UNRBA Board Meeting

MP and MRS Project
Status Updates

November 14, 2018

Monitoring Program Status Update

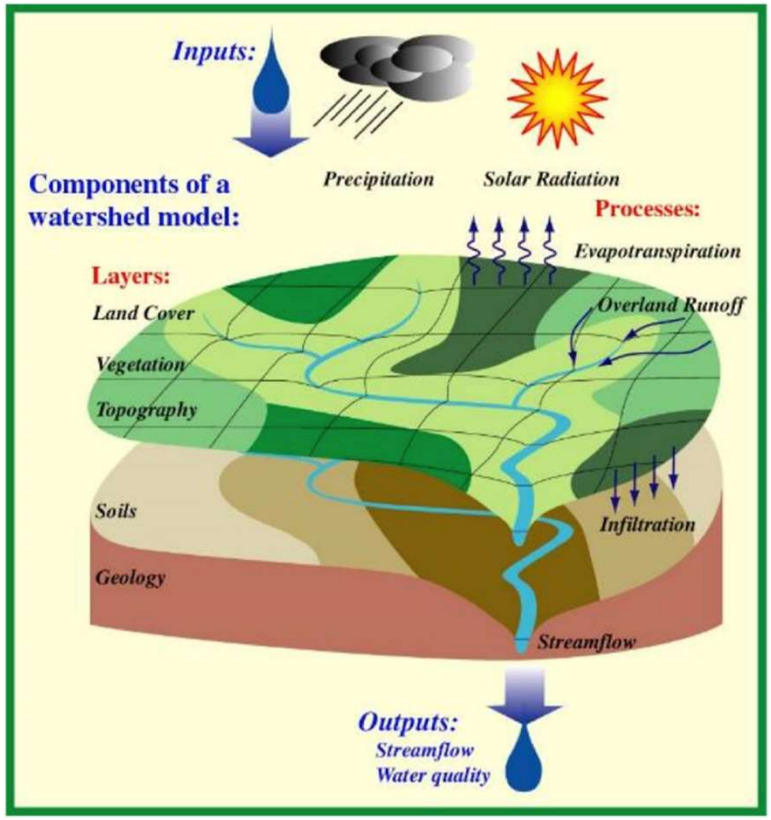
Status Update for the Monitoring Program

- Full monitoring program to support modeling ended in October
- Transition monitoring program began in November
- High flow sampling is complete (2 hurricanes since July)
- EPA recently provided their inlake sediment study results (to be summarized at a future meeting)
- Annual Report is in progress

Summary of Feedback from the Fall 2018 Stakeholder Meeting

Technical Presentations

- History of the UNRBA
- Re-examination efforts
- Description of the modeling units
  - Watershed
  - Lake
- Subset of model inputs/ data requirements
  - Meteorology data
  - USGS water data
  - Impoundments
    - Withdrawals
    - Releases
  - Wastewater treatment facilities



https://scwrs.files.wordpress.com/2016/04/model-components.png

Feedback Session

- Receive comments or input regarding the data sets described
- Understand stakeholder uses and needs from the modeling
  - What questions do they want to be able to answer?
  - What is the most useful format for the data?
  - How do they plan to use the data?

Decisions we make now affect what we can get out of the models later.

