Swearing Creek Watershed

GIS Modeling & Policy Recommendation Update

STAKEHOLDER MEETING # 6

JUNE 13, 2017

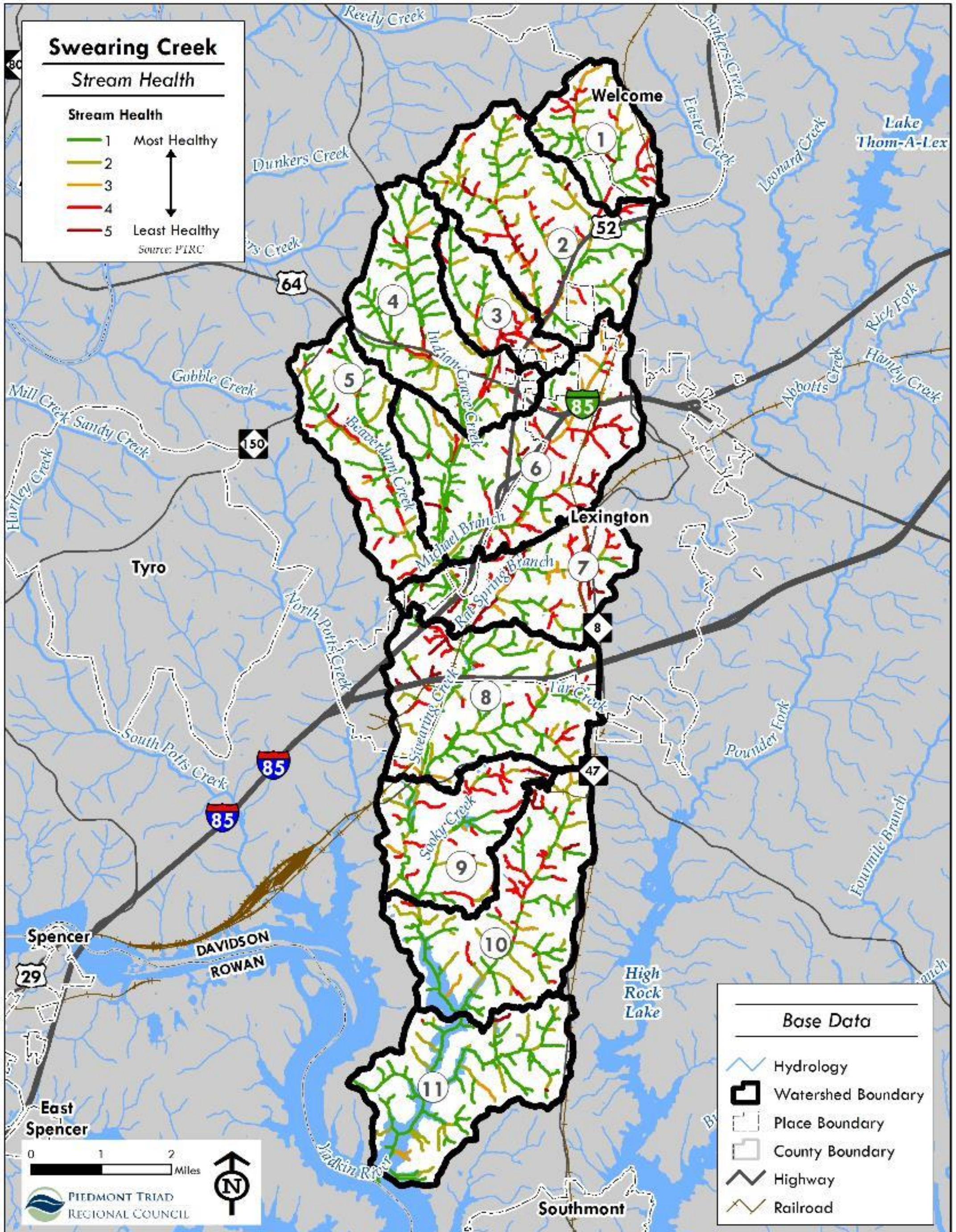
GIS MODELING

1. Buffer Analysis
2. GLWF Sediment & Nutrient Analysis
   - BMP Modeling

3. Project Prioritization

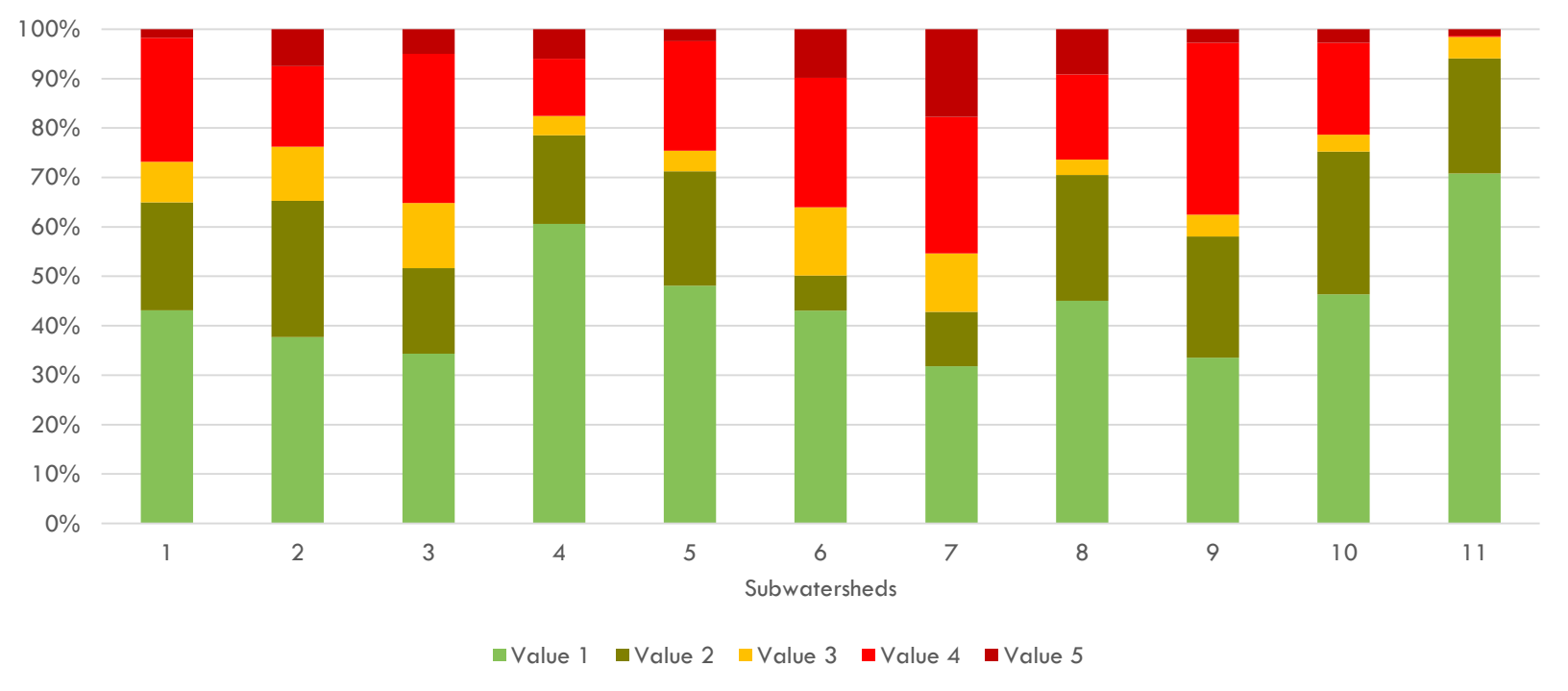
BUFFER ANALYSIS

- Reviewed vegetated cover within 100-foot stream buffer for each stream segments identified in the ArcHydro analysis (2,040 segments)
  - Only 364 segments in the NHD flowline dataset
  - These results will go into final GIS analysis for project prioritization
  - 5 tiered system:
    1. **Pristine** – complete cover
    2. **Impacted** – majority cover with some human activity
    3. **Managed** – human activity degrades streams; buffer absent on one side
    4. **Degraded** – buffer mostly absent on both sides
