NC State University
College of Agriculture and Life Sciences:

Water for a Growing World

Facilitated Session Report

North Carolina State University

November 2, 2015

Developed by:
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***Water for a Growing World* Forum**
An Overview

Purpose and Outcome: The College of Agriculture and Life Sciences at NC State University hosted its annual Stewards of the Future event on November 2, 2015, titled ***Water for a Growing World***. The Forum provided state, national, and international level perspectives about the challenges and solutions pertaining to water quantity and water quality. During the November 2 event, participants explored how to ensure water resiliency for North Carolina and a growing world (Appendix A: Conference Agenda, pg. 8).

Audience: The approximately 400 attendees included scientists, researchers, extension professionals, non-profit professionals, ag and natural resource professionals, the sponsors, the planning committee, and discussion leaders (Appendix B: Facilitation Team, pg. 9).

Facilitated Session: During the afternoon portion of the agenda, a percentage of conference attendees formed small discussion groups facilitated by volunteers. Initially, participants were asked to introduced themselves. Following an abbreviated introduction, three questions were introduced one at a time. This provided the participants time to reflect on the question being presented as well as time to share their individual responses. The participants' responses were gathered using MeetingSphere, an online collaborative software. The individual responses were then used to develop this report, which revealed an array of perspectives generated by conference attendees. The facilitated session:

1. allowed participants time to share their individual perspectives,
2. provided space to surface a range of perspectives, and
3. fostered awareness about the similarities and differences others contemplate when thinking about ways to ensure ample water quantity and protection of water quality.

The following three questions were asked of the participants:

Questions for Small Discussion Groups

Question #1:
What Did We Learn?

What did you discover or learn as a result of your participation in the ***Water for a Growing World*** Forum*?*

Question #2:
How Do We Ensure Ample Water Quantity?

a) What is the number one **challenge** that must be addressed to ensure ample water quantity?
b) What are key **solutions** to ensuring ample water quantity?
c) What **actions** will you and/or your organization take to ensure ample water quantity?

Question #3:
How Do We Protect Water Quality?

a) What is the number one **challenge** that must be addressed to protect water quality?
b) What are key **solutions** to protect water quality?
c) What **actions** will you and/or your organization take to protect water quality?

Discovery and Learning

Question #1:
What Did We Learn?

What did you discover or learn as a result of your participation in the *Water for a Growing World* Forum?

The participants were asked to describe what they had discovered or learned as a result of their participation in the ***Water for a Growing World*** Forum. As a result of the participants' responses, five major topic areas (with accompanying sub-themes) were developed.

1. Water Availability/Supply and Distribution/Use
2. Water Quality is Linked to Water Quantity
3. Governance and Stakeholder Networking/Capacity Building
4. Advancement in Technologies
5. Cultivate and Improve Water Management Strategies

As expected, an increase in knowledge, including confirming, updating and/or refreshing existing knowledge, ensued for some of the attendees as a result of their participation in the Forum. Several spoke about the value of the Forum as a link between the challenges of water quality, water quantity, and agricultural and ecological aspects of ***Water for a Growing World.*** Furthermore, participants interested in current research efforts were able to develop awareness about previous or ongoing efforts. As one attendee offered, *"I had a chance to talk with students and faculty involved in various research projects. Educating our youth is of utmost importance as well as protecting our environment."* Or, as another expressed, *"NC is not generally recognized as a drought prone region, this shows the effort and impact that early education can have on the population into the future."*

In conjunction with learning about previous and current research efforts, attendees also gained knowledge about various technologies in use or being developed by industry and/or academe in response to water related issues. As one person expressed, *"We need to share good information that is researched and science based. Events such as this are essential."*

Participants also shared their concerns about the challenges and complexities of managing for water quality and water quantity. As several individuals expressed, "*Water shortages are real and this is drawing a lot of attention from different groups."* Another stated, "*The spectrum of work on water quality is broad, which is exciting, but it creates challenges to holistic solutions."* Several participants stated

that the pressing challenges are being exacerbated by population growth and climate change, which impacts food production and the quality of the environment.

What participants clearly and unequivocally revealed was there is an appreciation and continued call for cooperative planning strategies across academe, industry, conservation, agriculture, agencies and organizations, and individual communities with respect to water related issues. As one person offered, "*Many issues [related to water availability and quality] have a very similar basis and a variety of perspectives can help clear misconceptions about how these problems should be addressed.*"

Please reference Appendix C (pgs. 10-16) for the categorized sections of individual responses received.

Ensure Ample Water Quantity

Question #2:
How Do We Ensure Ample Water Quantity?

a) What is the number one **challenge** that must be addressed to ensure ample water quantity?
b) What are key **solutions** to ensuring ample water quantity?
c) What **actions** will you and/or your organization take to ensure ample water quantity?

As a result of the participants' responses, six major challenges were identified as the most pressing issues to address in order to ensure ample water quantity:

1. Conduct Inventory, Analysis, and Accounting of Water Quantity Use and Demands
2. Increase Stakeholder Coordination
3. Increase Integrative and Long-term Planning Initiatives
4. Cultivate and Improve Water Management Strategies
5. Improve Applications of Governance
6. Create a Culture of Responsible Water Users in All Sectors

The potential or proposed solutions the participants described are included in the six corresponding sections.

In addition, seven major topics were identified as a result of the participants' responses, categorizing the actions individuals and/or their organizations planned to take to ensure ample water quantity:

1. Conduct Inventory, Analysis, and Accounting of Water Quantity Use and Demands
2. Increase Stakeholder Coordination
3. Increase Integrative Long-term Planning Efforts
4. Cultivate and Improve Water Management Strategies
5. Improve Applications of Governance
6. Advance and Invest in Research
7. Create a Culture of Responsible Water Users in All Sectors

Please reference Appendix D (pgs. 17-28) for the categorized sections of individual responses received.

Protect Water Quality

Question #3:
How Do We Protect Water Quality?

a) What is the number one **challenge** that must be addressed to protect water quality?
b) What are key **solutions** to protect water quality?
c) What **actions** will you and/or your organization take to protect water quality?

As a result of the participants' responses, six major challenges were identified as the most pressing issues to address in order to protect water quality:

1. Source of Water Pollution and Contamination
2. Water Management Strategies for Pollution Control
3. Build Collaboration Across Agencies and Organizations
4. Economics of Water and New Treatments
5. Realistic Public Expectations and Accountability
6. Developing Outreach and Education Upstream and Downstream

The potential or proposed solutions the participants described are included in the six corresponding sections.

In addition, six major topics were identified as a result of the participants' responses, categorizing the actions individuals and/or their organizations planned to take to protect water quality:

1. Control Water Pollution and Contamination
2. Promote Water Management Strategies

3. Collaboration and Engagement Across Stakeholder Groups
4. Advance Science, Research, Technologies, and Monitoring
5. Increase Funding Opportunities
6. Expand Outreach and Education to Specific Audiences

Please reference Appendix E (pgs. 29-42) for the categorized sections of individual responses received.

Appendix A: *Water for a Growing World* Agenda

8:00-9:00	Registration & Innovation Fair
9:00-9:15	Welcome - Dean Linton
9:15-10:15	*Chasing Water in a Rapidly Changing World*
10:15-10:45	Break & Innovation Fair
10:45-11:30	*North Carolina Water Issues*
11:30-12:30	Innovation in Action: Ensuring a Water Future: Partner Presentations
12:30-1:30	Lunch
1:30-2:15	Chancellor's Welcome Back
2:15-3:00	Case Study from a North Carolina River Basin: The Neuse
3:00-3:30	Break & Innovation Fair
3:30-3:50	*Water: A Farmer's Perspective*
3:50-4:50	Engagement Forum – Facilitated Discussion Groups
4:50-5:00	Close by Dean Linton (including announcement of winners)
5:00	Reception + Innovation Fair

Appendix B: *Water for a Growing World* Facilitation Team

The facilitation session was developed and managed by Dr. Mary Lou Addor of NC State Extension (project lead), Larry Roberts of Roberts Business Group, and Peter Beck and Mick Blasik of MeetingSphere.

We want to thank the volunteer facilitation team from multiple organizations throughout North Carolina:

Eastern Carolina University - Wendy Klein

Eastern Research Group - Denise Bevington

Dragonfly Resources - Dianne Reid

Gonzalez Resources - Grizel Gonzalez-Jeuck

NC Foundation for Soil & Water Conservation - Michelle Lovejoy

NC State College of Ag and Life Sciences
1. Mary Pershing
2. Shelby Rajkovich
3. Bryan Maxwell
4. Laura Merriman
5. Tiffany Messer
6. Jack-Kurki Fox
7. Karen Hall
8. Caela O'Connell
9. Smriti Pehim Limbu
10. Joseph Taylor

NC State Cooperative Extension Service
1. Spring Williams-Byrd – Burke County Extension Director
2. Diana Rashash – Extension Area Specialized Agent - Water Quality/Waste Mgt.
3. Donna Rewalt – Durham County Extension Community Specialist
4. Cameron Lowe – Currituck County Extension Director
5. Robbie Furr – Cabarrus County Extension Director
6. Wendy M. Patoprsty – Watauga County Extension Agent
7. Bill Lord – Franklin County Extension Agent
8. Kit Sanders – Harnett County Extension Agent
9. Eric Caldwell – West District Extension Director

Triangle Environmental Consulting - Gibbs Smith

Appendix C: What Did I Learn or Discover?

The participants were asked to describe what they had discovered or learned as a result of their participation in the ***Water for a Growing World*** Forum. Their responses revealed 5 major topic areas:

1. Water Availability/Supply and Distribution/Use
2. Water Quality is Linked to Water Quantity
3. Governance and Stakeholder Networking/Capacity Building
4. Advancement in Technologies
5. Cultivate and Improve Water Management Strategies

Each category and its respective subcategories are detailed below.

