# Use of a ground-water flow model to assess the effects of future pumpage in the New Jersey Coastal Plain

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# Objectives of Presentation

- **Overview of a regional ground-water flow model and the efforts to revise it for current applications**

- **Use of this model to support the NJ Dept. Environmental Protection (NJDEP) revision of the State's Water Supply Plan**

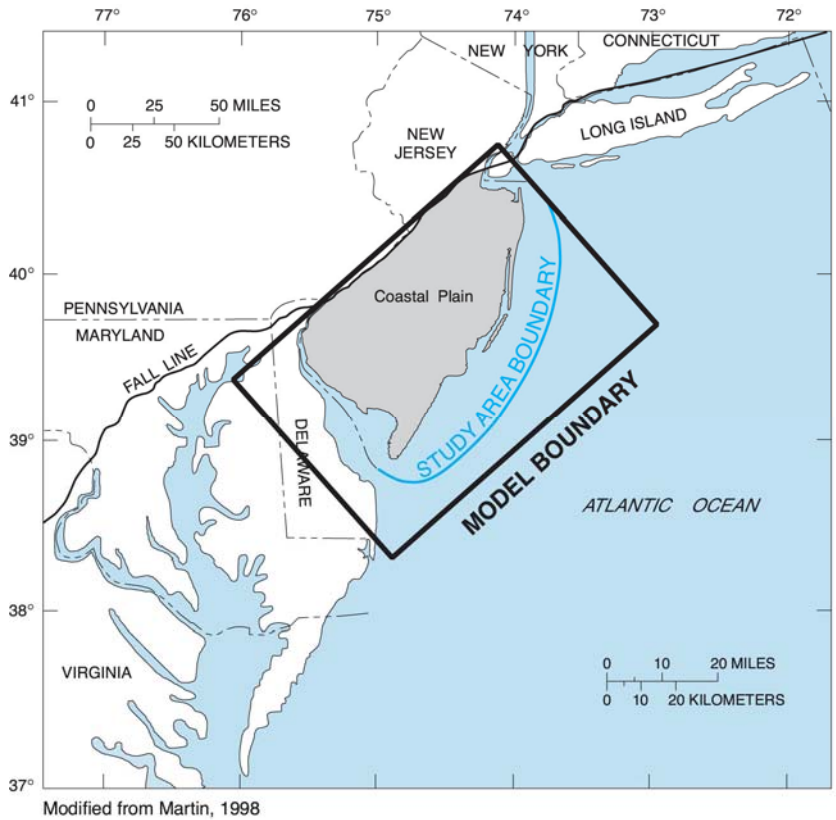
# RASA Model Overview

**Originally developed in early 1980s**

**Simulates ground-water flow in 10 Coastal Plain aquifers**

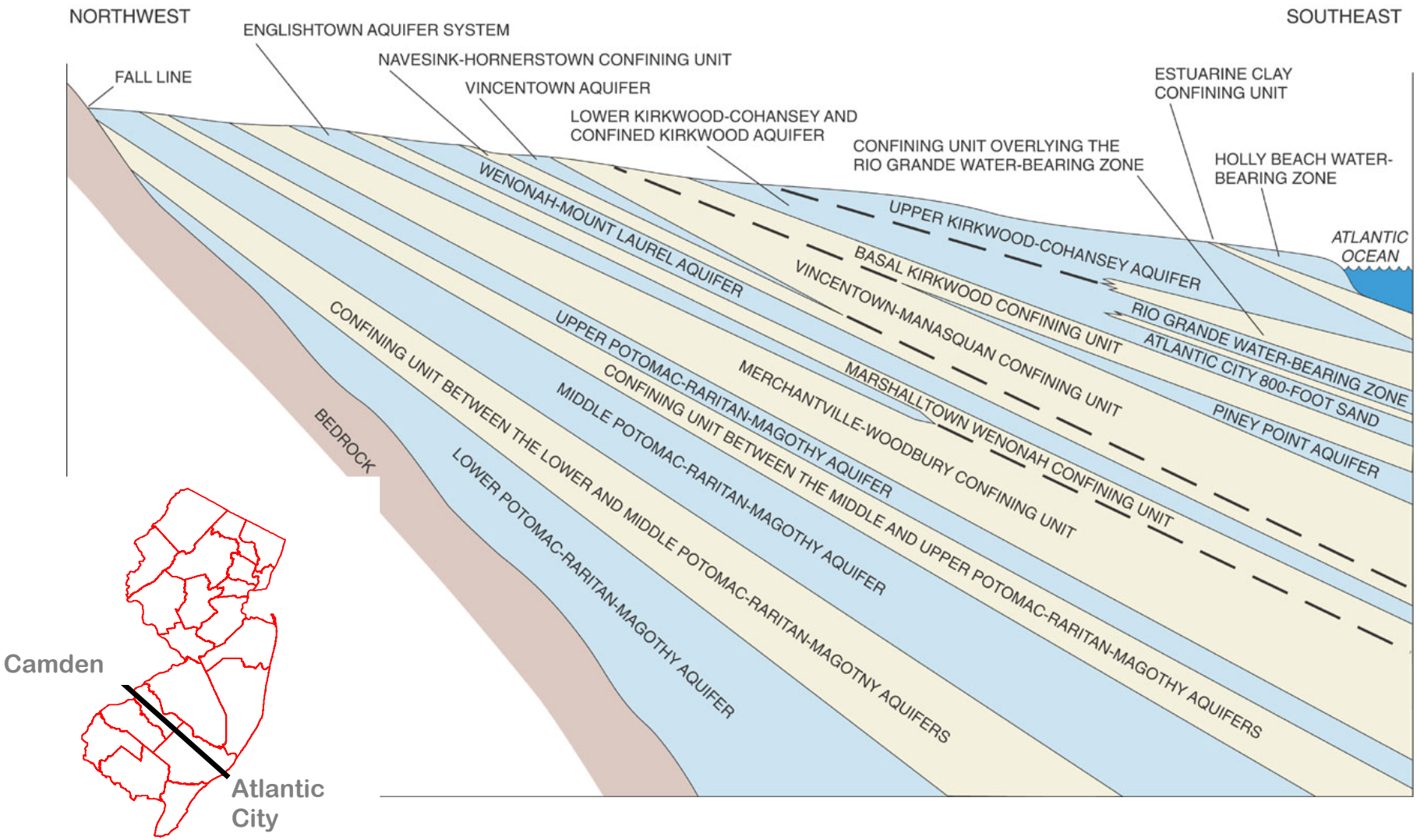
