The Pinelands Protection Program
Water Management

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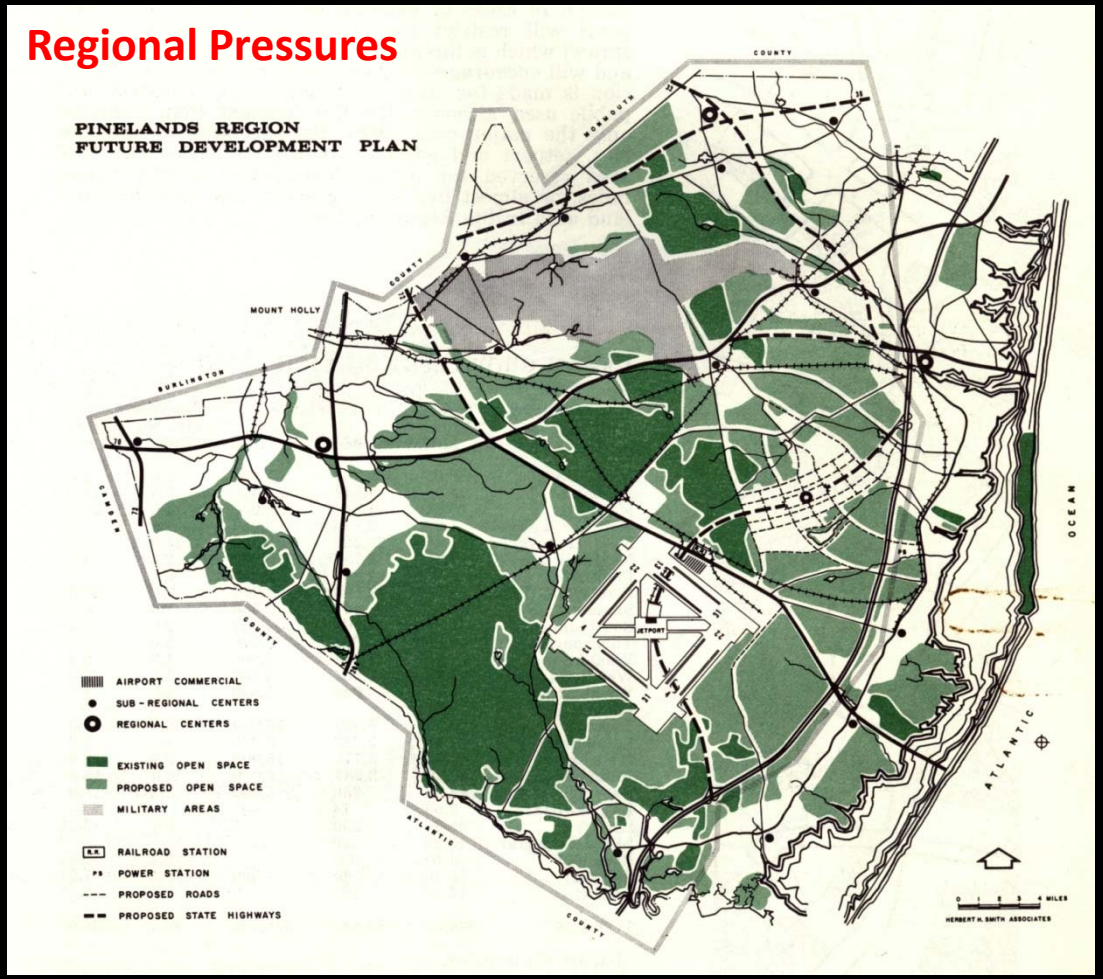
Not a “Park” – Who Lives Here?

Threats: Old and New

Regional Pressures



Over-Development

Linear Infrastructure

National Parks & Recreation Act of 1978

- Establishes Pinelands National Reserve
- Called for a Development Plan (CMP
- Authorizes more than $30 million for Land Acquisition
- Leads to…

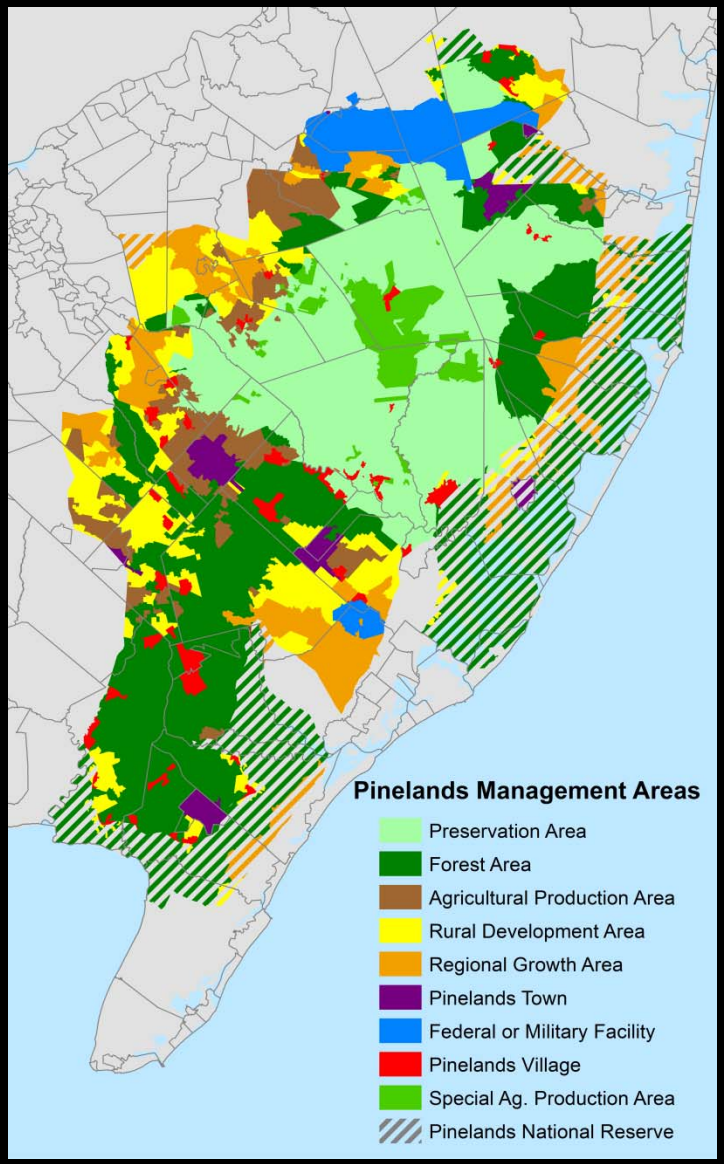
State Pinelands Protection Act (1979)