Top 8 Requests of Watershed Model in Order of Importance

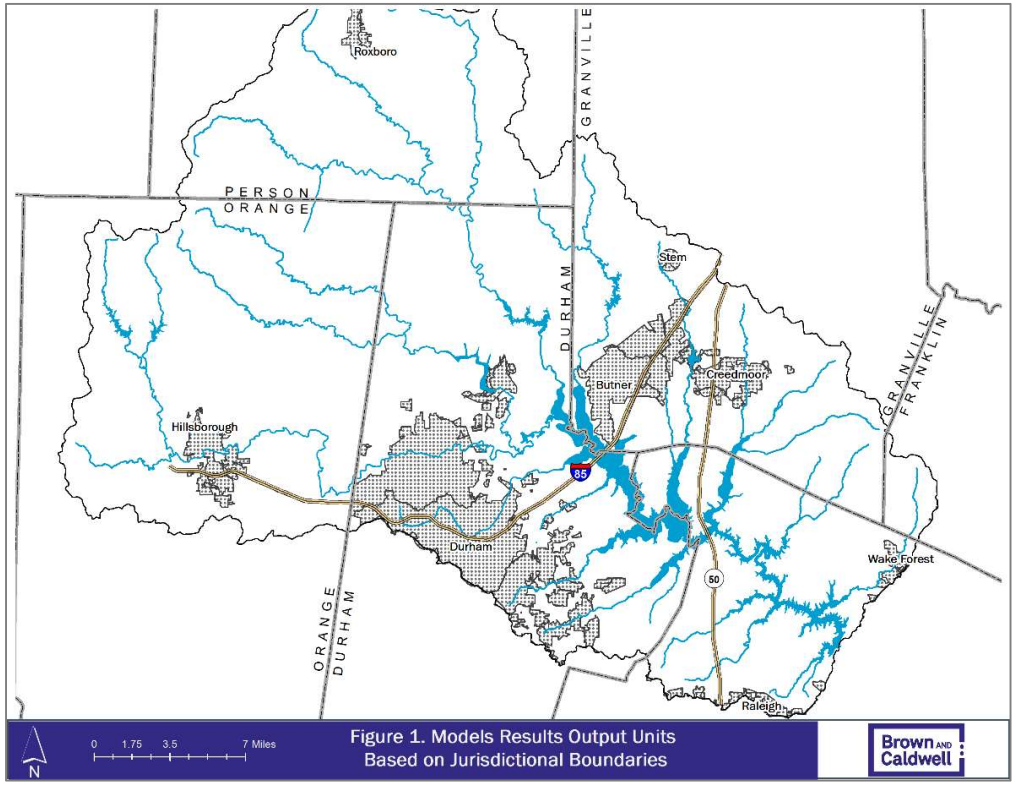
- Understand which **land uses or activities** contribute to the highest nutrient loads
- Predict the effects of implementing various **Best Management Practices** on nutrient loading to the lake
- Estimate and compare **jurisdictional loads** (City, County, Utility)
- Understand **where nutrient loading is highest** (tributaries, jurisdictions, soil types)
- Understand the role **atmospheric deposition** plays in nutrient loads
- Identify **unmanageable and manageable sources** of nutrient loading
- Provide **input to the lake model**
- Understand the relationship between **nutrient concentrations and nutrient loads**

Next 9 Requests of Watershed Model in Order of Importance

- Understand the effect of **legacy nutrients** bound in sediment
- Simulate **nutrient concentrations and loading** at specific locations
- **Identify areas needing further exploration** because the loads are not well explained by the models
- Understand how **adjacent wetlands** affect water quality in Falls Lake
- Understand how **storm events** affect concentrations and loading
- Understand **terrestrial loading of total organic carbon**
- Understand **ecological health baseline** for the watershed
- Understand how **onsite wastewater treatment systems** impact nutrient loading to Falls Lake
- Understand how linear facilities such as **roads** impact loading

Desired Summary Units for Watershed Modeling in Order of Importance

- Spatial scale
  - Jurisdictional/utility level
  - Modeling unit level
  - UNRBA monitoring station level
  - Perennial stream level
- Temporal scale
  - Daily
  - Monthly
  - Seasonally
  - Annually
  - Weekly
  - Quarterly



