C.6	Page 36, paragraph 1	Replace "there are several areas of continuation relative to the RSM that deserve attention" with "several areas of continuation relative to the RSM deserve further attention"	9	Agreed.	jcp	
697	Ponce	13 - Appendix C.6	Page 36, paragraph 2	Replace "finite state machine" with "finite-state machine"	9	Agreed.	jcp	
698	Ponce	13 - Appendix C.6	Page 37, paragraph 1	Replace "water resource control policies" with "water-resource control policies"	9	Agreed.	jcp	
699	Ponce	13 - Appendix C.6	Page 37, paragraph 3	Replace "industry standard" with "industry-standard"	9	Agreed.	jcp	
700	Ponce	13 - Appendix C.6	Page 37, paragraphs 5 and 6, bullets	Fill in hyphens in "closed loop", "piecewise linear", "user defined" and finite state"	9	Agreed.	jcp	
701	Ponce	13 - Appendix C.6	Page 38, paragraph 3	Replace "stream flow network abstraction" with "streamflow network abstraction"	9	Agreed.	jcp	
771	Schaffranek	13 - Appendix C.6	61	In the first sentence at the top of page 8, change "of an integrated aquifer-stream flow model" to "in an integrated aquifer-stream-surface system".	9	Agreed.	jcp	
702	Ponce	13 - Appendix C.6	Page 46, section 6.4	Replace "user specified discharge rating curves" with "user-specified discharge-rating curves"	9	Agreed.	jcp	
773	Therrien	0 - General Comments	7	There is a need to clearly define some notions used in the manual and use consistent terminology as well. Some examples are (7a and 7c are goal 5)	9	see #203 and #204 above for 7a and 7c responses	pef	
703	Ponce	14 - SFRSM Fact Sheet	Page 1, paragraph 1	Replace "regional modeling tool than can handle" with "regional modeling tool to handle"	9	I think it should remain as is	jmr	
704	Ponce	14 - SFRSM Fact Sheet	Page 1, paragraph 1	Replace "complexities of South Florida today and for years to come" with "complexities of South Florida well into the future"	9	I think it should remain as is	jmr	
774	Therrien	0 - General Comments	7b	The words cell, mesh, grid, volume are used throughout the manual to describe discretization, and I feel that sometimes they are synonymous but other times they are not, which can create confusion.	9	good point--a glossary would help, plus revisiting each usage. This has been flagged in the manual	pef	
329	Chin	14 - SFRSM Fact Sheet	1. Page 1, caption to left	Change "Our Mission is to manage and protect water resources of the region" to "Our mission is to protect the water resources of the region"	9	we can't change the District mission!	pef	
330	Chin	14 - SFRSM Fact Sheet	2. Page 1 first paragraph	This is not clear. A suggested modification is "The South Florida Regional Simulation Model (SFRSM) is an implementation of the Regional Simulation Model (RSM) covering a major portion of South Florida This calibrated and verified model will be implemented by December 2005. The model will simulate the operation of the water-management system within the District an provide screening-level analysis of system modifications."	9	toss-up	jmr	
331	Chin	14 - SFRSM Fact Sheet	3. Page 1, under "What are the Main Components of the SFRSM?", first paragraph	Replace "undertaken" by "done".	9	simpler, I agree	jmr	
332	Chin	14 - SFRSM Fact Sheet	4. Page 1, under "What are the Main Components of the SFRSM?", second paragraph	Replace "Hydrologic simulation comprises collating the necessary" by " The hydrologic simulation engine collates the necessary"	9	I agree. We're explaining the HSE, not hydrologic simulation	jmr	
333	Chin	14 - SFRSM Fact Sheet	5. Page 1, under "What are the Main Components of the SFRSM?", third paragraph	Replace "Management in the SFRSM portrays the Central" by "The management simulation engine incorporates the Central"	9	I agree. Again, we're describing MSE, not water management	jmr	
334	Chin	14 - SFRSM Fact Sheet	6. Page 2, item 5	Insert hyphens, i.e. use "regional-scale" and "project-scale"	9	agreed	pef	
335	Chin	14 - SFRSM Fact Sheet	7. Page 2, item 9	Insert hyphen, i.e. use "single-layer"	9	agreed	pef	
705	Ponce	14 - SFRSM Fact Sheet	Page 1, paragraph 1, bullet 1	Replace "Primary and certain select Secondary" with "primary and selected secondary"	9	I agree	jmr	
706	Ponce	14 - SFRSM Fact Sheet	Page 1, paragraph 1, bullet 3	Replace "Flexible mesh" with "A flexible mesh"	9	I agree	jmr	
707	Ponce	14 - SFRSM Fact Sheet	Page 1, paragraph 1, bullet 3	Replace "natural area like the Everglades" "natural areas such as the Everglades"	9	I agree	jmr	

#	Author	Document	Comment Location	Comment	Goal	Response	who	Response continuation
708	Ponce	14 - SFRSM Fact Sheet	Page 1, paragraph 1, bullet 4	Replace "SFWMD providing modeling flexibility in scenario investigation" with "SFWMD, providing modeling flexibility in scenario investigations."	9	agreed	pef	
709	Ponce	14 - SFRSM Fact Sheet	Page 1, paragraph 2	Replace "covering the major portion of South Florida" with either "covering a major portion of South Florida" or "covering the majority of South Florida"	9	agreed--a major portion	pef	
710	Ponce	14 - SFRSM Fact Sheet	Page 1, paragraph 2	Replace "regional level operational functionality" with "regional-level operational functionality"	9	agreed	pef	
711	Ponce	14 - SFRSM Fact Sheet	Page 1, paragraph 2	Replace "screening level analysis" with "screening-level analysis"	9	agreed	pef	
712	Ponce	14 - SFRSM Fact Sheet	Page 1, Section	This implementation is expected to	9	no issue noted	pef	
713	Ponce	14 - SFRSM Fact Sheet	Bullet 2	Replace "current best available tool" with "current available tool"	9	leave as is; there are multiple tools, but it is the best currently	pef	
714	Ponce	14 - SFRSM Fact Sheet	Bullet 3	Replace "individuals and consultants" with "professional practitioners"	9	agreed	pef	
715	Ponce	14 - SFRSM Fact Sheet	Bullet 3	Replace "run the model" with "interact with the model"	9	okay	pef	
716	Ponce	14 - SFRSM Fact Sheet	Paragraph 2	Replace "Tasks include: " with "Tasks include"	9	okay	pef	
717	Ponce	14 - SFRSM Fact Sheet	Paragraph 2	Replace "collection of necessary data" with "data collection"	9	okay	pef	
718	Ponce	14 - SFRSM Fact Sheet	Paragraph 2	Delete "pseudo cells" (Not necessary at this information level)	9	agreed	pef	
719	Ponce	14 - SFRSM Fact Sheet	Paragraph 3	Replace "control algorithm selections available to the modeler" with "available control-algorithm selections"	9	okay	pef	
720	Ponce	14 - SFRSM Fact Sheet	Paragraph 3	Replace "dictated by the imposed operational policies" with "dictated by imposed operational policies"	9	okay	pef	
721	Ponce	14 - SFRSM Fact Sheet	Page 2	Replace title with "Model features" or "Model features and capabilities" or "Model capabilities and limitations". Do not use "Assumptions".	9	will consider changing this--has been flagged	pef	
722	Ponce	14 - SFRSM Fact Sheet	Page 2, item 2	Replace "less than 30,000" with "approximately 30,000"	9	agreed	jmr	
723	Ponce	14 - SFRSM Fact Sheet	Page 2, item 4	Replace "if needed" with "if necessary"	9	agreed	jmr	
724	Ponce	14 - SFRSM Fact Sheet	Page 2, item 4	Replace "project scale" with "project-scale"	9	agreed	pef	
725	Ponce	14 - SFRSM Fact Sheet	Page 2, item 6	Replace "time-steps" with "time steps"	9	agreed	pef	
726	Ponce	14 - SFRSM Fact Sheet	Page 2, item 6	Replace "flood impact" with "flood hydrology"	9	FEMA wording--will double check	pef	
727	Ponce	14 - SFRSM Fact Sheet	Page 2, item 7	Replace "some secondary canals" with "selected secondary canals"	9	agreed	jmr	
728	Ponce	14 - SFRSM Fact Sheet	Page 2, item 8	Replace "flow-barriers" with "flow barriers"	9	agreed	pef	
729	Ponce	14 - SFRSM Fact Sheet	Page 2, item 9	Replace "single layer" with "single-layer"	9	agreed	pef	
730	Ponce	14 - SFRSM Fact Sheet	Page 2, item 9	Replace "simulate the surficial aquifer only" with "only simulate the surficial aquifer"	9	okay	pef	
731	Ponce	14 - SFRSM Fact Sheet	Page 2, item 12	Replace "climactic" with "climatic"	9	agreed	jmr	
732	Ponce	14 - SFRSM Fact Sheet	Page 2, item 16	Replace "where possible" with "whenever possible"	9	agreed	jmr	
733	Ponce	14 - SFRSM Fact Sheet	Page 2, item 16	Replace "higher resolution (e.g., topography)" with "higher spatial resolution".	9	agreed	jmr	
734	Ponce	14 - SFRSM Fact Sheet		Eliminate forced hyphenation on right margins to improve readability (Example "Manage-ment"). This comment applies also to Page 1 (Example "Simula- tion")	9	defer to technical editor	pef	
735	Ponce	0 - General Comments	1.	The manual has extensive problems with hyphenation and several spelling and grammatical errors. I recommend having the manual edited by a technical writer or someone who has a high level of knowledge in the formal use of the English language.	9	agreed; technical editor scheduled to begin work in October	pef	
775	Ponce	06 - Appendix B	Page 65, paragraph 2	Consider placing definition of "internal boundary conditions" at the beginning of section B.3.	5	see #145	pef	