1. Water Availability/Supply and Distribution/Use

Scale of Water Availability/Supply Issues* & *Distribution/Use

- Water shortages worldwide.
  - Water shortages are not confined to dry areas.
  - Water supply/availability is biggest global issue.
  - There is a precarious supply of clean water on our planet.
  - Demand is far outpacing our supply of clean water.
  - Worldwide shortage of water – identify regions suffering the most.
  - Status of global water shortages, and the alarm point when we can be aware of impending problem.
  - Water is being depleted in so many areas of the world; a cause for great concern.
  - How susceptible are societal perceptions to year-to-year variations in water supply (replenishment).
- Dynamics which shape the local regional or global water issues are complicated.
  - Confirmation of the dramatic water-removal issue from the Colorado River where demand far outpaces a supply of clean water.
  - Learning about examples from other areas of the US (ex: San Diego's various water supply initiatives).
  - Water Use and Management is a critically important and diverse issue.
  - Number of issues that provide opportunities for collaboration regarding water quality as well as water utilization.
  - Distribution is probably a larger issue than quantity.
  - Learned about increasingly costly water supply alternatives as we move away from more "low hanging fruits".
  - Outraged by our export of water to Saudi Arabia through alfalfa, while meanwhile we import oil. This pales in comparison to our other exports of water. We price water way too low, and thus externalize its costs.
  - In water scarce regions, >90% of consumptive water use is from irrigated agriculture. These scarce regions also produce 40% of the global food supply.
- Awareness about the various issues facing North Carolina.
  - Facing concerns of water management and the need to provide newer water resources.
  - Even in a state with ample water supplies there are still quantity and quality issues to be addressed.

Challenges to Availability/Supply & Distribution/Use

- Tremendous amount of water used in other parts of the world.
- Inequality in water availability and access.
- Population growth is exacerbating water related issues.
- Climate Change
  - Climate change is exacerbating the problem [of water quantity and quality]. Aware of the many negative impacts that climate change can cause but had not considered the effects it would have on water related issues.
  - Climate is influencing nutrient levels in our water.
  - Some of the major water crisis around the world due to climate change.
  - It isn't all about climate change.

2. Water Quality is Linked to Water Quantity

Intricately Linked to Quantity

- Water quality matters every bit as much as water quality. Many factors affect both and it's a complex problem.
- Need to learn much more about what can be done to protect these water resources.
- Much work to do in respect to water quality.
- Balancing of water quantity demands is very complicated.
- Importance of water (clean water) conflicts that may/can occur to have clean water.

Improvements Result in Benefits

- Learned one can put chemicals in a simulated stream and see a huge difference in the water quality.
- Improvements in Falls Lake water quality is estimated to have 50-200 million/yr. of economic benefit. That is not appreciated by all decision makers.
- BASF is developing and using ultrafiltration membranes to produce virus + microorganism free water.

Challenges Impacting Water Quality

- Animal agriculture is viewed as "one of" if not the major cause of water quality issues.
- Need for clean water is growing faster than the supply.
- Population growth is exacerbating water related issues.
- Climate Change
  - Climate change is exacerbating the problem [of water quantity and quality]. Aware of the many negative impacts that climate change can cause but had not considered the effects it would have on water related issues.
  - Climate is influencing nutrient levels in our water.
  - Some of the major water crisis around the world due to climate change.
  - It isn't all about climate change.

3. Governance and Stakeholder Networking/Capacity Building

Call for Ongoing Collaborative Efforts

- Need for collaboration across sectors.
- These issues impact many stakeholders in different ways.
- Water is a controversial issue; will take everyone working together to achieve goals.

- Water use and management is a critically important and diverse issue. Solving the challenges will involve a strong network of stakeholders working together.
- There are numerous stakeholders involved in water quality from industry to academia, government, and conservation organizations, all who may have somewhat different perspectives on water quality issues. But they are willing to talk in meetings like this to find some common solutions. Communication is key!
- A joint effort between agriculture, municipalities, consumers and government to continue to improve quality of water.
- If we don't share solutions and think together, all will thirst and starve together.
- Need for collaborative efforts.
- Still have a long way to go in working collaboratively across stakeholder groups to solve these complex problems.
- More confirmation than learning, but challenges to both water quantity and water quality need to be resolved by various groups with conflicting agendas.
- Water is a complex area with multiple stakeholders.
- Though some friction and finger-pointing between urban and ag, it didn't seem as bad as it was 15 years ago (at least in this Forum).
- To effectively address the challenge of H2O, particularly in policy, we (all aspects) need to come together as partners to develop a multi probed solution - it is really complex!
- Need for working together with a large range of stakeholders to come to a solution.
- Many sectors (agriculture, municipalities, etc.) will have to work together to solve future water issues.
- Need to work together with cities, families, and homeowners to protect water quality.

Look to Ongoing Cooperative and Partnership Strategies

- Impressed with the various methodologies being used to tackle the problems, including cooperation of academia and growers.
- Heard an interesting update on the Neuse River; a seed of potential "grassroots collaborative". Revisit the effort.
- Interdisciplinary and inter-sector perspective on Neuse Estuary/history/results.
- Much work being done to improve water use in agriculture and protect water quality.
- Unaware of the many private industry initiatives that address water use and quality issues.
- All segments (agriculture, municipalities, industry) are cooperating in finding solutions to clean water.
- Especially interested in water rights and incentivization between municipalities of cities and rural areas.
- Coming from an environmental perspective it was very helpful to hear about other stakeholder interests.

Challenges to Collaborative Efforts

- Many different cooperative strategies have been on going in terms of water quality and quantity. But it seems to be difficult to make progress and maintain that progress given diverse stakeholder use and demographic changes.
- There is a lot of dialogue among various stakeholders around water issues, but still a lack of understanding.
- Emphasis on how water is fast becoming one of the most important concerns for our planet. Unless our governments, citizens and entire populations face this dilemma, wars might result based on water.
- Probably lack the will to make the hard decisions and sacrifices to live sustainably.
- Basic need for all parties to have access to the same (current) data and information on environmental implementation and policy.

- Focus is on cities and farmers and not others.
- Prospect of solving the problems ahead of us is at the same time challenging and overwhelming.
- Starting with the first keynote speaker and then through the panel discussion, it is clear that the tension between agriculture, local government/municipalities and other stakeholders is going to be a challenge for NC in facing water quality/quantity issues.
- Future of water resources is impacted and needs to be addressed by a variety of stakeholders. When you operate in a "zone" it is easy to forget on a day to day basis how many players there are outside one's industry or area of concentration.

Understand Challenges Facing Policy Makers

- Forum reinforced the diversity and complexity of issues facing managers and policy makers/users regarding water quality and quantity, especially with the uncertainty of climate change.
- Became familiar with regulations, users, and technologies in relation to quantity and quality of water in NC.
- Major segments of the water consuming population are not paying needed attention to this alarming situation.
- Some key speakers need to update their facts, lots of discussions about cooperation but still need to address the political constraints and how to make change.

4. Advancement in Technologies

Coordination of Technologies

- Alot of good technology is being developed, but it will have to be brought together for the good of all as there is no one solution to the problem.
- Main challenge is not so much technology as it is good management of the technology.
- Sharing technologies can create challenges.
- Little discussion around applied technologies.

Overview of Technologies in Use or Being Developed

- Very interesting to learn what companies are doing to advance Ag tech, bio tech, other research.
- Promise of technological advancements in Ag sector.
- Sensor systems in agriculture are quite well developed. Drought resistant soybeans might have a huge potential in the future.
- Drought beans, tolerant soybeans.
- Learned agriculture industry has improved their technology to help conserve water.
- New appreciation for advances in agricultural water conservation!
- Numerous technologies available to improve nutrient management and to increase water efficiency.
- Very intriguing to have some of the tools presented that are being offered into the growing systems. John Deere, BASF, BAYER, SYNGENTA, in how we can produce more with less water.
- Desalination is becoming more of an option in the western US.
- Solution options for algae blooms.
- Some information on new technologies and drought resilient soybeans from Asia.

5. Cultivate and Improve Water Management Strategies

(Water Management Tools, Regulation and Policy Strategies, Water Conservation Strategies, Nutrient Management, Inclusion of Ecological Considerations and Indicators, and Research Responding to Complexities)

Water Management Tools

- Water management is conceptually not all that difficult but practical implementation is extremely difficult.
- Water conservation is not just a regional or even a national concern, but a global concern.
- Water management tools used in field to curtail or regulate water use loads exist.
- Inventory of local water quality and quantity procedures.
- Importance of BMP for building riparian buffers for agriculture fields (BMP management practices).
- Importance of understanding, interpreting definitions and statistics around water use.
- Provide more quantification of water use that would enable trading and overall efficient water use.
- First keynote address very informative and made the point clearly about the need for focusing on water related issues spanning from water quantity to quality.
- Extraordinary efforts are being undertaken or considered for moving water long distance at great cost in China and in North America.
- Water can be shared as a regional resource.

Regulations and Policy Strategies

- Wanted much more about the regulatory basis for water issues. Breadth of Neuse River Basin impacts.
- Georgia has an agricultural withdrawal permitting program.
- There are pragmatic ways to address water policy issues.
- Storm water management is actually worse off in Neuse Basin than before rules.

Water Conservation Strategies

- Look to Current Water Conservation Efforts.
  - Case studies highlighted successful implementation of water conservation plans involving multiple stakeholder groups was very interesting.
  - Thoughts on keynote presenter - good pts to consider. Recipe for preventing water shortage 1. Set sustainable limit on water extraction 2. Reduce consumption to a sustainable level 3. Quantify rights to use available water.
  - If you have money to offer [incentives], farmers will figure out how to save water.
  - Water Trading Initiatives.
    - Encouraged to learn about partnering of water scarce districts with those who can save/trade water allocations.
    - Opportunity to trade water quality credits between point source (cities and towns) vs. non-point source (agriculture).
    - City of Raleigh really wants point to non-point trading. "We can work together." If GA can, we surely can.
- Water Trading Strategies
  - Clear need to monetize water quality and quantity.
  - Farm quantified conservation potential for agriculture in addressing water supply issues; water trading should ensure natural systems not excluded from trading considerations.