Top 7 Requests of Lake Model in Order of Importance

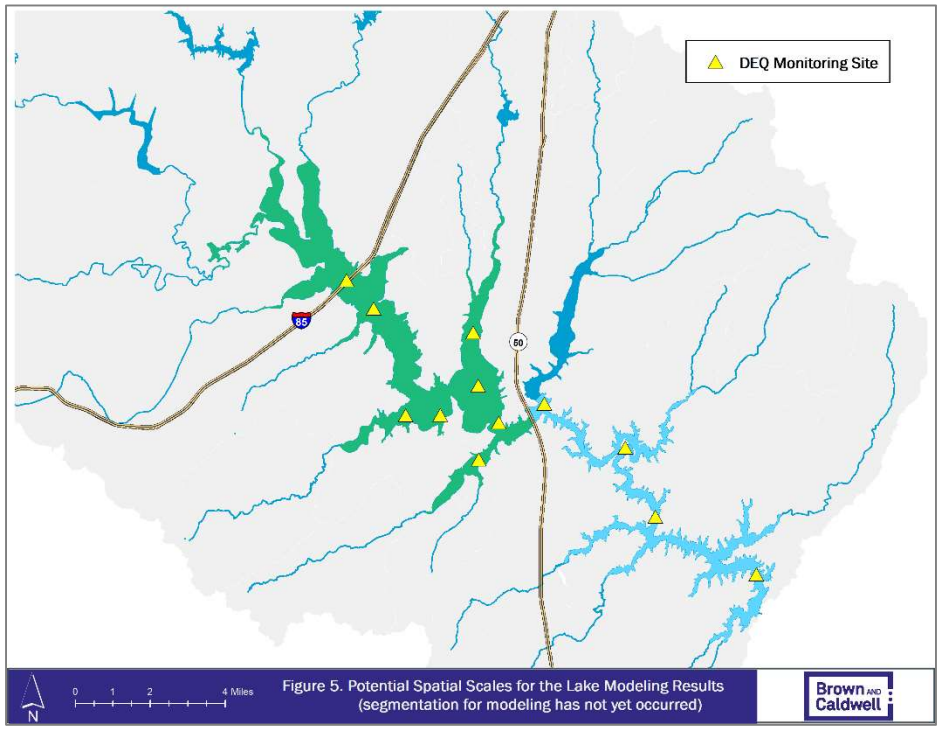
- Understand how **watershed management** affects levels of nutrients, chlorophyll, and carbon in the lake
- Understand the relationship between **nutrient loading and lake water quality**
- Quantify all of the **in-lake sources** of nutrients and carbon
- Quantify all of the **external sources** of nutrients and carbon
- Understand how **seasonal loading and flow patterns** affect water quality in the lake
- Predict **differences in water quality** in different portions of the lake (e.g., upper lake vs lower lake, tributary arms vs. main stem)
- Understand the variability in water quality from **year-to-year**

Next 7 Requests of Lake Model in Order of Importance

- Understand how **rainfall patterns, residence time, and causeways** affect water quality
- Predict water quality released to the **Neuse River** at the dam
- Understand how **lake management/operations** affect water quality
- Quantify the **reservoir of nutrients in the Falls Lake sediments** and understand how long it will take for those stores to deplete
- Evaluate a **range of weather conditions and long-term response to management**
- Ask “What if” questions such as Climate Change: what does **extreme weather/rain** do to lake health?
- Predict water quality at the **water supply intake**

Desired Summary Units for Lake Modeling in Order of Importance

- Spatial scale
  - Lake arms and incremental segments
  - Many locations to demonstrate how much water quality varies across the lake and how designated uses are maintained
  - Upper and lower lake (divided at Hwy 50)
  - Each DWR monitoring station
  - For the whole lake
- Temporal scale
  - Monthly
  - Daily
  - Seasonally
  - Annually
  - Weekly
  - Quarterly



Highlights from November Annual Conference of the NC American Water Works Association & NC Water Environment Federation

