

- D.1 Draft Literature Review on Nitrogen Fate & Transport Model Report

**Task Description:** A literature review will be conducted to determine the current practice for modeling nitrogen fate and transport in soils and ground-water. Particular attention will be paid to data gathered from the Task C literature reviews that have relevance to model parameterization of nitrogen fate and transport. If feasible, sensitivity analysis will be conducted based on previous work for conditions relevant to Florida soil and hydrology to help direct Task C monitoring and future modeling efforts.

Currently available models for nitrogen fate and transport will be reviewed, and the hydraulic and transport/transformation parameters for the models and estimation tools that the provider deems to be applicable, will be summarized so that a plan for fieldwork can begin to be developed at an early stage in the project. Existing available models specific to OSTDS or similar source types will be included in this review to determine the appropriate starting point for model development for this project.

Results of the literature reviewed in this task will be added to the searchable literature reference database established in Task A.

**Deliverables from Contract:** [Draft literature review](#) and updated reference database.

**Status:** Task Complete

- D.2 Final Literature Review on Nitrogen Fate & Transport Model Report

**Task Description:** The department will gather comments on the draft final report from RRAC and any other interested parties and transmit such comments to the provider within one month of receiving the draft. The provider will address these comments in preparing final deliverables within one month of receiving comments.

**Deliverables from Contract:** [Final literature review](#) and updated reference database.

**Status:** Task Complete

- D.3 Selection of Existing Data Set for Calibration Report

**Task Description:** The provider will select data from existing sites in Florida or elsewhere to evaluate the performance of a soil and aquifer model, and will provide recommendations for future data collection efforts for subsequent model calibration. The sites shall have information on a nitrogen plume, and data will be obtained via document review and by working with FDOH.

**Deliverables from Contract:** [Brief memo describing calibration data sets](#).

**Status:** Task Complete

- D.4 Draft QAPP N Fate and Transport Models

**Task Description:** A detailed QAPP will be drafted describing the sub-tasks to be completed in Task D. The overall goal will be to develop a model representing soil and shallow groundwater that is capable of predicting nitrogen concentrations at a specified location downgradient of an OSTDS source and determining nitrogen loadings/mass flux at a specified location. A simplified, user friendly modeling approach (e.g., programmed Microsoft Excel spreadsheet) will be employed that includes parameters that model the dominant soil and hydraulic factors that influence nitrogen reduction. The development of the fate and transport model will be accompanied with a parallel assessment of soil characterization at individual sites that provide data for model parameterization and calibration (Task C). The Florida soils classification system is one potential source of soil characterization data that could be used for a simple estimation of unsaturated zone transport.

The development of a model can include several steps from the concept over implementation of a mathematical model, assurance of numerical accuracy (code verification), adjustment of model parameters to best match a real world experimental data set (calibration), comparison of predictions from a calibrated model to different experimental data (model validation or verification), analysis of the effect of uncertainty in model parameter values on model results or of uncertainty and variability in data sets on calibrated parameter values (sensitivity analysis) and adjustments of the concept, mathematical, or calibrated model to better represent observations (model redesign) can be potentially a never-ending circular process as new data become available for comparison over time. The QAPP will describe how model development will proceed from the literature review, initial model development, calibration to existing data, model verification with other existing data or data gathered during this study, and model redesign to a final model product. It will also describe how the developed models and sensitivity analyses can guide data gathering efforts (in particular for task C), provide insights into nitrogen behavior in the environment, and provide a framework for decision making.

The final product of Task D is anticipated to be a simplified site scale model that predicts nitrogen concentration and mass flux at selected distances downgradient from the source loading location. Comparisons of this modeling approach with the results of non-steady state models and complex soil models will characterize the limitations of this model. The model will be a combination of a simple soil model and averaged aquifer model. The simple soil model will predict nitrogen reduction in unsaturated soil and the loading of nitrogen to the aquifer at the groundwater table surface. The simplified soil model may take the form of a simple algorithm or correlation that predicts nitrogen reduction as a function of such unsaturated soil characteristics as grain size distribution, water content and organic matter. The aquifer model will likely be time averaged and predict nitrogen concentration and attenuation with distance from the source. Input information includes the direction of groundwater flow at the average groundwater flow velocity and organic matter content. Model parameter values will be derived from calibration for Florida locations using data from Task C and suggested model parameters will be provided.

**Deliverables from Contract:** [Draft Task D QAPP](#).

**Status:** Task Complete

- D.5 Recommendation for Process Forward (per meeting)

**Task Description:** Based on the details agreed upon in the final QAPP, the provider will develop a recommendation whether or not to proceed with the remainder of Task D as outlined below, a revised cost estimate, or recommend an amendment to this contract. Both the provider and FDOH shall reach a written agreement prior to moving forward with Task D.

