# Assessing the Potential for Saltwater Intrusion in a Coastal Fractured-Bedrock Aquifer using Numerical Modeling

Thomas J. Mack, P.G., U.S. Geological Survey

## Abstract

Water availability is a fundamental concern for coastal areas of New England. Because unconsolidated aquifers in the area are spatially limited or fully utilized, the fractured-crystalline bedrock aquifer is increasingly being developed as a water source in response to rapid population growth and accompanying water demands. The sources of ground water in bedrock supply wells are localized high-yield fracture zones. Some high-yield fracture zones may intersect the ocean and, if overdeveloped, may lead to saltwater intrusion and contamination of this limited ground-water resource.

In coastal New Hampshire new bedrock supply wells are being located in some of the highest yielding bedrock aquifers in the State. A ground-water-flow model of coastal New Hampshire, incorporating a detailed water-level and discharge network, is presently being developed in cooperation with the New Hampshire Geological Survey and the New Hampshire Coastal Program to assess regional ground-water availability. Numerical simulation is an ideal tool for the assessment of complex regional ground-water resource issues and provides a means to integrate various data. The potential for salt-water intrusion in the bedrock aquifer is assessed using an equivalent-porous media ground-water-flow model incorporating regional fracture zones approximated as high-conductivity model cells, termed a fracture-zone continuum model. Mapped lineaments, analysis of over 1,000 bedrock well yields, local geologic mapping, and borehole geophysical analyses are used to provide likely orientations of simulated fracture zones. Fracture-zone continuum models are developed to assess the potential for hydraulic connection of selected ground-water withdrawals, through particle-tracking analysis, to the ocean. Model results are compared to water quality and ground-water head gradients and trends in selected bedrock wells. Ocean tide stresses are used to assess the connection of the bedrock aquifer, through simulated fracture zones, to the ocean. Analyses of the sensitivity of the bedrock aquifer system to fracture-zone hydraulic properties are made using parameter-estimation techniques.

This investigation provides insight into the implications of fracture zones on saltwater intrusion in bedrock aquifers. The findings of this study will identify data requirements for further analysis of the potential for saltwater intrusion relative to water availability in New Hampshire's coastal bedrock aquifers.

---

Mack, T.J., 2004, Assessing the potential for saltwater intrusion in a coastal fractured-bedrock aquifer using numerical modeling, *in* Fractured-Rock Conference, U.S. Environmental Protection Agency/National Ground Water Association, Portland, Maine, September 13–15, 2004, Proceedings, Denver, Colo., National Ground Water Association, p. 220–221.