Patrick Tara, PE – Lead Expert, MFLs and Groundwater / Surface Water Modeling and Analysis

Patrick Tara has 28 years of experience in water resources engineering, focused on surface water hydrology, groundwater, hydraulics, and integrated surface water/groundwater (SW/GW) hydrologic systems. His experience includes hydrologic data collection and analysis (both temporal and spatial), and the development and application of SW/GW, hydrologic, hydraulic, transport, water quality, and salinity numerical models. His data collection efforts include tracer studies for the evaluation of flushing. Mr. Tara has applied various models to watersheds, estuaries, rivers, lakes, reservoirs, and tidal inlets to support establishing minimum flows and levels (MFLs) needed to protect ecological resources, manage water supplies and natural systems, evaluate and implement restoration alternatives and actions, and estimate water quality impacts and sediment transport. He is experienced in temporal hydrologic data analysis including water budget studies, statistical modeling, and trend and cluster analysis. Mr. Tara routinely uses geographic information systems (GIS) as a tool for spatial data management and processing, particularly as it is related to land-use analysis and the assessment and management of water resources. His hydrologic data collection experience includes the installation and maintenance of equipment to record tide levels, water levels in wells, lake/river stage, rainfall, Doppler velocity, weather, pan evapotranspiration (ET), and soil moisture. Mr. Tara is proficient in using a wide variety of hydrologic and hydraulic modeling software and codes including MODFLOW, HSPF (Hydrological Simulation Program – FORTRAN), PRMS, HEC-RAS (Hydrologic Engineering Center River Analysis System), IHM (Integrated Hydrologic Model), MIKE SHE, HydQual, and PEST (Parameter ESTimation).

Years of Experience: 28

Education:
- MSCE, 1991, Civil Engineering, University of South Florida
- BSCE, 1989, Civil Engineering, University of South Florida

Professional Registrations/Affiliations:
- Professional Engineer, Florida, 1995, No. 48877
- Professional Hydrologist, AIH, 2005, No. 1644
- Member, American Water Resources Association
- Member, American Institute of Hydrology

Professional History:

2003 – Present	Senior Water Resources Engineer – INTERA Inc., Tampa, FL
1990 – 2003	Water Resources Engineer – University of South Florida, Tampa, Florida

Specialized Software Training:
- U.S. Environmental Protection Agency (EPA) Better Assessment Science Integrating Point and Non-Point Sources (BASINS), 2004
- Mike SHE integrated hydrologic model, 2005
- Mike 21 hydraulic model, 2008
- EPA Water Quality Analysis Simulation Program (WASP), 2006

Representative Project Experience

Peer Review of the Keystone Heights Area Lakes Transient Model, St. Johns River Water Management District, Palatka, FL. 2017 – Present. *Project Manager.* Reviewed the transient MODFLOW model of the Keystone Heights area and the baseline flows developed using the transient model. Responsibilities include project management, review of model data sets and methodology for the development of baseline flows. Results of the review were received by the District and used to strengthen the methodology for the calculation of baseline flows in support of the MFLs for Lakes Geneva and Brooklyn.

Independent Peer Review of MFL Programs (De Leon Springs, Alexander Springs, Gemini Springs Silver Glen Springs), St. Johns River Water Management District, Palatka, FL 2016 – 2017. *Project Manager.* Reviewed EFDC and HSPF models as well as supporting data collection used in the analysis of Minimum Flows and Levels for the respective water bodies. The review focused on the appropriate conceptualization of the model, appropriate data collected, and the use of a weight-of-evidence approach to evaluate impacts to the Silver River system. Model and parameter uncertainty was a focus of the review. Review technical memorandums recommended improvements for the MFL documentation, modeling strategy, and statistical tests for enhancements and increased defensibility of the final MFL development. For each water body, internal teleconferences were held presenting review findings to District staff.

Impact Analysis and Hydrologic Modeling of the Apalachicola, Chattahoochee, and Flint (ACF) Rivers, Florida Department of Environmental Protection (FDEP), Tallahassee, FL. 2010 – 2016. *Project Manager and Technical Lead.* Represented the FDEP in legal dispute between the state of Florida and the state of Georgia to protect Florida's interests in the water resources in the Apalachicola River and Bay. Provided process modeling and statistical analysis for the ACF rivers to support the legal action. Led the application of hydrologic and hydraulic models, including RESSIM, PRMS, xpSWMM, ROMS, and MODFLOW, to represent scenarios of un-impacted and future impacted conditions as well as multiple recovery strategies. Also led

statistical analysis of the observed flows used to define the boundary conditions to the model. Also performed technical review of legal expert reports.

Peer Review of the Minimum Flow and Level Modeling of the Silver Springs, Silver River, and Upper Ocklawaha River, St. Johns River Water Management District, Palatka, FL. 2013 – Present. *Project Manager.* Reviewed the steady-state HEC-RAS model of the Silver River system as well as the draft hydrologic data inventory. The review focused on conceptualization of the model and the use of a weight-of-evidence approach to evaluate impacts to the river system. The final review recommended improvements for the modeling strategy and statistical tests for enhancements to the final MFL development. An additional phase of this project included the review of the HSPF models of the Ocklawaha River Basin. Current efforts include, reviewing documents, representing the District in public meetings, and recommending future analyses.

Peer Review Services for the Application of the Integrated Hydrologic Model (IHM) for the Old Tampa Bay Integrated Modeling System, Tampa Bay Estuary Program (TBEP), Tampa, FL. 2013. *Technical Peer Review.* Reviewed and supported the application of the IHM as a component of the Old Tampa Bay Integrated Modeling System. The IHM was used to simulate the inflow quantity and quality into Old Tampa Bay. The IHM integrates both surface water and groundwater processes. Both are very important to isolate the component of streamflow to the Bay as their water quality concentrations can be different. TBEP consultants modified the IHM boundaries to extend the simulation to include water quality sampling efforts.

Peer Review and Development of Recharge and Groundwater Evapotranspiration Rates for the Northern District Model, Southwest Florida Water Management District, Brooksville, FL. 2013. *Project Manager.* This project provided model peer review and technical support for recalibration of the Northern District Model. As a part of the recalibration efforts, an HSPF model is being developed to compute the recharge and groundwater ET boundary conditions for the Northern District Model domain. In support of this effort, responsibilities included review of the model recalibration and recommendations to the District for model improvements.

Peer Review of the SSARR and HSPF Watershed and Lake Models, St. Johns River Water Management District, Palatka, FL. 2009-present. *Project Manager/Technical Lead.* Reviewed SSARR and HSPF models for eight lakes (Cowpen Lake, Etonia Chain of Lakes, Lake Tarhoe, Sylvan Lake, Lake Hiawassee, Prevatt Lake, Johns Lake, and Lake Avalon). The models are used to evaluate lake MFLs, and the review process included examining model boundary conditions, calibration, and sensitivity analysis. An emphasis was placed on the appropriate conceptualization and constraint of both the contributing watersheds and receiving waterbodies. The water balances of the models were closely examined to determine whether the models simulate appropriate fluxes for components such as rainfall, evapotranspiration, infiltration, baseflow, and surface runoff. The reviews highlighted the unconstrained fluxes in the models, such as lake seepage fluxes and ungauged lake outflows, and recommended improvements for the modeling strategy and future enhancements to the MFL development. These enhancements included the scrutiny of the water balance during model calibration, the inclusion of the water balance in the model documentation, and the performance of additional sensitivity analysis to model boundary conditions.