  - Although water rights trading is controversial, it appears to be an important part of future water conservation strategies.
  - Perhaps water rights trading would provide economic incentive for water management.
- Rain and Stormwater Harvesting Strategies.
  - Harvesting of storm water could close gap between supply and demand.
  - Role of storm water run-off as a key problem as yet unsolved.
- Drought Management Strategies.
  - Need to be planning today for the next drought.
  - Extent of drought in Western US aquifers not refilling enough due to excess consumption/use. Rivers are drying up. Potential impact on food.
  - Use drought tolerant plants.
- Challenges to Water Conservation Efforts
  - Water conservation is often cheaper option (limit demands) than options to increase supply. Issue isn't lack of water management technology, it's the application of it.
  - Water solutions are available but need to be implemented more broadly.
  - Much of the talks referenced the role of government in protecting these resources, but the presentations said little about what we can do voluntarily.
  - Response seems to be the result of a crisis (crisis mode).
  - Technology for water conservation (quantity and quality) is available but legislation appears to be biggest obstacle to overcome. Companies could reduce inputs in things (i.e., fertilizers) that will ultimately reduce impacts.
  - Perspectives on Irrigation
    - In water scarce regions, >90% of consumptive water use is from irrigated agriculture.
    - 40% of world's food comes from irrigated sources.
    - Agricultural water use is considered 100% consumptive.
    - Irrigated Ag consumes 90% of water in water scarce regions and 40% of food.
    - Irrigation accounts for a large consumptive use.
    - Shear demand of water irrigation for agriculture in the world.

Nutrient Management

- Site Specific Nutrient Issues
  - Neuse nitrogen loads are back to levels in 1990s (unclear why). Possible opportunity for nutrient trading to address the problem.
  - Nitrogen levels in the Neuse River Basin dropped by 30% since the adoption of the 1997 rules and then a subsequent rise of 30% has occurred.
  - Neuse River Basin plan has a mandatory 30% reduction in nitrates, users say they have met or exceeded goal, but levels in the river are still increasing.
  - N levels in the Neuse River are rising again, and it's a mystery. That Rich McLaughlin is a poet.
  - Neuse is highly regulated for nitrogen input, but seems to not address the issue.
  - Surprised to learn we are still having problems in the Neuse River Basin with nutrient management. Re-emphasize need for ongoing diligence/monitoring/action plans.
  - Nitrogen loading Neuse remains about the same despite policies and practices to reduce it.
- Nutrient Management Strategies
  - Management of nutrients in water is largest challenge facing NC; seem to be headed toward a crisis if we do no manage it well.
  - Perspectives on the utility [opportunities] of nutrient trading.

- Nutrient management in a river basin is impacted by climate and climate change.
- More work needs to be done to reduce nutrient inputs from urban storm water.
- Saturated buffer interest.
- Water trade and nitrogen trade concepts.

Inclusion of Ecological Considerations/Indicators

- Ecological impacts are early indicators of water over-allocation.
- Importance or need to keep water in the stream to protect aquatic ecosystems, specifically greater than 20% reduction will have a negative impact.
- Determine a reference point on the basis of best professional judgement for an appropriate ecological flow (ex: no reduction in normal flow patterns greater than 20%).
- Inclusive of ecological considerations.
- Opportunity for greater efficiency with less environmental impact.

Research Responding to Complexities

- Appreciation for Current Research.
  - Number of and types of research projects at NC State were more diverse than realized. Broad research at NCSU related to water quantity and water quality issues includes information regarding drought tolerant crops and extension's work with different industries.
  - NCSU is engaged in a broad range of solution based research to address water management for both water quantity and water quality. Knew about a lot of the research, but saw how many pieces connect from several different research areas.
  - Alot of interesting and promising research to help us live more sustainably!
  - My organization's investments in project funding at NCSU hits the bulls eye of critical water management strategies.
  - More research is needed!
  - Research related to fish cultures/food production, selenium pollution from coal ash and impacts on Mayflies.
- Ongoing Research Needed
  - Timelines of how we got here.
  - Need more monitoring data. The science of what's happening in H2O quality is complex. Interdisciplinary interactions are mandated to study and solve H2O issues but that is very rare.
  - Brought to light the depth to which water issues have been and continue to be investigated and addressed by both the public and private sectors.
  - Explore relative economics of approaches to address water quantity issues associated with virtual or embedded water.
  - Appears to be no or little monitoring of storm water damage.

Appendix D: How Do We Ensure Ample Water Quantity?

Appendix D is divided into two sections. The first section (pgs. 17-24) presents the most pressing challenges described by the participants who contributed to the facilitated portion of the Forum. Included in this section are the participants' recommendations or proposed solutions to ensure ample water quality.

The second section (pgs. 25-28) describes actions that the participants or their organizations plan to take to ensure ample water quantity.

A) What is the number one ***CHALLENGE*** that must be addressed to ensure ample water quantity?
B) What are key ***SOLUTIONS*** to ensuring ample water quantity?

As a result of the participants' responses, six major challenges were identified as most pressing to address in order to ensure ample water quantity:

1. Conduct Inventory, Analysis, and Accounting of Water Quantity Use and Demands
2. Increase Stakeholder Coordination
3. Increase Integrative and Long-term Planning Initiatives
4. Cultivate and Improve Water Management Strategies
5. Improve Applications of Governance
6. Create a Culture of Responsible Water Users in All Sectors

1. Conduct Inventory, Analysis, and Accounting of Water Quantity Use and Demands (Knowledge of the Footprint)

Pressing Challenges

- Better accounting and prediction models.
  - Better Models to assess use and efficiencies at all levels of use.
  - Knowing how much water is being used, where, by whom, and for what purpose. Knowing how much water there is, at what time, and where.
  - Acquire better data.
  - Realistic models of water use.
  - Define model consumption vs flow set targets and getting agreement across "consumers."
  - Accurate projections of water demands for at least 50 years in the future.
  - Accurate accounting of present water use and available water supplies.
  - Ensure all water resources are quantified.
  - Assess water usage at all levels (not returned): demands greater than resources.
  - Need to measure use, critical to managing water quantity. Very difficult to measure consumptive use in "non-point" systems.
  - Measuring how much is enough and evaluation.
  - Reduce demand in water-scarce areas.
  - Having enough clean fresh water and how to cut back on usage.

- Understanding the appropriate amount of water needed for intended use. Agriculture is a major user of water. Irrigated growers often use more than needed.
- Ensure that all water resources are quantified.
- Accurate accounting of present water use and available water supplies.
- Assigning economic (true) value to the available water supply.
- Use, efficiency, agriculture, landscape.
- Using proper quantity of water for each application.
- Smart, sustainable water use by growers.
- Get adequate information as to ATP "sustainable" conservative water use for each region/watershed.
- Changing demands: responsible use, needs vs. wants.
- Ill at ease with the concept of "ample" – embeds oxymoron in the phrase.
- Assessing the economics of treating and transporting water.
- Balance the economics of the various tiers of conservation and trade.
- Salt water intrusion due to over pumping or stressing certain aquifers on the coastal plain.

- Balancing supply management with ecological sustainability.
  - Further refinement and agreement in economic and environmental needs to better divine policy, technical and regulatory direction on where the water is allocated.
  - Combination of use of regional water sources and guaranteeing a high percentage of water withdrawn from surface waters is returned to the surface water system.
  - Variability in precipitation from year to year and from location to location with impact crop production systems.
- Realistic estimate of quantity available and then rational and fair approach to allocation.
  - Sustained management of aquifers & water supply resources.
  - Quantify water use by various major source and set sustainable limits of water use.
  - Agriculture utilizes approximately 70% of fresh water. With a projected human population of 9.6 billion in 2050 we need to produce more food with less water per calorie.
  - Allocation must be fair and sustainable. Therefore, laws and policies must be refined.
  - Who needs it most, who "owns" it.
  - Setting limits on sector use (ag. mini, etc.) in water sheds. Seeing the need to maintain in-stream flows.
- Responding to infrastructure needs.
  - Developing water supplies-competition; fix crumbling leaky infrastructure.

Proposed Solutions

- Planning/implementation processes.
  - Ability to capture run-off from big rainfall events, especially in NZC where we have rain, just not at the right times.
  - Planning future population growth and climate pressures on water supplies.
  - Practical, transparent and results driven action plans to ensure water quantities are used efficiently and wisely - systemic approach.
  - Implementing technologies, making sure users are aware of their consumption (vs. actual needs).
  - Design better low flow toilets that work!
  - Development of crops that require less water - conservation - slowing human population growth.
  - Plant breeding group exploring the development of crop varieties that require less water or that tolerate water with greater salinity.
  - Soil moisture sensors, field level actual evapotranspiration measurements to drive decisions for when and how much to irrigate.

  - Knowledge/education informed "water use policy" development; trade-offs and collaboration-better than in-fighting based on privilege.
  - Living sustainably (e.g. control growth, impact fees, etc.) setting limits to consumptive uses.
  - Sustainable use and reuse, attention and flexibility for uses of gray water, continued attention to water quality to ensure ample water quantity supply.
- Allocation structures.
  - Water extraction or withdrawals need to be limited/regulated.
  - Balanced distribution by user.
  - Reduce demand/increase efficiency, increase storage and new sources of water such as storm water and reclaimed water.
  - Matching water use and water availability.
  - Must get right balance between supply, demand, demand-side management and drought response. We need more reservoirs.
  - A portion of water conservation technologies by major water consumers (including residential technologies).
  - Water quantity regulation.
  - Understand and predict water needs for the variety of users.
  - Conflicting interests need to have a method of valuing water supply.
  - Understand true value of water.
- Monitoring processes.
  - Monitoring to obtain data for decades to come to establish base lines.
  - Limiting losses/monitor or regulate water "movement" modeling/prediction.
  - Water management technology - (moisture meter type timers for irrigation and lawn watering, for example).
  - NCDWR- capacity use program install more wells at DWR groundwater monitoring stations, collect pumping data and chlorides.