**Transient Model**

**Average annual ground-water withdrawals**

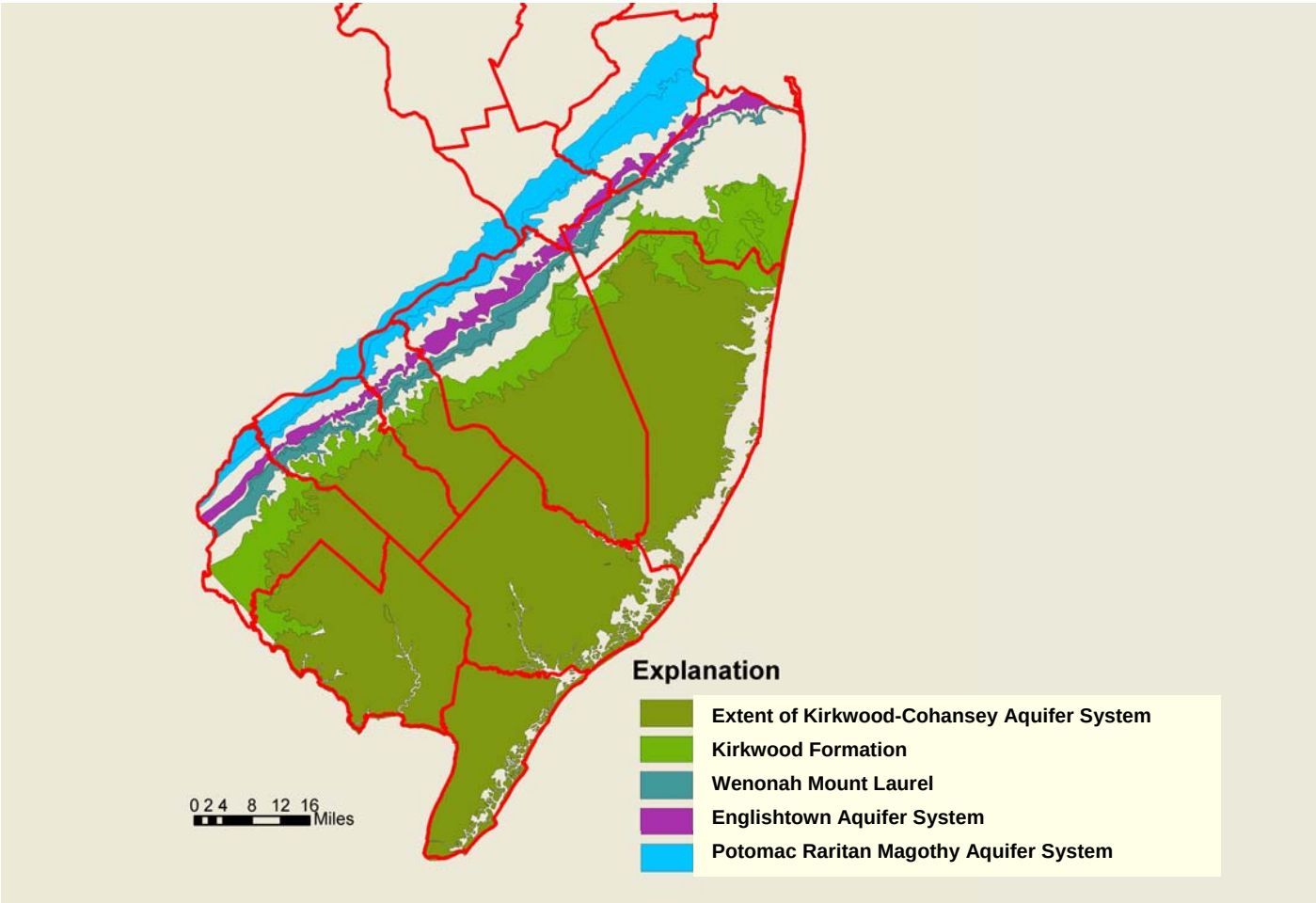


Modified from Martin, 1998

# Cross-Section of NJ Coastal Plain



# Recharge in Areas of Aquifer Outcrop



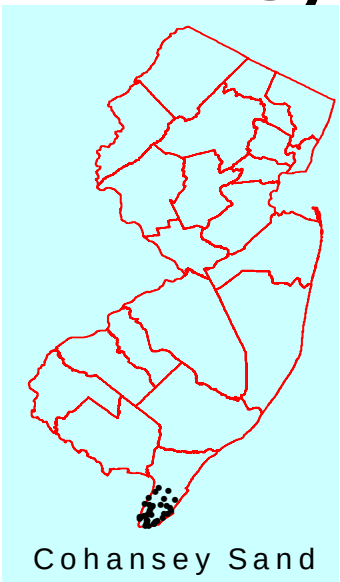
# Revisions to RASA Model

- **Finer grid size (0.25 – 3.16 sq. mi.)**
- **More accurate representation of streams**
- **Variable recharge rate**
- **Ground-water withdrawals updated to 2001**
- **Model recalibrated**

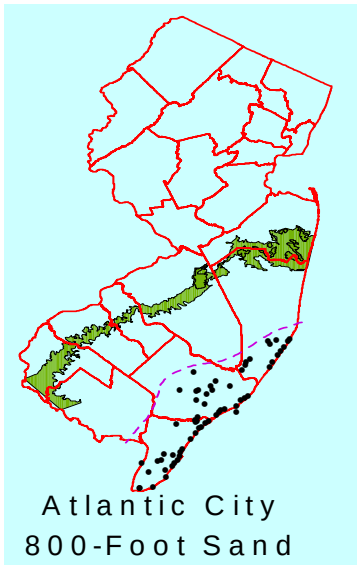
# NJ Data incorporated into the RASA Model