Peer Review of the St Johns River Watershed Water Supply Impact Study (WSIS) Model, St. Johns River Water Management District, Palatka, FL. 2009. *Project Manager/Technical Lead.* The District developed an HSPF model to evaluate the potential environmental impacts to the St. Johns River due to future surface water withdrawals. With this goal in mind, the watershed hydrology component of the WSIS was reviewed to assure the model was conceptualized, constructed, and calibrated using current and proper engineering practices. In the review process, emphasis was placed on the replication of the water balance. The water balance is the dominant component of the watershed hydrology model and alternative comparison. Finding of the review led to recalibration of the model parameters.

Peer Review of the District-Wide Regulation Model, Southwest Florida Water Management District, Tampa, FL. 2009. *Review Panel Member.* The District-Wide Regulation Model (DWRM) was developed to evaluate groundwater withdrawal permit applications. The model allows the evaluation to account for cumulative impacts. The DWRM also has a telescopic mesh refinement procedure built to better evaluate the nearfield impacts of the groundwater withdrawals. The comprehensive review included the evaluation of the model conceptualization, construction, and calibration, as well as an evaluation of the telescopic mesh refinement. The review team determined the validity of applying the DWRM for groundwater permitting review. Calibration was identified as a critical concern. The accuracy of the model calibration as it applied to meeting the model objectives was a component of the review team analysis. The construction of the river cells and drain cells were also of concern to the review team. The overall water balance and the model's ability to represent the physical processes were also components of the review process. Recommended model enhancements were adopted and applied.

INTERA
GEOSCIENCE & ENGINEERING SOLUTIONS

Renee Murch, PE – Lead Expert, Statistical Modeling and Analysis

Renee Murch has 14 years of experience in water resources, hydrology, and civil infrastructure. Her areas of expertise include the development and application of hydraulic, hydrologic, and statistical models to support minimum flow and level (MFL) development, restoration of surface water resources, evaluation of saltwater and freshwater interaction, simulation of regional- and local-scale hydrologic conditions as part of water resource planning efforts, and assessment of scouring and erosion processes associated with the construction of bridges and other civil infrastructure. Ms. Murch has specialized expertise in the development and application of statistical models, including multiple linear regression, artificial neural networks (ANNs), and Markov Chain Monte Carlo (MCMC) probabilistic simulations. She has developed, calibrated and applied models using such applications as HEC-RAS, MODFLOW, HSPF, ELM, XPSWMM, SSARR, and the Integrated Hydrologic Model (IHM). She has evaluated radiological and hydrologic data using methods such as principal component analysis, agglomerative hierarchical cluster analysis (AHCA), analysis of variance (ANOVA), bivariate correlation, multivariate regression, artificial neural networks, and hypothesis testing. Her experience also includes the application of geographic information system (GIS) tools for data analysis and model input development and hydrologic data collection. She has field experience related to instrumentation and data collection on water resources- and geotechnical-related projects, including the installation and maintenance of well transducers; weather stations; evaporation pans; and stream stage, runoff test bed, soil moisture, and tide gauges. Her current work focuses on developing, calibrating, and application of surface water, groundwater, and statistical models using applications such as MODFLOW, HEC-RAS, CE-QualW2, ELM, HSPF, IHM, SPLUS, and R to support water supply planning and MFL development in Florida.

Representative Project Experience

Peer Review of the Keystone Heights Area Lakes Transient Model, St. Johns River Water Management District, Palatka, FL. 2017 – Present. *Project Manager*. Reviewed the transient MODFLOW model of the Keystone Heights area and the baseline flows developed using the transient model. Responsibilities included review of MODFLOW data sets, model output, and review of the District's baseline flow methodology. Results of the review were received by the District and used to strengthen the methodology for the calculation of baseline flows in support of the MFLs for Lakes Geneva and Brooklyn.

Statistical Analysis and Modeling of the Apalachicola, Chattahoochee, and Flint (ACF) Rivers, Florida Department of Environmental Protection (FDEP), Tallahassee, FL. 2012 – 2016. *Project Engineer*. Provided modeling and statistical analysis for developing a revised alternative operations plan for the ACF rivers. Performed statistical analysis and modeling for the FDEP to support discussions between the state of Florida and the state of Georgia, protecting Florida's interests in the water resources in Apalachicola River and Bay. Served as the primary modeler for applying hydrologic and hydraulic models including: RESSIM, PRMS, xpSWMM, ROMS, and MODFLOW. Analyzed observed flow data to determine statistically significant trends. Simulated alternative unimpacted and impacted flow scenarios by modifying boundary flows in a Northwest Florida Water Management District xpSWMM distributary model of the lower Apalachicola River.

Years of Experience: 14

Education:
- MS, 2002, Civil Engineering, University of South Florida
- BS, 2000, Civil Engineering, University of South Florida

Professional Registrations/Affiliations:
- Professional Engineer, Florida, 2006, No. 64678
- Member, American Public Works Association
- Member, American Water Resources Association, Florida Section
- Florida Department of Environmental Protection Certified Erosion and Sediment Control Inspector

Professional History:

2008 – Present	Senior Water Resource Engineer – INTERA Inc., Lutz, FL
2002 – 2005	Senior Professional Engineer Trainee – Florida Department of Transportation, State Materials Office, Gainesville, FL
1999 – 2002	Research Assistant – University of South Florida, Tampa, FL
1998 – 2000	Engineering Assistant – Hayward Baker Inc., Tampa, FL
1998	Engineering Technician – Florida Cities Water Company, Sarasota, FL

Specialized Training & Software:
- HEC-RAS, CE-QualW2, Hydqual, HSPF, IHM, SSARR
- BASINS, IOWDM, ANNIE, GenScn, WDMUtil
- DMSTA, ELM, ICPR, Crystal Ball, ProUCL, XPSWMM
- MODFLOW, Groundwater Vistas
- SPLUS, R, Statistica, ArcMap, Map Windows, Visual Basic, perl

Independent Peer Review of MFL Programs (De Leon Springs, Alexander Springs, Gemini Springs Silver Glen Springs), St. Johns River Water Management District, Palatka, FL 2016 – 2017. *Lead Reviewer.* Reviewed EFDC and HSPF models as well as supporting data collection used in the analysis of Minimum Flows and Levels for the respective water bodies. The reviews focused on the appropriate conceptualization of the model, appropriate data collected, and the use of a weight-of-evidence approach to evaluate impacts to the Silver River system. Model and parameter uncertainty was a focus of the review. Review technical memorandums recommended improvements for the MFL documentation, modeling strategy, and statistical tests for enhancements and increased defensibility of the final MFL development. For each water body, internal teleconferences were held presenting review findings to District staff.

Peer Review for Caloosahatchee River (C-43) West Basin Storage Reservoir Freeboard Analysis and Separator Dam Update, South Florida Water Management District, West Palm Beach, FL. 2016. *Project Manager and Peer Reviewer.* Provided peer review services for a freeboard analysis and separator dam design of C-43 West Basin Storage Reservoir. Recommendations based on review of the model documentation included modifying the analysis to assume that outlet structures are wide open during the design event, the need to recommend a final freeboard height in the documentation and modifications to the documentation to provide additional modeling details. Responsibilities included review of consultant reports, participation in conference calls, and documentation of the peer review.

Peer Review of the Upper Ocklawaha River Basin Model, St. Johns River Water Management District, Palatka, FL. 2014. *Project Engineer.* Served as the primary reviewer for the HSPF model of the Upper Ocklawaha River Basin. The review focused on the appropriate conceptualization and calibration of the HSPF model to evaluate impacts to the Upper Ocklawaha system. The final review document recommended improvements for the modeling strategy and statistical tests for enhancements to the MFL development.

