For Discussion Purposes

TAC CHARRETTE WORKBOOK
Water Resource Management

NEW JERSEY HIGHLANDS COUNCIL

March 28, 2006

Overview of RMP Goals and Structure

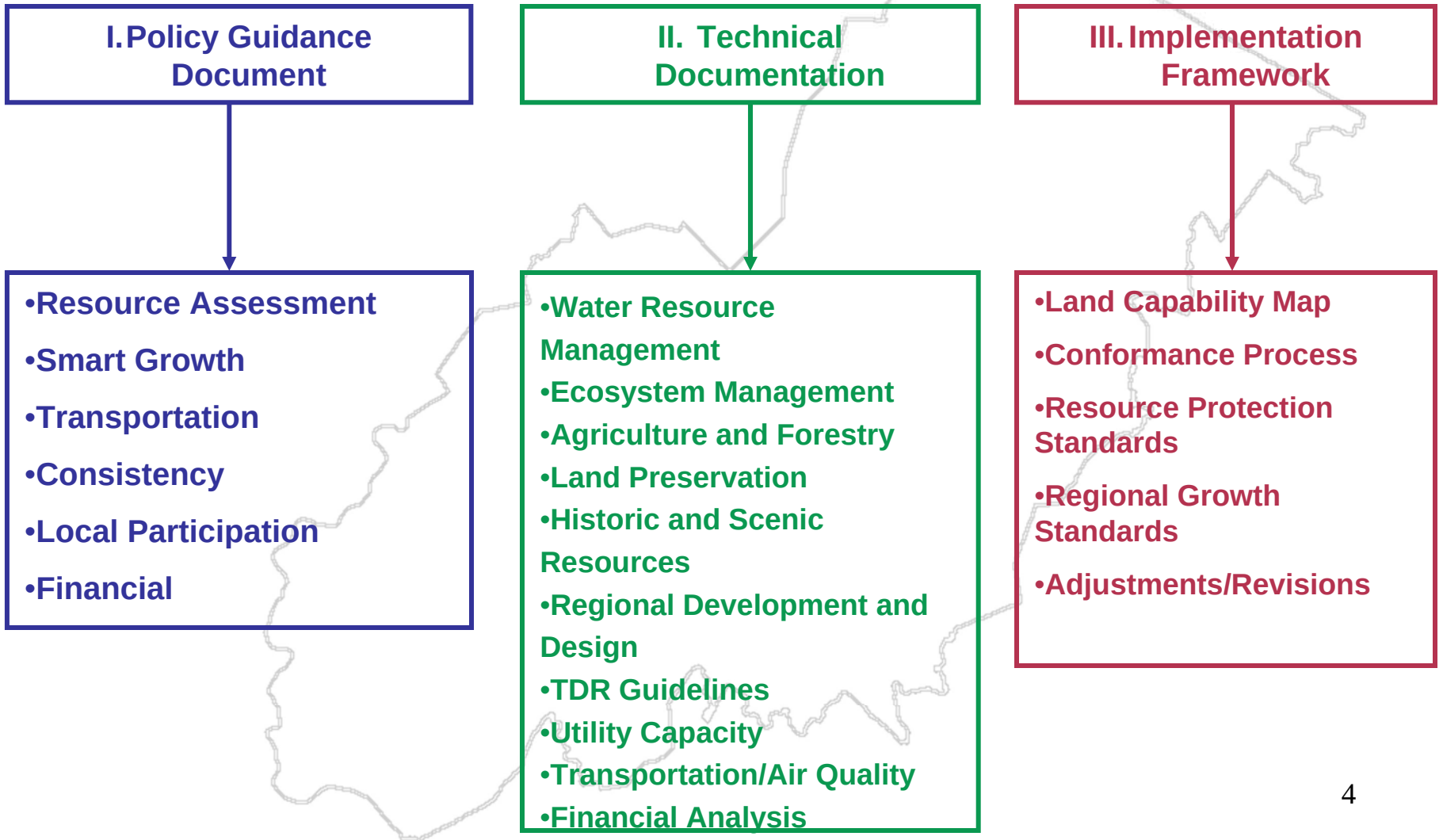
NEW JERSEY HIGHLANDS COUNCIL

New Jersey Highlands

Goals of the Act

- Protect and conserve the quality and quantity of drinking water
- Protect natural, scenic, recreational, cultural and historic resources
- Preserve contiguous lands in their natural state
- Preserve farmland and farming
- Promote appropriate patterns of development, redevelopment and economic growth
- Promote a sound and balanced transportation system

