

ATTACHMENT B

Watershed Based Plan

Name of Project: Denso Eco Park/North Mouse Creek Restoration Project

Lead Organization: City of Athens

Watershed Identification (name, location, 12-digit HUC, etc.): TN06020002084-1000 North Mouse Creek miles 22.61

Causes and Sources of Nonpoint Source Pollution in the Watershed

The water quality problems within the North Mouse Creek watershed include pathogen loads, siltation, habitat degradation and nutrient enrichment. The current 303d listing is for pathogens, total phosphorus, and alteration in stream-side or littoral vegetative cover. The listed causes in the 2014 303d List include **municipal point source, pasture grazing, and discharge from the MS4 area.**

During the past 5 years we have restored North Mouse Creek in the most visible location of impairment at the Athens Regional Park. This project was done with a Tennessee Department of Agriculture 319 Grant as well as Mitigation funds from TDOT. This project resulted in a mile of stream restoration. This section of North Mouse Creek is being monitored yearly and a TWRA fish shocking this summer found 21 species of fish some of which were pollutant intolerant species. We believe this section of North Mouse is functioning well, but we still have problems upstream and our biggest concern in making sure nonpoint source pollutants are removed before entering North Mouse Creek. The problem is we own very little property on the North Mouse Creek, but UT extension and TDA, and NRCS have done a great deal of work in this watershed to address the source of pollutants coming from pasture grazing and unfortunately farming in North Mouse Creek is becoming less an issue because more and more farmers are getting out of the business. In addition Athens Utility Board is making great progress in improving existing sanitary sewers and installing new sewers to areas with septic system which has addressed our concerns with municipal point source pollutants.

The biggest remaining cause of impairment is discharges from the MS4 area and nonpoint source pollutants. These pollutants enter the municipal storm water system going to North Mouse Creek from industrial, residential, and commercial sites with impervious surfaces. These impervious surfaces replaced natural plants and soils so where the normal filtering and uptake of fecal material, phosphorus, and nitrogen does not occur and those pollutants make it to North Mouse Creek. The pond at Denso Eco Park is an example of the problem as it collects sediments, nutrients, and pathogens from the 130 acre Industrial, commercial, and agricultural site. This is evident in the large amount of sediment built up in the pond and becomes re-suspended during large storm events.



The water in the ponds is very turbid and warm and does not support a diverse or healthy aquatic ecosystem.

The ponds also exhibit symptoms of the high nutrient loads being received from the surrounding 130 acres that pass through the pond going to North Mouse Creek. The incoming nutrients have made the ponds eutrophic and caused algal blooms.

Water temperatures are also being adversely affected by the ponds. Comparatively cool water enters the wide, shallow and unshaded ponds; leaving considerably warmer. This temperature increase is likely to negatively impact the downstream aquatic community in North Mouse Creek.

