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Australian Groundwater Modelling Guidelines

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IAH Groundwater Modellers Forum

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Background

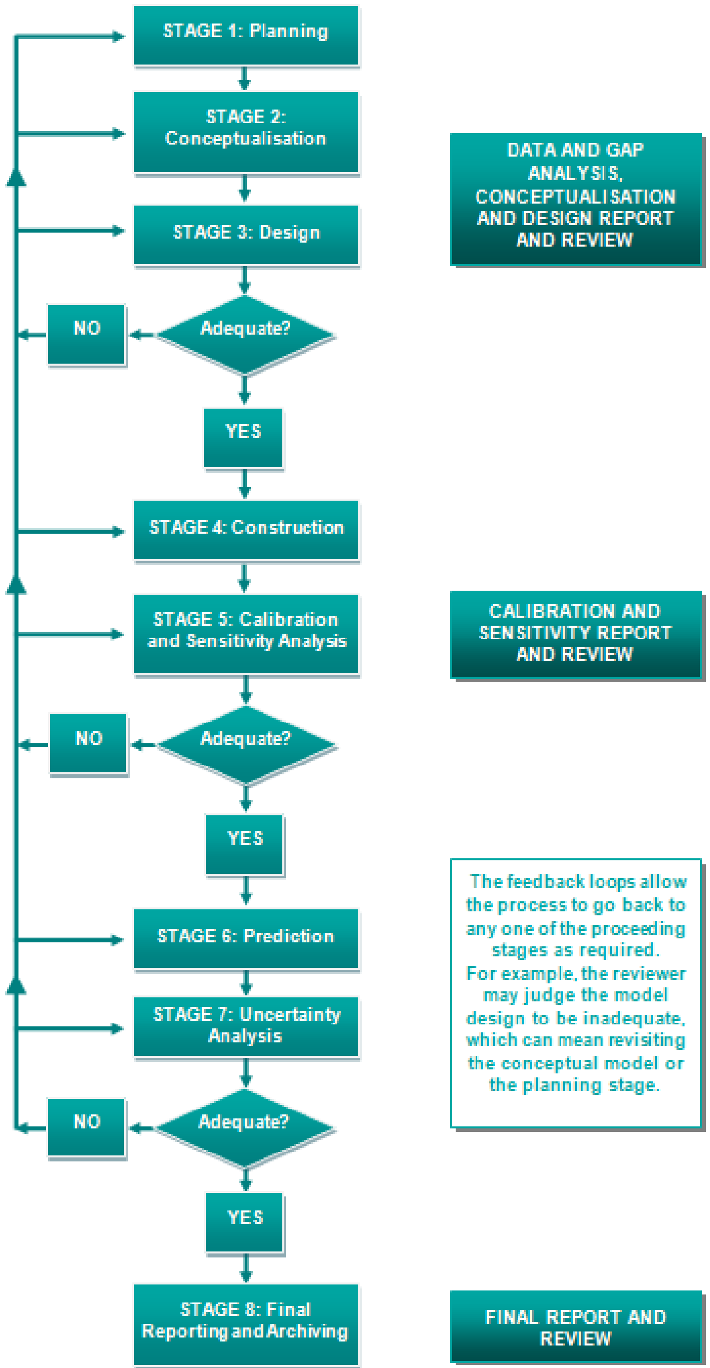
- Commissioned as part of the NWC Waterlines series
- In the absence of a national guideline, MDBC (2001) Groundwater Flow Modelling Guideline adopted as a de-facto Australian 'standard'
- NWC identified need to update and expand in line with current best practice and for use on projects with a variety of model applications and environments encountered in Australia

Development of the Guidelines

- Collaborative team with members from SKM, NCGRT, CSIRO, NTEC Environmental Technology, NRETAS, USGS, AWE and SS Papadopulos & Associates
- Two national workshops held during development with consultants, researchers, miners and regulators

Overview

- Objective is to promote a consistent and sound approach to the development of groundwater flow and solute transport models in Australia
- Builds on existing MDBA (2001) Guideline
- Point of reference, not a rigid standard
- Promotes model development as a series of interdependent stages with feedback loops


