USGS National Water Census

Coastal Carolinas Water Availability Study

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What is the USGS National Water Census?

Part of the Initiative
Our objective for the National Water Census

To place technical information and tools in the hands of stakeholders, allowing them to answer questions they face about water availability:

- Does the Nation have enough freshwater to meet both human and ecological needs?
- Will this water be present to meet future needs?

SECURE Water Act
Public Law 111-11, § 9507 and 9508
Water Withdrawals by Category, 2010

- **Livestock**: 1 percent
- **Self-Supplied Domestic**: 1 percent
- **Public Supply**: 12 percent
- **Thermoelectric Power**: 45 percent
- **Mining**: 4 percent
- **Aquaculture**: 3 percent
- **Self-Supplied Industrial**: 33 percent
- **Irrigation**: 1 percent

*Note: The category 'Self-Supplied Industrial' includes 'Livestock', 'Mineral', 'Aquaculture', and 'Public Supply' in its calculation.*
Population and Total Withdrawals
1950-2010

Billion gallons per day, BGD
Water Use Trends

• Total water withdrawals in 2010 were 355 billion gallons per day or 13% less than in 2005.

• Total population in 2010 was 313 million or 4% more than in 2005.

• This is the largest percent decline in water withdrawals nationally since we have maintained records.

• In 2010, water withdrawals reached a level not previously seen since 1970.

• All categories of use declined in water withdrawals, except for mining and aquaculture, which saw increases of 40% and 7%, respectively.
Focused Water Availability Assessments

- Water Use
- Eco Flows
- Water Quality
- Global Change
- Groundwater Resources
- Surface Water Trends, Precipitation, etc
- State, Local, Regional Stakeholder Involvement
- Defined Technical Questions to be Answered
Coastal Carolinas Focus Area Study

- Ongoing/projected population increases in this land limited coastal region = higher population density and sharper interface between fresh and saltwater ecosystems.

- Frequent Droughts/Hurricanes

- Groundwater Capacity-use Area

- Sea-level rise, land-use change and climate change will impact aquifer water levels and frequency, duration and magnitude of streamflow and salinity intrusion near water-supply intakes.
Why Coastal Carolinas?

GENERAL ASSEMBLY OF NORTH CAROLINA
SESSION 2015

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HOUSE DRH20059-MH-78 (03/09)

Short Title: Cape Fear Water Resources Availability Study. (Public)

Sponsors: Representatives Catlin, Szoka, and Glazer (Primary Sponsors).

Referred to:

1 2 3 4 5
AN ACT TO REQUIRE THE ENVIRONMENTAL RESOURCES COMMISSION TO
CONDUCT A STUDY OF WATER RESOURCES AVAILABILITY IN THE CAPE
FEAR RIVER BASIN.

The General Assembly of North Carolina enacts:

SECTION 1. The Environmental Review Commission, with the assistance of the
Department of Environment and Natural Resources, shall study the aggregate uses of
groundwater and surface water in or affecting the Cape Fear River Basin by all users,
including, but not limited to, public water systems, industrial facilities, and agricultural
operations. The study will include all of the following elements: (i) a summary of the current
and 50-year projected water-use demands along with the available water supplies for those
portions of Alamance, Bladen, Brunswick, Caswell, Chatham, Columbus, Cumberland, Duplin,
Dunham, Guilford, Harnett, Hoke, Lee, Moore, New Hanover, Onslow, Orange, Pender,
Randolph, Richmond, Robeson, Rockingham, Sampson, Scotland, and Wake counties within
the Cape Fear River Basin; (ii) an evaluation of the adequacy of currently available supplies to
meet the expected long-range needs for all water demands, including the identification of those
areas of the basin that do not have a sustainable long-term water supply for the anticipated
growth of that area; (iii) the identification of potential conflicts among the various users and
recommendations for developing and enhancing coordination among users and groups of users
in order to avoid or minimize those conflicts; and (iv) an enhanced review of the portions of the
Cape Fear River Basin within Brunswick, New Hanover, and Pender Counties addressing the
increased demands on groundwater and limited surface water options in that area.

The findings of the study will be included within the Department's Cape Fear River
Basin Plan. All the information and any analytical tools, such as models, employed in the
conduct of the study will be made available electronically for public review and use from the
Web site of the Department's Division of Water Resources.