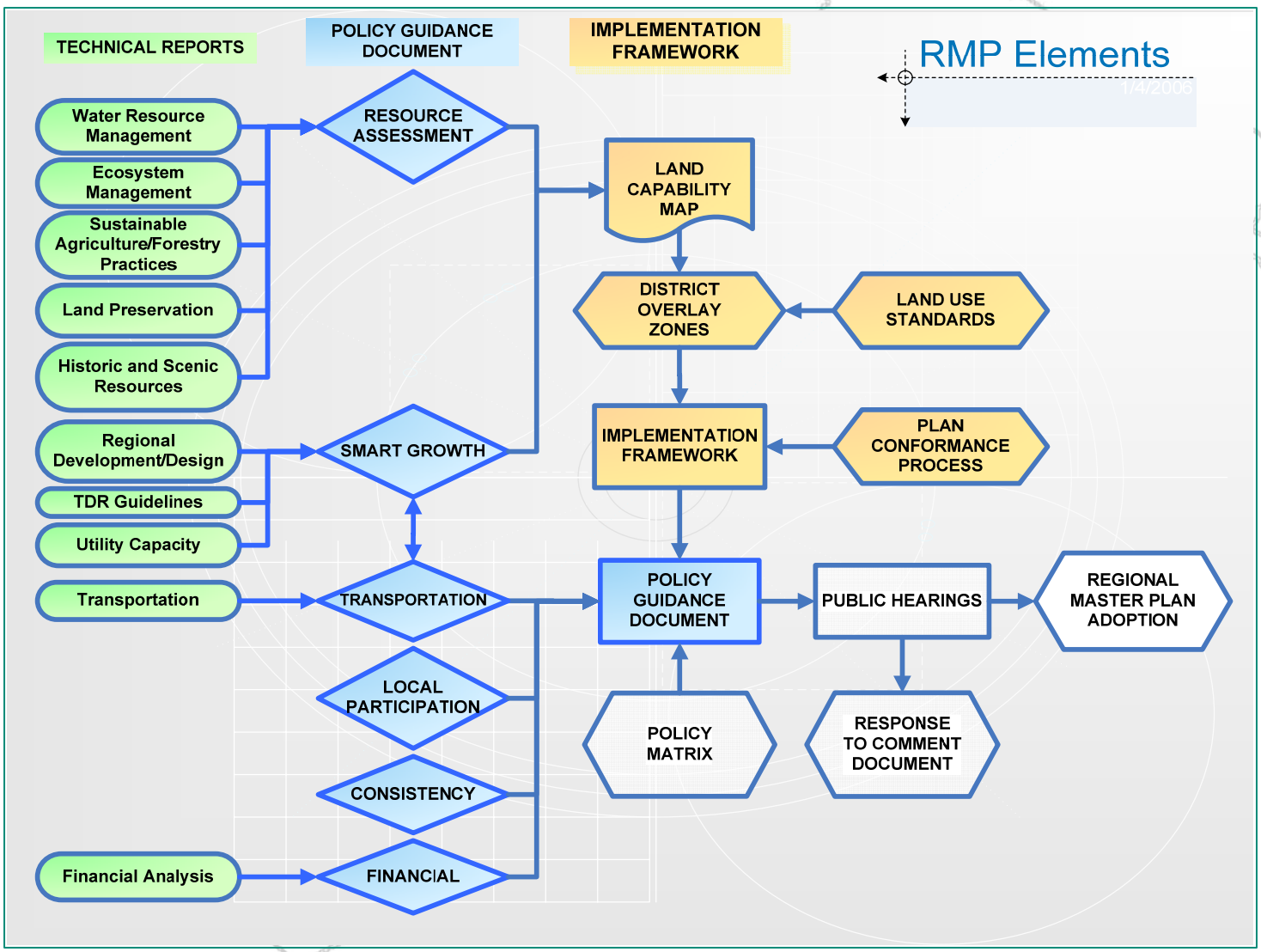
Highlands Regional Master Plan



Highlands Regional Master Plan

I. Policy Guidance Document	II. Technical Documentation	III. Implementation Framework
A statement of the goals, policies, strategies and public participation necessary to develop the RMP and implement the Act	The technical basis supporting the policies and standards, explains science and technical analyses supporting the RMP	The Land Use Capability Map, including district overlay zones and other tools for RMP conformance and implementation

Highlands Regional Master Plan



Water Resource Management Requirements of the Act

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Water Resource Management

Requirements of the Act

- **Determine "the amount and type of human development and activity which the ecosystem of the Highlands Region can sustain while still maintaining the overall ecological values thereof, with special reference to:**
  - **surface and ground water quality and supply;**
  - **contiguous forests and woodlands;**
  - **endangered and threatened animals, plants, and biotic communities;**
  - **ecological factors relating to the protection and enhancement of agricultural or horticultural production or activity;**
  - **air quality; and**
  - **other appropriate considerations affecting the ecological integrity of the Highlands Region"**

Highlands Act, N.J.S.A. 13:20-11.a(1)(a)