- Creates Pinelands Commission (PC)
- Gubernatorial Veto of Commission actions
- Pre-eminence of Pinelands Protection Act
- Mandates Consistency of State and Local laws

Planning & Assessment Activities

A. Planning:
   1. Comprehensive Land Use Plan
   2. Implemented Nine Management land use zones based upon watersheds and their carry capacity

B. Assessments:
   1. Twelve Year K/C Study
   2. Long Term Environmental Monitoring

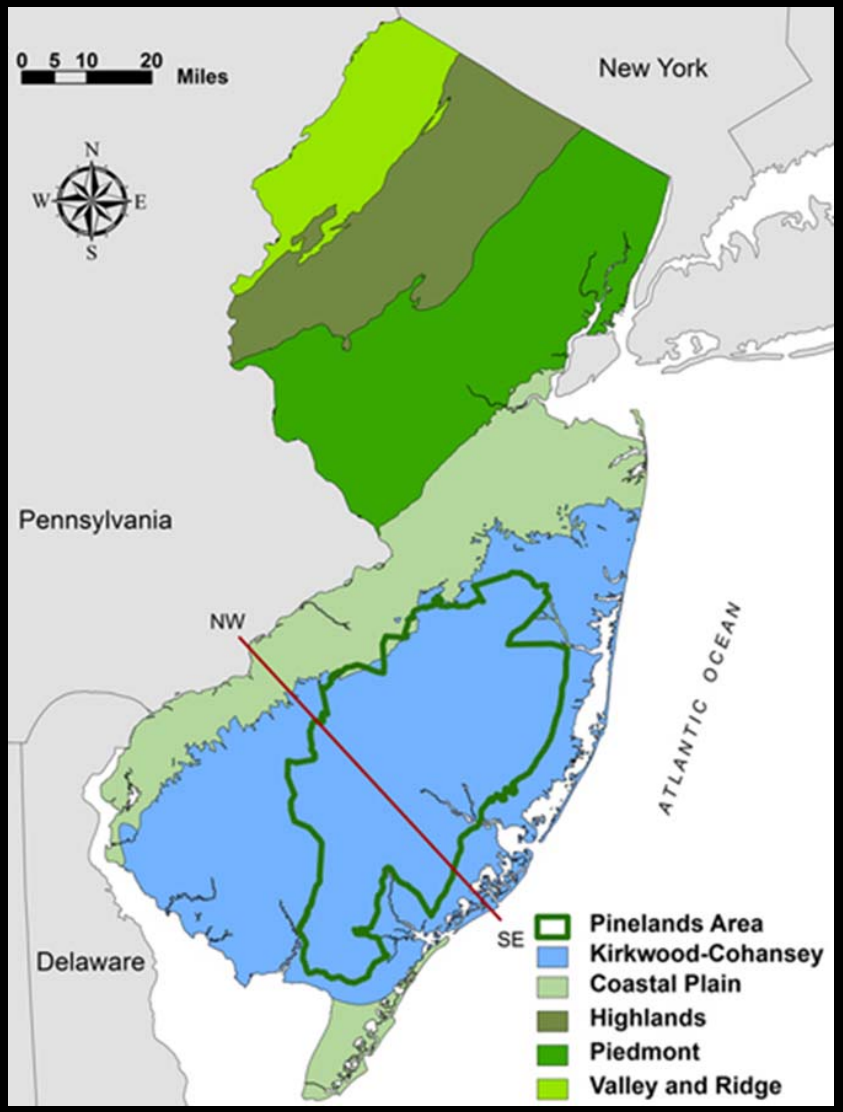


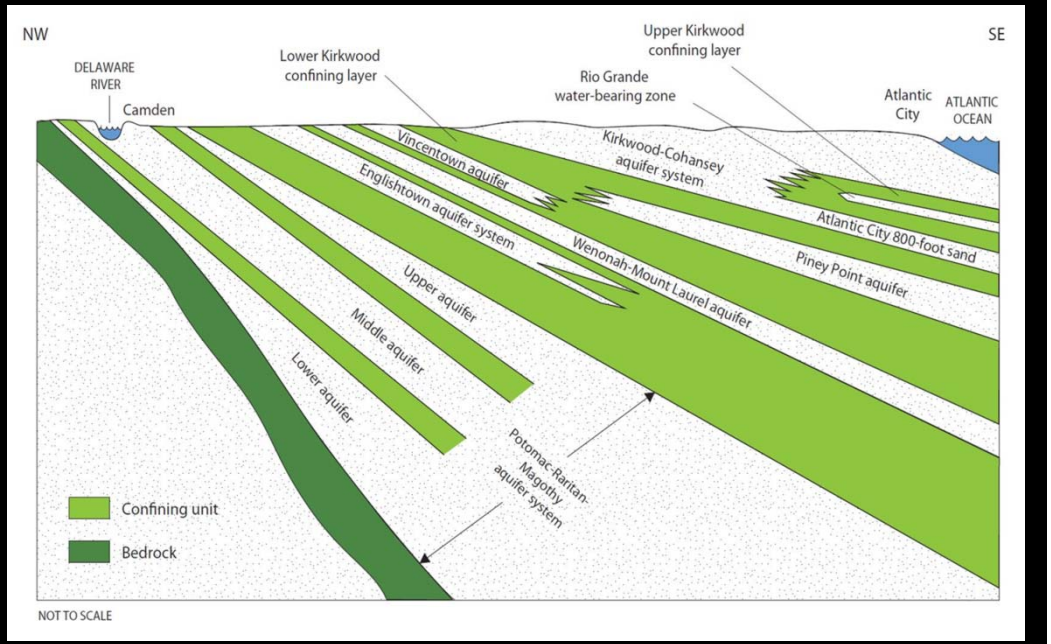
Water, Water, Everywhere…

The Kirkwood/ Cohansey Aquifer

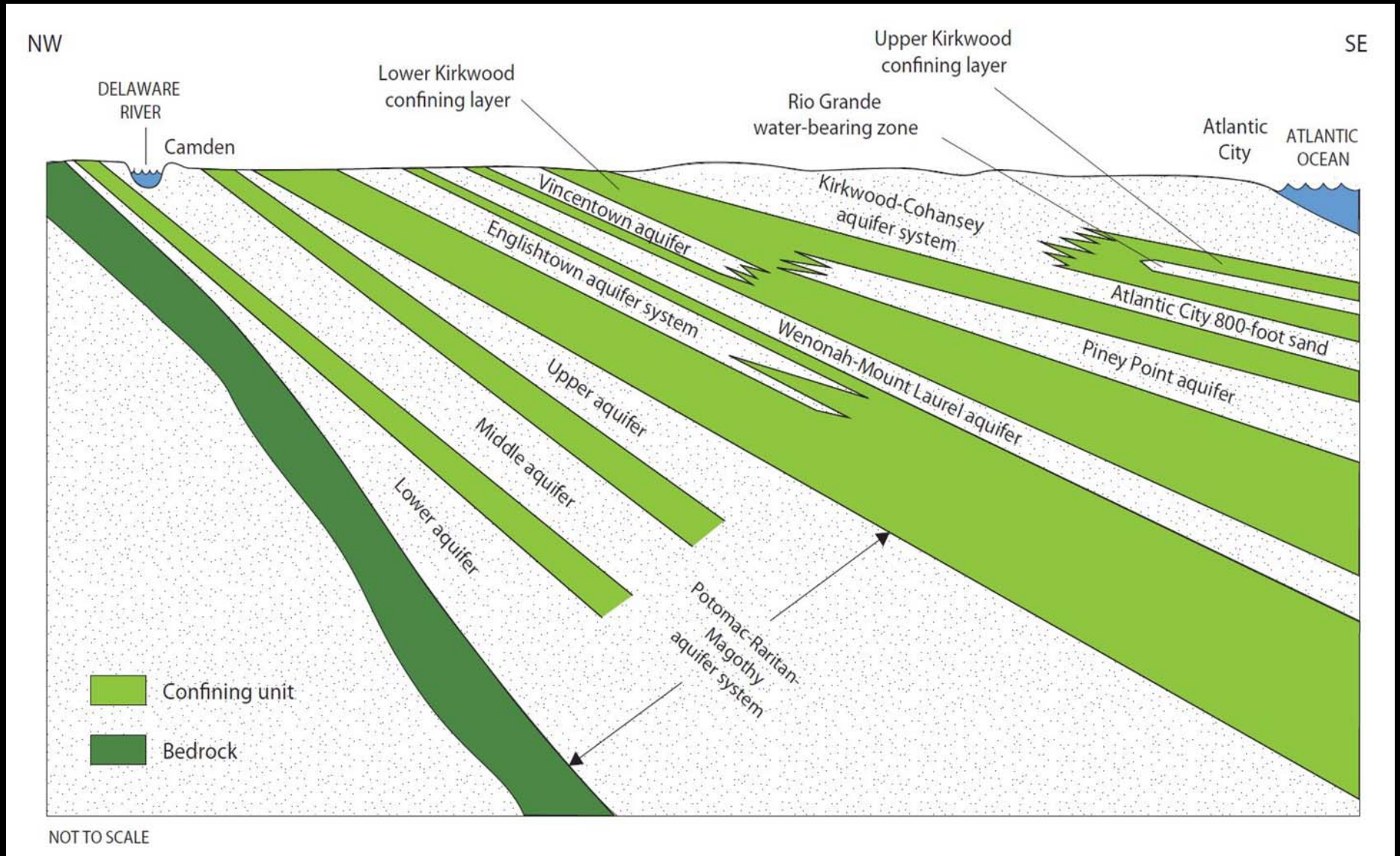
- 1 Million acres
- 17.7 trillion gallons of vulnerable pure water
- The aquifer serves
  - fresh drinking water for 1 million residents
  - supports rivers, streams, and coastal estuaries

New Jersey's Physiographic Provinces





The Kirkwood/Cohansey Aquifer



The Kirkwood/Cohansey Project

Co-operators:
Pinelands Commission, USGS, Rutgers, USFWS, NJDEP

$5 m State Legislation: "…determine how future water supply needs will be met while protecting the Kirkwood-Cohansey aquifer system and while avoiding any adverse ecological impacts."

Status: Research commenced 2003, Studies complete, Implementation Underway

Results: Peer-reviewed scientific publications, water supply planning, and upcoming rulemaking