STAGE 1: Planning
STAGE 2: Conceptualisation
STAGE 3: Design
Adequate?
NO
YES
STAGE 4: Construction
STAGE 5: Calibration and Sensitivity Analysis
Adequate?
NO
YES
STAGE 6: Prediction
STAGE 7: Uncertainty Analysis
Adequate?
NO
YES
STAGE 8: Final Reporting and Archiving
DATA AND GAP ANALYSIS, CONCEPTUALISATION AND DESIGN REPORT AND REVIEW
CALIBRATION AND SENSITIVITY REPORT AND REVIEW
The feedback loops allow the process to go back to any one of the proceeding stages as required. For example, the reviewer may judge the model design to be inadequate, which can mean revisiting the conceptual model or the planning stage.
FINAL REPORT AND REVIEW

Major changes from MDBA (2001)

- ‘Solute transport’ added as a distinct chapter
- ‘Surface water-groundwater interaction’ added as a distinct chapter
- ‘Calibration and sensitivity analysis’ and ‘Uncertainty’ chapters now promote the use of powerful parameter optimisation software to aid calibration and quantification of sensitivity and predictive uncertainty

Model confidence classification

- Intended to provide an indication as to the relative confidence with which a model can be used in predictive mode. Three classifications are described.
- Most models will not have all the defining characteristics of a particular class. The modelling team and key stakeholders should agree on the most relevant criteria for the project and set the target classification accordingly. During development this should be reviewed and, if necessary, revised.

Model confidence classification

- Class 1: simple models, either developed on few or sparse data sets that do not provide confidence in the hydrogeological conceptualisation and/or provide little or no data on which the model can be calibrated. Alternatively, data may be available but a decision has been made not to undertake an exhaustive calibration and validation procedure.

Model confidence classification

- Class 2: more complex models that are generally based on a sound understanding of the local and regional hydrogeology and have been calibrated to appropriate data sets and to a reasonable level (as defined by agreed quantitative and qualitative metrics).

Model confidence classification

- Class 3: the highest confidence models, that are based on extensive data sets that provide a good understanding of the regional and local hydrogeology and have been extensively calibrated to data sets that include both groundwater head and flux observations or estimates. Typically calibrated in steady state and transient modes, validated to illustrate the model's ability to replicate observed behaviour outside the data used for calibration and predictions are formulated in a manner that do not stray significantly from the calibration, in terms of both temporal scale and applied stresses.

Model confidence classification

- Generic models: not given a classification, these are models developed primarily to understand processes and not to provide quantitative outcomes for any particular aquifer or physical location. They can be considered to provide a high level of confidence when applied in a general, non-specific sense.

Model confidence classification

- There has been some confusion regarding requirements of models following release of the Guidelines.
- A Class 3 model is NOT necessary in all, or even most, cases.

Classification	Examples of use
Class 3	•Predicting arbitrary groundwater responses to arbitrary changes in applied stress of hydrological conditions anywhere within the model domain •Provide information for sustainable yield assessments for high value regional aquifer systems •Designing complex mine-dewatering schemes, salt interception schemes or water allocation plans •Simulating interaction between surface water bodies and groundwater to a level required for dynamic linkage to surface water models •Assessment of complex large-scale solute transport processes
Class 2	•Prediction of impacts of proposed developments in medium value aquifers •Estimating dewatering requirements for mines/excavations and the impacts •Designing groundwater management schemes such as MAR, salinity management schemes and infiltration basins •Estimating distance of travel of contamination through particle-tracking methods and defining water source protection zones.
Class 1	•Predicting long-term impacts of proposed developments in low value aquifers •Designing observation bore arrays for pumping tests •Understanding groundwater flow processes under hypothetical conditions •A starting point from which to develop higher class models

Further details

- SKM is considering running a more comprehensive workshop on the Guidelines. To register interest contact Doug Weatherill dweatherill@globalskm.com

References

Barnett et al., 2012. Australian groundwater modelling guidelines, Waterlines report 82, National Water Commission, Canberra.

Available at: http://archive.nwc.gov.au/library/waterlines/82

MDBA, 2001. Groundwater flow modelling guideline. Report prepared by Aquaterra Consulting Pty Ltd, January 2001.