    5. **Absent** – no vegetated buffer



Swearing Creek
Stream Health
Stream Health
1 Most Healthy
2
3
4
5 Least Healthy
Source: PTRC
Base Data
Hydrology
Watershed Boundary
Place Boundary
County Boundary
Highway
Railroad
Welcome
Lexington
Tyro
Spencer
East Spencer
Southmont
DAVIDSON
ROWAN
High Rock Lake
Lake Thom-A-Lex
Miles
Piedmont Triad Regional Council

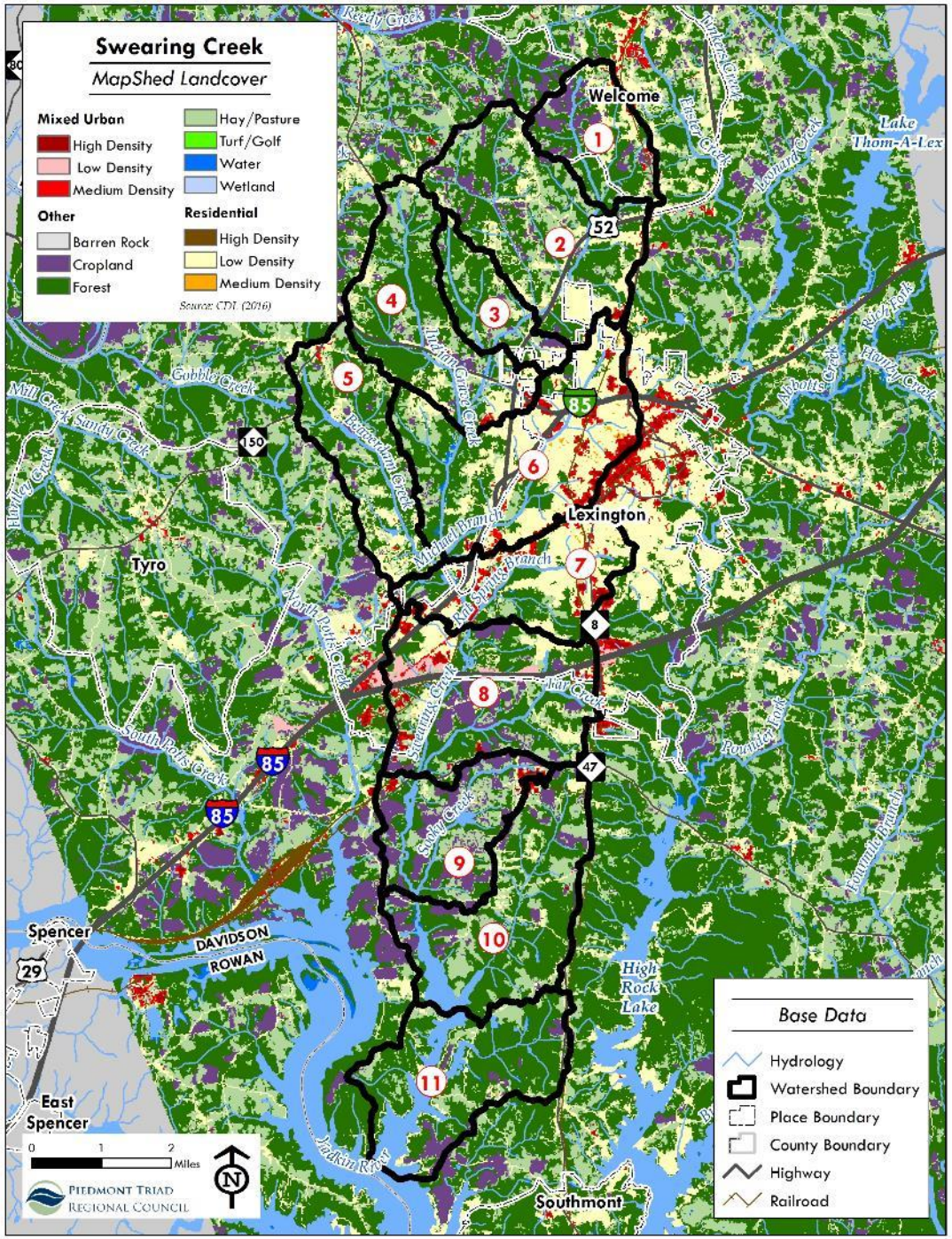
BUFFER ANALYSIS BY SUBWATERSHED



GWLF MODEL USING MAPSHED

- Generalized Watershed Loading Function (GWLF)
  - Assesses non-point source flow and sediment and nutrient loading from urban and rural watersheds
  - Simulates runoff, sediment, and nutrient loadings (N & P) from a watershed given land covers
  - Will model BMPs

- Compared existing land cover (CDL 2016) to an all forested condition to model the effects of land use.