2. Increase Stakeholder Coordination

Pressing Challenges

- Over coming competition for limited resources and come up with cooperative agreements.
- Planning to manage it well.
  - Manage competing interests.
  - Recognize where resources and support are insufficient.
  - Come to a consensus with water consumption and developing fool proof technology to minimize contamination.
  - Get stakeholders together for discussions.
  - Have all contributing sectors working together to keep supply sustainable for both Ag and urban interests.
  - Conservation that stakeholders buy in to.
  - Share resources amongst interests.
- Sharing available water resources among multiple users.
- Getting all entities (homeowners, business, etc.) to understand the importance of conserving water.
- People work together and are willing to look objectively at the issue.
- Better water recycling and cooperation amongst stakeholders, regulators and scientists.
- Need all users to share their usage and needs with everyone. This includes both in-stream and off-stream needs.

Proposed Solutions

- Striving for working agreements.
  - Balancing market and regulatory policy so that all are invested in the outcome.
  - Long-range basin planning using hydrologic models; convening stakeholder groups to establish possible policies toward water permitting.
  - Advanced awareness of the need, collaboration among multiple players, stakeholders, incentives to encourage above and addressing the storm water issue.
  - Having all stakeholders involved conservation/new technologies.
  - Cooperation and implementation of entities involved in conserving water.
  - Storm water management.
  - Agreement among stakeholder all along a river basin regarding water use.
  - Engage stakeholders to make policy decisions now so we won't have problems later. Politicians don't want to do this.
  - Find ways to get stakeholders to embrace technology and cooperation.
  - Stakeholder engagement and buy in.
  - Stakeholders work together (basin/watershed/regional groups), without legislative mandate.
  - Be aware of the issues/problem and willing to work toward solutions.
- Education programs directed to stakeholders regarding water conservation with incentive rewards for meeting goals (individual family's households to corporation).
- Fund monitoring efforts and advanced technologies.
  - Water cooperatives and joint initiatives to monitor and use water.
  - Drought tolerant varieties of row crops are important/reduced tillage and cultural practices to conserve.
  - Working together to assure reduced water usage in both urban/agriculture.
  - Cooperative efforts by all parties to ensure conservation principles are followed; credits for unused that have $ value.
  - Better more innovative ways to use for agricultural production.
  - Partnerships and conservation incentives.
  - Matching REAL need with expectations. Balancing growth with physical/economic limitations. Equitable allocation.

3. Increase Integrated and Long-term Planning Initiatives

Pressing Challenges

- Lack of integrated water planning.
  - Long range plan & balance of agricultural land urban use of water. collect storm water in both urban & agricultural settings.
  - Planning to manage it well.
  - Regional planning across all sectors.
  - Focus on long-range planning.
  - Adequately monitor the sources of water and use.
  - Having enough when you need it. Managing too much water when you don't need it.
  - Education, irrigation techniques.
  - Shared used of a non-increasing resource.
- Responsiveness to future population projections.
  - Planning for future population growth.
- Responsiveness to climate change.
  - Understanding climate pressures on water supply.
  - Mitigation efforts of climate change.
  - Mitigation efforts of salt water intrusion.
- Responsiveness to development pressures.
  - Development with increased water needs in areas of less natural/water resources.

- Water is too cheap so it is taken for granted.

Proposed Solutions

- Practical, transparent, and results driven action plans to ensure water quantities are used efficiently and wisely - systemic approach.
- Better planning. Early action. When problem identified and involvement by all water users. Voluntary actions should be 1st option!
- Addressing plant, animal and consumer usage and continuing to find improvements and solutions to save water usage.
- Working Ag Water Plan update now at our organization to better assess Ag water use and water supply needs. Seeking funding for Best Management Practices.
- Manage growth compatible with available water resources.
- Make sure that area/growth can sustain with the existing and future water development projects.
- We need a natural disaster to force people to care.

4. Cultivate and Improve Water Management Strategies

Pressing Challenges

- Maximizing use of conservation strategies like reuse, recycling, and reduction.
  - Lack of support and resources to do what needs to be done to conserve and reuse water.
  - Responding to resistance to conservation "someone else can do it" (passing the buck).
  - Reducing per capita consumption particularly when unnecessary -- i.e., irrigation dependent landscaping.
  - Conservation of water is demonstrated to be the cheapest and most effective method to ensure quantity - among all options.
  - Encouraging water conservation practices at the residential, industrial and agricultural levels.
  - Water reuse.
  - Reduce human-created water pollution in areas of the world where quantity is fine, but quality prevents human use.
  - Conservation practices to prevent over use.
  - Conservation technology including during times of ample supply.
  - Not wasting water, using wetlands to conserve water.
  - Lack of awareness-many people take it for granted that they will turn on the faucet and water will always flow out.
  - Conservation is the biggest challenge. This really can be translated to more efficient use of water and dedicated supply sources.
  - Controlling demand and making difficult lifestyle changes to live more sustainably as communities and globally.
  - Decreased consumption across all sectors of society and by individuals - agriculture - industry - personal consumption habits.
  - Conservation in agricultural and urban areas.
  - Water quantity challenges must be addressed by conservation efforts.
- Monitoring of aquifers, water use, run-off, and minimizing contamination. Balancing supply management with ecological considerations.
  - Cooperation amongst stakeholders needs to continue combined with a holistic view of the basic in question.
- Innovative application in efficiencies and use.
  - From a farming perspective; how can farmers better reuse the water they use?
  - Elevate possibilities for ground water re-charge and surface water retention.

  - Increased water use efficiency as populations and demand for food grows.
  - With energy production.
  - With climate change implications.
  - Drought management strategies.
  - Avoid pollution to ensure ample water.
  - Growing population and increased irrigation demand for residential and agricultural.
  - Being as efficient as possible in utilizing water.
- Education.
  - To teach about water use and consumption. People need to learn value of water. Control of water pollution.
  - Of suburban homeowner groups and in municipalities, developers, etc. regarding storm water management and best practices.

Proposed Solutions

Nutrient Management

- Proper management of nutrient loss. Nitrogen use efficiency. Storm water management.

Technological Advancements in Infiltration, Monitoring, Bio-Tech

- Advancing technologies (make them cost effective and encourage stakeholder involvement).
  - New technologies for water supplies and to mitigate pollution.
  - Technology development and policy support of applications and financing.
- Crop varieties/genetics, better timing for irrigation, Ag water reuse/recycle.
  - Developing chemistry solutions that increases a plant's water use efficiency.
  - Economically feasible methods to recycle and reuse waste water bioengineering input into water friendly genetics in food.
  - Effectively managing agricultural water and utilize advances in technology to increase the resiliency of crop production systems to climate change and variability.
- Increasing infiltration will be key to keeping a healthy water cycle with increasing development and impervious surfaces.
- Add storage capacity where available.
- Conservation, planning and monitoring of water usage; cannot manage what you do not value.
  - Clearing up existing pollution for both surface waters and groundwater storm water management.
  - Better practice of using water.
  - Capturing rainfall and utilizing very efficiently.
  - Use of better chemicals for breakdown of chemical pollutants in water.
  - Managing surface run-off.
  - Balance of flow - scale/movement - conservation - new technologies/research - recycling/repurposing - model successful collaboration.
  - Find innovation in water use for agriculture since it is the "most of the pie."
  - Ground water re-charge and surface water retention.
  - More work and dissemination needed to increase water productivity and to go for finding crops genetic engineering for doing away with lab water.
  - Conservation of resources/becoming more efficient. Fair distribution of water resources. Research.
  - Find ways to reuse water, especially for agriculture and other non-potable uses.
  - Water does not flow through a watershed and down the river but instead is retained in ground and surface water environments.

Monitoring (as part of inventory and assessment)

- Monitoring and recording are key elements of developing a conservation strategy.
- Water conservation and monitoring (most cost effective).

Drought Management Processes

- Short run -- next 10 years -- ID drainage, water management, irrigation management.
- Long run -- develop plants (corn, soybeans) with deeper rooting systems to take advantage of water supplies available at deeper depths.

Conservation Practices

- Conservation practices should be encouraged for all stakeholders.
- Conservation in water-scarce areas and land use and lifestyle strategies globally shifting to avoid future scarcity as human population increases.
- Implement conservation practices, monitoring to prevent over use.
- Better conservation practices including educating urban and Ag community.
- Limits on withdrawals of water, budgeting and sustainable resource policies.
- Providing growers with recommendations for reducing their water use.
- Conservation and reuse, optimization of water use systems.
- Find efficient ways to sterilize drinking water and to reduce pollution.
- Recycle water.
- Retain water from run-off.
- Reduce the waste of water, increase irrigation efficiency, and reduce pollution to water.
- Realize that water is limited, be frugal at the society level.
- Conservation of environmental/natural resource use as integrated into all consumer items, home ownership, business operation etc.
- Efficiency of use, innovative solutions to respond quickly to conditions (e.g. weather for farming) and planning ahead for water challenges.

Educational Strategies

- Grower education and funding of research to give growers simpler and better water management tools.
- Educate folks about how they can conserve water.
- Education and allocation management.
  - Public education about importance of conservation, and implications of lifestyle demands.
  - Educate people about the lack of water and how to conserve water, refine processes to use less water.