- **Synoptics – water levels measurements**
- **Water Use – withdrawals by aquifer**
- **Surficial Aquifer Studies - recharge**

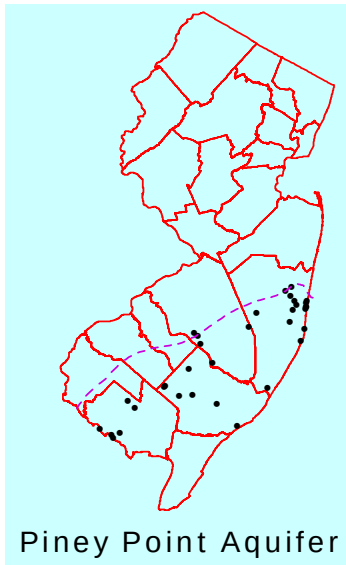
# New Jersey Coastal Plain Aquifers
# Synoptic Water-Level Measurements



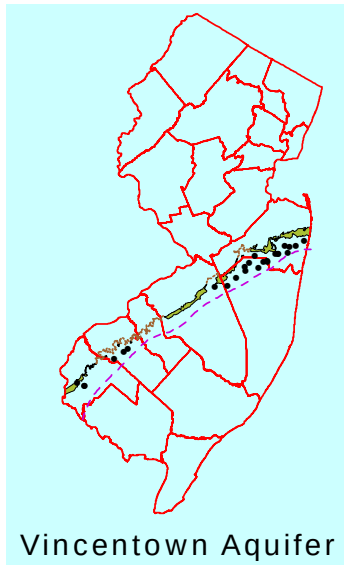
Cohansey Sand



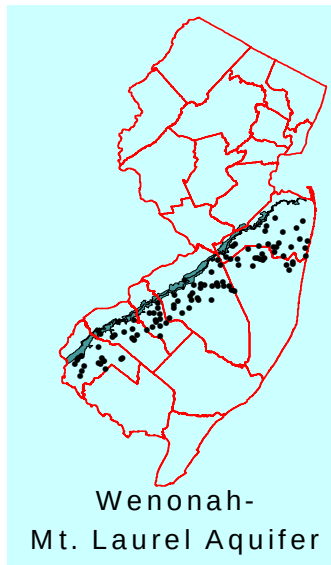
Atlantic City
800-Foot Sand



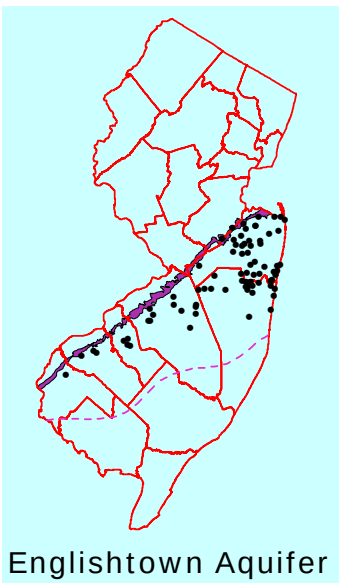
Piney Point Aquifer



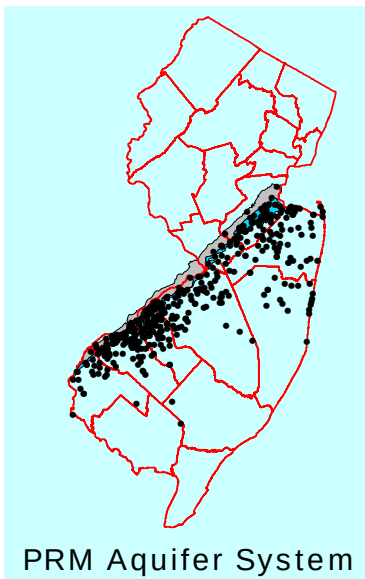
Vincentown Aquifer



Wenonah-
Mt. Laurel Aquifer



Englishtown Aquifer



PRM Aquifer System

- Cooperative NJDEP/USGS project
- Every 5 years since 1978
- ~750 wells measured in 6 wks
- Major confined aquifers
- Fall season (medium to low water)
- Water levels used in model calibration

# Water Use

*(Withdrawal Data obtained from NJDEP)*

- **Pumpage input into model by well location and by aquifer**
- **NJDEP issues permits to users w/ withdrawals >=100,000 gal/day**
- **Users report withdrawals quarterly or annually to NJDEP**
- **Pumpage collected for various water- use categories:**
  - **Public Supply**
  - Commercial self-supplied
  - Industrial self-supplied
  - Mining
  - Irrigation
    - Non-cranberry
    - Cranberry
  - Thermoelectric