Peer Review of the HEC-RAS Model and Statistical Analysis of Silver Springs and the Silver River, St. Johns River Water Management District, Palatka, FL. 2013. *Project Engineer.* Served as the primary reviewer for the steady-state HEC-RAS model of the Silver River system, as well as with the review of the hydrologic data inventory draft document for the District. The review focused on the appropriate conceptualization of the HEC-RAS model and the use of a weight-of-evidence approach to evaluate impacts to the Silver River system. The final review document recommended improvements for the modeling strategy and statistical tests for enhancements to the MFL development.

Peer Review and Development of Recharge and Groundwater Evapotranspiration Rates for the Northern District Model, Southwest Florida Water Management District, Brooksville, FL. 2013. *Project Engineer.* This project provided model peer review and technical support for recalibration of the Northern District Model. As a part of the recalibration efforts, an HSPF model is being developed to compute the recharge and groundwater ET boundary conditions for the Northern District Model domain. In support of this effort, responsibilities included review of the model recalibration and recommendations to the District for model improvements.

Review of the SSARR and HSPF Watershed and Lake Models, St. Johns River Water Management District, Palatka, FL. 2009-present. *Project Engineer.* Reviewed SSARR and HSPF models for eight lakes (Cowpen Lake, Etonia Chain of Lakes, Lake Tarhoe, Sylvan Lake, Lake Hiawassee, Prevatt Lake, Johns Lake, and Lake Avalon). The models are used to evaluate lake MFLs, and the review process included examining model boundary conditions, calibration, and sensitivity analysis. The water balances of the models were closely examined to determine whether the models simulate appropriate fluxes for components such as rainfall, evapotranspiration, infiltration, baseflow, and surface runoff. The reviews highlighted the unconstrained fluxes in the models, such as lake seepage fluxes and ungauged lake outflows, and recommended improvements for the modeling strategy and future enhancements to the MFL development. These enhancements included the scrutiny of the water balance during model calibration, the inclusion of the water balance in the model documentation, and the performance of additional sensitivity analysis to model boundary conditions.

Review of the St. Johns River Watershed Water Supply Impact Study (WSIS) Model, St. Johns River Water Management District, Palatka, FL. 2009. *Lead Model Reviewer.* Served as primary model reviewer for an HSPF model to evaluate the potential environmental impacts to the St. Johns River due to future surface water withdrawals. The watershed hydrology component of the WSIS was reviewed to assure the model was conceptualized, constructed, and calibrated using current and proper engineering practices. In the review process, emphasis was placed on the replication of the water balance. Findings of the model review resulted in model recalibration of the model parameters by the District.

Ken Watson, PhD, PH
President / Principal Hydrologist

HSW Engineering, Inc.

Education

- PhD, Soil Physics, University of Kentucky
- Research Associate, United States Dept. Of Agriculture, Beltsville, Maryland
- MS, Soil Physics, University of Kentucky
- BS, Soil Science, University of Florida
- Post-Doctoral Research Associate, Oak Ridge National Laboratories Environmental Sciences Division
- Courtesy Professor, University of South Florida, Geology Department, 2005-Present

Fields of Specialization

- Minimum Flows and Levels
    - SJRWMD (Peer review and MLF development)
    - SWFWMD (technical studies (modeling, statistics, wetlands) and Peer review)
    - SRWMD (MFL development and Peer review)
    - NWFWMD (technical assistance – modeling, planning)
- Expert Witness in Groundwater Modeling and Applied Mathematics
- Investigation of Groundwater, Surface Water, Soil and Sediment and Contamination
- Human Health and Ecological Risk Assessments
- Modeling:
    - Hydrologic and solute transport modeling in porous and fractured media (analytical and numerical – MODFLOW, MT3D)
    - Hydrologic (BASINS, IHACRES), hydraulic (HEC-RAS) and hydrodynamic modeling (EFDC) of surface waters
    - Instream Physical Habitat (SEFA)
    - Mixing zone modeling
    - Statistics and stochastic modeling
- Groundwater and Surface Water Hydrology
- Saturated and Unsaturated Hydraulic Conductivity Determinations
- Water Use/Consumptive Use Permitting
- Surface Water Quality and Permitting
- Total Maximum Daily Loads
- Water Conservation and Best Management Practices in Agriculture
- Wetland Investigations

Summary of Professional Experience

Dr. Ken Watson is a recognized expert in numerical and statistical modeling, and quantitative hydrology. As a Principal Hydrologist at HSW (1988 to present), he manages projects related to internal and external training, water resources investigations, surface water modeling studies, groundwater studies, hydrologic and solute transport modeling projects, internal and external training in water resources, and human health and ecological risk assessments. He is also involved in specific investigations dealing with establishing minimum flows and levels in water bodies in west-central Florida for the Southwest, St. Johns River, Suwannee River and Northwest

Years of Experience
35

Licensure

Certified and Registered Professional Hydrologist - Groundwater, 2000

Continuing Education

University of South Florida:
- Hydrology of Islands/Coasts, 1988
- Florida and Island Hydrology, 1990
- Analytical and Semi-Analytical Models, 1992
- Mathematics of Flow News and Analytic Elements, 1994
Risk Assessment (American Petroleum Institute)
Risk Analysis
Stochastic Methods (Monte Carlo) in Risk Analysis
Visual ModFlow
HSPF Modeling using BASINS
Vapor Intrusion 2012
Hydric Soils 2012
Advanced SEFA Modeling

Professional Affiliations

American Institute of Hydrology
National Groundwater Association
American Water Resources Association
Florida Association of Environmental Soil Scientists

Florida Water Management Districts. Dr. Watson is continually called upon to provide quantitative expertise with respect to groundwater, surface water and unsaturated zone hydrology, the transport of contaminants in surface and-subsurface waters, and has qualified as an expert in administrative hearings in the fields of groundwater modeling and applied mathematics. As president of HSW, he is in charge of corporate technical development.

After receiving his Ph.D., Dr. Watson held a Research Associate position (1983 – 1986) with Oak Ridge National Laboratories (ORNL). Under sponsorship of the Office of Health and Environmental Research and the University of Tennessee, Dr. Watson participated in some of the nation's earliest studies of the transport rates of trace contaminants from shallow land waste disposal sites, biodegradation of TCE, solidification techniques, geostatistics and various review committees dealing with hazardous waste disposal.

As a recognized expert in his field, Dr. Watson is regularly called upon to perform peer reviews of work performed by others, participate in Red Team reviews of proposals and important published reports and documents, and serve as an Expert Witness.

Project Experience – Water Resources / MFLs

- Evaluated Water Resource Values for MFLs developed by the SJRWMD using extreme value frequency analysis techniques for sections of the St Johns and Ocklawaha Rivers.

- Managed and member of a peer review panel that evaluated MFLs in the Suwannee River Water Management District, including the appropriate use of statistical, hydrologic, hydraulic, and hydrodynamic models (e.g., hspf (BASINS), and HEC-RAS). The surface water bodies evaluated include Madison Blue Springs, Lower Suwannee River, Manatee Springs, Fanning Springs, Alapaha, Wacasassa, and Upper Santa Fe Rivers.

- Assisted with Developing MFLs for the SRWMD for the Aucilla River and currently for the Upper Suwannee, Alapaha, and Withlacoochee Rivers.

- Assisted the SWFWMD on over twenty-five related projects for over ten rivers or river sections, including hydrologic, hydraulic, residence time, and statistical modeling and model review, and peer review.

