SAND2005-7522P

Potential Site #7 Flow Model - FEHM Software

Performance Assessment Workshop

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Sandia is a multiprogram laboratory operated by Sandia Corporation, a Lockheed Martin Company, for the United States Department of Energy's National Nuclear Security Administration under contract DE-AC04-94AL85000.

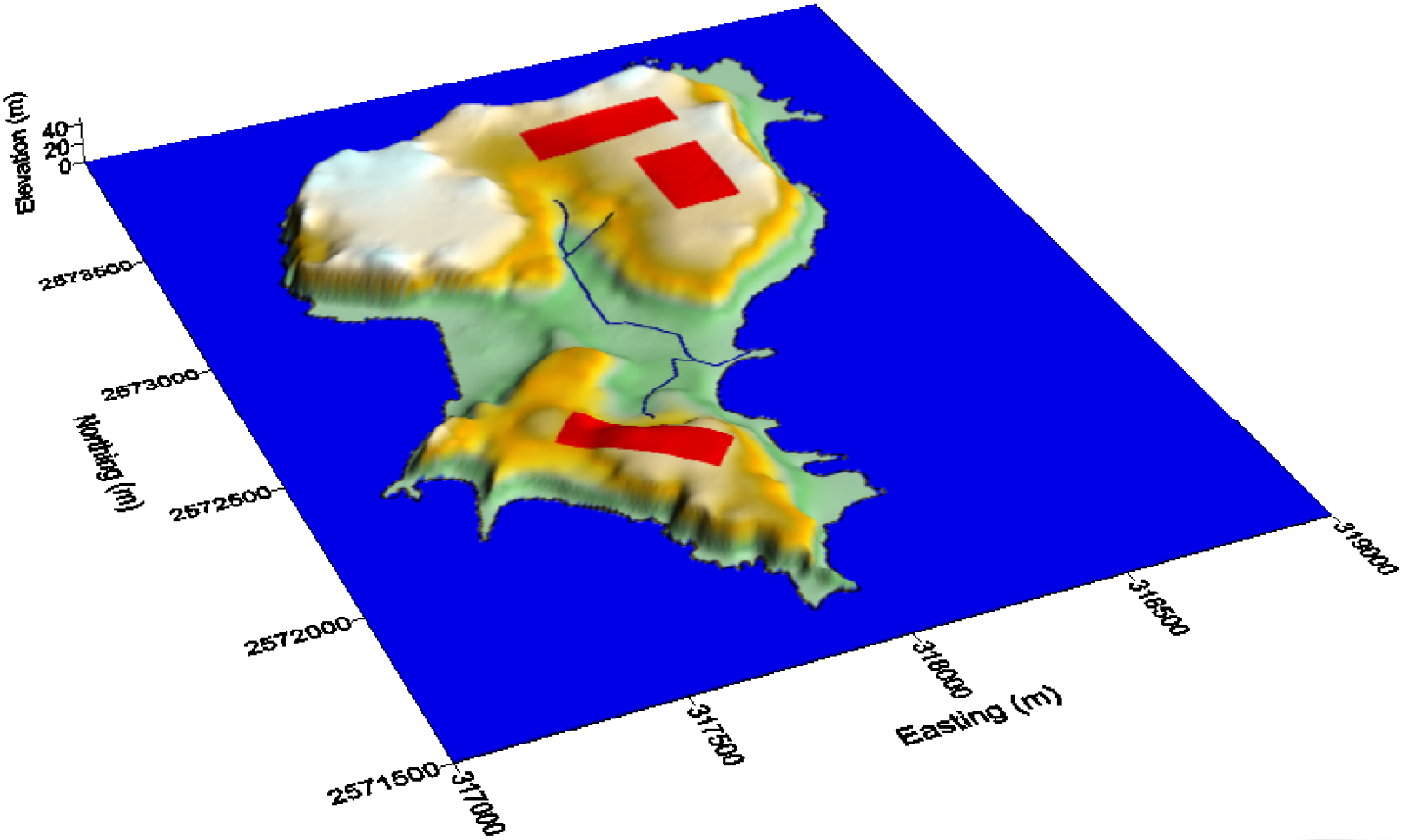
Objectives

- Site Characterization
  - Conceptual insights
  - Guide data collection
- Performance Assessment
  - Estimate groundwater flow rates
  - Delineate contaminant flow paths
  - Identify contaminant discharge locations
  - Basis for contaminant transport simulations
    - 2-D simulations with BLT code
    - Abstracted 1-D transport paths
  - Evaluation of uncertainty