5. Applications of Governance

Pressing Challenges

- Repairing/replacing an aging infrastructure.
  - Repairing inadequate or outdated infrastructure.
- Evaluation of state and local regulating regime, conservation and quality; proper mix of regulations and market based controls on withdrawal.
- Establishing a permit system.
  - Allocation of water extraction or withdrawals.
  - Water withdrawal permitting program.
  - Increasing the value of water.
  - Development of a permitting program. The need for a permitting system to protect the quantity of water for all uses including ecological needs.
  - Manage storm water run-off, develop a trading platform and determine most efficient uses; provide financial incentives for saving water.

  - Need to improve regulatory framework to allow for better water management.
  - Authority requires adequate resources to understand water requirements and permitting enforcement.
  - Build bigger impoundments.
- Government; reduce water run-off from the basin.
- Combination of regional and surface water use.
- Educating users and decision-makers on the benefits to them of water conservation and reuse. Learn what drives various users, work with them to develop effective messaging/education incentives.
- Capping city growth.
  - Population management.

Proposed Solutions

- That all uses are protected and that all parties are included in the process of identifying scientifically based needs.
- Don't over regulate to the point we can't collect important and accurate data and implement program in urban and rural areas on water quantity.
  - Proper mix of regulatory and market based controls on withdrawal.
  - Identification of what is a solution.
  - Efficiency in water use, conservation. Tariff structures, valuing water appropriately. Water withdrawal permitting based on source science. Off stream storage.
  - Establish a permit water rights system.
- Reduce nonsense use of water like irrigated lawns.
- Encourage restoration of hydrology and hydraulics in source (headwater) waters during redevelopment and land use changes in the future.

6. Create a Culture of Responsible Water Use in All Sectors

Pressing Challenges

- Creating a culture of responsible water use and conservation in all sectors-industry, agriculture, and the individual.
  - Decreased consumption across all sectors of society and by individuals.
  - Agriculture; industry; personal consumption habits.
  - Conservation mind set must become a way of life.
  - Education at all levels, but starting with the younger generation.

Proposed Solutions

- Massive publicity campaign to make the general public aware of the various ways in which we consume water, and the positive impacts of individual, modest water-savings practices. Not only direct consumption of water by individuals, but also consumption involved production of products.
  - Manage water usage in irrigation effectively. Plant yards that are drought tolerant.
  - Eliminate drip flow water faucets.
  - Conservation practices becoming part of our lifestyle.
  - Recognize and acknowledge the water (shortage) limits.
  - Education of University students in the context of our individual fields of expertise.
  - Make an effort to reduce water use by each person on a daily basis.

C) What ***ACTIONS*** will you and/or your organization take to ensure ample water quantity?

The participants identified the following actions that they or their organization planned to take to ensure ample water quantity based on the following major topics:

1. Conduct Inventory, Analysis, and Accounting of Water Quantity Use and Demands.
2. Increase Stakeholder Coordination.
3. Increase Integrative Planning Efforts.
4. Cultivate and Improve Water Management Strategies.
5. Improve Applications of Governance.
6. Advance and Invest in Research.
7. Create a Culture of Responsible Water Users in All Sectors.

The section below provides a summary of the responses received where appropriate, otherwise responses are listed as captured.

1. Conduct Inventory, Analysis, and Accounting of Water Quantity Use and Demands (Knowledge of the Footprint)

Ensure our customers know how much water he/she is using and using only as much as he/she intends; promote conscientious water use.

- Model water quantity and availability in North Carolina's surface waters. Better models possible if we had better (quantity locations and groundwater or surface water use) for agricultural operations.
- Work to develop new sources where demands warrant or distribute. Plan existing supplies where capacity allows.
- Improve our understanding of water distribution, quantity and quality.

2. Increase Stakeholder Coordination

- Increase interagency collaboration to make more efficient use of public resources.
  - Convene stakeholder groups to establish possible policies toward water permitting.
  - Promote interactive discussions with all stakeholders--press for realistic expression of need.
  - Advocate for agriculture continued access to ground and surface water within a balanced, consensual regime for managing ground and surface water.
- Continue to lead voluntary initiatives to protect water resources! Lead in the NC AgWater Plan. Go to ncagwater.com.
- Participate more in stakeholder processes (several comments).
- Better outreach, more research.
- Continue to operate as we do now, with a connection driven process.

3. Increase Integrative Planning Efforts

- Development of an integrated plan; continue river basin integrated planning and water resource planning.
  - Integrated water planning (pending policies).
  - Basin planning with hydrologic modeling in conjunction with regional planning.

  - Continue working with others who depend on our reservoirs to develop long range water supply plans and drought protocols.
  - Collaborate with other large water users to manage uses of the resources.
  - Participate in regional planning group.
  - DWR currently works with public water supplies in developing LWSPs and making long-range (50 year) projections to look at water supply and demand, possible supply alternatives, conservation planning.
  - Organization will continue to do water resources planning.
- Sharing water in a regional basis, outside the river basins.
- Develop a solid growth plan.
- Good growth plan. Small holder farms.
- Provide input to business regarding output today - lead product discussion in context of more complex landscape -buy the Chasing H2O book.

4. Cultivate and Improve Water Management Strategies:

Innovations and Technology Advancement

- Efficient Water Use
  - Ensure efficient use of water on our sites (example: collect rainfall for irrigation of greenhouse).
  - Continue to assist in managing irrigation canals to improve efficiency.
  - BMP's that retain soil moisture and trap rainfall. Build and maintain ponds large and small. Retain moisture in urban environment. Less impervious surface.
  - Implement techniques to improve infiltration of rainwater to improve resiliency of base stream flow.
- Efficient Production of Plants
  - Develop drought tolerant seeds.
  - Continue development of drought tolerant crop varieties.
  - In ag, take steps to enhance crop water use efficiency, grow crops that require less water e.g. genetic improvement - more stress tolerant.
  - Help to develop a resistant soybean variety to certain insect pests that would reduce the need for using broad spectrum insecticides.
- Develop New Technologies
  - Continue to develop economical and environmentally sustainable technologies (precision ag, softer chemistry, drought resistant varieties) which benefit our farmers/customers and meet the needs of society as a whole.
  - Implement waterless urinals corporation wide.
  - Developing "water-less" chemical production facilities that recycle virtual all the water required by the plant.
  - New technology development to increase irrigation efficiency.
  - Land application of bio solids actually serves as a water source to the applied field, reducing the need for nitrogen.
- Partner with Others for New Developments
  - Work with farmers to improve water efficiency in agriculture irrigation, offer cost share funding to change irrigation methods to be more efficient.
  - Fund collection cisterns on agriculture to be used for irrigation.
  - Implement the agricultural water resources assistance program (AgWRAP) to assist farmers to improve water use efficiency and on farm water storage.
  - Work with soil conservation districts to promote or educate programs like AgWrap that focuses on water quantity issues.

Conservation Strategies:

- Practicing water economy at all scales.
  - Closed loops/recycling processes.
  - Promote water conservation and efficiency measures.
  - Have a structure to limit use and implement conservation.
  - Provide strategies on how to moderate water applications.
  - Renovation of previously useless water to a quality that can have beneficial uses.
  - Finding & encouraging alternatives to residential green lawns.
  - Rainwater harvesting in facility design.
  - Promote best management practices to protect our water resources, quantity and quality.
  - Improve and construct water storage unit (pond; improve irrigation efficiency.
- Education/outreach to insure people are aware of issues.
  - Promotion of water conservation/efficiency measures with farmers.
  - Conservation of water resources.

5. Improve Applications of Governance

- Coordination with municipal partners, monitor storm water run-off infiltrate on site and limit density to sustainable levels.
- Implement pricing plans.
- Building less in locations with arid climates.
- Regulate certain users and track basin transfers of water and large withdrawals of water. Help ensure that water supplies are sustainable in the future and require supplies-use projections.
- Discuss watershed council strategies with utilities and Bill Holman.

6. Advance and Invest in Research

- Will focus more on partnership with industry/academia to identify opportunities for research and development that are applicable and cost effective.
- Invest in research for the following results:
  - Determine new ways to conserve and promote water conservation (several responses).
  - Encourage technical solutions to reduce crop water use.
  - Study data of water usage. Find ways to conserve.
  - Engineer services for innovative technologies, stakeholder, and collaborative solutions.
  - Enhance agricultural water management and relay results to producers.
  - Continue to support University studies.

7. Create Culture of Responsible Water Use in All Sectors

- Individual actions.
  - Install rain capture at home.
  - Recycle water, monitor usage.
  - Me – being aware of personal usage.
  - Track use, water conservation.
  - Reduce food waste, eat lower amounts of high water food (e.g., rice).
  - Educate family members and/or colleagues to save more water; improve the lawn irrigation practice.

  - Talk to homeowners about conserving water and eliminating water waste in my own home.
  - Be a model of citizen education or by setting an example and spreading the word.
  - Watering the yard less or when needed, taking short showers, wash full loads of clothes, pumping water on crops when needed (not over applying), grow crops requiring less water.
- Professional actions.
  - Work to better illuminate and communicate research results and case studies about effective solutions.
  - Consider the impact water has on the utilization of transgenic plants or growing crops in the field and how that affects water quality.
  - Providing science-based information (data) to understand what the major bottle necks are so that we solve the real problem. Helping all sectors trust that they are being told the truth about issues.
  - Striking the balance between Ag and everyone else.
  - Avoid waste of water; improve efficiency of our agricultural production.
  - Education of University students in the context of our individual fields of expertise.
  - Continue to lead voluntary initiatives to protect water resources! Lead in the NC AgWater Plan. Go to ncagwater.com.
  - As manager of an Ag research facility in NC we have a great opportunity to improve crop drought tolerance and water use efficiency.
  - Promote and implement the agricultural Water Resources Assistance Program (AgWRAP).
  - Teaching about modeling water conservation practices (in K-12 education and extension activities).
  - Conserve land to reduce sedimentation, preserve capacity and to maintain back flows, ecological flows in streams.
  - Develop educational materials about effective ways to conserve water such as conservation of water in irrigation.
  - Provide better reasons to provide onsite, individual information for all of us to actually account for our water usage.
  - Educating stakeholders on how to conserve and tools to assist.
  - Ag sector - irrigation efficiency, recycling water and storm water.
- Public actions.
  - Education of the public.
  - Making conservation a part of our lives.
  - Educate and conserve.
  - Create more awareness around the topic.
  - Raising awareness among communities.
  - Educating the public about research-based solutions and political will.
  - Advocate through community education and voting.
  - Education and learning to plan for future wars.