- Assisted the NWFWMD in preparing a work plan for the Development of Minimum Flows and Levels for Jackson Blue Springs and in evaluating a HEC-RAS model for Spring Creek.

- Developed IHACRES model for the Lower Santa Fe River in support of MFLs.

- Developed hydrodynamic model for the Homosassa River using EFDC in support of MFLs.

- Performed a detailed drainage and hydraulic conveyance model of Tampa Electric's Big Bend plant using SWMM.

- Project officer and lead modeler for water resource evaluation of the Belleair Wellfield. Developed a pumping optimization model and performed trend analysis and water level and water quality data.

- Served as project officer and lead modeler for modeling of selecting hydrogeologic settings in Pinellas County, Florida for locating of a brackish-water reverse osmosis water treatment facility.

- Developed water balance model for Lake Dan, located in the Eldridge Wilde Well field in west-central Florida for Tampa Bay Water.

- Compared various modeling strategies for determining solute travel times to water supply wells.

- Developed stochastic modeling techniques for water flow and solute transport problems.

- Applied complex numerical transport models to numerous hazardous waste areas.

- Investigated modeling techniques for biodegradation of TCE while at Oak Ridge National Laboratories.

- Investigated potential salt-water encroachment in the Northwest Hillsborough County area and developed a conceptual model of the transition zone in that region of the county.

Dean Mades, PE, D.WRE
Principal Engineer and Hydrologist

HSW Engineering, Inc.

Education

- Graduate Studies, Civil Engineering, University of Illinois
- MS, Civil Engineering, University of Illinois
- BS, Civil Engineering, Bradley University

Fields of Specialization

- Environmental Assessments Supporting MFLs, WRVs, and criteria development
- Hydro-ecological, Surface- and Ground-Water Hydrology, Hydraulics, Computer Modeling
- Hydrologic and Water-Quality Monitoring, Data Evaluation, and Statistical Modeling
- Permitting (Environmental Resource / Mitigation Bank, Water Use, Dredge & Fill, NPDES)
- Expert Testimony and Environmental Rule Development

Licensure

Professional Engineer, Florida – 48742

Diplomate, Water Resources Engineer

Professional Affiliations

American Society of Civil Engineers

Summary of Professional Expereince

Mr. Mades is an accomplished hydrologist with 30+ years of experience evaluating ecology, surface- and groundwater hydrology and quality throughout the United States, including nearly 10 years with the U.S. Geological Survey. He has managed and currently provides quality-assurance reviews on a variety of projects including Minimum Flows and Levels (MFLs) and Water Resource Values (WRVs) assessment, hydrologic and hydraulic modeling, environmental/water use/wastewater/stormwater permitting, site development, drainage engineering, forensic assessments, ecohydrology, and groundwater remediation. His ecohydrology work involves multi-discipline, scientific assessments to determine regulatory minimum flows and levels assessments for rivers, estuaries, springs, and lakes. He is well versed in the application of hydro-ecological models using software such as PHABSIM and SEFA, empirical estuary flushing models, and numerical modeling codes for the analysis of watershed and stream hydraulics (HEC-1/HEC-HMS, HEC-2/HEC-RAS, HSPF, SWMM), receiving water quality (WQRRS, QUAL-2E and CE-QUAL-W2), groundwater (MODFLOW, HST3D, Groundwater Vistas, Visual MODFLOW, InterSat and InterTrans), and estuary hydrodynamics and quality (EFDC).

Project Experience

MFLs / WRVs Assessment and Environmental Criteria Development

- SJRWMD: Peer review of MFLs methodology for sand-hill lakes (Brooklyn and Geneva). Environmental constraint analysis of the upper Suwannee River to support consumptive use permit application reviews. Technical quality-assurance reviews of WRV, hydro-ecology, hydrology, and field assessments supporting MFLs development for lower St. Johns River at Lake Poinsett and lower Ocklawaha River. Prepared an environmental constraint analysis of the upper Suwannee River to facilitate consumptive use permit application reviews.
- SRWMD: Technical quality-assurance (QA) reviews of hydro-ecology, hydrology, WRV, and field assessments supporting MFLs development for the upper Suwannee, Alapaha, Withlacoochee, Aucilla and Wacissa Rivers and Estuary; and priority springs (White Sulphur, Suwannee Springs, Madison Blue, Wacissa Springs Group, Nutall Rise). Assisted with the collation and review of literature and models that would support the MFLs development for four coastal rivers (Aucilla, Wacissa, Econfina, and Steinhatchee). Managed the development of spring-flow ratings for 17 priority, first- and second-magnitude springs based on available groundwater level and river stage data.
- SWFWMD: Technical quality-assurance reviews of statistical evaluations of streamflow hydrology and hydraulics, water quality, and biology in support of establishing MFLs for Brooker and Shell Creeks; Homosassa River and Estuary; and upper Alafia, Anclote, Little Manatee, and lower Manatee Rivers.
- NWFWMD: Technical quality-assurance reviews and development of a work plan for the technical assessment of MFLs for Jackson Blue Spring.

Hydro-Ecological, Statistical, and Surface Water Quantity/Quality Modeling and Analysis

- Technical quality assurance reviews of PHABSIM and SEFA modeling supporting MFLs development for upper Suwannee, Withlacoochee, and Alapaha Rivers (SRWMD), and Shell Creek (SWFWMD).
- Evaluated long-term records of daily streamflow to characterize annual exceedance and non-exceedance statistics in support of technical Water Resource Value assessments of MFLs proposed by SJRWMD for the St. Johns River at Lake Poinsett and lower Ocklawaha River.
- Technical quality assurance review of hydrodynamic modeling performed using EFDC and linear regression to characterize the salinity and thermal regimes of the Homosassa River for MFLs development.
- Technical quality assurance reviews of multiple linear and non-linear regressions calculated using SPSS to characterize watershed yield and relationships between annual rainfall, ET, and runoff for technical assessments of MFLs proposed by SRWMD for the upper Suwannee, Alapaha, Withlacoochee, Aucilla and Wacissa Rivers.
- Managed and performed technical QA reviews of multiple linear and non-linear regressions calculated using SPSS to characterize spring-flow ratings for 17 first and second order springs within the SRWMD jurisdiction.
- Managed a long-term rainfall-runoff analysis supporting an Indian River and St. Lucie Counties Water Resources Study for SFWMD, coordinated with SJRWMD. Model was used to simulate runoff from the 3 basins for subsequent evaluation of off-stream reservoir storage potential using a reservoir-pump sizing optimization algorithm.
- Managed the development of an interactive software computer program to implement a water balance model (Hydrologic Engine) in Sarasota County's SIMPLE GIS-integrated, pollutant load calculator. The work was completed on an expedited schedule to facilitate the County's annual compliance reporting requirements.
- Managed hydrology and hydraulic (H&H) modeling performed using HEC-HMS and HEC-RAS for project Q-1049 design of live-fire training ranges for Special Operations Forces at Marine Corps Base Camp Pendleton, California.
- Regional Water Supply Planning-Evaluated agricultural irrigation Best Management Practices (BMPs) to support SWFWMD Facility Agricultural Resource Management Systems (FARMS) Program.

