

## WRRI Priority Research Areas for FY 2010-2011

*The Water Resources Research Institute (WRRI) has established the following priorities for Institute supported research for the fiscal year 2010-2011 based on input from the WRRI Advisory Committee. In evaluating proposals, priority will be given to proposals that address these topics. However, all proposals that address water issues and problems in North Carolina will be considered.*

### A. Water Availability, Use and Climate Interaction

#### 1. **Water supply and demand:**

- Investigate potential effects of climate change on both supply and demand for water.
- Study barriers to increasing onsite water storage capacity.
- Determine feasibility of small scale aquifer storage and recovery systems.
- Determine the feasibility for regionalized water treatment and distribution for small water treatment systems and optimal scales at each level.

#### 2. **Conservation measures:** Determine effectiveness of conservation measures, including measures that improve the long-term efficiency of water use and measures that reduce demand during droughts.

#### 3. **Climate forecasts:** Determine climate forecasts to improve water management during droughts, including environmental instream flow determination and modeling.

#### 4. **Water collection and reuse:**

- Determine water quality benefits of cisterns and the public health concerns associated with using cistern water on vegetation for direct human consumption.
- Evaluate quality of gray water and harvested rainwater that has potential for reuse.
- Evaluate the cost and other factors affecting alternative approaches to reuse.
- Evaluate feasibility of dual potable water systems: one larger pipe for industry/fire water and a second smaller pipe treated to the highest level of drinking water quality.

### B. Drinking Water Quality

#### 1. **Contaminant screening:** Evaluate current and new techniques to screen drinking water regulated contaminants and other contaminants of special concern upstream of water intakes and downstream of wastewater discharges.

#### 2. **Compliance with drinking water standards:** Evaluate how water suppliers can most effectively comply with regulations for disinfection by-products (including nitrogenous DBPs) and other difficult-to-comply parameters.

#### 3. **Heavy metals:** Evaluate factors affecting lead, copper and other metals in household plumbing.

#### 4. **Groundwater quality and safety:** Evaluate criteria for groundwater standards, groundwater aquifer storage and recovery systems; groundwater safety for individual homes and small public systems with special attention to arsenic and radon.

**C. Surface Water Quality Management**

1. **Chlorophyll  $\alpha$  standard:** Evaluate alternatives to the use of chlorophyll  $\alpha$  standard as a water quality indicator.
2. **Nutrient balance in watersheds:**
  - Determine nitrogen sources, fate and transport, assess changes over time in loading, and assess time-scale of response to changes.
  - Determine the hydrological influences on nutrient cycling, including influence of hydromodification.
  - Determine and quantify relative-source contribution of atmospheric deposition of nitrogen on loading (urban, suburban, and rural).
  - Evaluate identification techniques of surface water impairment sources or stressors on 303(d) list.
3. **Improved effectiveness of water quality monitoring across North Carolina:** More effective monitoring is needed for permitting, modeling use support, and assessment of trends. Determine frequency of sampling in relation to environmental indicators, and fate and transport of important pollutants.
4. **Economic value and assessment:**
  - Determine economic and feasibility assessment of water quality and remote environmental monitoring programs.
  - Determine the economic value of water quality to the state of North Carolina and its communities including next steps in establishing tools that allow full estimation of the monetized economic benefits of restoring a given nutrient-impaired water.
5. **Agricultural impacts:**
  - Determine water quality impacts (nutrients, fecal coliform, pharmaceuticals, etc.) of concentrated animal feeding operations (CAFOs), land application of animal waste, pasture operations, municipal biosolids, organic farming, and livestock mortality disposal options.
  - Determine effect of spray operations on runoff of nutrients. Improved management strategies to decrease nutrient transport from sprayfields.
  - Quantify unit-area mass loading rates to surface waters of nitrogen and phosphorus from different management scenarios of grazed livestock land use. Address the relative deliveries of: open-access minimal management; exclusion fencing; excluded buffers; and managed/rotational grazing.
  - Agricultural best management practices (BMPs):
    - Determine water quality benefits associated with controlled drainage technologies for tile drain systems in nutrient sensitive watersheds.
    - Quantify the water quality benefits of pasture BMPs in nutrient sensitive watersheds.
6. **Local government nutrient management:** Evaluate nitrogen and phosphorus mass loading reduction effectiveness and cost-effectiveness of programmatic local government management measures applied to existing developed lands—(improved) street sweeping; pet waste ordinances; fertilizer application ordinances.
7. **Nitrogen loading comparisons:** Use quantitative statistical comparison of nitrogen loading to streams in developed residential settings to compare development that uses conventional onsite wastewater and development that uses central sewer in the Piedmont and Coastal Plain physiographic settings.