Technical Approach and Methods
Water Resource Management

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Water Resource Management

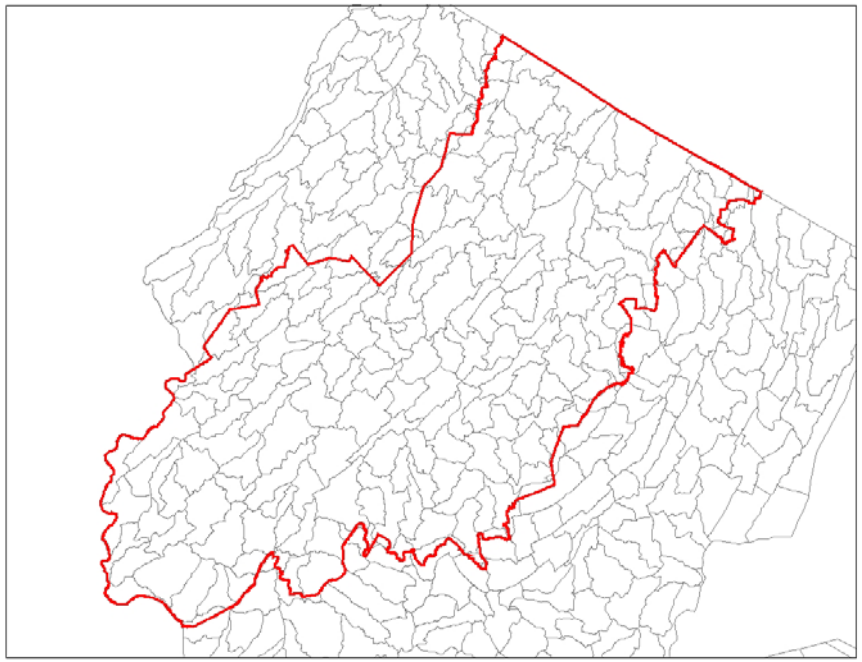
Objectives

- Determine the current status of Highlands water resources and their existing capacity to supply water for human uses.
- Examine the extent to which existing and future human populations can be served without impairing the quality or reliability of the resource.
- Establish level of protection necessary to sustain resource value.

Water Resource Management

Data Sources

- Ground and surface water quality and quantity data for all 183 HUC14 drainage areas
- GIS coverages and data bases for streams, aquifers, withdrawals, returns and other data sets needed to estimate water capacity
- Evaluate impact of existing land use characteristics on water supply



New Jersey Highlands HUC14 Drainage Areas

Water Resource Management

Technical Approach

- **Water Capacity Analysis**
  - Inventory Existing Ground and Surface Water Resources
  - Ground Water Capacity Analyses
    - ✓Low Flow Margin of Safety Analysis
    - ✓Base Flow Analyses (10 and 25 year)
    - ✓Ecological Flow Goals Pilot Studies
  - Surface Water Supply Safe Yield Review
  - Water Supply Growth Area Analysis Review
  - Establish Water Capacity by HUC 14
  - Water Supply Balance Analysis
  - Ground Water Recharge Area Analysis

Water Resource Management
Technical Approach

(continued)

- **Water Quality Assessment**
  - **Inventory Existing Ground and Surface Water Resources**
  - **Septic Density/Nitrate Dilution Assessment**
  - **Wellhead Protection Areas**
  - **Known Contaminated Areas**

Water Resource Management
Water Capacity Analysis

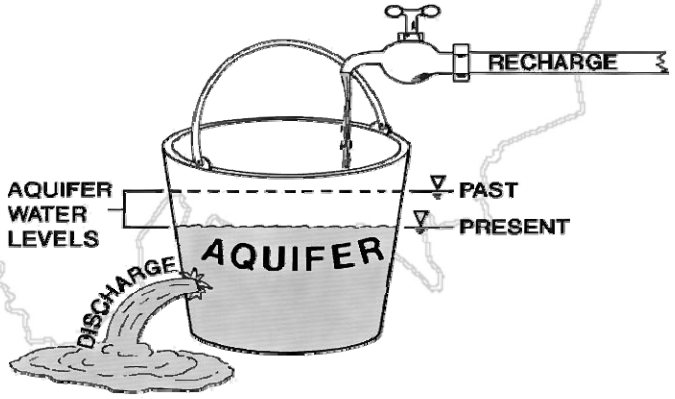
Inventory Existing Ground and Surface Water Resources

- **Identify HUC 14 Basin Characteristics**
  - **Drainage area, basin and slope, streams, geologic terrain, aquifer types, LULC, precipitation, evapotranspiration, aquifer recharge and stream discharge measurements.**
- **Compile Water Use Data (based on NJGS)**
  - **Ground water withdrawals by well, well information, stream and reservoir withdrawals, allocation per withdrawal by site/permit, withdrawal sites, water return and export, sewer and water service areas and linkages, and water supply growth area predicted water use.**