SEDIMENT ANALYSIS

- **Landscape erosion -** Sediment is generated by water moving across the terrain
- **Streambank erosion -** water flowing through channels
- Under completely **forested conditions,** streambank erosion contributes 71% (880 tons) of sediment while the forested landscape contributes only 29% (353 tons)
- **Existing land use conditions** show a substantial **increase** in the predicted transport of sediment.
  - **9.1** times the amount of landscape sediment
  - **12.7** times the amount of streambank sediment *(largely due to increases in runoff and streamflow in urban settings)*

FORESTED VS. EXISTING LAND USES

GWLF Total Loads for file: sc_total_forest-1

Source	Area (Acres)	Runoff (in)	Tons	
			Erosion	Sediment
Hay/Pasture	0	0.0	0.0	0.0
Cropland	0	0.0	0.0	0.0
Forest	31531	0.7	3317.2	352.6
Wetland	0	0.0	0.0	0.0
Disturbed	0	0.0	0.0	0.0
Turfgrass	0	0.0	0.0	0.0
Open Land	0	0.0	0.0	0.0
Bare Rock	0	0.0	0.0	0.0
Sandy Areas	0	0.0	0.0	0.0
Unpaved Roads	0	0.0	0.0	0.0
LD Mixed	0	0.0	0.0	0.0
MD Mixed	0	0.0	0.0	0.0
HD Mixed	0	0.0	0.0	0.0
LD Residential	0	0.0	0.0	0.0
MD Residential	0	0.0	0.0	0.0
HD Residential	0	0.0	0.0	0.0
Farm Animals				
Tile Drainage				0.0
Stream Bank				880.4
Groundwater				
Point Sources				
Septic Systems				
Totals	31530.6	0.70	3317.2	1233.0

9.1 x

12.7 x

GWLF Total Loads for file: sc_total_existing-1

Source	Area (Acres)	Runoff (in)	Tons	
			Erosion	Sediment
Hay/Pasture	5693	1.0	5260.5	559.2
Cropland	2785	2.5	21835.7	2321.1
Forest	13386	0.7	1910.3	203.1
Wetland	7	6.8	0.3	0.0
Disturbed	0	0.0	0.0	0.0
Turfgrass	0	0.0	0.0	0.0
Open Land	0	0.0	0.0	0.0
Bare Rock	5	6.8	0.2	0.0
Sandy Areas	0	0.0	0.0	0.0
Unpaved Roads	0	0.0	0.0	0.0
LD Mixed	282	2.9	0.0	2.8
MD Mixed	806	8.5	0.0	38.8
HD Mixed	418	12.2	0.0	20.1
LD Residential	7339	2.9	0.0	73.1
MD Residential	79	5.0	0.0	3.8
HD Residential	5	7.0	0.0	0.2
Farm Animals				
Tile Drainage				0.0
Stream Bank				11189.1
Groundwater				
Point Sources				
Septic Systems				
Totals	30804.1	1.90	29007.0	14411.5

SUBWATERSHED SEDIMENT ANALYSIS

- In urban subwatershed 6
  - **2** times the amount of landscape sediment
  - **193** times the amount of streambank sediment *(largely due to increases in runoff and streamflow in urban settings)*
  - Need for stormwater BMPs
- In agricultural subwatershed 9
  - **43** times the amount of landscape sediment
  - **6** times the amount of streambank sediment
  - Need for agricultural BMPs
  - Cropland has the highest sediment loading (tons/acre)