Development and Implementation of Nutrient Reduction Practices by the UNRBA

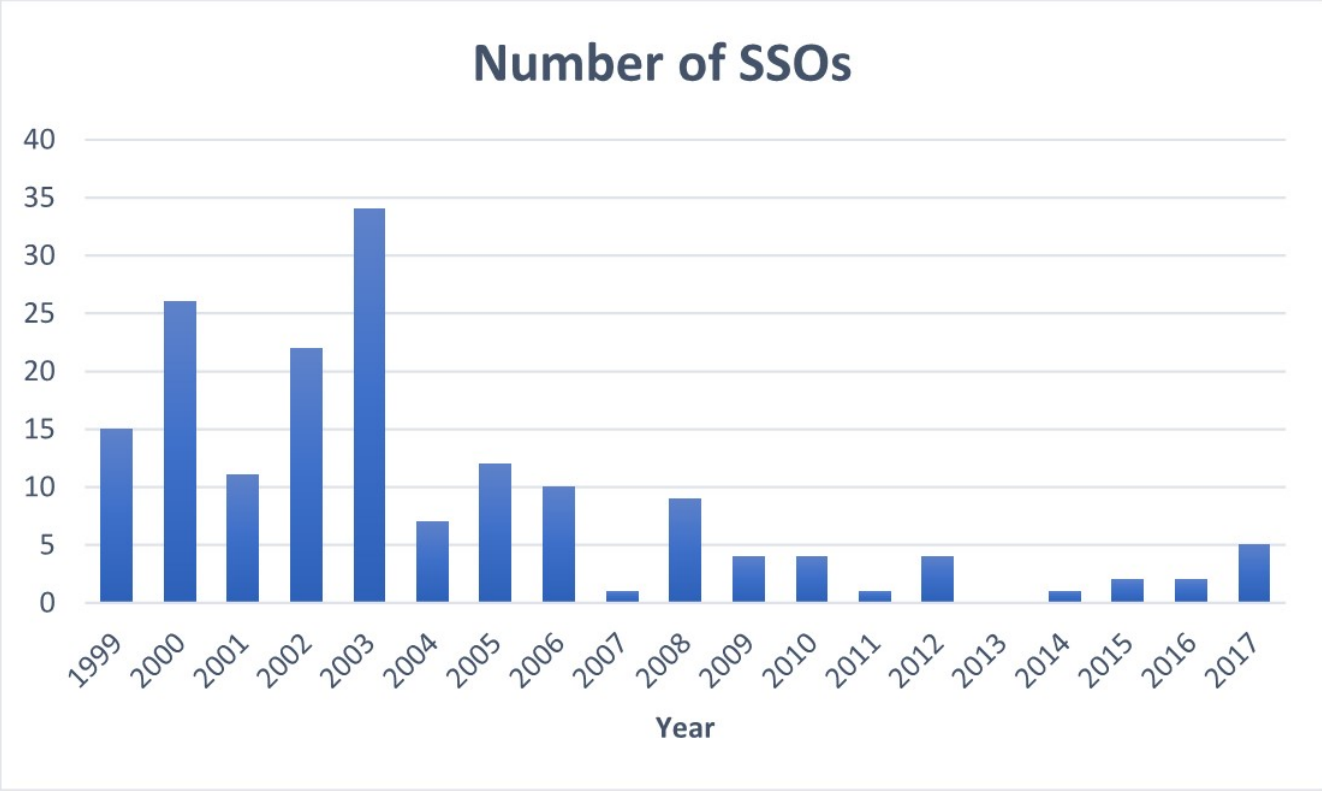
- Provided a background of the Falls Lake Nutrient Management Strategy
- Described challenges associated with meeting the stringent load reductions
- Summarized the UNRBA Nutrient Credit Project
- Provided links to new practices
  - UNRBA website
  - NC Stormwater Crediting Manual
- Described examples of practices implemented in the watershed

Year 2017 Projects Implemented for New Development

Community	Wet Pond	Bioretention	Dry Pond	Filterra	Stormfilter	Under-ground Detention	Stormwater Wetland	Level Spreader Filter Strip	Infiltration Trench	Swales	Stormwater Sand Filter	Cisterns
Butner	2	1										
City of Durham	4	4	2	1		2	1				5	
Granville County	1		1									
Hillsborough	3	4		3	2	4						
Orange County							2					
Person County			1					1				
Raleigh		1							1			
Wake County	7	2	12				7	7		2		2
Wake Forest		2										
Total (68)	**17**	**14**	**16**	**4**	**2**	**6**	**10**	**8**	**1**	**2**	**5**	**2**

Reducing Sanitary Sewer Overflows

- Town of Hillsborough aging infrastructure project
  - Significantly reduced the number of SSOs



Soil Improvement

- Town of Hillsborough pilot project at the town cemetery
  - Project cost = $1500
  - Included tillage, compost amendment, seeding and stabilization
  - Nitrogen credit – 0.05 lbs/yr
  - Phosphorus credit – 0.01 lbs/yr

