Williston Lake Watershed Assessment and Action Plan

December 28, 2018

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Contents

1.0 Introduction

The purpose of this plan is to provide guidance on the restoration of the Williston Lake watershed. The Williston Lake Watershed Assessment and Action Plan outlines a series of recommendations for watershed restoration, describes management strategies, and identifies priority projects for implementation. Planning level funding sources are listed, where feasible, and a preliminary schedule for implementation by 2025 is outlined. Financial and technical partners for plan implementation are suggested for various recommendations and projects. The watershed plan is intended to assist ShoreRivers, Caroline County Soil Conservation District, United States Department of Agriculture Natural Resource Conservation Service, Caroline County Government, Girl Scouts of the Chesapeake, agricultural consultants, and watershed residents in moving forward with restoration of the Williston Lake Watershed (Fig. 1).

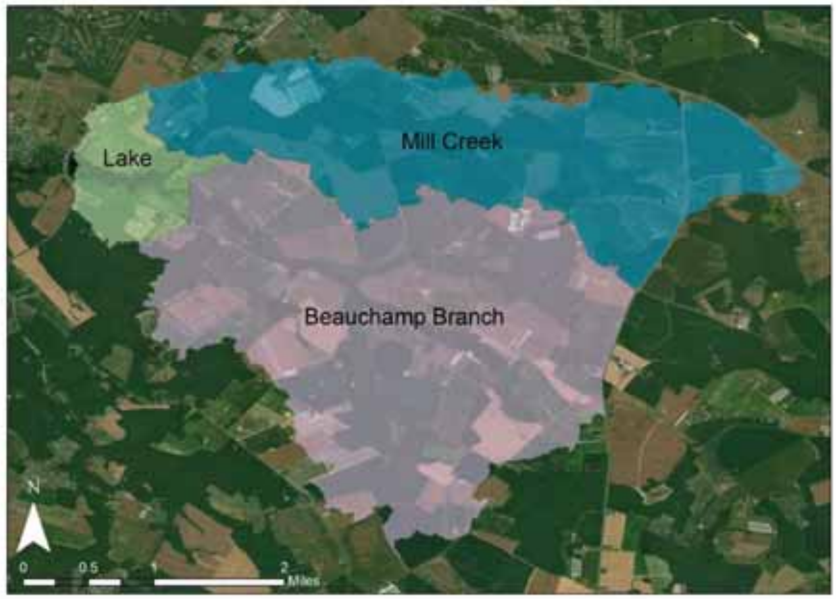

Figure 1. Williston Lake watershed consists of two tributaries, Mill Creek and Beauchamp Branch, in addition to small tributaries that surround the lake.

1.1 U.S. EPA Watershed Planning

In 2003, the U.S. Environmental Protection Agency (EPA) required that all watershed restoration projects funded under Section 319 of the federal Clean Water Act be supported by a watershed plan[1]. EPA identified nine key elements that are critical for improving water quality and should be included in watershed plans that intend to address water quality impairments. These nine elements have come to be known as the "A-I criteria":

[1] For more information on 319 grant funding opportunities, visit MDE's Nonpoint Source Program (319) Management and Financial Assistance website at http://www.mde.state.md.us/programs/Water/319NonPointSource/Pages/index.aspx

EPA A-I Criteria[2]

A. Identification of Causes and Sources of Impairments

B. Expected Load Reductions

C. Proposed Management Measures

D. Technical and Financial Assistance Needs

E. Information, Education, and Public Participation Component

F/G. Schedule and Milestones

H. Load Reduction Evaluation Criteria

I. Monitoring Component

This watershed plan meets the A-I criteria and Table 4 shows where these criteria are addressed throughout this watershed plan.

Table 1: Location of A-I Criteria Within this Report

Section of the Report	A	B	C	D	E	F	G	H	I
Section 1	x								
Section 2			x		x				
Section 3			x						
Section 4		x	x						
Section 5				x		x	x		
Section 6								x	x

[2] For a more detailed description on the nine key elements review Chapter 2 of the EPA's Handbook for Developing Watershed Plans to Restore and Protect Our Waters https://www.epa.gov/sites/production/files/2015-09/documents/2008_04_18_nps_watershed_handbook_handbook-2.pdf

1.2 Background

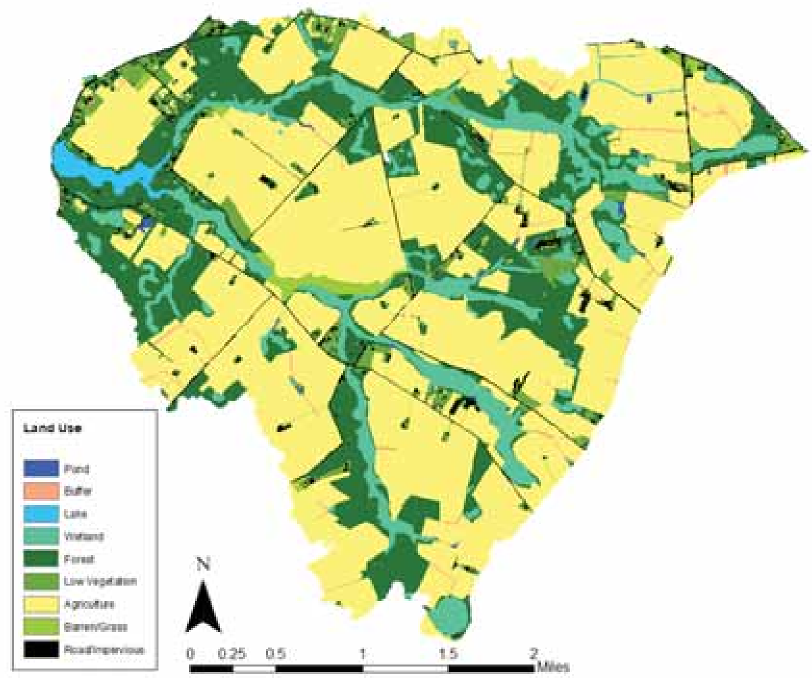

Figure 2. Land use of Williston Lake watershed. Agriculture is the dominant land use covering 58% of the total watershed area. Residential (Road/Impervious) covers 7% of the watershed, while the remainder is forest/natural vegetation, wetland or open water.

Williston Lake is a 64.2 acre (26-ha) dammed lake near the city of Denton in Caroline County, Maryland, USA (38°490 51.200 N, 75°500 26.9200 W, Figs. 1, 2). It is located at the headwaters of the Choptank River, one of the major tributaries of the Chesapeake Bay. The lake drains a 5,933 acres watershed that is largely agricultural cropland, principally corn, soybean, and small grains, fertilized with synthetic fertilizers and poultry litter. The surrounding landscape has been in continuous crop production (R. Foote, pers. communication). As a result, soils are phosphorus-enriched (in some areas phosphorus-saturated) and surface and groundwaters are typified by nitrate-nitrogen concentrations approximating 15 mg/L (Knee and Jordan 2013; Sanford and Pope 2013, Staver and Brinsfield 1998; Bachman and Phillips 1996). There are residential septic fields directly upstream and surrounding the lake, though their nutrient input is most likely minimal.

Williston Lake was created as a mill pond to operate a flour and grist mill. This required damming Mill Creek (formally Coquericus or Cokiases Creek and later Phillips Creek), a branch of the Choptank River. A mill on Cokiases Creek (now Mill Creek) was leased by James White to Nathaniel Potter as early as 1778. The mill and pond were purchased by Willard Todd in 1893. His son, Ulysses Grant Todd, inherited the mill and pond in 1930. He was an experimental engineer in Rochester, New York. He married Jennie T. Gotshall of Darby, PA and moved back to Denton in 1938. He and his wife acquired about 100 acres on the south side of the lake in 3 parcels in 1935, 1938 and 1940 which they named Camp Todd. In 1949, they formed the Camp Todd Association and provided 4 acres to local Boy and Girl Scout groups until 1954 when it was leased to the Girl Scouts exclusively. The lease for 100 acres was signed May 24, 1954. Ulysses Grant Todd died September 7, 1954. Various units were relocated in 1955 to allow erosion on the original site to heal. On September 10, 1958, the 100 acre camp and 65 acre Williston Lake were deeded as a gift to the Council by Jennie Todd Penrose and her new husband Walter Penrose. The deed restricts the use of the property to Girl Scouts or similar charitable youth organizations and included responsibility for the water level of the lake. The Girl Scouts share lake access with nineteen lakefront residential landowners. The camp and landowners primarily use the lake for recreational purposes, including bass fishing, canoeing, and swimming. Access outside of the lakefront community is restricted to a scenic overlook adjacent to the local highway that passes by the lake at the dam. Most of the lakefront properties are not actively farmed, though interviews with local residents suggest that much of the land was once cultivated.

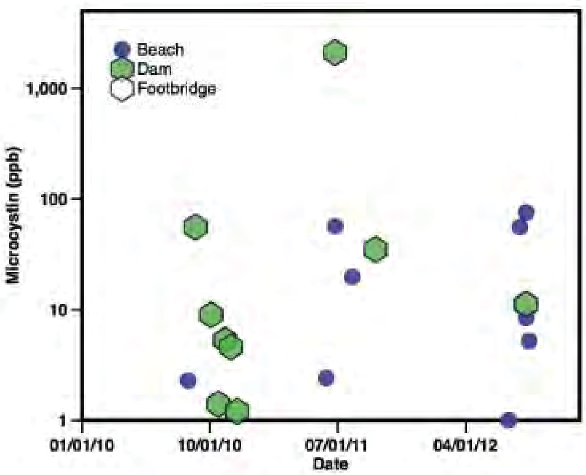

Figure 3.Microcystin toxin concentration in Williston Lake over the period 2010 to 2012.

The large lake currently has one main spillway, an approximately 10’ diameter corrugated metal pipe near the SW corner of the lake. This pipe carries flow under 2 roads and a grass median strip, approximately 140’ long. There is no water drop at the downstream end of this pipe where the concrete apron meets the stream.

Starting in the mid-2000s lake front residents started to notice increased frequency of green algal blooms. This came to the attention of state officials in August of 2008 during routine testing of the lake for bacteria (recreational use swimming necessitates state bacterial testing) when Department of Public Health officials noted that the lake was completely green. Following this visit the Maryland Department of Natural Resources (DNR) was contacted and scientists came out to the lake to take samples and were able to identify that the algae present was *Microcystis aeruginosa*, commonly known as blue-green alga. *M. aeruginosa* is actually a cyanobacterium that can photosynthesize (has chlorophyll-*a*) and can produce both neurotoxins and hepatotoxins.

Due to the toxins, during large blooms it can create a harmful algal bloom (HAB) that can kill aquatic organisms as well as pets and be harmful to human health. During the 2009 bloom cell abundance exceeded 1 million cells/ml and microcystin concentrations approximated 80 ppb (Sellner et al. 2015), well over the World Health Organization’s 10 ppb recreational use threshold (Fig. 3, World Health Organization 2015). Due to the cyanobactrium bloom the lake was closed

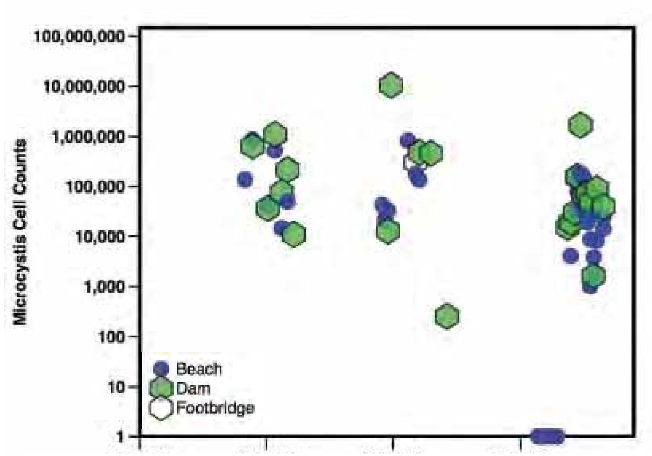

Figure 4. Microcystis cell count in Williston Lake over the period 2010 to 2012.

from 2009 through 2011 placing an economic burden on the Girl Scout camp due to lower attendance because of fear of the bloom in addition to the added expense of having to transport the girls at the camp to other nearby bodies of water. Lakefront residents also lost their ability to use the lake for recreation and were worried that their properties would depreciate in value due to the now toxic lake. The fear from the local residents and the Girls Scouts was well placed because the same HAB at another nearby pond in Dorchester County (Higgins Mill Pond) caused two dogs to die due to kidney failure stemming from ingesting pond water containing hepatotoxins from the bloom.

In 2011 through NOAA's Prevention, Control and Mitigation (PCM) program, A. Place and K. Sellner began assessing various mitigation strategies on Lake Williston. This started with getting basic characteristics of the lake: total volume and water quality of feeder streams and the lake. From the bathymetry data an estimated volume for Lake Williston is 16,396,494 ft^3 (464,297 m^3) when filled. The deepest parts of the lake are closest to the dam and at the beach. Two streams (Mill Creek and Beauchamp Branch) feed the lake continuously.

Ambient Conditions

Water quality was routinely monitored from 2011-2014. The water quality parameters reported were pH, dissolved oxygen (DO), chlorophyll *a*, phycocyanin, conductivity, alkalnity, PO_4^{3-}, NH_{4+}, NO_2, and NO_3-. Measurements were taken from surface grab samples at five sampling sites. A continuous monitoring YSI 6600 sensor array with conductivity, temperature, pH, DO, chlorophyll *a* and BGA-PC (blue-green algae-phycocyanin) probes was deployed at the Williston Lake dam. Algal cell counts were obtained for water samples taken off the beach diving float. SPATT samples (suspended resins that bind toxins in the water) were placed on the float for two-week deployments with subsequent elution and cyantoxin analysis. Since 2014 the Maryland Department of Natural Resources (MDNR) maintains a continuous monitoring station in the lake to track water quality changes (http://eyesonthebay.dnr.maryland.gov/eyesonthebay/).

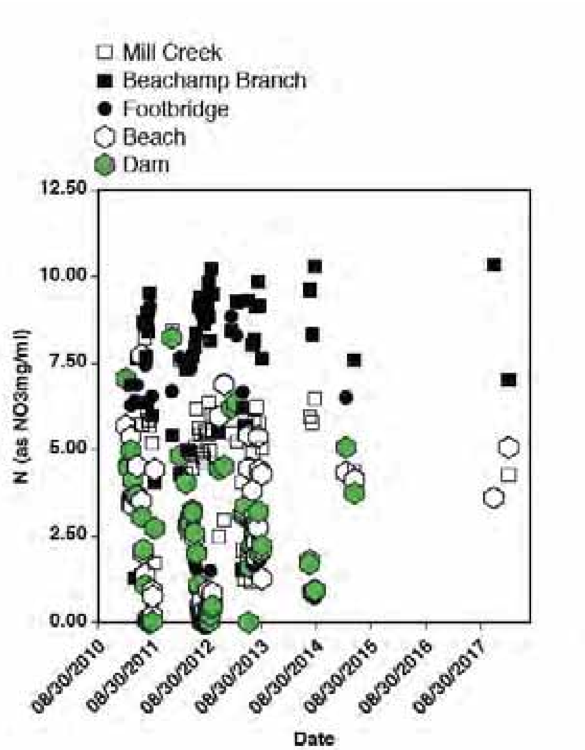

Figure 5. Nitrate-nitrogen concentration in the streams entering the lake, Williston Lake footbridge, Williston Lake beach, and at the Williston Lake Dam over the period 2010 to 2017.

Over the period 2011 through 2014 NO_{3-} and PO_4^{3-} concentrations entering the lake from Mill Creek and Beauchamp Branch were much higher than levels found in non-enriched streams (Fig. 5). Mill Creek mean NO_{3-} concentration was 4.91 mg/L with a maximum concentration of 8.43 mg/L, and Beauchamp Branch mean NO_{3-} concentration was 7.30 mg/L with a maximum concentration of 10.28 mg/L. Natural forested streams generally have NO_{3-} concentration below 0.5 mg/L. PO_4^{3+} mean concentration for Mill Creek was 0.06 mg/L with a maximum concentration of 0.23 mg/L. Beauchamp Branch mean PO_4^{3+} concentration was 0.05 mg/L with a maximum concentration of 0.31 mg/L. Natural levels of PO_4^{3+} in a forested stream are generally <0.03 mg/L.

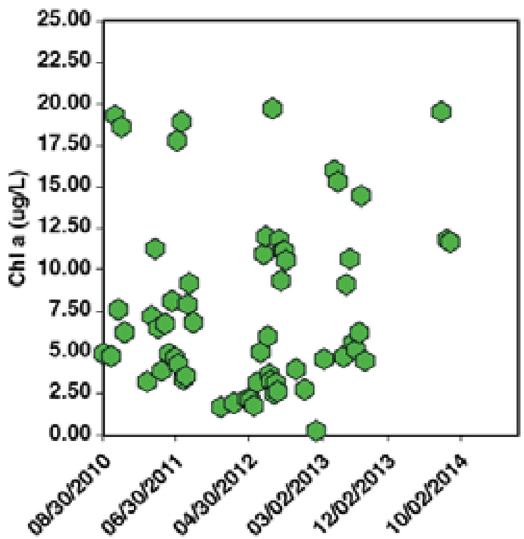

Figure 6. Chlorophyll-*a* (algae) concentration in Williston Lake over the period 2010 to 2014.

The elevated nutrient concentrations discharged from the streams into the lake created favorable growth conditions for both algae and cyanobacteria. Chlorophyll *a* concentrations were routinely higher than 10 ug/L, which is higher than the Maryland Department of Environment (MDE) guideline of <10 ug/L for seasonally stratified water-supply reservoirs (Fig. 6, MDE 2012). The chlorophyll *a* concentration of 10 ug/L is recognized as a boundary between mesotrophic (moderate amount of nutrients) and eutrophic (excessive amount of nutrients) with exceedance of 30 ug/L associated with a shift to cyanobacteria (blue-green algae) assemblages that can cause human and environmental health issues.

Causes and Sources of Pollution

Table 2. Isotope data from Williston Lake tributaries.

Sample Location	d15N	d18O
Mill Creek 1	9.36	3.93
Mill Creek 2	9.9	3.1
Beachamp Branch 1	6.97	3.58
Beachamp Branch 2	8.62	2.56

Nonpoint Source Pollution and Sources: Williston Lake watershed is 58% agriculture, 7% residential/developed, with the remainder of the land either forested, wetlands, or open water (Fig. 2). Since agriculture is the predominant land use, it is also the largest source of nonpoint source nitrogen, phosphorus, and sediment pollution. Isotope analysis of nitrogen and oxygen corroborate this with $\partial^{15}N$ and $\partial^{18}O$ signatures within the typical range of ammonia fertilizer, manure, and septic waste. Septic waste entering into the streams is most likely negligible due to the low intensity development in the watershed, thus most of the nitrogen pollution comes from agricultural sources. This was corroborated by sucralose testing, an indicator of contamination with human waste as from septic effluent, conducted on Mill Creek, Beauchamp Branch, and Williston Lake that showed no sucralose present in the water except for a single sample from Mill Creek that had a low response (Appendix F). Sucralose is used to determine if water is contaminated with human waste because sucralose is an artificial sweetener used in many different human foods and goes unprocessed through the human digestive tract and wastewater treatment process, allowing it to be used to detect human wastewater, such as septic effluent, entering into waterways. The low values of the heavy oxygen isotope in Table 2 indicate little denitrification in the watershed because both $\partial^{15}N$ and $\partial^{18}O$ values would be >10 if that important process was active.

Nutrient and sediment loads were estimated using the Stroud Water Research Center Model My Watershed application that is a part of WikiWatershed. Model My Watershed uses the Generalized Watershed Loading Function Enhanced (GWLF-E) algorithms to simulate 30-years of daily water, nutrient and sediment fluxes to estimate average annual nutrient and sediment loading[3].

Modeled results (Table 3) indicate that on average Williston Lake receives 101,160 lbs. of nitrogen, 6,957 lbs. of phosphorus and 977,458 lbs of sediment each year. Beauchamp Branch delivers more sediment, nitrogen and phosphorus to the lake when compared to Mill Creek due to the larger watershed size (3,192.0 acres vs. 2,158.5 acres) sustaining a greater water discharge, on average 4.9 cubic feet per second, in comparison to Mill Creek's average water discharge of 2.8 cubic feet per second.

Table 3. GWLF-E modeled annual nutrient and sediment load to Williston Lake determined from 30 years of modeled data.

Beauchamp Branch	**Sediment**	**Total Nitrogen**	**Total Phosphorus**
Total Loads (lbs)	634,842.6	65,480.5	4,237.9
Loading Rates (lbs/acre)	198.9	20.5	1.3
Mean Annual Concentration (mg/L)	66.6	6.87	0.44
Mean Low-Flow Concentration (mg/L)	404.55	7.03	1.21
Mill Creek	**Sediment**	**Total Nitrogen**	**Total Phosphorus**
Total Loads (lbs)	342,615.4	35,679.6	2,719.4
Loading Rates (lbs/acre)	158.7	16.5	1.3
Mean Annual Concentration (mg/L)	58.1	6.1	0.5
Mean Low-Flow Concentration (mg/L)	353.4	6.3	1.3
Total Watershed Loads (lbs)	977,458.0	101,160.1	6,957.3

Point Source Pollution and Sources: In 1972 a component of the Clean Water Act was established to control point source water pollution through a permitting system. Point sources are

3 For more information on the model please reference the Model My Watershed Technical Documentation at https://wikiwatershed.org/documentation/mmw-tech/.

defined as any conveyance such as a pipe or a man-made ditch that eventually discharges directly into the surface water. Municipal, industrial, and other facilities must obtain a National Pollution Discharge Elimination (NPDES) permits if their discharges go directly to surface waters. Maryland Department of the Environment (MDE) issues the NPDES permits in Maryland as a means of limiting the amount of pollution entering surface waters from industrial and municipal facilities. There are no permitted point sources in the Williston Lake watershed that contribute to nutrient and sediment pollution.

2.0 Watershed Goal, Strategies and Recommendations

Restoration of Williston Lake is a community-wide effort that requires participation from a number of stakeholders. The lake is owned by the Chesapeake Bay Girl Scout Council of Maryland and is used for recreation by the Girl Scouts and local residents who have properties on the lake. As noted above, the watershed is predominately agriculture with a few scattered residences. When developing this assessment and action plan, we met with agricultural landowners on a one-on-one basis to discuss best management practice options and recommendations. Meetings were held periodically with local stakeholders including the Girls Scouts, Caroline County Soil Conservation District, United States Department of Agriculture Natural Resource Conservation Service, Caroline County Government, and agricultural consultants. The plan was developed using input from stakeholders as well as the completion of a best management practice citing tool, The Agricultural Conservation Planning Framework (ACPF), developed by the United States Department of Agriculture to help streamline best management practice identification and prioritization.

2.1 Watershed Goal

A healthy Williston Lake that is safe for swimming and fishing, and is free from all water quality impairments.

2.2 Strategies

1. **Quantify the problem in terms of nutrient loads.** Identify the quantity and sources of nutrients, as well as the flow path from the pollution sources to the water.
2. **Public-private partnerships.** Leverage the county's resources in collaboration with the technical skills and expertise from the diverse group of watershed partners including the Girl Scouts, farmers, landowners, and a nutrient management specialist.
3. **Increase the knowledge of farmers, property owners, local government and agricultural consultants.** Use education to change behavior and increase the likelihood that individuals will be mindful of the impact of land management on the lake. Utilize conservation leases between landowner and farmers to ensure a clear understanding of

the conservation interests for the property.

4. **Manage nutrient application according to the best available science.** Applying nutrients using the 4R Nutrient Stewardship[4] concept (right fertilizer source, right rate, right time, right place) and the Phosphorus Management Tool[5] will increase efficiency and reduce runoff.
5. **Implement the appropriate nutrient management practices wherever space and site conditions allow.** Site-specific, also referred to as *full-farm conservation planning,* is the best way to efficiently manage agricultural runoff.
6. **Maintain and update septic systems within the watershed.** Properly maintained systems and Best Available Technology (BAT) systems are proven to remove the greatest amount of nutrients from the wastewater.
7. **Incorporate climate change adaptation strategies in project planning and implementation.** Impacts of climate change will affect how restoration practices perform into the future.

2.3 Recommendations

This section describes 7 recommendations for restoring the Williston Lake watershed. Not listed in order of priority, these recommendations are a result of modeling, fieldwork findings, and stakeholder interviews. When possible, multiple recommendations should be implemented simultaneously in order to effectively restore water quality. Combining these efforts with education and pollution prevention can lead to long-term behavioral change. Targeted outreach to landowners and farmers can have a beneficial impact while additional funding can be secured for the more costly recommendations.

1. **Utilize federal and state cost-share programs to accelerate the rate of project implementation**. Work with Caroline County Soil Conservation District and Natural Resource Conservation Services (NRCS) to utilize cost-share funding for applicable projects. To further incentivize the implementation of these practice, look for additional grant funding to pay for costs that exceed what cost-share covers.
2. **Full-farm management.** Approach the management of the farm property holistically. Utilize water control structures on the outlets of tile drains and ditches and filtering practices on the inlets. Balance buffers and wetlands with production areas to maintain or increase yield goals. Conservation drainage management and irrigation management are other tools that can be used in full-farm planning.
3. **Implement projects that can benefit as a demonstration effort.** Demonstration

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[4] To learn more about the 4Rs visit the Nutrient Stewardship website: https://www.nutrientstewardship.com/4rs/

[5] To learn more about Maryland's agricultural phosphorus initiative, the Phosphorus Management Tool, visit Department of Agricultura's website: https://mda.maryland.gov/Pages/PMT.aspx

projects are a great tool to encourage other landowners to utilize a nutrient removal project. When working with a landowner, ask for permission to access their property to show the project to stakeholders, funders and other landowners.

4. **Provide outreach and technical assistance to landowners and farmers.** Use the projects identified in this plan as a guide for landowner outreach. Providing direct outreach and landowner technical assistance will help to encourage greater participation in these plans. When possible, partner with NRCS and Soil Conservation Districts for a more targeted approach to landowners, and for a better understanding of the available resources at the state and federal level.
5. **Provide resources to periodically maintain and upgrade septic systems.** Work with the Caroline County Health Department to identify failing septic systems within the watershed. Provide education to the homeowners of those failing systems and encourage regular pump-outs and manufactured recommended maintenance. When it is time for an upgrade or new system, encourage the use of BAT systems and identify opportunities to use Bay Restoration Funds for the upgrades.
6. **Plan for increased rainfall amounts, rainfall intensity, and regional plant species migration due to changing climate patterns.** By planning for these expected changes we will be able to implement projects that are more resilient to the effects of climate change. Rainfall is more intense and more frequent, while we are also experiencing longer periods of drought-like conditions. These changes will have an effect on the size of water quality practices, as well as the plants that are used in natural filtration projects.
7. **Monitor the health of Williston Lake as a means of tracking progress.** Keep a pulse on the health of Williston Lake by conducting an on-going water quality monitoring program. Test the water for physical degradations as well as chemical impairments. Test the dissolved oxygen levels at the surface and the bottom of the water column. Test the nutrients and bacteria levels from different areas throughout the lake and the surrounding watershed. Identify emerging hot-spots of pollution. Utilize partners like the Department of Natural Resources and the Girl Scouts of the Chesapeake to assist with the monitoring.

3.0 Watershed Restoration Practices

This section provides an overview of the practices recommended for restoring Williston Lake (Table 4). Successful restoration requires collaboration among local, county and state government, watershed partners, landowners, and farmers. Local and state governments are able to implement projects on public property as well as financially support efforts on private property through cost-share programs and other incentives. Watershed partners, landowners, and farmers are encouraged to implement projects and programs on private property where they will be most effective. The variety of practices recommended in this plan are primarily efforts to control agricultural runoff, and are described in more detail below.

Table 4: Project applicability to different agricultural landscape features and practices.				
Project	**Ditch**	**Tile**	**Field**	**Stream**
Blind/Rock Inlet (Vertical Drain)		X		
Cover Crops			X	
Denitrifying Bioreactor/Wall	X	X	X	X
Drainage Water Management		X		
Grass Waterway			X	
Irrigation Water Management Plan			X	
Irrigation Water Reuse			X	
Nutrient Management Plans			X	
Phosphorus Sorbing Material in Agricultural Ditches and Fields	X	X	X	
Riparian Forest Buffer	X			X
Saturated Buffer		X		
Stream Restoration	X			X
Structure for Water Control	X	X		
Wetland Restoration	X		X	X
Two-Stage Ditch (Open Channel)	X			

1. **Blind Inlet (Underground Outlet), NRCS Standard 620** (Fig. 7) **-** Also known as a "French Drain," these are constructed by placing small aggregate and sand over perforated pipe which is connected to a underground outlet. Because the blind inlet acts as a filter, it can reduce the amount of sediment and other contaminants discharged through the outlet compared with perforated tile risers or flush inlets. Blind Inlets also provide obstruction-free equipment operations because they eliminate the perforated tile riser inlet.

Figure 7: Blind inlet example showing the filter (gravel) being placed over the subsurface perforated drainage pipes.

2. **Cover Crops, NRCS Standard 340** (Fig. 8)**-** Cover crops are the practice of growing a crop of grass, small grain or legumes primarily for seasonal protection and soil improvement. Cover crops reduce erosion from wind and water while also utilizing excessive soil nutrients and increasing soil health by adding organic matter.

Figure 8: Cover crop example showing vegetation covering the soil. (photo: Farmfuture.com)

3. **Denitrifying Bioreactor, NRCS Standard 605** (Fig. 9) – A denitrifying bioreactor is a structure that uses a carbon source (woodchips) to reduce the concentration of nitrate nitrogen in subsurface or ditch agricultural drainage flow via enhanced denitrification. This edge-of-field subsurface practice improves water quality by reducing nitrogen content of agricultural drainage flow. This practice usually involves a water control structure (see below).

Figure 9: Denitrification Bioreactor example showing the subsurface woodchip-filled pit.

4. **Drainage Water Management, NRCS Standard 554** (Fig. 10)**-** Drainage water management is the process of managing the drainage volume and water table elevation by regulating the flow from a surface or subsurface agricultural drainage system. Managing drainage water reduces nutrient loading, improves productivity and health of plants, and improves soil health.

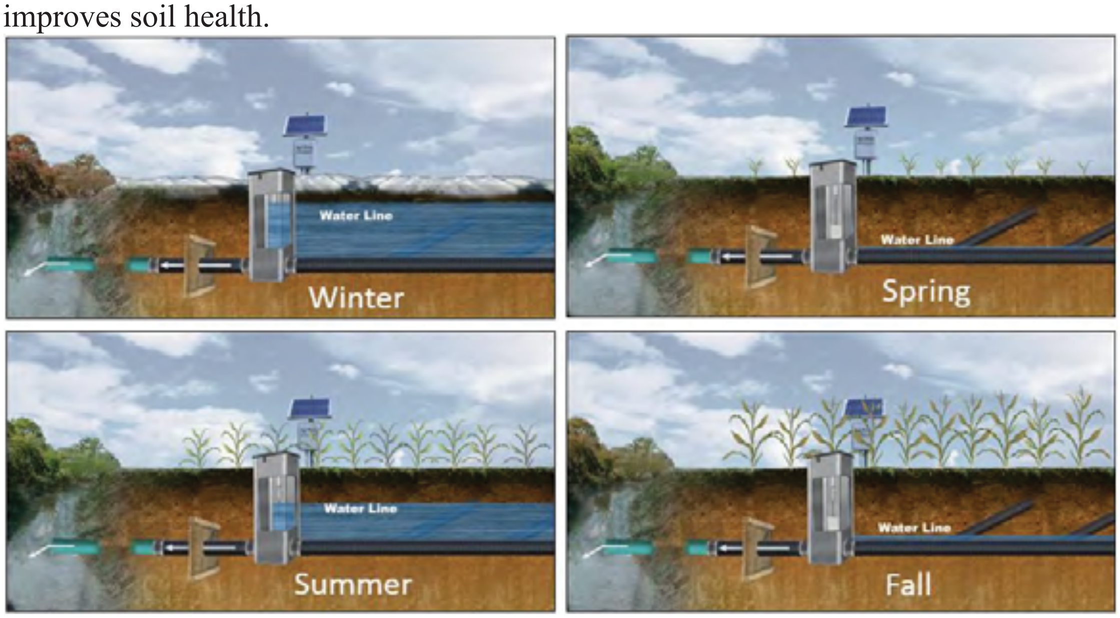

Figure 10: How Drainage Water Management works for better yields and nutrient management. (Photo Ecosystem Services Exchange)

5. **Grassed Waterway, NRCS Standard 412** (Fig. 11)– A grassed waterway is a graded or shaped channel established with vegetation suitable to convey water at a non-erosive velocity using a broad and shallow cross-section. Grassed waterways protect and improve water quality by filtering runoff and maintaining vegetative cover on water conveyance channels.

Figure 11: Grassed Waterways example showing the vegetative cover over the drainage channel. (Photo: NRCS)

6. **Irrigation System, Tailwater Recovery, NRCS Standard 447** (Fig. 12)– This is an irrigation system designed to collect, store and convey rainwater runoff and irrigation tailwater for reuse in irrigation. The practice of capture and reuse of irrigation water benefits offsite water quality, improves water use efficiency, and reduces energy use.

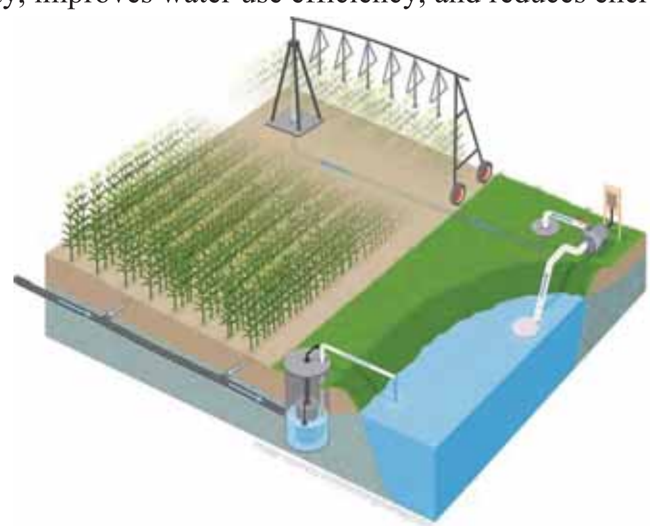

Figure 12: Tailwater recovery example showing captured runoff from a pond being used as irrigation. (Photo: transformingdrainage.org)

7. **Irrigation Water Management Plan, NRCS Standard 449** – An irrigation water management plan details the process of determining and controlling the volume, frequency, and application rate of irrigation water. Developing and implementing this plan will improve water use efficiency, minimize soil erosion, and decrease degradation of surface and groundwater resources.

8. **Nutrient Management [Plans], NRCS Standard 590 –** A nutrient management plan is a certified plan that details subsequent actions to manage the amount, source, placement, form and timing of the application of nutrients. Obtaining and following a nutrient management plan helps to minimize agricultural nonpoint source pollution and properly utilize manure and other organic fertilizers.

9. **Phosphorus Sorbing Materials in Agricultural Ditch[6] -** "Phosphorus-sorbing" materials to bind available dissolved phosphorus in cropland drainage systems for removal and reuse as an agricultural fertilizer. These in-channel engineered systems can capture significant amounts of dissolved phosphorus in agricultural drainage water by passing them through phosphorus-sorbing materials, such as gypsum, drinking water treatment residuals, or acid mine drainage residuals.

10. **Riparian Forest Buffer, NRCS Standard 391** (Fig. 13) **–** A riparian forest buffer is a corridor of trees and/or shrubs planted adjacent to a river, stream, wetland or water body. The planting is of sufficient width and up-gradient and near the water body to insure adequate functioning. The primary purposes for installing a riparian forest buffer includes protecting near-stream soils from over-bank flows, trap harmful chemicals or sediment transported by surface and subsurface flows from adjacent land uses, or provide shade, detritus and large woody debris for the in-stream ecosystem.

Figure 13. Riparian forest buffer example showing shorelines buffered from farm field by thick stands of trees.

[6] For more on Phosphorus Sorbing Materials visit the Maryland Department of Agriculture's website. https://mda.maryland.gov/resource_conservation/WIPCountyDocs/bmpdef_pg.pdf

11. **Saturated Buffer, NRCS Standard 604** (Fig. 14) **-** A saturated buffer is a subsurface, perforated distribution pipe that is used to divert and spread drainage system discharge to a vegetated area to increase soil saturation. This practice helps to reduce nitrate loading to surface water from subsurface drain outlets.

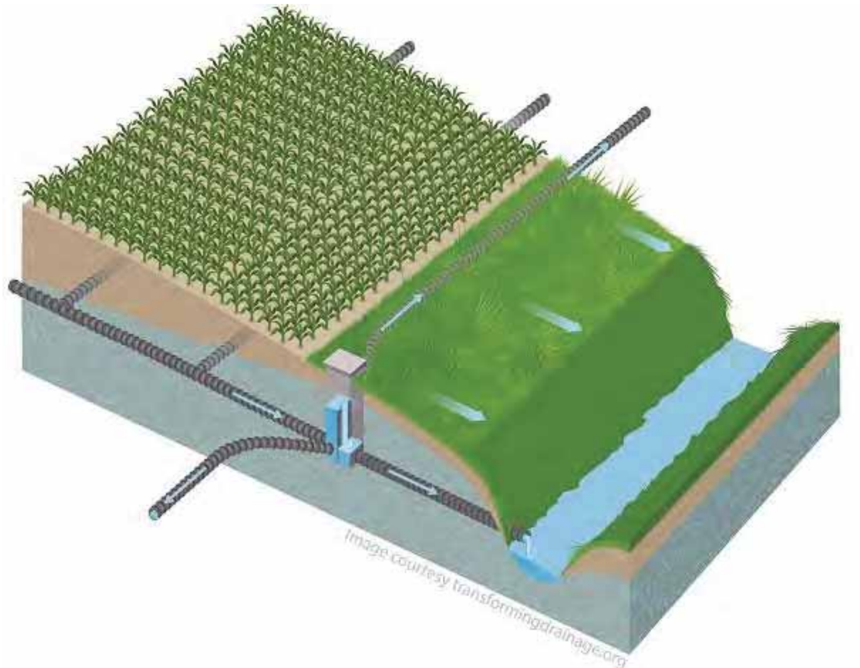

Figure 14: Saturated buffer example showing a tile drain spreading water to a riparian buffer before it enters a drainage ditch or stream channel. (Photo: transformingdrainage.org)

12. **Streambank and Shoreline Protection, NRCS Standard 580 –** This is the use of plants and other natural elements to stabilize and protect the banks of streams and drainage ditches. The benefit of streambank and shoreline stabilization is the ability to maintain the flow capacity of a stream, a reduction of sediment erosion impacting downstream habitats, and improvement of the stream corridor for fish and wildlife habitat.

13. **Structure for Water Control, NRCS Standard 587** (Fig. 15) **-** A structure in a water management system that conveys water, controls the direction or rate of flow, maintains a desired water surface elevation or measures water. This structure allows a farmer to control the stage, discharge, distribution, delivery and direction of water flow from a ditch or drainage tile.

Figure 15. Structure for water control installed in a ditch to help control water level and increase nutrient removal within the ditch.

14. **Two-Stage Ditch (Open Channel), NRCS Standard 582** (Fig. 16) **–** A design conversion that modifies the geometry of a ditch to establish benches within the ditch. The ditch provides a low-flow channel and then a vegetated bench that is flooded during higher flows. The vegetation provides some slowing of water flow where sediments and other heavier material in the flow might settle. A two-stage ditch is an in-channel practice.

Figure 16: Two-Stage Ditch example showing the extended benches within the ditch. This two-stage ditch is located in Talbot County, MD.

15. **Wetland Restoration, NRSC Standard 657** (Fig. 17) – The return of a wetland to an area with hydric soils. This involves managing the drainage volume, water table volume and vegetation at a site suitable for wetland restoration. The benefits of this practice are to filter nutrients from runoff while providing fish and wildlife habitat.

Figure 17. Wetland creation adjacent to a farm field Cecil County, Sassafras River watershed.