APPENDIX III: Minutes of Interactive Workshop on 22-23 June 2005

The attached minutes of the Interactive Workshop on 22-23 June 2005 were taken by Ken Black of Jacobs Engineering.

Regional Simulation Model (RSM) Peer Review

Interactive Planning Session
Agenda and Meeting Notes

June 22-23, 2005

Meeting Location:

Community Foundation
700 Dixie Highway
West Palm Beach, Florida

RSM PEER REVIEW PART I WORKSHOP AGENDA
Wednesday-Thursday, 22-23 June 2005

Community Foundation
700 South Dixie Highway
West Palm Beach, Florida 33401

<u>Note That Blue Text Items are Hyperlinked to the Presentations</u>

Wednesday	Topic & Presenter
0800 - 0830	**Conference Room Set Up & Socializing as Group Assembles**
0830 - 0845	**Welcome and Role of RSM in SFWMD –** *Dr. Jayantha Obeysekera*
0845 - 0900	**Meeting Logistics –** *Rich Sands*
0900 - 0915	**Goals of the Workshop –** *Dr. Zaki Moustafa*
0915 - 1045	**RSM Theory** – *Randy VanZee and Dr. Wasantha Lal* • Goal 1: Determining if proper and sound scientific approaches were used in the development of RSM, making sure that a self-correcting open process is in place • Goal 2: Evaluating if the conceptual framework of the model contains all of the important hydrological processes necessary to do regional scale modeling in South Florida
1045 - 1100	**Break**
1100 - 1200	**HPM Theory** – *Dr. Eric Flaig* • Goal 2: Evaluating if the conceptual framework of the model contains all of the important hydrological processes necessary to do regional scale modeling in South Florida • Goal 7: Suggesting tests for the HPM approach to simulating local hydrology and making recommendations for improvement or expansion of the approach
1200 - 1315	**Lunch**
1315 - 1345	**RSM Documentation** – *Pattie Fulton* • Goal 5: Making suggestions on the usefulness of the model documentation, including whether the level of detail is sufficient or more is needed, whether the conceptual framework is clear, etc.

1345 - 1415	**RSM Analytical Tests and Validation –** *Dr. Wasantha Lal* • Goal 6: Suggesting any additional tests that may be desired to further validate RSM
1415 – 1430	**Break**
1430 – 1600	**Further Questions and Open Discussion –** *Rich Sands, Facilitator* *Further questions, comments, responses* *Wrap up, review of agenda* *Public comment period*
1600 – 1830	**Peer Review Panel Meeting –** *Ken Black, Facilitator and Dr. Chin, Chair* *Panel organization issues* *Work assignments* *Format for Panel Report* *Scheduling*

Thursday	Topic & Presenter
0800 - 0820	**Conference Room Set Up & Socializing As Team Assembles**
0820 – 0900	**Meeting Logistics and Agenda Amendments –** *Rich Sands, Facilitator*
0830 – 0900	**Panel Report on Wednesday Panel Meeting –** *Dr. Chin, Panel Chair*
0900 - 1000	**Water District Overview –** *Dr. Jayantha Obeysekera*
0900 - 1000	**RSM Enhancements and Improvements –** *Dr. Joseph Park* • Goal 4: Making suggestions on modifications and future improvements to the model, including any suggestions for improved computational methods, and future model expansion ideas
1000 – 1015	**Break**
1015 - 1200	**SFRSM Implementation and Application –** *Dr. Ken Tarboton* • Goal 3: Determining the appropriate use of the model in South Florida conditions • Goal 8: Evaluating whether the model is suitable for meeting client goals
1200 – 1315	**Lunch**
1315 – 1600	**Open Discussion –** *Rich Sands, Facilitator* *Further questions, comments, responses*

	Wrap up, review of agenda for Friday tour *Public comment period*
1600 – 1830	**Peer Review Panel Meeting (optional)** – *Ken Black, Facilitator and Dr. Chin, Chair* *Panel organization issues* *Work assignments* *Format for Panel Report* *Scheduling*

Friday	Schedule
	A detailed agenda will be provided separately for the panelists participating in the helicopter/airboat tours.

Handouts/Posters

- Acronyms
- Government in the Sunshine
- Speaker Cards
- SFWMD Response to Panel's Advance Questions and Comments
- Presentation Slides
- Miscellaneous Working Maps
- Posters:
  - SEM, ENP – Sharika Senarath
  - MSE – Joseph Park
  - GUI – Rick Miessau
  - CMM – Steve Traver
  - Resources/RSM 2005 components
  - RSM 2005 Gantt Chart