Water Resource Management
Water Capacity Analysis

Ground Water Capacity Analysis

- **Primary drinking water source for Highlands communities and the critical component of streamflow during prolonged dry conditions**
- **Ground water capacity assessment needed to maintain stream habitat and ecological health and balance ground water demands and capacity**



Water Resource Management
Water Capacity Analysis

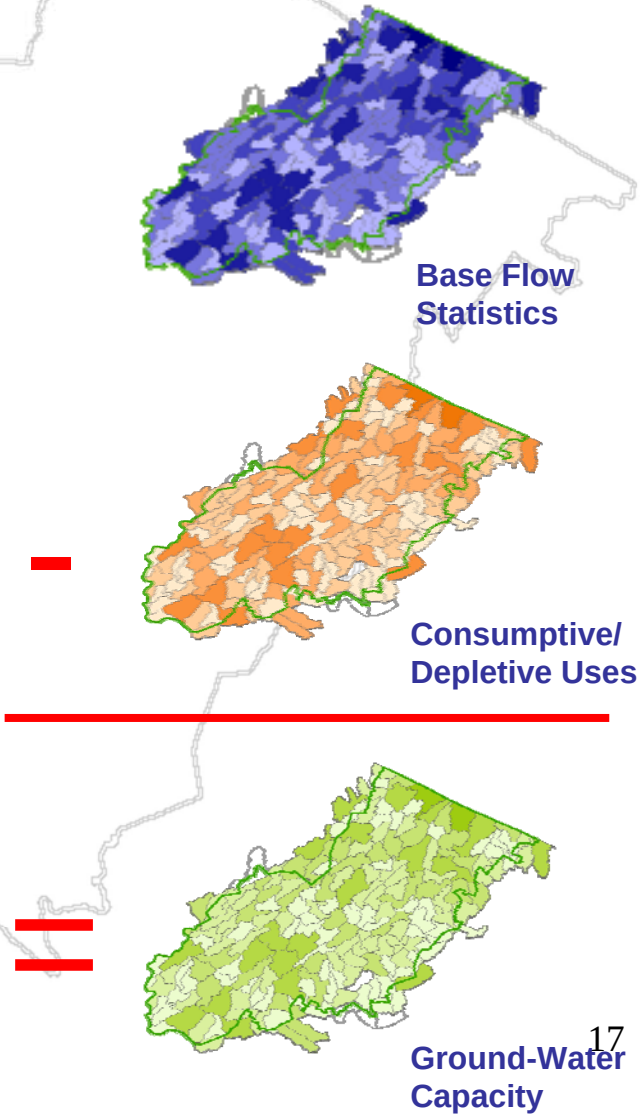
Ground Water Capacity Analysis (cont)

- **No State method or other consensus method for determining ground water capacity**
- **Testing three NJGS and USGS methods that utilize streamflow statistics and basin characteristics to help establish thresholds for ground water capacity**
- **Policy decisions needed on use of statistics**

Water Resource Management
Water Capacity Analysis

Ground Water Capacity Analysis (cont)

- Analyses will be used to help establish thresholds to determine water capacity by HUC 14 as part of the total water budget for ground water resources
- Compare total water capacity to current demands that remove water from the system
- Policy implications include effects of stream low flow conditions on both ecological and water supply uses



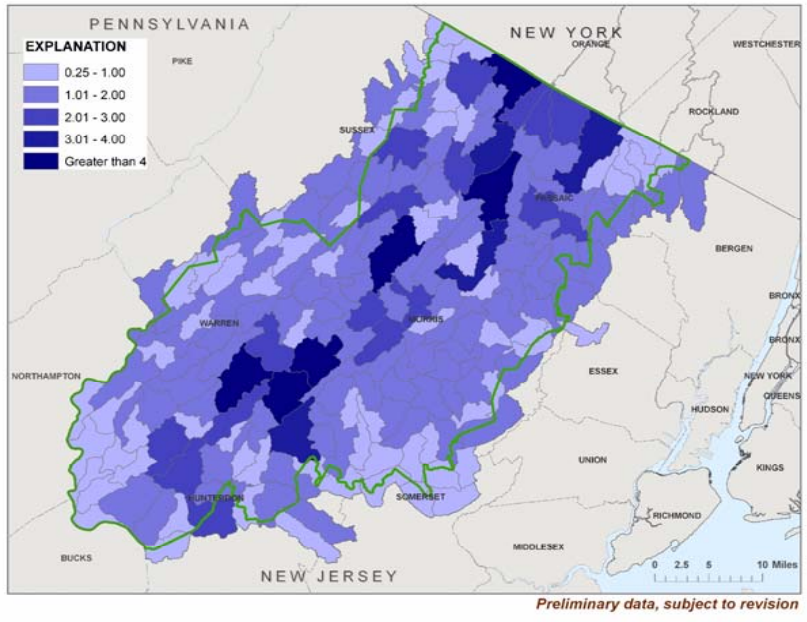
Water Resource Management
Water Capacity Analysis