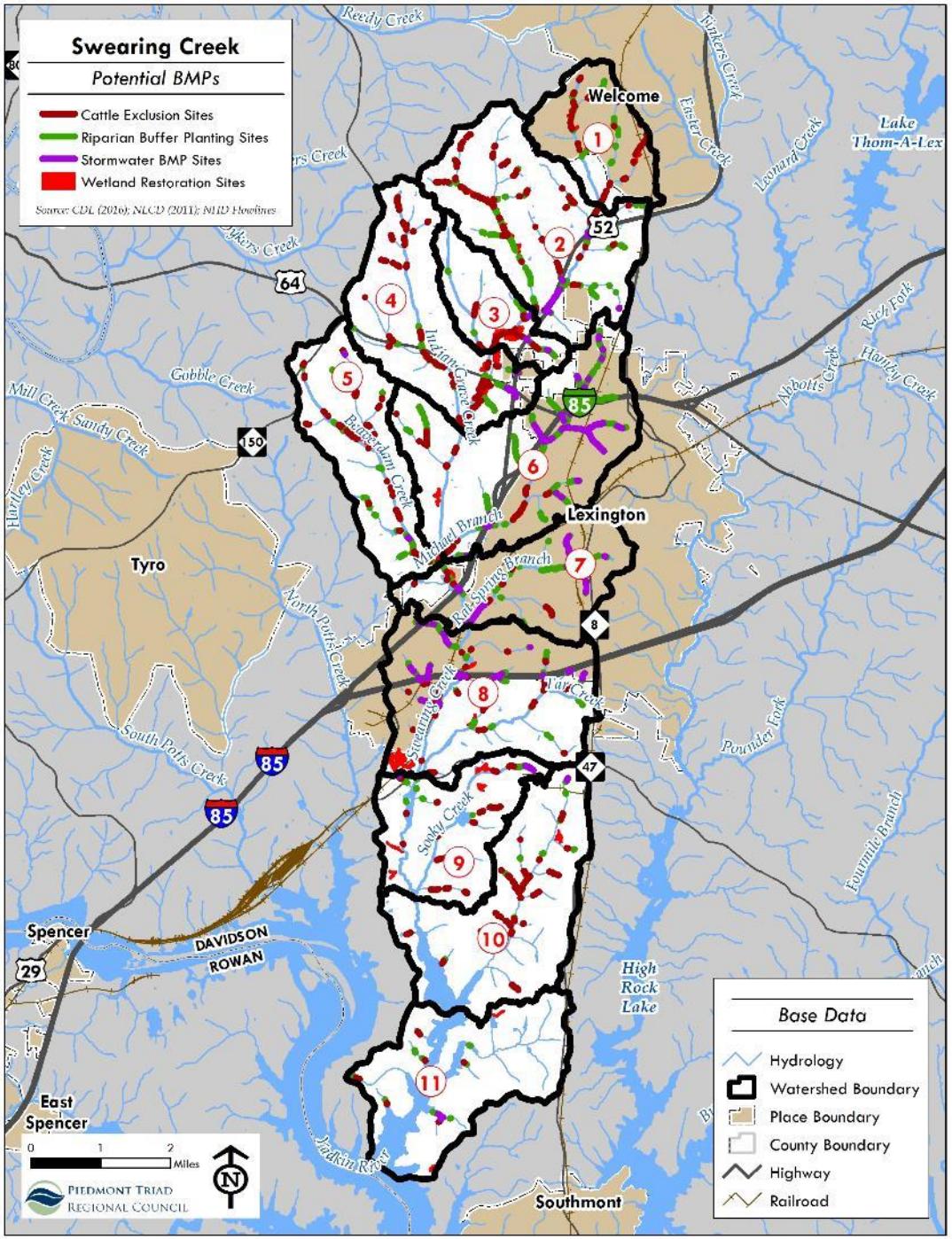
MAPSHED NEXT STEPS

- Nutrient Analysis
- Model Animal Operation Permits in subwatershed 9
- Model potential BMPs (discussed next…..)

BMP OPPORTUNITIES

1. Cattle Exclusion Fencing Sites – NHD flowlines intersected with hay/pasture CDL areas
2. Riparian Buffer Planting Sites – NHD flowlines intersected with all CDL areas except forested and turf/golf areas
3. Stormwater BMP Sites – NHD flowlines intersected with impervious areas >=20%
4. Wetland Restoration Sites – CDL wetlands, pasture, cropland and barren areas intersected with hydric soils and greater than 3 acres

Will be used in restoration analysis for project prioritization


Swearing Creek
Potential BMPs
Cattle Exclusion Sites
Riparian Buffer Planting Sites
Stormwater BMP Sites
Wetland Restoration Sites
Source: CDL (2016); NLCD (2011); NHD Flowlines
Welcome
Lexington
Tyro
Spencer
East Spencer
Southmont
DAVIDSON
ROWAN
Lake Thom-A-Lex
High Rock Lake
Reedy Creek
Leonard Creek
Rich Fork
Hamby Creek
Abbotts Creek
Gobble Creek
Mill Creek
Sandy Creek
Hurley Creek
Bumgardner Creek
Indian Grave Creek
Mitchell Branch
Red Spring Branch
North Potts Creek
South Potts Creek
Swearing Creek
Tar Creek
Powder Fork
Fourmile Branch
Sucky Creek
Jaikins Creek
1
2
3
4
5
6
7
8
9
10
11
52
64
85
150
29
47
0 1 2 Miles
Piedmont Triad Regional Council
Base Data
Hydrology
Watershed Boundary
Place Boundary
County Boundary
Highway
Railroad

PROJECT PRIORITIZATION

- Have modeled results based on out Regional Watershed Model
  - Priority projects selected are very small, mostly within Lexington
- Next step: modify the Lower Abbotts Creek model to incorporate the stream buffer analysis and potential BMPs
  - Project Atlas