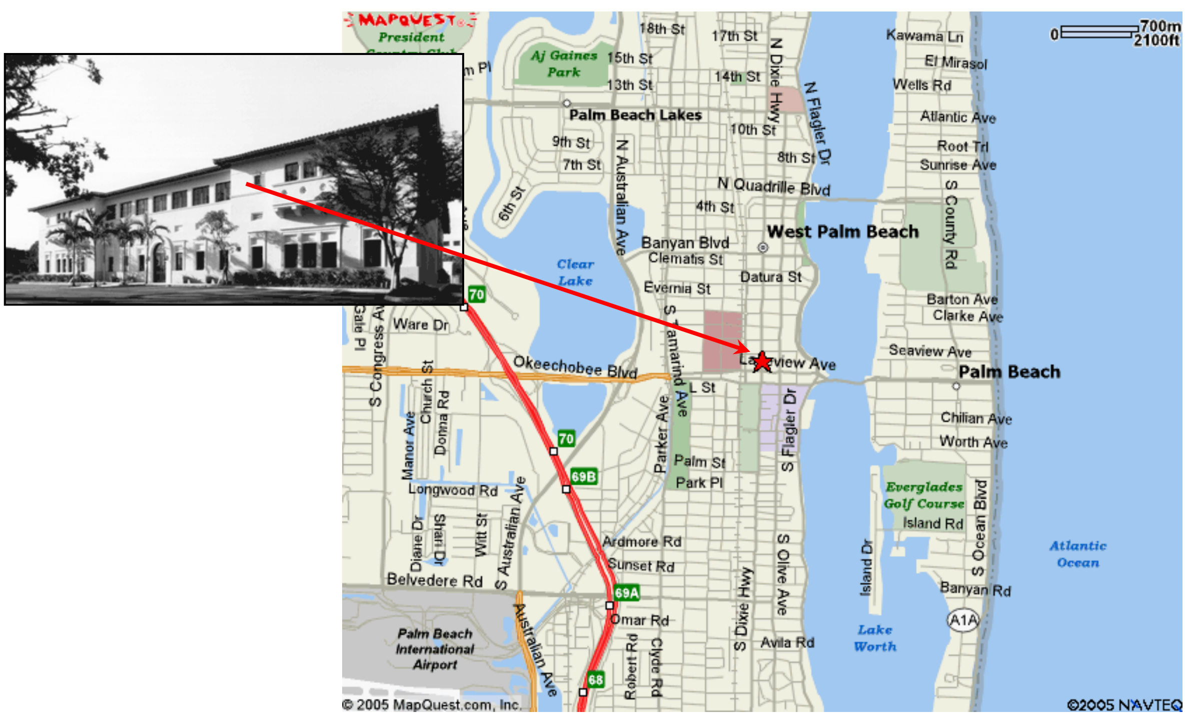
DIRECTIONS TO THE COMMUNITY FOUNDATION BUILDING

Community Foundation
700 South Dixie Highway
West Palm Beach, Florida 33401
(561) 659-6800

FROM I-95 SOUTHBOUND: Take the Okeechobee Boulevard exit, turn left (east) on Okeechobee Boulevard. Pass the Kravis Center and CityPlace. Turn left (north) on South Olive Avenue. Cross over Lakeview Ave (traffic light) and take immediate left (west) onto Trinity Place. Go approximately 100 feet and The Community Foundation building and parking lots will be on your right. The building entrance is on the east side of the building.

FROM I-95 NORTHBOUND: Take the Okeechobee Boulevard exit, turn right (east) on Okeechobee Boulevard. Pass the Kravis Center and CityPlace. Turn left (north) on South Olive Avenue. Cross over Lakeview Ave (traffic light) and take immediate left (west) onto Trinity Place. Go approximately 100 feet and The Community Foundation building and parking lots will be on your right. The building entrance is on the east side of the building.

FROM THE TURNPIKE NORTH OR SOUTH: Take Okeechobee Boulevard exist (east) on Okeechobee Boulevard. Pass the Kravis Center and CityPlace. Turn left (north) on South Olive Avenue. Cross over Lakeview Ave (traffic light) and take immediate left (west) onto Trinity Place. Go about 100 feet and The Community Foundation building and parking lots will be on your right. The building entrance is on the east side of the building.



Meeting Notes Recorded by Ken Black of Jacobs

Agenda Item 1: Conference Room Set Up and Socializing as the Group Assembles

Wednesday 6/22/2005 8:37 AM

Day 1 of Regional Simulation Model (RSM) Peer Review

Attendees:

RSM Peer Review Panel

Dr. David Chin, PE, Professor at University of Miami
Phone: (305) 284-3391; e-mail: dchin@miami.edu

Dr. John Dracup, PE, Professor at University of California Berkeley
Phone: (510) 643-4306; e-mail: dracup@ce.berkeley.edu

Dr. Norman L. Jones, PE, Professor at Brigham Young University and Director of the Environmental Modeling Research Laboratory
Phone: (801) 422-7569; e-mail: njones@et.byu.edu

Dr. Victor Miguel Ponce, Professor at San Diego State University
Phone:(619) 594-6070; e-mail: ponce@ponce.sdsu.edu

Dr. René Therrien, PE, Professor, Université Laval, Québec, Canada
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Raymond W. Schaffranek, U.S. Geological Survey Reston, VA
Phone: (703) 648-5891 rws@usgs.gov

Others attendees (click here to retrieve sign in sheets):

Rich Sands
Ken Black
Pattie Fulton
Ken Tarboton
Wasantha Lal
Randy VanZee
Chuck Downer
Trevor Campbell
Eric Flaig
Lucia Perez
Dave Welter
Zaki Moustafa
Angie White
Jayantha Obeysekera

Agenda Item 2: **Welcome and Role of RSM in SFWMD –** *Dr. Jayantha Obeysekera* **(Obey)**

8:52 AM - Obey begins opening comments, introduces attendees and begins comments on RSM

- 1993 original scope of work written by Obey
- About 45 modelers in OOM, all advanced degrees, 16 Ph. D.'s
- 3 divisions including Interagency Modeling Center (Akin Owosina), Model Development and Implementation Division (Ken Tarboton) and Model Application Support (Luis Cadavid)

9:00 AM – Obey begins modeling historical perspective (1970's to now) documented in the handout

9:07 AM – Discussing CMM including how this is being used for RSM.

9:09 AM – Discussing RSM design considerations documented in the handout

9:13 AM – Discussing RSM components, emphasizing HSE in this meeting, but he discusses the regional water supply coordination needed and how MSE helps achieve this.

9:17 AM – Discussing new technologies, OO design, computational methods, etc

9:18 AM – Four RSM goals for December 2005 (GIPC):

- Capability Maturity Model (CMM) principles being applied
- GUI development
- Series of Peer Reviews
- Two Implementations SFRSM (future alternatives) and NSRSM (pre-drainage conditions for Everglades)

9:21 AM – Obey notes that posters are scattered around the room for peer reviewers to learn about the SFRSM.

Agenda Item 3: **Meeting Logistics –** ***Rich Sands***

9:24 AM - Sands covers the plan for the next three days, discusses local restaurants, etc.

9:28 AM – Discussion of the Florida Sunshine Law, Obey is the official for this meeting, the entire Law provided to Dr. Chin in printed form.

9:32 AM – Public is invited, they can ask questions during the open forum of the meeting on 2:30 to 4 pm on 6/22 and 1:15 to 4 pm on 6/23/05.

Agenda Item 4: **Goals of the Workshop –** *Dr. Zaki Moustafa*

9:35 AM – Moustafa mentions the eight goals of the review, outlines the distributions of comments, and discusses how some comments will be covered in the meetings while others will be addressed in the final report.

9:40 AM – Moustafa completes presentation, some discussion of sunshine law applicability, stressing the need to use the web board for communications

9:47 AM – Ken Black should create Draft report forum on the web board

Agenda Item 5: **RSM Theory** – *Randy VanZee and Dr. Wasantha Lal*

Randy VanZee delivers this initial portion of the presentation

9:54 AM – RSM needed for the following reasons:

- to manage the complexity of the South Florida system;
- lower the cost of admission of using the model compared to the 2x2;
- give flexibility to the modelers;
- to utilize and take advantage of advanced software engineering.

9:59 AM – VanZee discusses **key milestones** in RSM development history, including:

- the significance and meaning of the "oflow" model
- the simultaneous solution of surface/ground/canal water flow
- usage of external solvers
- circumcenter method was developed
- watermover and waterbody abstraction
- Hydrologic Process Models (HPM)
- XML used for input
- Controllers /assessors
- Benchmarks – help make backwards compatibility, assures computational consistency

10:07 AM – Discussion of HSE base classes

- Waterbody
- Watermover
- Hydrologic Process Modules

10:11 AM – VanZee completes conceptual overview

10:12 AM ***Dracup asks for a definition of the roles and responsibilities of SFWMD***. VanZee explains the various aspects of how SFWMD manages water supply (flood control, water supply, water quality, and environmental enhancement).

10:15 AM ***Schaffranek inquires about model cell types***. VanZee explains that the HPM's reflect the land use distributions.

10:19 AM ***Therrien inquires about HPM's being one-way – they feed information into the regional simulation but do not receive information back***. VanZee agrees and explains how on the regional scale, feedbacks are not needed for most applications. The MSE can be used to provide a check of the HPM behavior and can be used to tell the HPM to give a cut-back if needed.