Preliminary Model

- The preliminary FEHM flow model for potential site #7 has been created using reasonable parameter values
- Significant uncertainty exists in most aspects of the flow model, given the lack of site-specific data
- Flow model should be calibrated to measured water levels in wells

Conceptual Model



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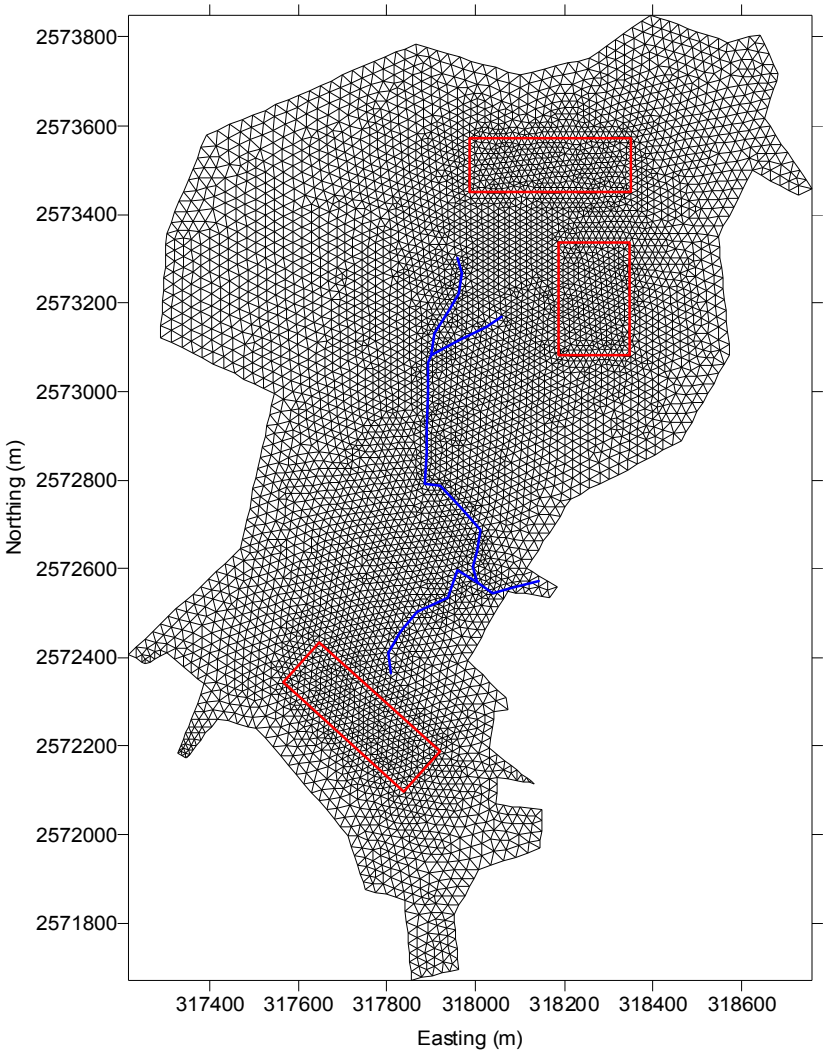
Conceptual Model

- Fractured basalt represented as homogeneous fractured continuum and sedimentary rocks included as porous medium
- Approximately steady-state flow
- System approximated as a confined aquifer
  - Upper boundary at topographic surface
  - Lower boundary at assumed salt water interface
- Uniformly distributed recharge (assume 100 mm/year, about 10% of precipitation)
- Constant head boundary at ocean shore
- Reduced infiltration beneath landfill covers

Grid Development

- 2-D grid was generated with “easymesh” software code, conforming to island shoreline
- 3-D grid was created by projecting the triangular finite-element mesh vertically and truncating at the topographic surface
- 3-D grid also truncated at the assumed saltwater interface beneath the island
- Small FORTRAN code (xwrite_3D_grid.for) for 3-D projection of grid is provided on workshop CD

