# Draft Guidance for Completing a DMRM Model and Report

The Division of Mineral Resources Management (DMRM) and the Division of Soil and Water Resources (DSWR) strongly suggest that all companies and/or consultants for the companies fulfilling the requirements of Ohio Administrative Code 1501: 14-5-01 (C) through construction of a numerical model schedule a pre-modeling meeting with DMRM and DSWR before beginning the model building process. Suggested topics for the meeting include conceptual model design, model boundary conditions, sources of data, reporting requirements, and any other topic the modeler wishes to discuss. Contact Kelly Barrett at (614) 265-6502 or Kelly.Barrett@dnr.state.oh.us to schedule a pre-modeling meeting.

## General Report Outline and Key Components

The goal of this guidance document is to assist in the development of a thorough model report and its application to ODNR, Division of Mineral Resources Management. The report must provide sufficient information to allow the hydrogeologist at ODNR reviewing the model to determine how the model was constructed, how the parameters and data used in the model relate to the actual geologic and hydrologic conditions that exist within the model domain, and to evaluate the model. This document is only guidance for completing a modeling report, it is not a guide on how to complete a model, nor is it a source for finding data to use in a model. It should also be noted that all ground-water flow models are unique and this document cannot address all possible model reporting requirements needed to evaluate every hydrogeologic situation.

**General Comments:** The guidelines below make reference to maps in several places. All maps must be at a scale of 1:24,000 or at a scale which can readily be viewed and understood. All maps must have a scale, a north arrow, and a key that includes a reference to the items (boundary conditions, quarry/pit boundaries, contour lines, etc.) that are depicted on the map.

1. Report Introduction
    a. The introduction of the report must discuss if expansion of the quarry/pit is lateral, vertical, or both. Include description of the current quarry dimensions, the ultimate sump elevation, and the history of mining at the quarry including start date, significant deepening, expansions, and previous sump elevations.
    b. Include a map of the current quarry extent and proposed expansion. The sump location should appear as it existed at model calibration. Make sure that the current boundaries and expansion boundaries are distinguishable from each other on any maps that are submitted with the report.

2. Hydrogeologic Setting
    a. Describe the geologic framework of the model domain. Include descriptions of the characteristics, thickness, and permeability of the unconsolidated deposits. Describe bedrock units including the aquifer and confining unit names, thicknesses, lithologies, and hydraulic properties. Also describe hydraulic properties of streams within the model domain.

b. Identify all large water users in the model domain (DSWR Water Withdrawal Facility Database) and include their average withdrawals in the model and the report.

c. If a potentiometric surface map was constructed as part of the model design or calibration, include it in the report and the water levels in an Appendix. If a preexisting or published potentiometric surface map was used in the model design/calibration include a copy and a reference to this map.

3. Description of Model Design

a. Provide a detailed narrative describing the conceptual model (Anderson and Woessner, 1992) and the basis for the conceptual model including the hydrogeological setting, geology, bedrock topography, glacial drift thickness, aquifer characteristics (especially measured values for hydraulic conductivity), aquifer boundaries, flow boundaries, etc. Provide diagrams/cross sections of the quarry representing conditions during model calibration and the expanded quarry condition. A conceptual cross section of the model showing model layers is strongly suggested.

b. Describe the logic (based on the hydrogeology of the model domain) for variations (or lack there of) in assigned values of hydraulic conductivity, recharge, streambed permeability (conductance), etc. Describe the logic (based on the hydrogeology of the model domain) for the use and placement of all boundary conditions.

c. Provide a map of the model grid on a topographic base that includes the location and the lateral extent of the quarry, and proposed expansion.

d. Provide a map showing all model boundary conditions on a topographic base with each boundary type indicated by some distinct color or pattern (rivers, specific heads, drains, no flow, etc.).

e. Provide a map showing the spatial distribution of input parameters for each model layers (hydraulic conductivity, recharge, etc.)

f. Describe and/or show on a map how river nodes and drain nodes vary across the model domain. Include information on streambed thickness, stream width, stream depth, and how hydraulic conductivity of the streambed changes (List these values in an Appendix).

g. Describe the logic in setting the model base (bottom of the model). The model base should be related to some vertical change in the hydrogeologic properties of the bedrock or sediments in the area of the quarry.

4. Description of Model Calibration

a. Provide a description of the calibration process used to obtain realistic values of input values such as MAE and RMSE (State what criteria were used to stipulate that the model was calibrated).

b. Provide a map showing the locations of all data points (wells) used in the calibration process, the well logs associated with those points, and a table summarizing the well logs data (such as total depth, static water level, year

and month completed, aquifer media, well head elevation, thickness of aquifer penetrated).

c. Indicate which parameters were adjusted during model calibration and the range of adjustment.

d. Include a map showing the residual values between simulated water levels and the measured water levels of the calibrated model. Indicate whether residuals are positive or negative and how they were calculated (MAE and RMSE).

e. Include a graph showing the measured vs. simulated heads from the calibration. Include the RMS error (stream flow losses simulated).

5. Description of Model Results

a. Provide a simulated potentiometric surface map that includes the effects of the expanded quarry

b. Provide a map of simulated drawdown that includes the effects of the expanded quarry including the 10-ft. drawdown line (Estimated inflow rate and estimated stream losses, lake losses, etc.).

c. Provide a graph and/or table showing mass balance/water budget of the model.

Additional Comments:

*Email*: Include email address to send comments. Comments will now be sent by regular mail and email.

*Definition of terms*: Boundary conditions, calibration, RMSE, MAE, Specific head, constant head, specific flux, and head-dependent flux.

Suggested Reference:

Anderson, M.P. and Woessner, W.W., 1992, Applied Groundwater Modeling, Simulation of Flow and Advective Transport: Academic Press, Inc., San Diego, 381 p.