10:23 AM –***Dracup inquires on data quality used in the implementation***. VanZee says data quality varies and a decision is made by Moustafa to discuss data quality in the open discussion forum.

10:24 AM – ***Chin inquires on HPM feedback***. VanZee discusses the freedoms given to programming HPM's and feedbacks can be allowed, if needed.

10:26 AM – Five minute break determined.

10:38 AM – Break concludes.

10:38 AM ***Chin inquires about how the comments will be addressed in the manual: will the comments be added to the manual quickly or over time?*** The District comment responses handed out today in printed form are preliminary responses, some of which will be discussed today (in response to Dracup quick comment). The District plans on covering all comments, including editorials, as they lead up to the completion of the final Peer Review report.

Wasantha Lal continues the Model Development Background and Theory Overview

10:43 AM Lal begins theory discussion outlined in the handout.

- Lal starts by stating that the concepts represented in RSM are not all visible, but they represent our ability to represent real-world behavior, much like mesons and gravitons are used to explain certain high-energy physics behaviors.

10:49 AM – Lal discusses how OO, computational methods and sparse solvers allowed the development of RSM.

10:51 AM – Governing equations are written to achieve conservation of mass, momentum, solute, etc.

10:52 AM – OO design concepts include:
- encapsulation (waterbody)
- inheritance (watermover)
- polymorphism (HPMs)

10:54 AM – RSM is based on the Reynold's transport theorem and the code is written for a generic situation.

The theorem describes the time rate of change in volume (waterbody) and the time rate of change due to flux through the control volume (watermover).

10:58 AM – Momentum equation shown and discussed.

- Local accelerations are neglected = 0,
- inertia = 0,
- diffusion flow has f = 0 and one variable (H) is solved instead of three (H,u,v)

11:01 AM – Sparse solvers (PetSc) allow them to solve nearly singular matrices. Prior to 1994, it wouldn't be possible to solve the RSM equations because the solver speed wasn't fast enough to solve the large matrices.

11:05 AM – The PetSc solver from Argonne National Lab was discussed and its advantages listed.

11:06 AM – A discussion of RSM object types was given including waterbodies and watermovers as well as SV and VS converters, conveyance objects and HPM's.

11:12 AM – ***Dracup asks how mass balance is maintained at the overland/gw flow interface.*** Lal explains that while the waterbody/watermover concept maintains the mass balance in the finite volume formulation which is nothing but a system of equations written for mass balance conditions using head as the state variable, the SV conver is used in converting volumes in the waterbodies to heads in the same waterbodies. Even if they are written in terms of the heads, the mass balance equations in the finite volume method are volume equations which give a specific volume for each waterbody at the end of the solution step. SV converter simply converts that volume to a head.

11:14 AM – ***A question from Ponce regarding canals: do they have flat bottoms?*** Lal describes that for most canals the bottoms are fairly flat. ***Second question: can these canals flow in two directions at the same time?*** Obey says that it can happen, but is rare, with only 1% occurrence of this condition.

11:17 AM – RSM uses SV and VS converters to generically explain the system being simulated, rather than solving 1D and 2D equations for flow in a canal, for example.

11:21 AM – ***Question from Therrien: is the upper figure on slide 15 showing 1 or 2 waterbodies?*** Lal answers, 1 waterbody but multiple water movers.

11:24 AM – ***Question from Dracup: does the E term have [L^3/t] dimensions?*** Lal: no, they are velocities [L/t].

11:26 AM – ***Question from Chin regarding SV converters and their behavior when the groundwater gets close to the land surface.*** Lal is going to show an example of an SV converter to help explain their behavior.

11:27 AM - Diffusion flow conditions explained as shown on slide page 17.

11:29 AM - Overland flow conditions explained as shown on slide page 18.

11:34 AM – Lal explains the conditions for overland flow as shown on page 18. ***Dracup and Chin ask minor questions about nomenclature, Ponce asks about dimensional consistency of T equations on slide 18. Ponce asks what are d and l?*** D is distance between circumcenters and l is the length of the wall interface between cells. ***Ponce asks where are u and v?*** Lal gave an explanation stating that u and v are derived from essentially the depth averaged shallow water equations that are left after dropping all the inertia terms. These expressions are explicit.

11:43 AM – Lal continues to explain that in the Everglades situation, the simplifying assumptions used (Raviart and Thomas, 1977) in deriving the equations have been shown to be reasonable.

11:46 AM ***Therrien asks two questions: (1) did you test any other methods of averaging other than arithmetic? (for h and n equations on slide 18). (2) What happens when one cell has overland flow and the neighbor doesn't. How is the transmissivity computed?*** Lal answers (1) by saying that he didn't test other averaging methods. He says it might need to be tested in the future for cases which have inertial effects included. Lal is going very fast during the answer to number (2) and is using example numbers and talking about typical behaviors in the Everglades type simulations and data quality issues such as data precision. I'm not sure what to write about it.

11:50 AM ***Schaffranek asks about testing of grid spacing to investigate the behavior of the equations on page 18.*** Lal says he has completed some testing.

11:51 AM ***Therrien rephrases his question and uses the rooms as water bodies and the door as the water mover. He asked about how the groundwater is computed.*** Lal explains how the equations are solved: two separate watermovers are written – one for gw and one for sw.

11:57 AM ***Black asks Lal for more clarification about the condition previously mentioned of one waterbody with overland flow and an adjacent cell without ol flow.*** Lal goes through an explanation of this condition and how it is solved.

11:57 AM ***Black asks Lal for more clarification about the condition previously mentioned of one waterbody with overland flow and an adjacent cell without ol flow.*** Lal goes through an explanation stating that a number of conditions are conducive to overland flow as described by the description of the overland flow water mover. They include not only conditions under which the upstream cell has water but also that the upstream head is higher than the downstream head or the ground level of the downstream cell.

11:59 AM Time for a one-hour lunch break. Lal will pick-up his discussion after lunch.

1:06 PM – lunch break ends and Lal begins where he left off in the morning with the overland flow watermover equations on slide 19.

1:13 PM Lal shows the Hirsh textbook examples showing cases of good and bad watermover formulations shown on slides 22 and 23.

1:16 PM Lal discusses canal flow watermovers shown on slide 24 and canal seepage watermover shown on slide 25.

1:19 PM Discussion of stage and volume converters and inverters. Lal shows how this approach follows from the Reynold's transport theorem. ***Schaffranek indicates that this SV approach cannot account for ridge and slough topography cutting through a cell.*** Lal indicates that it cannot represent this type of micro-topography exactly.

1:26 PM - ***Chin asks if RSM will be used for flooding projection or spatially varied flooding areas.*** Lal gives an explanation describing how SV capabilities can be used to have partial flooding, and how the flood level obtained using RSM considers partial flooding. With GIS mapping, this level can be converted to areas. This analysis is of course limited because certain momentum and conveyance terms are not considered in the current formulation. ***Tarboton asks for the reasoning behind the question because it is a goal for RSM to predict flooding.*** Tarboton indicates that the increased resolution provided by the new RSM grid provides better predictive capability of flooding. VanZee adds that in certain applications such as the L-8 example, partial flooding areas can be determined and used as calibration targets.

1:36 PM - ***Chin comments that he would avoid the term "sediment layer conductivity" in slide 25.*** Lal agreed with this statement and indicated he also wasn't comfortable with this term.

1:39 PM - Brief description of the HPM's and discusses slides 30-33. He moves onto the mass balance description and discusses how all the pieces fit together.

1:43 PM – ***Ponce asks if the SV curve is static (i.e., is the curve set independent of the hydrologic conditions used in the model and the curve doesn't change over time).*** Lal indicates that there are SV curves for all areas of the model and these represent the microtopography of those areas.

1:47 PM – Lal indicates that the regional solution is solved implicitly but the HPM's are explicit and assumed to be local in space and time, as defined on slide 36. The solutions are first-order accurate and Regional-HPM is kept simple.