Bioretention Cell

- Town of Hillsborough retrofit project at Cates Creek Park
  - Retrofit designed to divert parking lot runoff into an existing bioretention cell
  - Project cost = $41,754
  - Nitrogen credit – 1.8 lbs/yr
  - Phosphorus credit – 0.33 lbs/yr

Land Conversion

- Town of Hillsborough project at Public Works Facility
  - Includes removal of two buildings and a parking lot and planting in native species
  - Estimated project cost = $165,000
  - Nitrogen credit – 6.76 lbs/yr
  - Phosphorus credit – 0.82 lbs/yr

Durham County Soil and Water Conservation District Stream Restoration Projects

- Marbrey-Jackson Project
  - Estimated project cost = $650,000
  - More than 3,000 linear feet of stream restoration
  - 8 acres of land conservation
  - Nitrogen reduction – 495 lbs/yr
  - Phosphorus reduction – 41 lbs/yr
- Walker Project
  - Estimated project cost = $400,000
  - Includes more than 2,200 linear feet of stream restoration and 8 acres of land conservation
  - Nitrogen reduction – 270 lbs/yr
  - Phosphorus reduction – 22 lbs/yr

Photos courtesy of Durham County Soil and Water Conservation District

Durham County Soil and Water Conservation District Stormwater Projects

- Southern High School
  - Estimated project cost = $525,000
  - Stormwater wetland
  - Wet detention reuse pond
  - Bioretention cell
  - 2.2 acres of land conservation
  - Nitrogen credit – 74 lbs/yr
  - Phosphorus credit – 9.5 lbs/yr

Photo courtesy of Durham County Soil and Water Conservation District

The North Carolina Association of Soil and Water Conservation Districts selected Durham Soil and Water Conservation District as the 2018 "Conservation Technical District of the Year."