Grid Development



- 2-D Delaunay finite-element mesh generated first
- Grid is refined for disposal units and along stream channel

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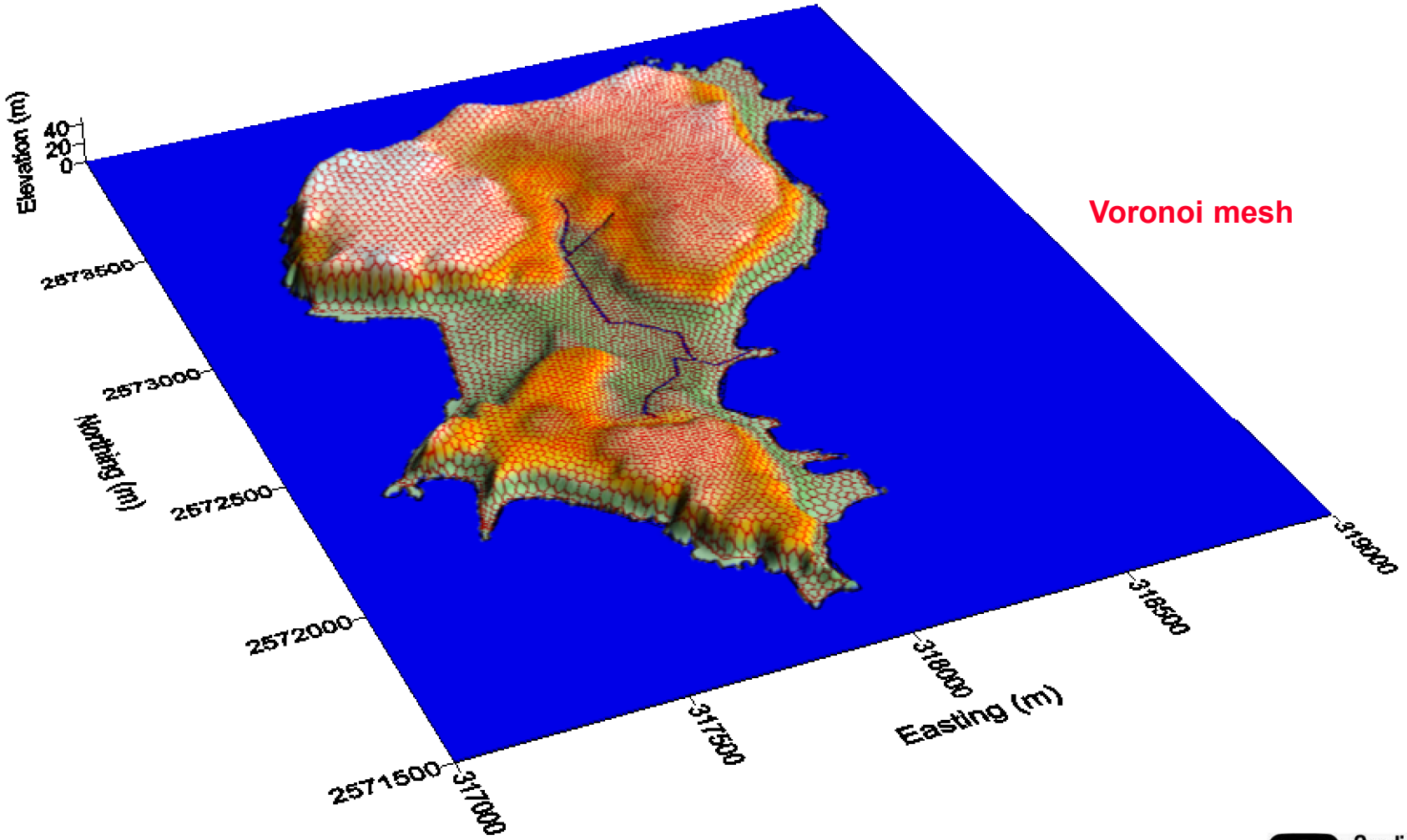
Grid Development