4.0 Project Selection and Site Planning

4.1 Project Selection and Plans

The creation of a watershed plan that covers an expansive area presents the challenge of identifying projects throughout the watershed, but also providing enough project detail to adequately describe and justify the installation of the conservation practices at the field scale. Many watershed plans provide either general project suggestions that can be applied throughout the watershed without pinpointing exact locations, or, in other instances, pin point in great detail a few projects, neglecting the remainder of the watershed. To overcome this challenge a new targeting method developed by the United States Department of Agriculture, (USDA) titled the Agricultural Conservation Planning Framework (ACPF), was employed to take advantage of the latest geospatial data to evaluate the entire watershed for various different nutrient reduction practices, providing a broad range of conservation options that are precisely located at the field scale. Executing the targeting method used the most recent light detection and ranging (LIDAR) derived digital elevation model data (DEM), soils survey data (gSSURGO), crop data from the USDA National Agricultural Statistics Service, in addition to data layers derived through analyses performed on the aforementioned data sets. The execution of the targeting method was completed through the use of the ACPF ArcGIS toolbox that analyzed the previously described data sets to identify field-level project opportunities[7].

The output from the ACPF targeting method produced over 140 suggested conservation measures (Fig. 18). The ACPF outputs are parcel-based plans, using a unique field boundary (FB) identification to distinguish each parcel. Conservation practice locations are identified by the field boundary identification number to easily categorize on what parcel the practice is located. The parcel-based categorization of conservation practices allows for the practices to be suggested at the property scale and provides tailored plans for each landowner within the watershed (Fig. 19). All the suggested practices are classified by general practice category with more detailed practice options in each category. All practices suggested in this plan are either approved Natural Resources Conservation Service (NRCS) best management practices that have national standards or best management practices that will be approved by the Chesapeake Bay Program Agricultural Workgroup in the near future.

[7] Additional information on the ACPF targeting method can be obtained on the ACPF website, https://acpf4watersheds.org/, and is also described in Appendix E.

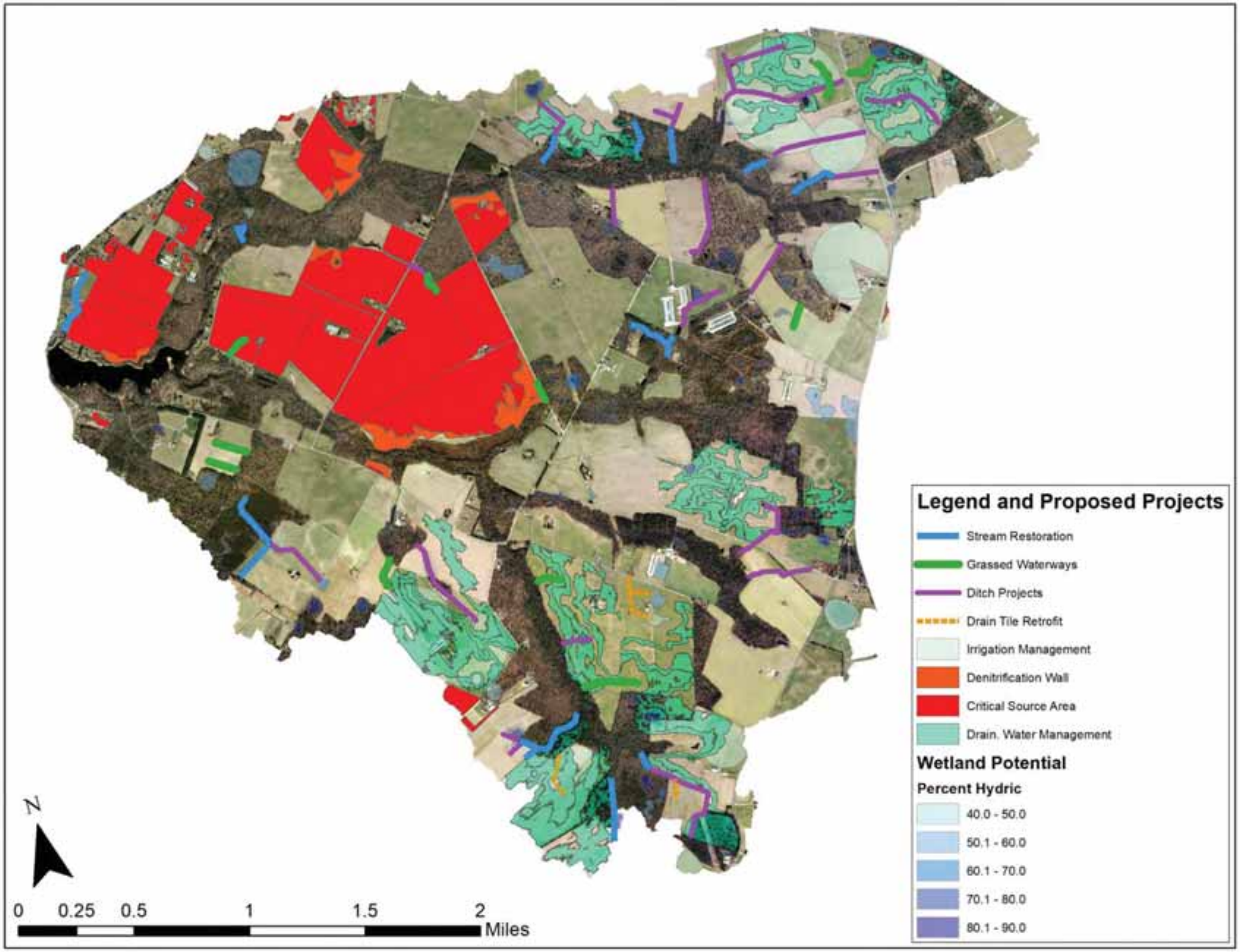

Figure 18. Williston Lake watershed project map generated through the ACPF targeting tool.

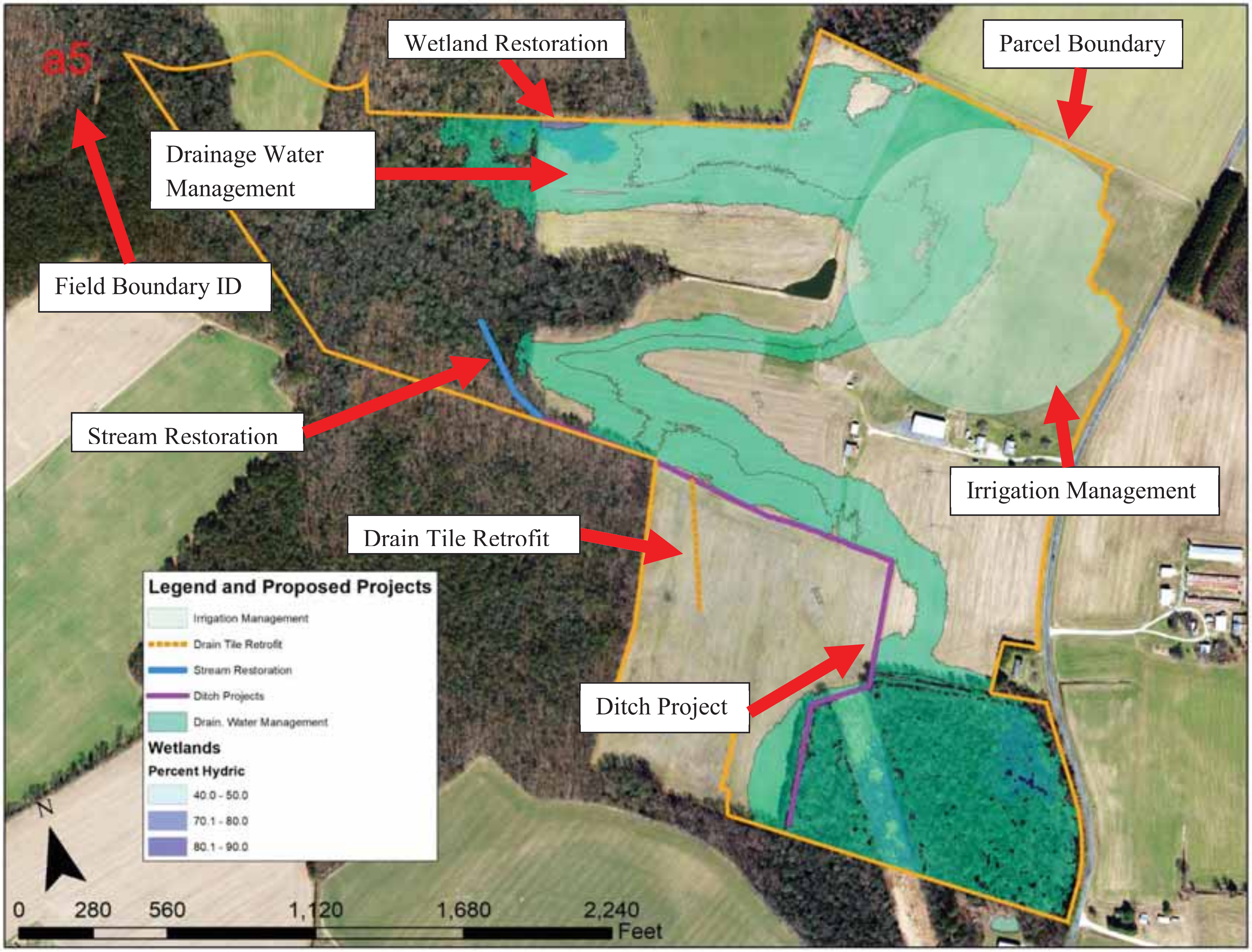

Figure 19. Parcel specific output from the ACPF targeting method. The unique field boundary ID (FBID) is located in the upper left corner.

4.2 Load Reduction

Nitrogen and Phosphorus reductions were estimated using Watershed Implementation Plan (WIP) III Best Management Practice (BMP) Efficiencies for Caroline County, MD. The BMP efficiencies are calculated based on nutrient pounds reduced per unit. The BMP units were either acres treated (watershed area) or acres of BMP installed. Two examples of this calculation are:

(1) **Water Control Structure**: 100 acres treated * 8.8 lbs. nitrogen reduced per unit = 880 lbs. nitrogen reduced

(2) **Forest Buffer**: 10 acres planted (installed) * 90.7 lbs. nitrogen reduced per unit= 907 lbs. nitrogen reduced

Total load reductions are projected as minimum and maximum reductions based on application of potential practices identified in the parcel plans. The minimum is based on commonly used practices. The maximum represents practice(s) that have the largest reduction (generally unpopular or uncommon practices) plus complimentary practices. Appendix B provides greater detail on project reductions identified by field boundary identification.

Table 5. Potential nutrient reductions from proposed projects.

Lbs. Reduced (Minimum)					
	Tile	**Ditch**	**Stream**	**Field**	**Total**
Nitrogen	67.2	15,469.5	1,443.6	31,216.4	48,196.7
Phosphorus	0	0	138.6	600.2	738.8
Lbs. Reduced (Maximum)					
	Tile	**Ditch**	**Stream**	**Field**	**Total**
Nitrogen	5,218.2	16,608	12,555.2	52,633.3	87,014.7
Phosphorus	703.2	706.09	623.8	987.8	3,020.89

- **Minimum field practices**: cover crops, nutrient management core N, tillage management, grassed waterways, irrigation management
- **Minimum ditch practices**: structure for water control
- **Minimum tile line practices**: structure for water control
- **Minimum stream practices**: urban stream restoration
- **Maximum field practices**: alternative crops, grassed waterways, irrigation management, wetland restoration headwater
- **Maximum ditch practices**: forest buffer, structure for water control, and phosphorus sorbing material in agricultural ditches
- **Maximum tile line practices**: structure for water control, phosphorus sorbing materials, and drainage management
- **Maximum stream practices**: urban stream restoration, wetland restoration floodplain, and wetland restoration headwater

5.0 Williston Lake Watershed Restoration Practices

5.1 Implementation Schedule

This watershed plan intends to achieve reduction in nutrients as well as engagement of landowners. Therefore, the following timeline is suggested for implementation over the remaining seven years of the Chesapeake Bay TMDL.

Table 5: Implementation Timeline – Percentage of Goals Achieved by Year

Goal	2019	2020	2021	2022	2023	2024	2025
Lbs Reduced*	10 % 6,700 N 190 P	25% 16,750 N 475 P		50% 33,500 N 950 P	65% 43,550 N 1,235 P	80% 53,600 N 1,520 P	100% 67,000 N 1,900 P
Property Parcels Engaged**	10% 3	25% 8		50% 15	65% 19	80% 24	100% 30

*Represents the average of lbs. reduced between the minimum and maximum options.
**There are 41 parcels listed in this watershed plan with the goal of engaging 30 parcels.

5.2 Funding Strategy

The Williston Lake Watershed Assessment and Action Plan was designed to provide the necessary information to request a project quote from a qualified contractor. To best prepare the watershed partners for implementing the projects and strategies identified in this plan, Appendix C provides a list of funding sources that have historically supported efforts similar to those proposed. By identifying the funder, the intended purpose of the funding, the funding limit, and the date of the last Request for Proposals for each program, partners are encouraged to plan accordingly to seek additional resources for design and implementation of these projects.

The first set of resources are environmental grant programs that seek to fund projects that reduce nutrient loads from entering local waterways. In general, these grants are applied for by non-profit organizations and local governments as a means of addressing issues on private and public properties. The grant programs are made available state- and nation-wide depending on the program, and therefore it is a very competitive process. To prepare the most competitive applications to fund the projects in this action plan, watershed partners are encouraged to collaborate and bring forth a diverse set of technical skills. In addition to engaging each other, partners should also engage local governments and form public-private partnerships.

The second and third set of resources provided in this appendix include information about the Maryland Agricultural Cost-Share Program (MACS), Conservation Reserve Enhancement Program (CREP), and the federal Environmental Quality Incentive Programs (EQIP). The resources are available directly to the farmer or landowner on whose property the project will be installed. Diverse partnerships should be formed to utilize cost-share funding when available, and then should seek any remaining funds from the previously mentioned grant programs. The cost-share opportunities listed are current as of the date of this plan.

6.0 Monitoring and Reporting Progress

Maryland has adopted the Chesapeake Bay Total Maximum Daily Load which calls for a specific amount of reduction of nitrogen, phosphorus, and sediment loads by 2025. Pursuant to this strategy, the State divided the necessary load reduction up by sector and by county. The State of Maryland, through the Departments of the Environment and Natural Resource, conducts periodic monitoring in Williston Lake to assess its condition. Additionally, researchers from University of Maryland and Hood College have a continued interest in monitoring the nutrient levels and algae and cyanobacteria populations in the lake and reporting on any progress seen as a result of project implementation.

Maryland Department of the Environment and Maryland Department of Agriculture are responsible for consolidating BMP implementation information that is shared with the Chesapeake Bay Program annually. This information provides an intermediate measure of implementation progress, including the rate and type of projects installed.

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APPENDICES:

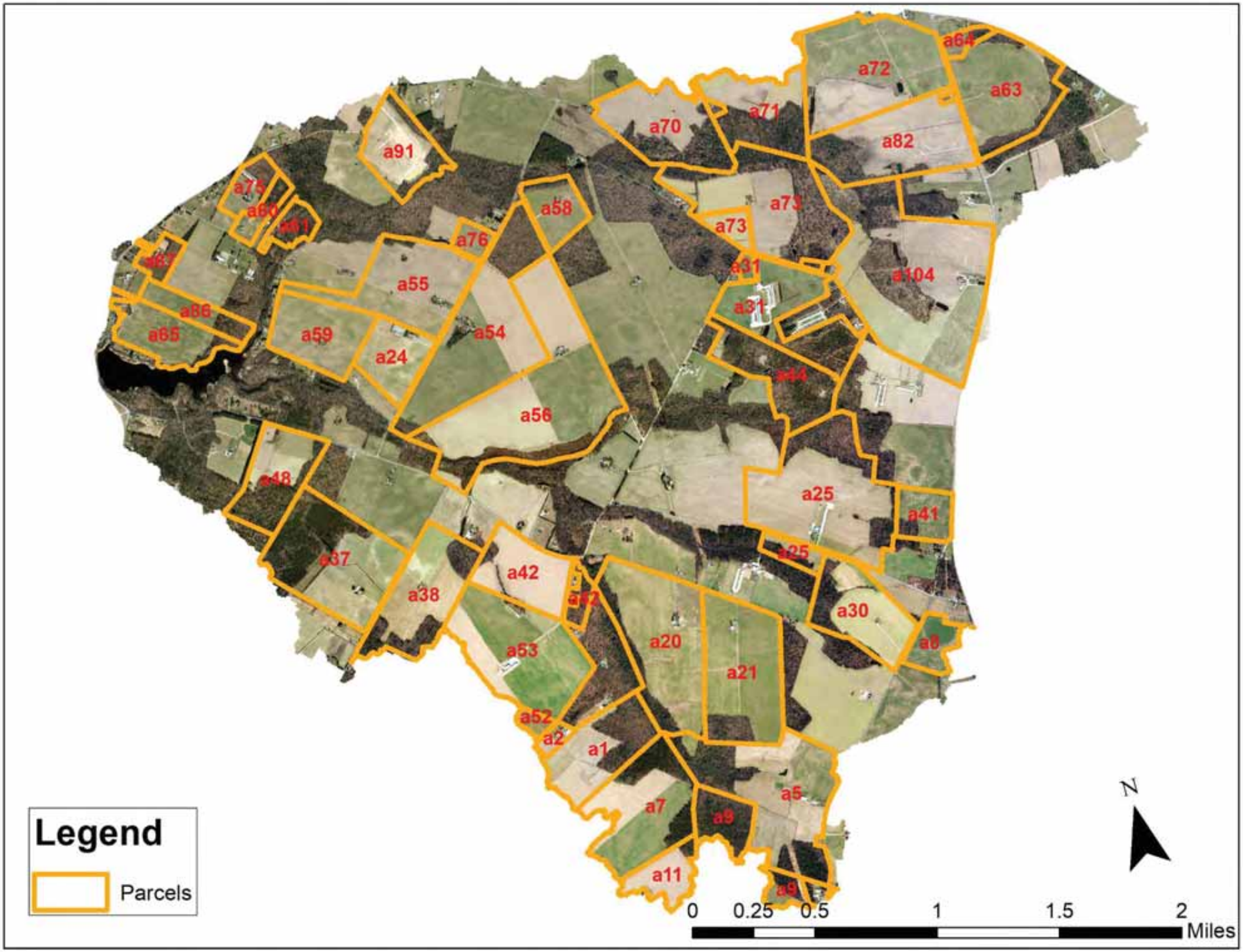
Appendix A: Parcel Plans

Project selection was completed through the ACPF targeting tool. This method generated parcel-specific plans geared towards farm-scale conservation. Each parcel is identified by a field boundary identification number that ties back to specific parcel information. The practices are our best recommendation based on spatial data sets and provide a basis for discussion with landowners.

Table 6. Field ID and corresponding parcel information for each site.

Field ID	Map	Grid	Parcel
a1	42	16	32
a104	38	20	33
a11	42	23	119
a2	42	11	152
a20	42	12	13
a21	42	12	10
a24	37	16	9
a25	43	1	54
a30	43	7	49
a31	38	19	3
a37	42	3	21
a38	42	4	20
a41	43	2	59
a42	42	5	17
a44	38	19	4
a48	37	21	230
a5	42	18	5
a52	42	16	31
a53	42	10	16
a54	37	23	8
a55	37	16	10
a56	37	23	5
a58	37	17	2
a59	37	16	46
a60	37	10	41
a61	37	10	190
a63	38	15	28
a64	38	9	67
a65	37	15	59
a67	37	9	54

a7	42	17	106
a70	37	12	7
a71	38	7	54
a72	38	8	38
a73	38	13	32
a75	37	9	42
a76	37	17	134
a82	38	14	36
a86	37	15	264
a9	42	24	7
a91	37	10	15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a64
a63
a70
a71
a82
a91
a75
a60
a61
a58
a73
a73
a76
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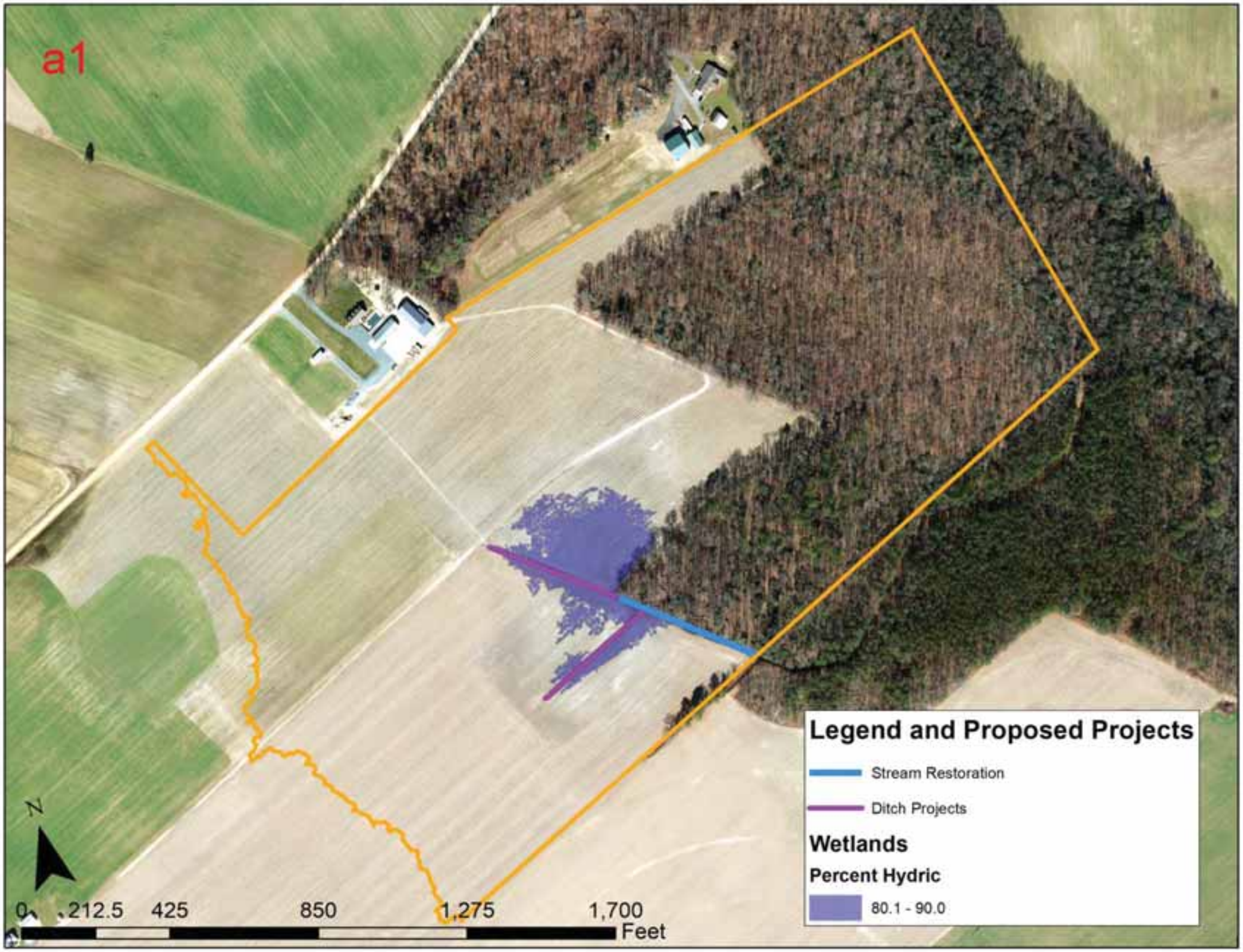
a55
a31
a104
a86
a31
a65
a59
a54
a24
a44
a56
a48
a25
a41
a37
a25
a42
a38
a62
a30
a20
a8
a53
a21
a52
a2
a1
a5
a7
a9
a11
a9
Legend
Parcels
N
0
0.25
0.5
1
1.5
2
Miles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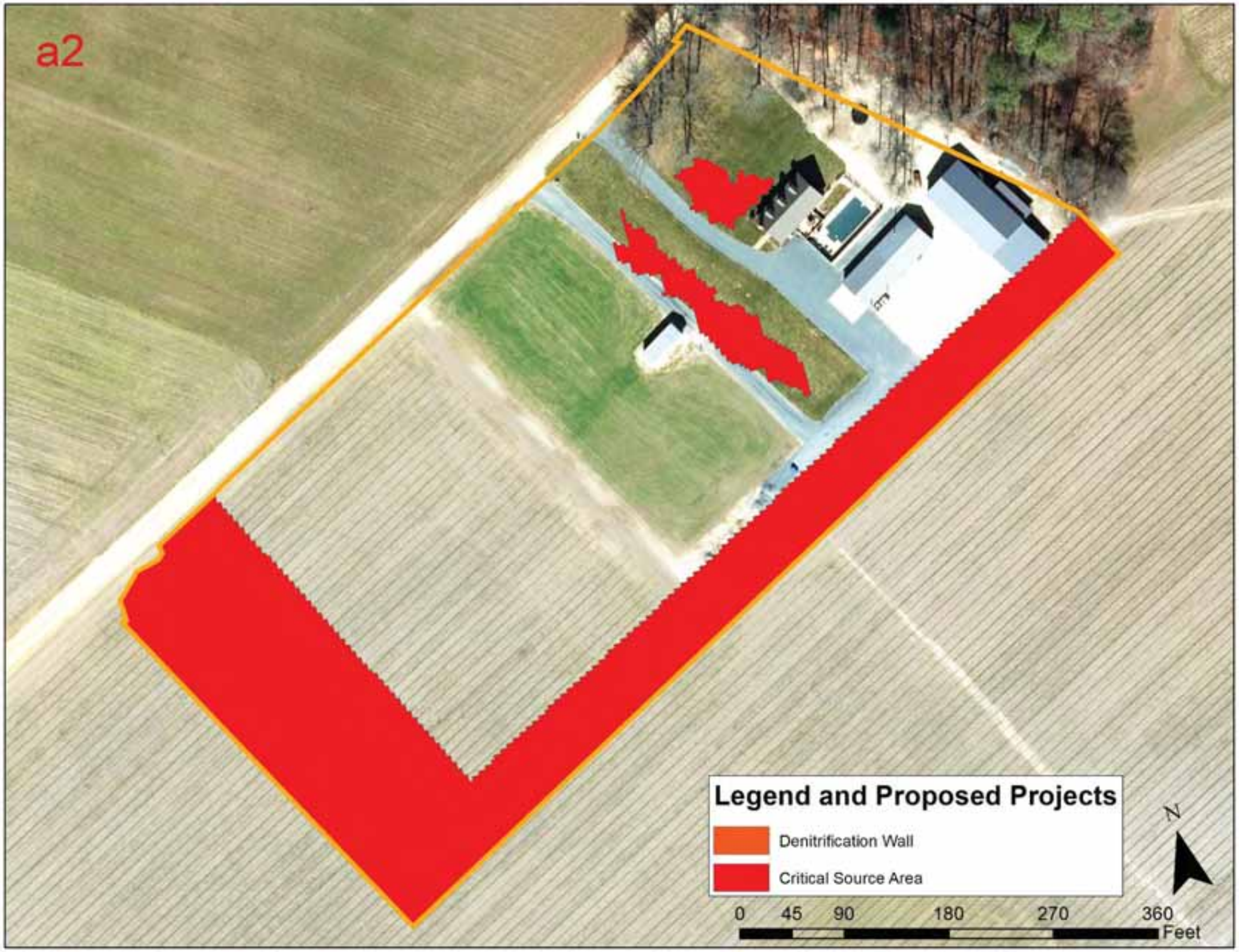
Legend and Proposed Projects
Stream Restoration
Ditch Projects
Wetlands
Percent Hydric
80.1 - 90.0
N
0
212.5
425
850
1,275
1,700
Feet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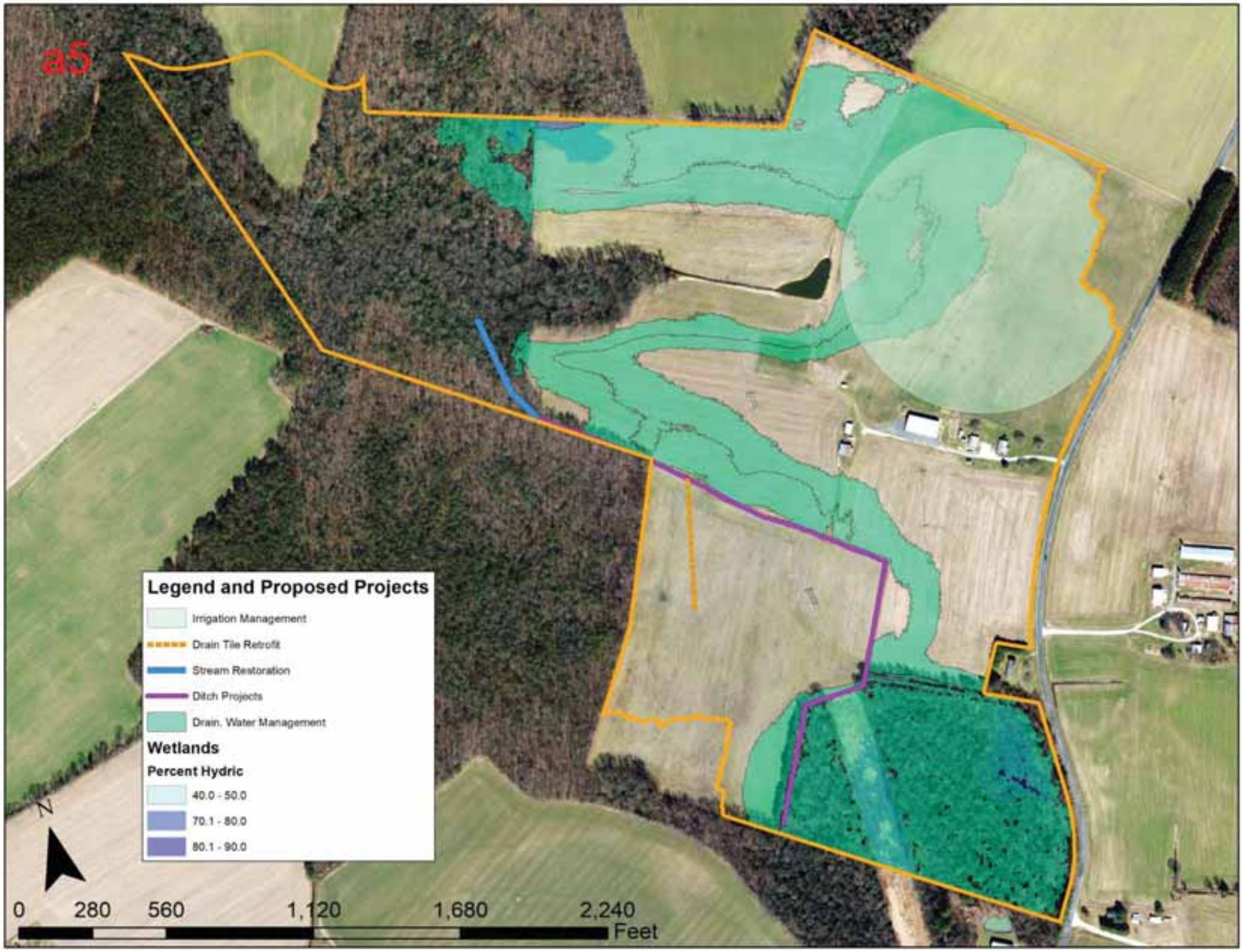
Legend and Proposed Projects
Denitrification Wall
Critical Source Area
0 45 90 180 270 360
Feet
N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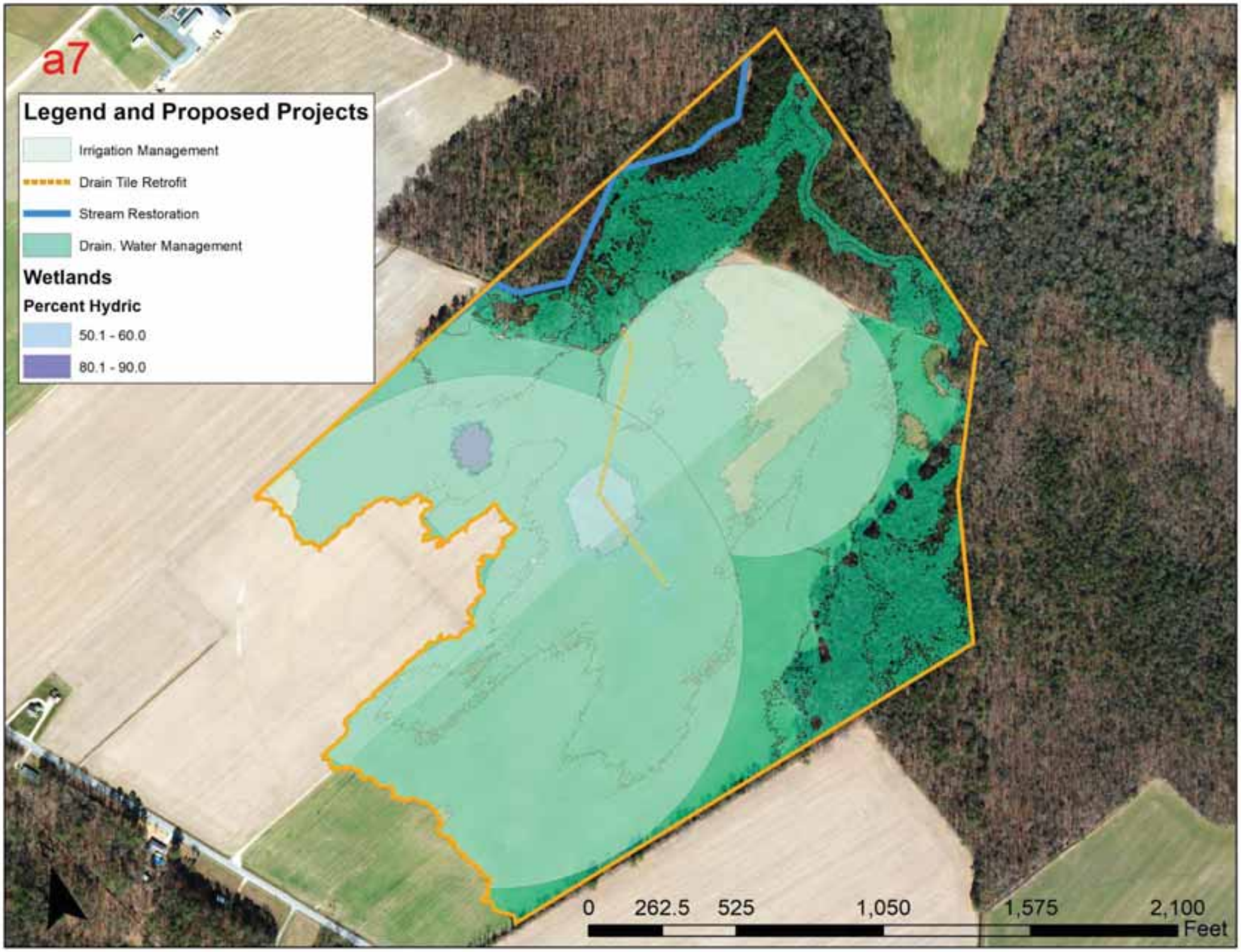
Legend and Proposed Projects
Irrigation Management
Drain Tile Retrofit
Stream Restoration
Ditch Projects
Drain. Water Management
Wetlands
Percent Hydric
40.0 - 50.0
70.1 - 80.0
80.1 - 90.0
N
0 280 560 1,120 1,680 2,240
Feet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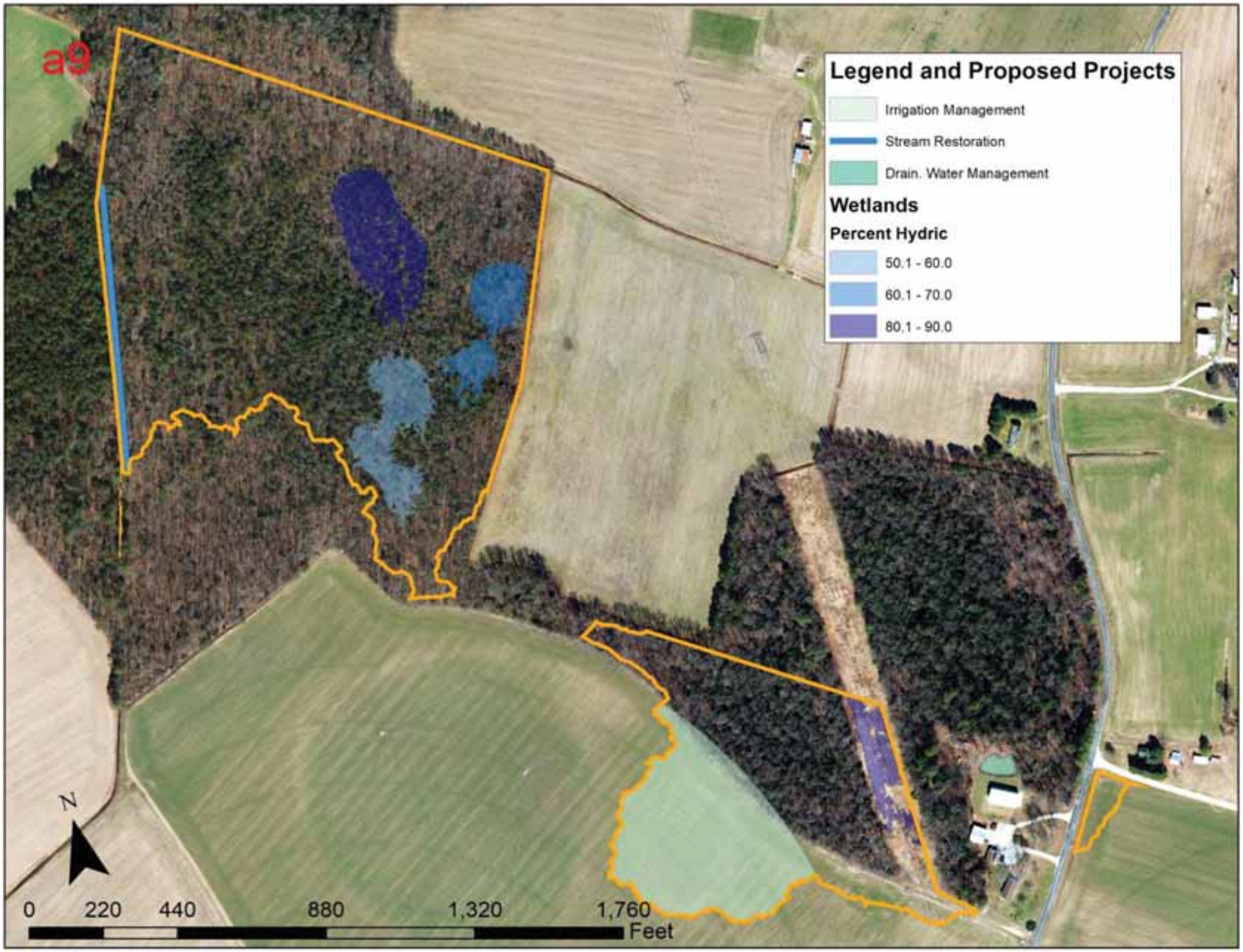
Legend and Proposed Projects
Irrigation Management
Drain Tile Retrofit
Stream Restoration
Drain. Water Management
Wetlands
Percent Hydric
50.1 - 60.0
80.1 - 90.0
0
262.5
525
1,050
1,575
2,100
Feet