K/C Study Outline

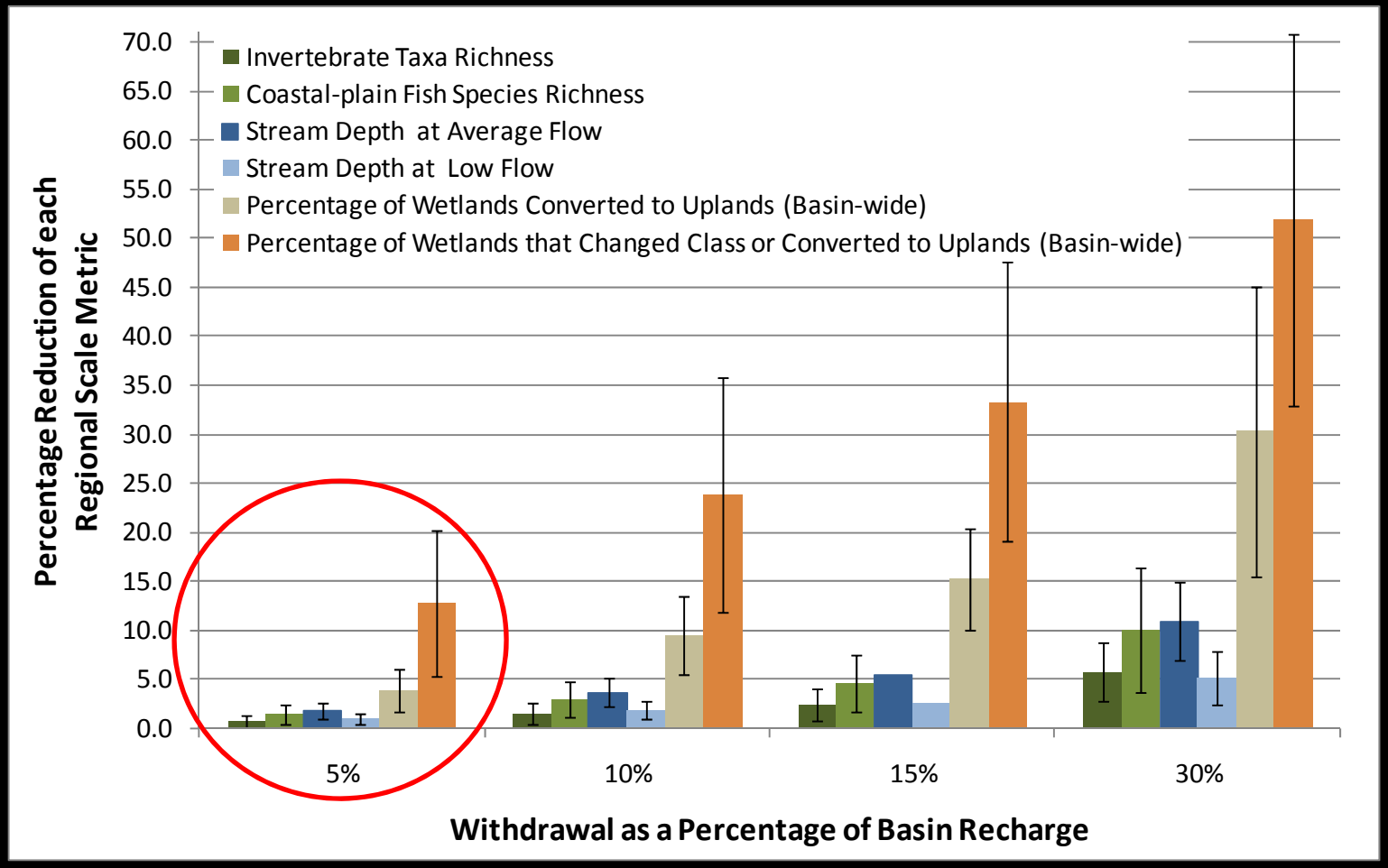
- Probable hydrologic effects of groundwater diversions on stream flows and wetland water levels
- Probable ecological effects of these hydrologic effects on aquatic and wetland communities

K/C Study Process

The Kirkwood/Cohansey Study consists of:

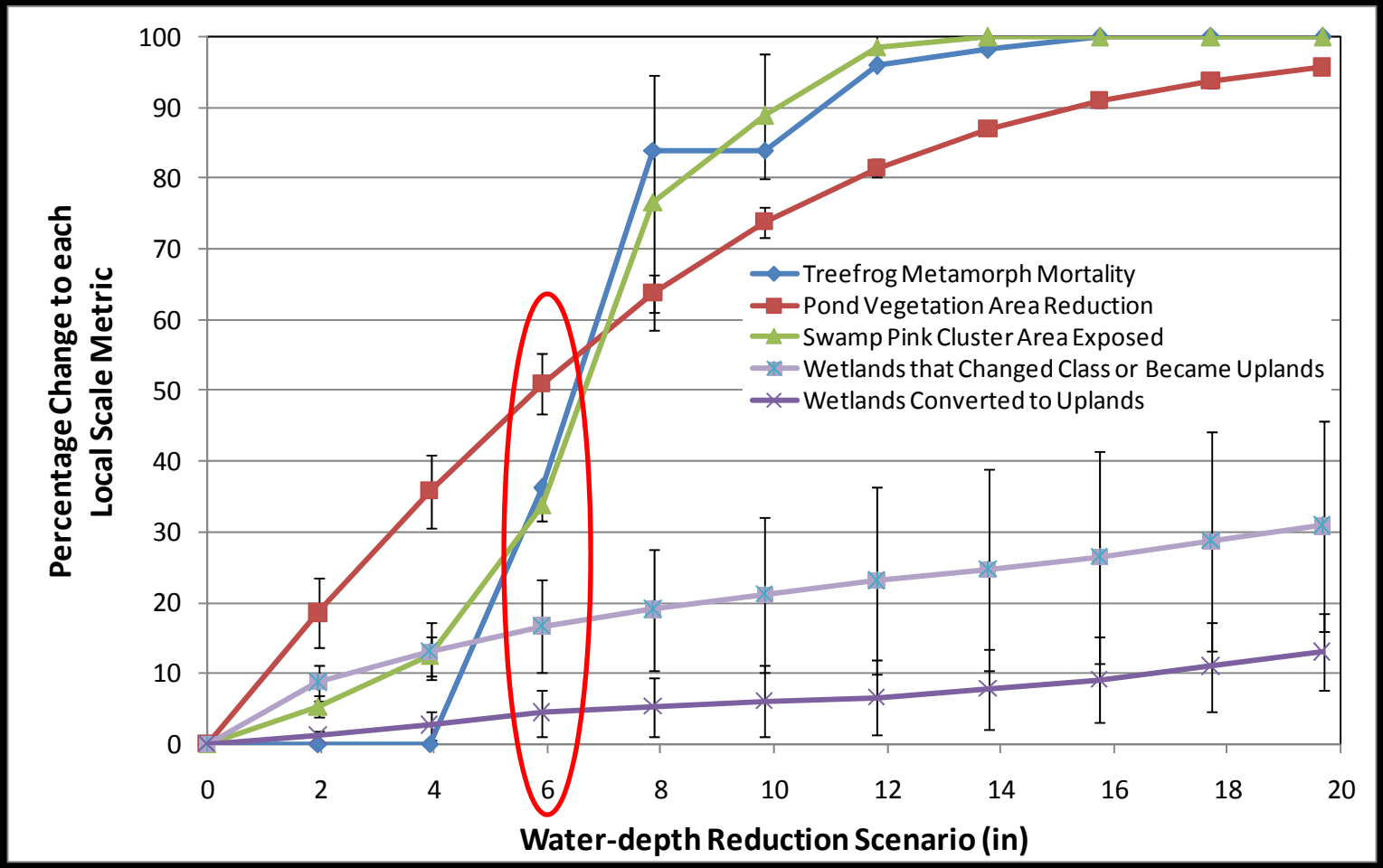
- 8 Ecological Studies
  - Stream and Fish Invertebrate Study
  - Nitrogen Laboratory and Field Study
- 4 Hydrological Studies
  - Hydrologic-Assessment Study
  - Hydrologic-Modeling Study
- Long-Term Ecological Monitoring