CONSERVATION ANALYSIS

REGIONAL

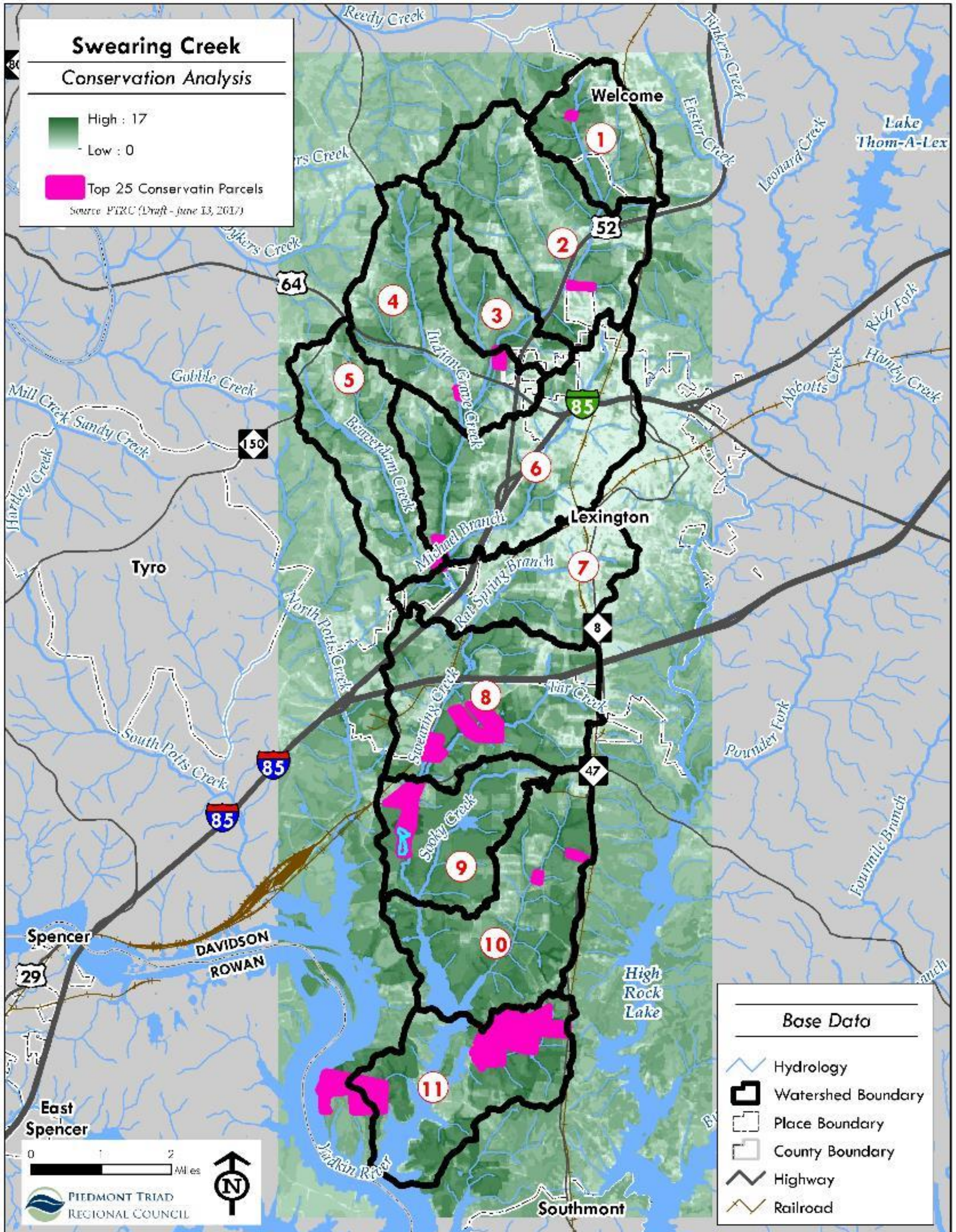
Conservation Layers				
Criteria	**Data Source**	**Factors**	**Integer Values**	**Total Layer Value**
Biodiversity/ Wildlife Habitat Assessment	NC NHP & VA Natural Landscape Network	1 - 4	65	31.9%
		5 - 6	65	
		7 - 8	79	
		9 - 10	110	
Low Impervious Surface Cover	NLCD 2006 Percent Developed Imperviousness	> 10%	0	22.9%
		5 - 9%	54	
		0 - 4%	174	
High Forest Cover	NLCD 2001 update	> 50%	134	13.4%
Hydric Soils	SSURGO	Partially Hydric	22	7.8%
		All Hydric	56	
Highly Erodible Soils	SSURGO (K factor)	0 - 0.23	0	7.1%
		0.24 - 0.39	14	
		0.40 - 0.49	57	
Floodplain	NC Floodplain Mapping Program; VA DCR	Within 500 Year Floodplain	65	6.5%
Low Population Density (Persons Per Square Mile)	Census Bureau, 2010	High (250 +)	0	4.9%
		Med (50-249)	20	
		Low (1 -49)	29	
Steep Slopes	USGS NED (1 arc second)	> 15%	37	3.7%
Large Parcel Size	Counties	> 50 Acres	12	1.2%
Zoning (Low Impact)	Counties/Municipalities	Planned Unit Development, Low Density Residential, Conservation, VAD	5	0.5%

LOWER ABBOTTS

Point System for Parcel Conservation Assessment and Ranking				
Criteria	**Data Source**	**Factors**	**Possible Points**	**Weight**
Low Impervious Surface Cover	2001 NLCD	0-4%	3	1
		5-9%	2	
		10-19%	1	
High Forest Cover	2001 NLCD	> 50%	1	1
1st & 2nd Order Streams	NC CGIA	Within 50 foot buffer	3	1
		Within 100 foot buffer	2	
		Within 330 foot buffer	1	
Large Parcel Size	Davidson County	> 50 acres	3	2
		20-49 acres	2	
		10-19 acres	1	
Low Impact Land Use	2011 County Data	Forest, Recreation	1	2
Low Impact Land Use	2011 County Data	Agriculture, SFR (Rural Res. >= 5 acres), Vacant, VAD	1	1
Publically Owned Land & Managed Conservation Lands	2011 County Data	City, County, or State	1	2
Significant Natural Heritage Area & Natural Heritage Element Occurrences*	DENR (Oct 2010)	4 points - any SNHA	6	1
		3 points - any NHEO S1 or S2 rank that is not a SNHA	5	
		2 points - any NHEO S3 or S4 rank that is not a SNHA	4	
		1 point - floodzones of the Greensboro Burrowing Crayfish combined areas (even though "very low" spatial accuracy)	3	
		0 points - all other "very low" spatial accuracy or "historic" species	2	
		**overlapping polygons were summed; values range from 0 to 6	1	
Landscape Habitat Indicator Guilds	NHP		1	1
Parcels with Lake/River Access	PTCOG; Davidson County	Existing Public	2	1
		Existing Private or Proposed Public	1	
Wetlands	NWI		1	1
Hydric Soils	SSURGO	All Hydric	2	1
		Partially Hydric	1	
Erodibility (K factor)	SSURGO	0.40-0.49	2	1
		0.24-0.39	1	
500 Year Floodplain	NC Flood Map		1	1
Steep Slopes	USGS 1/9 Arc Second DEM	> 15% Gradient	1	1
Conservation BMP Locations	PTCOG Field Data	Point	2	1
		0.25 mile buffer	1	
Proposed Greenways	PTCOG; Davidson County	Primary	2	1
		Secondary	1	
Bike Paths	PTCOG; Davidson County	0.25 mile buffer	1	1
		Total Possible Points	**39**	

Table 1: LAC Conservation Analysis Point System

Swearing Creek Conservation Layers			
Criteria	Data Source	Factors	Value
High Biodiversity/ Wildlife Habitat	NCDENR CPT	8 - CPT (SNHA)	3
		1 to 4 - CPT (Wetlands and streams)	1
Low Impervious Surface Cover	NLCD 2011 Percent Developed Imperviousness	0 - 4%	3
		5 - 9%	2
		10-19%	1
Large Parcel Size	County Data (Dissolved by owner name)	> 50 Acres	3
		20-49 Acres	2
		10-19 Acres	1
Stream Buffer Analysis	PTRC	1 - Pristine, complete cover	2
		2 - Impacted, majority cover with some human activity	1
Hydric Soils	SSURGO	All Hydric	2
		Partially Hydric	1
High Soil Erodability	SSURGO (K factor)	0.40 - 0.49	2
		0.24 - 0.39	1
Low Population Density (Persons Per Square Mile)	Census Bureau, 2010	Low (1 -49)	2
		Med (50-249)	1
Publically Owned Lands	County	Public Parcel	2
High Canopy Cover	NLCD 2011 Percent Canopy	> 50%	1
Floodplain	NC Floodplain Mapping Program	Within 500 Year Floodplain	1
Steep Slope	USGS NED (1 arc second)	> 15%	1
Low Impact Zoning	Counties/Municipalities	RA, RS, RC 5+ acres; vacant; VAD	1
		Total Possible Points	23