Voronoi mesh

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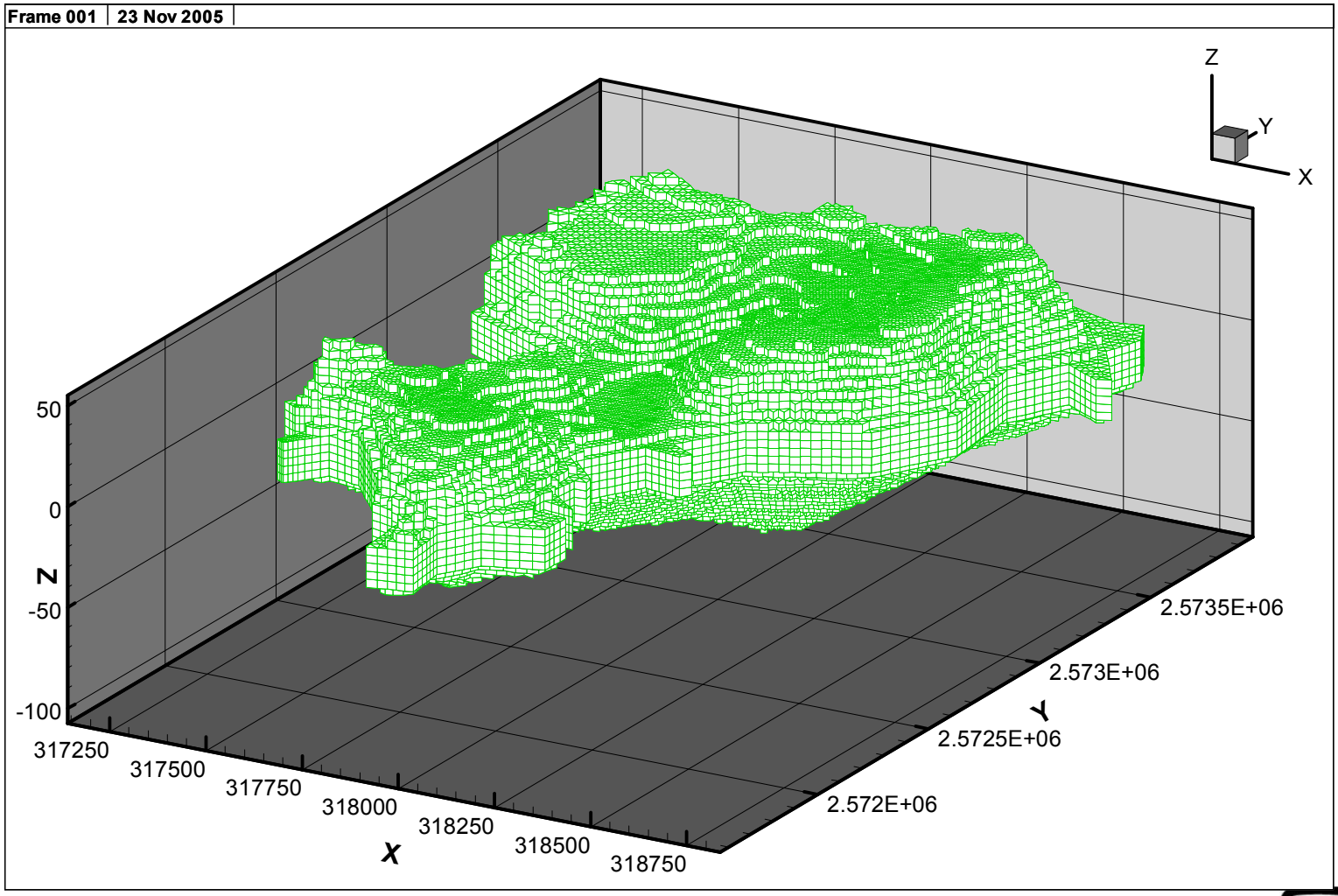
Grid Development