Environmental Monitoring and Hydrologic Data Analysis

- Designed and implemented synoptic flow and bottom-material measurements to provide data for calibrating PHABSIM/SEFA physical habitat models of four sites on the upper Suwannee River to support MFLs development.
- Provided technical quality-assurance review of synoptic surveys of streamflow performed using an Acoustic Doppler Current Profiler (ADCP) and Acoustic Doppler Velocimeter (ADV) to collect data for calibrating a SEFA habitat simulation models of upper Shell Creek, Alapaha and Withlacoochee Rivers for MFLs development.
- Managed and QA-reviewed annual permit-compliance inspections of wetlands and uplands at Conner Preserve, a Florida Department of Transportation wetland mitigation bank being maintained by SWFWMD for the FDOT.
- Managed the design, instrumentation, and maintenance of a statewide network of 44 automated water quality samplers and hydrometric monitoring stations located at 13 airports to characterize runoff quantity and quality. Results supported rulemaking for a new Florida General Permit for airside stormwater management systems.
- Evaluated >500 field discharge measurements to determine stage-discharge ratings and long-term daily flow records for 8 gaging stations within Babcock Ranch and vicinity for use in calibrating the HEC-HMS rainfall-runoff model and USGS GSFLOW integrated groundwater and surface water model.
- Designed and implemented a network of streamflow and rainfall monitoring stations at the directive of the Sixth Judicial Circuit Court in Pasco County to support a circuit court injunction order in a drainage dispute.
- Managed regional monitoring and retrospective data assessments for a pilot USGS National Water Quality Assessment (NAWQA) Program study to describe the occurrence and distribution of SW-quality parameters, and association with natural and anthropogenic factors throughout the 12,500 square-mile upper Illinois River Basin.

Expert Testimony and Consultation

- Expert review of draft MFLs hydrology assessment for the lower Santa Fe and Ichetucknee Rivers for SRWMD.
- Expert review of Merritt Mill Pond/Spring Creek HEC-RAS modeling to support MFLs development of MFLs for Jackson Blue Spring by NWFWMD.
- Expert review of SWFWMD's draft technical assessment of the lower Peace River / Shell Creek MFLs for the City of Punta Gorda which relies on withdrawals from Shell Creek Reservoir for potable supply.
- Flow Measurement Expert on the 3-member Lake Michigan Diversion Accounting 5th Technical Committee. The Committee report was part of the USACE's submittal to the U.S. Supreme Court.

Senior Water Resources Engineer

TECHNICAL SPECIALTIES:

Scientific and Technical Peer Review.♦Hydrodynamics, Sediment Transport,Water Quality and Eutrophication Modeling ♦ Hydraulic Modeling with HEC-RAS ♦Watershed Studies and Modelingwith BASINS/HSPF,LSPC and SWMM ♦Ground Water Modeling with MODFLOW, MT3D and SEAWAT♦TMDL ♦Modeling Data Collection and Analysis ♦Coastal Tide and Wave Analysis and Modeling Using SWAN, STWave

EDUCATION and EXPERIENCE:

Ph.D., Environmental Engineering and Science, Clemson University, 1999
M.E., Water Resources, China Inst. of Water Res and Hydropower Res., Beijing, China, 1989
B.E., Hydraulics and Hydropower Engineering, Hohai University, Nanjing, China, 1986
Years of Professional Experience: 29; with Dynamic Solutions, LLC: 7

PROFESSIONAL REGISTRATION and MEMBERSHIPS:

Registered Professional Engineer: Florida #69540, and Georgia #032171
Member, American Society of Civil Engineers
Member, American Water Resources Association
Member, International Association of Hydrological Sciences

PROFESSIONAL BACKGROUND:

Dr. Lu is a registered Professional Engineer and a Diplomat of American Academy of Water Resources Engineers (AAWRE). He has 29 years of diverse research and consulting experience in surface water and coastal hydraulics and hydrodynamics, groundwater hydrology, and watershed hydrology. His expertise includes hydrodynamic, sediment transport, and water quality modeling of lakes, rivers, estuaries, coastal marshes and wetlands; coastal tide and wave analysis and modeling; and groundwater, watershed and hydraulic modeling. He has led a number of3D hydrodynamic, sediment and waterquality modeling studies including the Indian River Lagoonin Florida and numerous 3D hydrodynamic, sediment and water quality modeling in Southeast States, Texas, Oklahoma, and California. He has extensive experience and knowledge of public domain surface water models and groundwater models including BASINS/HSPF, SWMM, EFDC, WASP, HEC-RAS, MODFLOW, MT3D and SEAWAT. He hadconducted hydrologic and hydrodynamic modeling software training including EFDC, HSPF and WASP for SFWMD, FDEP, USACE Jacksonville District and Sacrament District. He is experienced in performing wave modeling using SWAN and STWave. Dr. Lu has published sixteen peer-reviewed papers and has served as a peer reviewer for Water Resources Research, Journal of American Water Resources Association, and Transport in Porous Media.

SELECTED PROJECT EXPERIENCE:

Loxahatchee River and Estuary and Big Bend and Cedar Key Hydrologic Models and Hydrodynamic and Water Quality Models Review and Recommendations for Estuary Waters, Florida Dept. Environmental Protection (FDEP), FL.
Performed technical review and evaluation of hydrologic (LSPC), hydrodynamic (EFDC) and water quality (WASP7) model developed to support TMDLs for Loxahatchee river and estuary and Big Bend and Cedar Key watershed load reductions of sediment and nutrients. Compiled

Senior Water Resources Engineer

data from NOAA NODC, USGS, SFWMD, Water Quality Portal and FDEP IWR for inventory of historical data. Prepared technical report with recommendations, model review, and evaluation of model credibility to support TMDL determinations.

Technical Review and Evaluation of Alabama-Coosa-Tallapoosa (ACT) Draft EIS for Water Control Manual Update, Alabama Power Company, Birmingham, AL.

Performed technical review of basin-wide hydrodynamic (HEC-ResSim) and water quality (HEC-5Q) modeling system developed to support simulated water quality assessments of strategies for operational plans for basin reservoirs. Reviewed Draft EIS, technical appendices and updates to Water Control Manual. Compiled station data time series and extracted model results for comparison to data at selected station locations in the Coosa River and Weiss Lake. Prepared technical memorandum documenting findings of peer review.

Technical Review and QA and QC for Various Hydrologic Models, Hydrodynamic and Water Quality Models, Groundwater Models

Routinely conducted technical review and QA and QC for various surface and groundwater models developed internally within DSLLC or our sub-consultants to ensure the best quality products for our various clients.

Engineering QA/QC, FEMA Flood Hazard and Mapping – Northeastern Atlantic Ocean Coasts, FEMA

Performed engineering QA/QC for various engineering analyses and calculations using FEMA's Guidelines and Specifications for Coastal Flood Hazard Analysis and USACE's Coastal Engineering Manual. The engineering QA/QC included peak over threshold (POT) analyses, extreme value distribution analyses, stillwater elevation analyses, wave setup, wave runup, and storm-induced coastal erosion analyses using CHAMP (WHAFIS and RUNUP) and CEDAS (ACES).

Task Manager and Lead Modeler, Indian River Lagoon (IRL) Tributary Total Maximum Daily Load (TMDL) ModelDevelopment, FDEP, Florida.

Dr. Lu served as the lead modeler in developing, calibrating and validating eight (8) hydrology and water quality watershed HSPF models for thirteen (13) tributary waterbodies with impaired dissolved oxygen (DO) and nutrient/Chl-a. The modeling effort included data collection and analysis/ evaluation, selection of proper model domain and resolution, selection of proper boundary conditions and simulation periods, model setup, model calibration and validation, and analysis and interpretation of the model results and recommendations.He supervised and provided technical guidance and mentoring to other three (3) modelers. He reviewed the IRL mainstem and eight (8) tributaries hydrodynamic and water quality EFDC models which incorporated oxygen, nutrients, algae, sediment transport, internally coupled sediment diagenesis modeland the effect of solids, algae and color on light attenuation and provided comments in support of FDEP's TMDL development. Conducted HSPF model training for FDEP's staff.