Study Findings



Assumes use is 100% consumptive/depletive

Study Findings - Continued



Assumes use is 100% consumptive/depletive

Putting the Study to Use

The Comprehensive Management Plan says:

- Avoid Inter-basin transfer of water
- No water export (10 mile)
- Include:
  - Water-saving devices and other conservation steps
  - Well design to minimize impacts
  - Distribution loss reduction
- Permit Only if:
  - No viable alternative, or
  - No adverse ecological impact (assessment limited by existing tools)

Regulation/Allocation of Water

- 1. Land Use Controls
  - Use permitted by zones
  - Intensity controls (e.g., density, coverage)
- 2. Purveyor Allocation Approvals
  - All increased allocation or new wells must receive approvals
  - Coordination with NJ DEP
  - Approvals before final NJ DEP action

NJDEP Permitting "Coordination" Issues

- Impacts to T & E species
- Enforcement of PC conditions
- NJGS modeling for wetlands impacts only good to ≥12" drawdown (T&E impacts start at 3")
- Test wells do not reach equilibrium
- Purveyors face "double jeopardy" (DEP and PC)

Planning Initiatives

- Pinelands Area Build-Out Analysis
- Water supply planning (by purveyor)
  - Regional Impacts
  - Local Impacts
- Rulemaking: sound water-supply policies for the Kirkwood-Cohansey aquifer.

Build-Out Analysis

- Three Scenarios:
  - Max Build-Out (high)
  - Constrained Build-Out (medium)
  - Current Trends Build-Out (low)
- Three Development Types:
  - Residential
  - Non-Residential
  - Agriculture