Ground Water Capacity Analysis (cont)

- **"Low Flow Margin of Safety" Analysis**
  - **Hydrologically-based – defines water capacity using gauging stations not affected by reservoirs/major transfers**
  - **Defines extreme low flow condition as lowest flow over seven consecutive days during a ten-year period (7Q10 – historic policy level for low flows)**
  - **Establishes critical flow regime for aquatic ecosystems as the lowest median monthly flow (September)**
  - **"Low Flow Margin" defined as a percentage of the difference between September median flow and 7Q10 flow**
  - **Policy decision – what portion of the difference is "available" for use? Can be area/watershed specific?**

Water Resource Management
Water Capacity Analysis

- **"Low Flow Margin of Safety" Analysis (continued)**
  - **"Low Flow Margin of Safety" is "Low Flow Margin" times percentage**
  - **Will need a monitoring program (post-RMP) capable of validating and improving upon the estimates of water capacity**



Low-flow margin, in Mgal/d
Drainage area ratio basins over regression basins

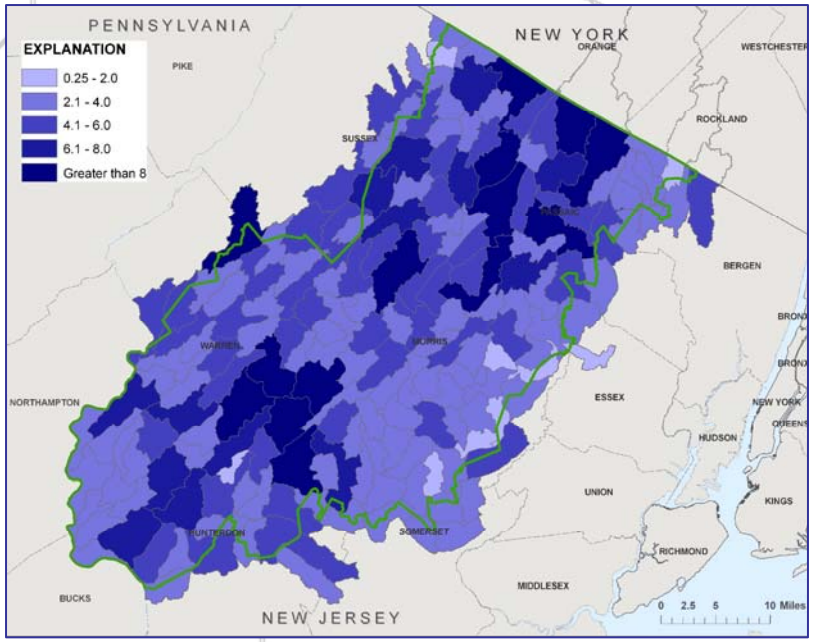
Water Resource Management
Water Capacity Analysis

Ground Water Capacity Analysis (cont)

- **Base Flow Analysis**
  - Partitions stream flow to estimate base flow (equivalent to ground water discharge) at 10 and 25 year recurrence intervals
  - Estimate available water by HUC-14 using base flow
- **Ecological Flow Goals Pilot**
  - Estimates stream flow patterns (high and low) needed to sustain aquatic ecosystems
  - Analysis of baseline vs. current stream flow, considers passing flows, allocated/ consumptive withdrawals and impacts on stream flow variability – sophisticated, data intensive process
  - Pilot project – four basins will be assessed

Water Resource Management
Water Capacity Analysis

- **Ecological Flow Goals Pilot (cont)**
  - Utilize the pilot project results to help evaluate “available water supply” values derived from Low Flow Margin of Safety and Base Flow analyses
  - Develop a program to fully implement Eco-Flow goals as a next step after the adoption of the RMP



Preliminary data, subject to revision

Base flow, in Mgal/d, for the 10-yr recurrence interval
Drainage area ratio basins over regression basins

Water Resource Management
Water Capacity Analysis

Ground Water Capacity Analysis (cont)

- **Estimating Ground Water Capacity**
  - **Assess viability of Low Flow Margin of Safety and Base Flow analyses to estimate ground water capacity on a HUC-14 basis**
  - **Compare to Ecological Flow Goals results**
  - **Establish conservative estimates of water capacity utilizing some combination of these methods, to address inherent uncertainty and ecological consequences of unsustainable water withdrawals**
  - **To the extent practical, incorporate ecological and water quality indicators to inform available water supply based on selected methods**