The Environmental Review Commission may submit an interim report to the 2016
Regular Session of the 2015 General Assembly and shall submit a final report of its findings
and recommendations, including any legislative proposals, to the 2017 General Assembly.

SECTION 2. This act is effective when it becomes law.
Objectives and Scope

• Develop water-use estimates at HUC-10 scale and refine estimates for agriculture, public supply and industrial sectors.
  • Build site-specific water-use data in SWUDS to support the tracking of water from source, to user, to disposal, both within and out of the study area

• Surface-water models to evaluate potential changes in water availability and salinity in response to various water-use and climate change scenarios

• Ecological (fish and invertebrate) response models to alterations in flow

• Groundwater flow model of surficial and deeper water-supply aquifers to simulate impacts of ET and water-use scenarios and susceptibility of saltwater encroachment and leakage from pumping
Conceptual Design

Stressors

INPUTS

Climate (Precip, ET, Temp., etc)
Existing Data (Q, WLS, QW, Water Use)
Population Change/Water Withdrawal Scenarios
Land Use Data

Groundwater Model (MODFLOW/SEAWAT)
Surface-Water/QW Models (HSPF/SWAT, Empirical Models)

Database of Simulated Groundwater Levels and Quality
Database of Simulated Streamflow and Salinity Conditions

Groundwater Decision Support System/User Interface
Streamflow/Salinity Decision Support System/User Interface (PRISM-2+)

Ecological response models
See figure 4 for details of ecological modeling
Database of Ecological Community Change

Ecological Change Decision Support System/User Interface
ICLUS Model Results
2060

Population and Land-use Change Modeling
A surface-water model of the Cape Fear River basin will be developed to simulate watershed response to various scenarios of extreme climate events (droughts, hurricanes, etc.), climate and land-use changes and water-use.

The surface-water model will be used to simulate water level, streamflows and salinity, including potential effects of projected water-use and climate change in the study area.
1. Existing fish (TN and ACF River basins) and invertebrate (Delaware and NC) response models will be applied using community data obtained from NC and SC State biomonitoring programs to forecast community change associated with the various surface-water model scenarios.

2. Investigate the effects that implementing differing ecological flow standards (7Q10 and 80% flow-by) would have on water availability for societal purposes and on the protection of fish and invertebrates during drought.
Groundwater Flow Modeling

The groundwater flow model will be developed to:

- Simulate results of historic and future stresses on the groundwater system in the coastal areas;
- Simulate and evaluate impacts of ET and various water-use scenarios in the study area on groundwater/surface-water interactions;
- Create hypothetical scenarios that will predict future water-level and salinity conditions in the aquifers.
Potential Saltwater Intrusion Groundwater Modeling Effort

• Could add the ability to simulate saltwater movement into the groundwater flow model.

• Localized saltwater intrusion models would be extracted from the larger groundwater flow model and focus on coastal areas with existing or potential saltwater intrusion and upconing issues.

• Although the saltwater modeling effort does not fall within the current project scope, due to limited time and funding, the work being done creates an opportunity to find additional funding partners to study the saltwater issues of the region at significantly reduced costs.
Groundwater Modeling Benefits

• The models will be a tool that can be used to manage the groundwater resources of the region.

• The model can be used optimize well fields pumping to potentially minimize water level drawdowns and saltwater movement.

• Allow water suppliers to be proactive to potential problems that may arise with the future development of new supply wells or alternative well pumping schedules.
Proposed Decision Support Systems

- DSSs for Streamflow, Ecological and Aquifer response to water- and land-use scenarios from a range of population growth projections and climate/sea-level rise scenarios:

- DSSs and user interfaces could allow users to retrieve predictions based on a predefined library of modeled water-use, ecological-flow requirement, and(or) climate change/sea-level rise scenarios.
Expected Results of the FAS:

- More refined and representative water-use estimates at the HUC-10 or -12 levels from pts of diversion or withdrawal

- More accurate assessment of effect of consumptive water demands (ET) on water availability, leveraging remote-sensing work of Water Census topical study

- Modeling Tools and Alternative Water-Use Scenarios
  - Surface-water and Salinity models;
  - Ecological response models; and
  - Groundwater flow and salt-water intrusion models;
Questions/Discussion