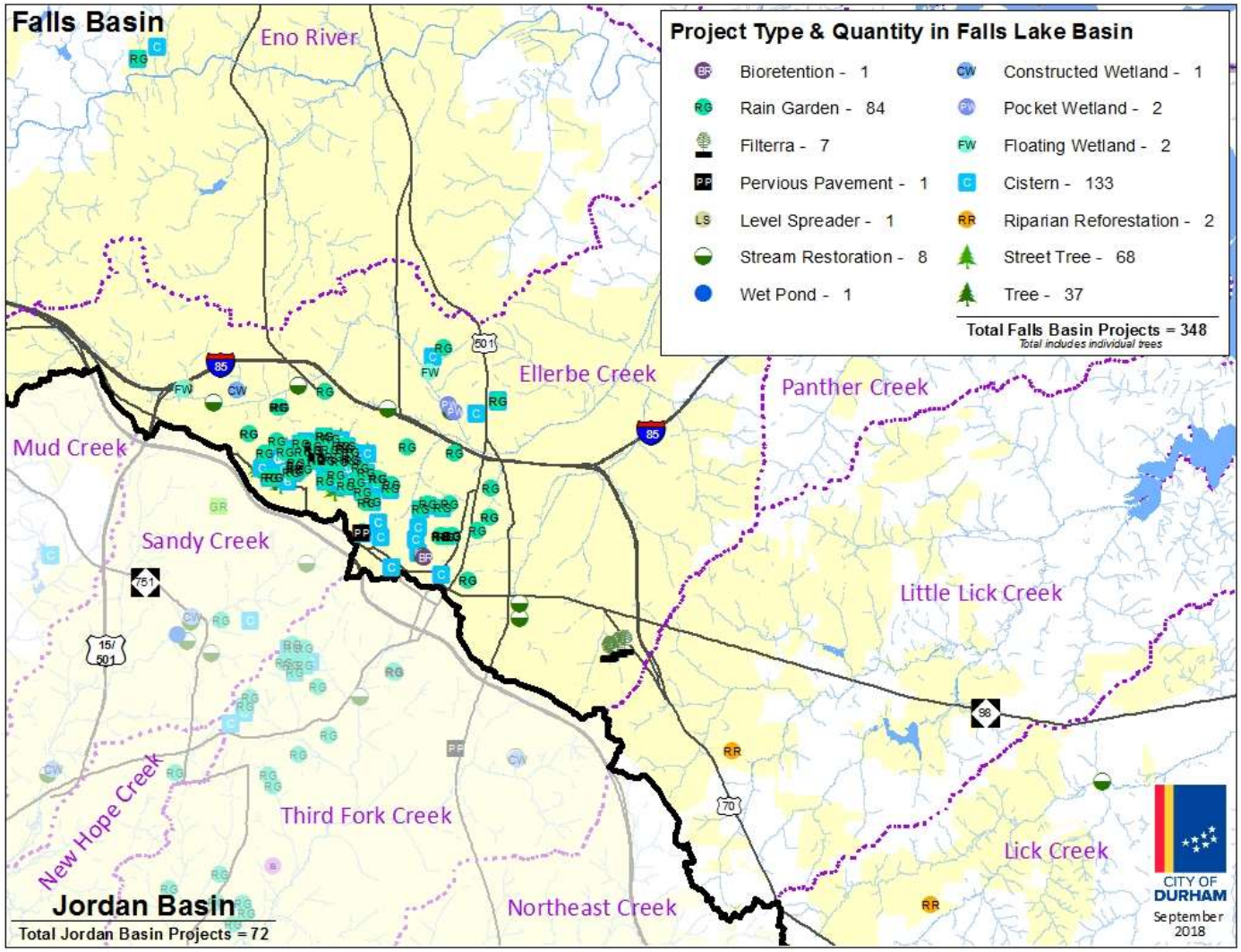
South Ellerbe Stormwater Wetland

- City of Durham retrofit project at former Duke Diet and Fitness Center near Downtown Durham
  - Project cost = ~$8,000,000 (plus amenities)
  - Retrofit wetland designed to treat 485 acres of developed downtown area. 2.1 acres of impervious area including a building will be removed.
  - Nitrogen credit – ~500 lbs/yr
  - Phosphorus credit – ~80 lbs/yr

Rain Gardens and Cisterns

- City of Durham Small Scale Retrofits over 80 rain gardens and over 130 cisterns installed (ongoing program)
  - Estimated project cost = $500 -$1500 per device
  - Includes Nitrogen credit – < 1.0 lbs/yr per device
  - Phosphorus credit – < 1.0 lbs/yr per device

City of Durham Retrofits (348 Falls Projects) for Existing Development Compliance