a8
Legend and Proposed Projects
Wetlands
Percent Hydric
40.0 - 50.0
0
130
260
520
780
1,040
Feet
N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Legend and Proposed Projects
Irrigation Management
Stream Restoration
Drain. Water Management
Wetlands
Percent Hydric
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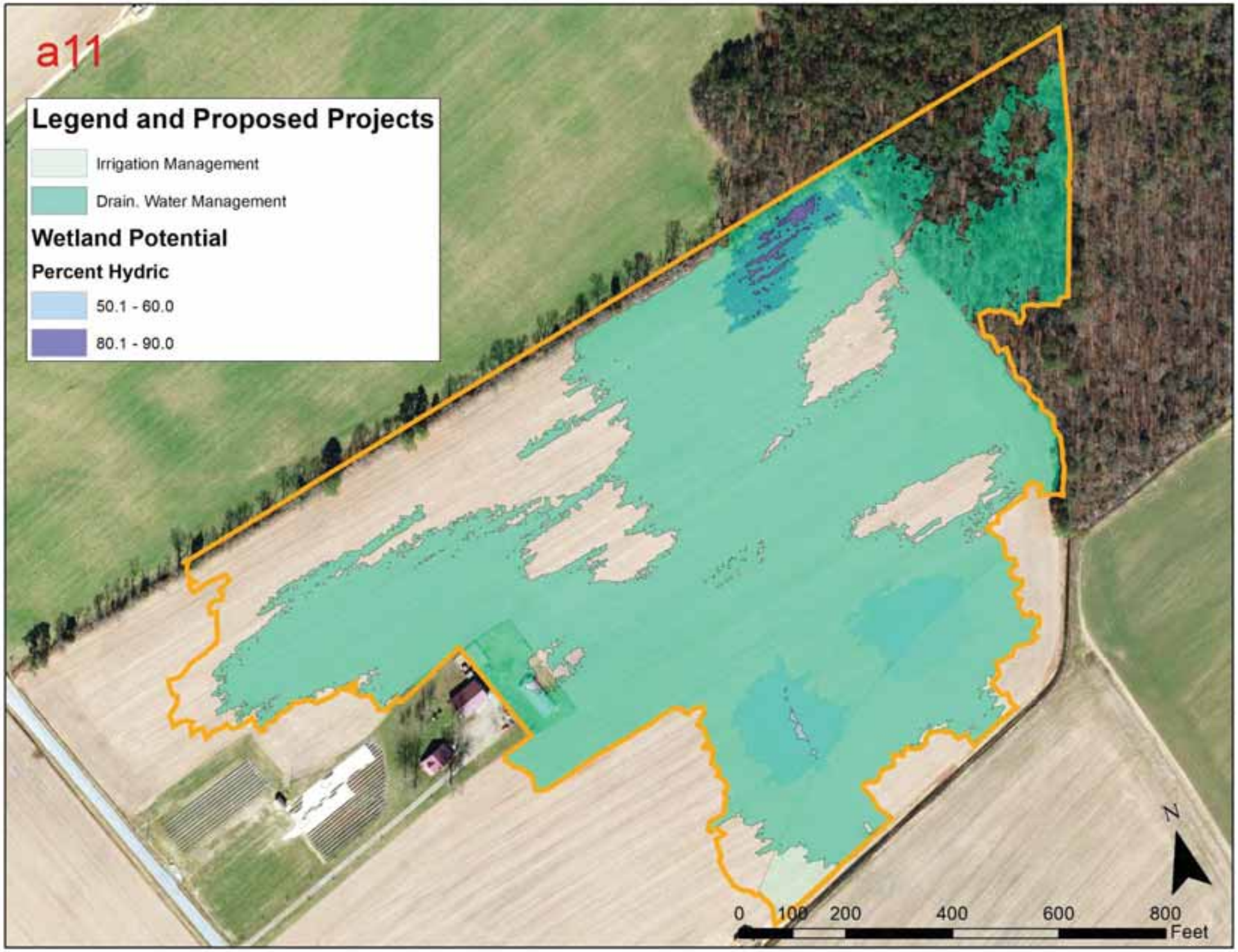
60.1 - 70.0
80.1 - 90.0
N
0
220
440
880
1,320
1,760
Feet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Irrigation Management
Drain. Water Management
Wetland Potential
Percent Hydric
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80.1 - 90.0
N
0
100
200
400
600
800
Feet


a20
Legend and Proposed Projects
Grassed Waterways
Ditch Projects
Wetland Potential
Percent Hydric
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80.1 - 90.0
Drain. Water Management
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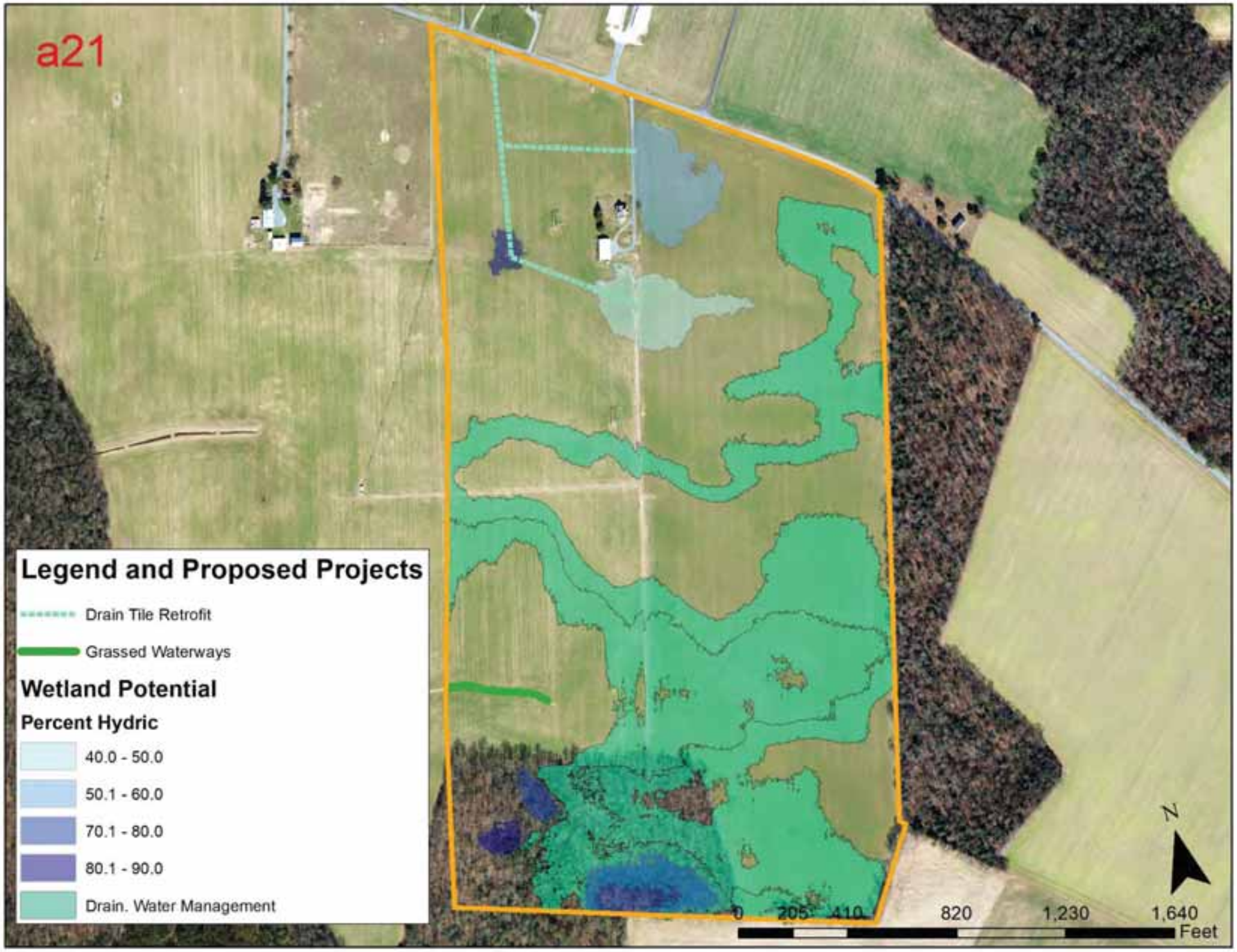
0
240
480
960
1,440
1,920
Feet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Drain Tile Retrofit
Grassed Waterways
Wetland Potential
Percent Hydric
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50.1 - 60.0
70.1 - 80.0
80.1 - 90.0
Drain. Water Management
N
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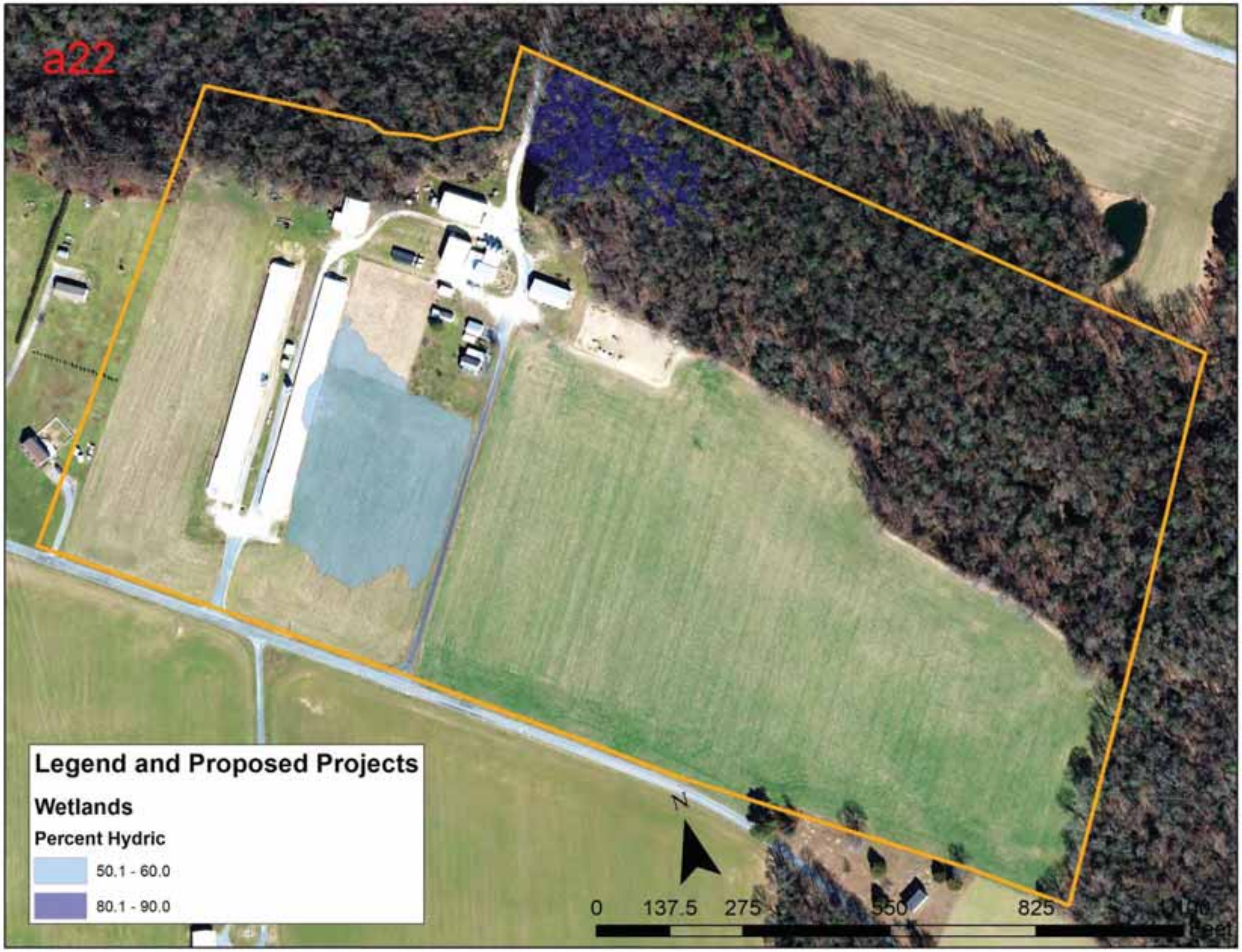
Feet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Legend and Proposed Projects
Wetlands
Percent Hydric
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80.1 - 90.0
N
0
137.5
275
550
825
Feet


a23
Legend and Proposed Projects
Wetlands
Percent Hydric
80.1 - 90.0
N
0
250
500
1,000
1,500
2,000
Feet


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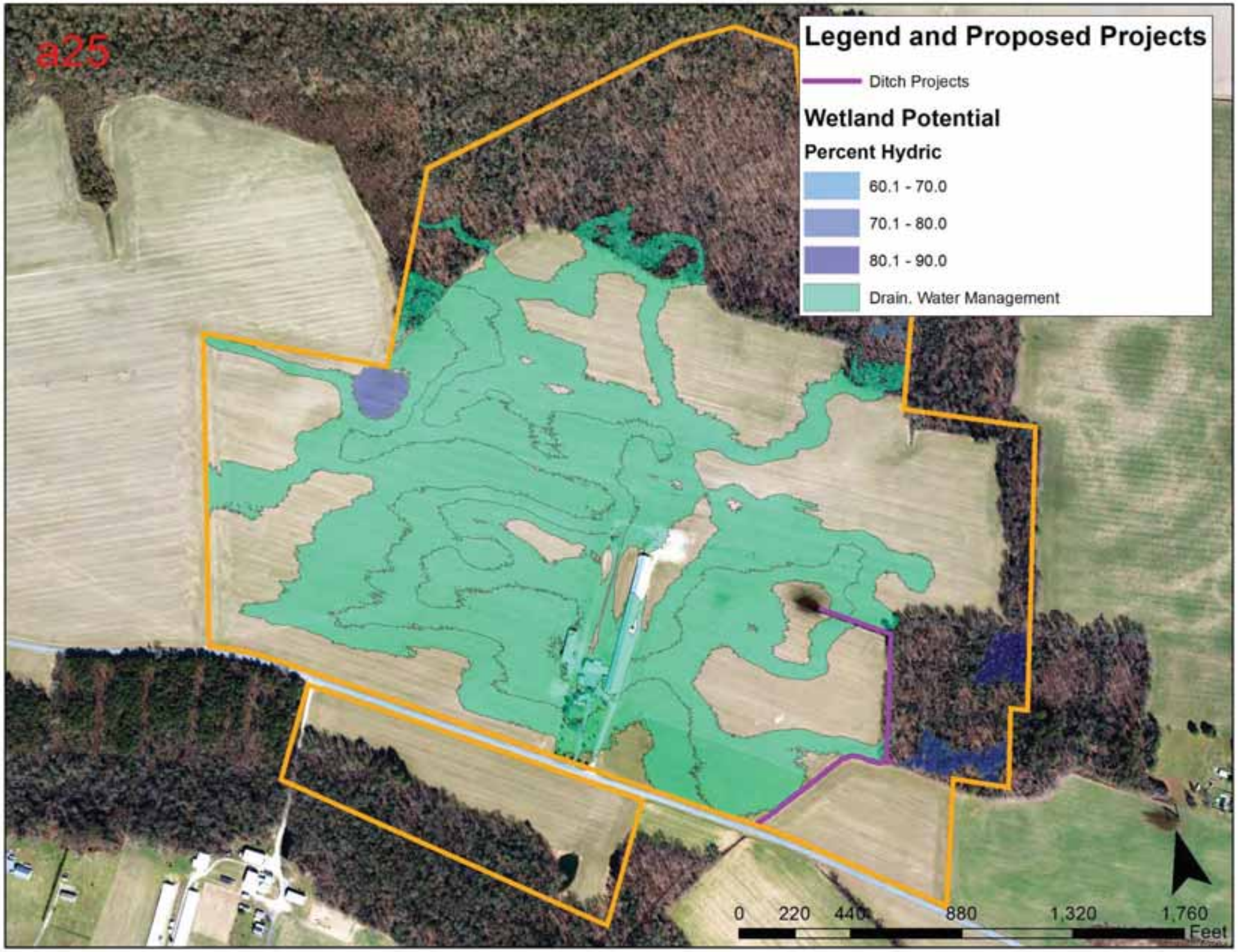
Legend and Proposed Projects
Wetland Potential
Percent Hydric
40.0 - 50.0
Critical Source Area
N
0 120 240 480 720 960
Feet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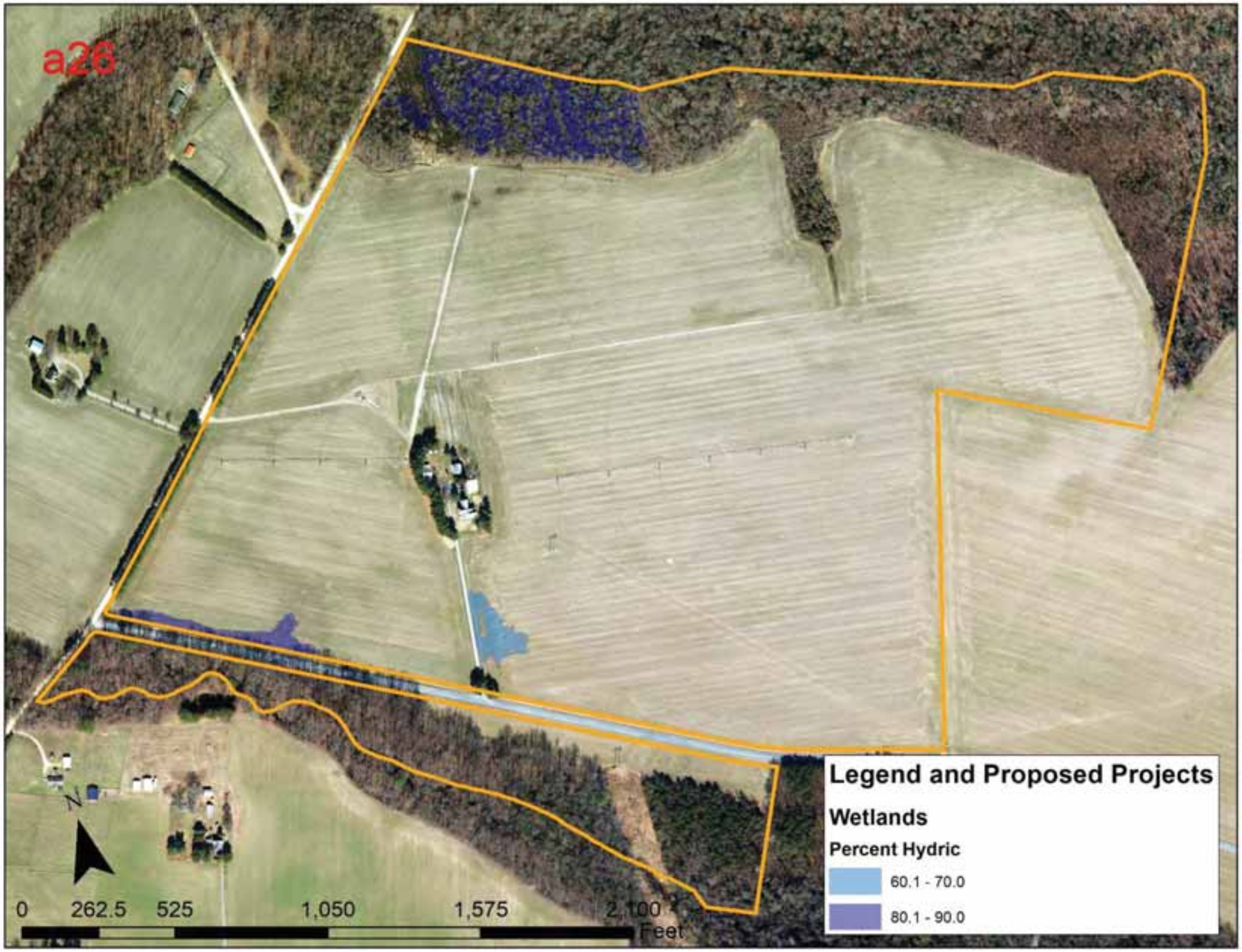
Legend and Proposed Projects
Ditch Projects
Wetland Potential
Percent Hydric
60.1 - 70.0
70.1 - 80.0
80.1 - 90.0
Drain. Water Management
0 220 440 880 1,320 1,760
Feet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80.1 - 90.0
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1,575
2,100
Feet


a30
Legend and Proposed Projects
Ditch Projects
N
0 155 310 620 930 1,240
Feet


a31
Legend and Proposed Projects
Ditch Projects
Wetland Potential
Percent Hydric
70.1 - 80.0
80.1 - 90.0
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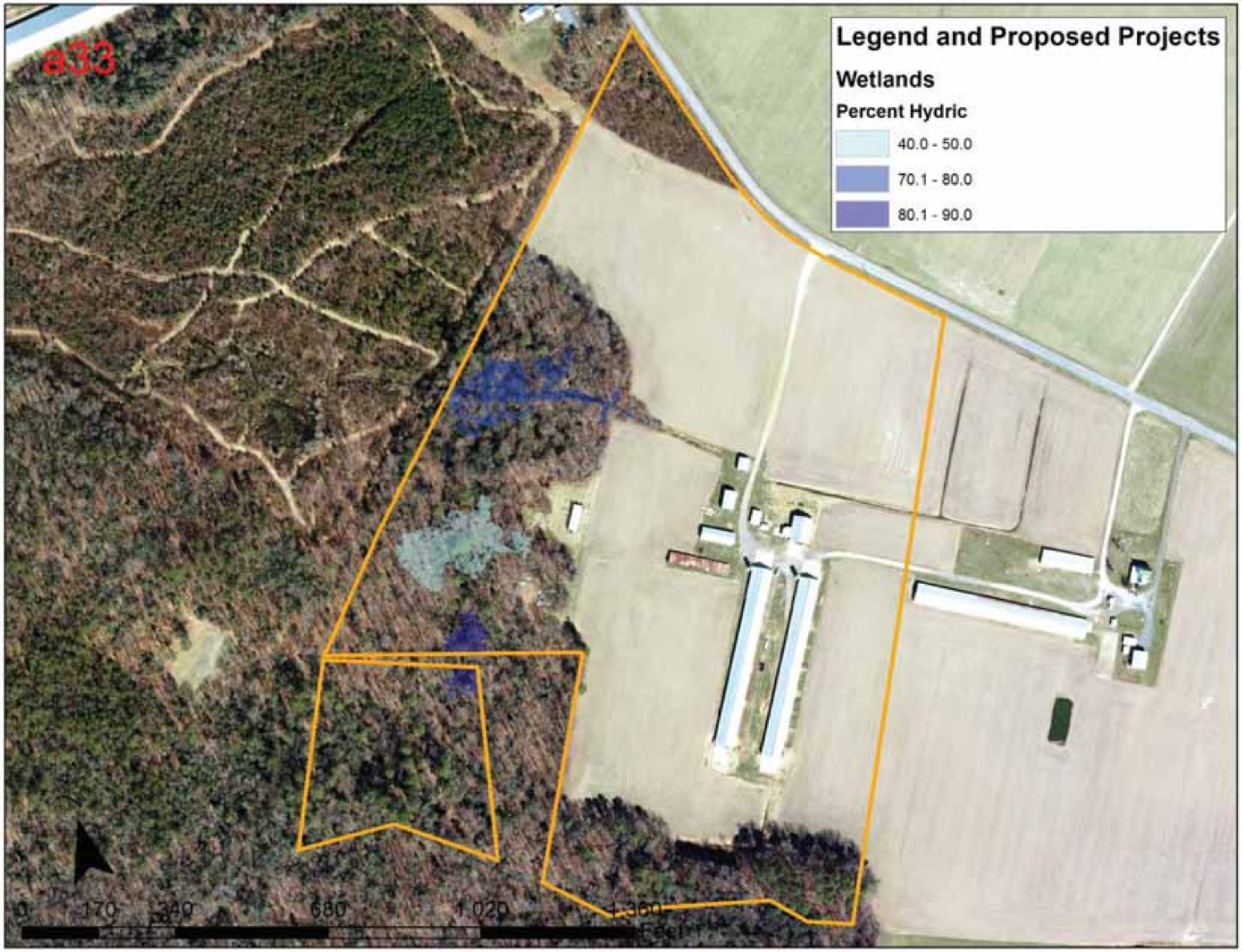
0
170
340
680
1,020
1,360
Feet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Legend and Proposed Projects
Wetlands
Percent Hydric
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70.1 - 80.0
80.1 - 90.0
0
170
340
680
1,020
1,360
Feet


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Legend and Proposed Projects
Wetlands
Percent Hydric
50.1 - 60.0
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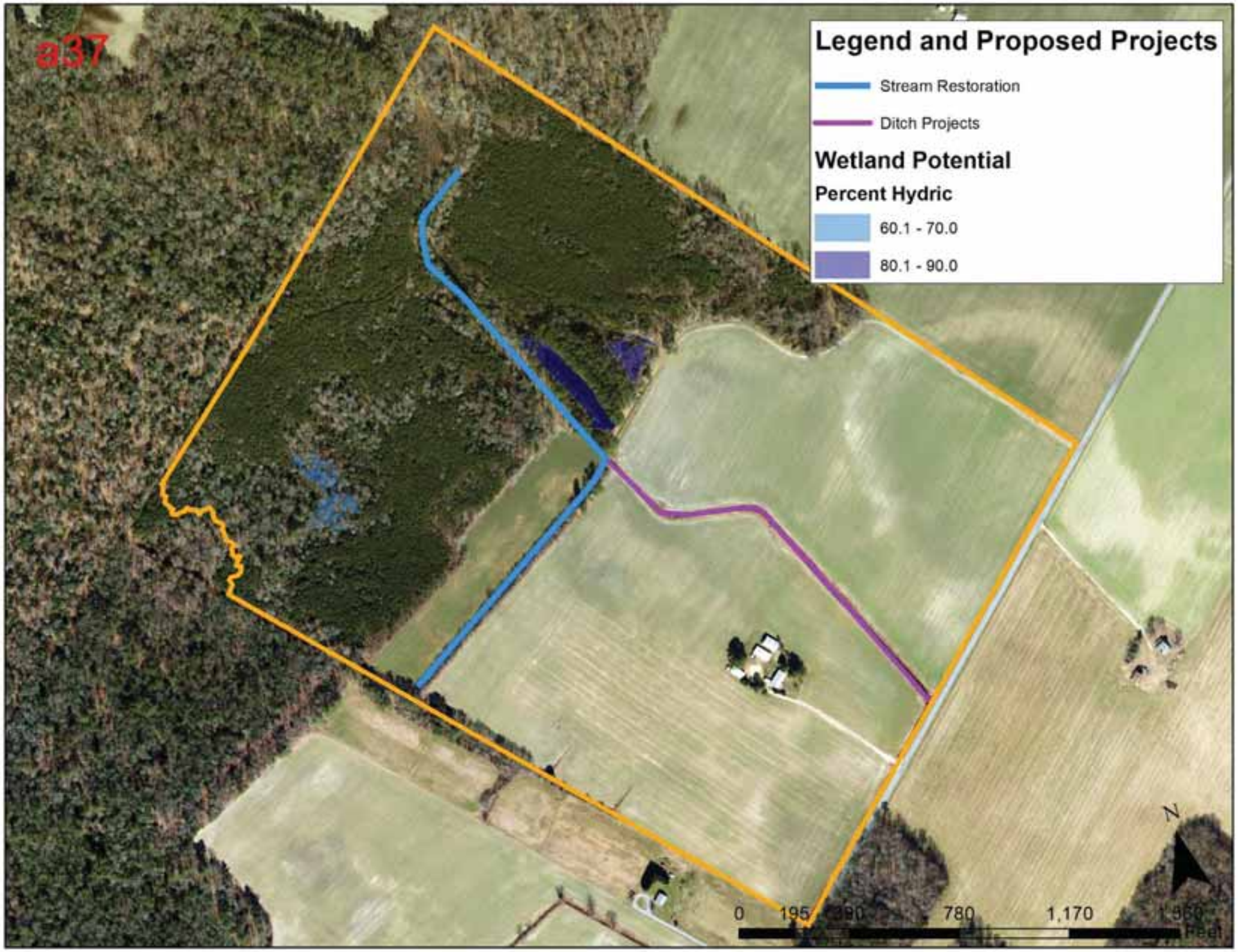
Feet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Stream Restoration
Ditch Projects
Wetland Potential
Percent Hydric
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80.1 - 90.0
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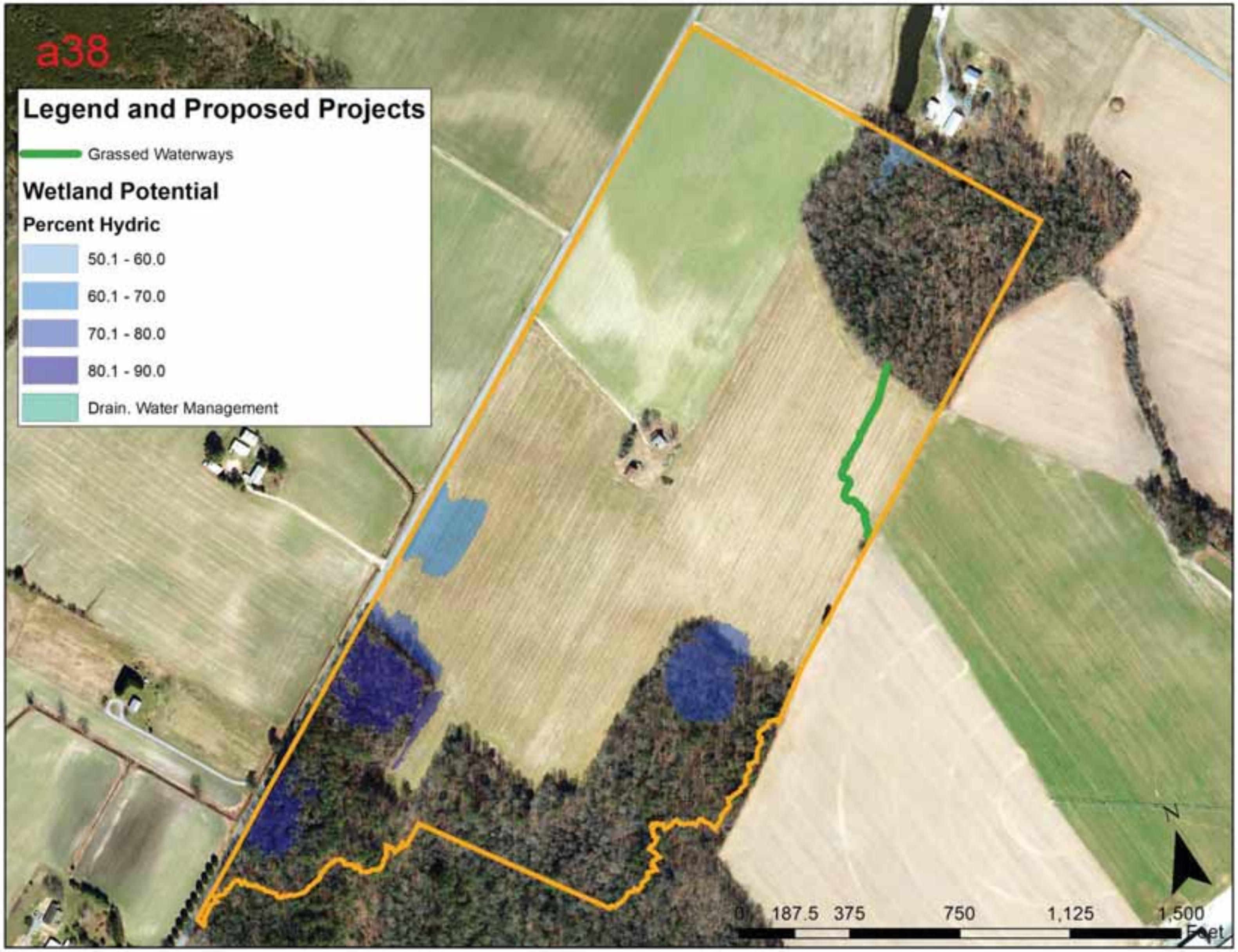
195
780
1,170
Feet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Grassed Waterways
Wetland Potential
Percent Hydric
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60.1 - 70.0
70.1 - 80.0
80.1 - 90.0
Drain. Water Management
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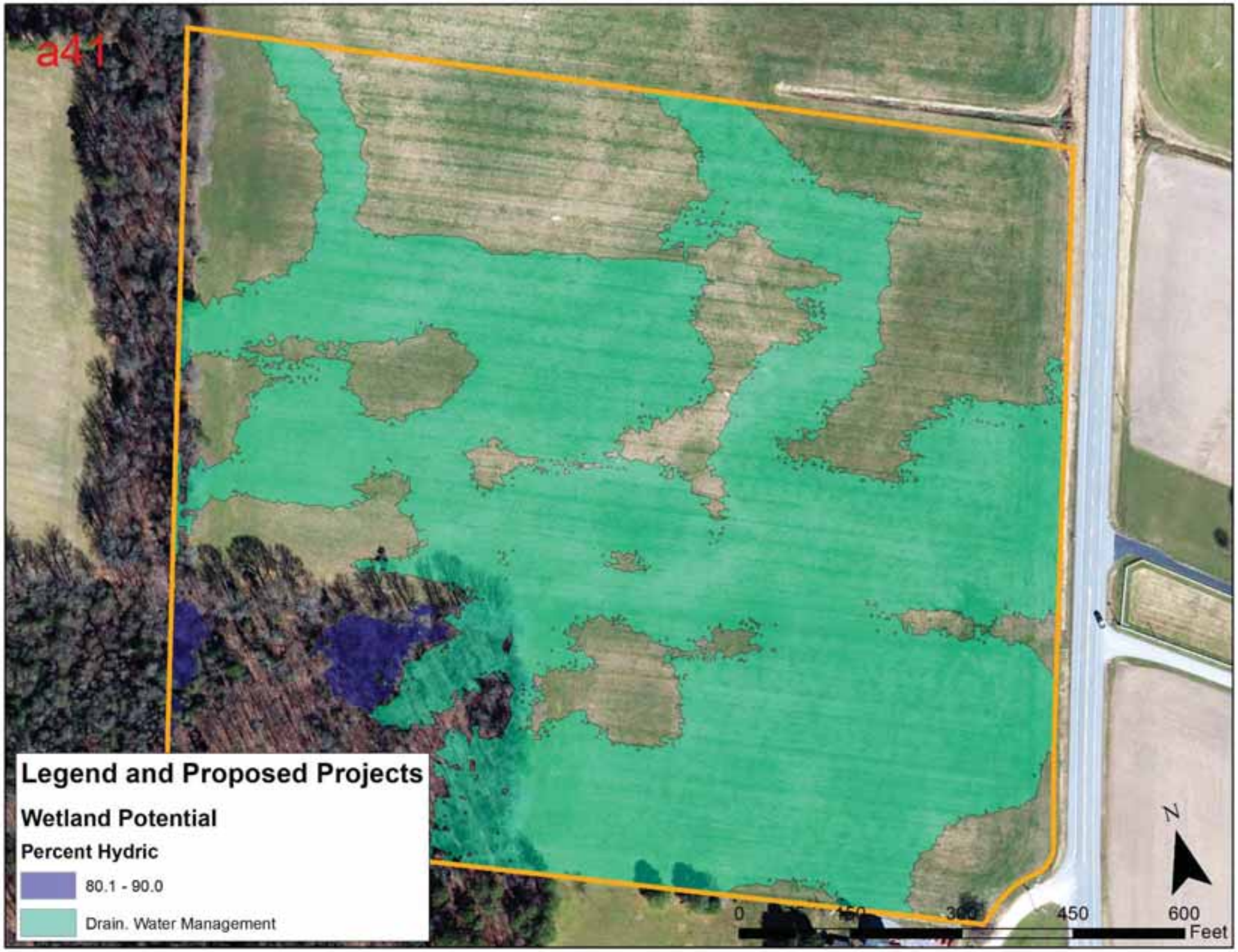
Feet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Wetland Potential
Percent Hydric
80.1 - 90.0
Drain. Water Management
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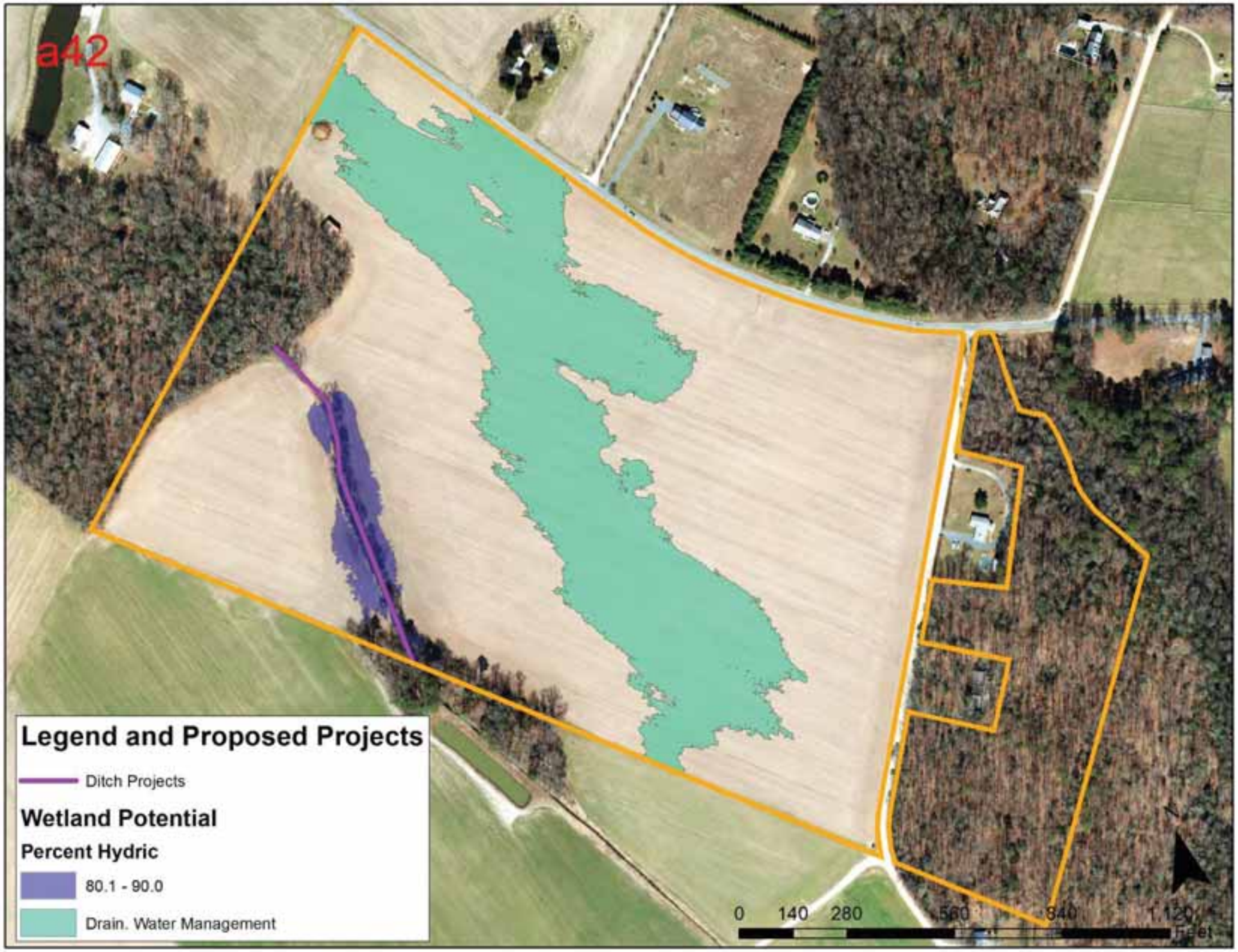
150
300
450
600
Feet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Ditch Projects
Wetland Potential
Percent Hydric
80.1 - 90.0
Drain. Water Management
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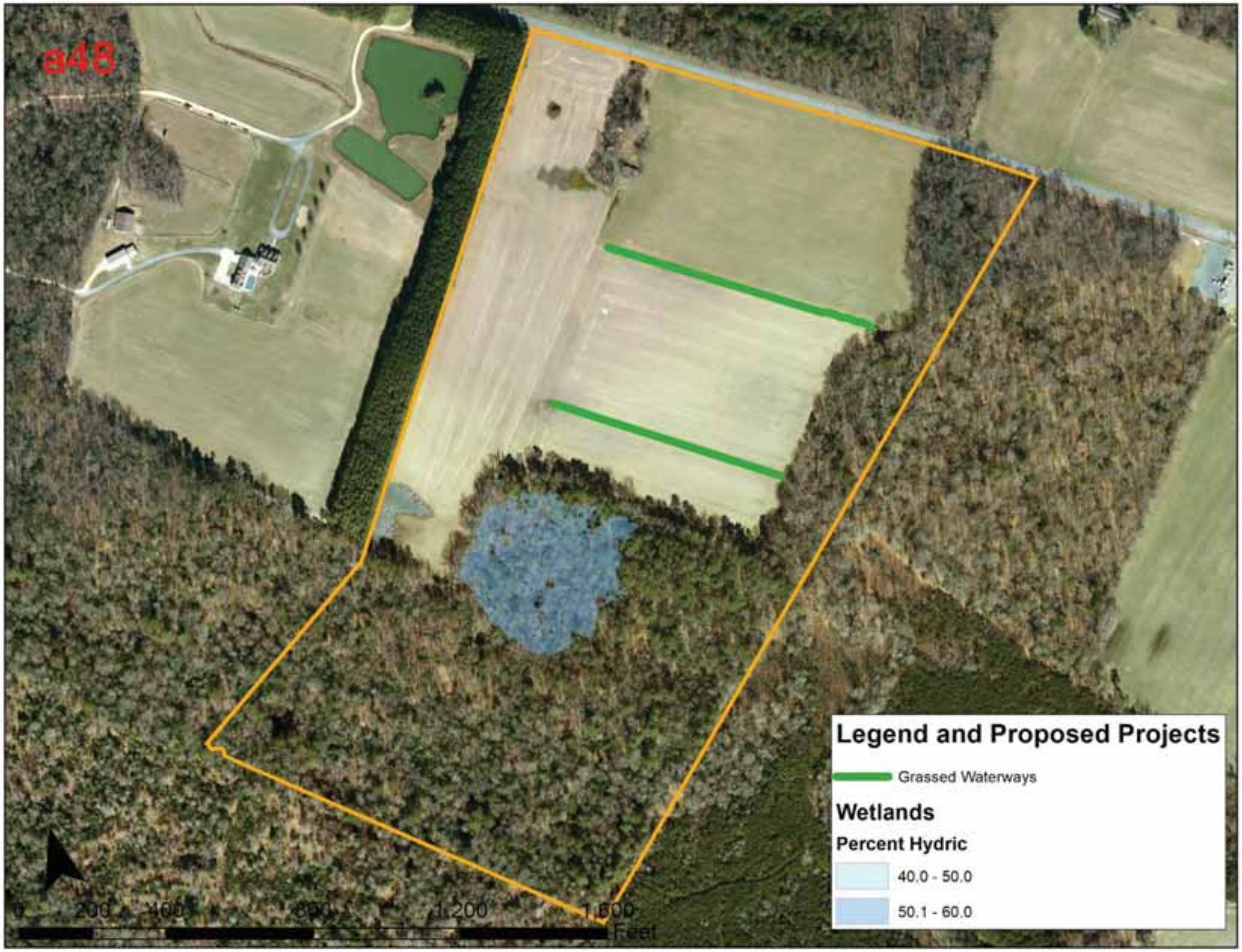
Feet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Grassed Waterways
Wetlands
Percent Hydric
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50.1 - 60.0
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200
400
800
1,200
1,600
Feet