Experience Summary

Mr. Leonard is an environmental flow and aquatic impact assessment expert who has conducted instream and environmental flow studies, hydrologic analysis, and watershed assessments throughout the Eastern U.S. for the past 30 years, including extensive habitat, hydrologic, and water management modeling studies on streams and river throughout the Southeast United States, including the James, Maury, Tar, Pamlico, Yadkin-Pee Dee, Neuse, Little, Chattahoochee, Oconee, Ocmulgee, Cheoah, Tallulah, Tugalo, Savannah Rivers, Catawba, and Wateree, as well as projects in California, Connecticut, Idaho, Illinois, Maine, Massachusetts, and Wisconsin. These studies have included many facets of water resource modeling, including instream habitat modeling (River-2D, PHABSIM, RHABSIM, FESWMS), basin hydrologic modeling (e.g., HEC-ResSim; OASIS, WEAP, HSPF), hydrodynamic modeling (e.g., EFDC, River 2-D), hydraulic (e.g., RIV-1, HEC-RAS, HEC-HMS, water quality modeling (CE-QUAL-W2, CE-QUAL-2E, EFDC), hydrologic and time-series analysis (e.g., programmed Excel analysis, IHA, BFI), sediment transport analysis and modeling (HEC-6), specialized adaptations of databases (e.g., Visual Basin, Access, Excel, and other Windows-based programming) for specific project needs, and statistical analyses. He is a Certified Fisheries Professional with vast experience managing a wide variety of water resource, energy, and environmental impact assessment projects. Most of his experience has involved the evaluation and balancing of water management alternatives, hydrologic and hydrodynamic analysis and modeling, new and existing reservoir operations management, evaluation of instream flow regimes and fisheries issues, analysis of potential impact analysis of water withdrawals and hydromodification for energy production and water supply, water quality analysis, and water supply planning and permitting. He has served as expert witness for water withdrawal and permitting cases, provided expert testimony preparation for instream flow issues, hydrologic analysis, water quality, and water adjudication, and provided technical review of the work of others for many projects in various water resource disciplines.

Assignment

Environmental Flows Expert

Education

M.S., Fisheries Science/Statistics, Virginia Polytechnic Institute and State University, 1983

B.S., Aquatic Science/Biology, Allegheny College, 1978

Certifications

American Fisheries Society, Certified Fisheries Scientist

NAUI and PADI Certified scuba diver

Experience

30 years

Joined Firm

2017

Relevant Expertise

- *Aquatic ecology*
- *Ecological assessments*
- *Environmental permitting*
- *Large river studies*
- *Hydrologic analysis*
- *Instream flow analysis*
- *Natural resource permitting and consulting*
- *Project management*

Hydrodynamic, Water Quality, and Habitat Modeling of the Tar River and Pamlico Sound, Greenville Utilities Commission (GUC), Pitt and Beaufort Counties, North Carolina. Project Director. GUC needed to address the complex interactions of North Carolina's Central Coastal Plain Capacity Use Area, water quality, and Tar Pamlico total maximum daily load (TMDL) and nutrient limitations of the Tar-Pamlico Nutrient Strategy as it plans to expand its water treatment plant and wastewater treatment plant. Developed a broad suite of water quality, hydrologic, and hydrodynamic models that comprise the Lower Tar and Pamlico River (LTPR) Hydrodynamic, Water Quality, and Habitat Evaluation Model. Elements included the Tar Basin Hydrologic Model, the Hydrodynamic Model based on the Environment Fluid Dynamic Code (EFDC), and the Water Quality Analysis Simulation Program module. This study elucidated the river response to withdrawals in the tidally influenced Tar-Pamlico River system. The LTPR model also predicts changes in the location of biologically important salinity thresholds and the frequency distributions of salinity in tidal riverine, transitional, and estuarine habitats used as indices of the potential impacts of water management alternatives.

Reservoir, Stream, Watershed, and Water Quality Modeling for Water Resource Management Options in the Little River Basin, Public Utilities Department, City of Raleigh, North Carolina. Project Director. Supported the client with a water management alternatives analysis by conducting a broad suite of water quality, stream hydrodynamic, hydrologic, and habitat sampling and modeling for the Little River and the proposed Little River Reservoir. Addressed various water management options and Clean Water Act issues including future water supply alternatives, water quality issues, permitting of a potential new WWTP, the proposed Little River Reservoir, projected reservoir water quality, environmental flows, and Endangered Species Act issues.

National Instream Flow Technical Support Services Contract, U.S. Forest Service (USFS), North Carolina. Program Manager, Instream Flow Expert. Principal-in-charge for the team for a 5-year contract with USFS to provide professional technical services to national forests nationwide. Services included design and evaluation of technical support and guidance related to instream flow issues ranging from hydrologic analysis, instream flow methodologies and techniques, fish habitat requirements and habitat suitability indices, and habitat modeling. The purpose was to provide support to USFS staff engaged in the hydroelectric licensing process or other licensing or permitting issues that involve streamflow alteration, fisheries and instream habitat issues, analysis of project operations modeling, and water quality issues.

Technical Support for Litigation Associated with the Apalachicola-Chattahoochee-Flint (ACF) and Alabama-Coosa-Tallapoosa (ACT) Water Wars, Georgia, Alabama, and Florida. Project Manager and Fisheries Lead. Confidential; description of services by request.

Yadkin Hydroelectric Project and Tillary-Blewett Hydroelectric Project, Alcoa Power Generation, Inc. (APGI): Yadkin and Pee Dee Rivers, North Carolina and South Carolina. Project Principal. Led team providing expert review and oversight of an instream flow study for a 90-mile-long segment of the Pee Dee River in North Carolina and South Carolina. The study involved the evaluation of the relationship between flow and habitat under different operational scenarios. to assist in developing and evaluating various minimum flow, load-following, and generation pattern alternatives to protect and enhance river flow and habitat conditions for resident, migratory, anadromous fish and aquatic species.

Instream Flow and Hydrologic Analysis Support Negotiating Instream Flows for the Tapoco Project, USFS, Cheoah River, North Carolina and Tennessee. Project Manager. Provided technical assistance and strategic consultation to support the U.S. Forest Service in the relicensing process for APGI's Tapoco project. Included in-depth analysis of the historical flow record, synthesis of a long-term reservoir inflow record, evaluation of the applicant's reservoir operations model assumptions and output, and evaluation of regional reference hydrologic conditions for high flows and rate of change. Team developed decision support tools to assist in the group evaluation of flow and operations alternatives including interactive, spreadsheet-based hydrologic and habitat models.

James River Instream Flow Study and EIS, Camp Dresser & McKee, Henrico County, Virginia
Project Manager. Managed a large and complex multidisciplinary assessment of existing and proposed water supply withdrawals and cumulative water withdrawals at the Falls of the James River in Richmond and produced the Affected Environment and Environmental Consequences sections of a Draft EIS. Included in-depth application of the IFIM to produce flow-habitat relations for 18 warm water fish species in four habitat-use guilds and flow-suitability information for nine recreational activities. Included extensive hydrologic analyses, anadromous fish passage evaluations, recreational use and preference studies, fisheries biological assessments, and temperature/water quality modeling. The James River Report received commendations from state and federal resource and regulatory agencies.