1:50 PM – On slide 37, the term alpha is used as a weighting factor in an attempt to improve the simulation results.

1:54 PM – ***Therrien comments on the use of the alpha weighting factor and the term implicit.*** A truly implicit solution is when alpha =1, Crank-Nicholson when alpha = 0.5, and explicit when alpha = 0. ***He also asks a question about the lowermost equation on slide 37 and whether iteration is used.*** Lal gives a long explanation of how the code used to iterate but now, after many years of trials, iteration is no longer used. It was explained that the iteration with updated matrices was not necessary in RSM unlike in the case of SFWMM because of the use of the SV converter which could transform the volume of the waterbody to a cell head at any stage of the iteration without a mass balance error. Mass balance during the single iteration is not violated as long as the system of linear equations is solved. The price to pay for not iterating more with updated matrices is in the numerical error of the solution. It was found that this error is within the first order error range which is what you get even after iterations. This shows that the need for intensive iterations is less. Some of these ideas should be tested more in the future. ***Ponce also remarked on the term alpha (a different definition of alpha compared to Therrien) and asked for an explanation of the effect of alpha on the solution.*** Lal gave an explanation describing how alpha = 0.5 is ideal if it works as in the case of benchmarks, but is impossible most of the time because of instability. As a result, alpha has to be increased closer to 1. There may be other times in the future where iterations may be needed to solve non-linear problems – ***this was said in response to comments made by Schaffranek regarding iterations.***

2:02 PM – ***Therrien again mentions that MODFLOW uses Picard iteration and this is needed to ensure mass balance.*** Dave Welter mentions that RSM does a head updating based on the SV relationship, and this isn't done in MODFLOW (it is done via iteration). This difference may be why iteration isn't needed in RSM. Lal sums up by saying that iteration may have to be added later.

2:11 PM – ***Chin asks about HPM's and the mass balance equation on slide 34.*** He mentions that consistency is needed in the HPM figures that show the Q from water supply going either one way or both ways. Lal says that they will update the figures and make sure the equations are consistent.

2:16 PM – Lal works through the last three slides. ***Chin asks about why if the matrix equation is solved in terms of head, why are SV converters needed?*** Lal explains that the solution is solved for delta Head, which is really a change in volume, and the new head is calculated from the VS inverter.

2:25 PM – ***Chin recommends changing the term E in the momentum equation to V (slide 9).*** He gave reasons why this change should be made.

2:26 PM – ***Therrien asks what happens in the solution when the water level drops in a canal to below the bottom of the canal.*** He indicates that the solver wouldn't like that because the transmissivity term drops to 0. Lal describes how water is borrowed from the home cell to refill water to the bottom of the canal. This borrowed water is reported in the mass balance table, and VanZee indicates that the model user will be notified of this difficulty and should strive to minimize this occurrence.

2:31 PM – ***Therrien asks if a heavy storm event could be simulated where a near-surface ponded condition develops above the water table.*** Van Zee indicates that HPM's could be used to simulate this behavior.

2:32 PM – ***Schaffranek asks a question about numerical behavior of RSM.*** Lal gives a detail response to this question but I couldn't keep up with his answer.

2:33 PM – 5 minute break specified

2:50 PM – Break has finished.

Public comment period has just opened and no comments have been received. The period will now be closed.

Agenda Item 6: **HPM Theory –** *Dr. Eric Flaig*

2:51 PM – Review of key HPM Concepts shown on slide 2

2:55 PM – HPM's can incorporate existing code from others; this is already completed for AFSIRS.

2:56 PM – ***Dracup asks about urban consumptive use.*** Flaig responded by saying that HPM's can be written to do anything desired. He gave multiple examples of how water can be complexly distributed for multiple reasons. ***Chin elaborated on the bi-directional arrows previously mentioned for the water supply component of the HPM***. Flaig responded by saying that this item will be checked and other consistency comments will be addressed.

3:06 PM – Flaig discusses HPM types (Natural System, Agricultural, and Urban). He indicated the desire to expand the list of existing HPM's.

3:09 PM – ***Dracup asked about collecting data for all of the triangles in the 6 mile square area depicted in the current slide.*** Data exists for land-use type and data is collected from local water municipalities and county extension. Obey added that GIS land-use coverages exist and physical data can inferred from the land-use distribution. Flaig talked about how complex HPM distributions are set, how they are used, including how the information is processed with mass balance tools.

3:15 PM – ***Schaffranek asks about how precipitation is entered into the model.*** Obey commented that over 500 rain gauges exist and spatial and temporal interpolation is used as a pre-processing step to create the model rainfall input file.

3:17 PM – ***Ponce asked how rainfall is converted to runoff.*** Flaig stated that all HPM's have their own abstraction methods. In a typical daily time step simulation, infiltration-limited runoff is not necessary in the sandy soils because the rainfall reaches the water table within this time frame.

3:20 PM – ***Schaffranek asks about the characterization of paved areas.*** Flaig states that HUB are used for these areas. Flaig shows examples of how an agricultural area (slide 11) and an Urban area (slide 12) are discretized into HUBS. Flaig shows the HPM distributions shown in poster form on the back wall.

3:26 PM – Examples of default, simple and comprehensive HPM's were given.

3:29 PM – Flaig summarizes the review comments into 4 categories as shown in slide 19. He quickly moved onto the HPM implementation slide and discussed how these features are created using the GIS.

3:33 PM – Options for conducting testing and verification examples were outlined.

3:36 PM - ***Therrien asks about runoff options in HPMs vs runoff in HSE.*** Flaig gives an orange grove example where both forms of runoff can exist. Another case he mentioned failed, so in that model, the structural settings of the model need to be modified. ***Therrien mentioned the usage of the HELP model and its potential as a verification test case against RSM.***

3:43 PM **–** ***Chin comments on the lack of basic governing equations for HPMs.*** He wasn't able to understand the functioning of HPMs without this information. Flaig states that he didn't present the details today because the comments from the panel were mostly related to PRR and Mbrcell. He assumed that the panel didn't have problems with the other HPMs. He also stated that some HPMs are not as accurate as others because they contain less complete descriptions of the local hydrologic processes but that they are included to give users multiple choices. ***Schaffranek recommends checking equations for dimensions and consistency.***

3:54 PM **–** ***Ponce asks has potential ET is calculated.*** It is computed outside the model using a method described in a paper that Ken Tarboton is going to provide to the panel. ***Ponce suggests adding ET to RSM so that if Temperature is input, ET can be calculated.***

4:00 PM **–** ***Chin asks whether there are any verification / validation testing that exists for HPM's.*** Flaig responded that verification is difficult because of lack of data but that some field data exists that could be tested for a couple of urban and agricultural areas. ***Chin continues emphasizing the need to validate the HPM's because models can be calibrated with incorrect conceptualization and formulations.***

Agenda Item 7: **RSM Documentation –** *Pattie Fulton*

4:06 PM – Pattie presents information on RSM documentation – the entire suite of documents are listed in slide 7.

4:14 PM - Pattie asks reviewers for input on particular items listed in her slides. There are questions posed to the reviewers that the District wants the reviewers to include in the report.

4:16 PM – ***Ponce recommends some thought be given to the term "theory" versus "reference" for the current "Theory Manual".***

4:18 PM – ***Schaffranek requests terminology list, math symbols, and dimensions be given for all equations in the Theory Manual.*** Black notes that the HSE User's guide contains all dimensions for model input parameters.

Agenda Item 8: RSM Analytical Tests and Validation – *Dr. Wasantha Lal*

4:22 PM Five methods of testing and analysis will be discussed

4:24 PM Lal rapidly moves through slides 1 through 6

4:29 PM Lal discusses model run time and maximum error chart and mentions that not only do the proper spatial and temporal discretizations need to be properly selected, the solution method must be correctly chosen.

4:38 PM **–** Tidal data needs hourly representation in the time step to achieve 1% error.