#### **D. Urbanization Impacts on Water Quality**

1. **Stormwater management:** Evaluate how well stormwater best management practices (BMPs) and management strategies protect downstream water quantity and quality at the watershed scale. Evaluate performance of practices for addressing coastal stormwater discharges. Evaluate the barriers to stormwater retrofits and off-stream management for water quality.
2. **Low impact development (LID):**
  - Determine which LID techniques work best in North Carolina coastal, piedmont and mountain regions to minimize development impacts to watersheds.
  - Evaluate how the use of LID could affect the hydrology of a watershed as compared to our present "detention-based" program would be more desirable. Develop recommendations on the most appropriate design storm(s) or other hydrologic standard(s) for use in applying the LID framework in the physiographic regions of NC.
3. **BMPs in the mountain physiographic region:** Since Western North Carolina has 80 percent of the state's high quality waters and trout streams it is important to measure the effectiveness and performance of BMPs for both erosion and sediment control and stormwater.
  - Evaluate effectiveness and performance of erosion and sediment control BMPs and buffer widths as associated with slope.
  - Identify adaptations needed for post-construction stormwater BMPs to effectively protect water quality, and recommendations on best mountain stormwater BMPs. Evaluate minimum widths of riparian buffers and determine vegetative types needed to protect water quality, maintain stable banks, trap sediment, and process nutrients.

#### **E. Aquatic Ecosystem Functions and Instream Flow Needs**

1. Review and test methods for evaluating environmental instream flow needs to determine a simple, effective approach for North Carolina waters. How can results from site-specific Instream Flow Incremental Methodology (IFIM) studies be extrapolated for river basin water allocation purposes?
2. Evaluate methods to incorporate the surface water/groundwater interaction into river basin water allocation models.
3. Evaluate environmental instream flow and wetland functional assessment approaches.
4. Develop effective approaches to aquatic ecosystem restoration.
5. Evaluate needs for protection of rare and endangered aquatic species in North Carolina streams.
6. What are the key measures for the aquatic ecology of a reservoir?

## F. Waste Management

### 1. **Biosolids disposal:**

- Determine alternative uses and markets for biosolids generated from wastewater.
- How should municipal biosolids and septage be considered in nutrient sensitive water (NSW) strategies?
- Quantify the water quality impacts of biosolids and septage application at municipal and agricultural sites for NSW strategies.
- Evaluate if "emerging contaminants" may be leaching into water table aquifer at biosolids application fields. Assess the utilization rates of biosolids by various crops to help develop comprehensive land application rates that will not result in groundwater contamination under land application fields.

### 2. **Fogs, oils and greases (FOGs):** Investigate factors leading to sanitary sewer overflows, including disposal of FOGs.

### 3. **Waste and energy:** Determine generation of power during wastewater treatment process.

## G. Groundwater

### 1. **Shallow groundwater:** Determine the relationship between the Coastal Plain's surficial aquifers, surface water, and the first confined aquifer. Determine the relationship between the transfer of contaminants and waste discharges from land and surface waters to surficial aquifers and vice versa.

### 2. **Naturally occurring chemicals:** Compile latitude and longitude coordinates and well and water depth of areas that have naturally occurring chemicals in soil that affect groundwater. Working with US Geological Survey datasets would be useful.

### 3. **Residual agricultural chemicals:** Examine the occurrence of nutrients and pesticides in wells where former agricultural fields have been converted to housing developments. Determine/Predict areas of North Carolina and conditions under which such contamination may occur.

### 4. **Geochemical conditions:** Examine the geochemical conditions under which adverse reactions will occur due to aquifer storage and recovery, or the range of combinations of injected water quality, native water quality, aquifer geochemistry, and storage/recovery times that should have minimal adverse reactions. Mobilization of arsenic is of primary concern.

### 5. **Concentrated animal feeding operations (CAFOs):** Assess impacts of CAFOs on groundwater quality.