**STATE OF FLORIDA**
**DEPARTMENT OF ENVIRONMENTAL PROTECTION**

**Scope of Work Summary**
**for Task Assignment (TA) No.: WQ168 TA4**
Execution through April 26, 2023

The following scope of work details the services that *Tetra Tech, Inc. and Applied Ecology, Inc.* will provide to the Florida Department of Environmental Protection (DEP) to update the Spatial Watershed Iterative Loading (SWIL) Model. The SWIL Model was originally developed in 2011–2014 as part of the Indian River Lagoon (IRL) total maximum daily load (TMDL) refinement effort, and was recently applied by DEP to estimate nutrient starting loads for stakeholders in the North IRL, Central IRL, and Banana River Lagoon basins as part of the IRL Basin Management Action Plans (BMAPs).

*Tetra Tech, Inc. and Applied Ecology, Inc.* will provide technical support to DEP to update and refine the SWIL model for use in the IRL BMAPs. The update to the SWIL model will include updates to the model input layers, verification of watershed boundaries, examination of model period of record runs, and model calibration/validation. Tasks will include participation in meetings and conference calls, data collection and processing, scientific analyses, programming, and consultations/contacts with DEP staff as needed.

The specific work to be performed to update the SWIL model under this task assignment is outlined below. Tasks labeled as "optional" are dependent upon the availability of the appropriate data.

**TASK 1: Update SWIL Model Input Layers for the Runoff Component**

- Acquire and evaluate data for all the input layers required for updating the direct runoff component of the SWIL model (see below).
- Assess and evaluate received stakeholder datasets relevant to the surface runoff component of the model for integration during model development.
- After consensus is reached in the conceptual model and input data methodology, Applied Ecology, Inc. (AEI) will initiate the development and refinement of model inputs, such as:
    - Monthly rainfall datasets
    - Evapotranspiration (ET) monthly datasets
    - Land use refinement and update based on stakeholder input data for up to 2 land use years
    - Land use layer development for a new, recent, land use layer (year to be determined)
    - Soil hydrologic continuous layer based on most recent Natural Resources Conservation Service (NRCS) inputs
    - Treatment layer updated based on stakeholder information and updates on the land use layers described above
- Evaluate and compare previously used event mean concentrations (EMCs) and runoff coefficients for direct runoff against stakeholder provided data and newly published and accepted values.
- Validate a percentage of the developed land use layers using aerial photointerpretation.
- Prepare developed model input layers to be delivered using a File Geodatabase.
- Address up to 24 hours of comments from DEP and/or stakeholders on the specific input datasets and participate in 2 virtual meetings with DEP/stakeholders for this task.

**TASK 2: Update SWIL Model Input Layers for the Subsurface Flow Component**

- The focus of the subsurface component model update is on spatially and temporally refining EMCs for groundwater, rather than the current uniform EMCs included in SWIL.
- Acquire and evaluate all input layers required for updating the baseflow component of the SWIL model, including long-term continuous flow gauged stations, groundwater quality datasets, monitoring locations, and depth to water table.

- Assess and evaluate received stakeholder datasets relevant to the subsurface runoff component of the model for integration during model development. The evaluation of the stakeholder inputs will determine the extent of updates for the subsurface flow component of the model, including the optional Task 3.
- Evaluation of best available stakeholder data, the methodology for the development of refined subsurface flow EMCs, and any major conceptual model changes will be included in a draft memorandum report. One set of revisions will be addressed in a final subsurface flow model tech memo report.
- Once consensus is reached on the best proposed option to pursue, AEI will develop refined subsurface EMCs.
    - EMCs will be provided in tabular format or associated with spatial layers (if spatially refined) and provided for input and review.
- Participate in 1 virtual meeting with DEP/stakeholders for this task.