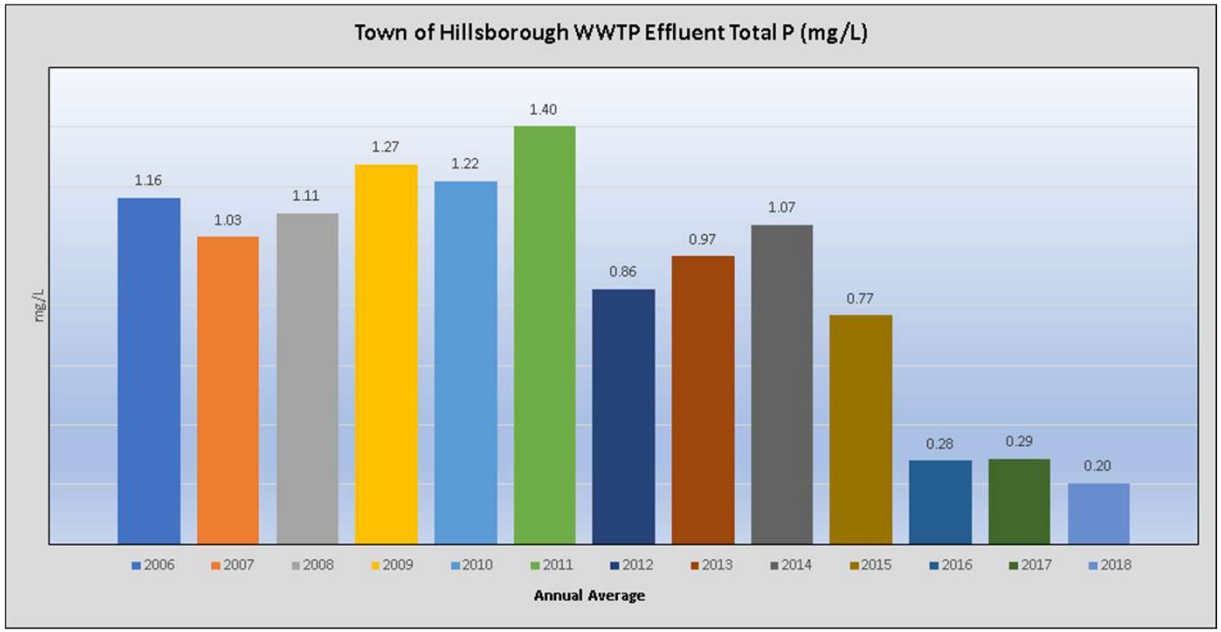


Algal Floway (Algal Turf Scrubber)

- City of Durham potential retrofit project (pilot study completed)
  - Project cost = $5.7 million to $9.6 million
  - Retrofit designed to harvest algae to provide nutrient pollution removal. 10 – 25 MGD sizes.
  - Nitrogen credit: ~2800 - 7000 lbs/yr
  - Phosphorus credit: ~500 - 1200 lbs/yr

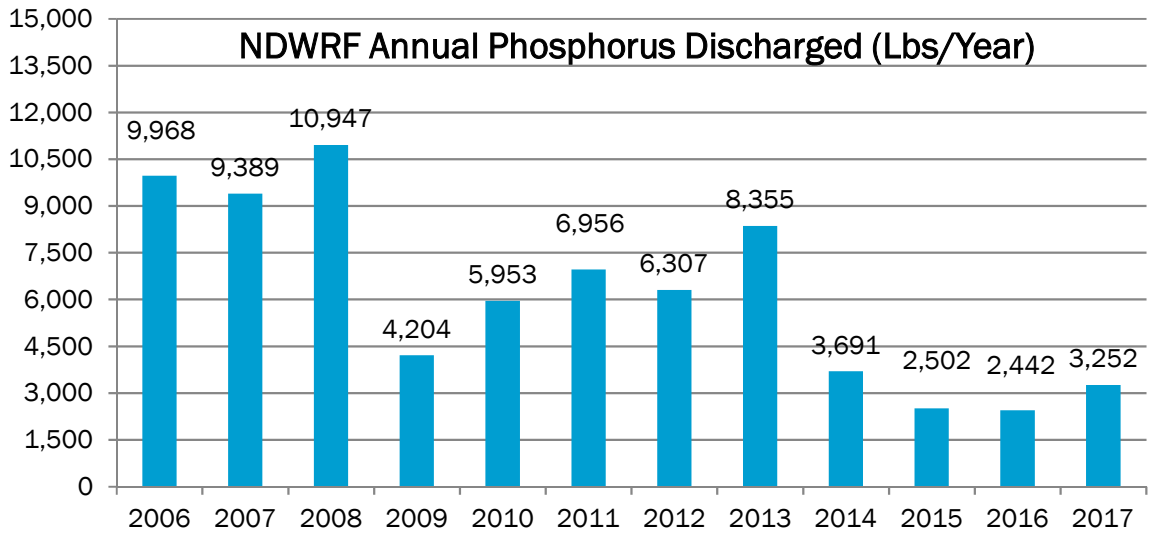
Improvements at Wastewater Treatment Facilities

- Town of Hillsborough - $16 million in upgrades
  - Total nitrogen concentrations reduced from ~14 mg/L to ~ 2 mg/L
  - Total nitrogen loads reduced by 29,000 lb/yr
  - Total phosphorus concentrations reduced from 1.4 mg/L to 0.2 mg/L
  - Total phosphorus loads reduced from 2,900 lb/yr