4:41 PM **–** ***A short discussion between Ponce and Lal occurred on the calculated time for simulation estimation equation in slide 10.***

4:49 PM **–** "Badness Testing" exists and should be used for helping design the model grid.

4:51 PM **–** ***Ponce asked how model results would be perturbed by changing the 1 day time step choice (and accompanying grid) to 0.5 day.*** Lal said that the error resulting from this change would be on the order of 1 to 1.5%.

4:55 PM **–** Lal discusses the guiding principals in slide 17.

4:57 PM **–** Lal begins the discussion of the aquifer/canal study used to estimate aquifer parameters. He moves through the discussion quickly because of a time shortage.

5:05 PM **–** Lal discusses early test cases and moves through the rest of the presentation quickly due to time constraints.

5:09 PM **–** ***Chin asks about the typical cell size***. Lal indicates that the cell size will be dependent upon the requirements of the model. Tarboton gives max, min and average cell sizes of the SFRSM.

5:13 PM ***– Schaffranek asks if it is possible to have variable time stepping.*** Lal indicates that they should implement this feature. They had this before PetSc was used, but this feature was removed along the way.

5:18 PM **–** ***Therrien asks about the publication of the verification tests.*** Fulton responds by indicating that the Benchmark guide exists but will be expanded in the future. Fulton notes that this guide is on the peer-reviewer web site.

Agenda Item 9: Open Discussion – Rich Sands

No public comments were received and the panel was satisfied with the day's progress and the questions that they had have already been asked, so no open discussion ensued.

Agenda Item 10: Peer Review Panel Meeting – Dr. David Chin

The peer review panel met to discuss the events of the day and how to prepare for the peer review status report to be presented tomorrow morning. No notes were taken during this time except by Dr. Chin, and these notes were used to formulate the report to be presented tomorrow.

This completed Day 1 of the RSM Peer Review

Day 2 of RSM Peer Review

Thursday 6/23/2005 8:44 AM

Attendees:

RSM Peer Review Panel

Dr. David Chin
Dr. John Dracup
Dr. Norman L. Jones
Dr. Victor Miguel Ponce
Dr. René Therrien
Raymond W. Schaffranek

Others attendees (click here to retrieve sign in sheets):

Rich Sands
Ken Black
Pattie Fulton
Ken Tarboton
Wasantha Lal
Trevor Campbell
Eric Flaig
Dave Welter
Michelle Irizarry
Jorge Rivera
Raul Novoa
Joseph Park
Rick Miessau
Randy VanZee
Jorge Rivera
Zaki Moustafa
Jayantha Obeysekera
Chuck Downer

Agenda Item 1: Opening Comments – Dr. Jayantha Obeysekera (Obey)

8:45 AM – Obey introduces new attendees, discusses plan for the day, future work plans, etc.

Agenda Item 2: Meeting Logistics – Rich Sands

No comments recorded.

Agenda Item 3: Peer Review Panel Update and Status – Dr. David Chin

8:47 AM – Discussion of the proposed structure of the peer review report
8:48 AM – The structure is:

- Exec Sum
- Intro
- 8 peer review goals listed in individual sections
- Summary and conclusions

Moustafa asks if preliminary comments will be included as an appendix. Chin responds that these comments would provide the content for the client goals and would not be included as an appendix.

8:51 AM ***Obey requests another section be added to the report and placed before the summary and conclusions section.*** The purpose of this new section is to attempt to answer whether the RSM is the best available tool for long term planning and modeling in South Florida.

8:54 AM ***Schaffranek asks if client goals could be given to the panel in written form.*** Obey indicates that the District will discuss these during the meeting today.

8:55 AM Chin continues with the panel plan

- Panel input to chair by July 1
- Six other intermediate target dates listed
- Draft Report by July 15
- District Response to Draft Report by August 19
- Final Report by September 9

8:57 AM Chin continues with the plans for today's panel meeting. The panel will discuss Documentation issues (8 listed items), Technical issues (2 items), Other issues (e.g., client goals)

Additional (New) Agenda Item: **Water District Overview –** *Dr. Jayantha Obeysekera*

Obey announced that a new topic is being added to today's agenda. This discussion is being added to help the peer reviewers understand the roles and responsibilities of the SFWMD and to gain a better understanding of the water management system.

9:00 AM – ***What is the water management system?*** Obey will discuss this and the role of the SFWMD.

The SFWMD is the regional water management agency. They get involved in regulatory aspects of permitting. The modelers have to have a regional model to help solve client's goals. Ecosystem restoration is a client of the Office of Modeling (OoM). A lot of details were presented on slides, many of which help to quantify the complexity of the water management system. Some facts include:

- EAA is sugarcane area
- 1800 miles of canals and levees
- 160 drainage basins
- 2000 water control structures
- 27 pump stations

9:06 AM The SFWMD will operate the storm water treatment areas which are the largest engineered wetlands in the world (they are nearing completion). New reservoirs are also being built as part of restoration program.

Obey discusses the Central and Southern Florida Project which is intended to provide flood control and other purposes.

- Kissimmee River is being de-channelized.
- Detailed discussion of the flow system in Southern Florida
- Physical system complications are increasing with additional system components and operations are becoming more complicated with new regulatory rules and competing interests.
- A Lake Okeechobee example will be discussed. If large slugs of water are released from Lake Okeechobee during times of excess water, damage can arise in the downstream areas.
- If canals need water to minimize salt water intrusion, the water is delivered from the interior system.
- EAA generates 1,000,000 acre-feet and they need 400,000 acre-feet and they are concerned when operations of Lake O operations are changed. EAA is simulated as a special case since it is the primary ag area and has special features such as 8 feet of subsidence compared to the Natural System.
- ***It is impossible to keep up with Obey during this talk*** … too much information for me to record.
- RSM needs to be able to manage the operations of the water control structures.

- Obey discusses the major objectives of CERP including reservoirs, canal elimination, deep freshwater injection
- The road raising should occur over the next 5 years, total CERP estimated at 50 years.

9:23 AM ***Obey discusses how the various systems are defined – they are shown in map view***

- Large well fields exist in the Biscayne aquifer along the lower east coast (LEC). When canals don't receive enough water and provide recharge to this aquifer, salt water intrusion can occur along the LEC. This is why changes to the regulatory operations of Lake Okeechobee concern planners in the LEC.

- Models are used during drought periods to help decide on water usage rates and to propose restrictions if needed.

- There are numerous performance measures (>900 in the 2x2 model) used to investigate how client needs are being addressed.

- The water control system will be changing and the RSM needs to be able to simulate these changes.

- The model needs to be able to be used in the regulatory planning mode to show that changing operations will not change the water resources that people currently receive.

- It is now mandated that all models and tools used in the future for water supply management must now be peer reviewed.

- The RSM is NOT being advertised as a tool to be used for flood control. More detailed models need to be used for this purpose.

- The operations division uses 36 year simulation results to help in their planning.

9:34 AM ***Lake Okeechobee multi-objective management problem is discussed in some detail***

- Climate forecasts are used to help plan for Lake O management.

- The RSM needs to be able to simulate the WSE Operational Guidelines Decision Tree developed for Lake O.

- Operators use a 15-minute management timeframe while the model contains a 1-day time step.

9:37 AM Obey asks for questions.

- The MSE is an attempt to decouple the management controls from the model code so that arbitrary (user-defined) controls can be entered in the model as needed.

9:38 AM Opinion by Ken Black.

- This is an excellent presentation and Obey delivers it in interesting fashion, with a great depth of knowledge. The District should consider translating this information into a chapter for inclusion in the RSM documentation suite since it helps explain the complexity that is so often the topic of conversation and which in large part is the driving force behind the need for advance modeling tools like RSM.

Agenda Item 4: RSM Enhancements and Improvements – *Dr. Joseph Park*

9:39 AM – Park begins with a discussion of the MSE design goals. These are listed in his first slide, which can be accessed by clicking on the blue hyperlink above.

9:42 AM – Early approach to MSE is detailed in slide 3

9:45 AM – The MSE design was reformulated (slide 4) with assessors introduced to allow the pre-processing of HSE state information.