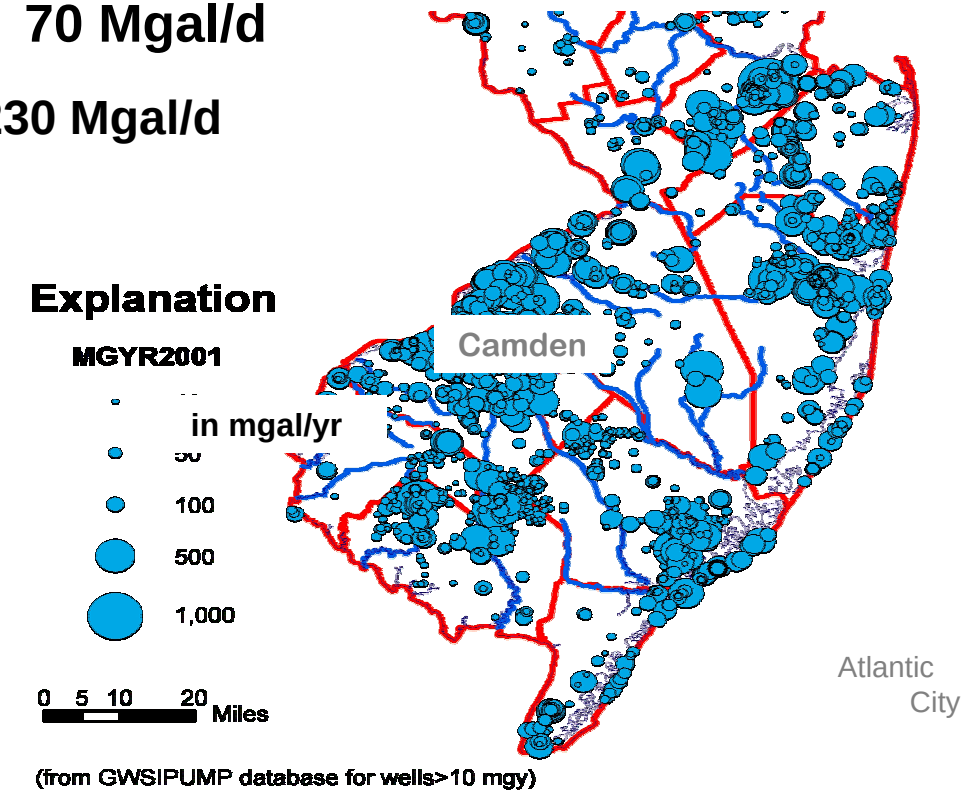
*Cooperative NJDEP/USGS project*

# 2001 Ground-Water Withdrawals

**Coastal Plain Aquifers = 300 Mgal/d**

**Unconfined Aquifers = 70 Mgal/d**

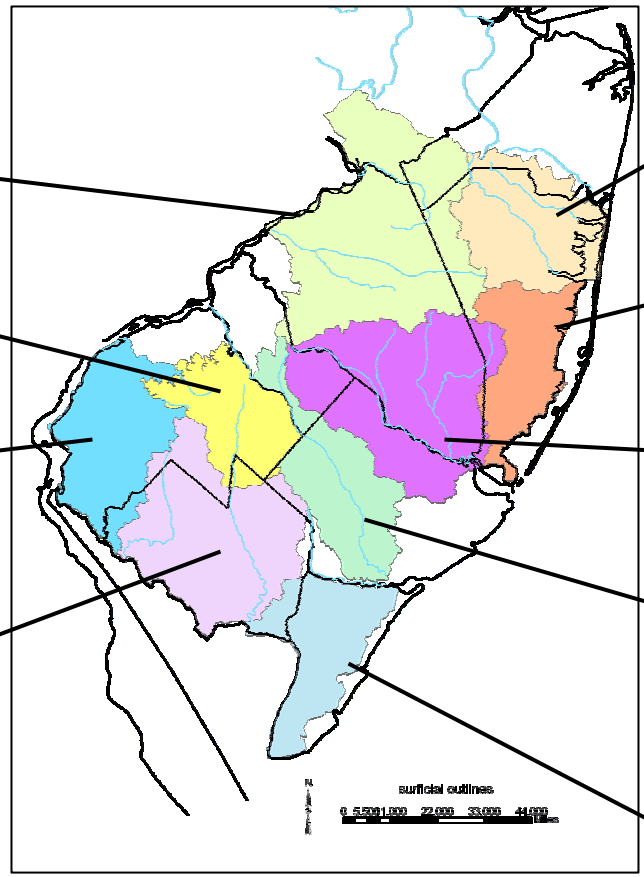
**Confined Aquifers = 230 Mgal/d**



# Studies Used to Determine Recharge

**Produced water-table maps**

**Water-budget of study area- recharge rates 12-19 in/yr**




Toms & Metedeconk

Rancocas

Southern Ocean

Upper Maurice

Mullica

Salem area

Great Egg Harbor

Lower Maurice & Cohansey

Cape May

*Cooperative NJDEP/USGS project*

# Application of RASA Model

- USGS technical support for revision to the New Jersey Water Supply Plan

- Project in cooperation w/ NJDEP and NJGS

# NJ Statewide Water Supply Plan

- **Mandated by the 1981 Water-Supply Management Act**
- **Addresses need for water-supply management strategy**
- **Delineates water-supply planning areas**
- **Evaluates water resources in the planning areas**
- **Last updated 1996 & currently being revised**

# Project Approach using RASA Model

- **Delineate water-supply planning areas**
  - unconfined aquifers- HUC11 scale
  - confined aquifers- 41 budget areas delineated
- **Quantify current (1998) availability** of ground water by flow-budget analysis in planning areas using model results
- Incorporate **projected ground-water demand** to 2010 and 2020 at existing wells
- **Flow-budget analysis** with **projected pumpage**
- **Compare results** with current budget and water levels