Improvements at Wastewater Treatment Facilities

- South Granville Water and Sewer Authority
  - Total nitrogen concentrations reduced from ~6 mg/L to ~ 2.5 mg/L
  - Total phosphorus concentrations reduced from ~0.78 mg/L to ~ 0.3 mg/L
- North Durham Water Reclamation Facility (relative to 2006)
  - Total nitrogen loads reduced by 31,528 lb/yr
  - Total phosphorus loads reduced by 6,716 lb/yr



Land Conservation

- 9,330 acres of land have been conserved since 2006 with a total cost of $78 million
- Cost effectiveness depends on the amount of credit which has been under negotiation since 2014
  - Nitrogen: $6,000/lb-N to over $800,000/lb-N
  - Phosphorus: $36,000/lb-P to over $400,000/lb-P

Example Durham County conservation site (Triangle Land Conservancy)

Range of Nitrogen Credits for Land Conservation

Nitrogen Credit (lb-N/ac/yr)	Total Credit for All 9,330 Acres Conserved (lb-N/yr)	Cost Effectiveness ($/lb-N) assuming total costs of $78 million	Cost Effectiveness ($/lb-N) assuming cash investments of $68.66 million
1.2	11,196	$ 6,967	$ 6,133
1	9,330	$ 8,360	$ 7,359
0.62	5,785	$ 13,484	$ 11,869
0.54	5,038	$ 15,482	$ 13,628
0.5	4,665	$ 16,720	$ 14,718
0.45	4,199	$ 18,578	$ 16,353
0.35	3,266	$ 23,886	$ 21,026
0.25	2,333	$ 33,441	$ 29,436
0.1	933	$ 83,601	$ 73,591
0.07	653	$ 119,430	$ 105,129
0.01	93	$ 836,013	$ 735,906

Range of Phosphorus Credits for Land Conservation

Phosphorus Credit (lb-P/ac/yr)	Total Credit for All 9,330 Acres Conserved (lb-P/yr)	Cost Effectiveness ($/lb-P) assuming total costs of $78 million	Cost Effectiveness ($/lb-P) assuming cash investments of $68.66 million
0.2	1,866	$ 41,801	$ 36,795
0.1	933	$ 83,601	$ 73,591
0.061	569	$ 137,051	$ 120,640
0.052	485	$ 160,772	$ 141,520
0.05	467	$ 167,203	$ 147,181
0.043	401	$ 194,422	$ 171,141
0.035	327	$ 238,861	$ 210,259
0.02	187	$ 418,006	$ 367,953
0	0	Not applicable	Not applicable

Comparison of Costs per Pound

Project	Project Cost	$/lb-N/yr	$/lb-P/yr
UNCWI Land Conservation	$ 78,000,000	$6K – 736K	$37K – 368K
Land Conversion at Public Works	$ 165,000	$ 24,408	$ 201,220
Cemetery Soil Improvement	$ 1,500	$ 30,000	$ 150,000
Bioretention Retrofit	$ 41,754	$ 23,197	$ 126,527
South Ellerbe Wetland	$ 8,000,000	$ 16,000	$ 100,000
Highschool Stormwater	$ 525,000	$ 7,095	$ 55,263
Walker Project	$ 400,000	$ 1,481	$ 18,182
Marbrey-Jackson Project	$ 650,000	$ 1,313	$ 15,854
Algal Floway	$ 7,650,000	$ 1,561	$ 9,000
Hillsborough WWTP Upgrades	$ 16,000,000	$ 552	$ 5,517
Rain Gardens/Cisterns	$ 1,000	>$1,000	>$1,000

For comparison, gold cost $1,233 per ounce,
or $19,728 per pound based on 11/5/2018 data.

Summary of Activities in the Watershed

- New development regulations have been in effect since 2012
  - Limit increases in loading from new development
  - May decrease loading from some sites
- Significant reductions in loading from WWTP's have been realized
  - The three major facilities are meeting or exceeding the Stage 1 reduction requirements
- Agriculture has exceeded their Stage 1 requirements
- Several local governments are implementing practices to reduce loading from existing development
  - Conventional stormwater practices
  - New practices or design variants funded by the UNRBA
  - Innovative practices like the algal turf scrubber

Questions ?