Swearing Creek
Conservation Analysis
High : 17
Low : 0
Top 25 Conservatin Parcels
Source PTRC (Draft - June 13, 2017)
Base Data
Hydrology
Watershed Boundary
Place Boundary
County Boundary
Highway
Railroad
Welcome
Lexington
Tyro
Spencer
East Spencer
Southmont
DAVIDSON
ROWAN
High Rock Lake
Lake Thom-A-Lex
Reedy Creek
Tinkers Creek
Leonard Creek
Rich Fork
Abbotts Creek
Hamby Creek
Gobble Creek
Mill Creek
Sandy Creek
Hartley Creek
Indian Grave Creek
Beaverdam Creek
Michael Branch
Rat Spring Branch
North Potts Creek
South Potts Creek
Swearing Creek
Fair Creek
Sooky Creek
Pounder Fork
Fourmile Branch
Yadkin River
1
2
3
4
5
6
7
8
9
10
11
52
64
85
150
8
47
29
0
1
2
Miles
N
Piedmont Triad Regional Council

STRESS ANALYSIS

REGIONAL

Stress Layers				
Criteria	Data Source	Factors	Integer Values	Layer Percentage
High Impervious Surface Cover	NLCD 2006 Percent Developed Imperviousness	1 - 4%	26	45.5%
		5 - 9%	141	
		> 10%	288	
Highly Erodible Soils	SSURGO (K factor)	0 - 0.23	0	8.7%
		0.24 - 0.39	24	
		0.40 - 0.49	62	
High Density of Impact Sites	NCDWR & VA DEQ	Low (1-7 per sq. mile)	27	8.1%
		High (8-48 per sq. mi)	54	
High Road Density	NCDOT & VDOT	Low	0	7.6%
		Med	0	
		High	76	
Low Forest Cover	NLCD 2001 update	< 50%	66	6.6%
High Population Density Change (2000 to 2010)	U.S. Census Bureau	1 - 9%	3	5.9%
		10 - 24%	5	
		25 - 49%	8	
		> 50%	44	
High Population Density (2010)	U.S. Census Bureau	Low (1 -49)	6	5.2%
		Med (50-249)	19	
		High (250 +)	27	
Small Streams with Less than 50% Canopy Cover	NHD unnamed streams; NLCD canopy cover	Within 100 ft. buffer where forest cover <50%	45	4.5%
Steep Slopes	USGS NED (1 arc second)	> 15%	37	3.7%
Small Parcel Size	Counties	< 10 Acres	16	1.6%
Zoning (High Impact)	Counties/Municipalities	Commercial, Industrial, High Density Residential, Multi-family & Office	14	1.4%
Floodplain	NC Floodplain Mapping Program & VA DCR	Within 500 Year Floodplain	12	1.2%

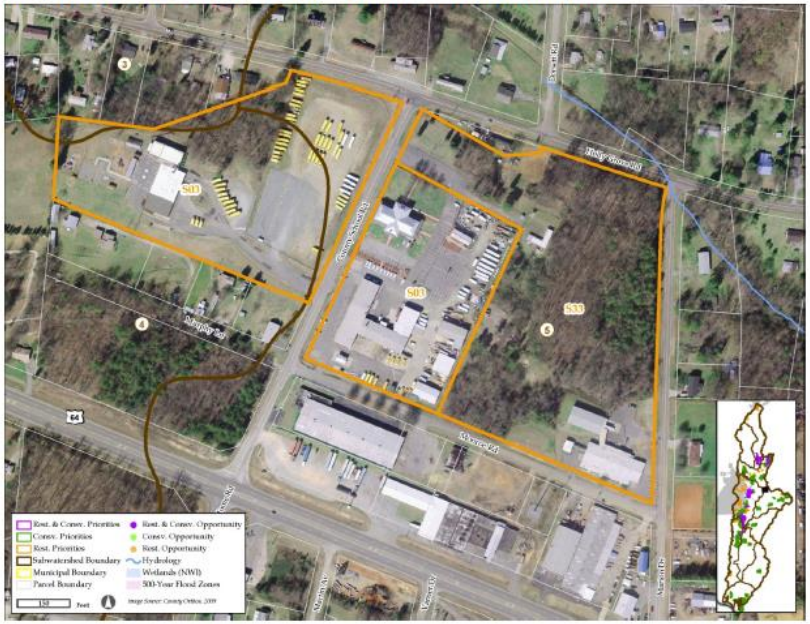
LOWER ABBOTTS

Point System for Parcel Stressor Assessment and Ranking				
Criteria	Data Source	Factors	Possible Points	Weight
High Impervious Surface Cover	2001 NLCD	> 20%	3	1
		10-19%	2	
		5-9%	1	
Low Forest Cover	2001 NLCD	<50%	1	1
1st & 2nd Order Streams	NC CGIA	Within 50 foot buffer	3	1
		Within 100 foot buffer	2	
		Within 330 foot buffer	1	
Large Parcel Size	Davidson County	> 20 acres	3	2
		10-20 acres	2	
		5-10 acres	1	
High Impact Land Use	2011 County Data	Commercial, Industrial	1	2
High Impact Land Use	2011 County Data	Government, Institutional, MFR, Office, Utilities	1	1
Publicly Owned Land	2011 County Data	City, County, or State	1	2
Wetlands	NWI		1	1
Hydric Soils	SSURGO	All Hydric	2	1
		Partially Hydric	1	
Erodibility (K factor)	SSURGO	0.40-0.49	2	1
		0.24-0.39	1	
500 Year Floodplain	NC Flood Map		1	1
Steep Slopes	USGS 1/9 Arc Second DEM	>15% Gradient	1	1
Stress BMP Locations	PTCOG Field Data	Point	2	1
		0.25 mile buffer	1	
Animal Operation Permits	NC CGIA		1	1
High Potential for Future Growth	See table 3		0 - 18	0.25
		Total Possible Points	32.5	