# Delineate Planning Areas in Confined Aquifers for Budget Analysis

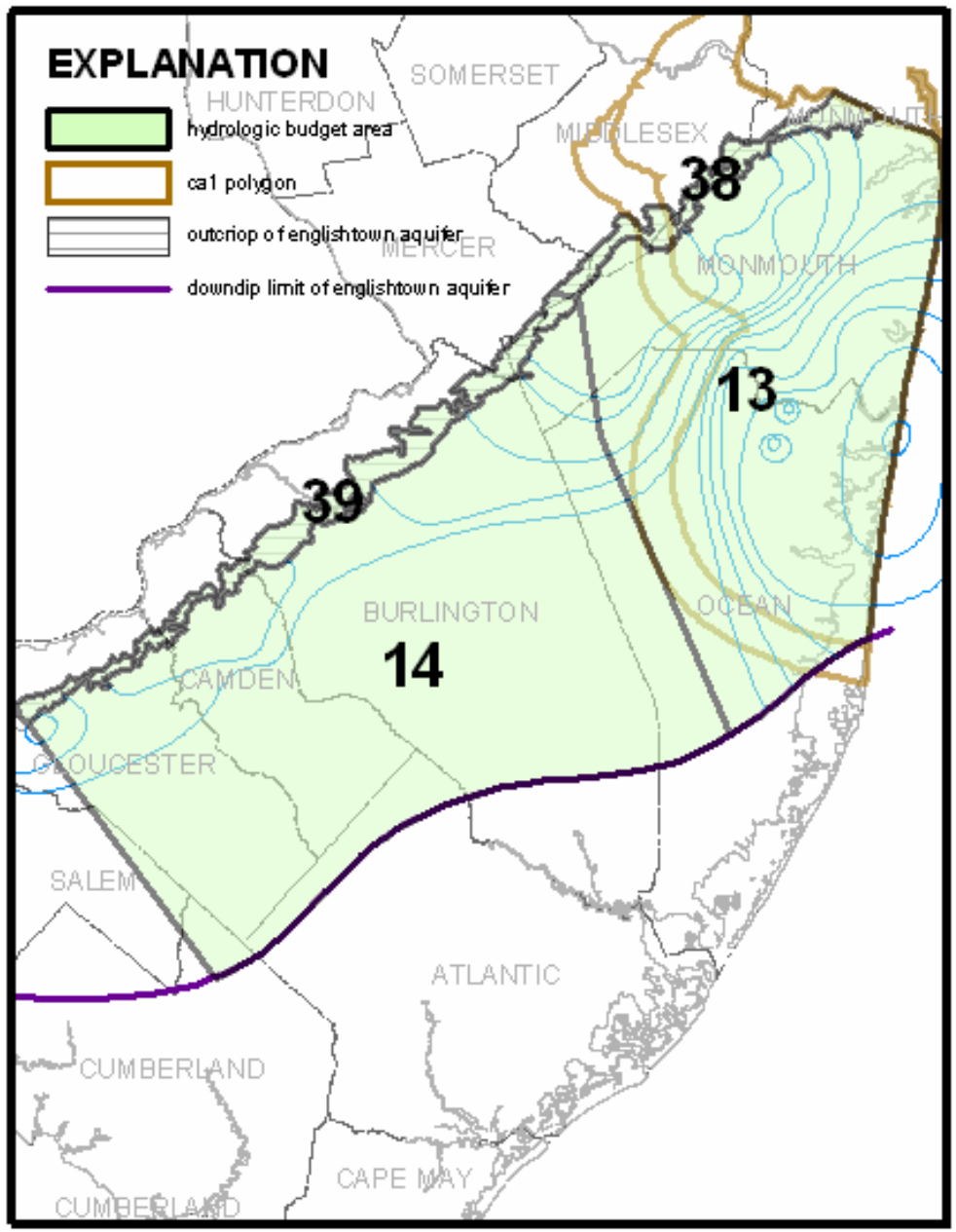
## Delineation based on—

**Hydrologic Boundaries**

- Ground-water divides
- Aquifer limits
- Outcrop areas

**Regulated conditions**

- Location of 250-mg/L isochlor
- Critical areas (areas of regulated withdrawals)



# Projected Ground-Water Demand and Growth Simulations

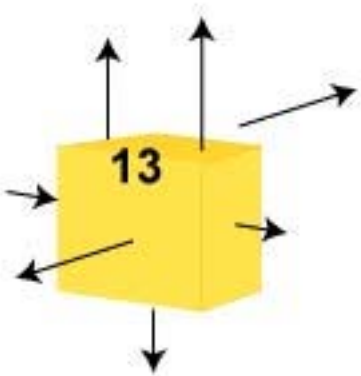
**Projected increases for 2010 and 2020 determined by NJGS by 3 methods:**

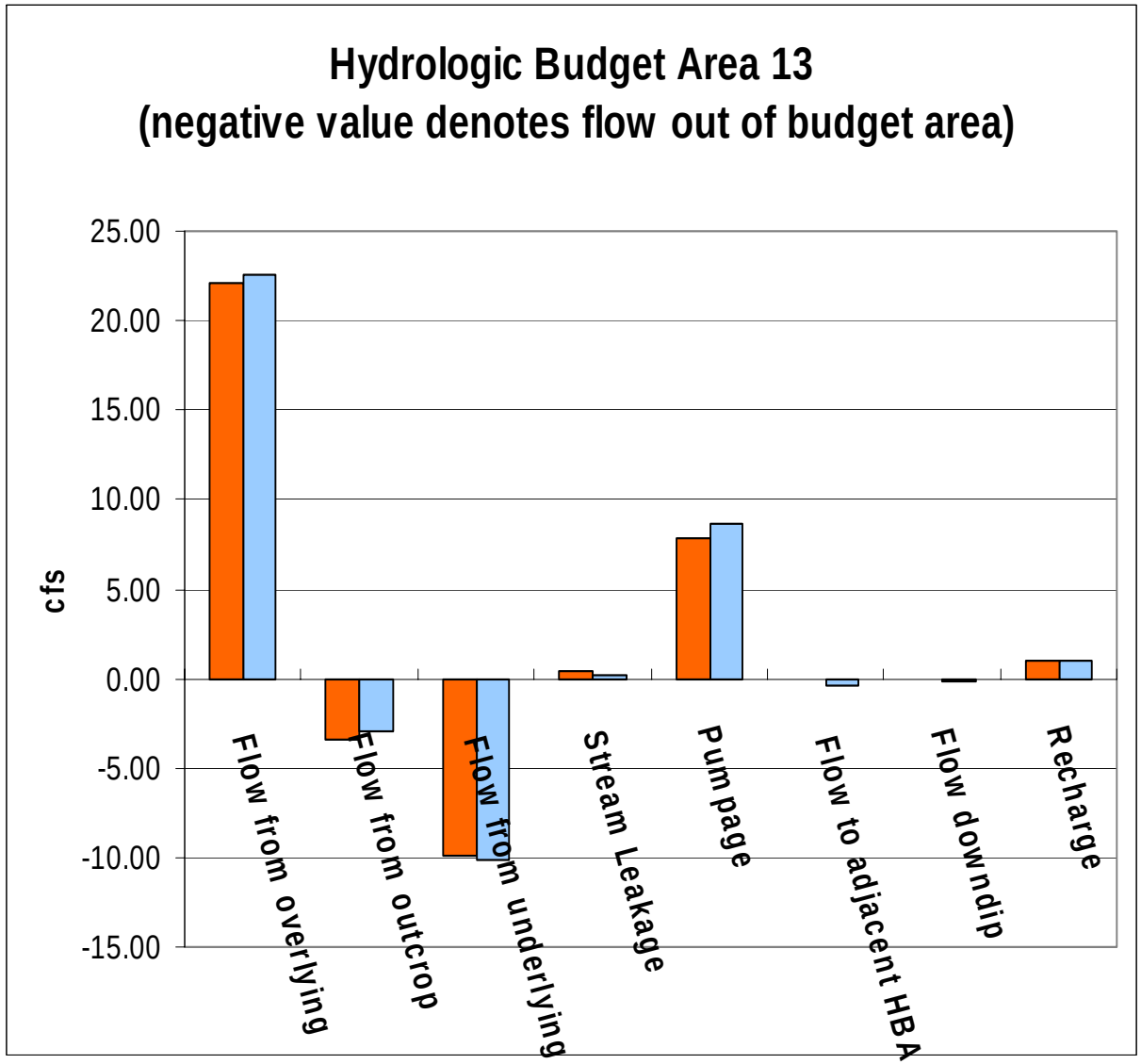
1. **US Census data-- county population growth**
2. **Trend Analysis-- 1990-99 ground-water withdrawals**
3. **NJ State Planning Office– areas of growth**