a49
Legend and Proposed Projects
Wetlands
Percent Hydric
70.1 - 80.0
N
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95
190
380
570
760
Feet


a52
N
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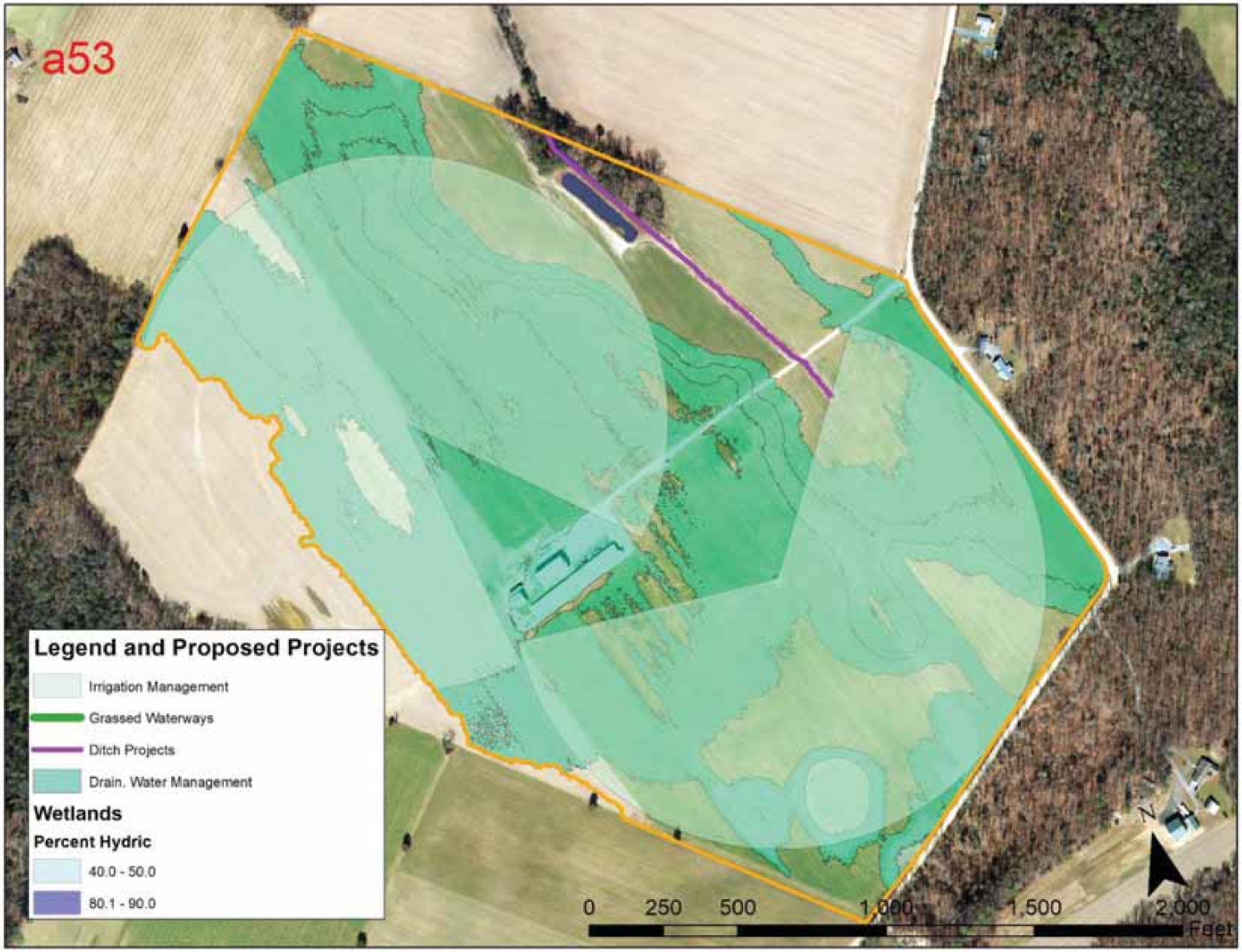
Feet
Legend and Proposed Projects
Denitrification Wall
Critical Source Area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Legend and Proposed Projects
Irrigation Management
Grassed Waterways
Ditch Projects
Drain. Water Management
Wetlands
Percent Hydric
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80.1 - 90.0
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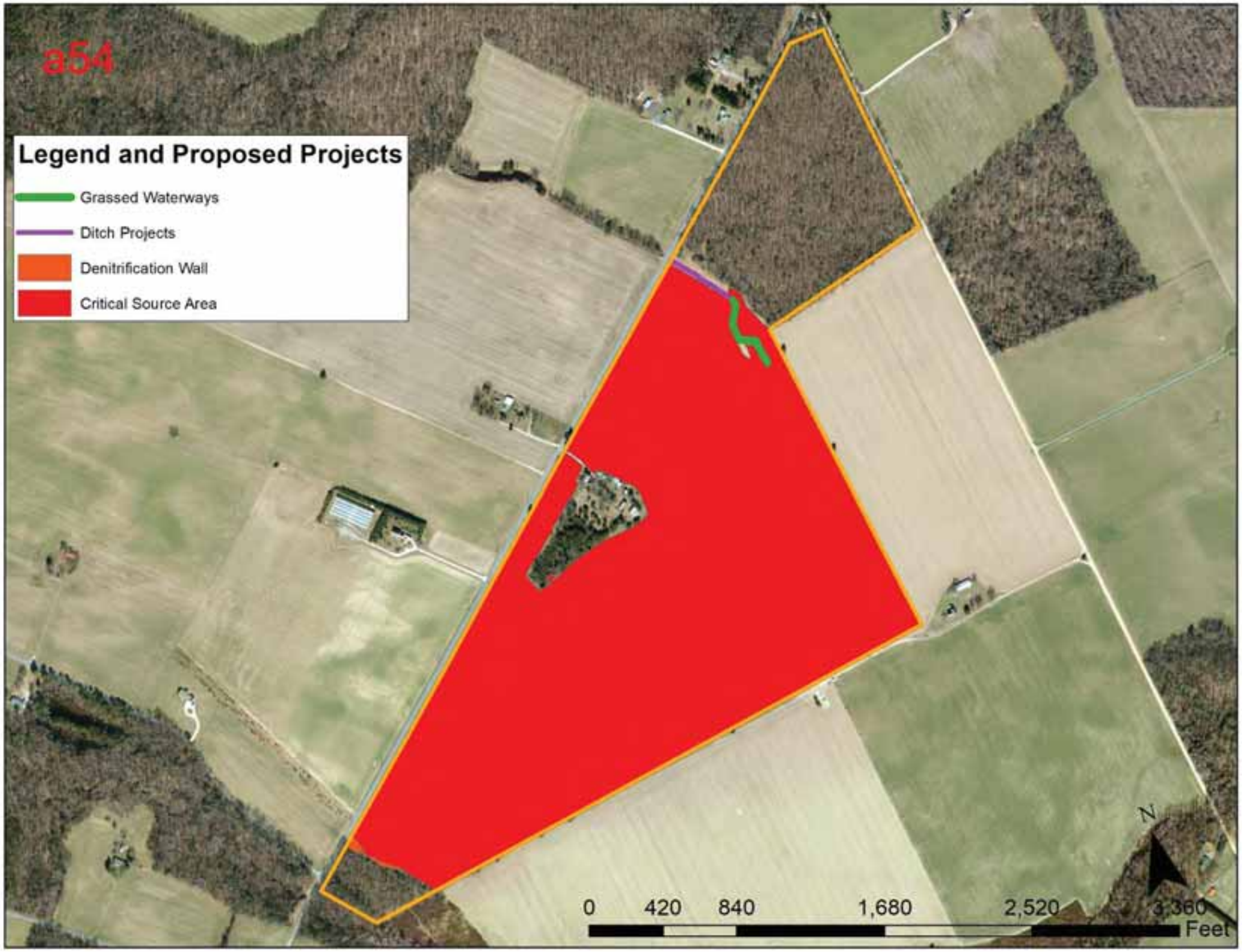
250
500
1,000
1,500
2,000
Feet
N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Legend and Proposed Projects
Grassed Waterways
Ditch Projects
Denitrification Wall
Critical Source Area
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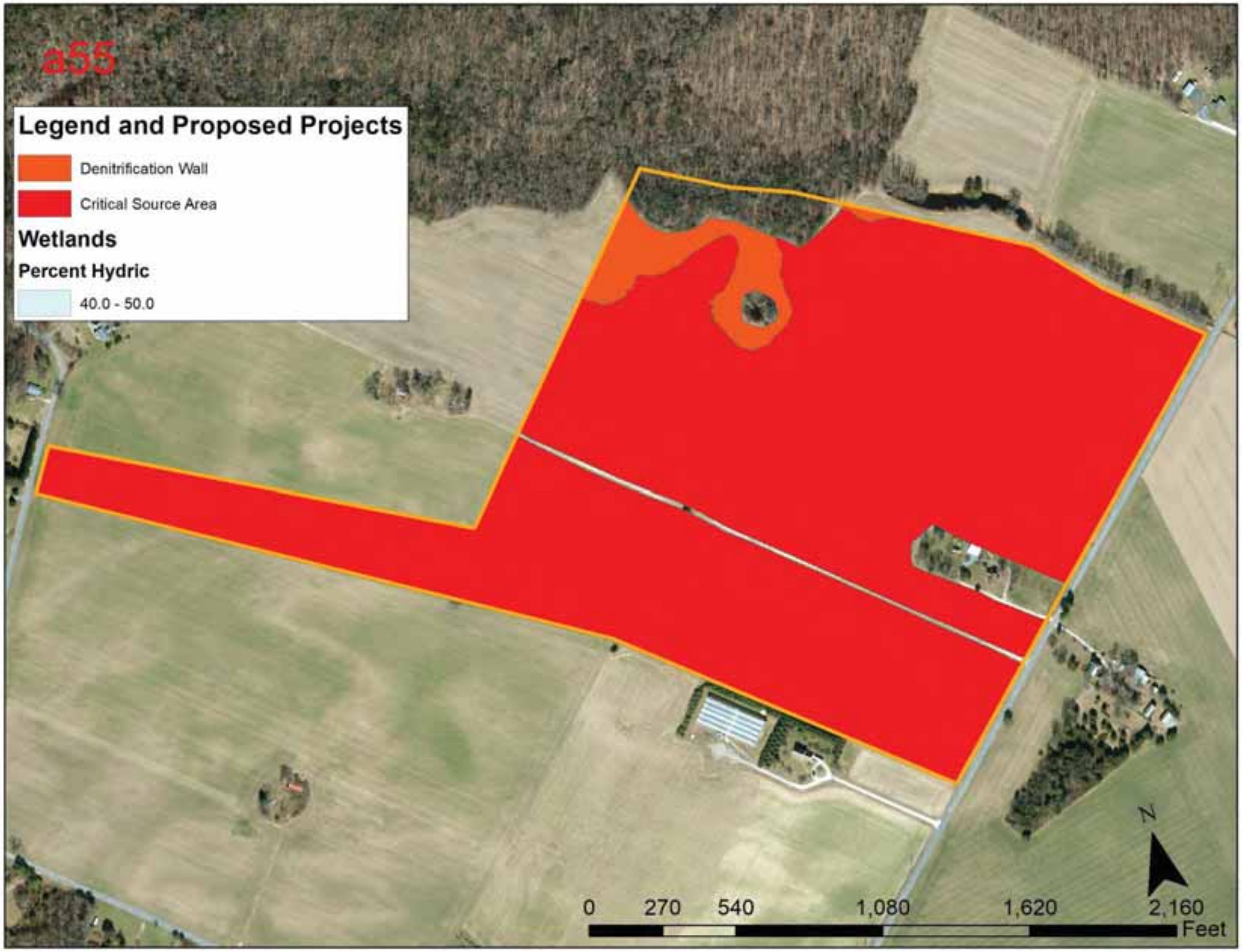
420
840
1,680
2,520
3,360
Feet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Legend and Proposed Projects
Denitrification Wall
Critical Source Area
Wetlands
Percent Hydric
40.0 - 50.0
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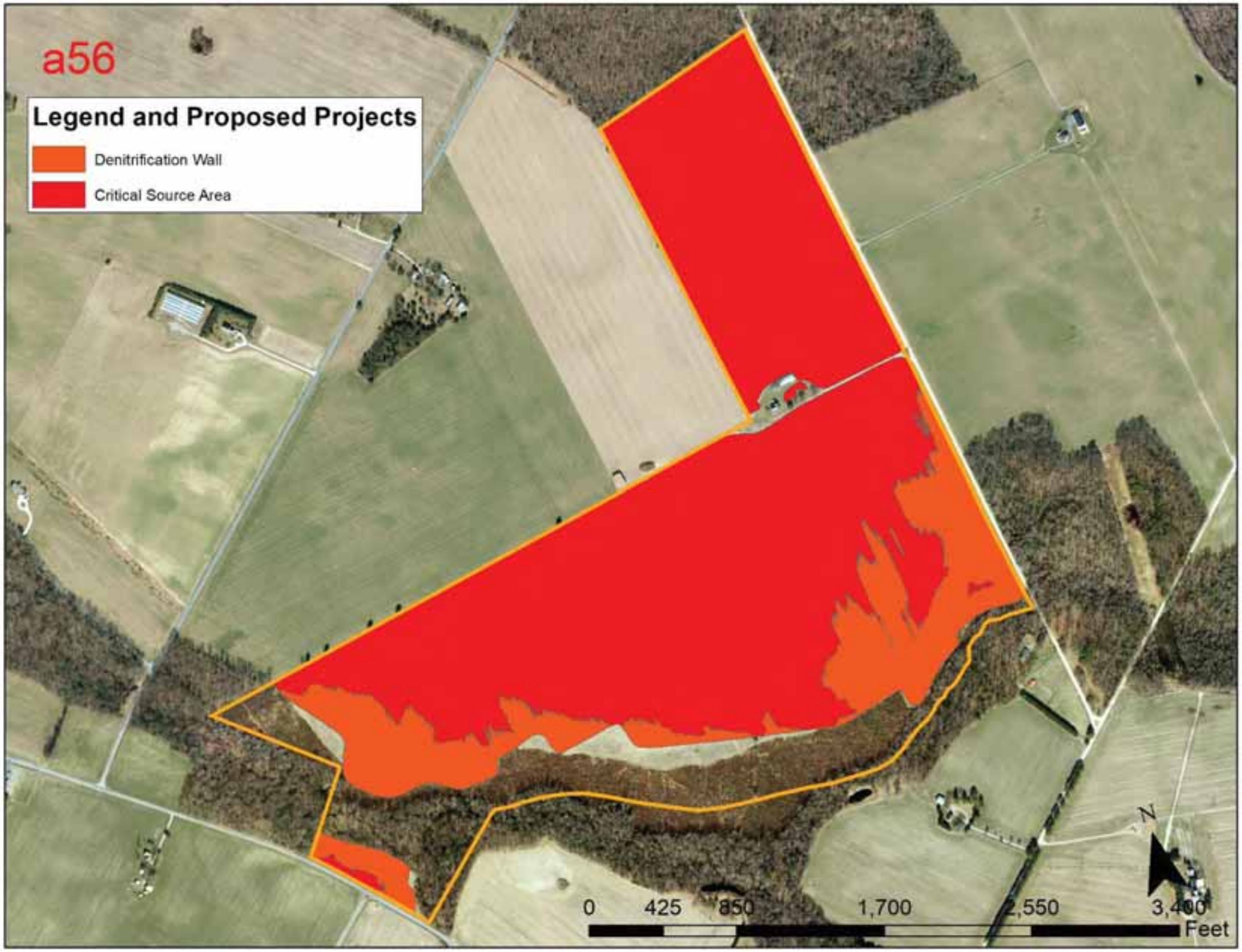
0
270
540
1,080
1,620
2,160
Feet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Legend and Proposed Projects
Denitrification Wall
Critical Source Area
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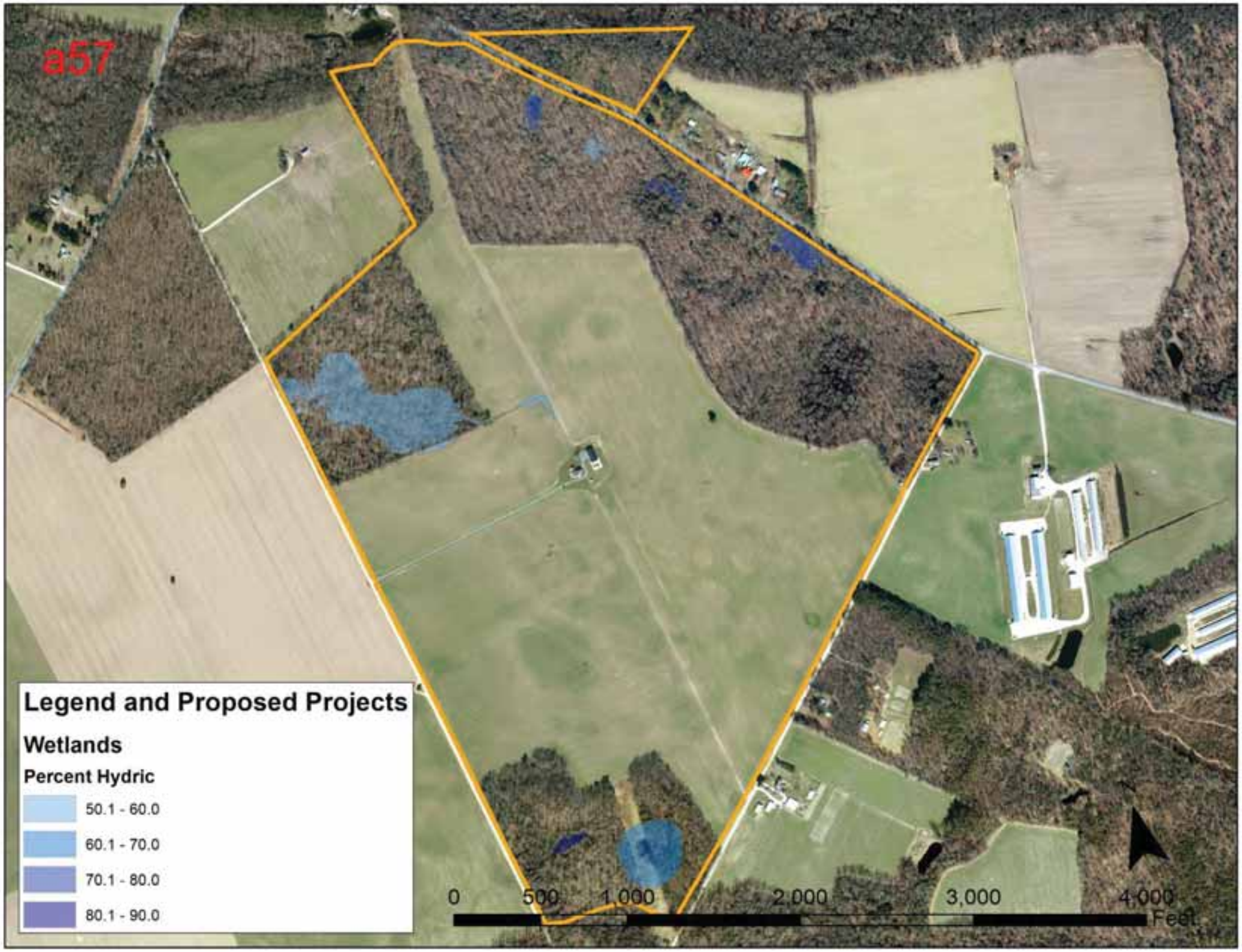
850
1,700
2,550
3,400
Feet
N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Legend and Proposed Projects
Wetlands
Percent Hydric
50.1 - 60.0
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70.1 - 80.0
80.1 - 90.0
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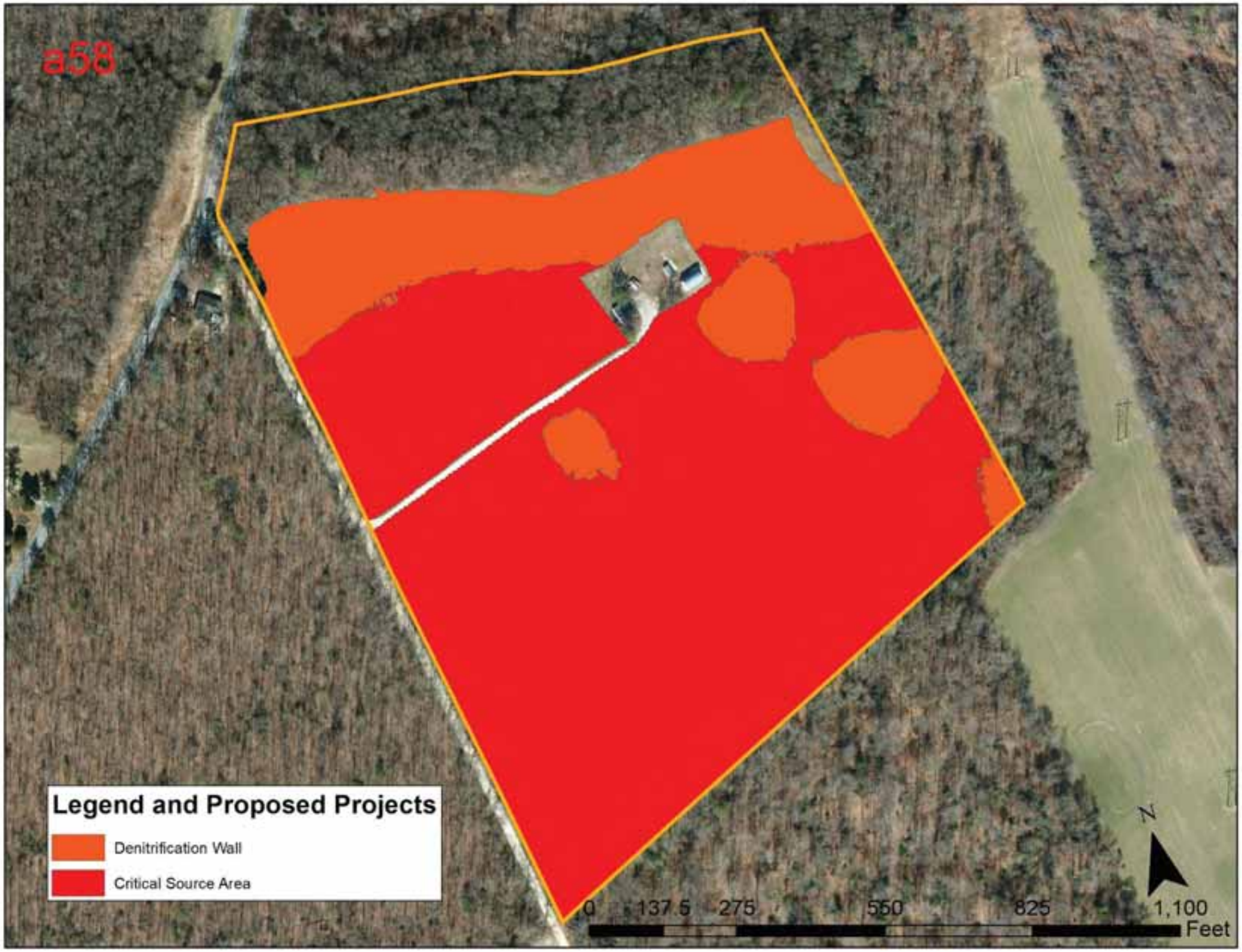
3,000
4,000
Feet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Denitrification Wall
Critical Source Area
N
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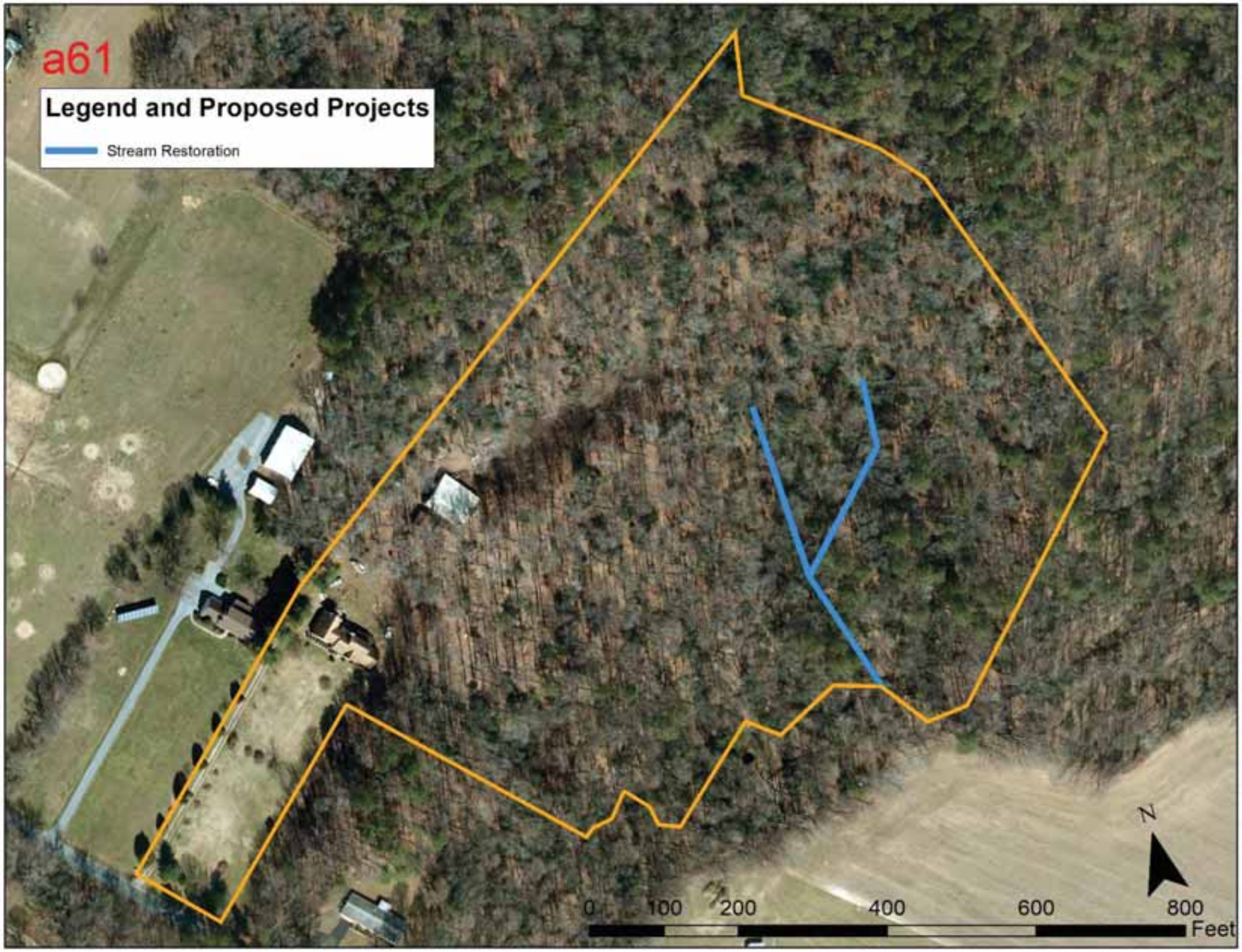
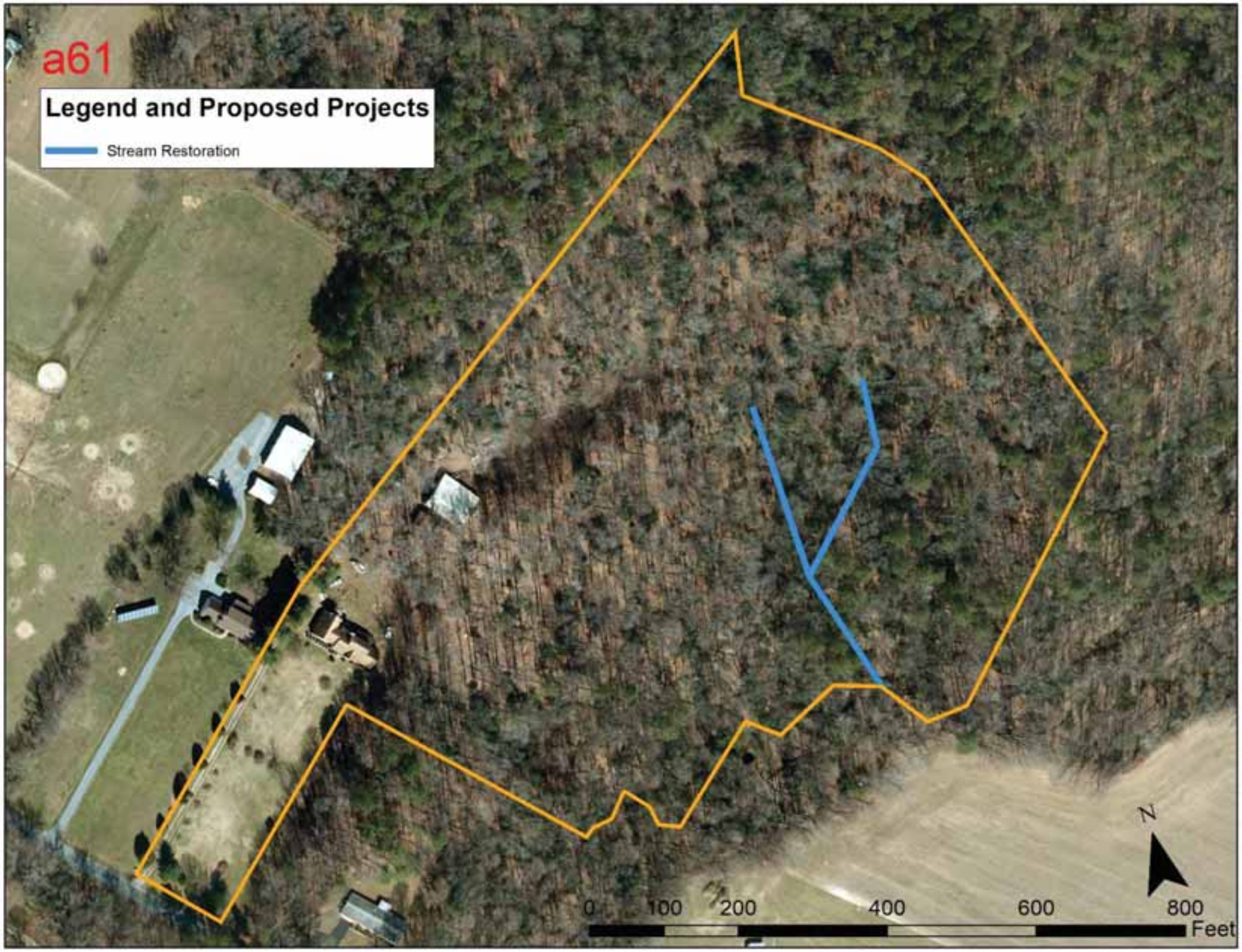
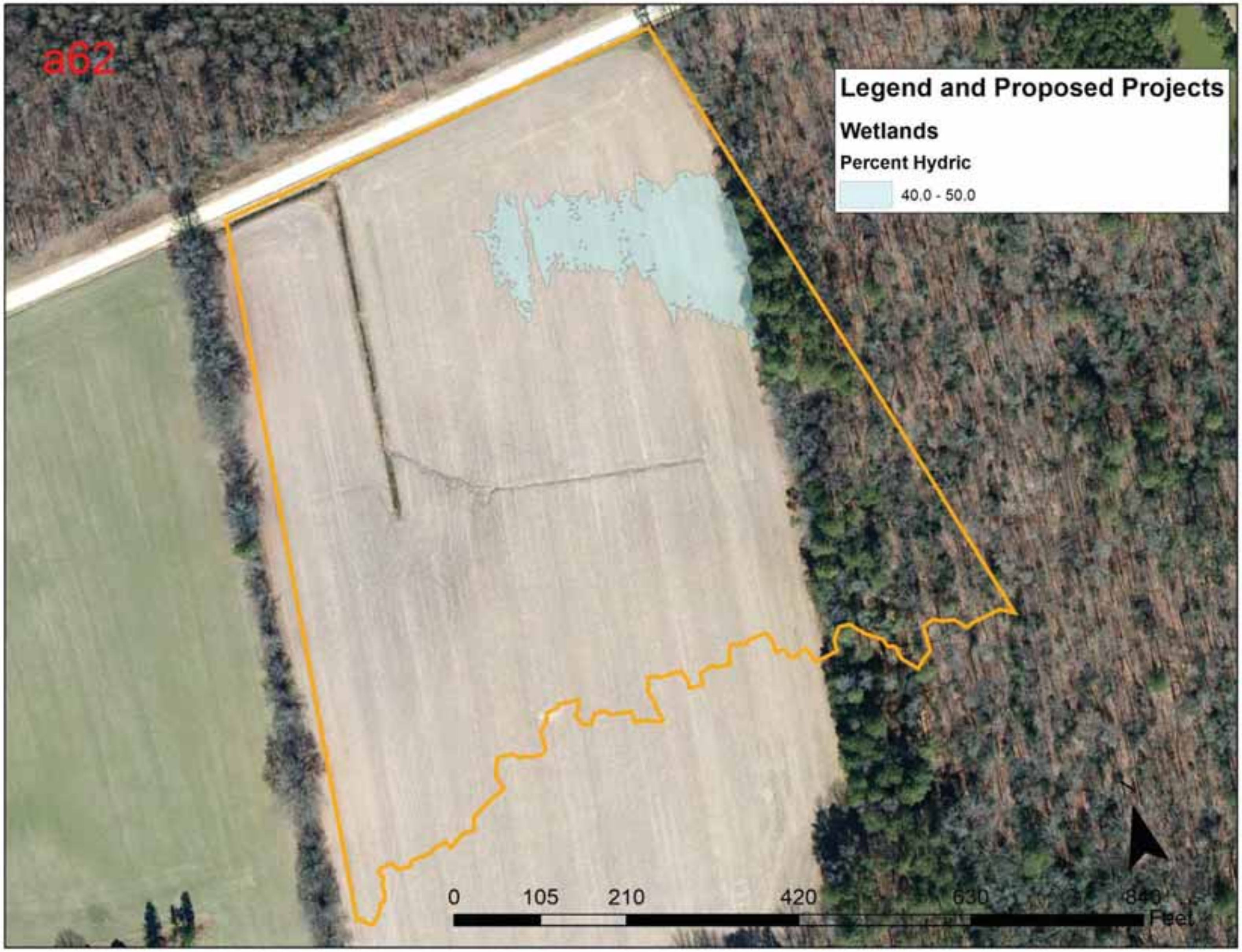
Feet

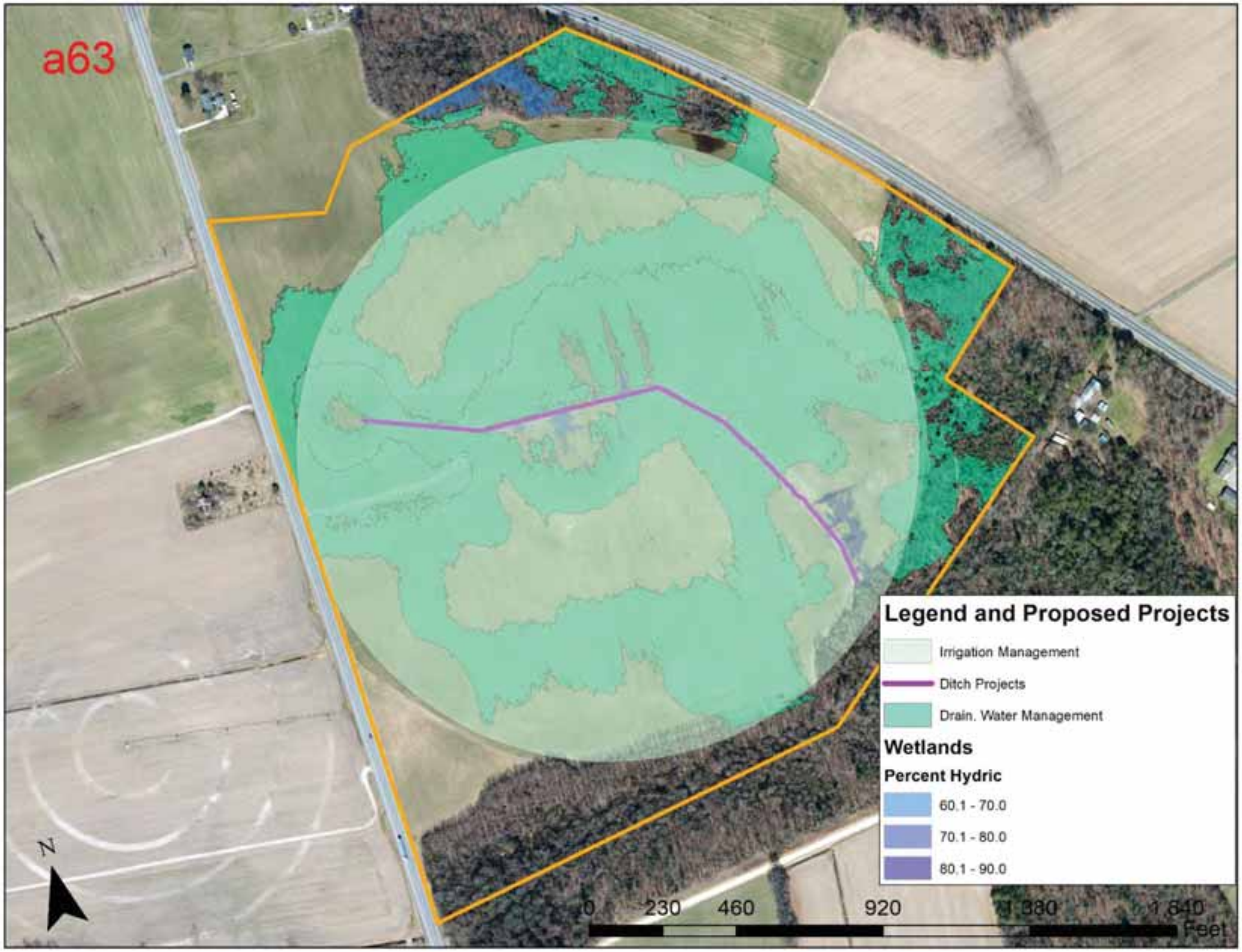

a59
Legend and Proposed Projects
Grassed Waterways
Critical Source Area
N
0
160
320
640
960
1,280
Feet


a60
Legend and Proposed Projects
Critical Source Area
0
130
260
520
780
1,040
Feet


a61
Legend and Proposed Projects
Stream Restoration
N
0
100
200
400
600
800
Feet


a61
Legend and Proposed Projects
Stream Restoration
N
0
100
200
400
600
800
Feet

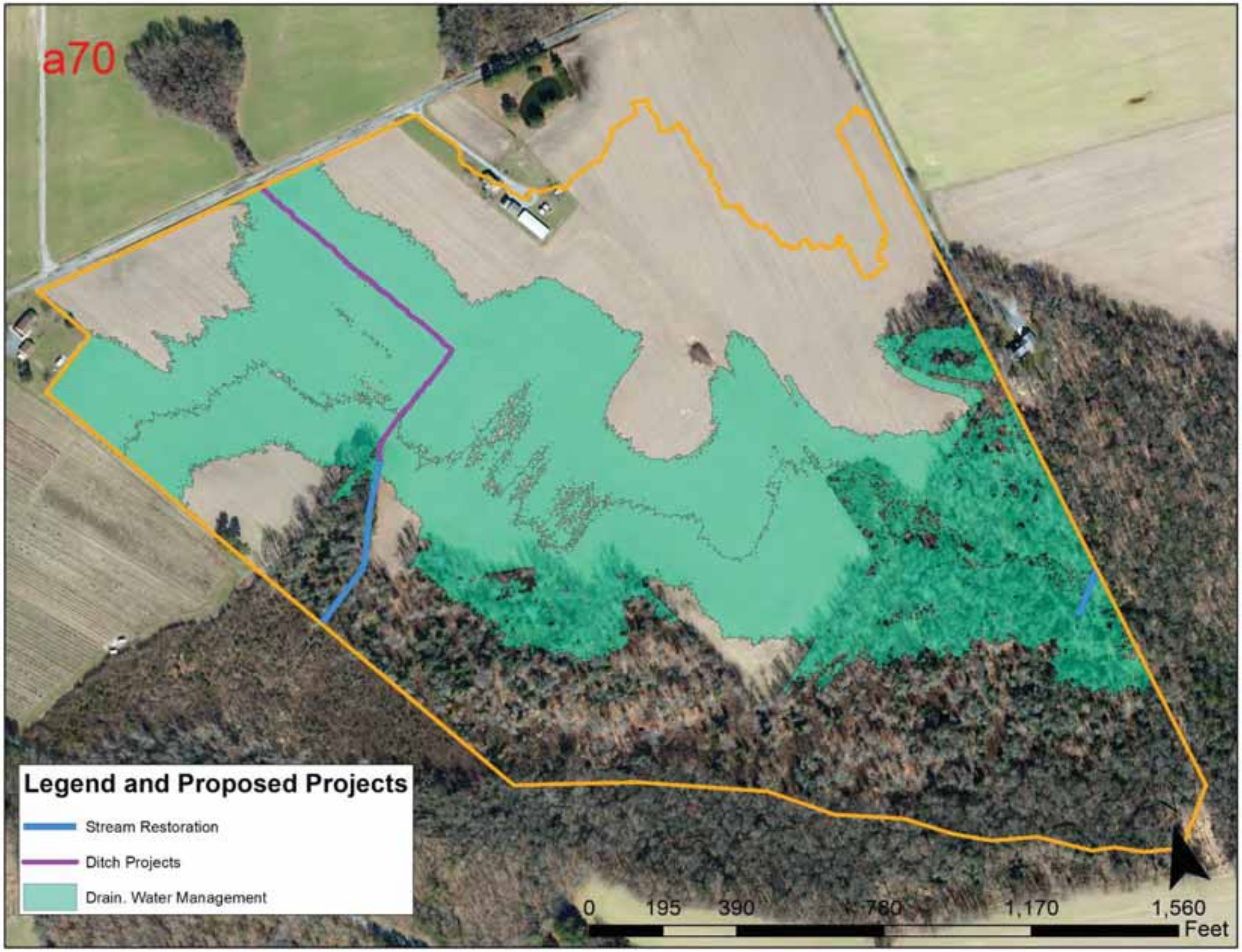

a62
Legend and Proposed Projects
Wetlands
Percent Hydric
40.0 - 50.0
0
105
210
420
630
840
Feet