**Deliverables from Contract:** [Meeting summary and recommended scope and budget revisions](#).

**Status:** Task Complete

- D.6 Final QAPP N Fate and Transport Models

**Task Description:** The department will gather comments on the draft QAPP from RRAC and any other interested parties and transmit such comments to the provider within one month of receiving the draft. The provider will address these comments in preparing final deliverables within one month of receiving comments.

**Deliverables from Contract:** [Final QAPP acceptable by FDOH](#).

**Status:** Task Complete

- D.7 Simple Soil Tools

**Task Description:** The simple soil tools will be a series of look-up tables providing estimated nitrogen removal based on common OSTDS operating conditions. The tables will be generated from the complex soil model

developed in subsequent tasks (subtask D8 through D13), or from existing numerical models (e.g., HYDRUS-2D). The model will be corroborated and calibrated for a subset of conditions for which data exist. The specific conditions included in the simple soil model tools will be limited (not to exceed 60 conditions) and agreed upon by FDOH.

**Deliverables from Contract:** [Report](#) describing simple soil tool development, tool use, and the look-up tables.

**Status:** Task Complete

- D.8 Complex Soil Model

**Task Description:** This subtask includes development of the conceptual framework for the complex soil model including the coding and code evaluation required to implement the theory. The complex soil model will be based on unsaturated soil transport mechanisms adapted to Florida-specific soil and climate data, but incorporated into a simplified approach (e.g., STUMOD programmed into a Microsoft Excel spreadsheet) that includes parameters representing dominant soil properties. The soil treatment module will enable estimation of site-specific soil treatment in the vadose zone with the model output being the loading at the water table (input to aquifer models). This soil-treatment module will be developed to account for evapotranspiration, and the effect of high/seasonal variable water tables on nitrogen removal in the soil.

**Deliverables from Contract:** [Complex Soil Model Specification Report](#) including theory for coding and code evaluation progress.

**Status:** Task Complete

- D.9 Complex Soil Model Performance Evaluation

**Task Description:** The general user will most likely assess performance by comparing model output to field observations (e.g., simplified comparison of values). Similar implementation checks will be performed using robust field data sets (as available). Performance evaluation will also include corroboration/calibration to better understand the quality and quantity of data required by comparing simulated parameter values to the corresponding measured values (calibration targets). Calibration targets will include nitrogen concentrations (weighted equally in space) and mass loading of contaminant from the OSTDS. In addition, a parameter sensitivity analysis will be performed to identify the most relevant model parameters. An uncertainty analysis will also be performed where probability-based ranges for model input parameters will be used to generate probable model outcomes.

A more rigorous performance evaluation approach is required for technical users. For this case, the model-performance assessment will be conducted by using model-evaluation statistics to determine whether the model can appropriately simulate the observed data. Multiple methods for evaluating the model performance will be used to ensure model quality assurance evaluation that is not hindered by the specific limitations of a single calibration statistic or identify if further evaluation of the model is warranted.

**Deliverables from Contract:** [White Paper - Complex Soil Model Performance Evaluation](#)

**Status:** Task Complete

- D.10 Validate/Refine Complex Soil Model

**Task Description:** Based on the results from subtask D9, the complex soil model will be revised/improved. As additional data is available from Task C, the model will be revised to incorporate more complex mechanisms. Validation will be used to compare the corroborated/calibrated model to actual field data. Model validation ensures that the model meets the intended requirements and identifies the range of appropriate conditions (e.g., capabilities and limitations). Data from Task C home sites as well as other available data sources will be used to validate the model.

**Deliverables from Contract:** [Complex Soil Model report](#), nomographs for conditions represented in D7, and the final complex soil model in electronic format (e.g., Microsoft Excel spreadsheet).

**Status:** Task Complete

- D.11 Aquifer Model Combined with Complex Soil Model Development

**Task Description:** A steady state or non-steady state aquifer model will be developed, possibly by revising an existing model, to simulate nitrogen concentrations and mass flux in space and time from a single OSTDS source, or a surface area that can be estimated as a single OSTDS source. This aquifer model and the complex soil model (D.10) will be integrated together to produce groundwater output predictions for nitrogen concentration or mass flux from a single OSTDS source. The integration will allow for utilization of simple soil model output as input for the aquifer model.

**Deliverables from Contract:**

- a. Aquifer Model Specification Report describing review and development of the aquifer model (subtask is 50% complete).
- b. [Aquifer-Complex Soil Model Specification Report](#) describing progress status for integrating the two models (subtask is 75% complete).
- c. Draft integrated model in electronic format (subtask is 100% complete).