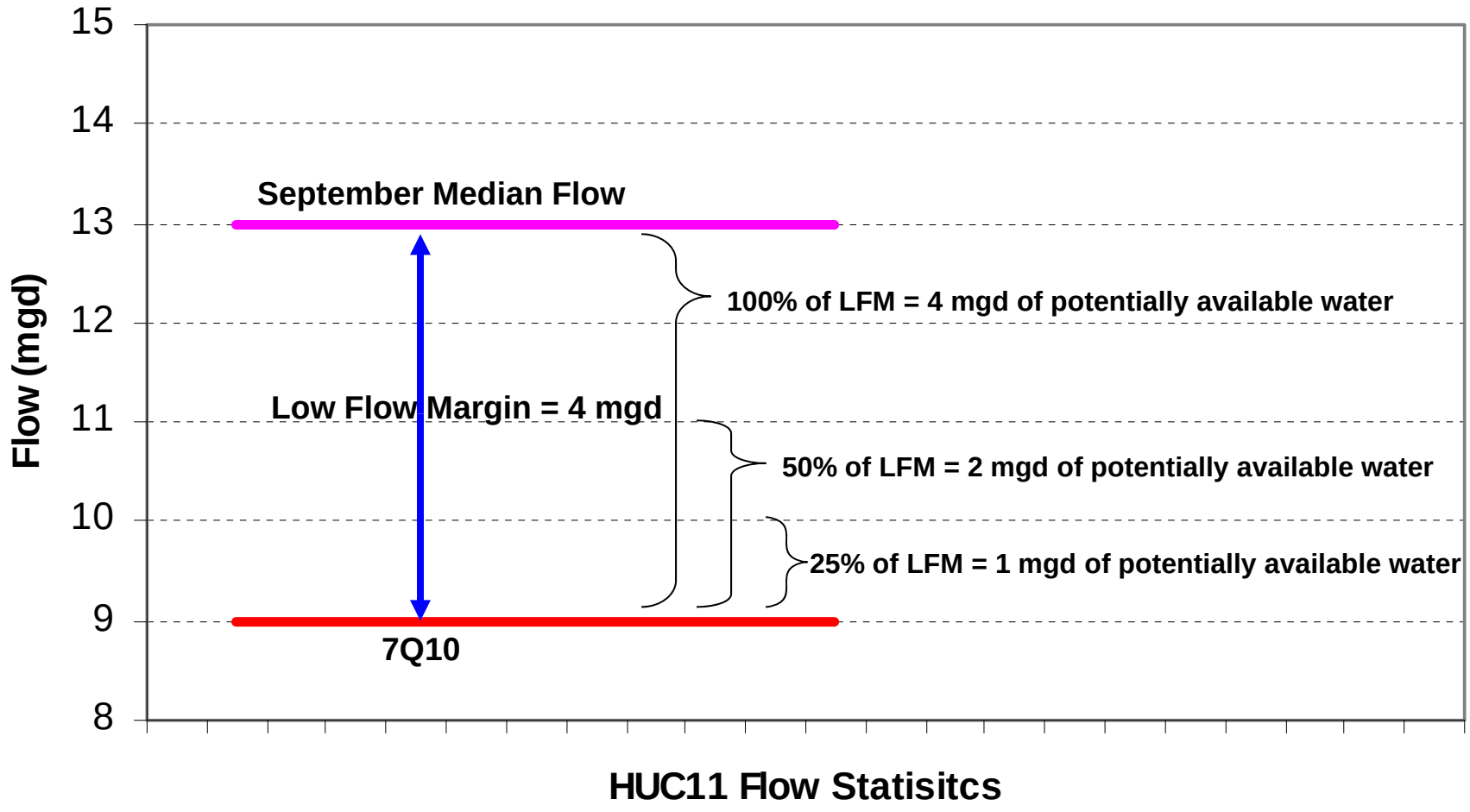
Planning: Regional Impacts

- A. **Low Flow margin** (preferred method)

- B. **Other options**:
  1. Current staff method (or variation thereof): Maximum % Basin recharge
  2. USGS: wetland vulnerability with Gompertz

Determining Water Availability:

Low-Flow Margin



Devising a Low-Flow Threshold

- *Possible NJ DEP Policy: up to 25% may be chosen as an acceptable LFM threshold*
  - Assessed currently "stressed" areas. (Results: 20-30% maximum)
  - Looked at ecological flow goals (Results: 30-40% maximum)
- *Highlands: already using 5%-20%*
- *Pinelands: like Highlands, vary by area sensitivity?*

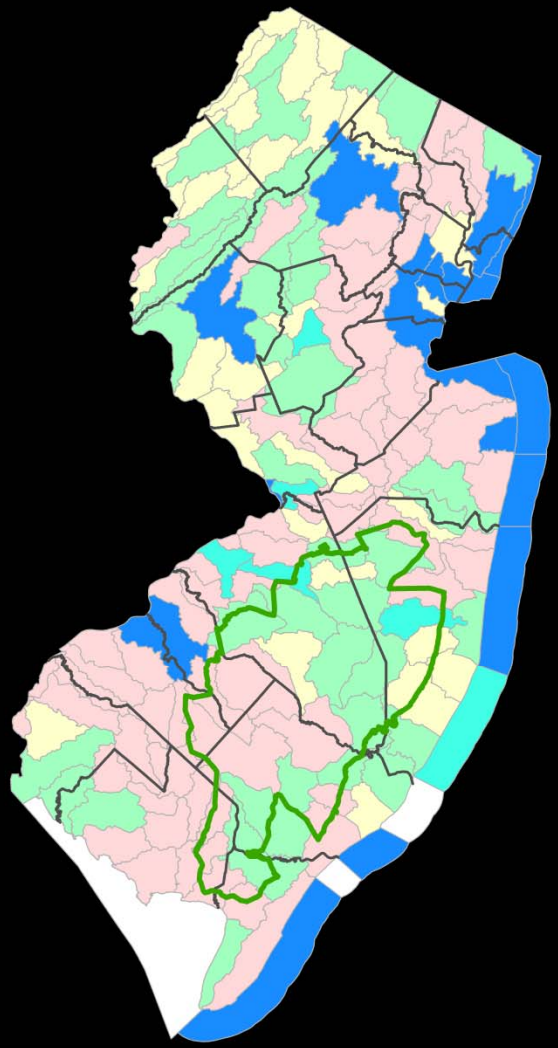
What is the Proper Size of a Pinelands "Watershed"?

	Number	Average Size (mi^2)
Pinelands HUC14	225	8.7
Pinelands HUC11	37	65
Pinelands Science Units	92	21

At usage of no more than 5% recharge, minimum basin size for a 1 MGD well is 21 square miles.

25% of Low-Flow Margin Available

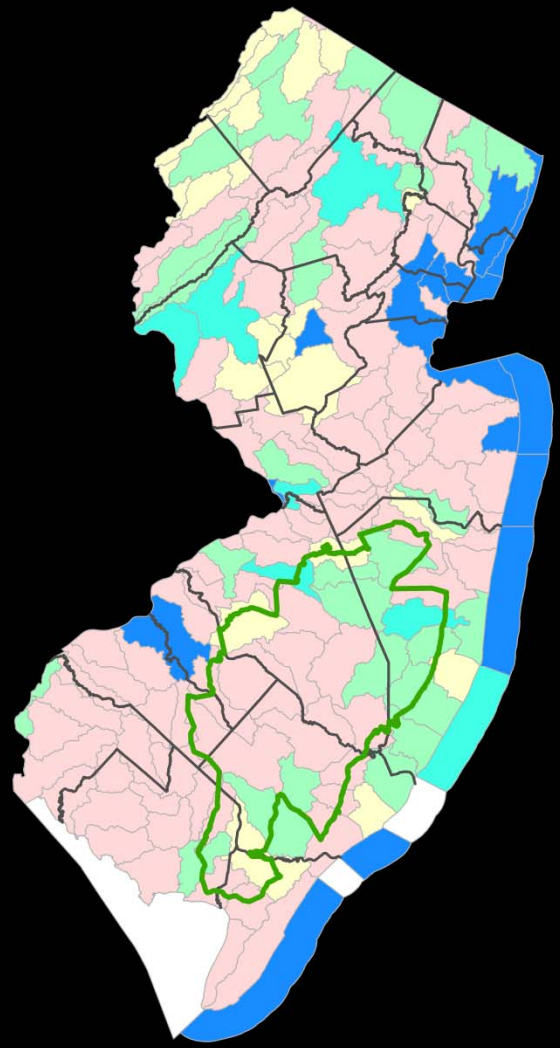
Remaining Available Water at
Current Depletive/Consumptive



Water Availability

- Stressed
- 0.1 - 1 MGD Available
- 1.1 - 5 MGD Available
- 5.1 - 10 MGD Available
- >10 MGD Available
- N/A