**Simulate each method separately**

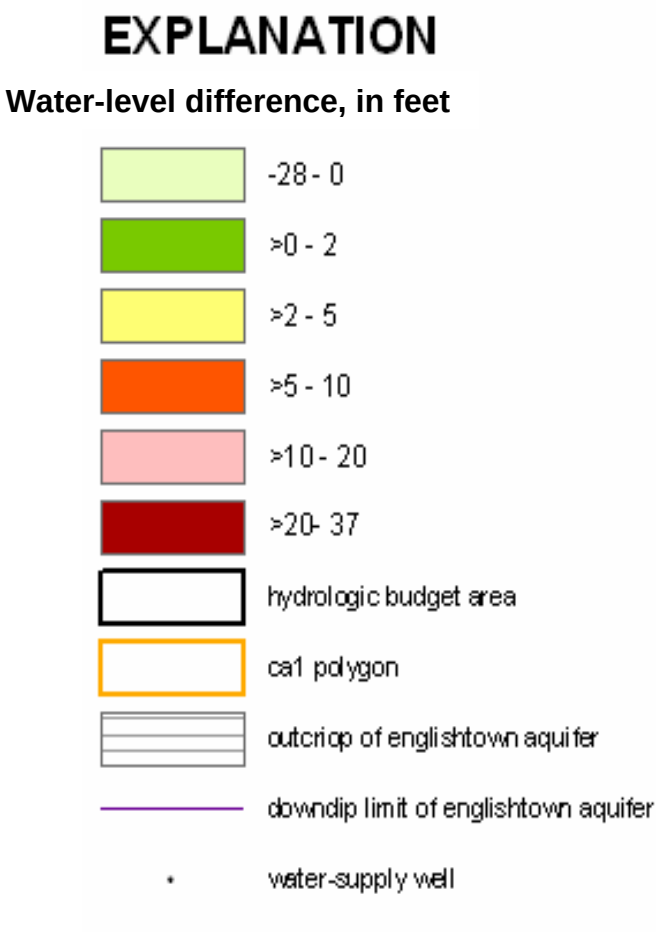
**Compare results of each method to the baseline (1998) simulation for each budget area**