Water Resource Management
Water Capacity Analysis

Surface Water Supply Safe Yield Review

- **Document existing surface water safe yields from available data sources**
  - **Review safe yield documents from water purveyors, NJ Statewide Water Supply Plan**

Water Supply Growth Area Analysis Review

- **Identify conflicts between unused surface water supply allocations and projected water demands in their service areas**
  - **Review NJDEP Water Supply Growth Area Analysis**
  - **Identify surface water supplies dependent on Highlands source waters and demands on them**
  - **Identify potential issues between the results of that analysis and modeling efforts described above in terms of potential Growth areas within the Highlands**

Water Resource Management
Water Capacity Analysis

Establish Water Capacity by HUC 14

- **Determine overall water capacity for Highlands surface and ground water resources.**
  - **Based on all the analyses above, determine available water by HUC-14 subwatershed**

Water Supply Balance Analysis

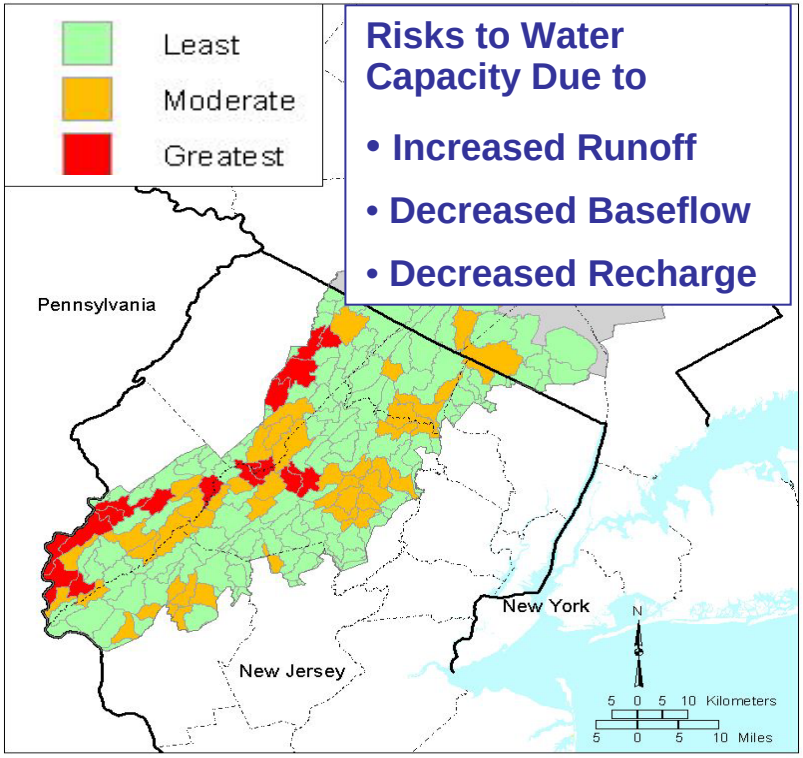
- **Identify areas where existing demands, current allocations or projected demands exceed available water supplies from a HUC-14 subwatershed**
  - **Calculate current demands (depletive and consumptive water uses)**
  - **Calculate total water allocations by HUC-14 (Water Utility Tech Report)**
  - **Calculate projected demands by HUC-14 (Build-out Analysis)**
  - **Compare to "total water capacity" to determine "net water capacity"**
  - **Identify where "net water capacity" is equal to or less than zero**

Water Resource Management
Water Capacity Analysis

Ground Water Recharge Analysis

- **Identify, characterize and rank ground water recharge areas**
  - Not for estimation of water capacity, but geographic identification of recharge areas
  - Using long-term median and drought recharge estimates (NJGS), evaluate recharge areas by rate of recharge, correlation with aquifer locations, estimated relative yields, and aquifer type. Rank areas by yield, size and recharge
  - Identify "prime" recharge areas for use as potential "critical areas" in Land Preservation Technical Report (regional and by watershed)

New Jersey Highlands Ground Water at Risk



Source: USFS 2002 Regional Update

Water Resource Management
Water Quality Assessment

Inventory Existing Ground and Surface Water Quality

- **Compile available surface and ground water quality data**
- **Parameters may include physical property, major/minor inorganics, nutrients, biological, organics, radiochemicals and sediment data**
- **Sort data and summarize statistics by HUC 14 watersheds**

Water Resource Management
Water Quality Assessment

Septic Density and Nitrate Dilution Assessment

- **Evaluate existing nitrate loadings in ground water**
  - **Compile available surface and ground water nitrates data, summarize and assess statistics**
- **Characterize background nitrate loadings based on land use association**
  - **Relate LULC to known Highlands nitrate levels through regression analysis to determine what factors best explain variations in nitrate levels**
  - **Use regression correlations to estimate current nitrate levels in ground water for subwatersheds lacking data**