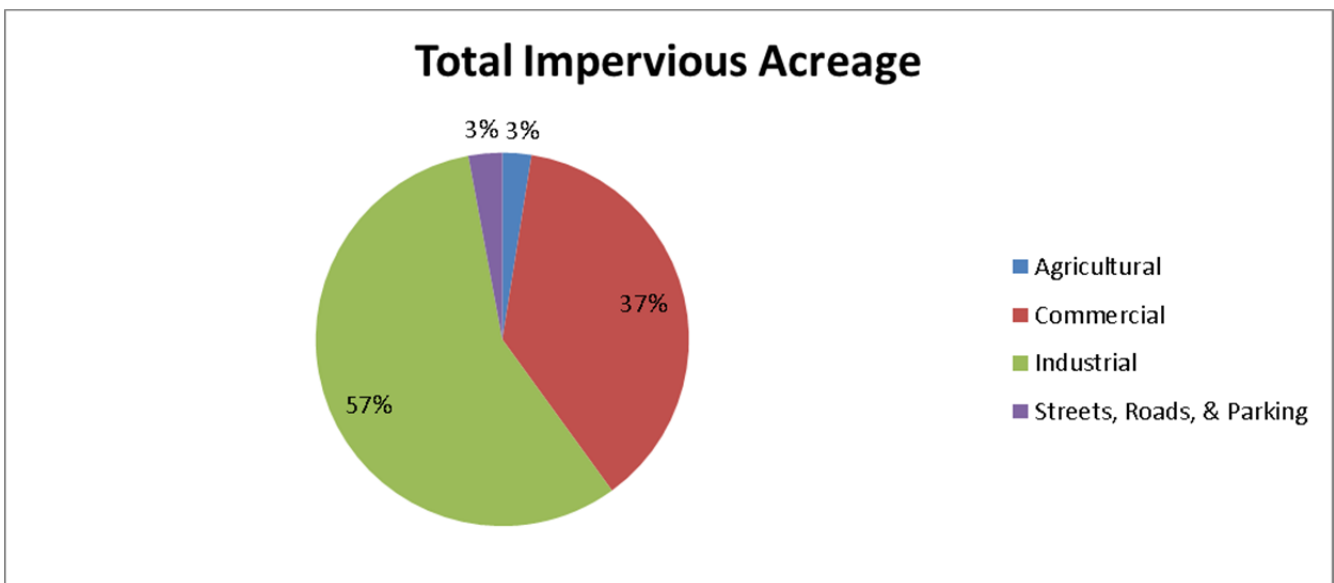
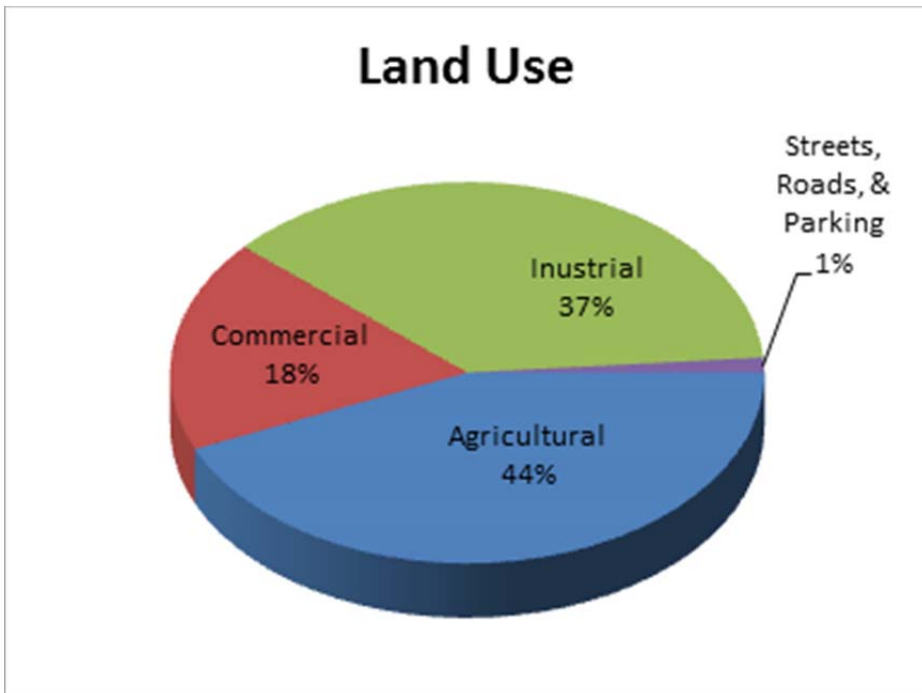
Finally, stream banks in the area of the ponds have been severely eroded. This erosion is harming the aquatic habitat and adding to sediment loads. The erosion is caused by the increasing amount of imperviousness upstream. The ponds themselves may have contributed to stream bank erosion by extending the duration of channel forming flows. The pictures below show the channels and smaller ponds, which were recently cleared of privet and do not have native vegetation to hold them in place.





Watershed Runoff Characteristics

A derivative of the Watershed Treatment Model (WTM), created by EPA, was used to estimate the waste load going to the Denso Eco Park Property and some of the benefits of the BMP's proposed. The Tennessee NPS Program Pollutant Reduction Estimation Tool and The North Carolina Division of Water Quality Best Management Practices Manuals were also used to find the best waste reduction tools available to go into the EPA WTM model. Together these sources were used to determine sediment, fecal coliform, nitrogen and phosphorous loads based on land uses within the sub watershed. The WTM is a simple mass flux model based on yearly runoff volumes and constituent concentrations published in the literature. The sub watershed contributing to the Denso Eco Park ponds was broken into land uses. The distribution of land uses is shown below.



These land uses are considered the primary sources within the WTM. Impervious surfaces, industrial and commercial uses are the primary contributors of nutrients and fecal coliform. .

Secondary sources not directly tied to land use were also considered. Sediment loads from channel erosion and nitrogen loads from lawn fertilization were the main secondary source contributions. It was too difficult to calculate the loads of pathogens coming from Commercial, industrial and streets and road areas because averages from these land uses were not published because of too many variables. We did show the probably amount of bacteria in billions/acre from Agricultural lands draining to North Mouse Creek through this sub watershed.