9:47 AM – Slide 5 continues to show the continue refinement and begins a lengthy (but very interesting!) historical development of neural networks and universal approximators and their relationship to the water management system.

9:54 AM – The MSE controllers and supervisors are listed in slide 6.

9:56 AM – The simple canal segment test model is shown with examples of different types of controllers demonstrated. ***Therrien asks for more information on the charts and then asks a question regarding how the flow is actually modulated.*** Joseph replies that the watermover flow is amplitude modulated by a value between 0 and 1. Lal expounds upon this by explaining that the 0-1 flow amplitude modulation naturally expresses that a gate opening is applied or a pump flow rate is changed. Joe indicates that the sigmoid feedback controller was shown to work better than the PID controller.

10:05 AM – Lal discusses how the MSE controller signals were shown to him to be effective.

10:10 AM – Discussion continues on how MSE relates to the physical system; Joe mentions a time-step disconnect between the model and the real world. The model is 1 day, real-world is minutes. The controllers need minute-level time stepping to be effective and this difference in time-stepping is currently limiting their ability to use MSE for simulating the real system control algorithms.

10:14 AM – ***Dracup asks whether MSE material being presented is included in their SOW.*** The District responses from Rich, Pattie, Obey and Joe all indicate that this presentation is ancillary information and that the Peer Review Panel should comment on the 9 pages in the theory manual. Other comments on the MSE approach presented would be appreciated.

10:17 AM – ***Therrien asks whether the 2x2 has controllers like MSE.*** Park responds that the control information is embedded in the source code and some optimization is conducted during the simulation through iteration.

10:19 AM - Park presents results from the supervisor evaluation conducted using a partial model of the LEC.

10:23 AM – Supervisor evaluations continued with the development of the SFRSM. Subsequently, testing began on more regional-scale models than were tested before.

10:26 AM – Three deficiency in the approach were identified during this larger scale testing.   These are detailed on a slide but are summarized here:

1. Controllers and supervisors have no feedback with concurrent HSE state information.
2. With the use of User defined supervisors, the coding was getting complex.
3. Providing a modular, extensible, easily understandable implementation of MSE with User Defined Supervisors and Controllers would be a challenge.

10:30 AM – the MSE network was then abstracted from the HSE network to provide a stream flow and hydraulic structure representation which simplifies the expression of control constraints and provides a unified data store for MSE relevant state information.

Assessors were then added to provide estimates for daily time-step simulations. ***Therrien asked if a look-ahead in HSE is possible to help the assessors estimate upcoming conditions during the next daily time step.*** The District responded that this is not included at this time. However, work is currently underway to incorporate this capability.

10:36 AM – Park continues discussing the role of the assessors.

10:39 AM - Assessors didn't solve all of the problems being experienced with the MSE. There are 4 issues listed on the last slide that provide information on where MSE is headed, including sub time step iterations between HSE and MSE.

10:42 AM – ***Chin asks about the role of the MSE in the RSM. Is it capable of more than just providing planning information to operators, considering limitations in how the system is managed in reality?*** Joe responds that the inherent computational limitation of SFRSM (daily time step) may not be appropriate for operational control decisions which are based on sub-daily time scales. Obey indicates that SFRSM is primarily a planning and operational policy assessment tool, a regional model aimed at addressing large timescale, regional water policy planning issues.

10:51 AM – ***Therrien asks about the run time for RSM.*** Joe responds that 60% of the time is spent in matrix inversion and the majority of the time remaining is spent on IO and a few other tasks take a few percent of the time.

Break and re-adjourn at 11:03.

Agenda Item 5: **SFRSM Implementation and Application** – *Dr. Ken Tarboton*

11:07 AM – Tarboton begins discussing the conditions for appropriate use of models in slide 5.

11:10 AM – Moving to the model examples that have been used to refine RSM.

11:12 AM - Kissimme Basin simulation is the first example, used for proof of concept and speed of solution (CPU requirements). This example was also simulated by a Berkeley team with 2 second time steps vs 6 hours with RSM.

11:16 AM – ***Ponce asks Lal a question about a diffusion wave speed, or how to find the transition from steady to unsteady flow***. Lal responds with a technical answer that I am unable to reproduce due to the detail included in the response.

11:21 AM – Tarboton briefly covers the Everglades National Park example and moves onto L-8 drainage example followed by Loxahatchee National Wildlife Reserve example.

11:22 AM – The RSM highlights and lessons are shown for each model on slides 7 to 15. *This is good information for documenting the history and capabilities of RSM.*

11:24 AM – Lal explains what it means for proof of concepts. Some detailed discussion occurred regarding the existence of the dynamic wave. The conversation was too detailed to record accurately.

11:30 AM – ***Chin comments on the need to better define the terms verification and validation.*** There are verification examples that exist for RSM but he hasn't seen any validation examples. ***Therrien agrees with this comment.***

11:31 AM – Tarboton continues moving through the existing applications of RSM.

11:38 AM – Moving onto the Mission Statement stated on slide 17. The calibrated and verified model will exist by Dec 2005. The model should include some regional level operations.

11:40 AM – Tarboton shows SFRSM grid and begins discussing assumptions. ***Schaffranek asks about how water is moved from Lake O to the surface water.*** Lal responds with a discussion of watermovers that have been written for this purpose.

11:43 AM - ***Schaffranek asks why the tidal mixing zone was included down on the southerwestern part of the domain.*** Lal responds that by having the mixing zone included allows more accurate boundary conditions to be selected. Tarboton also mentions that the 2x2 model domain did not include this zone and this was a criticism of the 2x2. Moustafa mentions that data along the southwest coast has only been collected over the past 3 years. Tarboton recommends that the panel give input to the District on these types of issues.

11:51 AM – ***Jones asks about how the remainder of the western boundary was selected***. Tarbonton responds that these are water basin boundaries and these are shown graphically.

11:54 AM – ***Ponce asks about the implicit solution and whether Lal has tested if this method leads to more stable solutions.*** Lal responds with some technical details of his testing history of explicit vs implicit, and the fully implicit schemes have to be used with responsibility. Lal indicates that you cannot "cheat" with explicit schemes but you can with implicit schemes.

11:58 AM – Tarboton continues with slide of peer review comments.

12:00 PM – Details of cell sizes

- 23,896 cells
- Area = 9730 square miles
- Average cell size = 0.4 square miles
- Smallest = 0.2 square miles

12:02 PM – 2x2 model was started in early 80's and became operational in about 1985.

12:03 PM – Tarboton discusses canals and structures shown on slide 24. ***Dracup asks a question about whether the structures are automatically managed***, and Ken responds that some structures have to be manually controlled.

12:09 PM – Tarboton continues showing slides of topography and hydraulic conductivity (K) distribution. ***There were a couple of questions about the K distributions – how were they determined (Black) and how are they perturbed (Jones)?*** Tarboton answered these by saying that the District hydrogeologists have determined the K distributions and Welter briefly metioned how the K's are perturbed during parameter estimation.

12:13 PM - ***Ponce asks if soils maps exist.*** Flaig says they do but they are not being used at this time. Flaig indicates that these maps will be included in future HPM documentation.

12:14 PM Final slide (22) show the land use map and some discussion ensues on starting the model with simple land use coverages followed by adding more complexity as needed, depending upon problems encountered during calibration. Additional discussion occurs on how vegetation type variations within large land-use areas are simulated. Flaig discusses several approaches being used/tested in the NSRSM to handle anisotropy in Mannings, ridge and slough topo, etc.   ***Ponce recommends mapping the soils because in the future, people will be asking about it.***

12:26 PM– Break for lunch
1:31 PM – Lunch ends

1:32 PM Tarboton continues the presentation with information on calibration of SFRSM (slide 27).