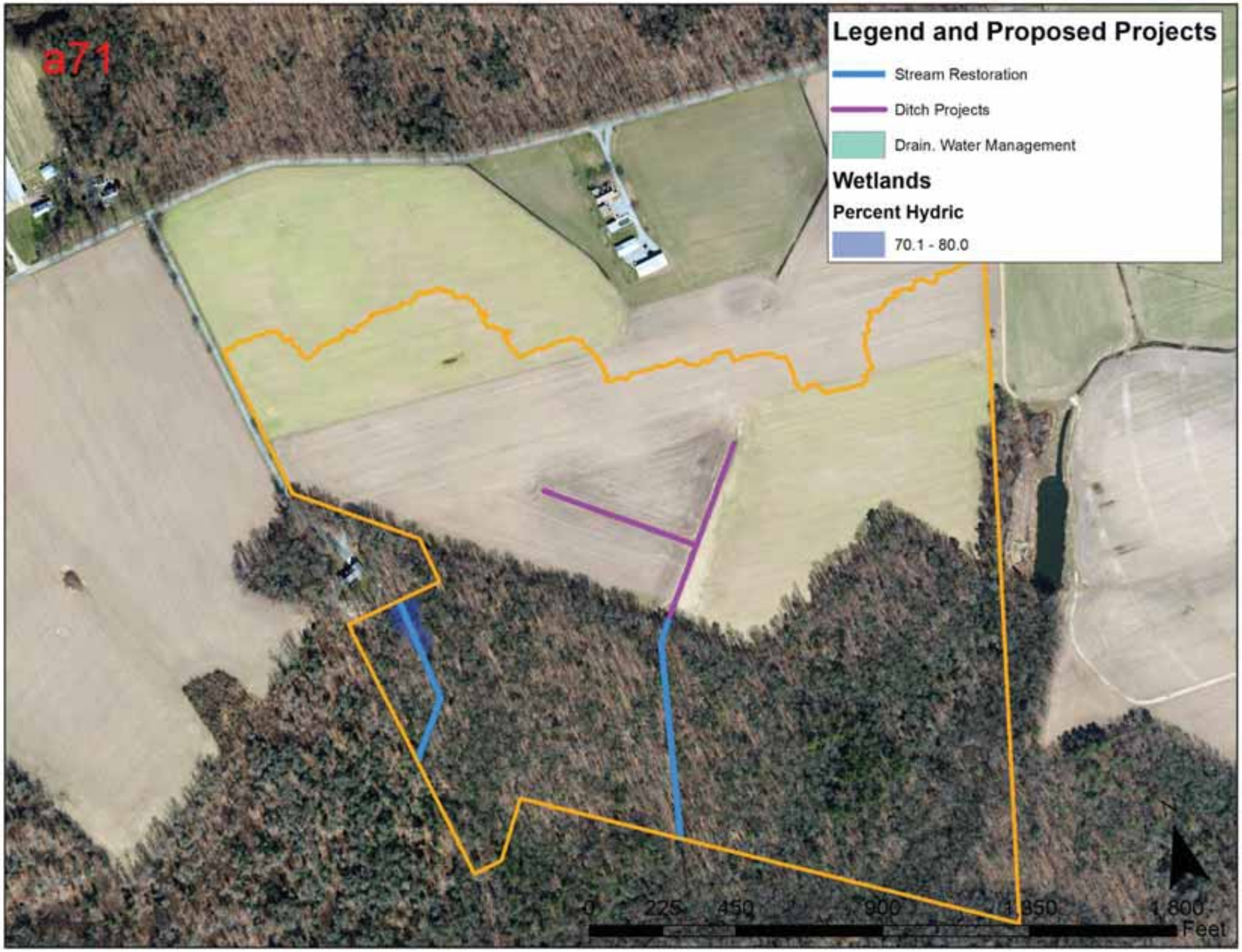

a63
Legend and Proposed Projects
Irrigation Management
Ditch Projects
Drain. Water Management
Wetlands
Percent Hydric
60.1 - 70.0
70.1 - 80.0
80.1 - 90.0
0
230
460
920
1,380
1,840
Feet
N

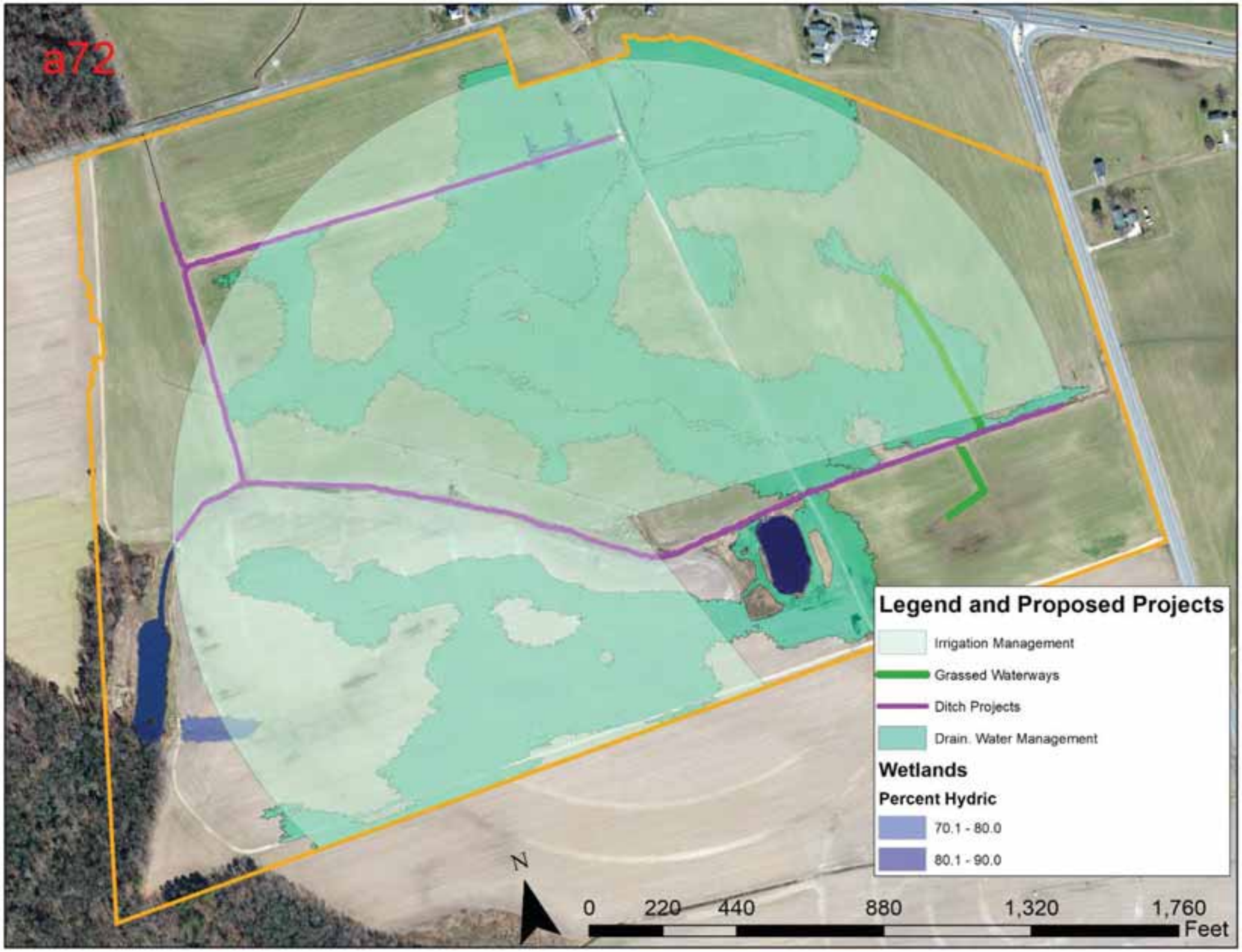

a64
Legend and Proposed Projects
Wetlands
Percent Hydric
60.1 - 70.0
0
75
150
300
450
600
Feet
N

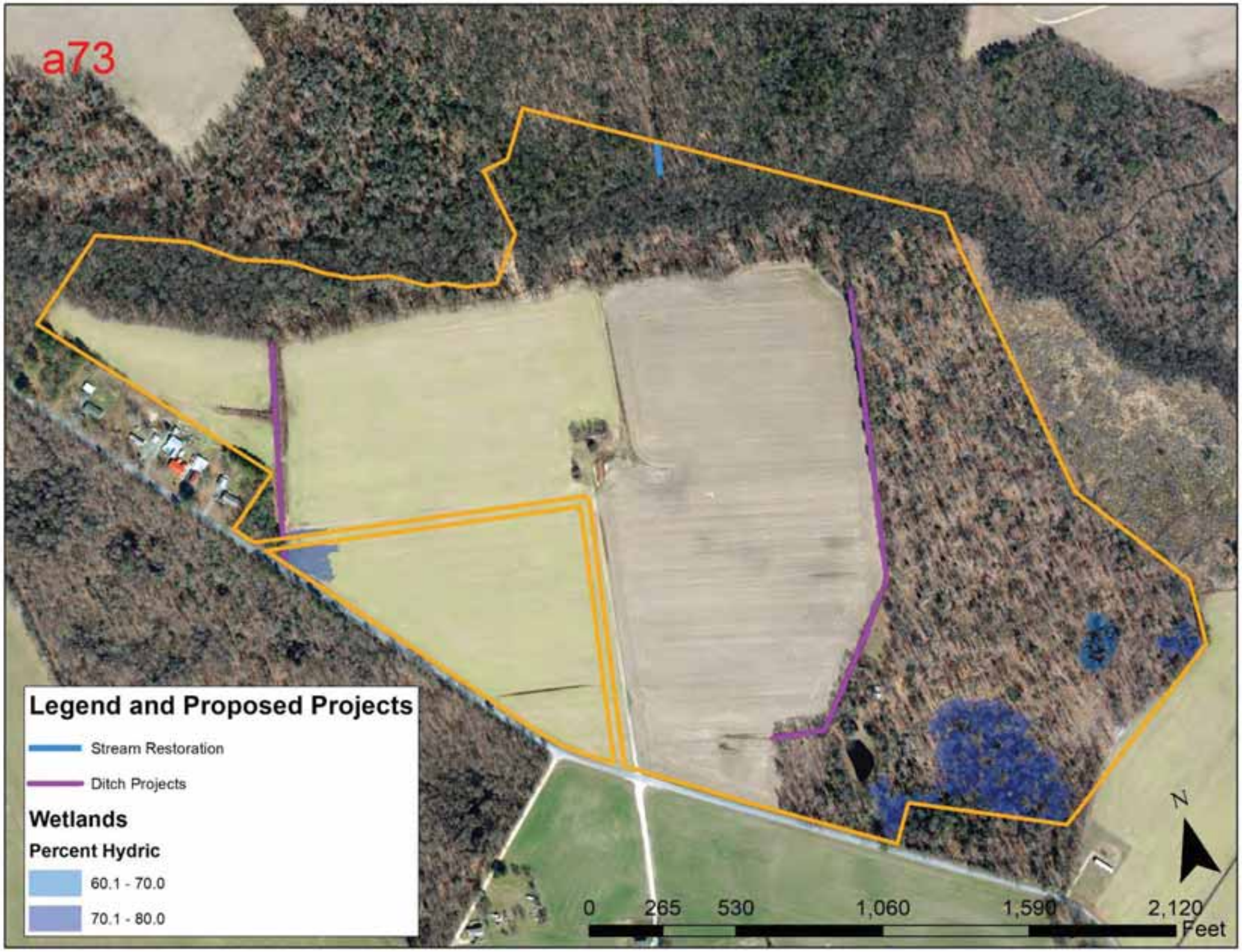

a65
Legend and Proposed Projects
Stream Restoration
Denitrification Wall
Critical Source Area
1,080
1,440
Feet


a67
Legend and Proposed Projects
Critical Source Area
0
90
180
360
540
720
Feet


a70
Legend and Proposed Projects
Stream Restoration
Ditch Projects
Drain. Water Management
0
195
390
780
1,170
1,560
Feet

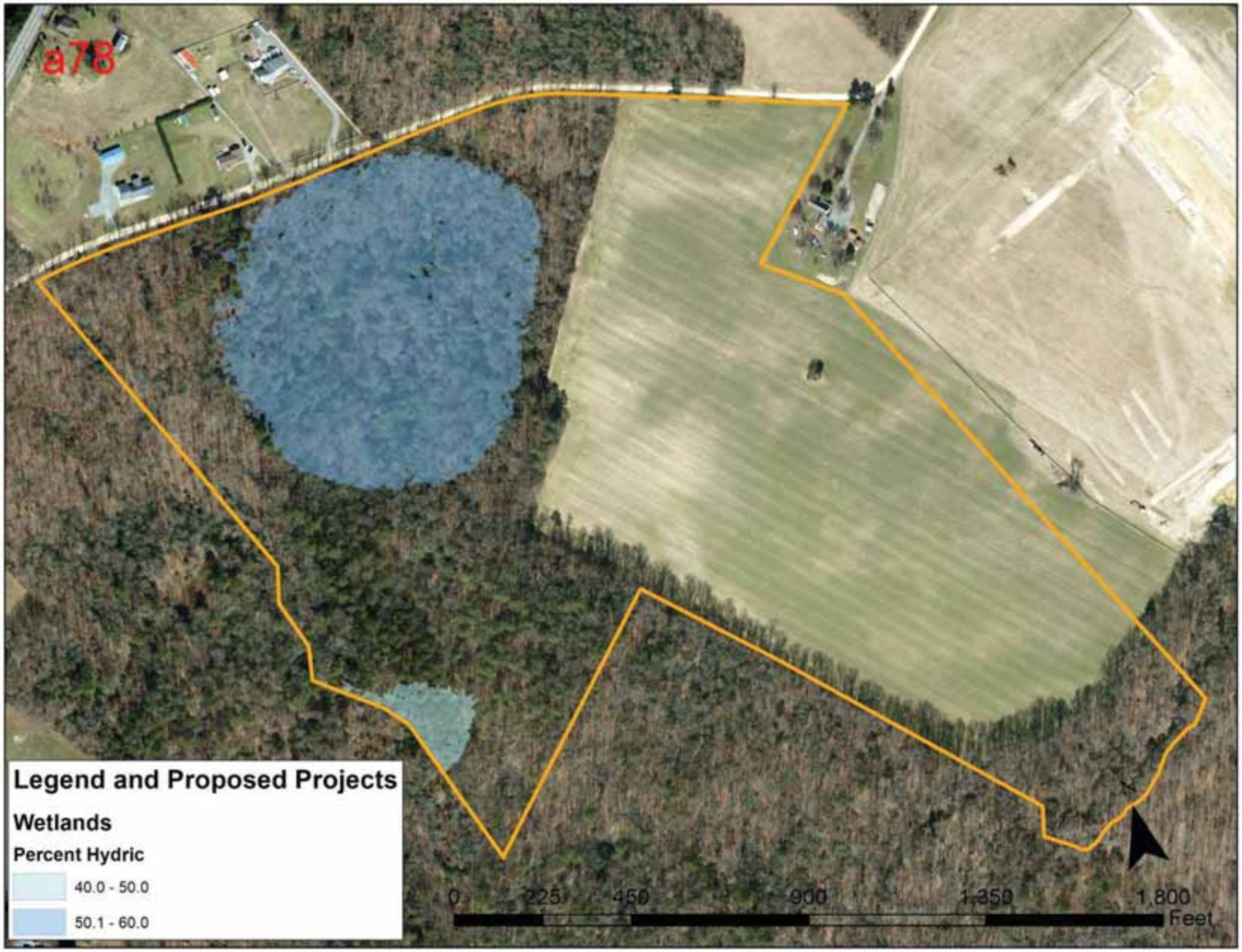

a71
Legend and Proposed Projects
Stream Restoration
Ditch Projects
Drain. Water Management
Wetlands
Percent Hydric
70.1 - 80.0
0
225
450
900
1,350
1,800
Feet


a72
Legend and Proposed Projects
Irrigation Management
Grassed Waterways
Ditch Projects
Drain. Water Management
Wetlands
Percent Hydric
70.1 - 80.0
80.1 - 90.0
N
0
220
440
880
1,320
1,760
Feet

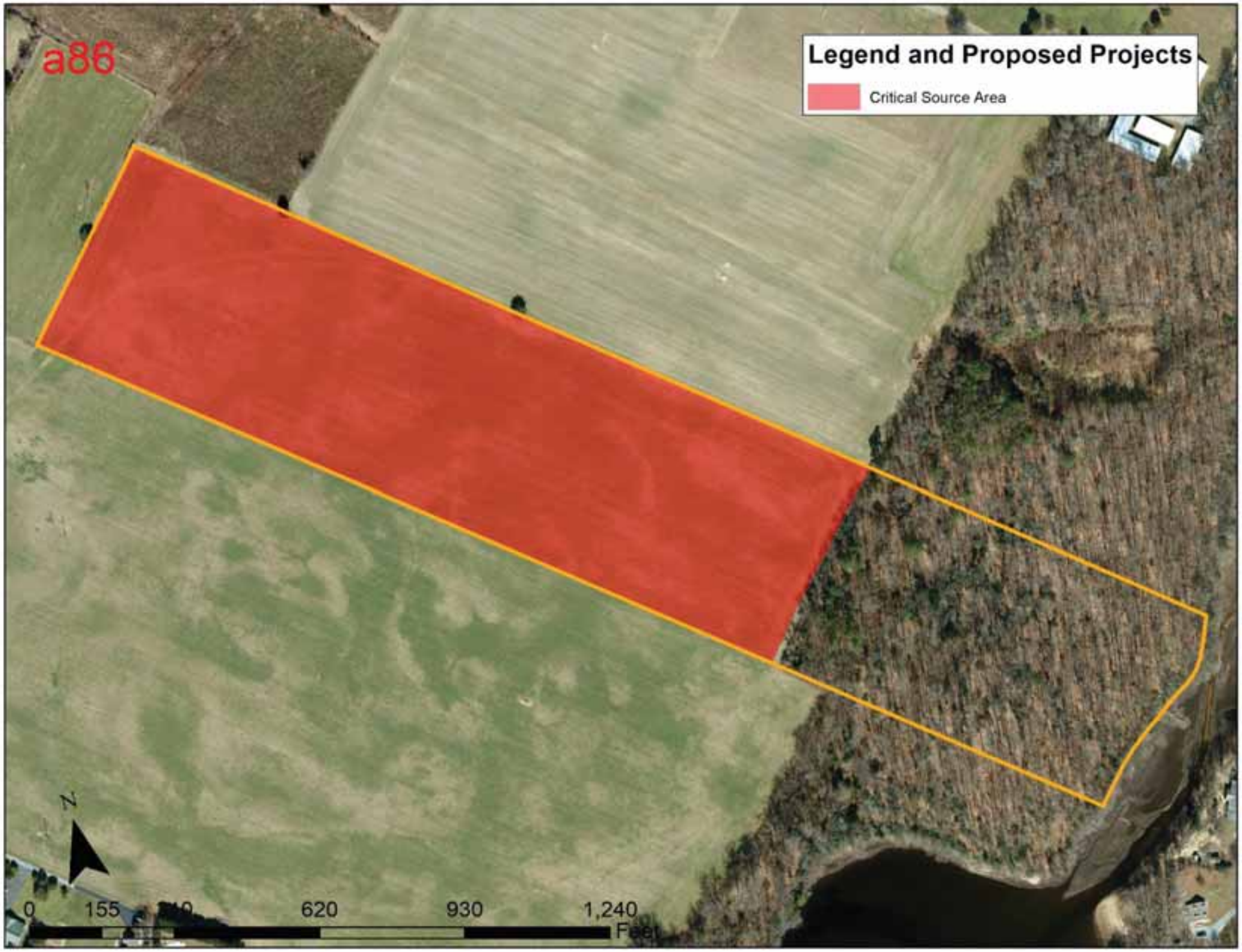

a73
Legend and Proposed Projects
Stream Restoration
Ditch Projects
Wetlands
Percent Hydric
60.1 - 70.0
70.1 - 80.0
N
0
265
530
1,060
1,590
2,120
Feet

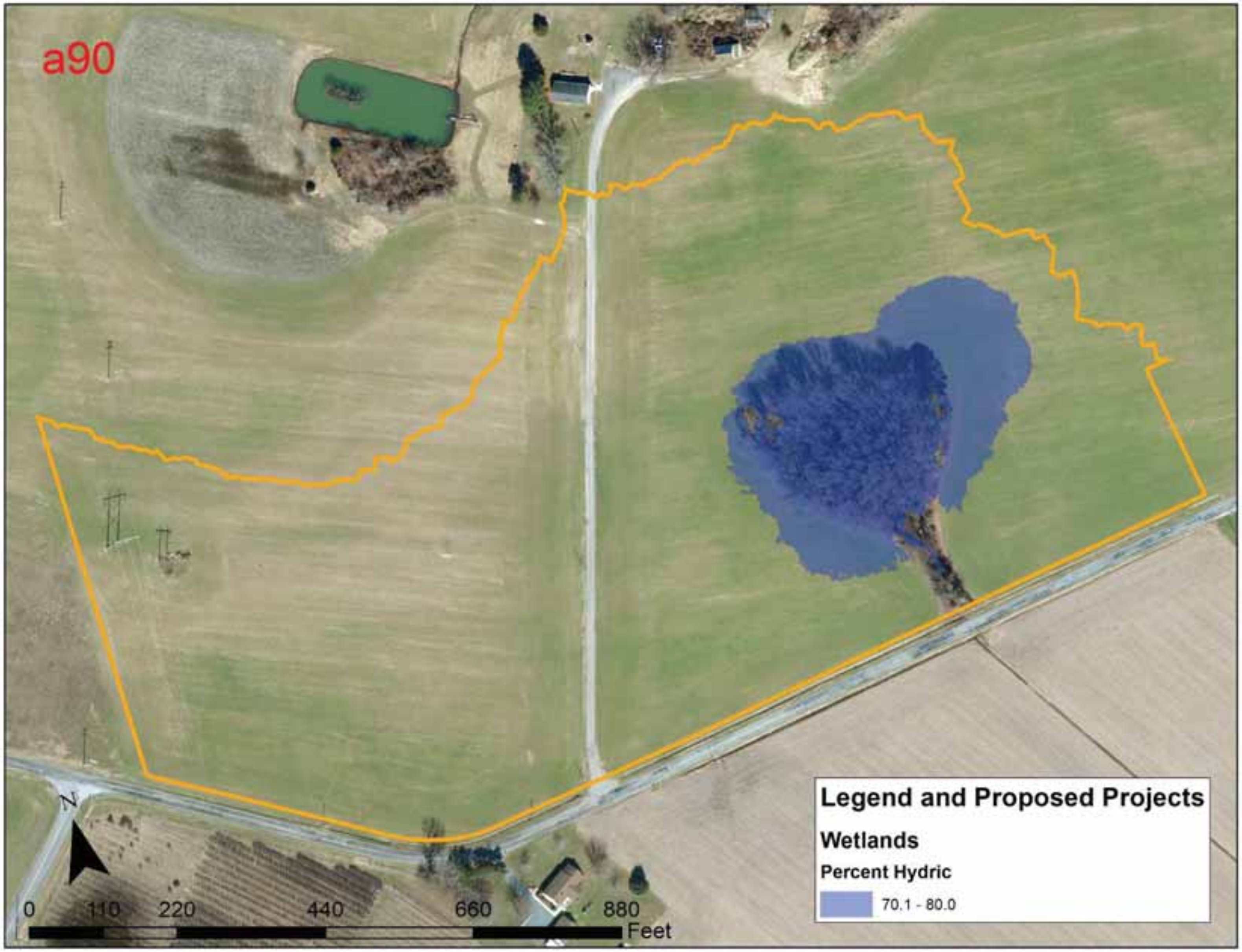

a75
Legend and Proposed Projects
Critical Source Area
0
115
230
460
690
920
Feet

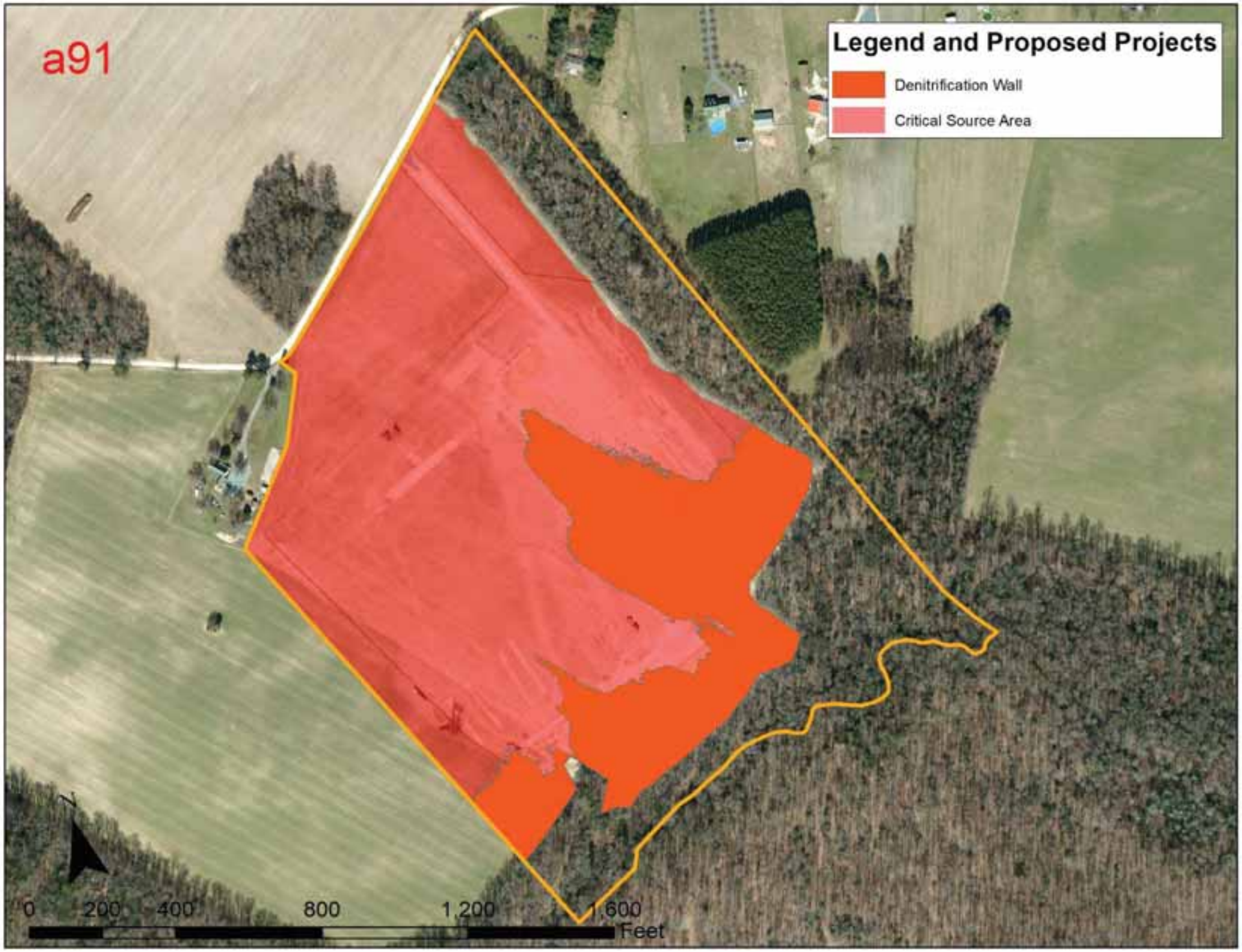

a76
Legend and Proposed Projects
Critical Source Area
0 75 150 300 450 600
Feet

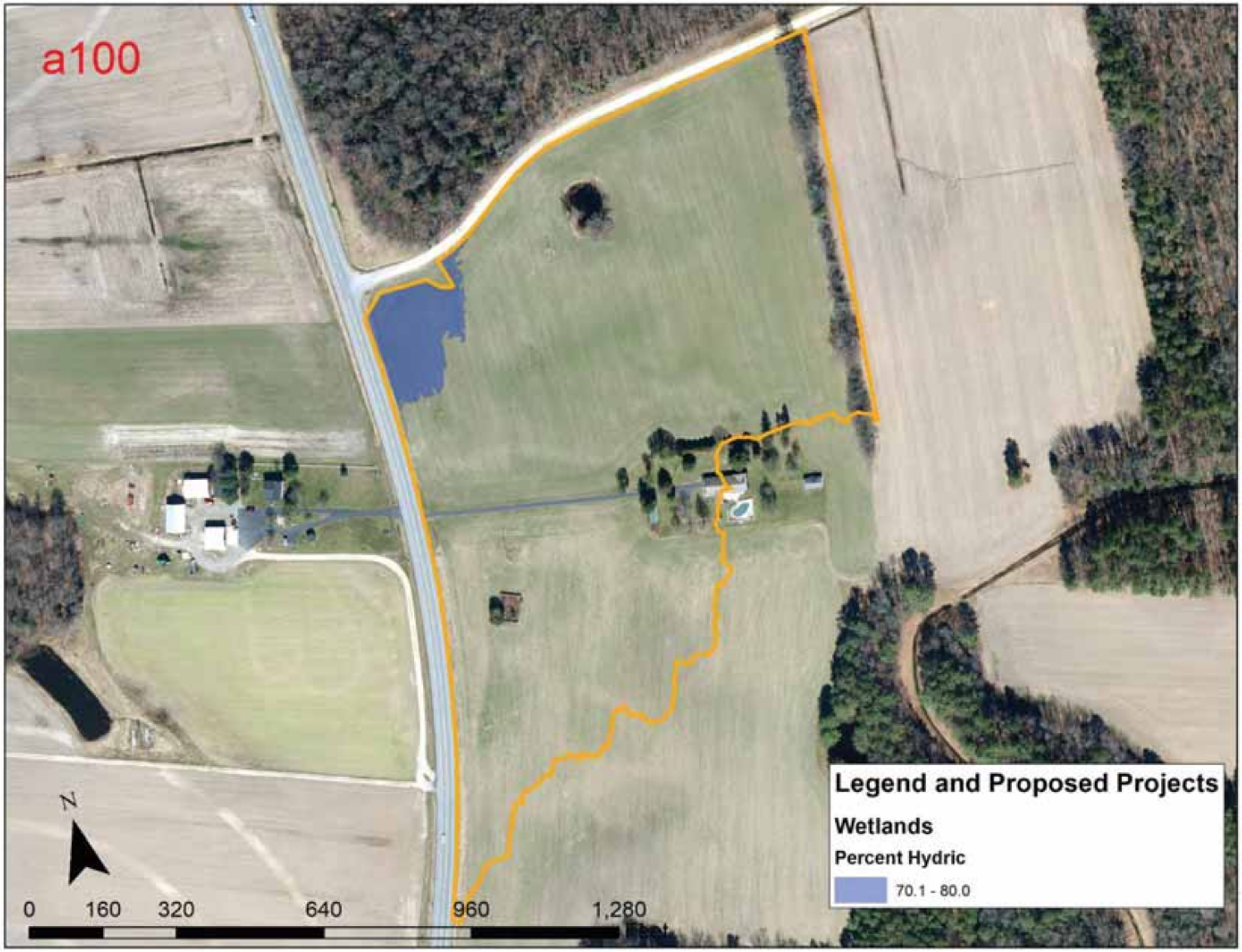

a78
Legend and Proposed Projects
Wetlands
Percent Hydric
40.0 - 50.0
50.1 - 60.0
0
225
450
900
1,350
1,800
Feet
N

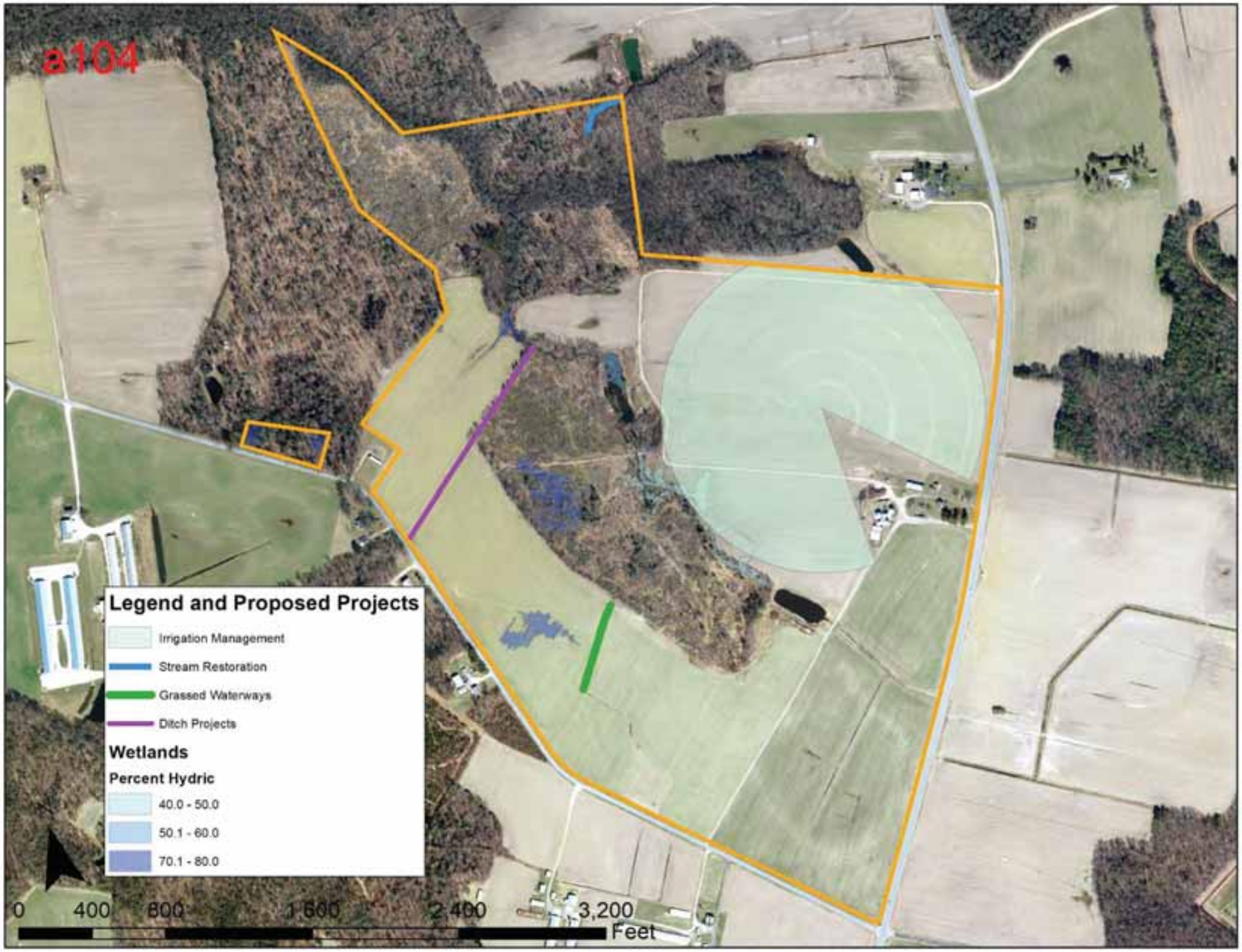

a82
Legend and Proposed Projects
Irrigation Management
Stream Restoration
Ditch Projects
Drain. Water Management
N
0
235
470
940
1,410
1,880
Feet


a86
Legend and Proposed Projects
Critical Source Area
N
0
155
620
930
1,240
Feet


a90
Legend and Proposed Projects
Wetlands
Percent Hydric
70.1 - 80.0
N
0 110 220 440 660 880
Feet


a91
Legend and Proposed Projects
Denitrification Wall
Critical Source Area
0
200
400
800
1,200
1,600
Feet


a100
N
0
160
320
640
960
1,280
Legend and Proposed Projects
Wetlands
Percent Hydric
70.1 - 80.0


a104
Legend and Proposed Projects
Irrigation Management
Stream Restoration
Grassed Waterways
Ditch Projects
Wetlands
Percent Hydric
40.0 - 50.0
50.1 - 60.0
70.1 - 80.0
0
400
800
1,600
2,400
3,200
Feet

Appendix B: Project Options and Nutrient Reduction

The tables in this appendix contain nutrient reductions associated with different best management practices suggested in this plan. Reductions are based on the Maryland Department of Agriculture (MDA) WIP III nutrient reductions for Caroline County, Maryland. Each practice can be applied in the field identified in the Field ID column, which can be located in Appendix A.