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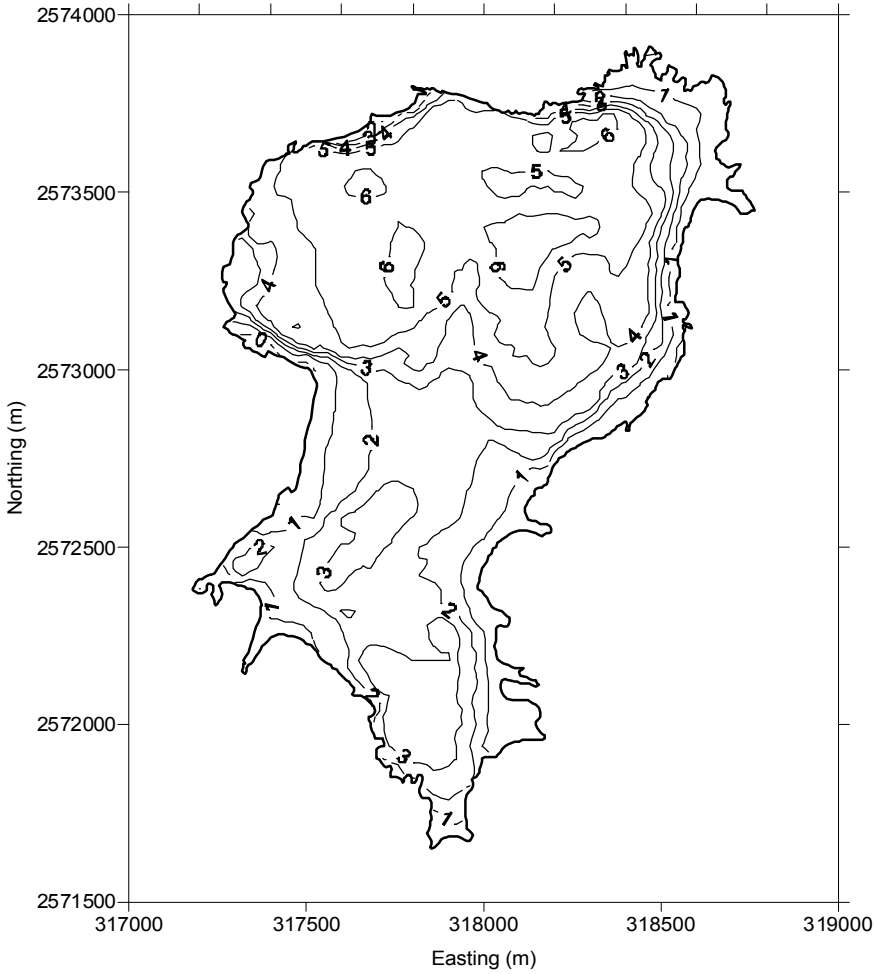
Flow Model Results

Simulated Head – Model Top



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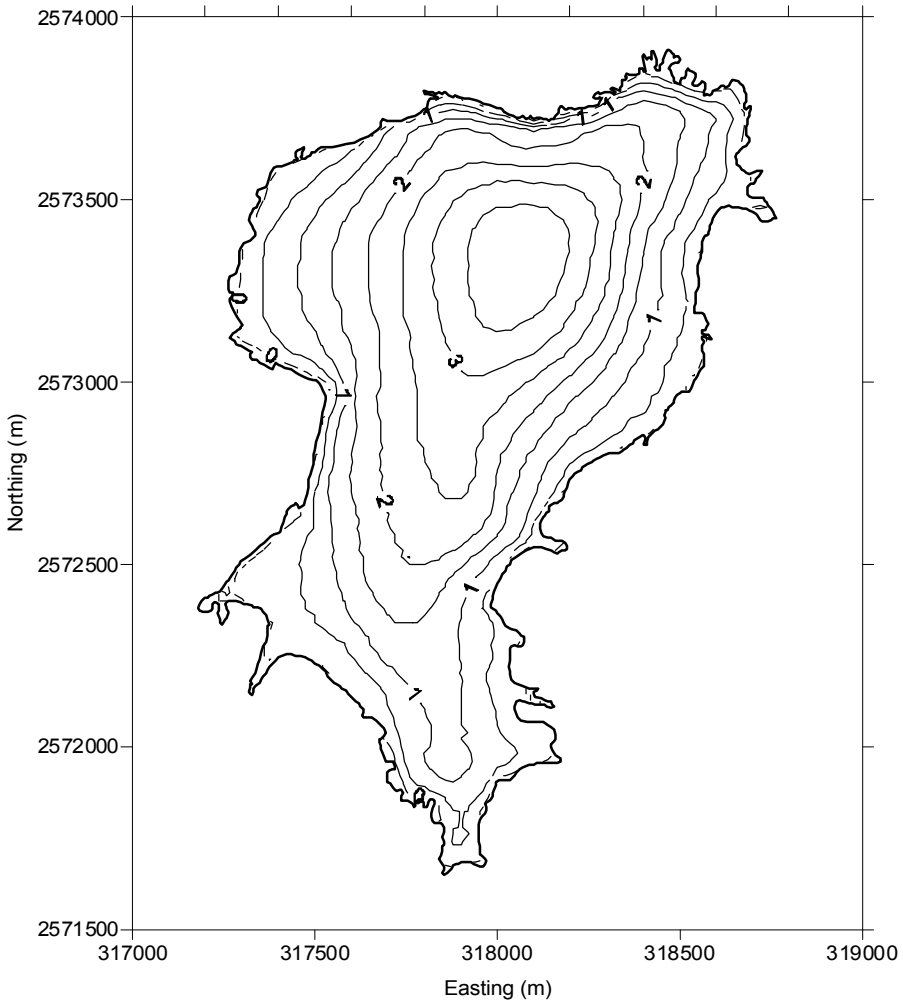
Flow Model Results