Swearing Creek Stress Layers			
Criteria	**Data Source**	**Factors**	**Value**
Low Impervious Surface Cover	NLCD 2011 Percent Developed Imperviousness	20% +	3
		10-19%	2
		5-9%	1
Large Parcel Size	County Data (Dissolved by owner name)	> 20 Acres	3
		10-19 Acres	2
		5-9 Acres	1
Stream Buffer Analysis	PTRC	5 - Absent	2
		4 - Degraded	1
Hydric Soils	SSURGO	All Hydric	2
		Partially Hydric	1
High Soil Erodability	SSURGO (K factor)	0.40 - 0.49	2
		0.24 - 0.39	1
High Density of Impact Sites	NC DWQ	High (8-48 per sq mi)	2
		Low (1-7 per sq mi)	1
High Road Density	NCDOT	High	3
		Med	2
		Low	1
High Population Density Change (2000-2010)	Census Bureau, 2010	50% +	3
		25-49%	2
		1-24%	1
High Population Density (Persons Per Square Mile)	Census Bureau, 2010	High (250+)	3
		Med (50-249)	2
		Low (1 -49)	1
Publically Owned Lands	County	Public Parcel	2
Low Canopy Cover	NLCD 2011 Percent Canopy	< 50%	1
High Biodiversity / Wildlife	NCDENR CPT	1 to 4 - CPT (Wetlands and streams)	1
Floodplain	NC Floodplain Mapping Program	Within 500 Year Floodplain	1
Animal Operation Permits		Parcel	1
Steep Slope	USGS NED (1 arc second)	> 15%	1
High Impact Zoning	Counties/Municipalities	Commercial, Industrial	2
		Institutional, Office, Multifamily	1
		Total Possible Points	32

PROJECT ATLAS SAMPLE

Project 01: Davidson County School Administration Site



Recommended Actions:

- Immediately contact landowner to determine willingness to retrofit site for improved stormwater management (IC = 42%)
  - Develop a site-specific retrofit plan in concert with City of Lexington, NCSU B&AE staff, and Stormwater SMART
    - Currently no stormwater management on-site at all
  - Include green roofs, depressed parking islands, enhanced tree cover, and constructed wetland
  - Determine financial value of ecosystem services in on-site forest, especially to absorb emission pollutants of bus fleet
- Integrate stormwater plan with site needs, including bus fleet maintenance, school curricula needs, and Safe Routes to Schools

ATTRIBUTE	S-03	S-33	TOTAL
Site Location	Davidson County		
Subwatershed	3, 4, & 5	5	
Land Use	Institutional		
Area (acres)	14.37	11.2	25.57
Linear Stream (Feet)	N/A	N/A	N/A
Lake Area (acres)	N/A	N/A	N/A
Impervious Surface Cover	9.4	1.4	10.8
	65%	13%	42%
Floodplain Area (acres)	N/A	N/A	N/A
Wetland Area (acres)	N/A	N/A	N/A
Forest Coverage (acres)	1.1	7.8	8.9
	8%	70%	35%

Project Assessment:

This project offers a study in contrasts of how these properties were developed. S-33 has been largely left untouched, with almost 8 acres in forest of 11 –acre parcel. There are a couple of small buildings on the property, but both are far from the stream, which has been buffered from development on this property by the forest. This parcel does appear as a stress priority, though, due to its presence near headwater streams, location within valuable ecological habitat, institutional use, and public ownership. It is also in a heavily residential and industrial neighborhood at the border among three different subwatersheds of the larger lower Abbotts Creek watershed. However, no adverse impacts to water quality were identified directly on this property.

The Davidson County Schools Administrative buildings site, on the other hand, is highly impervious, is an area of intense vehicle use and washing, has very little tree cover, and does not appear to have stormwater controls. There are no streams on this property, but the impacts of such properties on downstream waters are the priority issue in this watershed. All of the Rich Fork Creek watershed headwaters are similarly developed and similarly disregarded stormwater management when developed. As a result, both Rich Fork Creek and Lower Abbotts Creek are subject to extreme flash floods following average rain events, have highly channelized stream structures resulting from these flashy events, and suffer from the nutrients and sediment pollution in this runoff. Though not lying immediately along any bodies of water, sites such as this administrative building have a larger impact than streamside properties that adequately buffer their streams and practice stewardship in the property management (i.e. minimal fertilizer use).

There are currently no stormwater retrofits anywhere in Davidson County, or in the Cities of High Point, Lexington, or Thomasville. There have been efforts to address current stormwater concerns with outreach, education, and improving future development practices, but little attention given to the expensive and needed retrofits to highly impervious properties in these communities that led to the currently-degraded conditions. This project is an example of the ideal site that could be retrofitted to improve the function of its site, workplace environment, and watershed conditions.

Review of Watershed Impairments

- Swearing Creek first listed as impaired in 2004 due to "fair" ecological/biological integrity of fish community
- NC DEQ identified non-point source pollution as primary concern
- Water Quality Concerns
  - High pH, turbidity, & chlorophyll-a (which suggests high nutrient loads)

Comprehensive Watershed Management

Addressing water quality on multiple levels, while meeting NPDES Phase II requirements

- Public education, outreach, & involvement
- Illicit discharge detection & elimination
- Construction site runoff control
- Post-construction runoff control
- Pollution prevention

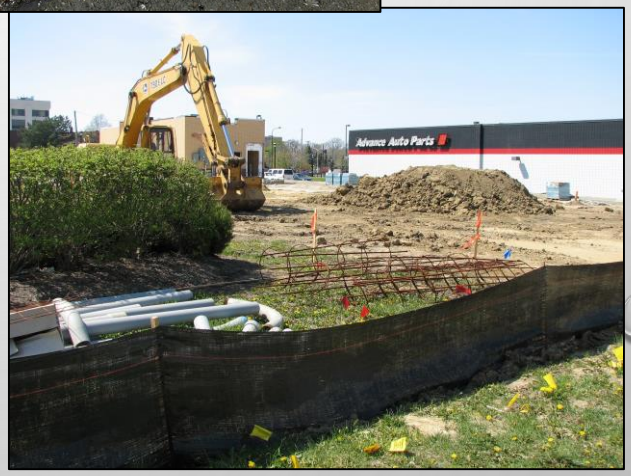
Policy Recommendations

Illicit Discharge Detection & Elimination

- Continue water quality monitoring & work to increase number of sampling sites
- Educate public about hazards of improper waste disposal through strategic sign placement
- Create report hotline for enforcement