CAROLINE COUNTY BMP NITROGEN LOAD REDUCTIONS

Sector	Best Management Practice (BMP)	Unit	TN lbs Reduced Per Unit
Agriculture	Agricultural Stormwater Management	Acres Treated	436.8
Agriculture	Barnyard Runoff Control	Acres	250.6
Agriculture	Loafing Lot Management	Acres	250.6
Agriculture	Forest Buffer-Streamside with Exclusion Fencing	Acres	196.9
Agriculture	Grass Buffer-Streamside with Exclusion Fencing	Acres	188.3
Agriculture	Forest Buffer	Acres	90.7
Agriculture	Grass Buffer	Acres	70.5
Agriculture	Wetland Restoration - Floodplain	Acres	61.8
Agriculture	Forest Buffer-Narrow with Exclusion Fencing	Acres	56.1
Agriculture	Grass Buffer-Narrow with Exclusion Fencing	Acres	53.7
Agriculture	Wetland Restoration - Headwater	Acres	49.6
Agriculture	Wetland Creation - Floodplain	Acres	35.1
Agriculture	Wetland Creation - Headwater	Acres	35.1
Agriculture	Forest Buffer - Narrow	Acres	31.3
Agriculture	Tree Planting	Acres	30.2
Agriculture	Alternative Crops	Acres	29.9
Agriculture	Grass Buffer - Narrow	Acres	28.9
Agriculture	Land Retirement to Ag Open Space	Acres	27.8
Agriculture	Land Retirement to Pasture	Acres	22.6
Agriculture	Water Control Structures	Acres	8.8
Agriculture	Irrigation Water Capture Reuse	Acres	6.1
Natural	Wetland Enhancement	Acres	4.2
Natural	Wetland Rehabilitation	Acres	4.2
Agriculture	Cover Crop Traditional Wheat Late Other	Acres	3.3
Agriculture	Nutrient Management Core N	Acres	3.1
Agriculture	Cover Crop Commodity Normal	Acres	2.7
Agriculture	Manure Transport	dry tons	2.6
Agriculture	Manure Incorporation Low Disturbance Late	Acres	2.6
Agriculture	Cover Crop Traditional with Fall Nutrients Wheat Late Other	Acres	2.4
Agriculture	Nutrient Management N Rate	Acres	2.4
Agriculture	Dairy Precision Feeding and/or Forage Management	Animal Units	2.2
Agriculture	Nutrient Management N Timing	Acres	2.2
Agriculture	Soil Conservation and Water Quality Plans	Acres	2.1
Agriculture	Tillage Management-Conservation	Acres	1.2
Agriculture	Cropland Irrigation Management	Acres	1.2
Agriculture	Nutrient Management N Placement	Acres	1.0
Agriculture	Precision Intensive Rotational/Prescribed Grazing	Acres	0.9
Agriculture	Animal Waste Management System	Animal Units	0.8
Agriculture	Off Stream Watering Without Fencing	Acres	0.5
Agriculture	Poultry Litter Amendments (alum, for example)	Animal Units	0.5
Natural	Non Urban Stream Restoration	Feet	0.1
Natural	Non Urban Shoreline Management	Feet	0.05
Agriculture	Lagoon Covers	Animal Units	0.04
Agriculture	Biofilters	Animal Units	-
Agriculture	Horse Pasture Management	Acres	-
Agriculture	Nutrient Management Core P	Acres	-
Agriculture	Nutrient Management P Placement	Acres	-
Agriculture	Nutrient Management P Rate	Acres	-
Agriculture	Nutrient Management P Timing	Acres	-
Agriculture	Sorbing Materials in Ag Ditches	Acres Treated	-

CAROLINE COUNTY BMP PHOSPHORUS LOAD REDUCTIONS

Sector	Best Management Practice (BMP)	Unit	TP lbs Reduced Per Unit
Agriculture	Forest Buffer-Streamside with Exclusion Fencing	Acres	59.3
Agriculture	Grass Buffer-Streamside with Exclusion Fencing	Acres	58.6
Agriculture	Agricultural Stormwater Management	Acres Treated	31.5
Agriculture	Forest Buffer-Narrow with Exclusion Fencing	Acres	17.5
Agriculture	Grass Buffer-Narrow with Exclusion Fencing	Acres	16.7
Agriculture	Barnyard Runoff Control	Acres	11.3
Agriculture	Loafing Lot Management	Acres	11.3
Agriculture	Wetland Restoration - Floodplain	Acres	2.4
Agriculture	Forest Buffer	Acres	2.3
Agriculture	Wetland Restoration - Headwater	Acres	2.0
Agriculture	Wetland Creation - Floodplain	Acres	1.7
Agriculture	Wetland Creation - Headwater	Acres	1.7
Agriculture	Grass Buffer	Acres	1.5
Agriculture	Forest Buffer - Narrow	Acres	1.3
Agriculture	Tree Planting	Acres	1.3
Agriculture	Grass Buffer - Narrow	Acres	0.6
Agriculture	Land Retirement to Ag Open Space	Acres	0.6
Agriculture	Manure Transport	dry tons	0.5
Agriculture	Alternative Crops	Acres	0.5
Agriculture	Sorbing Materials in Ag Ditches	Acres Treated	0.4
Agriculture	Precision Intensive Rotational/Prescribed Grazing	Acres	0.4
Natural	Wetland Enhancement	Acres	0.4
Natural	Wetland Rehabilitation	Acres	0.4
Agriculture	Horse Pasture Management	Acres	0.3
Agriculture	Nutrient Management Core P	Acres	0.3
Agriculture	Tillage Management-Conservation	Acres	0.3
Agriculture	Manure Incorporation Low Disturbance Late	Acres	0.2
Agriculture	Soil Conservation and Water Quality Plans	Acres	0.2
Agriculture	Dairy Precision Feeding and/or Forage Management	Animal Units	0.1
Agriculture	Nutrient Management P Placement	Acres	0.1
Agriculture	Off Stream Watering Without Fencing	Acres	0.1
Agriculture	Irrigation Water Capture Reuse	Acres	0.1
Agriculture	Nutrient Management P Rate	Acres	0.1
Agriculture	Nutrient Management P Timing	Acres	0.1
Natural	Non Urban Stream Restoration	Feet	0.1
Agriculture	Land Retirement to Pasture	Acres	0.04
Agriculture	Animal Waste Management System	Animal Units	0.03
Natural	Non Urban Shoreline Management	Feet	0.03
Agriculture	Nutrient Management Core N	Acres	0.01
Agriculture	Poultry Litter Amendments (alum, for example)	Animal Units	0.001
Agriculture	Biofilters	Animal Units	-
Agriculture	Cover Crop Commodity Normal	Acres	-
Agriculture	Cover Crop Traditional Wheat Late Other	Acres	-
Agriculture	Cover Crop Traditional with Fall Nutrients Wheat Late Other	Acres	-
Agriculture	Cropland Irrigation Management	Acres	-
Agriculture	Lagoon Covers	Animal Units	-
Agriculture	Nutrient Management N Placement	Acres	-
Agriculture	Nutrient Management N Rate	Acres	-
Agriculture	Nutrient Management N Timing	Acres	-
Agriculture	Water Control Structures	Acres	-

Table B1. In field practices to address **critical source areas**. These practices can also be applied throughout the watershed where acceptable.

		Best Management Practice (Lbs Reduced)																							
		Alternative Crops		Land Retirement		Cover Crop		Nutrient Mangement Core N		Cover Crop Commodity		Nutrient Mangement N Rate		Nutrient Mangment N Timing		Tillage Mangement		Nutrient Management N Placement		Nutrient Mangement P Rate		Nutrient Mangement P Timing	
Field ID	Acres	N	P	N	P	N	P	N	P	N	P	N	P	N	P	N	P	N	P	N	P	N	P
a2	2	59.8	1	55.6	1.2	6.6		6.2		5.4		4.8		4.4		2.4	0.6	2			0.2		0.2
a24	41	1225.9	20.5	1139.8	24.6	135.3		127.1		110.7		98.4		90.2		49.2	12.3	41			4.1		4.1
a52	7	209.3	3.5	194.6	4.2	23.1		21.7		18.9		16.8		15.4		8.4	2.1	7			0.7		0.7
a54	120	3588	60	3336	72	396		372		324		288		264		144	36	120			12		12
a55	91	2720.9	45.5	2529.8	54.6	300.3		282.1		245.7		218.4		200.2		109.2	27.3	91			9.1		9.1
a56	176	5262.4	88	4892.8	105.6	580.8		545.6		475.2		422.4		387.2		211.2	52.8	176			17.6		17.6
a58	27	807.3	13.5	750.6	16.2	89.1		83.7		72.9		64.8		59.4		32.4	8.1	27			2.7		2.7
a59	64	1913.6	32	1779.2	38.4	211.2		198.4		172.8		153.6		140.8		76.8	19.2	64			6.4		6.4
a60	8	239.2	4	222.4	4.8	26.4		24.8		21.6		19.2		17.6		9.6	2.4	8			0.8		0.8
a65	42	1255.8	21	1167.6	25.2	138.6		130.2		113.4		100.8		92.4		50.4	12.6	42			4.2		4.2
a67	12	358.8	6	333.6	7.2	39.6		37.2		32.4		28.8		26.4		14.4	3.6	12			1.2		1.2
a75	12	358.8	6	333.6	7.2	39.6		37.2		32.4		28.8		26.4		14.4	3.6	12			1.2		1.2
a76	11	328.9	5.5	305.8	6.6	36.3		34.1		29.7		26.4		24.2		13.2	3.3	11			1.1		1.1
a86	19	568.1	9.5	528.2	11.4	62.7		58.9		51.3		45.6		41.8		22.8	5.7	19			1.9		1.9
a91	41	1225.9	20.5	1139.8	24.6	135.3		127.1		110.7		98.4		90.2		49.2	12.3	41			4.1		4.1
Total	673	20122.7	336.5	18709.4	403.8	2220.9	0	2086.3	0	1817.1	0	1615.2	0	1480.6	0	807.6	201.9	673	0	0	67.3	0	67.3

Tabe B2. **Ditch** best management practices. Buffer practices can be applied adjacent to the ditches and can be associated with in ditch practices such as a structure for water control. Currently, there is no nutrient reduction in the Chesapeake Bay Model for two-stage ditches.

Best Management Practice (Lbs Reduced)															
			Forest Buffer		Grass Buffer		Wetland Creation-Floodplain		Water Control Structures		Two-Stage Ditch		Sorbing Materials in Ag Ditches	
Field ID	**Length (Ft)**	**Drainage**	**N**	**P**	**N**	**P**	**N**	**P**	**N**	**P**	**N**	**P**	**N**	**P**
a1	121.5	21.5	15.2	0.0	11.8	0.3	5.9	0.3	189.2		TBD	TBD		8.6
a1	116.8	3.0	14.6	0.0	11.3	0.2	5.6	0.3	26.4		TBD	TBD		1.2
a104	382.0	37.1	47.7	0.1	37.1	0.8	18.5	0.9	326.5		TBD	TBD		14.8
a20	184.3	23.6	23.0	0.1	17.9	0.4	8.9	0.4	207.7		TBD	TBD		9.4
a25	440.7	104.4	55.1	0.1	42.8	0.9	21.3	1.0	918.7		TBD	TBD		41.8
a30	97.6	104.4	12.2	0.0	9.5	0.2	4.7	0.2	918.7		TBD	TBD		41.8
a30	462.2	82.3	57.7	0.1	44.9	1.0	22.3	1.1	724.2		TBD	TBD		32.9
a31	403.5	31.0	50.4	0.1	39.2	0.8	19.5	0.9	272.8		TBD	TBD		12.4
a37	472.5	110.0	59.0	0.1	45.9	1.0	22.8	1.1	968.0		TBD	TBD		44.0
a5	796.6	100.8	99.5	0.3	77.4	1.6	38.5	1.9	887.0		TBD	TBD		40.3
a53	688.8	115.3	86.1	0.2	66.9	1.4	33.3	1.6	1014.6		TBD	TBD		46.1
a54	135.9	178.3	17.0	0.0	13.2	0.3	6.6	0.3	1569.0		TBD	TBD		71.3
a63	560.2	42.4	70.0	0.2	54.4	1.2	27.1	1.3	373.1		TBD	TBD		17.0
a70	317.3	40.9	39.6	0.1	30.8	0.7	15.3	0.7	359.9		TBD	TBD		16.4
a71	325.6	16.8	40.7	0.1	31.6	0.7	15.7	0.8	147.8		TBD	TBD		6.7
a72	1555.3	162.2	194.3	0.5	151.0	3.2	75.2	3.6	1427.4		TBD	TBD		64.9
a73	234.1	33.9	29.2	0.1	22.7	0.5	11.3	0.5	298.3		TBD	TBD		13.6
a73	559.7	54.7	69.9	0.2	54.4	1.2	27.1	1.3	481.4		TBD	TBD		21.9
a82	650.9	30.7	81.3	0.2	63.2	1.3	31.5	1.5	270.2		TBD	TBD		12.3
a82	303.6	232.3	37.9	0.1	29.5	0.6	14.7	0.7	2044.2		TBD	TBD		92.9
a82	303.6	232.3	37.9	0.1	29.5	0.6	14.7	0.7	2044.2		TBD	TBD		92.9
Total	9112.8	1757.9	1138.5	2.9	884.9	18.8	440.6	21.3	15469.5	0.0	0.0	0.0	0.0	703.2

Table B3. **Drain tile** best management practice options and reductions. Denitrifying bioreactor, saturated buffer, and blind inlet do not have reduction efficiencies in the Chesapeake Bay Model.

Best Management Practice (Lbs Reduced)							
			Water Control Structure	Denitrifying Bioreactor	Saturated Buffer	Blind Inlet	
Field ID	Length	Acres	N	N	N	N	P
a7	1011	2.3	20.4	TBD	TBD	TBD	TBD
a5	503	1.2	10.2	TBD	TBD	TBD	TBD
a21	1814	4.2	36.6	TBD	TBD	TBD	TBD
Total	3328.0	7.6	67.2				

Table B4. **Drainage water management** acres. This practice works with drainage tile lines using structure for water control. Patterned tile layout must be used with this practice and denitrifying bioreactors, saturated buffers, and blind inlets can be used with this practice.

Best Management Practice (Lbs Reduced)		
	Drainage Water Management	
Field ID	Acres	N
a5	54.5	479.4
a7	16.6	146.4
a7	41.4	364.1
a7	24.5	215.7
a11	22.8	200.4
a20	17.3	152.2
a20	22.5	198.1
a20	17.6	154.7
a21	16.8	147.6
a21	25.2	221.6
a25	18.1	159.2
a25	23.5	207.1
a25	26.4	232.6
a41	16.1	141.5
a42	15.5	136.0
a53	20.7	182.3
a53	32.0	281.9
a53	33.3	293.3
a63	31.4	276.3
a63	21.3	187.6
a70	17.3	152.5
a70	22.4	197.2
a72	30.8	271.0
a72	17.3	152.2
Total	585.3	5151.0

Table B5. **Stream restoration** best management practice options and reductions. Stream restoration can be completed with or without a wetland restoration.

Best Management Practice (Lbs Reduced)								
			Wetland Restoration Headwater		Wetland Restoration Floodplain		Non-Urban Stream Restoration	
Field ID	**Length**	**Acres**	**N**	**P**	**N**	**P**	**N**	**P**
a1	447.0	112.4	696.9	28.1	493.2	23.9	44.7	44.7
a37	2364.0	184.7	1145.1	46.2	810.4	39.2	236.4	18.5
a44	1534.0	95.5	592.1	23.9	419.0	20.3	153.4	9.6
a5	450.0	104.4	647.3	26.1	458.1	22.2	45.0	10.4
a61	712.0	3.2	19.8	0.8	14.0	0.7	71.2	0.3
a65	1623.0	59.0	365.8	14.8	258.9	12.5	162.3	5.9
a7	1773.0	112.4	696.9	28.1	493.2	23.9	177.3	11.2
a70	712.0	54.6	338.5	13.7	239.6	11.6	71.2	5.5
a71	819.0	21.3	132.1	5.3	93.5	4.5	81.9	2.1
a71	786.0	24.3	150.7	6.1	106.6	5.2	78.6	2.4
a82	609.0	64.0	396.8	16.0	280.8	13.6	60.9	6.4
a82	1148.0	204.8	1269.8	51.2	898.6	43.5	114.8	20.5
a9	1459.0	8.9	55.2	2.2	39.0	1.9	145.9	0.9
Total	14436.0	1049.5	6506.9	262.4	4604.7	223.0	1443.6	138.4

Table B6. **Grass buffer** options and reductions. This practice helps reduce transport of nutrients and sediment from fields to streams and ditches.

Best Management Practice (Lbs Reduced)				
		Grass Buffer Narrow		
Field ID	**Length (ft.)**	**Acres**	**N**	**P**
a54	5933.9	95.1	3699.4	57.1
a59	2345.8	85.2	3314.3	51.1
a59	4494.9	85.2	3314.3	51.1
a48	9016.9	6.1	237.3	3.7
a104	5800.2	16.2	630.2	9.7
a56	5128.1	12.6	490.1	7.6
a38	8484.4	131.2	5103.7	78.7
a20	10429.5	78.6	3057.5	47.2
a21	4740.8	78.6	3057.5	47.2
a48	7813.5	5.3	206.2	3.2
a20	6557.9	15.4	599.1	9.2
a64	8488.5	31.6	1229.2	19.0
a72	6453.4	14.0	544.6	8.4
a72	3165.0	8.7	338.4	5.2
Total	88852.7	663.8	25821.8	398.3

Table B7. **Irrigation management** reductions associated with irrigation water reuse.

Best Management Practice (Lbs Reduced)			
		Irrigation Water Capture Reuse	
Field ID	**Acres**	**N**	**P**
a89	6.0	36.9	
a72	10.1	61.4	
a82	2.8	17.0	
a63	6.4	39.1	
a104	4.6	28.0	
a9	13.8	84.2	
a5	2.0	12.2	
a7	0.9	5.5	
a7	2.7	16.2	
a53	3.7	22.4	
a53	4.9	30.0	
a82	10.1	61.4	
Total	67.9	414.4	

Table B8. **Wetland restoration** options and reductions.

Best Management Practice (Lbs Reduced)							
		Wetland Restoration-Headwater		Wetland Creation-Floodplain		Wetland Creation-Headwater	
Field ID	Acres	N	P	N	P	N	P
a1	3.0	148.8	6	105.3	5.1	105.3	5.1
a100	1.0	49.6	2	35.1	1.7	35.1	1.7
a104	0.5	24.8	1	17.55	0.85	17.55	0.85
a104	1.0	49.6	2	35.1	1.7	35.1	1.7
a104	1.0	49.6	2	35.1	1.7	35.1	1.7
a104	1.0	49.6	2	35.1	1.7	35.1	1.7
a11	1.0	49.6	2	35.1	1.7	35.1	1.7
a11	1.0	49.6	2	35.1	1.7	35.1	1.7
a20	1.0	49.6	2	35.1	1.7	35.1	1.7
a21	0.5	24.8	1	17.55	0.85	17.55	0.85
a21	2.0	99.2	4	70.2	3.4	70.2	3.4
a21	2.0	99.2	4	70.2	3.4	70.2	3.4
a22	3.0	148.8	6	105.3	5.1	105.3	5.1
a23	1.0	49.6	2	35.1	1.7	35.1	1.7
a25	2.0	99.2	4	70.2	3.4	70.2	3.4
a25	1.0	49.6	2	35.1	1.7	35.1	1.7
a26	1.0	49.6	2	35.1	1.7	35.1	1.7
a31	3.0	148.8	6	105.3	5.1	105.3	5.1
a33	1.0	49.6	2	35.1	1.7	35.1	1.7
a34	12.0	595.2	24	421.2	20.4	421.2	20.4
a37	0.5	24.8	1	17.55	0.85	17.55	0.85
a37	1.0	49.6	2	35.1	1.7	35.1	1.7
a38	2.0	99.2	4	70.2	3.4	70.2	3.4
a38	1.0	49.6	2	35.1	1.7	35.1	1.7
a38	2.0	99.2	4	70.2	3.4	70.2	3.4
a42	2.0	99.2	4	70.2	3.4	70.2	3.4
a48	0.5	24.8	1	17.55	0.85	17.55	0.85
a48	3.0	148.8	6	105.3	5.1	105.3	5.1
a49	2.0	99.2	4	70.2	3.4	70.2	3.4
a5	3.0	148.8	6	105.3	5.1	105.3	5.1
a5	0.5	24.8	1	17.55	0.85	17.55	0.85
a53	4.0	198.4	8	140.4	6.8	140.4	6.8
a53	0.5	24.8	1	17.55	0.85	17.55	0.85
a53	3.0	148.8	6	105.3	5.1	105.3	5.1
a55	7.0	347.2	14	245.7	11.9	245.7	11.9
a57	1.0	49.6	2	35.1	1.7	35.1	1.7
a57	7.0	347.2	14	245.7	11.9	245.7	11.9
a57	3.0	148.8	6	105.3	5.1	105.3	5.1
a62	1.0	49.6	2	35.1	1.7	35.1	1.7
a63	0.5	24.8	1	17.55	0.85	17.55	0.85
a63	0.5	24.8	1	17.55	0.85	17.55	0.85
a64	3.0	148.8	6	105.3	5.1	105.3	5.1
a7	1.0	49.6	2	35.1	1.7	35.1	1.7
a7	3.0	148.8	6	105.3	5.1	105.3	5.1
a71	0.5	24.8	1	17.55	0.85	17.55	0.85
a71	1.0	49.6	2	35.1	1.7	35.1	1.7
a71	0.5	24.8	1	17.55	0.85	17.55	0.85
a72	0.5	24.8	1	17.55	0.85	17.55	0.85
a72	1.0	49.6	2	35.1	1.7	35.1	1.7
a72	0.0	0	0	0	0	0	0
a72	1.0	49.6	2	35.1	1.7	35.1	1.7
a73	1.0	49.6	2	35.1	1.7	35.1	1.7
a78	1.0	49.6	2	35.1	1.7	35.1	1.7
a78	12.0	595.2	24	421.2	20.4	421.2	20.4
a8	10.0	496	20	351	17	351	17
a82	1.0	49.6	2	35.1	1.7	35.1	1.7
a82	0.5	24.8	1	17.55	0.85	17.55	0.85
a82	0.5	24.8	1	17.55	0.85	17.55	0.85
a9	1.0	49.6	2	35.1	1.7	35.1	1.7
a9	2.0	99.2	4	70.2	3.4	70.2	3.4
a9	1.0	49.6	2	35.1	1.7	35.1	1.7
a9	1.0	49.6	2	35.1	1.7	35.1	1.7
Total	126.5	6274.4	253.0	4440.2	215.1	4440.2	215.1

Appendix C: Funding Sources

Funder	Grant Program	Grant Purpose	Last RFP Due Date	Grant Limit or Range	Notes
Chesapeake Bay Trust	Non-Tidal Wetland Restoration	Implement cost-effective wetland projects to provide valuable wetland functions, including habitat for a wide range of species and improved water quality, flood attenuation, recharge of groundwater, and aesthetics in the State's local watersheds	1-June-17 mandatory site visit. 6-Jul-17 Proposal	$500,000, or greater upon approval $7,000-$9,000 Per acre Easement acquisition value available*	All proposed projects must acknowledge and confirm the ability to adhere to Performance Standards and Monitoring (attached to this RFP) *A recent appraisal is needed to show eligibility for easement acquisition funding.
Chesapeake Bay Trust	Outreach & Restoration	Supports outreach and community engagement activities that increase stewardship ethic of natural resources and on-the-ground restoration activities that demonstrate restoration techniques and engage Maryland citizens in the restoration and protection of the Chesapeake Bay rivers.	Sep-18	$5,001-$75,000 depending on the track*	*Track 1: Outreach: up to $30,000 for projects focused on education and awareness as project outcomes, up to $50,000 for behavior change projects. Track 2: Restoration: up to $50,000 for implementation projects Track 3: Outreach and Restoration: up to $75,000 for projects that combine restoration and outreach elements to measurably build knowledge within the community served.
Chesapeake Bay Trust & Maryland Dept of Natural Resources	Watershed Assistance Grant Program	Supports design assistance, watershed planning and programmatic development associated with protection and restoration program and project that lead to improved water quality in the Maryland portion	Sep-18	$5,001 - $75,000	

Funder	Grant Program	Grant Purpose	Last RFP Due Date	Grant Limit or Range	Notes
		of the Chesapeake Bay watershed.			
National Fish and Wildlife Foundation	Chesapeake Bay Stewardship Fund – Small Watershed Grant (SWG)	Projects that promote community-based efforts to protect and restore the diverse natural resources of the Chesapeake Bay and its tributary rivers and streams. SWG Implementation grants are awarded for projects that result in direct, on-the-ground actions to protect and restore water quality, species, and habitats in the Bay watershed; SWG Planning and Technical Assistance grants are awarded for projects that enhance local capacity to more efficiently and effectively implement future on-the-ground actions through assessment, planning, design, and other technical assistance-oriented activities.	4-Sep-18*	$20,000-$200,000 depending on the program**	*Prior to 2017, the deadline for this grant was early May. **SWG Implementation program will range from $20,000-$200,000 for two year projects and requires a one-third non-federal match. SWG Planning and Technical Assistance grants will not exceed $50,000 for a one year project.
National Fish and Wildlife Foundation	Chesapeake Bay Stewardship Fund – Innovative Nutrient & Sediment Reduction Grant (INSR)	A program designed to accelerate the implementation of water quality improvements specifically through the collaborative and coordinated efforts of sustainable, regional-scale partnerships and networks of practitioners with a shared focus on water quality restoration and protection.	4-Sep-18 Pre-proposal 13-Nov-18 Full Proposal	$750,000 - $1 million	These grants encourage non-federal matching contributions equal to the grant request. All 2018 INSR-RSI grants must be completed within three years of grant award.

Funder	Grant Program	Grant Purpose	Last RFP Due Date	Grant Limit or Range	Notes
Maryland Department of the Environment	319 Nonpoint Source Program	Provides financial assistance to local and state entities for the implementation of nonpoint source best management practices and program enhancements as a means of controlling the loads of pollutants entering the state's waterways.	Every summer		§319(h) Grant funds can pay for planning, design, construction, monitoring and analysis. However, the majority of §319(h) Grant funding in Maryland is intended for implementation of projects that will: Reduce or eliminate water quality impairments listed in the Maryland's List of Impaired Water (303(d) List), particularly in watersheds where Total Maximum Daily Loads (TMDLs) have been approved; and result in quantifiable or measurable improvements in water quality and habitat, including, pollutant load reductions for impairments addressed in TMDLs or identified in the 303(d) List. A prerequisite for §319(h) funding of implementation projects (any project involving in-the-ground construction) is EPA acceptance of a watershed plan.
Maryland Dept of Natural Resources	Chesapeake & Atlantic Coastal Bays Trust Fund	Fund the most cost-effective, efficient nonpoint nutrient and sediment reduction project proposals in geographic targeted areas of the State. The Trust Fund encourages projects that will achieve the greatest reduction per dollar invested	19-Jan-18 Letter of Intent 30-Mar-18 Full Proposal	Typically $100,000-$750,000	

Maryland Agricultural Water Quality Cost-Share Program (MACS)					
Code	**Practice Name**	**Notes**	**Unity Type**	**Unit Cost**	**Limit**
340	Cover Crops	Applications accepted June 21 to July 17. Payments are no longer offered for harvested cover crops.	Acre	$75	$22.5 mill

Maryland Agricultural Water Quality Cost-Share Program (MACS)					
					state-wide
412	Grassed Waterway	Cost-share authorized for Site preparation, grading, shaping, filling, and lime, fertilizer and seed for establishing a permanent vegetative cover, filter cloth, mulch and/or erosion control matting plus anchoring materials	Total	87.5%	$50,000
391	Riparian Forest Buffer	Required 35’-100’ buffer	Total	87.5%	$50,000
390	Riparian Herbaceous Cover	Required 35’-100’ buffer	Total	87.5%	$50,000
587	Structure for Water Control		Total	87.5%	$50,000
657	Wetland Restoration	Practice must meet standards and applied on farmland	Total	87.5%	$50,000

NRCS Environmental Quality Incentive Program (EQIP).					
Code	**Practice Name**	**Component**	**Unity Type**	**Unit Cost**	**Share Rate**
620	Blind Inlet/Underground Outlet	UO 15 to 18 inch	ft	$16.75	100
620	Blind Inlet/Underground Outlet	HU-UO 15 to 18 inch	ft	$20.10	100
620	Blind Inlet/Underground Outlet	UO 21 to 24 inch	ft	$26.92	100
620	Blind Inlet/Underground Outlet	HU-UO 21 to 24 inch	ft	$32.30	100
620	Blind Inlet/Underground Outlet	UO 27 to 30 inch	ft	$34.01	100
620	Blind Inlet/Underground Outlet	HU-UO 27 to 30 inch	ft	$40.81	100
620	Blind Inlet/Underground Outlet	UO 6 inch or less	ft	$5.64	100

NRCS Environmental Quality Incentive Program (EQIP).					
620	Blind Inlet/Underground Outlet	HU-UO 6 inch or less	ft	$6.76	100
620	Blind Inlet/Underground Outlet	UO 6 inch w Riser or less	ft	$5.76	100
620	Blind Inlet/Underground Outlet	HU-UO 6 inch w Riser or less	ft	$6.91	100
620	Blind Inlet/Underground Outlet	UO 8 to 12 inch	ft	$7.28	100
620	Blind Inlet/Underground Outlet	HU-UO 8 to 12 inch	ft	$8.74	100
620	Blind Inlet/Underground Outlet	UO 8 to 12 inch w Riser	ft	$8.40	100
620	Blind Inlet/Underground Outlet	HU-UO 8 to 12 inch w Riser	ft	$10.08	100
620	Blind Inlet/Underground Outlet	UO over 30 inch	ft	$43.26	100
620	Blind Inlet/Underground Outlet	HU-UO over 30 inch	ft	$51.92	100
620	Blind Inlet/Underground Outlet	UO with Boring, all sizes	ft	$25.71	100
620	Blind Inlet/Underground Outlet	HU-UO with Boring, all sizes	ft	$30.85	100
340	Cover Crop	Cover Crop - Adaptive Management	Ea	$1,885.28	100
340	Cover Crop	HU-Cover Crop - Adaptive Management	Ea	$2,262.33	100
340	Cover Crop	Cover Crop - Basic (Organic and Non-organic)	ac	$63.47	100
340	Cover Crop	HU-Cover Crop - Basic (Organic and Non-organic)	ac	$76.16	100
340	Cover Crop	Cover Crop - Basic Organic	ac	$76.34	100
340	Cover Crop	HU-Cover Crop - Basic Organic	ac	$91.61	100
340	Cover Crop	Cover Crop - Multiple Species (Organic and Non-organic)	ac	$74.18	100
605	Denitrifying Bioreactor	Denitrifying Bioreactor	CuYd	$36.83	100
605	Denitrifying Bioreactor	HU-Denitrifying Bioreactor	CuYd	$44.19	100

NRCS Environmental Quality Incentive Program (EQIP).					
554	Drainage Water Management	Drainage Water Management (DWM)	Ea	$80.76	100
554	Drainage Water Management	HU-Drainage Water Management (DWM)	Ea	$96.91	100
130	Drainage Water Management Plan - Written	DWMP - Tile Map Available	no	$2,049.37	100
130	Drainage Water Management Plan - Written	HU-DWMP - Tile Map Available	no	$2,459.25	100
130	Drainage Water Management Plan - Written	DWMP - No Tile Map Available	no	$2,444.86	100
130	Drainage Water Management Plan - Written	HU-DWMP - No Tile Map Available	no	$2,933.83	100
412	Grassed Waterway	Grass Waterway with Stone Checks	ac	$5,032.97	100
412	Grassed Waterway	HU-Grass Waterway with Stone Checks	ac	$5,987.68	100
412	Grassed Waterway	Waterway, small, 0.2 Acres or less	sq ft	$0.11	100
412	Grassed Waterway	HU-Waterway, small, 0.2 Acres or less	sq ft	$0.14	100
412	Grassed Waterway	Waterway, over 0.2 acres	ac	$3,516.21	100
412	Grassed Waterway	HU-Waterway, over 0.2 acres	ac	$4,167.58	100
449	Irrigation Water Management	1st Year, Computer Record Keeping System	ac	$223.04	100
449	Irrigation Water Management	HU-1st Year, Computer Record Keeping System	ac	$267.64	100
449	Irrigation Water Management	Annual Crops, Vegetables, 1st Year	ac	$47.77	100
449	Irrigation Water Management	HU-Annual Crops, Vegetables, 1st Year	ac	$57.33	100
449	Irrigation Water Management	Annual Crops, Vegetables, 1st Year, with Data Logger	ac	$95.33	100

NRCS Environmental Quality Incentive Program (EQIP).					
449	Irrigation Water Management	HU-Annual Crops, Vegetables, 1st Year, with Data Logger	ac	$114.39	100
449	Irrigation Water Management	Annual Crops, Vegetables, 2nd and 3rd Year	ac	$25.81	100
449	Irrigation Water Management	HU-Annual Crops, Vegetables, 2nd and 3rd Year	ac	$30.97	100
449	Irrigation Water Management	Basic IWM 30 acres or less	ac	$21.66	100
449	Irrigation Water Management	HU-Basic IWM 30 acres or less	ac	$25.99	100
449	Irrigation Water Management	Basic IWM over 30 acres	ac	$11.68	100
449	Irrigation Water Management	HU-Basic IWM over 30 acres	ac	$14.01	100
449	Irrigation Water Management	Field Crops, Grains, 1st Year	ac	$13.38	100
449	Irrigation Water Management	HU-Field Crops, Grains, 1st Year	ac	$16.05	100
449	Irrigation Water Management	Field Crops, Grains, 1st Year, with Data Logger	ac	$32.40	100
449	Irrigation Water Management	HU-Field Crops, Grains, 1st Year, with Data Logger	ac	$38.88	100
449	Irrigation Water Management	Field Crops, Grains, 2nd and 3rd Year	ac	$6.72	100
449	Irrigation Water Management	HU-Field Crops, Grains, 2nd and 3rd Year	ac	$8.06	100
590	Nutrient Management	Adaptive NM	Ea	$2,045.66	100
590	Nutrient Management	HU-Adaptive NM	Ea	$2,454.80	100
590	Nutrient Management	Basic NM with Manure and/or Compost (Non-Organic/Organic)	ac	$14.00	100
590	Nutrient Management	HU-Basic NM with Manure and/or Compost (Non-Organic/Organic)	ac	$16.81	100
590	Nutrient Management	Basic NM with Manure Injection or Incorporation	ac	$26.61	100
590	Nutrient Management	HU-Basic NM with Manure Injection or Incorporation	ac	$31.93	100

NRCS Environmental Quality Incentive Program (EQIP).					
590	Nutrient Management	Basic Precision NM (Non-Organic/Organic)	ac	$38.27	100
590	Nutrient Management	HU-Basic Precision NM (Non-Organic/Organic)	ac	$45.93	100
590	Nutrient Management	Small Farm NM (Non-Organic/Organic)	Ea	$217.16	100
590	Nutrient Management	HU-Small Farm NM (Non-Organic/Organic)	Ea	$260.59	100
104	Nutrient Management Plan - Written	Nutrient Management CAP Less Than or Equal to 100 Acres (Not part of a CNMP)	no	$1,766.27	100
104	Nutrient Management Plan - Written	HU-Nutrient Management CAP Less Than or Equal to 100 Acres (Not part of a CNMP)	no	$2,119.53	100
104	Nutrient Management Plan - Written	Nutrient Management CAP 104- 101-300 Acres (Not part of a CNMP)	no	$2,355.03	100
104	Nutrient Management Plan - Written	HU-Nutrient Management CAP 104- 101-300 Acres (Not part of a CNMP)	no	$2,826.04	100
104	Nutrient Management Plan - Written	Nutrient Management CAP 104 Greater Than 300 Acres (Not part of a CNMP)	no	$2,943.79	100
104	Nutrient Management Plan - Written	HU-Nutrient Management CAP 104 Greater Than 300 Acres (Not part of a CNMP)	no	$3,532.55	100
104	Nutrient Management Plan - Written	Nutrient Management CAP 104 Less Than or Equal to 100 Acres (Element of a CNMP)	no	$2,943.79	100
104	Nutrient Management Plan - Written	HU-Nutrient Management CAP 104 Less Than or Equal to 100 Acres (Element of a CNMP)	no	$3,532.55	100
104	Nutrient Management Plan - Written	Nutrient Management CAP 104 - 101-300 Acres (Element of a CNMP)	no	$4,121.31	100
104	Nutrient Management Plan -	HU-Nutrient Management CAP 104 - 101-300 Acres (Element of a	no	$4,945.57	100

NRCS Environmental Quality Incentive Program (EQIP).