Appendix E: How Do We Protect Water Quality? (Question 3)

Appendix E is divided into two sections. The first section (pgs. 29-38) presents the most pressing challenges described by those participants who contributed to the facilitated portion of the Forum related to water quality. Included in this section are the participants' recommendations or proposed solutions to protect water quality.

The second section (pgs. 38-42), describes actions that participants or their organizations plan to take to protect water quality.

A) What is the number one ***CHALLENGE*** that must be addressed to protect water quality?
B) What are key ***SOLUTIONS*** to protecting water quality?

As a result of the participants' responses, six major challenges were identified as most pressing to address in order to ensure ample water quality:

1. Source of Water Pollution and Contamination
2. Water Management Strategies for Pollution Control
3. Build Collaboration Across Agencies and Organizations
4. Economics of Water and New Treatments
5. Realistic Public Expectations and Accountability
6. Developing Outreach and Education Upstream and Downstream

1. Sources of Water Pollution and Contamination

Pressing Challenges

- Run-off
  - Non-point run-off
    - Non-point source pollution, especially urban contribution.
    - Non-point sources of pollution such as run-off (storm water or not).
    - Non-point source pollution, because it is much harder to regulate, and there are many different sources that contribute --> it's all of us.
    - Non-point sources; run-off from multiple locations-urban and Ag run-off, though the likely growing source is urban run-off.
    - Non-point source pollution - agriculture and storm water.
    - Non-point sources – run-off, etc.; and pharmaceuticals/other products not being treated by municipal systems.
    - Parking lot run-off.
    - Reduce emissions (by law), reduce contamination.
    - Run-off--urban contamination from streets/parking lots.
    - Organic compounds (medicines etc.). Run-off from urban/suburban landscapes.
    - Technology adoption to address non-point sources.
    - Trying to reduce usage of insecticide or other chemical to protect quality.
    - Minimizing pollutant load by reducing surface run-off.
    - Pollutant discharge to water ways.

- Storm water run-off
    - Storm water, especially urban.
    - Municipal storm water management.
    - Storm water run-off is a major issue that is being poorly addressed.
    - Addressing storm water run-off.
    - Storm water from developed landscape and minimal regulation of non-point source run-off.
    - Reducing chemicals and excess nitrogen in surface run-off.
    - Storm water run-off filled with nutrients and sediments.
    - Reduce off site delivery of sediment.
    - Reduce sedimentation and heated storm water run-off.
    - With regard to ground water, take measures to prevent salt water intrusion.

- Nutrient loading
    - Reducing nutrient and pollution run-off and leaching into water sources.
    - Excessive nutrient loading from all sources, point and diffuse.
    - Nutrient loading and understanding/protecting water quantity are linked.
    - Nutrient - nitrogen, reduce, slow movement off-site.
    - Excessive sediment and nutrient loading from disturbed watersheds must be reduced and mitigated.
    - Reduce nutrient loading.
    - Non-point source loss of nutrients from fields with animal waste applied needs to be better quantified.
    - Excess nutrients' impacts and nonpoint sources.
    - Nitrogen content.
    - Nutrient over-enrichment based on human activities. We all need to eat and we all excrete nutrients.
    - Nutrient management and run-off reduction.
    - Meeting nutrient reduction requirements for Jordan and Falls Lakes.
    - Sustainable growth to reduce nutrient load downstream.
    - Increase in nutrients and equal increase in phosphorus in storm water run-off.

- Agriculture
    - Pesticides and fertilizers.
    - Rural fertilizers and chemicals moving from the fields to streams.
    - Phosphorous run-off; animal waste or fertilizer.
    - Reducing fertilizer leaching.
    - Protection of our rivers and streams by making sure livestock farmers have good lagoon systems.
    - Optimization of nutrient, chemical and other inputs with the appropriate actions -- not unrealistic and impractical goals.
    - Agricultural pollutants affecting the downstream ecosystem.
    - Applying only what is needed. Managing water so yields will take up what was applied. Drainage and irrigation that remove only the minimum water necessary and apply the minimum necessary to produce target yields.
    - Monitoring and/or need for closed loop swine and poultry operations.
    - Management and pesticide application.
    - Accepting to increase our percentage of our income going towards food; farming practices reflect this: we expect very high yields, but this comes at a high cost.
    - Reducing the amount of inputs in agricultural (pesticides, herbicides) areas, only 100% biodegradable detergents, then the water after use.

- Human development and interaction.
  - Population growth.
    - Development- urbanization of watersheds. As we study the problem the problem may be changing.
    - The increase in population leading to an increased need for infrastructure and food production.
    - World population.
  - Waste water.
    - Sanitation in developing countries.
    - Wastewater releases must be prevented.
  - Pharmaceuticals.
    - Managing multiple contaminants that may have synergistic and chronic effects on aquatic and humans.
    - Pharmaceutical contamination, organic pollutants (Dioxin e.g.).

Proposed Solutions

- Control water pollution & contamination.
  - Minimize water soluble contaminants in agriculture.
  - Nutrient management plans - including homeowners.
  - Control run-off sources.
  - Prevent pollution, maintain natural systems to assimilate pollutants, riparian buffers.
  - Address storm water run-off and nutrient issues.
  - Nutrient management and run-off reduction.
  - Developing smart, sustainable means to control and purify urban storm water and run off.
  - How can nutrient trading work? How can we incentivize pollution reduction efforts from this private sector?
  - Efforts to reduce sediment in run-off and variable rate application in Ag.
  - Transparency (do we know where water and or pollution came from?).
  - Nutrient management (rye rates), urban storm water management.
  - Develop better disposal methods for medical wastes - utilize all available, advanced technologies to help regulate non-point sources.
  - Containing pollutants at the source.
  - Storm water run-off management structure.
  - State of the art wastewater treatment and protecting aquatic fauna -especially freshwater mussels, which provide natural filtration.
  - Implement the most cost-effective and beneficial projects, maybe storm water BMPs on stream restoration.
  - Water conservation is probably the best.
  - Create barriers from allowing surface and ground water impairment; run-off from urban/agricultural lands.
  - Reducing nutrient run-off into water resources; reducing sediment and storm water run-off; working together with cities, farms, and homeowners to protect water quality by offering incentives and fines; showing the benefit for our future.
  - Reduce/control the wastewater production, recycle/purify the wastewater.
- Protection.
  - Protection of riparian areas and key watershed areas around major water sources, around Jordan Lake.
  - Precision Ag riparian buffers.
  - Larger/better riparian buffers around stream systems; cover crops in "off-season" periods in certain regions; direct in-water inactivation or intervention (wetland installation) to restore impacted systems.

  - Riparian buffers, improve technology for testing quality and increase usage thereof, make technology affordable.
  - Solving problems individually with the best plan but integrating the overall plan for solution to address the issue across all sectors- urban-prevent storm water from entering streams; smart irrigation; conservation.
  - Adequate buffers on perennial/intermittent/ephemeral streams; high density development in urban areas; limits to suburban sprawl; effective storm water infrastructure.
  - Integrity of riparian buffer.
- Mitigation.
  - Reduce the pollutants.
  - Nutrient removal from all wastewater treatment plants.
  - Help devise plan to correct actions.
  - Find good ways to clean up water that is contaminated. New recycling technologies. Ways to avoid contamination—run-off.
  - Run-off-i.e. clearing muddy water, plant vegetation to prevent soil erosion.
- Agriculture.
  - Organic farming.
  - Apply what is needed. Manage water so yields will take up what was applied. Drainage and irrigation that remove only the minimum water necessary and apply the minimum necessary to produce target yields.
  - More encouragement/education maybe cost share programs to enhance efficient nutrient use of crops.
  - Ag-good conservation, smart irrigation better management practices.
  - Optimize nutrient application based on crop needs. Apply optimum water based on crop needs, avoid surface run-off.
- Infrastructure.
  - Checking water/sewage systems to identify leaks/failures. Repairing those and avoid siting new septic systems in unacceptable areas.
  - Installing and maintaining infrastructures that best treats water for the given land use and pollutant sources.

2. Water Management Strategies for Pollution Control

Pressing Challenges

- The difficulty in simultaneously controlling all pollutant types (N, P, sediments, synthetic organics, and trace elements), particularly from non-point sources, but also pharmaceuticals.
- Management of all human facilitated nutrient and chemical inputs into the whole watershed. How do we continue to grow our urban environments at high rates and feed the expanding population while supplying sound agricultural practices that meet an increasing food demand?
- Control of all types of pollution--chemical, microbial, erosion.
- How to reduce pollution both from urban sources; both run-off and sewer discharge.
- Limiting the sources of pollution (reducing the degradation of water quality).
- Keeping resources in their useful places.
- Realizing water quality improvements in urbanized areas. Ultimately though, all sectors have challenge and reductions should be equitable.
- Effective use and management of BMPs.
- Establishing a direct relationship between quality and quantity and costs.
- Quantifying and implementing strategies for non-point discharge.

- Efficient and maintained storm water BMP's.
- Link between water quality and quantity.