**TASK 3: (Data-dependent) Incorporate Septic, Reclaimed, and Other Surface Treatment Disposal Methods in theSubsurface Flow Model Component**

- Further refine the EMCs associated with the Subsurface Flow component of the watershed loads.
    - Dependent on stakeholder data availability and integrity for the model area of interest.
- Acquire and evaluate available information associated with the potential impact of wastewater discharges on the groundwater nutrient loading. This includes datasets such as:
    - Available groundwater nutrient data timeseries
    - Available surficial groundwater elevation data
    - Well location
    - Well log information
    - Wastewater treatment plant (WWTP) permitted and measured mean nutrient discharge data
    - WWTP service areas for reclaimed
    - Rapid infiltration basins (RIBs)/spray fields and other surface water discharge types permitted or/and measured nutrient concentrations
    - Locations of RIBs/Spray fields
    - Identification of parcels services by onsite sewage treatment and disposal systems (OSTDS) or/and central sewer
- Develop a watershed-based soil hydraulic conductivity raster dataset and, based on available information, generate a waterbodies/connected waterways layer.
- Recommend a methodology to refine subsurface EMCs based on a combination of factors: land use, sewer service type, hydraulic conductance, distance to water, permitted or measured typical discharged, and/or measured typical groundwater quality data.
    - Dependent on evaluation of data processed in Task 2 and Task 3.
- A draft memorandum report will include a summary of evaluated data, and proposed methodology for updating the subsurface EMC information. One set of revisions will be addressed in a final refinement of subsurface EMCs technical memorandum report.
- Participate in 1 in-person local meeting with DEP/stakeholders for this task.
- The developed EMC values will be provided to DEP and stakeholders and up to one set of revisions on these values will take place prior to model development.

**TASK 4: (Data-dependent) Developing Retrofit Projects or Best Management Practices (BMPs)**

- Provide the ability of incorporating stormwater retrofit projects or BMPs in the SWIL direct runoff model component.
    - Currently, only permit required stormwater treatments associated with development or increases in impervious area are incorporated in the SWIL model.
    - Would allow ready-to-use data collected annually by DEP or provided by stakeholders to be incorporated in an additional input layer for reduction in direct runoff volumes and nutrient loads.
    - At minimum, project information would need to include a delineated treated basin area (in geographic information system [GIS] format), year of implementation, and specific project type.

- Assign percentages of nutrient removal based on DEP's provided Statewide Annual Report (STAR) data or typical accepted removal efficiencies for the BMP type.
- Modify SWIL model code to allow BMP removal efficiencies to be incorporated within the Direct Runoff Module.
- Deliver input datasets for this task will be delivered in a File Geodatabase with associated metadata.

**TASK 5: Watershed Loading Model Code Update and Full Model Execution**

- Update SWIL 4.0 model input code for the direct runoff module to integrate the new model basin area, temporal extent, and input layers revised in Task 1.
- Update code for the Baseflow component of the model, in anticipation that both Tasks 2 and 3 will take place. Update and modify the aggregation module, where total monthly and annual volumes are aggregated, to report dry season and annual values. Update the Python code to make it fully functional in ArcGIS Pro.
- Improve model run time and update error handling of input layer deficiencies.
- Validate model code prior to a complete model execution for the entire model period of record agreed upon in Task 1.
- Deliver the model inputs, outputs, and model itself to DEP.

**TASK 6: Hydrological Calibration (Total Flow, Baseflow versus Direct Runoff)**

- Hydrological calibration of the model, which initiates with a selection of up to7 total calibration basins within the watershed.
    - Subset calibration models will be developed for each of these areas to speed up run times in case changes in data inputs are required.
- Obtain and evaluate measured gauged data, identify corresponding basin characteristics, and calculate monthly stream discharge and daily flow statistics for each calibration area.
- Separate direct runoff and subsurface flow and independently calculate statistics will be calculated for each. Compare against simulated SWIL model volumes.
- Report goodness of fit statistics by calibration basin, for total volumes as well as direct runoff and subsurface flow volumes.
- Produce a draft technical report that includes the hydrological calibration methodology and results. One set of comments will be addressed in a final memo report.
- Participate in 1 in-person local meeting with DEP/stakeholders or 2 virtual meetings for this task.