	Written	CNMP)			
104	Nutrient Management Plan - Written	Nutrient Management CAP 104 Greater Than 300 Acres (Element of a CNMP)	no	$5,004.44	100
104	Nutrient Management Plan - Written	HU-Nutrient Management CAP 104 Greater Than 300 Acres (Element of a CNMP)	no	$6,005.33	100
104	Nutrient Management Plan - Written	Nutrient Management CAP Less Than or Equal to 100 Acres (Not part of a CNMP)	no	$1,766.27	100
104	Nutrient Management Plan - Written	HU-Nutrient Management CAP Less Than or Equal to 100 Acres (Not part of a CNMP)	no	$2,119.53	100
104	Nutrient Management Plan - Written	Nutrient Management CAP 104- 101-300 Acres (Not part of a CNMP)	no	$2,355.03	100
782	Phosphorous Removal System	Ditch	Ea	$3,452.45	100
782	Phosphorous Removal System	HU-Ditch	Ea	$4,142.94	100
391	Riparian Forest Buffer	Bareroot, hand planted with tube	ac	$2,909.57	100
391	Riparian Forest Buffer	HU-Bareroot, hand planted with tube	ac	$3,439.61	100
391	Riparian Forest Buffer	Large container, hand planted	ac	$4,690.10	100
391	Riparian Forest Buffer	HU-Large container, hand planted	ac	$5,472.49	100
391	Riparian Forest Buffer	Small container, hand planted	ac	$2,482.51	100
391	Riparian Forest Buffer	HU-Small container, hand planted	ac	$2,927.13	100
604	Saturated Buffer	Saturated Buffer	ft	$6.27	100
604	Saturated Buffer	HU-Saturated Buffer	ft	$7.52	100

NRCS Environmental Quality Incentive Program (EQIP).					
580	Streambank and Shoreline Protection	Bioengineered	sq ft	$0.99	100
580	Streambank and Shoreline Protection	HU-Bioengineered	sq ft	$1.19	100
580	Streambank and Shoreline Protection	Bioengineered with Toe Protection	sq ft	$2.79	100
580	Streambank and Shoreline Protection	HU-Bioengineered with Toe Protection	sq ft	$3.35	100
580	Streambank and Shoreline Protection	Geotextile Wrapped	sq ft	$24.43	100
580	Streambank and Shoreline Protection	HU-Geotextile Wrapped	sq ft	$29.32	100
580	Streambank and Shoreline Protection	Structural small, banks less than 4 ft	CuYd	$90.72	100
580	Streambank and Shoreline Protection	HU-Structural small, banks less than 4 ft	CuYd	$108.87	100
580	Streambank and Shoreline Protection	Structural, >5 ft bank	CuYd	$89.08	100
580	Streambank and Shoreline Protection	HU-Structural, >5 ft bank	CuYd	$106.90	100
580	Streambank and Shoreline Protection	Vegetative	sq ft	$0.61	100
580	Streambank and Shoreline Protection	HU-Vegetative	sq ft	$0.73	100

NRCS Environmental Quality Incentive Program (EQIP).					
587	Structure for Water Control	Basin, earthen	LnFt	$22.57	100
587	Structure for Water Control	HU-Basin, earthen	LnFt	$27.09	100
587	Structure for Water Control	CMP Turnout	Ea	$749.09	100
587	Structure for Water Control	HU-CMP Turnout	Ea	$898.90	100
587	Structure for Water Control	Commercial Inline Flashboard Riser	InFt	$3.34	100
587	Structure for Water Control	HU-Commercial Inline Flashboard Riser	InFt	$4.01	100
587	Structure for Water Control	Concrete Turnout Structure	Ea	$2,873.05	100
587	Structure for Water Control	HU-Concrete Turnout Structure	Ea	$3,447.66	100
587	Structure for Water Control	Concrete Turnout Structure - Small	Ea	$1,086.26	100
587	Structure for Water Control	HU-Concrete Turnout Structure - Small	Ea	$1,303.51	100
587	Structure for Water Control	Culvert <30 inches CMP	InFt	$2.33	100
587	Structure for Water Control	HU-Culvert <30 inches CMP	InFt	$2.79	100
587	Structure for Water Control	Culvert <30 inches HDPE	InFt	$2.17	100
587	Structure for Water Control	HU-Culvert <30 inches HDPE	InFt	$2.60	100
587	Structure for Water Control	Flap Gate	ft	$1,379.61	100
587	Structure for Water Control	HU-Flap Gate	ft	$1,655.53	100
587	Structure for Water Control	Flap Gate w/ Concrete Wall	CuYd	$924.98	100
587	Structure for Water Control	HU-Flap Gate w/ Concrete Wall	CuYd	$1,109.98	100
587	Structure for Water Control	Forestland Waterbar	Ea	$119.07	100
587	Structure for Water Control	HU-Forestland Waterbar	Ea	$142.89	100

NRCS Environmental Quality Incentive Program (EQIP).					
587	Structure for Water Control	Gated Pipe	ft	$10.80	100
587	Structure for Water Control	HU-Gated Pipe	ft	$12.96	100
587	Structure for Water Control	Grated Dropbox	Ea	$941.61	100
587	Structure for Water Control	HU-Grated Dropbox	Ea	$1,129.93	100
587	Structure for Water Control	Inlet Flashboard Riser, Metal	InFt	$2.78	100
587	Structure for Water Control	HU-Inlet Flashboard Riser, Metal	InFt	$3.33	100
587	Structure for Water Control	Inline Flashboard Riser, Metal	InFt	$2.94	100
587	Structure for Water Control	HU-Inline Flashboard Riser, Metal	InFt	$3.52	100
587	Structure for Water Control	In-Stream Structure for Water Surface Profile	ft	$207.10	100
587	Structure for Water Control	HU-In-Stream Structure for Water Surface Profile	ft	$248.52	100
587	Structure for Water Control	Rock Checks for Water Surface Profile	Ton	$46.83	100
587	Structure for Water Control	HU-Rock Checks for Water Surface Profile	Ton	$56.19	100
587	Structure for Water Control	Slide Gate	ft	$1,587.75	100
587	Structure for Water Control	HU-Slide Gate	ft	$1,905.30	100
587	Structure for Water Control	Trench Drain with grate	Ea	$1,254.65	100
587	Structure for Water Control	HU-Trench Drain with grate	Ea	$1,505.57	100
587	Structure for Water Control	Water Bar	Ea	$645.96	100
587	Structure for Water Control	HU-Water Bar	Ea	$775.15	100
657	Wetland Restoration	Depression Sediment Removal (Pothole)	Ea	$2,275.12	100
657	Wetland Restoration	HU-Depression Sediment Removal (Pothole)	Ea	$2,730.15	100

NRCS Environmental Quality Incentive Program (EQIP).					
657	Wetland Restoration	Drain Tile Plug	ft	$1.46	100
657	Wetland Restoration	HU-Drain Tile Plug	ft	$1.75	100
657	Wetland Restoration	Estuarine Fringe Levee Removal	ac	$12.89	100
657	Wetland Restoration	HU-Estuarine Fringe Levee Removal	ac	$15.47	100
657	Wetland Restoration	Hydrologic restoration with embankment or ditch plug	ft	$22.73	100
657	Wetland Restoration	HU-Hydrologic restoration with embankment or ditch plug	ft	$27.27	100
657	Wetland Restoration	Riverine Channel and Floodplain Restoration	ac	$363.67	100
657	Wetland Restoration	HU-Riverine Channel and Floodplain Restoration	ac	$436.41	100
657	Wetland Restoration	Riverine Levee Removal	CuYd	$2.58	100
657	Wetland Restoration	HU-Riverine Levee Removal	CuYd	$3.09	100
658	Wetland Creation	Wetland Creation	ac	$2,664.13	100
658	Wetland Creation	HU-Wetland Creation	ac	$3,196.95	100
659	Wetland Enhancement	Depression Sediment Removal and Ditch Plug	ac	$1,164.91	100
659	Wetland Enhancement	HU-Depression Sediment Removal and Ditch Plug	ac	$1,346.02	100
659	Wetland Enhancement	Enhanced wetland Topography	ac	$1,026.65	100
659	Wetland Enhancement	HU-Enhanced wetland Topography	ac	$1,180.10	100
659	Wetland Enhancement	Estuarine Fringe Levee Removal	ac	$272.27	100
659	Wetland Enhancement	HU-Estuarine Fringe Levee Removal	ac	$274.85	100
659	Wetland Enhancement	Mineral Flat	ac	$270.84	100
659	Wetland Enhancement	HU-Mineral Flat	ac	$273.13	100

NRCS Environmental Quality Incentive Program (EQIP).					
659	Wetland Enhancement	Riverine Channel and Floodplain Restoration	ac	$623.05	100
659	Wetland Enhancement	HU-Riverine Channel and Floodplain Restoration	ac	$695.79	100
659	Wetland Enhancement	Riverine Levee Removal and Floodplain Features	ac	$570.72	100
659	Wetland Enhancement	HU-Riverine Levee Removal and Floodplain Features	ac	$632.99	100

Appendix D: Generalized Watershed Loading Function Enhanced

Nutrient and sediment loads were estimated using the Generalized Watershed Loading Function Enhanced (GWLFE) through the Stroud Water Research Center WikiWatershed model (https://app.wikiwatershed.org/) and additional information can be obtained in this manual: https://wikiwatershed.org/documentation/mmw-tech/ . This model simulated 30 years of precipitation data to estimate the hydrologic parameter precipitation, evapotranspiration, surface runoff, subsurface flow, point source flow, and stream flow. This was completed for both Beauchamp Branch watershed and Mill Creek watershed.

Table D1. Hydrologic parameters for Beauchamp Branch and Mill Creek.

Beauchamp Branch Average Hydrologic Parameters						
Month	**Precip (cm)**	**ET (cm)**	**Surface Runoff (cm)**	**Subsurface Flow (cm)**	**Point Src Flow (cm)**	**Stream Flow (cm)**
Jan	7.72	0.56	0.91	3.02	0	3.94
Feb	7.66	0.86	0.79	4.12	0	4.91
Mar	8.65	2.33	0.61	5.47	0	6.08
Apr	8.23	5.16	0.11	5.36	0	5.47
May	9.6	9.82	0.17	4.03	0	4.19
Jun	9.17	13.89	0.38	2.33	0	2.71
Jul	10.07	13.31	0.39	1.21	0	1.61
Aug	9.29	9.13	0.3	0.58	0	0.88
Sep	8.68	6.04	0.55	0.29	0	0.84
Oct	7.44	4.17	0.44	0.4	0	0.84
Nov	8.37	2.2	0.52	0.52	0	1.04
Dec	8.75	1.11	0.87	1.51	0	2.38
Total	103.63	68.58	6.04	28.84	0	34.89

Mill Creek Average Hydrologic Parameters						
Month	**Precip (cm)**	**ET (cm)**	**Surface Runoff (cm)**	**Subsurface Flow (cm)**	**Point Src Flow (cm)**	**Stream Flow (cm)**
Jan	7.72	0.62	0.94	2.44	0	3.38
Feb	7.66	0.95	0.83	3.72	0	4.54
Mar	8.65	2.59	0.64	5.1	0	5.75
Apr	8.23	5.46	0.13	5.06	0	5.18
May	9.6	10.2	0.19	3.74	0	3.93
Jun	9.17	14.4	0.4	2.09	0	2.48
Jul	10.07	13.88	0.42	1.06	0	1.47
Aug	9.29	9.36	0.32	0.5	0	0.82
Sep	8.68	6.1	0.58	0.22	0	0.8
Oct	7.44	4.33	0.46	0.3	0	0.76
Nov	8.37	2.34	0.55	0.37	0	0.92
Dec	8.75	1.2	0.9	1.13	0	2.02
Total	103.63	71.43	6.36	25.73	0	32.05

The hydrologic parameters were used to estimate nitrogen, phosphorus, and sediment loading based off of 2011 National Land Cover database, soil survey (gSSURGO), 30-meter elevation data, estimates of shallow groundwater nitrogen concentration (United States Geologic Survey), county level farm animal populations, estimates of soil phosphorus concentration (United States Geologic Survey), and estimates of soil nitrogen concentration (USGS).

Table D2. Nutrients and sediment loads from Beauchamp Branch and Mill Creek modeled by the GWLF-E.

Beauchamp Branch Nutrients and Sediment			
Sources	**Sediment (lbs)**	**Total Nitrogen (lbs)**	**Total Phosphorus (lbs)**
Hay/Pasture	44127	273	71
Cropland	521472	3028	469
Wooded Areas	1071	30	2
Wetlands	504	98	5
Open Land	248	2	0
Barren Areas	0	0	0
Low-Density Mixed	961	26	3
Medium-Density Mixed	0	0	0
High-Density Mixed	0	0	0
Other Upland Areas	0	0	0
Farm Animals	0	9804	3254
Stream Bank Erosion	66460	31	9
Subsurface Flow	0	52188	424
Point Sources	0	0	0
Septic Systems	0	0	0
Total	634843	65481	4238

Mill Creek Nutrients and Sediment			
Sources	**Sediment (lbs)**	**Total Nitrogen (lbs)**	**Total Phosphorus (lbs)**
Hay/Pasture	30266	196	50
Cropland	267120	1548	235
Wooded Areas	745	18	1
Wetlands	435	93	5
Open Land	188	4	0
Barren Areas	0	0	0
Low-Density Mixed	1259	35	4
Medium-Density Mixed	50	1	0
High-Density Mixed	0	0	0
Other Upland Areas	0	0	0
Farm Animals	0	6590	2188
Stream Bank Erosion	42551	20	7
Subsurface Flow	0	27173	229
Point Sources	0	0	0
Septic Systems	0	4	0
Total	342615	35680	2719

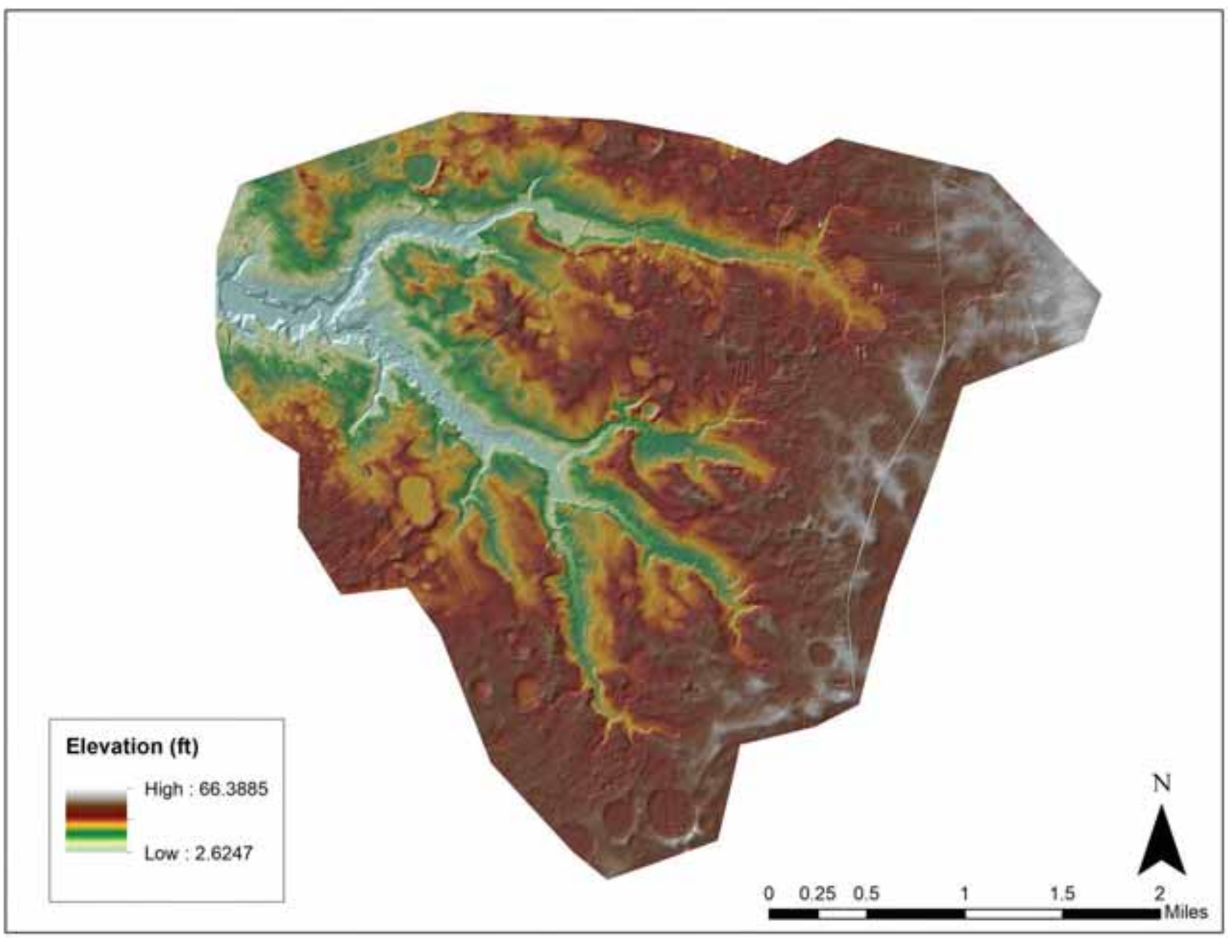
Appendix E: ACPF Work Flow and Output Products

The Agricultural Planning Framework (ACPF) was developed by the United States Department of Agriculture-Agricultural Research Service for Midwestern agricultural watersheds. ACPF consists of a GIS database and a GIS toolbox. The ACPF GIS database contains land use, elevation, and soil survey data. The GIS toolbox has a variety of conservation options that uses data from the database to select the best location for conservation practice. For the analysis of the Williston Lake watershed land use, elevation, and soil survey data had to be downloaded from outside of the ACPF GIS database because the database only covers Midwestern United States.

General work flow of the ACPF GIS toolbox:

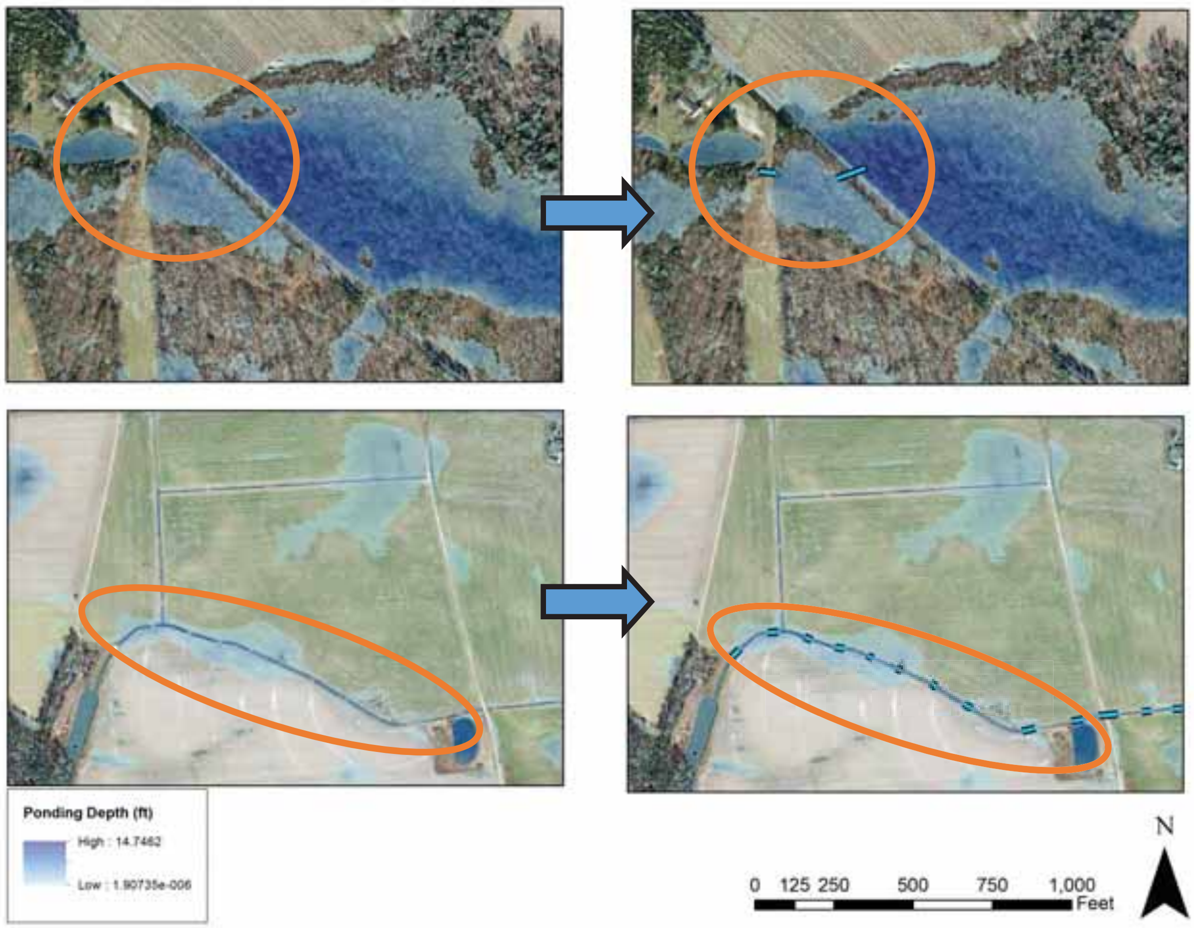
The ACPF tool follows a step-by-step progression to create layers that are usable by different tools within the toolbox. The first step is DEM preparation (pit fill and hydro-conditioning). The next step is stream network development. This is followed by field characterization (field Slope, tile-drainage, distance to stream, runoff risk assessment). Using the stream network and field characters from the previous step precision conservation practices (wetlands, drainage water management, and grassed waterways) can be sited throughout the watershed. A riparian assessment (height above channel and riparian function assessment) provides ancillary information on appropriate buffers for streams and ditches.

Preparation of elevation data and stream network development for Williston Lake:

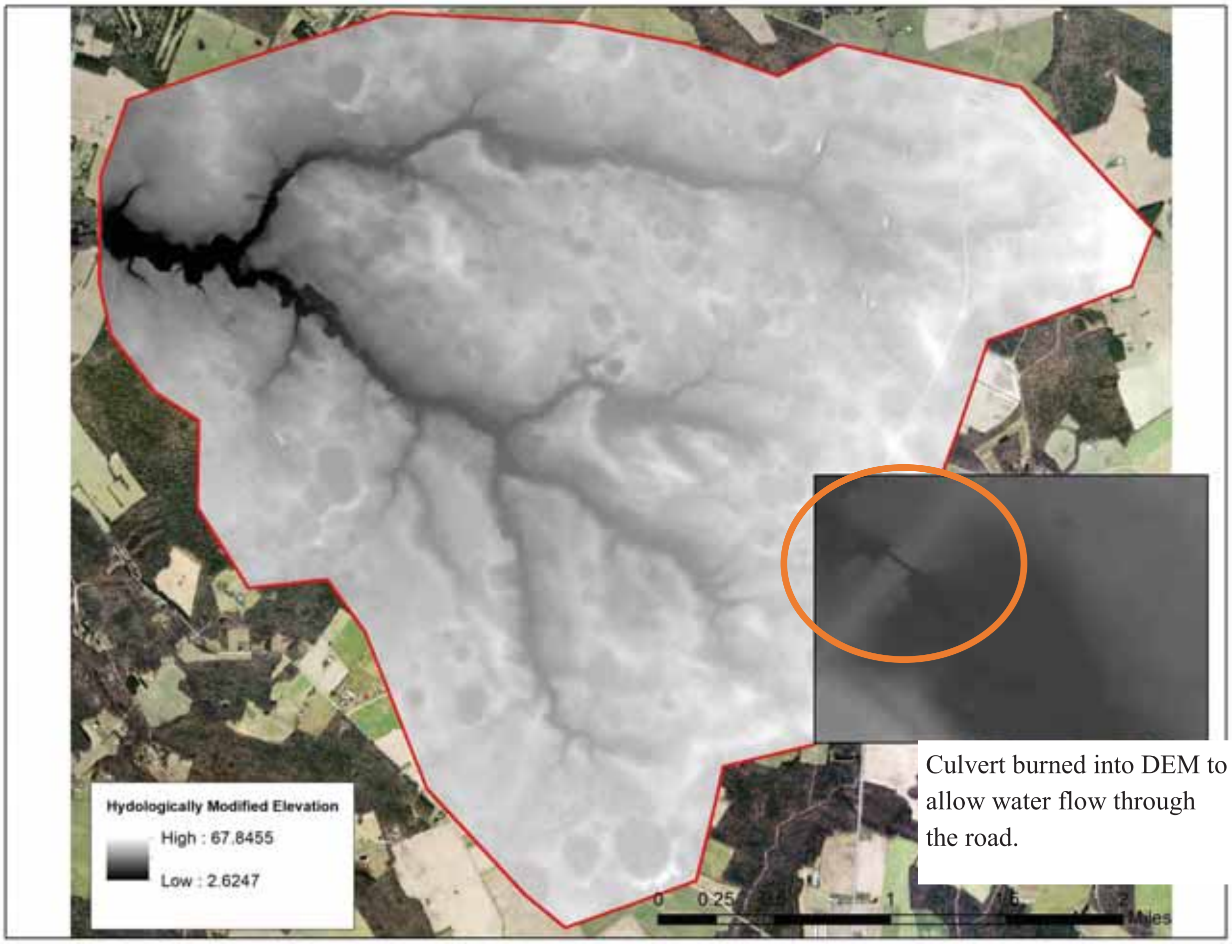


Digital elevation model (DEM) derived from 2013 6 cm LIDAR data. Hillshade was created and overlaid on DEM to add better relief.

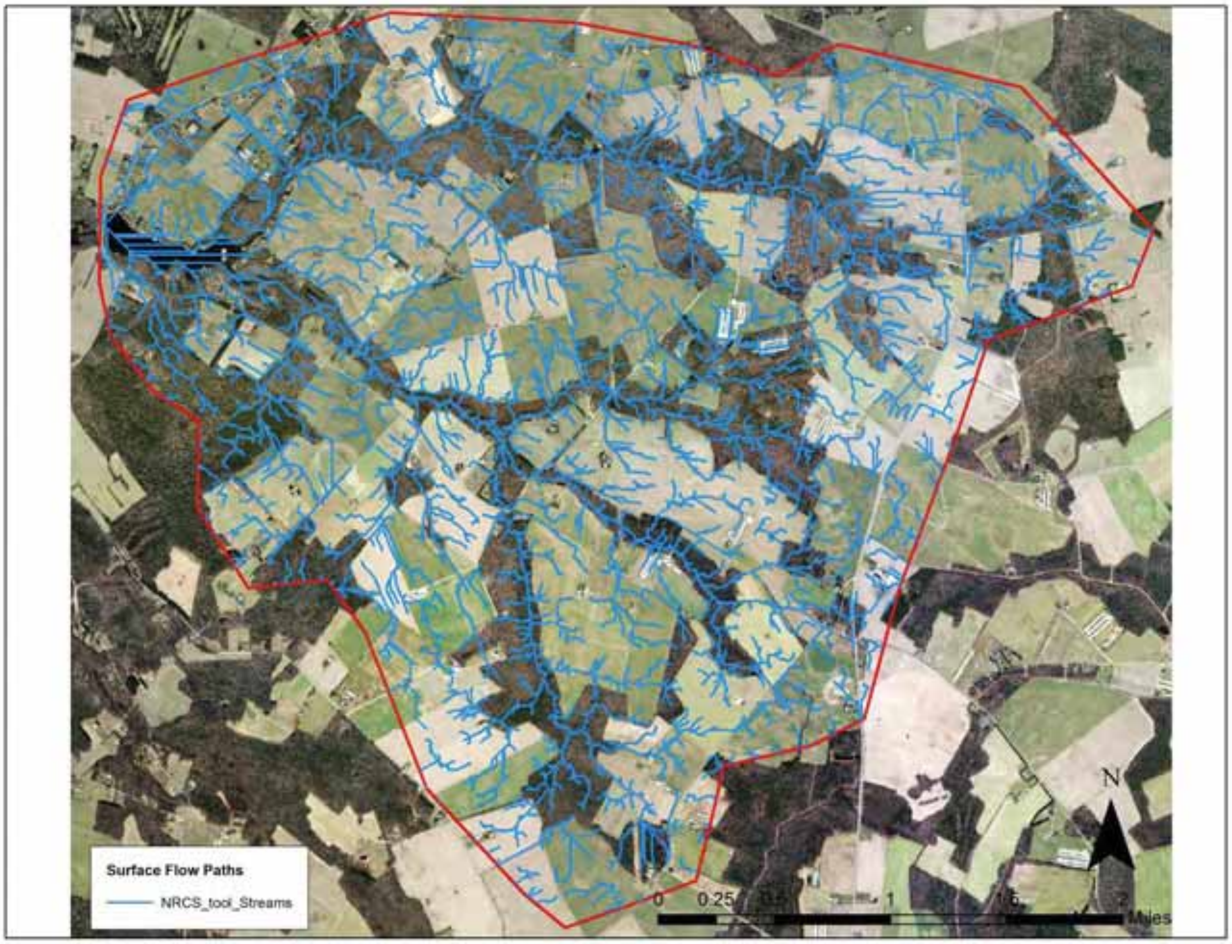
Ponding depth was created to identify where water backs up or ponds behind landscape features. This layer helps identify where culverts exist, but also helps identify where potential wetland restorations could occur.



Using the ponding depth data set, culverts were identified and created as a separate layer. The culvert layer was subsequently used to hydrologically modify the DEM by "burning-in" the culverts to allow water passage through these features (see next page).



The hydrologically modified DEM incorporates the "burned-in" culverts as well as a Fill operation to smooth small features to better model surface water flow across the DEM.



The hydrologically modified DEM was used to create Accumulation and Flow Direction rasters that were used to produce the surface flowpath dataset.

Input Data

All data were in the projected coordinate system NAD 1983 UTM Zone 18N, linear and vertical unit meter, some product outputs were converted to feet.

Digital Elevation Model (DEM): Dorchester_Caroline_2013, Vertical Accuracy: 16.2 cm RMSE, Vertical Datum: NAVD88

Land Use: Chesapeake Conservancy High Resolution Land Use for the Choptank River watershed, 2014, 1-meter resolution

Soil Survey: Gridded Soil Survey Geographic (gSSURGO) for Maryland

Crop Information: USDA National Agricultural Statistics Service (NASS) Cropland Data Layer 2017 (CDL 2017), 30 meter resolution

Field Boundary: Parcel data downloaded from Maryland IMAP were used to create the field boundary layer (fieldboundaryC)

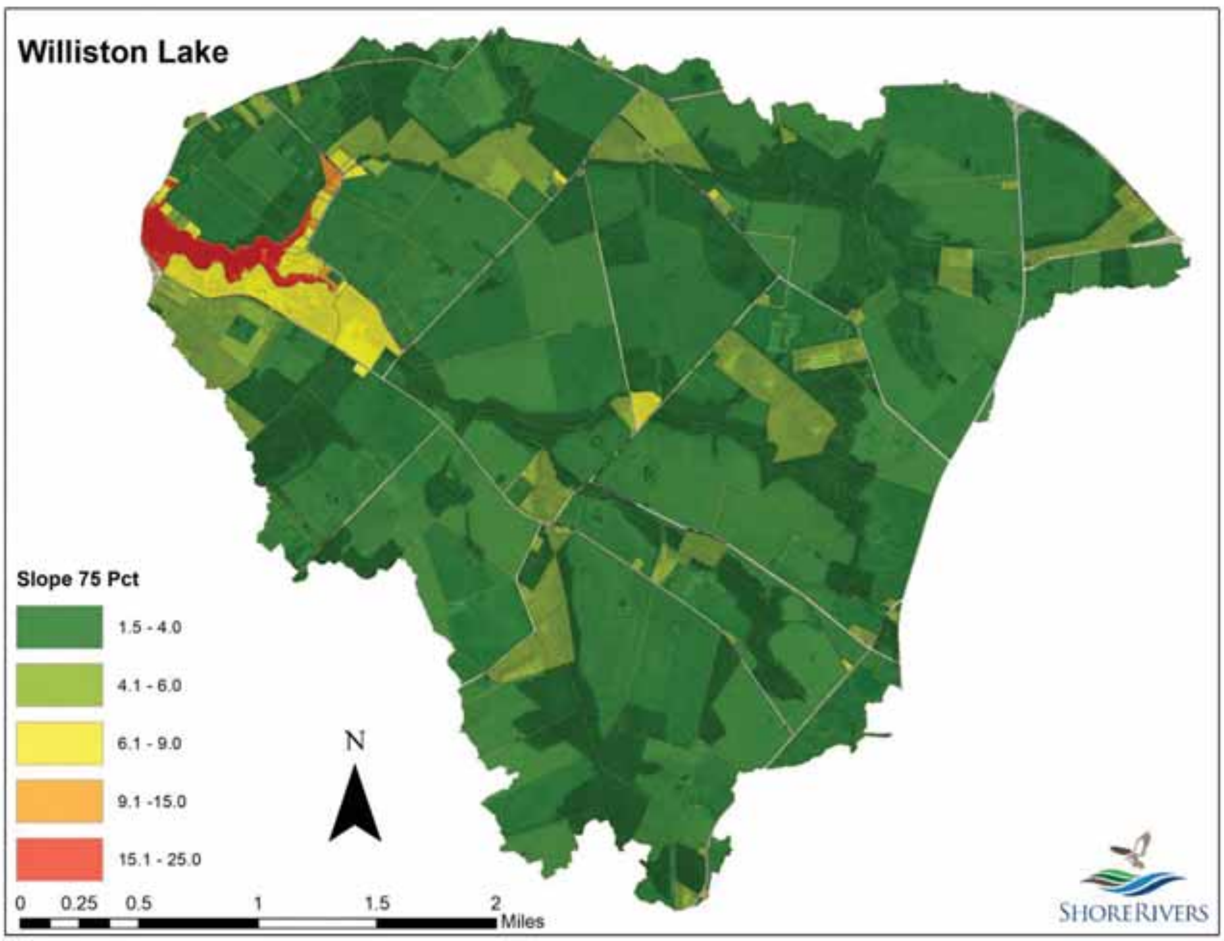
Products

Information on the products created through the ACPF analysis comes from the ACPF user's manual that can be accessed here: https://acpf4watersheds.org/training/. All information covered in the following pages comes from the Agricultural Conservation Planning Framework ArcGIS® Toolbox User's Manual Version 3.0 (Porter et al. 2018).

Field Slope Classification

The by-field slope statistics tool generates 2 outputs: 1) a slope raster (in percent rise), and 2) a slope table, containing slope related statistics on a field-by-field basis. The slope raster is created using the input DEM and the Slope tool in ArcGIS. The slope table can be linked to the field boundary feature class through a unique "FBndID" field in the fieldboundaryC layer. Slope statistics contained in this table will provide information to identify the extent of tile drained fields in the watershed, the relative risk of runoff among fields, and identify fields suitable for runoff control practices such as grassed waterways and contour buffer strips.

The image below is visualized using the 75th percentile slope to identify the steepest fields.



Tile Drainage Classification

The Tile Drainage Determination tool estimates which fields, among those with an "isAG" value of 1 or 2, are likely to be tile drained based on a combination of by-field slope and soils information. The output of the tool is a drainage table (drainagetable + inHUC), containing by-field slope and soils information and a drainage classification (YES, NO, or NonAg). "Null" values in the drainage classification indicates a field that drains entirely out of the watershed. Two conditions are examined, slope and soils. Fields must have ≥ 90% of field is less than 5% slope and the field has a mean hydric soils percentage ≥ 10% or ≥ 40% of field consists of a dual drainage hydrologic group (A/D, B/D, or C/D) or D class soil. For the Williston Lake ACPF analysis this is how the analysis was set up within ArcGIS ACPF toolbox Tile Drainage Classification tool:

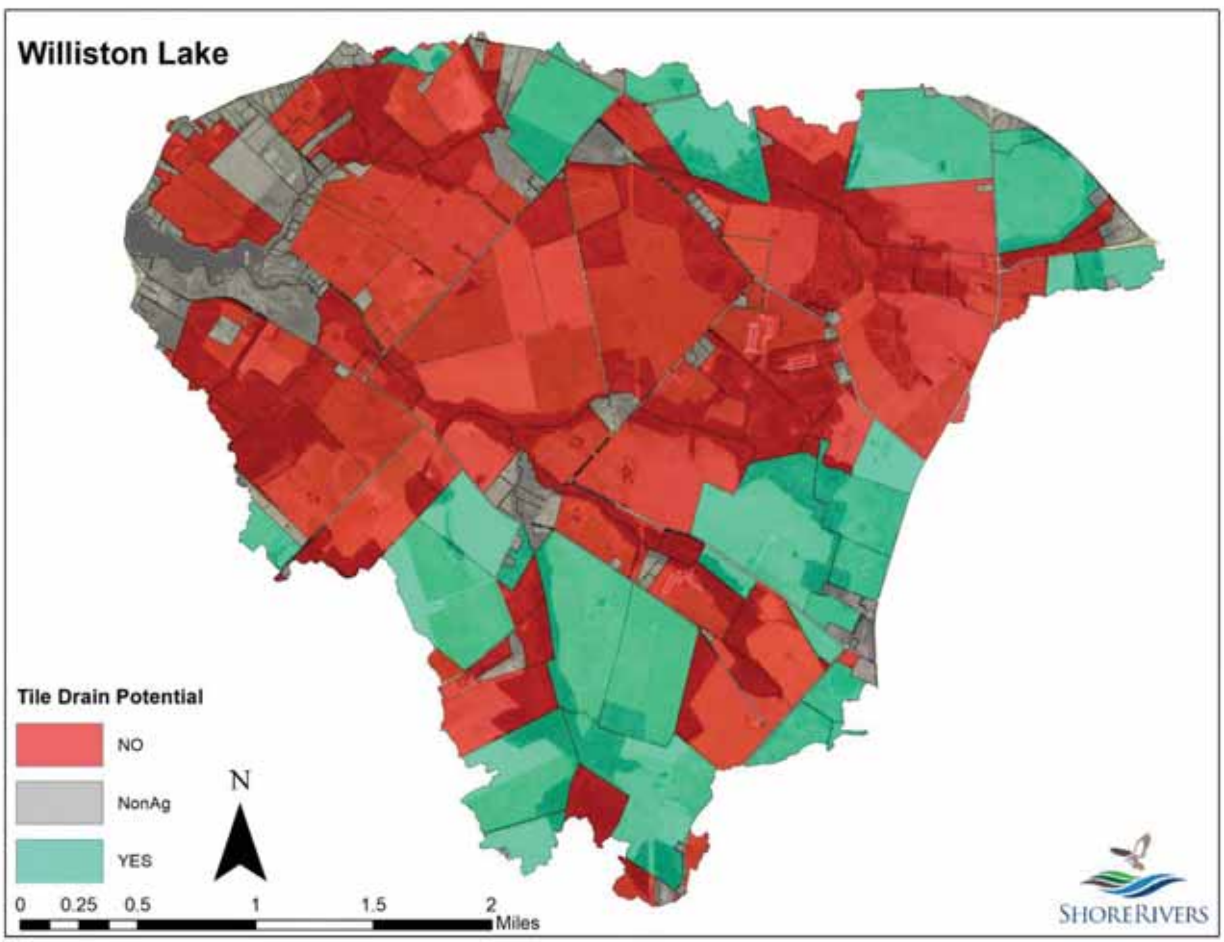
Boundary Field Class- field boundary (fieldboundaryC)

gSSURGO Raster- Downloaded for the state of Maryland and adjusted to have HYDROGRP=Wettest classification for dual class fields, example A/D=D.

Condition 1: Slope, ≥ 90% of the field is <5% slope

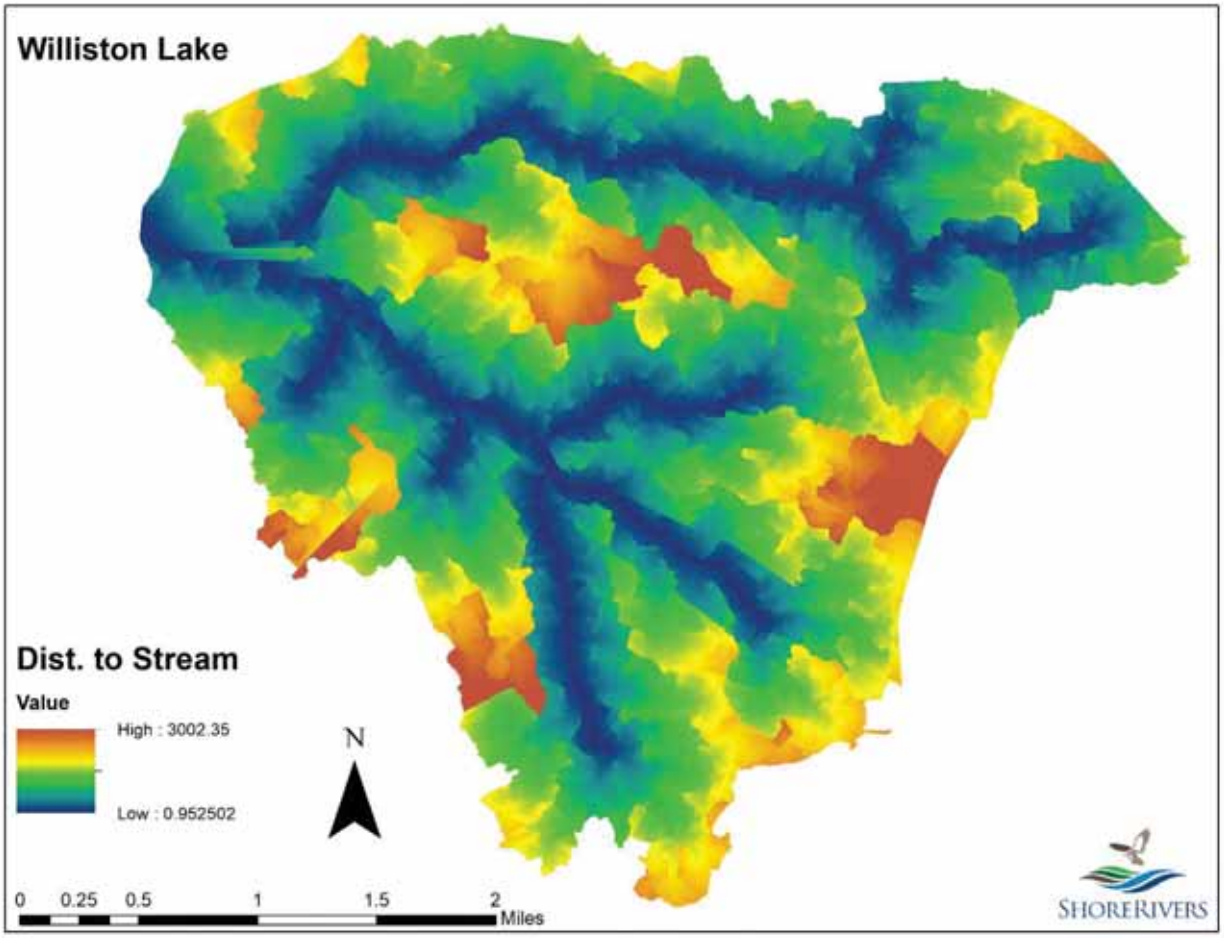
AND / OR- Used AND designation, most restrictive; both conditions must be met.

Condition 2 Soils- Used option A, if the field has ≥ 10% mean hydric soils percentage, than the condition is met.



Distance to Stream Classification

The "Distance to Stream (D8)" tool uses an input Stream Reach (polyline) and a D8 Flow Direction grid to calculate the horizontal distance (in meters) to the channel from each grid cell, moving downslope according to the D8 flow model until a stream grid cell is encountered. The stream reach should represent only perennial flow, a distinction that is achieved by populating the "StreamType" field of the flow network prior to running the "Stream Reach & Catchments" tool. The stream reach polyline is converted to a raster and serves as the input stream raster grid in the "D8 Distance to Stream" tool available in TauDEM software. The output is a Distance to Stream raster, a continuous grid where each cell value is the horizontal distance (in meters) from that cell to the stream reach, following the flow path defined by the D8 Flow Direction grid. Results of this tool are used to rank fields according to relative risk of sediment delivery. This classification used the stream reach flow network (StreamReachflownetwork) and D8 flow direction (newdir1) to calculate the distance of each pixel to the perennial stream.