**Status:** Task Complete

- D.12 Aquifer-Complex Soil Model Performance Evaluation

**Task Description:** Performance evaluation of the aquifer-complex soil model will include implementation checks, corroboration/calibration, parameter sensitivity analysis and an uncertainty analysis. Data sets from Florida identified during subtask D3 and Task C will be used. Metrics will include comparisons of average concentration in the plume or mass flux crossing a boundary between actual field data (as available) and model output, the range in calibrated parameter set values that result in similar agreement between model results and data, model-parameter correlation and bias, and the potential for different parameter combinations to achieve the same agreement between model results and data.

Similar to the complex soil model, a more rigorous performance evaluation is also required. Model-evaluation statistics will be used to determine whether the model can appropriately simulate the observed data. Multiple methods for evaluating the model performance will be used to ensure model quality assurance evaluation that is not hindered by the specific limitations of a single calibration statistic or identify if further evaluation of the model is warranted.

**Deliverables from Contract:**

- a. Aquifer-Complex Soil Model Specification Memo describing progress status for performance evaluation (subtask is 50% complete).
- b. [Report describing performance evaluation methods and preliminary results \(subtask is 100% complete\)](#).

**Status:** Task Complete

- D.13 Validate/Refine Aquifer-Complex Soil Model with Data Collection from Task C

**Task Description:** Based on the results from subtask D12, the integrated aquifer and complex soil model will be revised/improved using site-scale field data collected from Task C. Validation will be used to compare the corroborated/calibrated model to actual field data. The validation/refinement procedure will be an iterative process and may suggest revisions in the data collection plan or in the model itself (parameterization or

improvements). Data from Task C home sites as well as other available data sources will be used to validate the model.

**Deliverables from Contract:** [Integrated Aquifer-Complex Soil Model report](#) and the [final integrated model in electronic format](#) (e.g., Microsoft Excel spreadsheet).

**Status:** Task Complete

- D.14 Development of Aquifer-Complex Soil Model for Multiple Spatial Inputs

**Task Description:** A model will be developed, possibly by revising an existing model, to simulate nitrogen concentrations and mass flux in space and time from several OSTDS in a development-scale area. The model will be calibrated using existing data from a development-scale plume, based on metrics such as average concentration in the plume or mass flux crossing a boundary.

**Deliverables from Contract:** [Aquifer-Complex Soil Model for Multiple Spatial Inputs report](#) and the [model in electronic format](#) (e.g., Microsoft Excel spreadsheet).

**Status:** Task Complete

- D.15 Decision-Making Framework Considering Uncertainty

**Task Description:** A methodology will be developed to describe how planners can include the uncertainty associated with both calibrated and non-calibrated models in the decision-making process. The report will be in the form of a guidance manual to guide users through the assessment of parameters, tool selection, and how to use those tools.

**Deliverables from Contract:** Modeling decision-making framework report.

**Status:** Task Eliminated

- D.16 Task D Guidance Manual (Draft)

**Task Description:** The Task D draft final report will be developed based on a compilation of Task D reports, progress reports, and technical memos to summarize the results of the Task D modeling. The report will be in the form of a Guidance Manual and User's Guide providing a decision support framework (Task D.15), model development, input parameter selection, and uncertainty assessment. The Guidance Manual will provide an introduction to each tool, assumptions/limitations of the tool, and how to use the tools. The complementary User's Guide will provide detailed technical data including fundamental assumptions that were incorporated into tool development, description of the tool development, and description of parameters that affect nitrogen reduction performance.

**Deliverables from Contract:** [Draft Task D Guidance Manual](#).

**Status:** Task Complete

- D.17 Task D Guidance Manual (Final)

**Task Description:** The department will gather comments on the draft guidance manual from RRAC and any other interested parties and transmit such comments to the provider within one month of receiving the draft. The provider will address these comments in preparing final deliverables within one month of receiving comments.

**Deliverables from Contract:** Final Task D Guidance Manual with final models in electronic format.

**Status:** Task Eliminated

- D.18 Change-order

**Task Description:** From time to time the Department may find it necessary to make minor changes or adjustments to activities under this task based on results that indicate a potential improvement to the project by making a change. Examples of such changes include additional or revised sample locations or parameters, minor modifications to test systems or field activities based on problems encountered, or conditions that develop requiring expedient actions to correct a potentially serious problem. Up to \$10,000 will be allocated from the contract budget for such minor changes to research activities under this task. Upon determination by the Department the changes should be made, all or a portion of these funds may be authorized by written notification from the Department to the Provider directing specific changes to research activities be made, and the amount budgeted for the changes specified.

**Deliverables from Contract:** Deliverables outlined in authorization letter

**Status:** Task Eliminated