Proposed Solutions

- Use and management.
  - Look at the problem in a holistic way and investigate across spatial scales ranging from farm to watershed scales.
  - BMP at farm/local level.
    - BMPs.
    - Action.
  - Better maintenance of municipal systems to reduce spills.
  - Holistic systems that address and mitigate water run-off (both municipal and agricultural) will improve water quality most. It is not just about buffers but also upland management.
  - Monitoring and sampling from ambient sources as well as regular contact and inspection of water conveyance systems and potential sources of pollution.
  - Making each person responsible for his/her wastes. Just kidding. Sort of.... Taking an industrial metabolism perspective of inputs and outputs. More of a systems perspective.
  - Biological controls, low volume chemical & controlled application - soil and water management practices.
  - Improve management of controlled drainage. Increase capture and reuse of municipal and infiltration storm water, improve fertilizer management for residual users.
  - Value water more realistically. If water was not so "cheap" individuals/cities/companies will do a better job protecting our water resources.
  - Recycling, community recycling/education programs, efficiency in production to get best use of nutrient sources.
  - Demonstration, education, incentives, more money to fix problems, figure out how to allow cities to work on private properties without liability to maintain in perpetuity, fix the process from planning to inspection to project completion, city inspectors should have to stamp grading of landscaping not just building grading.
  - In regard to groundwater, have right-sized monitoring network and program. Develop real time data management program do something to evaluate and make decisions with data.
  - Water quality needs to be managed at a state level and not at a national level. Each region has its own water quality issues. They are not the same from state to state. Better BMP's for storm water and use best available technology and BMP's for discharges that are cost effective.
  - Targeted allocation of resources identified water quality concerns.
  - Slow down water, direct resources to reduce impacts to water quality. Direct resources to invest on private lands for public benefit.
  - Responsible, documented practices based on research data. Research driving applications in usage (new technology). Address quantity- will affect quality.

3. Collaboration Across Organizations and Governing Agencies

Pressing Challenges

- Stakeholders.
  - Build relationship of regulatory and industry to manage risk base on science.
  - Bring stakeholders together and stop finger pointing.
  - Long term planning that involves everyone so that the issue is accepted as important.
  - Cooperation instead of finger pointing.
  - Stakeholder work and solid research to define contributions to impairment.
  - Coordination among all of the stakeholders.
  - Collaboration among urban and Ag sectors to reduce pollution.
- Politics, policy, regulators, and regulations.
  - Politics, water quality would be better managed by more conscious regulators.
  - Agree on what acceptable water is -- collectively.
  - Appropriate standards.
  - Regulation/policy applied fairly.
  - Regulatory charges that will allow us to monitor conditions in a way land owners will not fear a regulatory action. Need to build trust to get the data we need to quantify the problem.
  - Relevant metrics and measurements --> what is policy?

Proposed Solutions

- Stakeholder engagement.
  - Key stakeholders in each river basin need to come together and develop consensus-based solutions.
  - Stakeholder interaction and involvement.
  - Address all sources in a fair and equitable way.
  - Every sector continuously improving their reduction of nutrients through new, improved practices.
  - Complete public buy in to offset technology and infrastructure associated with water quality protection.
  - Cooperation among all water users, from homeowners, factories, other businesses - but more importantly farmers must use better producers in both amount of fertilizers and chemicals use and how and when they are applied.
  - Engaging businesses who understand sustainable water to help sell the message.
  - Economical water filtration consumer and corporate buy in.
  - Make BMPs more approachable, i.e. beneficial to user. Simplicity of management.
  - Stakeholder awareness-building.
  - Do not pollute. Don't sit back and let others handle quality issues -- be proactive.
- Collaboration.
  - Teamwork among all stakeholders.
  - Collaboration between different sectors (Ag/urban) and education/outreach to make people more aware how their actions can affect water quality.
  - Carrots with sticks. It shouldn't be one or the other.
- Organizations.
  - River basin planning organization - each basin needs one.
  - Solutions need to be at watershed/local level.
- Regulation and policy.
  - Strict fines on pollution/incentives for good work.
  - Resolve political issues pertaining to water quality and enforce more rules/laws pertaining to the enhancement of water quality.
  - Adequate regulation and policy, economic stimulates to improve quality.

  - Effective regulation and government/policy makers willing to take steps now that may be unpopular plus find the areas of common ground and compromise.
  - More monitoring, more regulations.
  - Tighter regulations and better chemical products in states with lower impact on biological oxygen demand of water.
  - Enforcement of water quality criterion.
  - More regulation of non-point sources.
  - Implement nutrient management technology policies. Storm water - a resource to capture and reuse. Next generation cycled swine and poultry production.
  - Build upon current federal/state policies and voluntary initiatives.
  - Heavier fines!
  - Science focused; place science first.
- Technology.
  - Introduction of technologies and fewer levels.
  - Newer technology that reduces/optimizes environmental loads, etc.
  - Range of technologies need to be adopted.
  - Technology development.
  - Better utilization of water control structures, innovative technologies that enhance nutrient utilization.
  - Improve existing technologies/management for WQ protection. Create better solutions (technologies & management).
  - Innovation.
  - New technique to clean or ultrafiltration of water.
  - New technologies to improve fertilizer utilization efficiency, reduce fertilizers.
  - Supporting appropriate technology for conservation and waste management.
  - Technological innovation to reuse and recycling and Identify and honor a ground water threshold.
  - Using GIS mapping and up to date technology to identify the exact points in
  - watersheds where measures can be taken to improve water quality; education, partnerships.

4. Economics of Water and New Treatments

Pressing Challenges

- Continue providing funds for research run-off water.
- Properly value water so that financial incentives drive desired action to preserve water quality.
- Economics of treatment options.
- Cost
- Lack of financial resources to address issue.
- Monetize water quality.
- Economic technologies for water purification.

Proposed Solutions

- Funding.
- Increased funding for agricultural water quality.
- More cost-share.
- Maximize incentives (rewards) for good stewardship such as on-site management.
- Economics.
- More financial resources for: education, research, technical assistance, best management practices, monitoring.

5. Realistic Public Expectations and Accountability

Pressing Challenges

- Accountability.
  - Recognizing we all are responsible.
  - Recognize that it will require individual actions.
  - Respect for the value and importance of water. All segments of the community must put water high on their list of important issues.
  - Getting developers, cities and citizens to think outside the box and use infrastructures like wetlands that provide multiple ecosystem services.
  - Realize that we are polluting.
  - Being proactive, not reactive.
  - To be accountable -- all of us -- for how we treat water systems.
- Realistic Expectations
  - People in general are used to quality water so it is not top of mind to take steps, small or large, to make changes that would inconvenience themselves - therefore education "Lag Time" what works & what doesn't.
  - US - an informed public that understands lifestyle - water quality tradeoffs. ("Blue Crabs or Green lawns - you may have to decide").
  - Recognizing water quality protection practices could take years to see the benefits.
  - Defining what is appropriate and achievable. Overcoming unrealistic expectations.
  - The lag between actions and response in large rivers.

Proposed Solutions

- De-emphasis on green lawns.
- Focus on own contributions.
- Self-interest of the individual aligned with the greater good.
- Attack impairment at the source-continue to encourage absence of "opinion" in identification of problems.
- Action without education is a waste of resources.
- Cultural practices will be improved upon.
- Think little. Creek by creek, drip by drip, address quality on a smaller scale.

6. Developing Outreach and Education Upstream and Downstream

Pressing Challenges

- Lack of understanding the problem. Too many assumptions for valid solutions to be invented.
- Understanding and agreement around the causes of the problem(s).

- Identify the "real" water quality issues-not perceived.
- Identifying sources (PS/NPS, and type of each); identifying reasonable background surface/GW concentrations.
- Better identify who is responsible for degradation. Get a handle on septic tank pollution.
- Clarity around true cause(s) impacting quality seems very complex.
- Changing the perception in NC that we don't have a water quality issue and begin to think about people upstream/downstream.
- Education of farmers and users of pesticides & fertilizers. Soil & water conservation practices, nutrients
- Improve knowledge of source of nutrient impacts. Why efforts so far have not improved water quality in estuaries.
- What my actions cause in water quality. Where does my run-off go?
- Raise awareness and also invest in ways to increase water quality to utilize biotechnology and other technologies.
- Public awareness of nutrient pollutants and sources-then how to manage these sources so not to pollute storm water/groundwater/water bodies.
- Knowledge of actual conditions. Limited data limits our ability to understand the pure water quality conditions and how to improve the problem.
- More people need to understand just how very important H2O quality is to our human health and well-being.
- Awareness of water quality problems in a post water burning era.
- Non point sources education from urban/rural issues.
- Awareness and training of end-users and repetition!
- Everyone needs to be able to see their own impact on water quality so that everyone can be part of the solution.

Proposed Solutions

- Education.
- Better data on sources that improve models.
- Community education and outreach to make sure that residential industrial and other land use or users are aware of how they can impair waterways and steps for prevention.
- Continued research - teach good environmental practices to communities, both rural and urban.
- Education, recommendations on best practices on local regional basis.
- More data, better data and good analytics--plus needs to be easy to get an assessment of water quality and then the information needs to be easy to use for decisions. Water quality maps and charts etc. based on real time.
- Education about impact of choices. Manage land use.
- Take care and study the consequences of all actions - everything on earth is connected to water.
- Education-real research science-based information- to identify the water quality issues understand the water users concerns and how it affects the other groups.
- Education- relate water quality to quality of life, recreation.
- Awareness.
- Education programs that focus on generational solutions.
- Measuring and correlation studies, degree of monitoring, regulation and thoughtful planning to manage uses not in place.
- Massive education at the farmer level by providing sensors.
- Learn and sell the benefits of run-off reduction and treatment at the source including the benefits of keeping rainwater onsite for use.
- Awareness and education.
- Educate people about water quality problems and their impact.
- Be aware of what can damage quality.

- More water quality monitoring and better analysis of parameters to understand sources of pollutants.
- Education and demonstrating the value of high quality water.
- Know the effects of what is being put on the land +flushed down the toilet. Be able to enforce rules when put into place. Smart growth.
- More research on the legacy nutrients in ground water.
- Education, delivering research results in accessible ways to public and to specific stakeholder groups.
- Legislate and educate urban areas about water use.