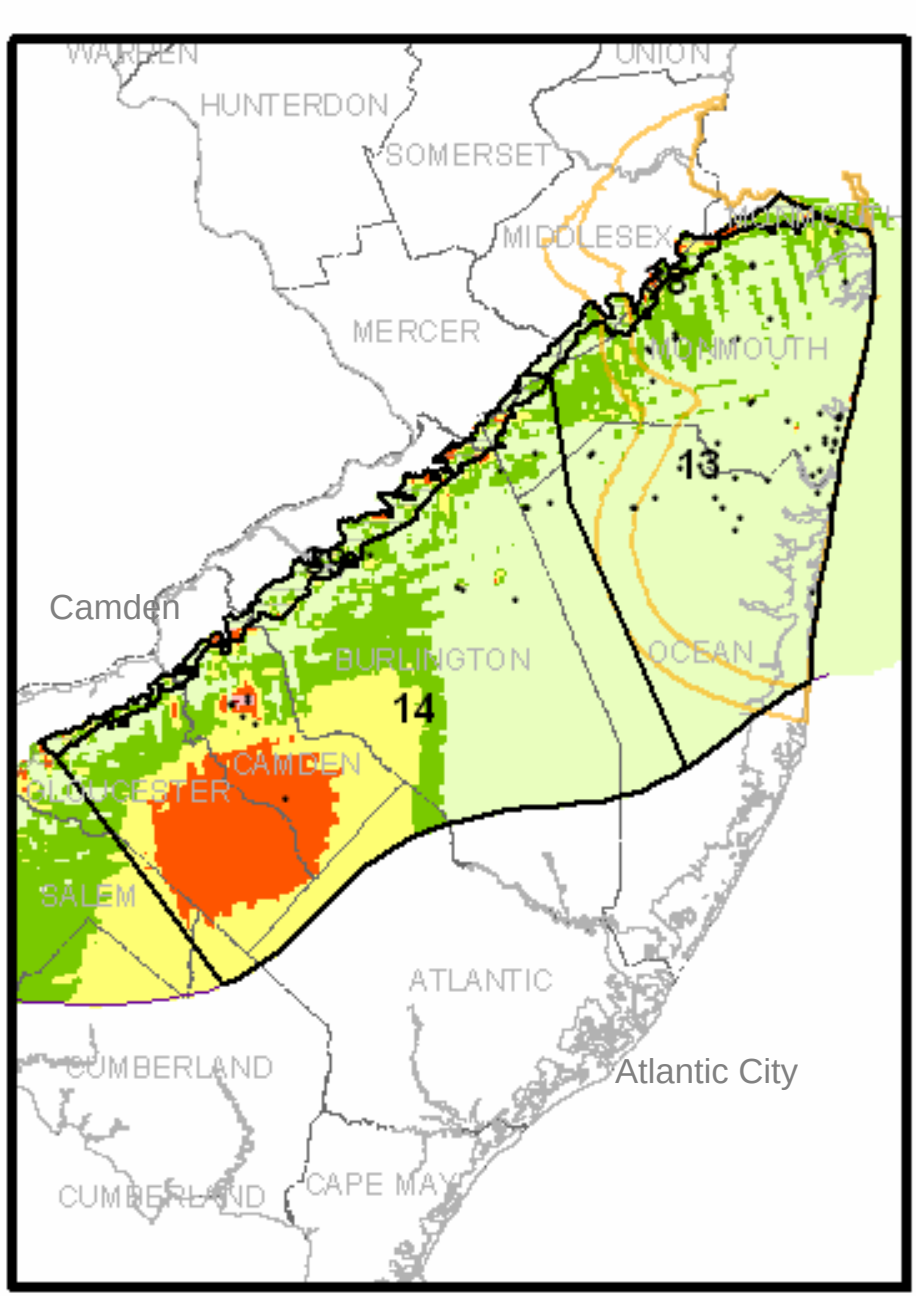
# Flow-Budget using Trend Analysis



# Difference in Simulated Water Levels (1998–2010) using Trend Analysis



# RASA Model is used to assess other Water-Supply Concerns in NJ Coastal Plain

- Simulate **Declining Water Levels-** new permits
- **Water Availability**- effects of new wells
- Quantify **Streamflow Depletion**- limited by model discretization
- Determine flow directions and fluxes in existing areas of **Saltwater Intrusion**

Questions?

Thank you!

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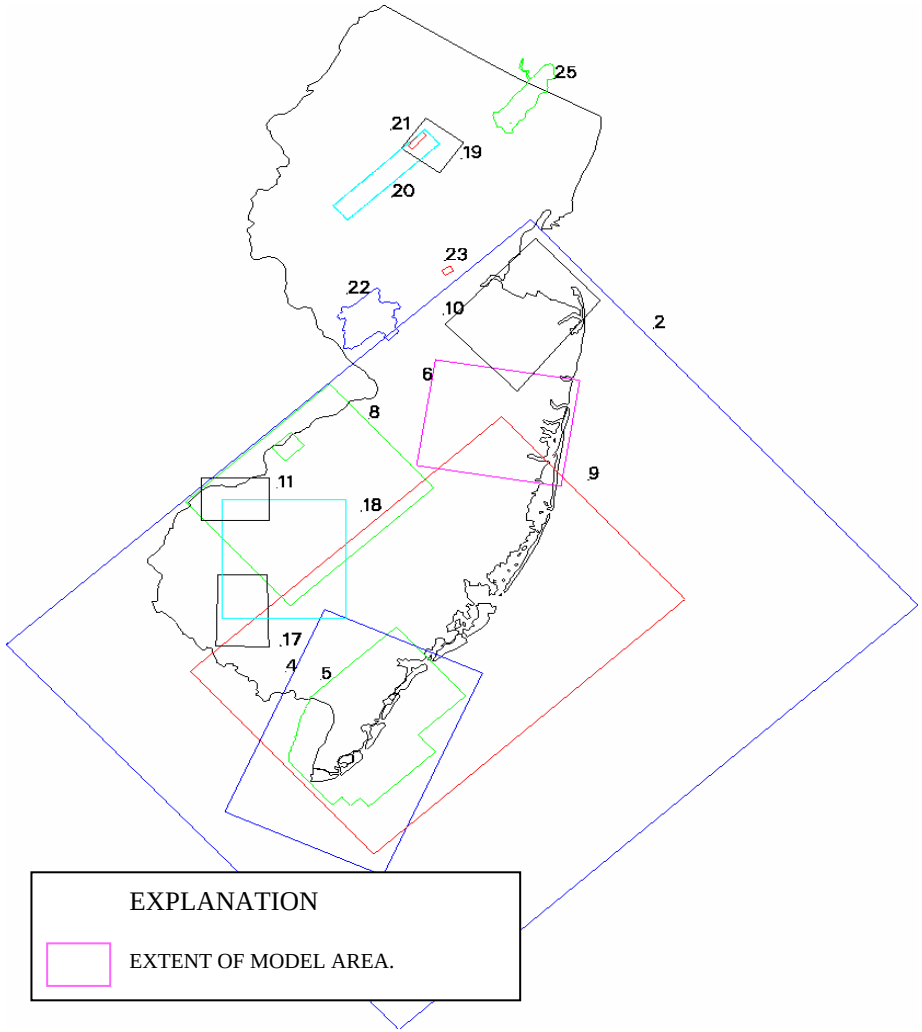
# Model Maintenance Project (in cooperation w/ NJ Dept. of Environmental Protection

Numerical models have been used as tools to address water-supply issues

Archive NJ Ground-water flow models

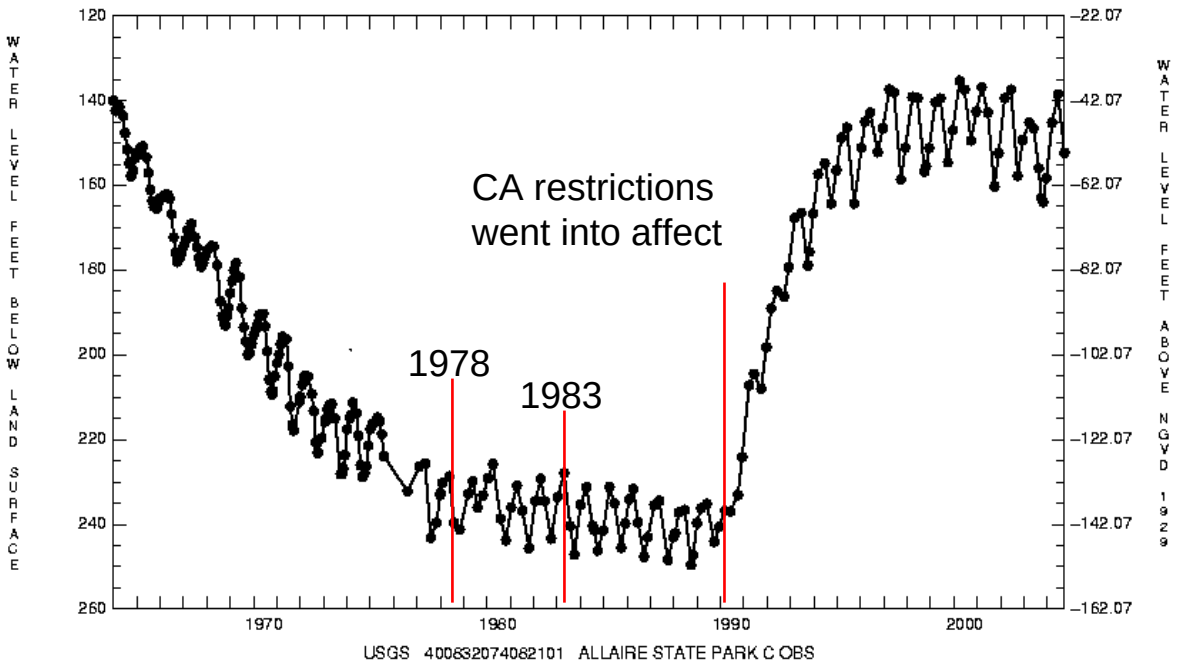
Models can be updated to address increasing ground-water use in an more efficient and cost-effective manner