Proposed BMP's Effects on Water Quality

The Farm Pond to Wetland approach This approach will convert a traditional farm pond into a constructed stormwater wetland and 3 different ecological zones will be demonstrated to show property owners 3 models. It will include components such as wetland plants, fore bays, sand filters, and aeration. Deeper pools exposed to solar light and aeration will also remove 50% or more of the bacteria. Pollutant reduction from Storm water Wetland has been found to remove on average 85% of total suspended solids, 40% Total Nitrogen, 35% of Total Phosphorus and 70% of the pathogens in this model.

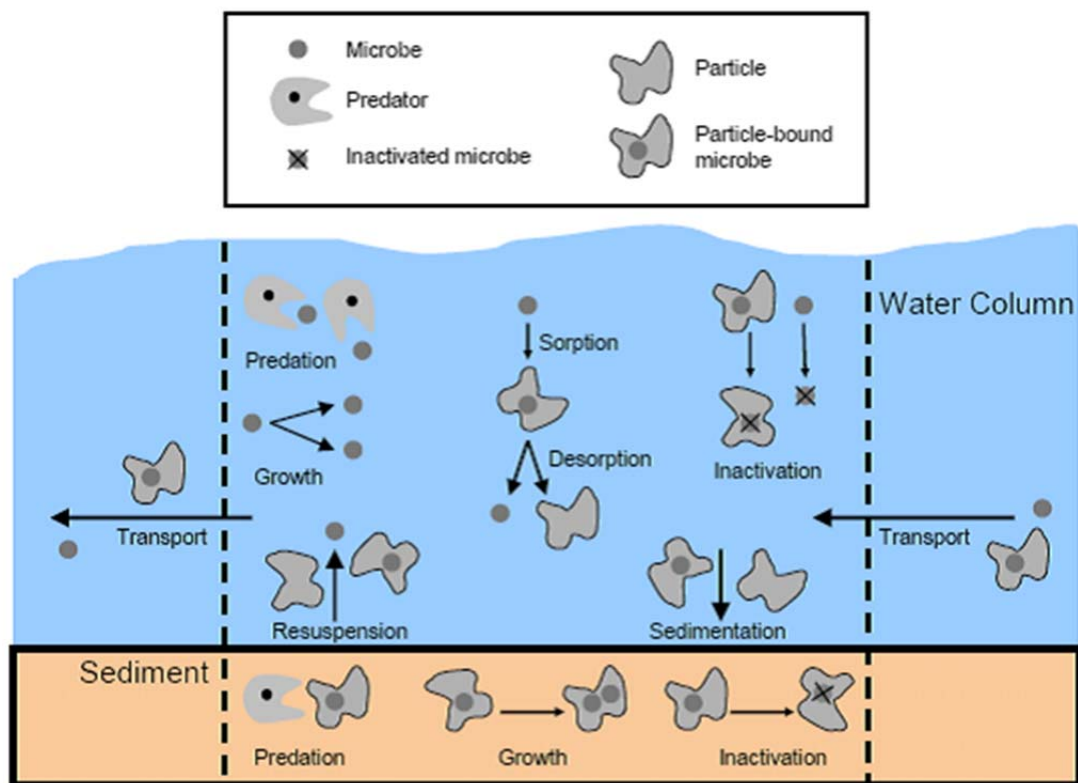


Figure 5. The Possible Fates of Microbes (Fecal Indicators and Pathogens) in Environmental Water and Sediment (the fate of nucleic acids may be different; this figure does not include those sources). SOURCE: Adapted from Olivieri et al. (2007).

Restored Riparian Buffer

Riparian buffers are very good at removing pollutants and require at least 50 feet. Our buffer will in many cases be much wider than 50 feet. It is estimated that the riparian buffer is capable of removing on average, 60% of the total suspended solids, 40% total nitrogen, and 35% total phosphorus.

Pervious Green Parking Lot

Pervious pavers and turf stone reduce the amount of runoff from a site which reduces the amount received by the stream including the pollutants they carry. The reduction in runoff that we expect based on the current soils and drainage area is about 25% so by reducing runoff by 25% you reduce the amount of nitrogen, phosphorus, and suspended solids by 25% as well.

Rooftop Disconnection

Rooftop disconnection works similarly to pervious parking lots by reducing the amount of runoff from a site. The amount expected from this BMP is a 25% reduction in runoff.