C) What ***ACTIONS*** will you and/or your organization take to ensure ample water quality?

The participants identified the following actions that they or their organization planned to take to ensure ample water quality based on the following major topics:

1. Control Water Pollution and Contamination
2. Promote Water Management Strategies
3. Collaboration and Engagement Across Stakeholder Groups
4. Advance Science, Research, Technologies, and Monitoring
5. Increase Funding Opportunities
6. Expand Outreach and Education to Specific Audiences

1. Control Water Pollution and Contamination

- Reduce water pollution.
  - Pollution reduction programs and implementation. Municipal wastewater reduce/reuse.
  - Development of systems which enable to reject micro pollutant and heavy metal ions for water treatment.
  - Improved use of N levels in soil to guide N application.
  - Actions that remove phosphorous.
  - Prevention is more effective than clean-up. What can we do to keep pollutants from entering ground & surface waters?
  - Avoid chemicals. Dispose chemicals in the right way. Detect water microbial system to balance.
  - Apply nutrients at agronomic rates. Apply water to enhance water use efficiency. Minimize surface run-off and sediment loading.
  - Push for more/better buffers.
  - Designing best management practices that treat run-off for pollutants such as nitrogen, phosphorus and total suspended solids.
  - Promote technical and science base strategies to promote contaminants from entering the surface and ground water.
- Expand individual accountability.
  - Continue work in watershed work in watershed planning restoration + conservation.
  - Stewardship.

- Be good stewards of our products. Make recommendation of our product use to limit movement to water.
- Continue to plant at least one tree for every day I live; especially, native species that need little or no fertilization as well as minimal use of pesticides.
- Minimize land disturbance on my property.
- I don't fertilize; I don't waste food. I try and provide positive solutions.
- Conserve & use responsibly.
- Use lawn products carefully and recycle.
- Live sustainably.
- Raingarden, reduction of lawn, little use of fertilizers.
- Use best management practices when making fertilizer application, increase the amount of acres grown with limited tillage.
- On individual level, attempt to use less harmful household chemicals, soaps, etc. to reduce cost of water clearing and recycling.
- Be more responsible by refraining from avoidable contamination of water.
- Eat organic food and use 100% biodegradable detergents.
- Reduce the water consumption volume, control the pesticide uses for lawn/garden.

- Improve agricultural practices.
  - Enable farmers to maximize fertilizer use efficiency.
  - Smaller environmental footprint, crop protection and seed/traits/technologies. Systems approach that improve overall agronomic productions. Seeds/traits/chemistry/biologicals/cover crops -- improved yields. Maximize benefits and minimize risks.
  - Minimize dosage of fertilizer.
  - Encourage precision agricultural activities.
  - Use of cover-crops and improving health of soil can reduce fertilizer application and field losses.
  - Continue to apply measures and further innovate to ensure sustainable use of our crop protection productions.
  - Work to improve agricultural practices that protect water quality.
  - Use better procedures in application and amount of fertilizers and chemicals applied to yards and farm fields.
  - Continue to improve agriculture practices that protect water quality such as no till variable rate application with fertilization pesticides.
  - Continue to initiate and support fertilizer use efficiency.
  - Have crops that are more efficient at up taking nutrients.
  - Plant cover crops, buffers, and bedding; new ditches.

2. Promote Water Management Strategies

- Structural/non-structural methods for water protection.
- Maintain protection water supply? Regulations, riparian buffers, limit on density, encourage cluster development, make sure storm water & erosion & sedimentation control best management practices are properly functioning.
- Manage waste, reduce it.
- Develop better, more cost-effective, best management practices that can be installed/used on the ground.
- Design infrastructure that treats water and can be easily maintained.
- Improvement BMPs.
- Watershed management plans, stream restoration projects, and storm water run-off control.

- Continue to do the integrated river basin planning.
- Work to keep waters within water quality standards and address exceedances in a multidisciplinary fashion.
- Promotion of BMP for agriculture - urban non-point sources.
- Ag BMP's - Nutrient management, urban storm water BMP's, forestation of marginal land.

3. Collaboration and Engagement Across Stakeholder Groups

- Collaboration.
  - NC should be building a consortium that focuses on water quality and water quantity.
  - State with engagement of industry/government/community stakeholders.
  - Relay to association membership best management practices for water quality.
  - Work with all parties to minimize impact.
  - Work with cities to design and finance green infrastructure to reduce storm water pollution.
- Stakeholder engagement.
  - Encourage all to limit pollution even on their own property.
  - Bring all players to the table for gut level honest discussions.
  - Advocate for reasonable actions for Jordon & Falls Lakes.
- Policy/legislation.
  - Policy support that will encourage implementation of water treatment technologies.
  - Develop Jordan/Neuse rules, trying to implement program site inspections, monitor use, and enforce regulations to meet Ag standards.
  - We have many consensus-driven policies regarding water quality already.

4. Advance Science, Research, Technologies, and Monitoring

- R & D.
  - Identify areas of concern.
  - Conduct more research.
  - Constant focus on developing new products that satisfy grower needs while minimizing the impact to the environment.
  - Same as quantity- water-less chemical production facilities that don't have any waste discharge. Developing fertilization systems to apply fertilizer and crop protection chemistries with minimal application rates.
  - Conducting on-farm research to understand the potential impacts of chemicals on our waterways.
  - Work with science based approaches to create improvements to water quality.
  - Support research to use less chemicals that end up in water proper disposal of drugs.
  - Continue dedication to research the conservation of freshwater mussels.
  - Explore little creeks and tell their stories.
- Documentation.
  - Better document how various practices reduce nutrient loading so action can be focused.
  - We will continue to collect water quality data summarize the results of consolidating that data and present suggestions for where and what issues to focus on.
- Standards.
  - More data, better data and good analytics--plus needs to be easy to get an assessment of water quality and then the information needs to be easy to use for decisions. Water quality maps and charts etc. based on real time.

  - Be pro-active, based on science and technology to work toward saving/reducing nutrient run-off.
  - Making sure tools used to measure and set water quality standards are protective for all uses (we do toxicity testing with mollusks).
- Monitoring.
  - Identifying early indicators of problems.
  - Home lawns: fertilize based on soil test.
  - Real time strategies monitoring.
  - Monitoring and sampling from ambient sources as well as regular contact and inspection of water conveyance systems and potential sources of pollution.
  - Regarding groundwater, implement a comprehensive monitoring program using appropriately spaced monitoring wells. Don't expect a computer model to do it alone.
  - Better quantify non-point pollution.
  - Continue to review water quality standards and adjust as necessary or allowed.
- Technology.
  - Research into new technologies.
  - Development of technology that removes contaminants at a low cost.
  - Use technology that limits move into water.
  - Demonstrate new in-water management technologies.
  - Water quality sensors and apps that are readily deployable and accessible.
  - Technology development.
  - Promote automation of controlled drainage.
  - New tech development to reduce fertilizing leaching, increase fertilizing utilization efficiency.
  - Supporting biotech based approaches to commercializing relevant products or technologies; anaerobic digestion, wastewater treatment, etc.
  - Using new technology to help keep water clean.

5. Increase Funding Opportunities

- Adoption of agriculture cost-share programs.
  - Work to increase funding for Ag cost-share programs.
  - Identify funding resources for all producers in a supply chain to implement new technology or biotechnology.
  - Promote and administer the Ag Cost Share Program, Community Conservation Assistance Program.
  - Conservation reserve enhancement program.
- Increase impact fees to fund storm water infrastructure.
- Working to get more funding for implementation of water quality strategies for education, research, technical assistance, best management practices.

6. Expand Outreach and Education for Specific Audiences

- Investment in research and advocacy, green practices locally.
- For the public.
  - Education, grass roots.
  - Education and outreach (example drainage water management).

- Provide/conduct educational meetings.
- Extension and cooperative effort to apply what we know and what we learn.
- Educate the public using virtual reality tools and "immerse" them in the actual river/body of water so that they can see water quality issues and improvements--this would be a great education tool.
- Education, talking about the issues.
- Demonstrations of ways to avoid erosion.
- Learn the vulnerabilities of water and respect these limitations.
- Raise awareness/inform the public about the water that we drink, the ways that we as a community can help resolve these issues.
- Our main function is education & research. Our role is to inform the public to be better stewards of a limited resource.
- Be aware of possible pollutants in the products I use (in the home and the yard).
- Show benefits to users.
- Educate people.
- Education, delivering research results in accessible ways to public and to specific stakeholder groups.
- Education of the public on water quality issues.
- Education and demo.
- Awareness.
- Define and promote cultural practices.

- For organizations and politicians.
  - Bring back to organization messages - how do products (beyond chemistry) impact H2O quality?
  - Support local soil and water boards to education them about programs, like Ag cost share, so they can help farmers implement conservation efforts (similarly for urban areas and programs like Community Conservation Assistance Program).
  - Show success of current water quality/quantity restoration and protection programs in terms of long term financial benefits then expand these programs in a deliberate and prioritized manner to ensure no more future derations.
  - Bring water quality issues and recommendations to the attention of local, regional and state leaders/politicians.
- For growers.
  - Helping growers determine appropriate nutrient rates and timing of application.
  - Adhere to buffers in permit proper temping of applications educating farmers.
- Communicate research.
  - Teach state-of-the-art knowledge on soil-based regulation of NPS pollutants.
  - Improve our understanding, modeling, design of water treatment systems at the field edge.
  - Help improve communication and distribution of research results success stories.
  - Quantify the economic value of water quality services they provide.
  - We had a very unusual event in Feb 2014 that impacted an entire river basin negatively. We have changed our culture and our processes to learn from that event and to help ensure it never happens again.
  - Teaching and modelling sound practices.

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