# CRITICAL AREAS

**NJ USGS synoptics in 1978 and 1983 show major declines in 4 aquifers**

- **1990 restrictions (40% decrease) went into affect**
- **by 1995 Englishtown aquifers recovered by ~100 ft**

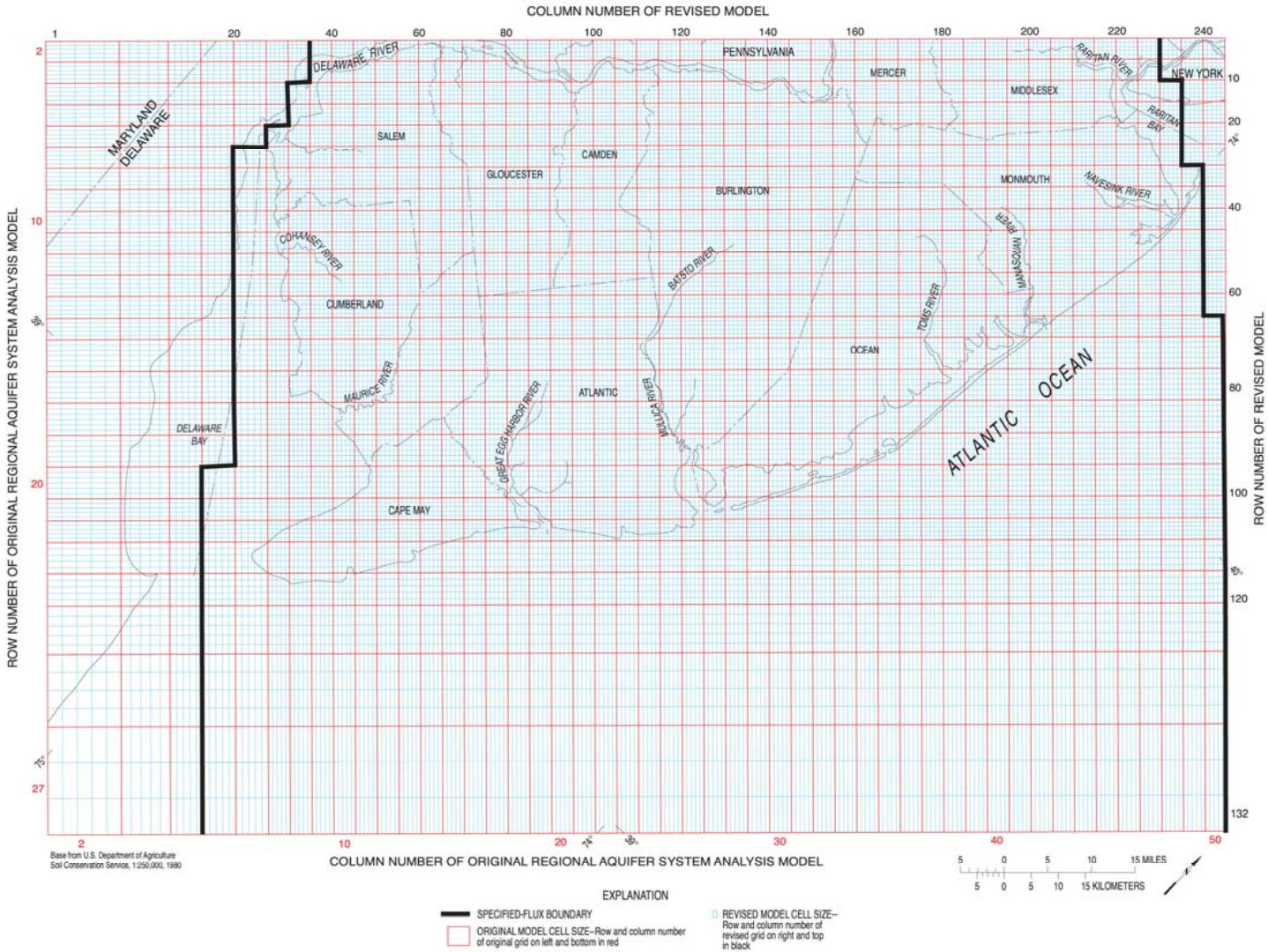


# RASA MODEL

U.S. DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY

PREPARED IN COOPERATION WITH
NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION

WATER-RESOURCES INVESTIGATIONS REPORT 03-4268
Finite-difference grid and generalized lateral boundaries-PLATE 1
Voronin, L.M., 2004, Documentation of revisions to the regional aquifer system analysis model of the New Jersey Coastal Plain




FINITE-DIFFERENCE GRID AND GENERALIZED LATERAL BOUNDARIES OF THE ORIGINAL AND REVISED REGIONAL AQUIFER SYSTEM ANALYSIS MODELS OF THE NEW JERSEY COASTAL PLAIN

By
Lois M. Voronin
2004