Swift Creek Instream Flow Study and Biological Assessment for Dwarf Wedgemussel, D.E. Benson WTP, City of Raleigh, North Carolina. Project Manager. Completed an Instream Flow Incremental Methodology (IFIM) of Swift Creek for the City of Raleigh to support permitting requirements for construction of a new 18 mgd WTP and negotiate a minimum flow downstream of Lake Benson, the water source for the new WTP. Combined a two-dimensional hydraulic model and a spreadsheet-based reservoir operations model to address potential impacts downstream of Lake Benson in Swift Creek. Examined the potential change in habitat for endangered mussel species based on analysis of a 60-year synthesized hydrologic time series.

Flambeau River Instream Flow Study, Northern States Power Company, Wisconsin
Project Manager. Instream flow study performed in response to a FERC Additional Information Request. This project involved the analysis of hydropower peaking operations on habitat for aquatic biota and the evaluation of alternative operational and minimum flow scenarios. It was successfully completed under a demanding schedule with extensive agency consultation. Innovative approaches included the application of habitat-use guilds and "dual-flow" habitat modeling.

Alix Rooker Matos, PE

Experience Summary

Alix Matos, PE, is an environmental engineer with over 18 years' experience assessing the impacts of human activities on the natural environment. She has experience developing Environmental Assessments and Environmental Impact Statements for mining activities, water supply infrastructure projects, and regional wastewater treatment projects. Ms. Matos also has expertise in temperature, water quality, wasteload allocation, and watershed modeling including evaluations of temperature, nutrient loading, eutrophication, fecal coliform, sediment, dissolved oxygen dynamics, and mercury transformations. Her experience in planning and conducting field monitoring studies includes water quality, flow measurement, bathymetry, storm event, sediment mapping, sediment oxygen demand and reaeration, time of travel determinations, surveying, streambank erosion assessment, and use of biological integrity indices. She has experience developing models including QUAL2E and its updated version QUAL2K as well as BATHTUB, BASINS, and GWLF. She has served as the Project Manager for projects using EFDC, HSPF, and WARMF models.

Assignment

Surface Water Modeling

Education

MS, Civil Engineering, North Carolina State University, 2000

BS, Environmental Engineering, North Carolina State University, 1999

Registration

Professional Engineer, North Carolina, #302728

Experience

18 years

Joined Firm

2017

Relevant Expertise

- Environmental Impact Statements
- Environmental Assessments
- TMDL Assessment
- Implementation Planning (BMAP)
- Water Quality Assessment
- Water Resource Modeling
- Watershed Analysis

Numeric Nutrient Criteria (NNC) Evaluation, FL

Modeling Lead. Ms. Matos studied the implications of the USEPA NNC regarding the adequacy and rational of the proposed criteria. She supervised a team of five who set up 40 screening-level lake models using the USACE BATHTUB model in less than three weeks. The models were developed to simulate nutrient concentrations that would result in attainment of the proposed chlorophyll-a criteria and compared to the proposed downstream protective values and instream protective values to determine if different sections of EPA's proposed rule were consistent. This work led to the alteration of the final rule regarding downstream protective values, application of the BATHTUB model as the preferred method to determine protective values (rather than the originally proposed Vollenweider method), and inclusion of Site Specific Alternative Criteria (SSAC) as part of the final rule.

Development of a Fertilizer Loading Model for the Indian River Lagoon Area, Florida

Project Manager. Ms. Matos was the project manager for this project, which quantified the percentage of nutrient loading from residential developments caused by turfgrass fertilizer. The modeling was based on the HSPF models developed for the Indian River Lagoon watershed by FDEP. Rather than simulate nutrient loading from this land use using a lumped runoff concentration, sources of loading to specific residential surfaces were simulated. Seasonal plant uptake rates and fertilizer composition (slow or fast release) were directly simulated in the model. The model predicts the impacts of various fertilizer best management practices such as removing fertilizer from impervious surfaces and altering irrigation patterns.

UNRBA Modeling and Regulatory Support Project – NC

Project Manager. Ms. Matos is the project manager for the Modeling and Regulatory Support project for the reexamination of the Falls Lake Nutrient Management Strategy. The project team includes three firms and several independent technical experts who will be developing one watershed, two lake, and one statistical model to evaluate water quality and designated uses. Ms. Matos has managed projects for this client for the past several years including the Reexamination Planning, Nutrient Credits, and Monitoring Program projects. Significant interactions with watershed stakeholders and agency staff have occurred throughout the project and will continue for the next several years.

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Stream and Pit Lake Modeling for the Midas Gold Mine EIS, Idaho
Resource Lead. Ms. Matos is the resource lead for the stream and pit lake temperature and dissolved oxygen modeling for the Midas Gold Mine in Idaho. Ms. Matos is leading a team of engineers and scientists in the development of these models using QUAL2K (for streams) and GLM (for pit lakes). Supplemental tools including Ttools and Shade.xls are being applied to generate topographic and vegetative shading from LiDAR data. Once the existing conditions models are developed and calibrated, they will be used to evaluate the impacts of mining and restoration on temperature and dissolved oxygen in the study area.

Third Party Review for the Haile Gold Mine EIS
Resource Lead. Ms. Matos was the resource lead for surface water quantity and quality assessment for the Haile Gold Mine environmental impact analysis. This third-party assessment required integration among various modeling studies conducted by Haile, Inc., the third-party reviewer, and several other consultants. Ms. Matos coordinated the surface water impacts with the other water dependent resources including aquatic resources, wetlands, water supply, and groundwater. She was also the technical lead for the thermal modeling that was developed to represent the stream network in the study area. This model was developed using the USEPA QUAL2K model and interfaced with the mine water balance model, the groundwater model, and the hydrologic model to evaluate temperature changes under baseline, mining, and post-mining conditions.

Little River Proposed Reservoir Data Analysis
Modeling Lead. Ms. Matos served as the technical lead for the water quality data analysis summary which compared impacts of river flow, air temperature, and water temperature on hourly observations of dissolved oxygen, pH, and conductance for two separate monitoring periods. She conducted comparative analyses using the USACE BATHTUB model for the proposed water supply reservoir and two existing Piedmont Lakes to assess potential impacts of the proposed reservoir. Each application was normalized for nutrient loading and lake morphometry using land use based nutrient loading rates and water quality data obtained from NCDWQ. Simulated water quality of the proposed reservoir was compared to State water quality standards to assess potential impacts.

Tar River Flow Study
Modeling Task Lead. Ms. Matos coordinated the modeling efforts to assess the impacts of increased surface water withdrawals on the tidally influenced Tar River. A hydrodynamic/water quality model using the USEPA EFDC model was developed to assess impacts on salinity, water quality, river flows, and riverine and estuarine habitats. This study involved coordination with a Technical Advisory Committee including federal and state agency staff to ensure development of an end product that may be used for future permitting applications to meet NEPA and SEPA requirements. Since completion of the flow study, the state agency NCDWR has adopted the Tar River hydrodynamic model as the State's model for assessing flow impacts in the lower Tar River Basin.

Support for Reexamination of the Falls Lake Nutrient Management Strategy, NC
Project Manager. Ms. Matos was the project manager for the Upper Neuse River Basin Association (UNRBA) Reexamination Planning project. The Falls Lake Nutrient Management Strategy (similar to a TMDL) requires significant reductions in nutrient loading to the lake. The UNRBA began a project in 2011 to reexamine the Strategy. The planning project involved collecting and analyzing large datasets to identify spatial and temporal trends, summarizing historic and recent reports, reviewing existing watershed models and lake response models developed by the State to set the nutrient load allocations, calculating nutrient loading to the lake using alternative techniques, recommending future monitoring and modeling studies needed for the reexamination, providing cost estimates for implementing the nutrient reductions, and summarizing the regulatory options relevant to the reexamination process (use attainability analyses, site specific criteria, variances, etc.).