Full Allocation at
Current Depletive/Consumptive



Other Possible Regional Assessments

1. Maximum percentage of basin recharge

2. Wetlands Impacts from withdrawals: wetlands vulnerability/Gompertz.

Max Percentage of Recharge Alternative

- Study by Dan Van Abs, NJ Future:
  - Long-term recharge is a good proxy for stream flow in a region where most annual average stream flow is derived from ground water.
  - Assume no more than **5%** of drought recharge can be removed from a sub watershed

- Example:

Subwatershed	LFM Approaches			Comparison to Recharge
	LFM (MGD)	5% LFM	20% LFM	5% Drought GWR
Haynes Creek	2.01	0.10	0.40	0.199

Wetlands Vulnerability/Gompertz Alternative

- Evaluation by Pinelands Preservation Alliance:
  - Based on study by USGS Charles and Nicholson, 2012
  - Estimates the percentage of wetlands in select sub watersheds that experience reductions in water levels of 5, 10, 15 and 30 centimeters based on current withdrawals.
- Example:

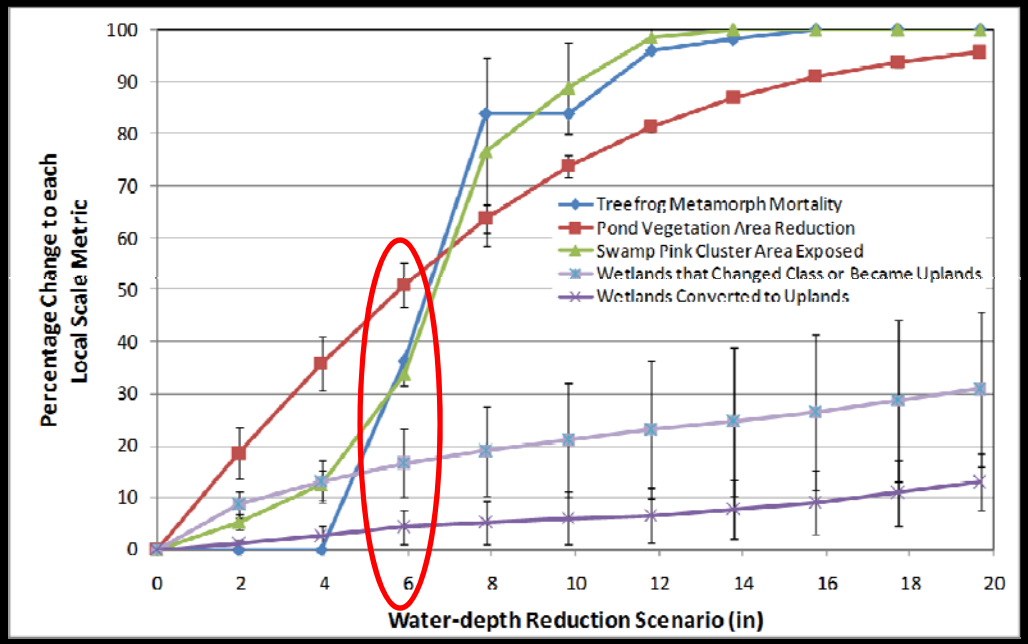
Subwatershed	Sustainable Yields and Actual Usage				Impact of Actual Usage (Gompertz) Wetlands Drawdown:		
	5% of Drought Recharge (MGD)	5% LFM (MDG)	20% LFM (MGD)	Net Withdrawal (Unconfined & SW) (MGD by HUC11)	>= 5 cm	>= 15 cm	>= 30 cm
Hammonton Creek	0.13	0.07	0.28	1.5	73.4%	67.2%	56.2%

Planning: Local Impacts

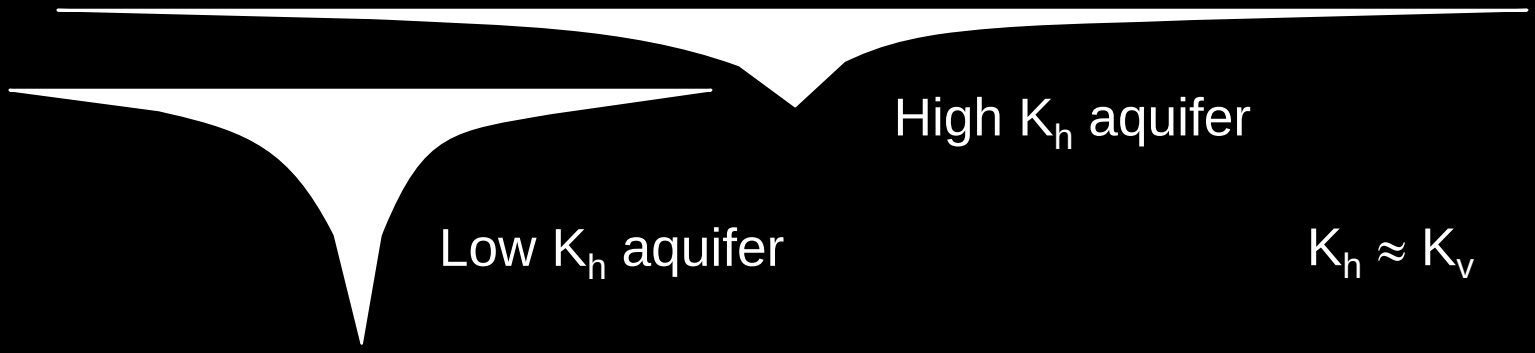
- Goal: Better Measure Impacts of increased or new pumping near wetlands
- What new metrics can we derive from the K/C study?
- Can we regulate with these metrics?
  - By individual well
  - As a planning tool