Simulated Head – Sea Level



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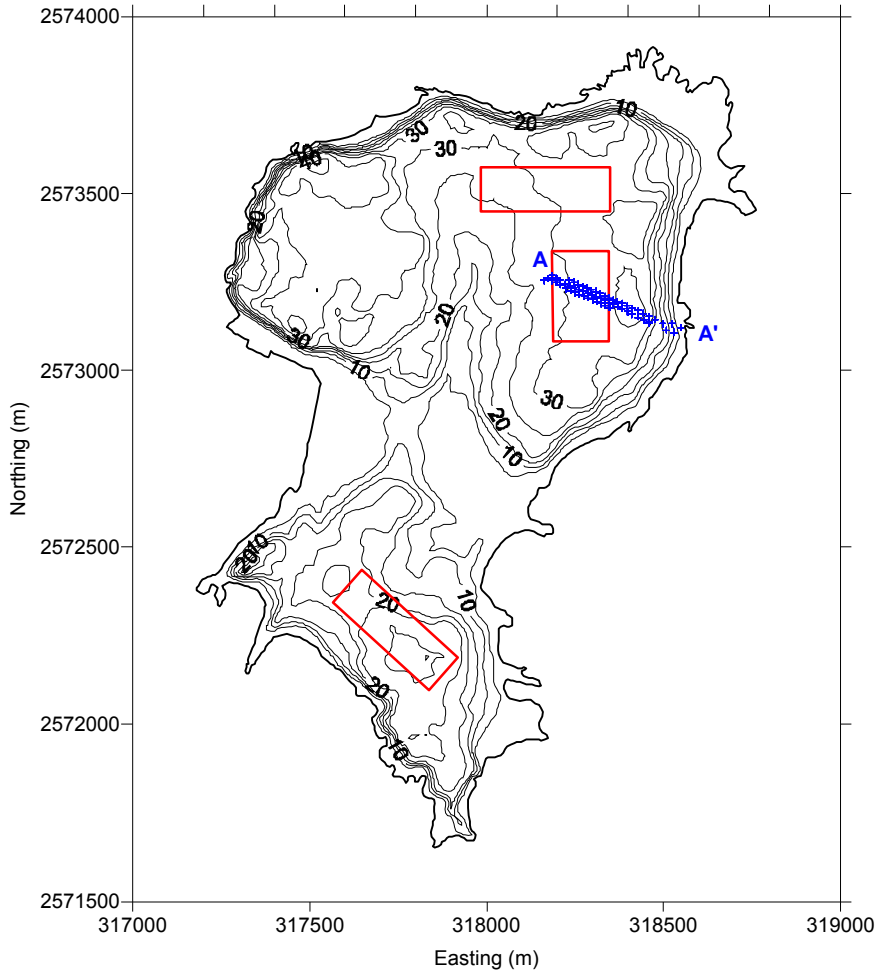
Flow Field Extraction for BLT Simulation