Construction Site Runoff Control

- Erosion & sediment control program for activities that disturb 1 or more acres
  - Silt fences or temporary stormwater ponds
  - Work with DEQ to improve enforcement



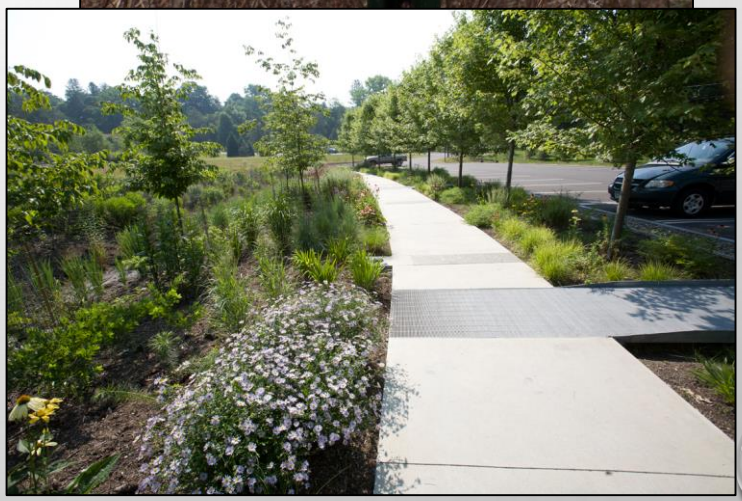
Policy Recommendations

Post-Construction Runoff Control

- Update ordinances to specifically address stormwater
- Improve site design standards (encourage low impact development)
- Agricultural BMPs (cattle exclusion fencing, fertilizer & pesticide reduction, proper waste disposal, etc)
- Land conservation
- Riparian buffers
- Stormwater retrofits (impervious → pervious)

Pollution Prevention/Good Housekeeping

- Municipal staff training on pollution prevention measures and techniques
  - Reduction in use of pesticides or street salt
  - Frequent catch-basin cleaning



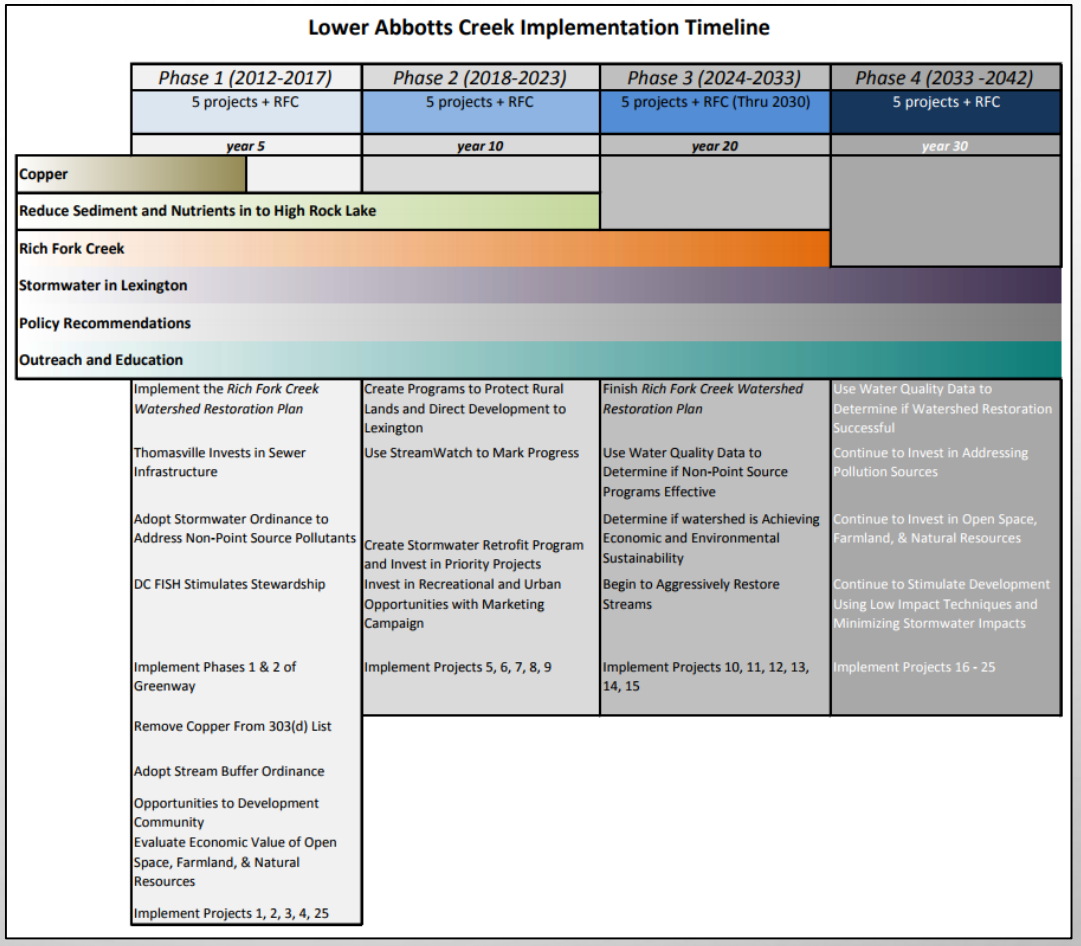
Implementation Timeline

Broken into separate phases:

- Short-term
- Mid-term
- Long-term

Based on feasibility and positive impacts on watershed conditions

Will include measurable milestones to meet EPA watershed plan requirements



Watershed Outreach & Education

Public Outreach & Education

- StormwaterSMART programs
- Brochures for Swearing Creek landowners/businesses
- Increased signage

Public Participation/Involvement

- Continue social media outreach and project website
- Encourage attendance at final presentation

TRIP
Tourism Recreation Investment Partnership
DAVIDSON COUNTY FOUNDATION
www.visitdavidsoncounty.com