Not All Wetlands are Equal

1. Ponds & Pine Barrens Tree Frogs: Max 3” drawdown
2. Other wetlands: Max 6” wetland drawdown



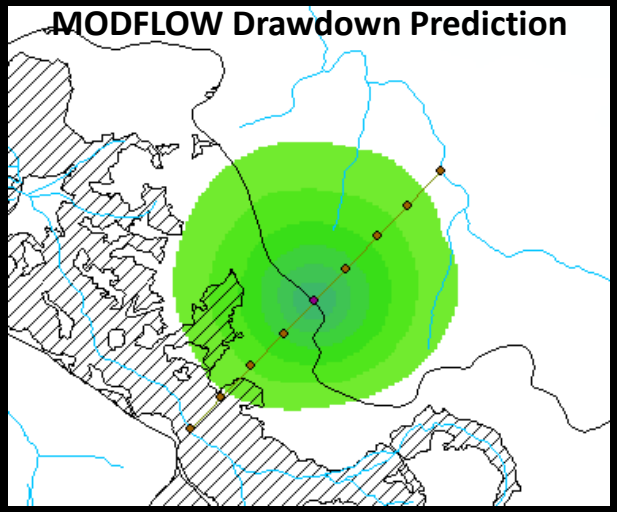
Well Drawdown (Cone of Depression)



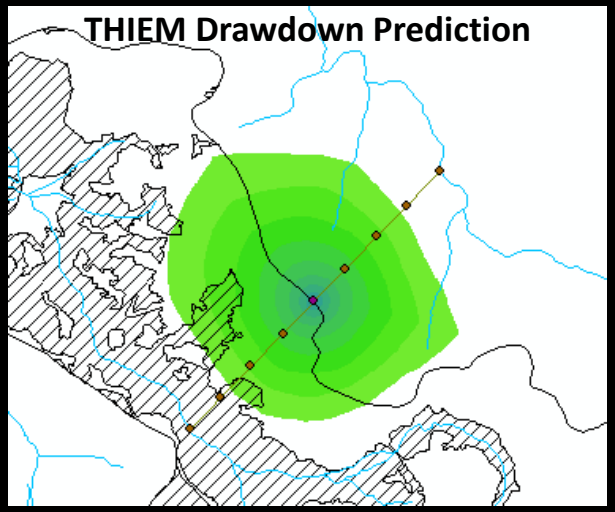
- A zone of low pressure is created centered on the pumping well
- Drawdown is a maximum at the well and reduces radially
- Head gradient decreases away from the well and the pattern resembles an inverted cone called the **cone of depression**
- The cone expands over time until the inflows (from various boundaries) match the well extraction
- The shape of the equilibrium cone is controlled by hydraulic conductivity

Measuring Drawdown Impacts

- MODFLOW Model
  - Complex
  - So called “gold standard”



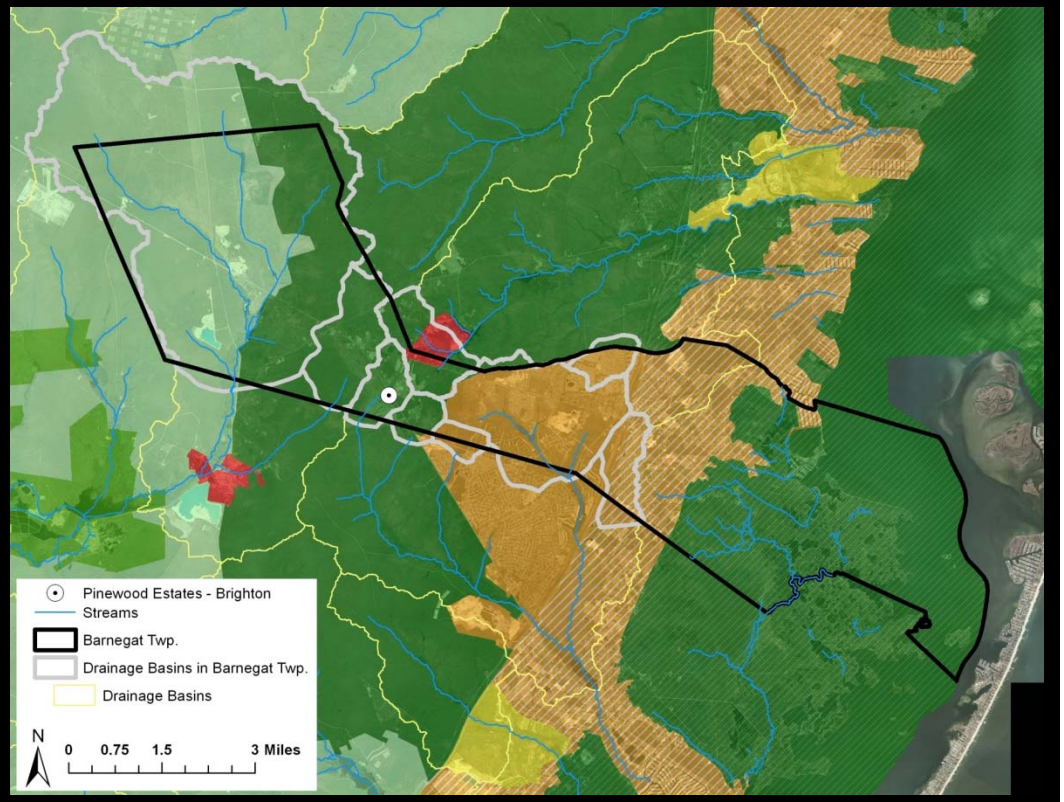
- “Enhanced” Thiem Model
  - Simple
  - Applicable Everywhere in Pines
  - Less accurate than MODFLOW



USGS

Can the K/C in Barnegat Accommodate New Wells?

- Possible HUC 14 watershed?
  - **Yes**
- Existing depletive wells?
  - **None**
- Can basin sustain 2 wells (future needs)?
  - **No, go to HUC 11**
- Basin extend beyond the municipality?
  - **Yes, Joint Municipality Planning**
- Where should a new well be put?
  - **Downstream part of the basin**



Conclusion: The K/C Study and Pinelands Water Supply Planning

- Predict future well needs
- Can K/C meet the needs
- Guide best areas to locate wells

Contact Information

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