Education Programs

The biggest reduction in nonpoint sources will be from our education and demonstration programs. This is also the least quantifiable. If our project leads to other farm ponds being converted to natural swimming pools, improved riparian buffers, wetlands plantings, or the addition of floating wetlands than those areas will give us a gain in total wetland acres in the Hiwassee Watershed and reduce phosphorus, sediment, pathogens, and nitrogen going into our streams in addition they will reduce the temperatures of the waters and increase oxygenation. The world has no environmental problems only problems with people. Our biggest success in this project will be the impacts from changing the people in our watershed in how they look at development, farm ponds, wetlands, and various BMPs. The roof disconnect project is meant to show people how an existing roof can train directly in to rain gardens located below the drip line and be part of the sites landscaping. The green parking lot will also be an example of green development in a place that will influence thousands of visitors a year. Our educational programs directly related to this project will include the following:

1. Guided and Unguided tours of the Eco Park to learn the functions of the various BMPs and how to incorporate. Participants will have and up close encounter with wetlands along the board walk and will gain an appreciation for the plants, animals, and processes of our natural wetlands.
2. Boardwalk with information along it will give participants access to the constructed wetland and they will learn how constructed wetlands can remove pollutants and increase habitat. Fishing will also be permitted in this constructed wetland as deep pools will support an array of fish.
3. How to build a floating wetland class. Participants will learn how to build a floating wetland
4. Plant harvest days- At the Denso Eco Park as well as at the EG Fisher Wetland we will advertise native plant harvest days to remove various plants that are becoming too abundant or when monoculture start to develop. This may include live stake making and removal of submergent plants. Plants will be harvested for the participant to take home and plant or for other stream or wetland projects within the Watershed.

Estimate of Load Reductions

Estimated Loads

Land Use	Total Impervious Acreage	Acres	Total Nitrogen	Total Phosphorus	Total Suspended Solids
Agricultural	1.14	57.03	132,186	19,828	2,643,726
Commercial	17.05	23.68	21,956	2,196	823,332
Industrial	25.95	48.97	56,752	9,080	2,724,088
Streets, Roads, & Parking	1.33	1.66	2,309	385	115,461
Totals	45.47	131.33	213,203	31,489	6,306,607

Water quality testing in recent years shows the current farm pond with E. Coli Counts about 2,400. The chart above shows the likely pollutant loads going to the existing farm pond and continuing to North Mouse Creek through an unnamed stream.

Pollutant Reeducation by BMP using the EPA WTM

							Effectiveness and WQv of Retrofits						
Water Quality Volumes							WQv (cf)	Effectiveness (%)					
	Area Captured (acres)	Impervious Percentage	Is this a Retrofit of an Existing Facility?	What Practice Was the Original Facility?	Dominant Soil Type in Drainage Area	Depth to Groundwater (from Practice Bottom)	Target WQv	TN	TP	TS	Bacteria	Runoff Reduction	
Practice Type													
Stormwater Wetland	130	35%	Yes	Grass (open) Channel	D Soils	3-5 Feet	233,590.50	40%	75%	85%	70%	0%	
Permeable Pavement	1	25%	Yes	Grass (open) Channel	D Soils	>5 Feet	1,542.80	25%	25%	25%	0%	45%	
Riparian Buffer	11	5%	Yes	Grass (open) Channel	D Soils	>5 Feet	11,380.10	85%	41%	46%	0%	0%	
Rooftop Disconnection	0.1	100%	Yes	Grass (open) Channel	D Soils	>5 Feet	190	0%	0%	0%	0%	25%	
Totals/averages	142.1	33%					246,703.30	42%	73%	83%	66%	0%	

BMP List, Educational Activities and Budget

BMP Name	Quantity	Cost/Unit	Budget Estimate
Stormwater Constructed Wetland with Board Walk	2.26 acres	\$47,345	\$107,000
Green Parking Lot Pervious Pavers and Turf Stone	19,495 Sq./ft.	\$3.85	\$79,100
Improved Riparian Buffer	6.94 acres	\$10,943.80	\$75,950.00
Roof Disconnect Project	2,400 Sq./ft.	\$3.42	\$8,200
Total			\$270,250

Educational Event	Quantity	Cost/Unit	Budget Estimate
Learn to build a floating wetland	1 per year	0	0
Wetland Plant Harvesting to plant at home ponds	1 per year	0	0
Eco Park Tours	Weekly- Monthly	0	0
Snorkeling Tours of Natural Pools and Fish of North Mouse	Monthly during summer months	0	0
Total			0

Total Budget for Project:

\$270,250

Timeline, Tasks, and Assessment of Progress

Tasks	Time Line	Benchmark/Progress
Publish RFQ and Select Consultant Firm	2 month from award	Firms will be solicited and selected within two months of contract signage.
Purchase Green Parking Lot Materials	3 months from Award	We have already designed this parking lot so material amounts are known and bidding can take place as soon as contract for grant is executed.
Begin Installation of Green Parking Lot	4 months from Award	This task is weather dependent and some will be installed by City Crews. If this task falls behind it may be contracted out in part or in total to meet deadline for completion.
Receive finished plans and permit application	6 months from Award	RFQ will include a short turnaround time for end product to make sure this timeline is made. Consultant firm will be asked not to submit and proposal unless they can meet our time line.
Complete Green Parking Lot and Rooftop disconnect rain garden	8-12 months from Award	The pavilion is complete and city crews with other funds will be building retaining walls and landscaped platforms that the rain gardens will be built within making their construction easier. The plants may need to be planted in early spring or fall, but that should be the only delay.
Receive Permits and begin Constructed Wetland of Farm Pond	12 months from Award	We are currently talking with TDEC ARAP section to make sure

construction and restoration efforts		that we understand the permitting process and we have had TDEC local field office to the site a few times. We have already submitted a General Construction Permit that may be modified later, but this should speed up the permitting process.
Submit Progress Report as specified by the Contract	12 months from Award or by September 15 of first year.	We do weekly and monthly reports on all projects so annual reports are very easily put together.
Complete constructed wetland and stream and wetland restoration efforts	22 Months from Award	This could be delayed because it is very weather sensitive so even though project should be completed in the first 2 years and 3 time if requested in case we miss the first or second construction season.
Complete Educational Materials	25Months from Award	The educational materials are already being developed and our partners are working on others. The grant funding is just to print these materials and install kiosk.
Complete final wetland and stream plantings	26 Months from Award	This is dependent on the completion of the farm pond retrofit. The planting only takes a few days to complete and Keep McMinn Beautiful has agreed to organize it whenever it is needed. Planting of trees will take place during dormant season and wetland plants can go in from

		spring to fall.
Submit Progress Report as specified in the contract	12 months from Award or by September 15 of second year.	We do weekly and monthly reports on all projects so annual reports are very easily put together.
Complete Presentation on Lessons Learned and how to go forward with Farm Pond to Wetland Program.	28 Months from Award	This presentation will be developed through process so we document all the lessons learned so putting together the presentation will only take a day when project is finished.
Submit Close Out Report as Specified by Contract	36 months from Award	Close out could take place much sooner, but was placed at 36 months in case any trouble arises in the project due to weather or permits.
Educational Programs	During and after Award	Educational programs have started on this site before any work was completed and will continue through the project and after the project with the programs listed with the help of UT Ext. and other agencies.

Criteria to Assess Achievement of Load Reduction Goals

The City of Athens will continue regular monitoring of this site with other areas of our MS4 program including Visual Stream survey, pathogens, and macroinvertebrate studies. We are also working to purchase instream monitors for conductivity, PH, and biological oxygen demand and will use it to monitor progress as well.

Monitoring and Documenting Success

The city of Athens has a monitoring station right below this site where the unnamed

tributary enters the North Mouse Creek. We conduct macroinvertebrate testing, visual stream surveys, and pathogen monitoring at this site every 5 years. This site will become a city park at its unavailing and will be included in our permanent stormwater pollution prevention plan for the site which will require monthly monitoring to be sure it is functioning properly. In addition TDEC is a valuable member of our watershed team and we will work with them to make sure their monitoring efforts will be useful to gauging our success in this project and in this sub watershed. Beside the raw data of sampling there are several other ways to monitor and document the success of this project. Here are some of the ways we will track its success:

1. Number of tours per year conducted at the site
2. Park attendance
3. Number of private farm ponds/acres modified to include a wetland BMP such as a floating wetland, constructed wetlands, riparian improvements, or berm removal so it will return to natural wetland.
4. Attendance at special programs
5. Number of professional attending programs
6. Number or projects that are inspired to use green parking lot technologies or roof disconnects.

The next tributary and sub watershed going to North Mouse is immediately adjacent to this property and success of this project should help us to acquire several more acres of wetlands on this property also owned by McMinn Economic Development Authority. These properties will be developed into high functioning and protected wetlands with walking trails that connect to the Denso Eco Park. It is our hope that this will take place before the Tennessee Wetland Festival outgrows our currently location at the EG Fisher Library Wetland Park on the Oostanaula so we can keep this festival in Athens. I believe the success of this project will facilitate this next project and if we are unsuccessful it is less likely to be realized.

Athens hopes to apply or be part of a UT or state application EPA for a Farm Pond to Wetland Development Grant. If that grant is applied for and successful at bringing the Farm Pond to Wetland Program approach to the entire state of Tennessee then this program would be considered a tremendous success.