**TASK 7: (Data-dependent l) Water Quality Calibration**

- Water quality calibration of the model, which initiates with a selection of up to 5 calibration basins with sufficient water quality data for total nitrogen (TN) and total phosphorus (TP) to represent direct runoff and subsurface flow conditions.
    - Task is dependent on data availability, including stakeholder datasets, and the available time period.
- Identify the minimum calibration model period for water quality in selected calibration basins.
- Compare mean-weighted measured TN and TP concentrations at different time scales against predicted model concentrations for the same time period and assess goodness of fit.
- Produce a draft technical report that includes the water quality calibration methodology and results. One set of comments will be addressed in a final memo report.
- Participate in 1 in-person local meeting with DEP/stakeholders or 2 virtual meetings for this task.

**TASK 8: Allocation Watershed SWIL Model Run (One-Year Run)**

- Produce outputs, similar to those provided as inputs to the load estimation tool (LET) for BMAP load allocations.

- Input grid cells (50 x 50 meter) will be used as input basins for a custom allocation model run to create baseload layers that can be used to estimate baseloads (and subsequently load reductions) from small BMPs.
- Resample rainfall raster and ET raster datasets to a 10 x 10-meter cell size for the entire approved model temporal extent.
- Allocation model run to only include one year of watershed loads, using representative period of record (POR) rainfall means and the latest available previously developed land use cover.
- Calculate POR means and standard deviation for the annual and dry season results.
- Provide summary inputs by sublagoon and waterbody identification number (WBID) for total volumes, TN, and TP loads in a summary report. Deliver two baseload datasets (annual and dry season) with associated metadata.
- Participate in up to 2 virtual meetings for this task.

**TASK 9: (Data-dependent) Natural Background Condition SWIL Model Run**

- Execute a natural background run using the same polygon grid input as Task 8, allowing a direct comparison between the two outputs.
- Prepare a representative land use from pre-development conditions, following the SWIL model land use consolidated codes. Consolidated classes that correspond to natural land uses there include the following:
    - Dry Prairie
    - Hydric Hammock
    - Mesic Flatwoods
    - Scrub
    - Upland Flatwoods
    - Upland Mixed
    - Water
    - Wet Flatwoods
    - Wet Prairies
    - Wetland
    - Xeric Hammock
- Using the oldest available St. Johns River Water Management District (SJRWMD) land use layer for 1943, AEI will replace any agricultural or urban areas with the most likely type of natural land use for the area, based on elevation, proximity to the Lagoon/waterway, soil type and available historic imagery.
    - 1943 land use is only available for SJRWMD portion of the watershed and will have to be expanded based on ancillary data and historic aerials.
- Outputs of the natural model run and comparison to the allocation estimates can be included in the memorandum report for Task 8.
- Participate in one virtual meeting for this task.

**TASK 10: (Data-dependent) LET Automation**

- Streamline the load allocation manual processes used for the LET for stakeholder allocations in the BMAP.
- Design conceptual tool to be implemented by using Python that can be ran in ArcGIS Pro. If natural background loads are calculated (Task 9) and need to be removed prior to allocating loads, this tool will also be able to incorporate that processing step.
- Deliver a ready-to-use GIS tool for DEP to quickly process future IRL BMAP allocation efforts.

**TASK 11: Data Transfer; Training and User Support**

- Provide DEP training for the Full Watershed Loading Model execution (Task 5) and the LET (Task 10).
- Develop a User Guide and a detailed How-To-Video on how to run the Watershed Loading Model (full run) as well as provide on training session for DEP staff. Also includes development of a brief User Guide and live demonstration (virtual meeting) for the LET tool.