Experience Summary

Ms. Hamideh Riazi is a Hydrologist and water resources engineer with 7 years' experience in water resources management. Her expertise is in hydrologic modeling and analysis, time series modeling (including autoregressive integrated moving average (ARIMA)) and hydrological data analysis. She has experience working and modeling with hydrology and hydraulic software including SSARR, HEC-HMS, HEC-RAS, HSPF and SWMM. She utilizes GIS and AutoCad in support of this work. Hamideh is a former hydrologist III employee with the St. Johns River Water Management District (District). Relevant experience with the District included evaluating and updating the Etonia chain of lakes SSARR model to analyze the long-term hydrologic simulation results. This analysis would help to provide initial limits to the groundwater withdrawals (in this case the Floridan aquifer). This model contains several lakes including Lake Brooklyn and Lake Geneva which are sandhill lakes within the upper Etonia Creek chain of lakes in Florida. To support the lake Brooklyn and Geneva modeling results and analysis, she has evaluated and /or updated several sandhill lakes models which were modeled using SSARR or HSPF including Grandin lakes, Swan Lake, Lake Shaw, Indian Lake and Lake Como. For this purpose, she had to collect and analyze different type of time series data such as rainfall, evaporation, discharge, stage and potentiometric surface level. She performed several sensitivity analyses regarding to the fluctuation of groundwater levels to check how it will affect lake stages. To perform this analysis, she used a linear relationship between the population and groundwater use to estimate time series of ground water use up to early 1900. This method is developed in the District. In her PhD work, Hamideh used ARIMA model to simulate and predict the water quality variables.

Assignment

Surface Water Quality and Quantity Modeling

Education

Ph.D., Civil Water Resources Engineering, University of Texas at Arlington, 2015

M.S., Agriculture Engineering, Tehran University, 2009

B.S., Agriculture Engineering, Tehran University, 2006

Registration

Engineering-in-Training, No. 56166, 2016

Experience

7 years

Joined Firm

2018

Relevant Expertise

- *Hydrology/Hydrogeology*
- *Water Quality*
- *Hydraulic Modeling*
- *Programming: R, MATLAB, FORTRAN*
- *AutoCAD, Arc GIS, HEC-HMS, HEC-RAS, HSPF, SSARR, SWMM*

Re-evaluation of Lake Brooklyn and Geneva Minimum Flow and Level, St. Johns River Water Management District, Florida

Hydrologist III. One way that the St. Johns River Water Management District (District) is working to protect Florida's water resources is through its minimum flows and levels (MFLs) program. MFLs define the limits at which further water withdrawals would be significantly harmful to the water resources or ecology of an area. MFLs are one of many effective tools used by the district to assist in making sound water management decisions and preventing significant adverse impacts due to water withdrawals. Lake Brooklyn and Lake Geneva are sandhill lakes within the upper Etonia Creek chain of lakes in Florida. The District is currently completing a reevaluation of minimum levels for both systems. MFLs for both lakes were originally established in 1994. Hamideh evaluated and updated complex hydrologic studies. She identified data required to develop numerical model input data sets from available hydrologic/hydrogeologic data. Hamideh performed statistical analyses of hydrologic data using various software tools. She updated Streamflow Synthesis and Reservoir Regulation (SSARR) models of several sandhill lakes in support of Brooklyn and Geneva modeling results and analysis. Lastly, she prepared written and oral reports describing research results, using illustrations, statistical analysis, appendices, and other information.

Development of Real-Time Data Assimilation and Initialization Modules for HSPF for Improved Water Quality Prediction and Monitoring, National Institute of Environmental Research, Republic of Korea

Research Assistant. Being able to predict water quality in the river system accurately is critical to protecting public health from harmful water quality conditions such as algal blooms or bacterial pollution and to allowing the decision makers to respond more quickly to emergency situations such as oil spills for protection of water resources systems. One effective way to improve accuracy of water quality prediction is to reduce uncertainties in the initial conditions (IC) of water quality models, which are due to large

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dimensionality of the state vector and limited number of available observations. Data assimilation (DA) is a technique that optimally combines computer model results with observations to provide a more accurate estimate of the model initial conditions. Therefore, a DA technique was used to develop and evaluate a prototype algorithm updating the initial conditions of the watershed water quality model, the Hydrologic Simulation Program – Fortran (HSPF), based on real-time observations of water quality and streamflow. Hamideh developed and evaluated a prototype algorithm which updated the initial conditions of a watershed water quality model. This used a data assimilation technique to improve the accuracy of short-range water quality forecast. She analyzed water quality and quantity data sets using different statistical techniques. Hamideh also assessed the predictability of water quality variables by a data driven modeling and prepared written and oral reports describing the research results and progress.

Bratash Pump Station Project, Agriculture Organization of Ilam, Ilam, Iran

Technical Engineer. The Bartash Pump Station supplies water for farmlands in the Bartash irrigation command area. Hamideh was involved in the hydraulic design, drafting and cost estimation of the water diversion project. She conducted the spatial data analysis and presentation with ArcGIS and prepared monthly progress reports.

Incheh Sofla Channel Project, Khorasan Regional Water Authority, North Khorasan Province, Iran

Technical Engineer. To prevent immigration and to improve the water distribution system for the Incheh-ye Sofla village, a water conveyance system was installed and distribution canals were built. Hamideh assisted with the preparation of documents including the progress report and correspondence with stakeholders. She also assisted with the hydraulic design, drafting, river engineering and flood management including hydrological and flood modeling with HEC-HMS and HEC-RAS.

Water Treatment Plant in Gohardasht Phase II, Tehran Regional Water Authority, Karaj, Iran

Technical Engineer. The Karaj province is one of the fastest-growing cities in Iran located west of Tehran. There was an immediate need to increase the capacity at the water treatment plan. Hamideh assisted in the preparation of reports for monthly activities and communicated with the client conveying project status, site construction, procurement, or engineering

Koot Amir Water Treatment Plant, Khuzestan Water and Power Authority, Ahvaz, Iran

Technical Engineer. There had been an increasing pollution in the surface water in Ahvaz, Iran. Surface water was one of the main water supplies in Ahvaz, therefore, there was a need to design and construct several clarifiers and flocculators for the water treatment process. Hamideh prepared reports for monthly activities and reviewed engineering designs, drawings to identify potential problems.

Publications

1. K. Kim, S. Kim, H. Riazi, D.-J. Seo, C. Shin. Improving Operational Water Quality Forecasting with Ensemble Data Assimilation. Journal of Water Management Modeling. 2014.
2. S. Kim, H. Riazi, D.-J. Seo, C. Shin. Improving Water Quality Forecasting Using HSPF via Ensemble Data Assimilation. Journal of Hydrology. 2014.
3. A. Asghar Montazar, H. Riazi. Optimum Allocation of Land and Water Resources within Irrigation Schemes. Presented at 2th International Perspective on Water Resources and Environmental Conference, Singapore. 4 January 2011.
4. A. Asghar Montazar, H. Riazi. Conjunctive Water Use Planning in an Irrigation Command Area. Journal of Water Resources Management. May 2009.
5. A. Asghar Montazar, H. Riazi. Optimal Allocation of Land and Water Resources within Qazvin Irrigation Scheme. Presented at International Perspective on Environmental and Water Resources Conference, Thailand. 5 January 2009.
6. A. Asghar Montazar, H. Riazi. Optimization of Water Allocation in Qazvin Irrigation Command Area. Journal of Applied Irrigation Science, Volume 43