Water Resource Management
Water Quality Assessment

Septic Density and Nitrate Dilution Assessment (cont)

- **Nitrate Dilution Modeling**
  - Run NJGS nitrate dilution (Trela-Douglas) model for HUC14/HUC 11 basins, using various recharge scenarios and nitrate target values
- **Ground Water Nitrate Dilution Assimilative Capacity**
  - Council policy decision – nitrate concentrations and recharge to use as planning thresholds for constraining septic system density
  - Do results vary sufficiently among HUC-14 units to warrant development of nitrate assimilative capacity targets for individual hydrologic units?
  - Based on Council determinations, determine nitrate dilution assimilative capacity in ground water for the Highlands

Water Resource Management
Water Quality Assessment

Septic Density and Nitrate Dilution Assessment (cont)

- **Examples of the variables used for statistical analysis of ground-water nitrate concentration in the New Jersey Highlands**

•aquifer type
•concentrations of nitrogen and phosphorus species
•distance to and number of dams
•distance to and number of roads
•distance to the nearest stream
•individual septic system density
•land slope
•length of local roads
•length of major roads
•number of solid waste landfills
•length of open interval in the well
•length of streams
•number of golf courses
•distance to and number of known contamination sites

•distance to and number of NJPDES discharge sites (ground, surface and stormwater)
•distance to and percentages of all Anderson land-use 1 and 2 categories, Land use fractions within contributing area
•1972, 1986, 1995 and 2002 land-use
•number of sewage treatment plant locations
•percent impervious surface in 1995
•population density
•site use
•soil organic percentage
•soil permeability
•water use
•well depth

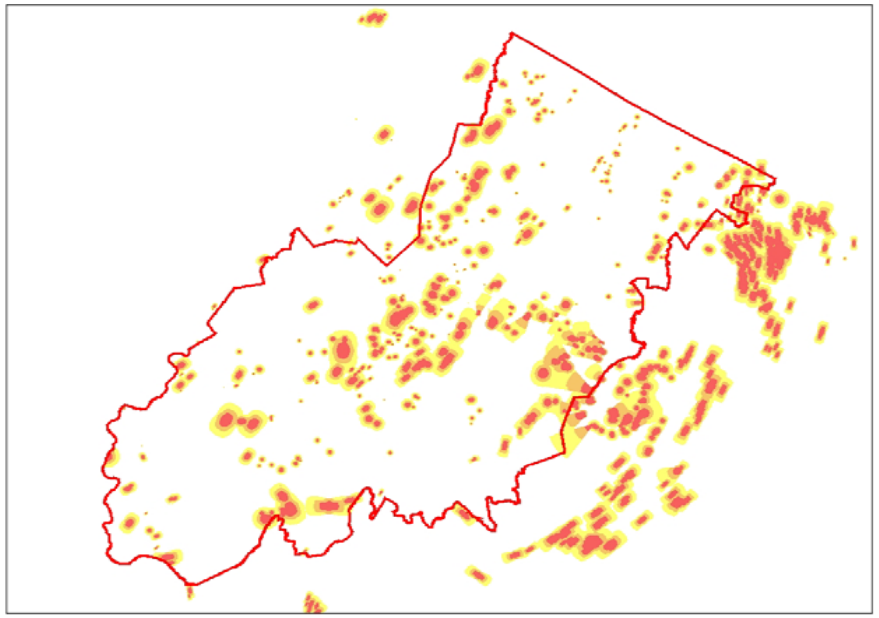
Water Resource Management
Water Quality Assessment