- Define two-dimensional cross section parallel to groundwater flow through one of the three disposal units
- Project simulated values of flow from the FEHM model onto the cross section (using "xtract_velocities_xsection" FORTRAN code)
- Interpolate vectors of groundwater flux onto a regular grid with anisotropic inverse distance squared method (using SURFER software)
- Export components of groundwater flux along cross section in a format for incorporation in the BLT grid

Extraction of Cross Section

FEHM Nodes Within Specified Distance of Cross Section



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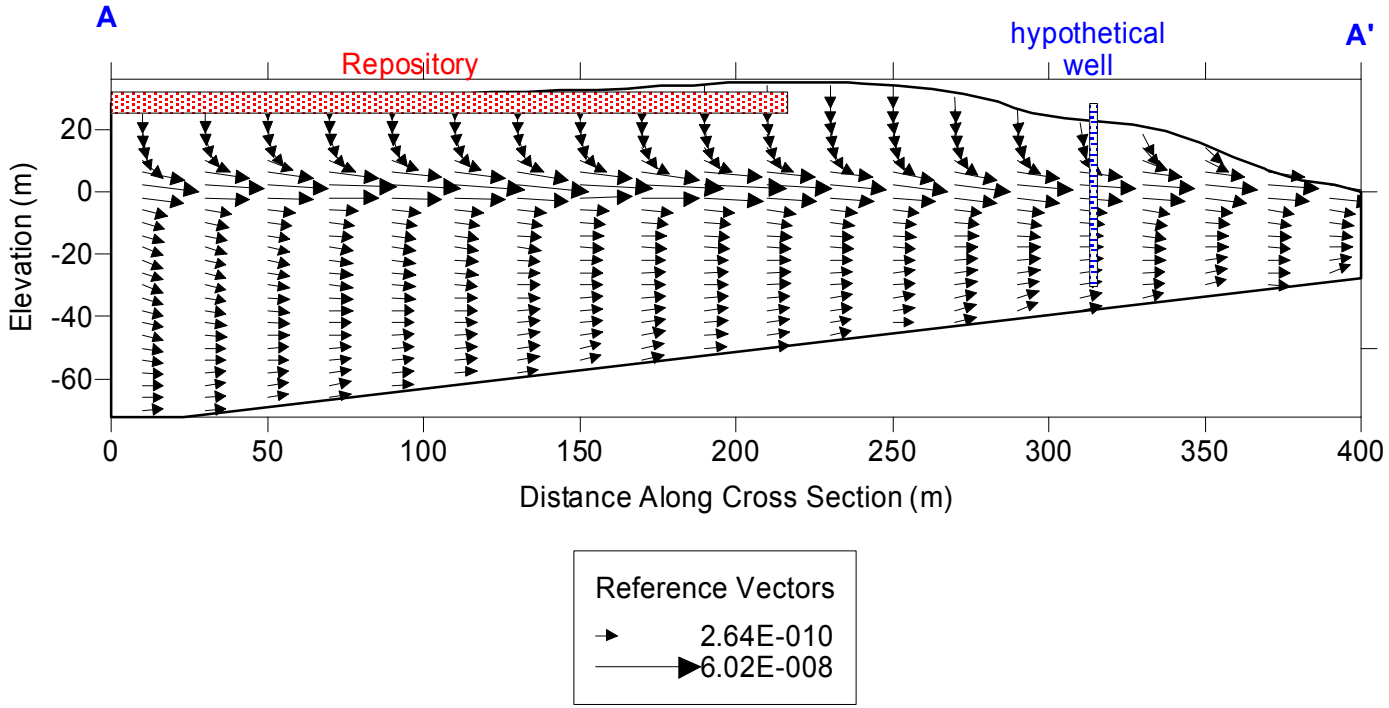
Extraction of Cross Section



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1-D Transport Model Using GoldSim

- Groundwater flow field is also represented using three “pipes” in the GoldSim model
- Transport in GoldSim “pipes” includes matrix diffusion for fractured basalt and porous medium for sedimentary rock unit
- Each of the three pipes is attached to the chosen disposal unit and consists of two segments
- The first segment represents vertical flow (q = 0.045 m/yr) in the unsaturated zone beneath the disposal unit and the second segment represents primarily horizontal flow (q = 1.3 m/yr) in the saturated zone