OKLAHOMA DEPARTMENT OF ENVIRONMENTAL QUALITY

Groundwater Modeling and Contaminant Transport

Modeling is one of many tools that can be used to help determine remedial options. The use of groundwater modeling for contaminant fate and transport predictions is common in the risk-based decision-making process. Models range from simple mathematical equations to complex computer-generated models. Models are generally used to support remedial decisions where groundwater contamination exists above a prescribed action level. While models can be used to develop and support remedial options, they should not be expected to substitute for real-world data. DEQ will require contaminant plume delineation and monitoring to confirm model predictions. An approved monitor well network that includes both sentinel wells and contaminated wells is needed. The following procedures should be used to make data provided by the models usable by the DEQ.

1. Develop a Site Conceptual Model. Regardless of the predictive model selected, site characterization and development of an initial site conceptual model is very important. DEQ's approval of the site conceptual model is an important step to help ensure there will be agreement on modeled results.
2. Propose a Predictive Model. Obtain DEQ approval of the proposed predictive model before pursuing the analysis and presenting model results.
3. Propose Input Values. Obtain DEQ approval for proposed input values prior to running the model. Models can be very sensitive to the various input values. Models presented without prior DEQ approval of input parameters are unlikely to be accepted.
4. Calibrate Model to Existing Conditions.
5. Run a Sensitivity Analysis. Identify and evaluate the sensitivity of various input parameters.

Use of a computer model does not always minimize the need for sample data, borings, or wells. In fact, more data may be required to adequately calibrate the model to fit existing site conditions.

DEQ uses approved modeling results as one of many tools for decision-making purposes, but only if sufficient information is obtained to allow verification of the overall model and various model inputs. Information needed typically includes:

- a listing of all computer software necessary to run the various programs,
- a report detailing the models/programs used,
- how the modeling was run,
- copies of maps used as input, and
- spreadsheets for various data inputs in downloadable format.

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(Fact Sheets\LPD\Ground Water Modeling.indd 9/2022)

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No model is perfect for all situations. A mathematical equation or computer-generated model does not provide a unique solution to an environmental problem. It provides a scenario based on specific assumptions and specific input values. Varying certain input parameters can have a dramatic effect on the results of a model. Selecting proper boundary conditions and other parameters can be difficult. Any modeling effort should include a full written description of sensitivity analysis results and a written justification for any assumptions and input parameter values used other than model defaults. The model should be calibrated to existing site conditions. Once calibrated, the model can be run in predictive mode to generate results for a range of sensitive parameters.

Model output should be evaluated and summarized. Conclusions and recommendations should be made. Confirmation of predictions is expected through continued monitoring. Failure to achieve model predictions must be considered. Contingency plans need to be defined and should be implemented in the event a sentinel well shows contamination above a pre-established action level Although MODFLOW may not be the most appropriate model in all cases, it is USGS-approved and is becoming an industry standard for groundwater modeling.

ASTM Risk Based Corrective Action (RBCA) for petroleum release sites is generally inappropriate for complex sites, especially sites with DNAPLs/chlorinated organic contaminants. The RBCA method is generally approved for gasoline or diesel contamination at small sites only. Under certain circumstances, the RBCA methodology might be allowed; however, before submitting any assessment using this method, a clear understanding of its limitations should be discussed with the DEQ. DEQ recommends more robust models, such as MODFLOW, for complex sites.

Procedural Checklist:

_____ Site characterization.

_____ Site conceptual model.

_____ DEQ (letter) approval of site conceptual model.

_____ Model selection and input parameters/values.

_____ DEQ (letter) approval of model selection and input parameters/values.

_____ Model calibration to existing conditions.

_____ Sensitivity analyses.

_____ Run model for various ranges of sensitive input parameters.

_____ Evaluate results/develop contingency plans.

_____ DEQ (letter) approval of Model Results/contingency plans.

_____ Monitor site.

_____ Verify model results/accuracy of model predictions.

If you have any questions about modeling, you may contact:

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