- Domain split into three basins: LECSA, LOSA, and Glades
- Subteams broken out and 5 phases of calibration defined.
- Subteams are nearly completed with phase 2 and have made progress on stage 3.
- ***Jones asks about parameter estimation methodology*** and Lal responds by stating that the District that SVD was used over the past few weeks. ***Jones suggested looking at PEST and SVD assist because of recent advancements (some papers will be published in WRR) and that thousands of unknowns can be estimated with little computational load.*** Tarboton states that the District is using a subcontractor to assist with auto-calibration.

1:46 PM Glades, Lower East Coast Surface Area (LECSA), and Lake O Surface Area (LOSA) basin approaches (slide 28-30) are discussed.

1:53 PM – Tarboton reviews initial calibration results on slide 31. ***Therrien inquires about R^2 and indicates the possible need of using the correlation coefficient, which is just R.***

2:05 PM – Several questions were asked about the calibration stats. Tarboton answered some of the the questions.

1. ***Ponce talked about using multiple stage calibration data sets.***
2. ***Chin mentioned the use of the Nash performance measures.***
3. ***Jones comments on the bias plots indicating that the symbols should be all circles with multiple colors.*** Tarboton indicates that this is just a display issue because in the printed version, multi-colored circles are used.

Lal talks about data quality over these long records of observation and that "data error" and "data deficiencies" do exist. Moustafa indicates that 10% error can exist in flow measurements.

2:15 PM Tarboton talks about why rain wasn't included over the canals. The canal area is about ½% of the total domain areas, not including the secondary and tertiary canals. He indicated that rain over the canals might be added at a future time.   Soft calibration targets are used to compare RSM results to SFWMM results. Some discussions ensued on the differences between the SFWMM simulation results and the RSM simulation results. ***The panelists indicate that the District should be careful comparing soft calibration targets because of differences in plan-view model areas, discretizations, etc.*** Because the RSM has smaller cell sizes, the distributions of ET and rain could be different than the SFWMM if higher-resolution ET and rainfall coverages are interpolated and used to apply these terms to cells in the model. ***A series of short and diverse comments were made about other calibration issues, most of which could not be recorded because of their brevity.***

2:34 PM Tarboton moves onto the NSM pre-drainage application

Ponce asks about the Manning's n distribution, with values of 1 being used (Ponce indicates 0.8 should be about the maximum value used while Schaffranek says a Florida researcher found Manning's ranging from 0.38 to 0.52). Lal says that this term should be used carefully. The Manning's value of 1 has been used in this model and Lal does recognize that it is high. He gives some justification that the natural topographic variation of the system includes areas where sheet-flow is not smooth and water has to move around obstacles. ***Detailed discussions ensue with Ponce, Lal, Obey and Chin discussing the values of Manning's n.*** Lal doesn't want to push the value of n too large because it can create problems in the simulated results. ***Dracup notes that Rouse Hunter wrote a paper (1942 in ASCE transactions…) that could provide some insight into proper parameter selection.***

2:47 PM Back to NSM. Initial simulations being conducted from 1965 to 1995 (slide 36).

2:52 PM Introduction to client goal #8.

Chin asks for a definition of the District's clients. Tarboton indicates internal modelers, internal clients (e.g., water supply division) , and consultants that might use RSM are all considered clients.

Dracup asks for examples of litigation that the District has been involved in. Obey covers a lot of information fast. Obey indicates that lawsuits occasionally occur and modelers get involved because models are usually used in studies related to water (planning, regulatory, etc). A question always asked is "Is the model peer-reviewed?". Typically environmental groups will file the lawsuits.

3:02 PM **–** Client input on their goals was solicited and the six goals on slide 39 were determined. **All six goals are expanded into more detail on slides 40 to 45.**

3:12 PM **–** Tarboton moves onto slide 46, which describes initial run time and file size.

3:14 PM ***Chin inquires about client goals: (1) to what extent is RSM better than SFWMM in structured flow calculations?*** Ken says we don't know the answer to this at this time. ***(2) does RSM have improved hydraulic simulation of canals?*** Ken defers to VanZee or Lal. VanZee indicates RSM has a more sophisticated way of handling flow through canals. Ultimately more functionality will be gained, but a number of other issues have occurred which make implementing the MSE more difficult. ***Schaffranek indicates that more rigorous calibration will be needed with the improved canal formulation, including the measurement of flow in the canals.***

3:21 PM ***Additional comments about flow in canals occurs between Lal, Ponce and Schaffranek.*** Discussions wander around, generally most issues related to the difficulties of simulating canals in the real world. Are accelerations terms needed? Will dynamic solutions be needed in the future? Many issues batted around without well-defined conclusions.

3:29 PM ***A Public comment is received on the populating the NSRSM grid versus the SFRSM.*** The commenter noted that there are differences in the meshes which would not allow the physical properties to be transferred from one grid to the other.

3:30 PM Break time.

3:50 PM Break over. RSM GUI tools. Pre-processing uses ESRI GIS and Post-processing uses python.

3:53 PM Python was chosen because it is open source. Tarboton quickly moves through the remaining slides showing examples of the GUI.

Agenda Item 6: Open Discussion

3:56 PM Moving into open discussion. Sands covers tomorrow's itinerary.

4:10 PM The open discussion period ensued with the panel members discussing the report format and the work that is required to finish it.

4:19 PM ***Jones asks why can't the time step be reduced, considering the modest run times?*** Lal responds that smaller time steps could be used if needed, but they are thinking that as long as the model is behaving nicely, there is no reason to go to a smaller time step. Obey says that numerical reasons might trigger a smaller time step (e.g., stability, not matching the physical processes in 1 day time step).

4:21 PM ***Dracup asks how the operators use the water management model.*** Obey responds that the models are used for longer term planning, not for real-time operations decisions.

4:24 PM ***Jones asks if parallel processing has been considered.*** Obey responds that Linux clusters are being used but the code has not been written to take advantage of parallel systems.

4:30 PM ***Jones asks about output file formats.*** Jones recommends to the District that they look into the use of HDF5 format file for RSM. ***Jones will send information to the District on this file format..*** File compression is very good with this format.

4:35 PM ***Jones asks about HPM's and hubs.*** Jones recommends clustering the similar HPM's together in GIS and writing a GIS application to assign these to the mesh cells. VanZee agrees.

4:38 PM ***Jones asks about 3D groundwater flow.*** VanZee indicates that the 3D capabilities are not sufficiently documented to show them to the peer reviewers. This is considered a work in progress.

4:40 PM ***Therrien asks about anisotropy in the 2D groundwater solution. Will anisotropy be installed?*** Lal says it is on the list and they think that they know how they will do it, but they haven't written the code.

4:42 PM ***Jones asks a calibration question.*** He mentions some assumptions in MODFLOW and compares RSM to it. Lal and he talk about a few things in this regard.

4:47 PM Ponce asks about sensitivity to the alpha weighting factor. He recommends doing sensitivity testing of time step and/or the alpha factor. A long discussion ensues about the weighting factor. Lal discusses his testing history about this topic.

4:53 PM. ***Ponce asks if the model goes unstable under any circumstance?*** Lal responds that short, deep canals, can cause this type of problem. ***Ponce asks will this***

model go unstable 2 years from now if he is the new user? What documentation exists to help the user in times of need? Lal responds that error analysis is documented and will be included in one of the manuals. This methodology will allow users to choose time stepping and grid size for given material properties.

5:06 PM ***Therrien explains his concerns regarding the lack of iteration and how he expects emerging problems with this approach, especially when MSE is superimposed.*** He recommends that there are ways to pull out the problem areas and solve them with only 1 matrix inversion. VanZee agrees and suspects that this type of problem is what is causing them grief now and will be the focus of their work over the next 6 months.

5:10 PM ***Jones discusses the Horizons to 3D mesh utility in GMS 6, for creating 3D grids. He also discusses new file formats that should be investigated by the District.***

5:19 PM Time for the panel discussion after a short break.

Agenda Item 7: Peer Review Panel Meeting

No notes taken by Ken Black. The notes were taken by Dr. Chin.

End of Day 2 of RSM Peer Review