Wellhead Protection

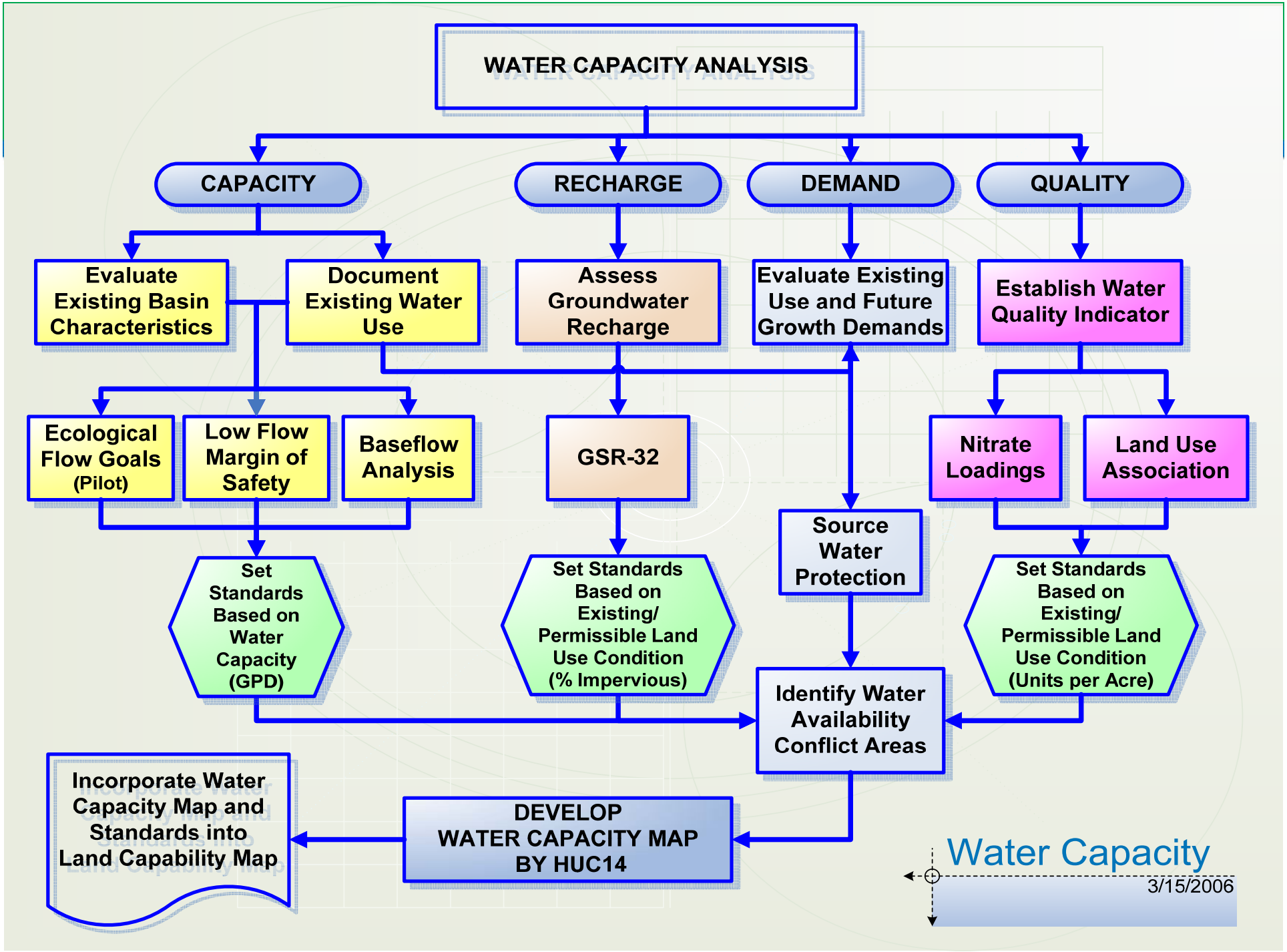
- **Identify wellhead protection areas using available NJDEP data**

Known Contaminated Areas

- **Identify known contaminated ground water areas using available NJDEP data**



New Jersey Highlands Wellhead Protection Areas


WATER CAPACITY ANALYSIS
CAPACITY
RECHARGE
DEMAND
QUALITY
Evaluate Existing Basin Characteristics
Document Existing Water Use
Assess Groundwater Recharge
Evaluate Existing Use and Future Growth Demands
Establish Water Quality Indicator
Ecological Flow Goals (Pilot)
Low Flow Margin of Safety
Baseflow Analysis
GSR-32
Nitrate Loadings
Land Use Association
Source Water Protection
Set Standards Based on Water Capacity (GPD)
Set Standards Based on Existing/ Permissible Land Use Condition (% Impervious)
Set Standards Based on Existing/ Permissible Land Use Condition (Units per Acre)
Identify Water Availability Conflict Areas
Incorporate Water Capacity Map and Standards into Land Capability Map
DEVELOP WATER CAPACITY MAP BY HUC14
Water Capacity
3/15/2006

Problem Statements
Water Resource Management

Water Resource Management

Problem Statement #1

- **Is the subwatershed-based screening approach to water resource assessment adequate to identify the most critical water resource issues for planning purposes? What other approaches can we utilize/develop to quickly improve the assessment of water resources and develop a water resource management strategy that addresses water supply, ecological, recreational and other critical, and sometimes competing, water concerns over time?**

Water Resource Management

Problem Statement #2

- **Are there other measures/methods beyond those included to date that could be used to help determine water capacity taking both the need for potable water supply and ecological integrity into account?**

Problem Statement #3

- **What land use management approaches are appropriate and feasible for ensuring that water uses remain within acceptable levels (as defined through the water capacity analysis?**

Water Resource Management

Problem Statement #4

- **What indicators and systems are appropriate to measure and assess progress toward meeting water budget and water quality objectives?**

Problem Statement #5

- **What are useful methods for understanding the relationship between land use management and other implementation strategies to protect critical water and water-related resources and environmental change?**