Run off Risk Assessment

The 3 x 3 "runoff risk assessment" matrix is completed for agricultural fields only (identified by an "isAG" value of "1" or "2" in the attribute table of the field boundary feature class), and is used to classify a given field according to its risk of direct runoff contribution to stream channels in the watershed. Risk classification includes A (very high risk), B (high), C (moderate), and D (low) designations. The analysis for Williston Lake was completed using these inputs:

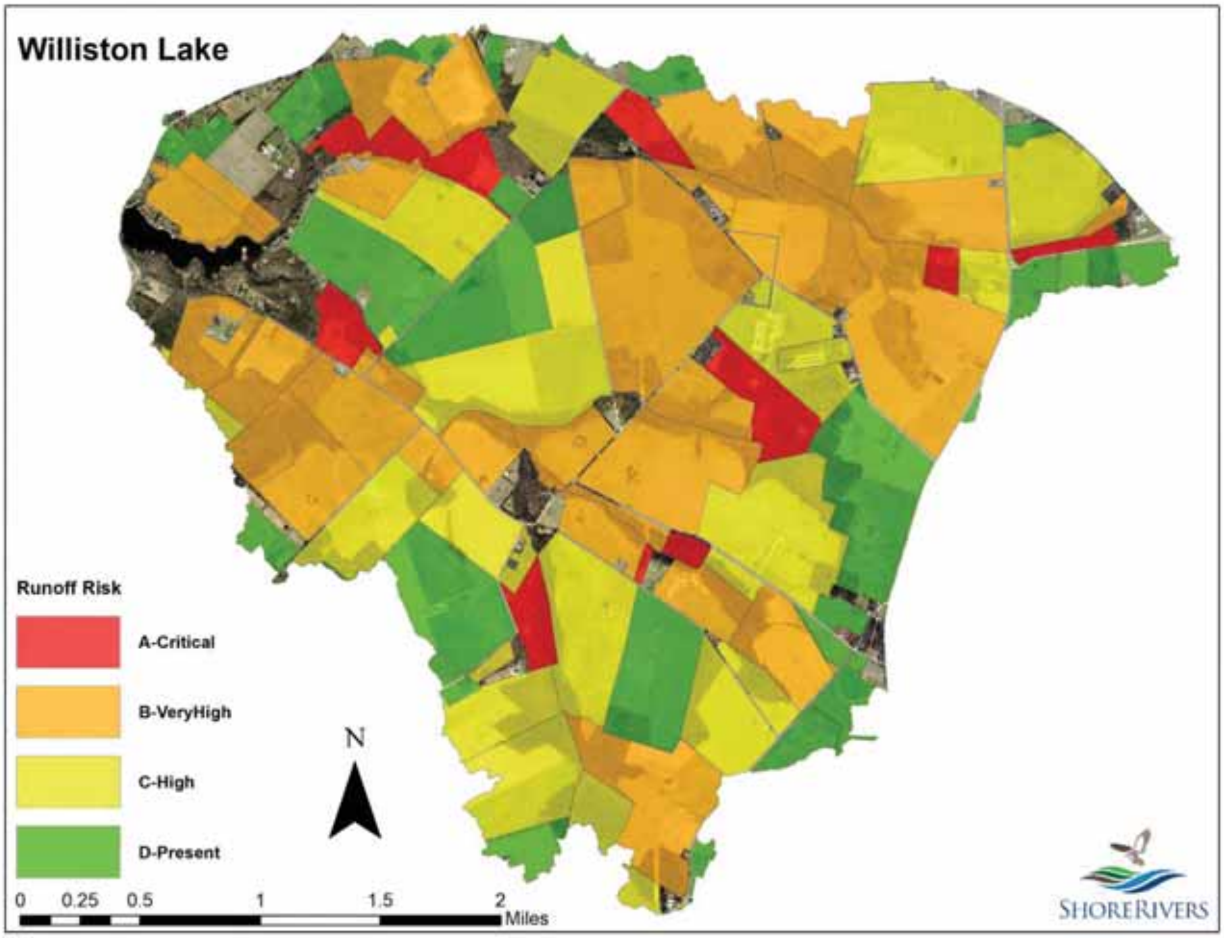
Field Boundary: Field boundary using parcel data (fieldboundaryC) layer

Field Slope: Slope table (slopetb)

Break values: 20 40 40 automatic

Field Steepness: Steepness- 75% slope for each field using slope table

Distance to stream and slope used to determine runoff risk assessment.



Depression Identification

The depression identification tool identifies surface depressions in the input DEM. This is performed by performing a "fill" process on the input DEM, then subtracting the input DEM from the filled DEM. Depression regions are then converted to polygons, and polygons are overlaid with the input DEM to extract the range of elevation values within each depression. This range of values represents the maximum depths of ponding that may occur in each depression. Polygons are also overlaid with gSSURGO to determine the mean percent of hydric soils within each depression. This layer was used to identify potential wetland areas. For the Williston Lake ACPF analysis this is how the analysis was set up within ArcGIS ACPF toolbox for depression identification:

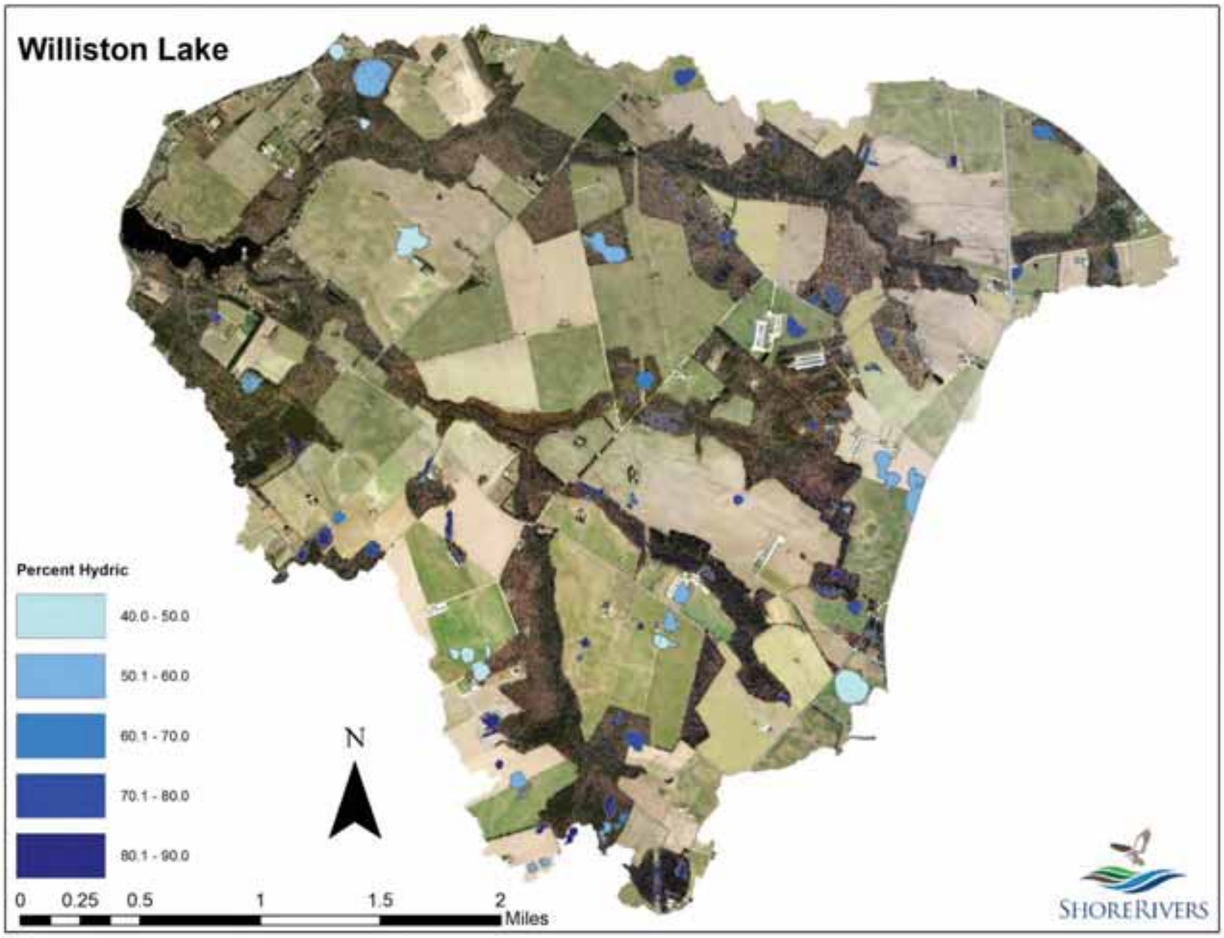
Elevation: Lidar DEM

Soils: SSURGO data used % hydric at 40% or greater

Boundaries: Field boundary feature class not used

Surface water: Stream reach feature class not used

Ponding settings: Minimum depth was 14 cm. Minimum acres was 0.25 acres



Drainage Water Management

This tool uses an input field boundary feature class, drainage table (output from "Tile-Drainage Determination"), and unfilled DEM to identify agricultural fields suitable for drainage water management.

Drainage water management may be used on fields with flat topography (typically one percent or less slope). The practice can be expensive to design and install in areas with steeper slopes because of the number of control structures required in a typical field. A single control gate (dependent on its size) can influence the water table within approximately 0.5 meter change in elevation.

Process: The tool identifies all areas within tile-drained, agricultural fields where a single user-defined contour zone (between 0.3 and 1.5 meter), comprises more than a minimum acreage or a minimum user-defined percentage of the field.

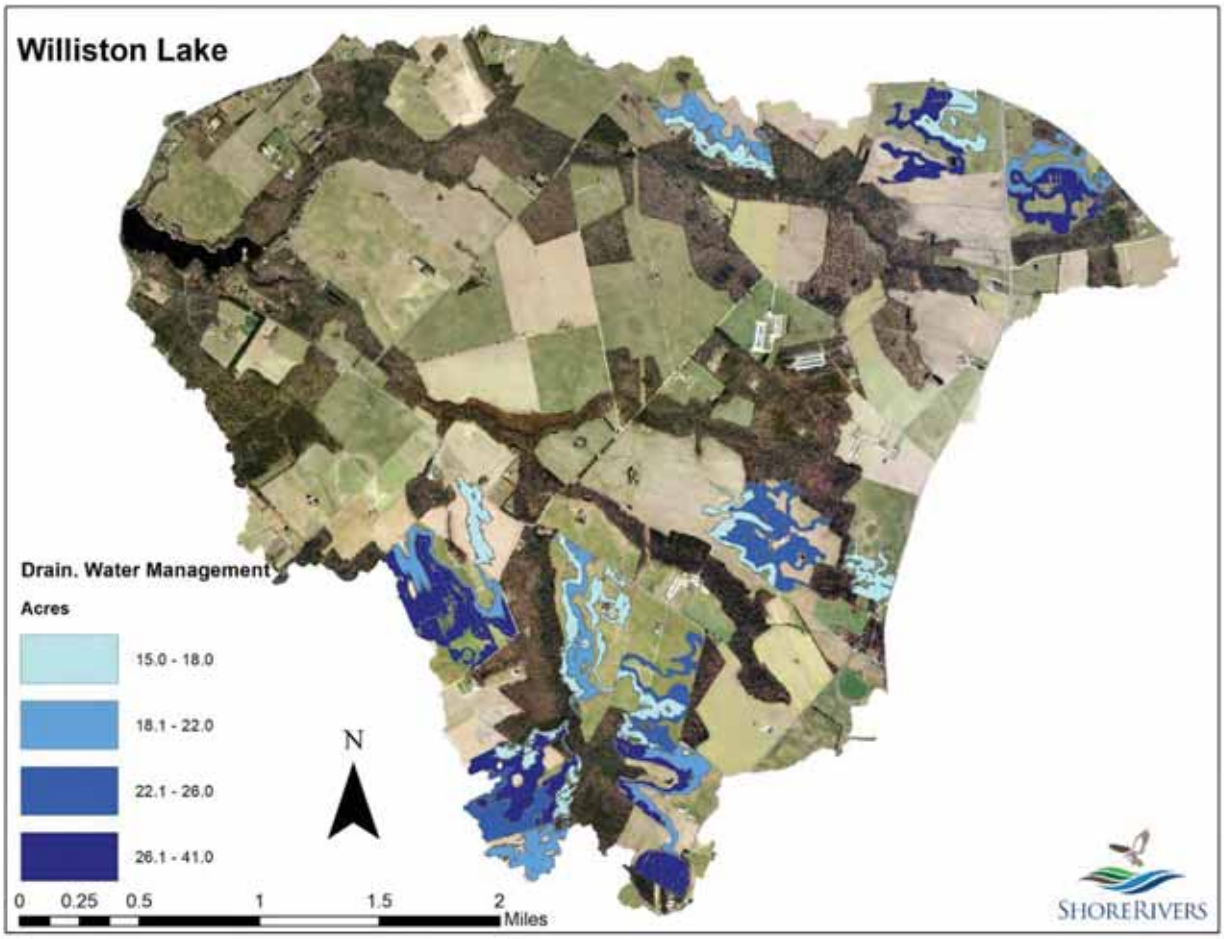
The approximate number of user-defined contours within each tile-drained, agricultural field (rounded to the nearest integer) is found. In the example that a 1-meter contour interval is chosen, a field with an elevation range of 432 cm contains approximately four 1-meter contours, while a field with an elevation range of 465 cm contains approximately five 1-meter contours

432/100 = 4.32 -----> 4 (Round Down)

476/100 = 4.76 -----> 5 (Round Up)

The field is then sliced into that number of equal interval zones, and each zone is analyzed for drainage management suitability. If any single contour occupies more than the minimum acreage or the minimum user-defined percentage of the field, that field is flagged as a candidate for controlled drainage and the contour is added to the output drainage management opportunity feature class.

This tool uses the drainage table to reduce the number of sites analyzed (must be drained). The field boundary feature class was used to determine field acres and then as bounding area for contour intervals and also provides field boundary ID (FBndID). The drainage table provides information on whether or not a field might have tile drainage. For the analysis the contour interval was 0.5 meters with the minimum acreages used for the practice of 15 acres.



Moore Terrain Derivatives

Secondary topographic attributes combine two or more primary attributes (slope, aspect, plan and profile curvature, flow-path length, and upslope contributing area), and can be used to characterize the spatial variability of specific hydrological, geomorphological, and ecological processes occurring in landscapes (Wilson and Gallant, 2000). The Moore Terrain Derivatives tool generates two of these secondary topographic attributes from an input digital elevation model, and can be used to infer surface characteristics about the susceptibility of landscapes to erosion (Stream Power Index - SPI) and the landscape distribution of soil water movement and accumulation (Topographic Wetness Index - TWI).

SCA-specific catchment area- created based off of d infinity method, contributing area per unit length

SPI-Stream power index- measure of erosive power of flowing water spi=ln(sca*tan of slope)

TWI- topographic wetness index-zones of saturation where specific catchment area is large and slope is small twi= ln(sca/tan of slope)

Elevation: Hydrologically modified DEM

Slope: Slope raster

Grassed Waterway

The grassed waterways – SPI threshold tool applies a user-defined threshold to an input stream power index (SPI) raster. SPI is a measure of the erosive power of flowing water, and is based on the assumption that discharge (q) is proportional to specific catchment area. SPI predicts net erosion in areas of profile convexity and net deposition in areas of profile concavity (decreasing flow velocity). The tool interface requires that the user define either a standard deviation threshold (between 2 and 5 standard deviations above the mean SPI value), or a specific SPI value. SPI values that are greater than the value specified will be selected as locations suitable for grassed waterways. SPI values above the selected threshold are first recoded to a value of 1, then smoothed using a majority filter. Values of 1 are expanded by 1 cell to increase overall connectivity between cells, then thinned to a maximum width of 1 cell. Regions are then converted to an output polyline layer. The input stream reach polyline is converted to a raster and serves to remove grid cells corresponding to the stream network. The output is clipped to agricultural field (excluding pasture) as identified by an "isAG" value of "1". Finally, grassed waterways less than 50 meters in length are excluded from the output. For the Williston Lake ACPF analysis this is how the analysis was set up within ArcGIS ACPF toolbox Grassed Waterway tool:

Field Boundary: field boundary feature class (fieldboundaryC)

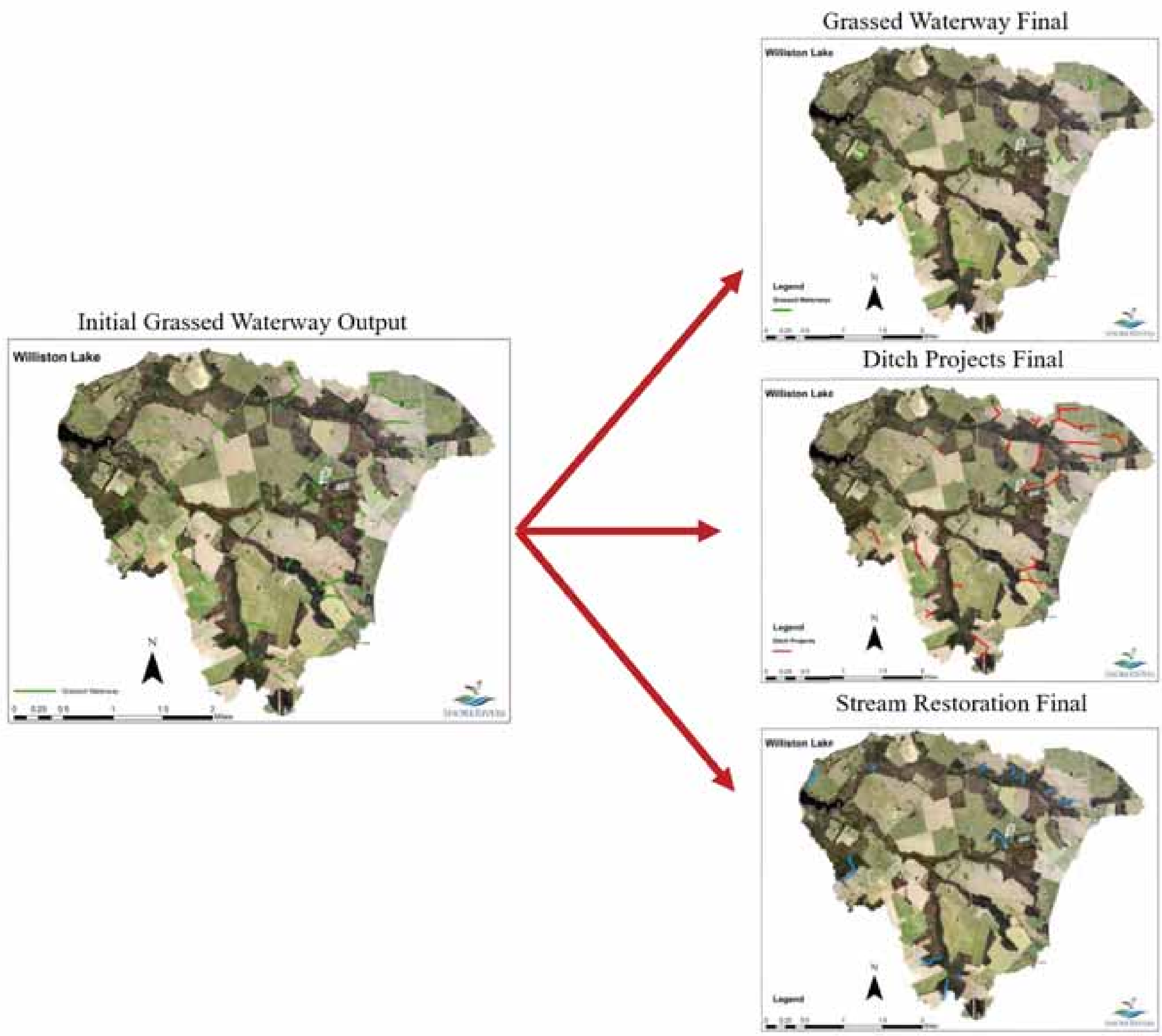
Stream Reach: stream network

SPI: stream power index

*Standard Deviation Threshol*d: Used 4 standard deviations

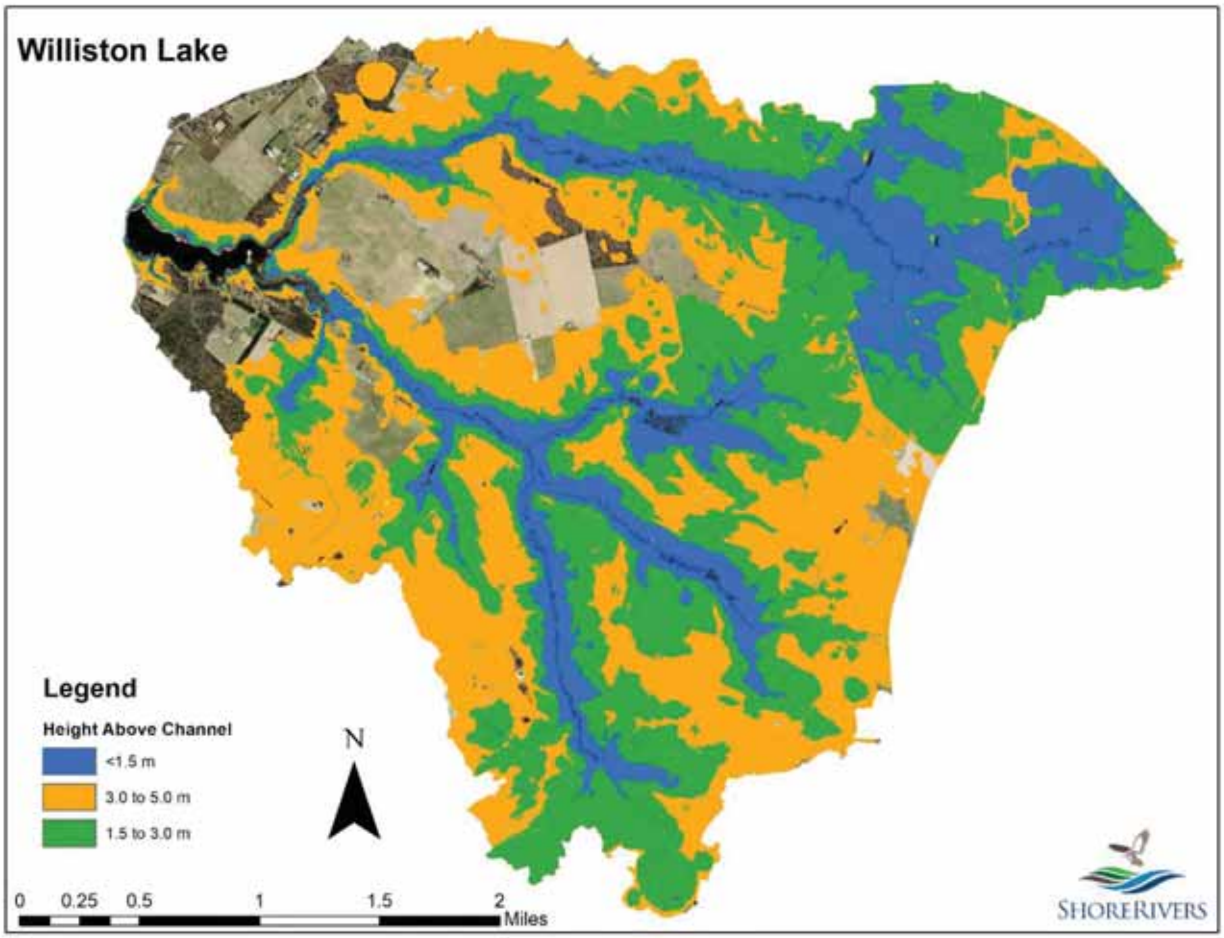
Input Depressions: Did not use depressions

Many ditch and stream channels were selected by the tool, with only a few actual field erosion sites. The initial grassed waterway results were broken down into stream, ditch, and grassed waterway conservation opportunities.


Grassed Waterway Final
Initial Grassed Waterway Output
Ditch Projects Final
Stream Restoration Final
Williston Lake
Legend
N

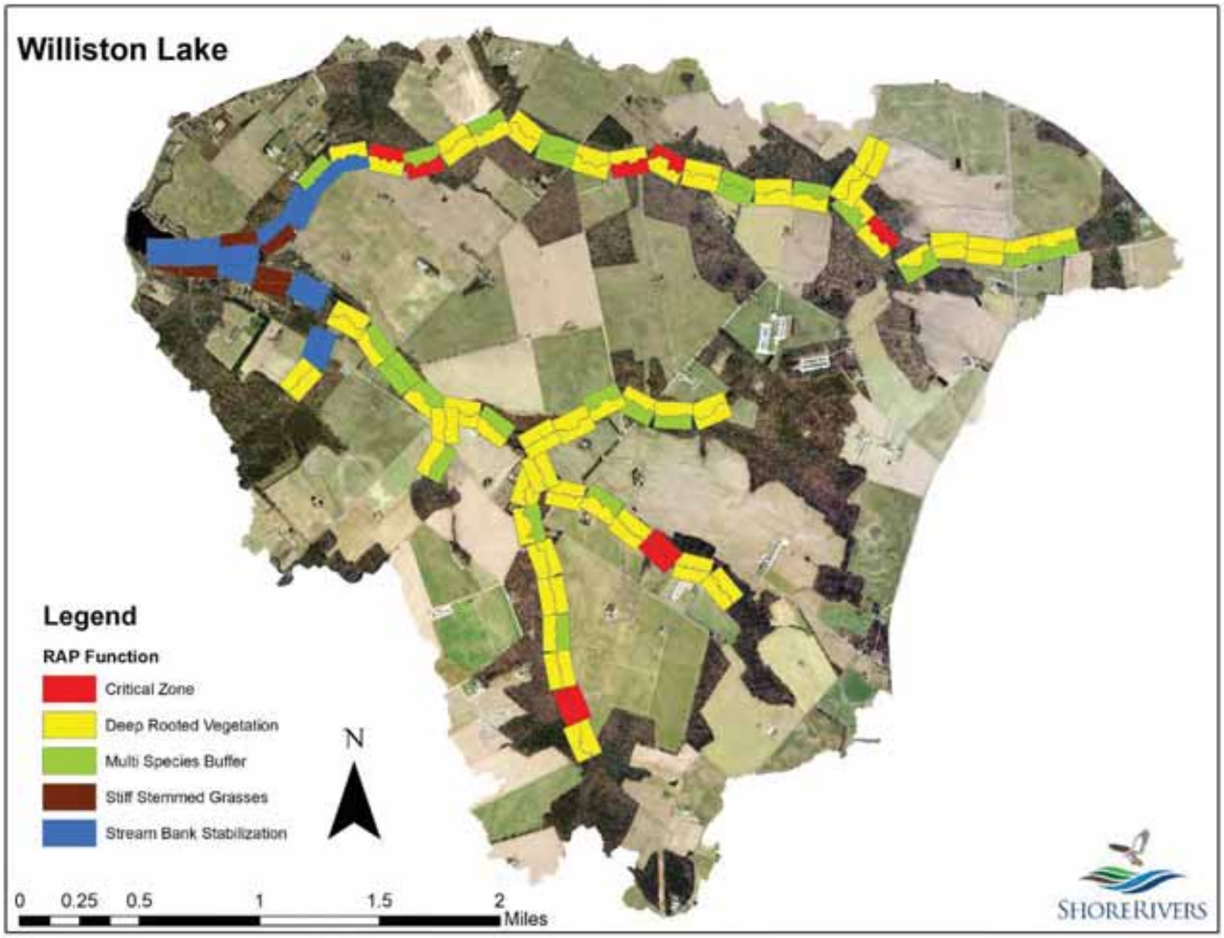
Height above Channel

The Height Above Channel tool uses an input unfilled DEM, D8 Flow Direction grid, and Stream Reach feature class (polyline) to find the elevation difference between each grid cell in the input DEM and the stream-channel grid cell that will receive overland flow from that cell. These elevation differences are reclassified into height above channel categories and used to estimate the extent of low-lying areas along the riparian corridor. That is, elevation differences are found between the grid cells of the unfilled DEM and the elevation found along the stream reach polyline where flow from that cell enters the channel or water body, following D8 Flow Direction flowpaths. The result is the Relative Elevation raster, a continuous raster of elevation difference relative to receiving channel and water body elevations. Below is the output for the height above channel analysis for Williston Lake.



RAP (Riparian Assessment Polygons)

The second supplemental matrix in the conservation planning framework, "Riparian Assessment" (Fig. 12), can be used to determine site-specific designs for riparian buffers. The process analyses two variables within each riparian catchment; 1) The potential for the riparian zone within each catchment to provide denitrification of shallow groundwater, which is based on the width of the low-lying land (< 1.5 meter height) within 90 meters of the stream, and 2) the amount of drainage area passing through the riparian zone of each catchment (equal to the size of the riparian catchment). The riparian zone within each catchment is defined as a 90 meter buffer out from the stream reach associated with each riparian catchment. Each variable is ranked into a high, medium, or low category, and a cross classification is then applied to map the relative correspondence of potential runoff contributions with the extent of low-lying areas (where water tables are likely to be shallow and subject to influence of plant roots) throughout the riparian corridors in the watershed. The results of the cross classification can be used to identify opportunities to improve riparian management by installing permanent vegetation in ways specifically designed to intercept surface runoff, influence shallow groundwater in low-lying areas, and stabilize stream banks, in places where consequent water quality benefits can be best realized. Below is the output for the RAP assessment for Williston Lake.



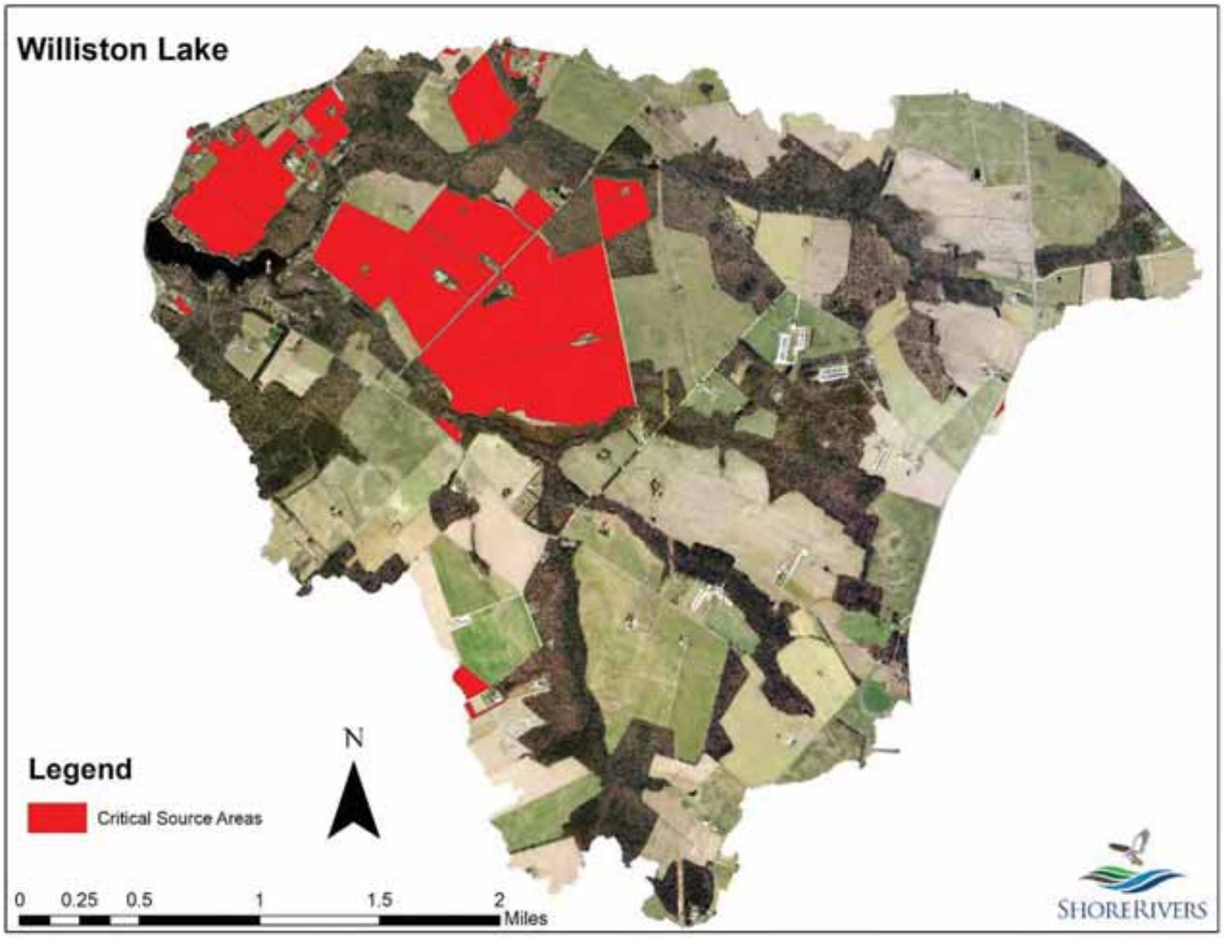
Critical Source Areas

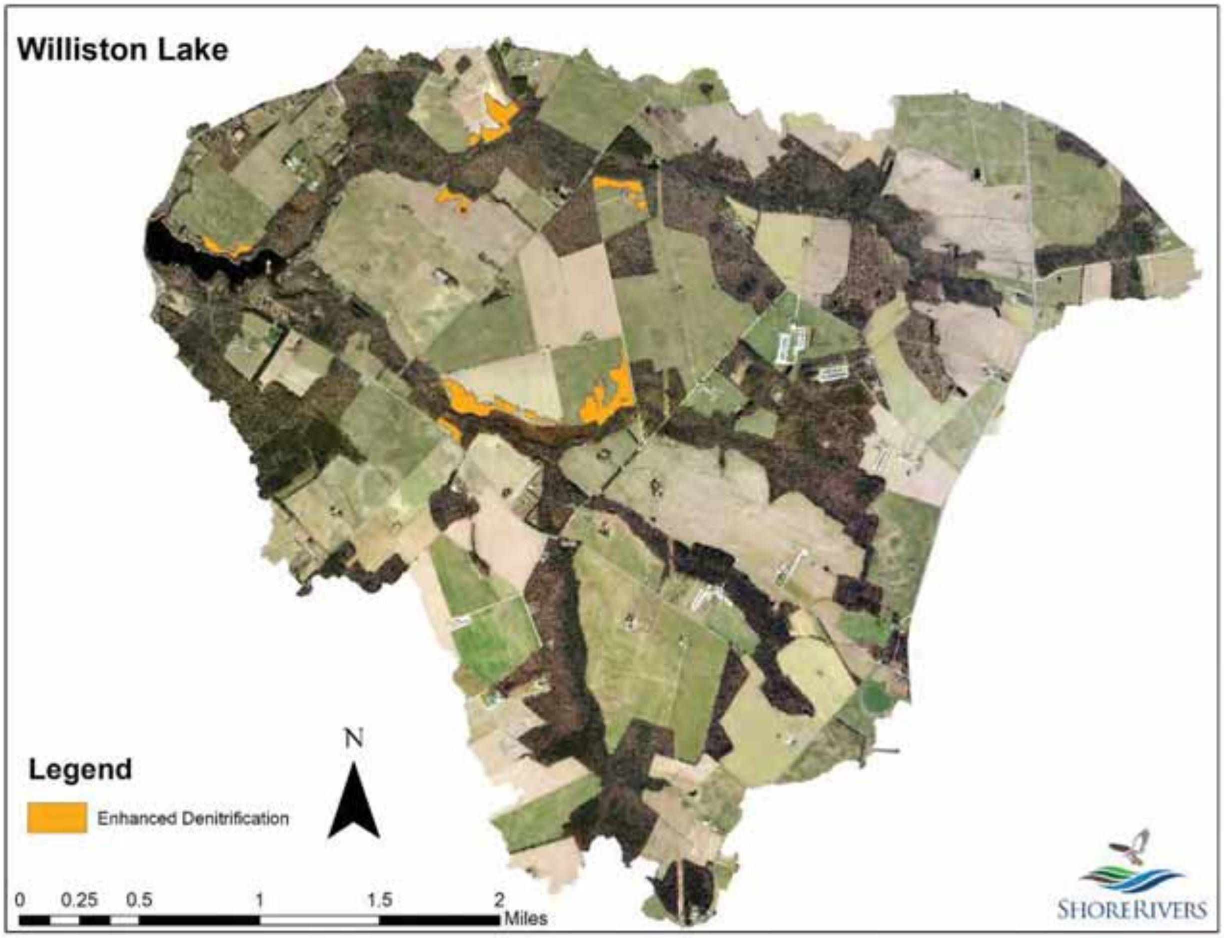
This tool identifies farm fields that have the potential to have high nitrogen loss to the subsoil and low natural denitrification potential. The denitrification wall tool uses this information in conjunction with estimated height above channel to identify areas that could work for denitrification walls.

Input layers to identify critical source areas:

2014 Chesapeake Conservancy land use was used to identify agricultural land and was converted from a raster to polygon (vector).

Field boundary (parcel boundary) layer with drainage table joined to select fields with <10% poorly drained soils. This was used as a proxy for well drained soils. This layer was clipped using the agricultural land identified from the 2014 Chesapeake Conservancy land use. Denitrification wall (enhanced denitrification) potential was identified as areas that were within the critical source area with the height above the channel <3.0 m (proxy for high water table).


Williston Lake
N
Legend
Critical Source Areas
0 0.25 0.5 1 1.5 2
Miles
SHORERIVERS


Williston Lake
Legend
Enhanced Denitrification
N
0 0.25 0.5 1 1.5 2
Miles
SHORERIVERS

Appendix F: Sucralose Testing Results

Table F1. This table shows the sucralose data obtained from samples taken from Beauchamp Branch (BB) and Mill Creek (MC).

Component Name		Curve Index	Weighting Ir	Origin Index	Equation															
Sucralose		Quadratic	Equal	Ignore	Y = -0.00592177+0.0163642*X+6.92998e-005*X^2 R^2 = 0.9973															
							Specified	Calculated												
Filename	**Sample Type**	**Sample Name**	**Integ. Type**	**Area**	**ISTD Area**	**Area Ratio**	**Amount**	**Amount**	**%Diff**	**%RSD-AMT**	**Peak Status**	**Level**	**Units**	**RT**	**Sample ID**	**Volume Extracted (ml)**	**Extract Volume (ml)**	**Sample Concentration factor**	**Dilution Factor**	**Final Concentration Factor**
std18	Std Bracket Sample		Method Settir	208821	682720	0.306	18.520	17.723	-4%	6.2%		cal20		2.57	1					
std18_180912012910	Std Bracket Sample		Method Settir	233874	671059	0.349	18.520	19.970	8%	6.2%		cal20		2.57	1					
std18_180912014002	Std Bracket Sample		Method Settir	217898	684322	0.318	18.520	18.388	-1%	6.2%		cal20		2.57	1					
std3	Std Bracket Sample		Manual Integr	37358	780963	0.048	3.130	3.241	4%	3.6%		cal3		2.57	1					
std31	Std Bracket Sample		Method Settir	409726	728904	0.562	31.250	30.716	-2%	3.4%		cal30		2.57	1					
std31_180912020144	Std Bracket Sample		Method Settir	401003	723164	0.555	31.250	30.347	-3%	3.4%		cal30		2.57	1					
std31_180912021236	Std Bracket Sample		Method Settir	416301	699342	0.595	31.250	32.316	3%	3.4%		cal30		2.57	1					
std3_180912002402	Std Bracket Sample		Method Settir	36606	808134	0.045	3.130	3.090	-1%	3.6%	Response Low	cal3		2.57	1					
std3_180912003456	Std Bracket Sample		Method Settir	36409	824581	0.044	3.130	3.021	-3%	3.6%	Response Low	cal3		2.57	1					
std50	Std Bracket Sample		Method Settir	646586	668589	0.967	50.000	49.206	-2%	3.0%		cal50		2.57	1					
std50_180912023418	Std Bracket Sample		Method Settir	649353	673508	0.964	50.000	49.079	-2%	3.0%		cal50		2.57	1					
std50_180912024510	Std Bracket Sample		Method Settir	667867	650271	1.027	50.000	51.773	4%	3.0%	Response High	cal50		2.57	1					
std9	Std Bracket Sample		Method Settir	101978	683318	0.149	9.430	9.129	-3%	2.2%		cal10		2.57	1					
std9_180912005638	Std Bracket Sample		Method Settir	109203	705420	0.155	9.430	9.444	0%	2.2%		cal10		2.57	1					
std9_180912010728	Std Bracket Sample		Method Settir	112876	723468	0.156	9.430	9.513	1%	2.2%		cal10		2.57	1					
QC1	QC Sample		Method Settir	256783	744754	0.345	18.520	19.776	7%	3.5%		cal20		2.57	1					
QC2	QC Sample		Method Settir	258595	732243	0.353	18.520	20.213	9%	3.5%		cal20		2.57	1					
QC3	QC Sample		Method Settir	247099	754549	0.327	18.520	18.866	2%	3.5%		cal20		2.60	1					
Blank10	Blank Sample		User Settings	NF	612868	NF	NA	NF	NF	NF	Not Found	NA		NF	1					
Blank11	Blank Sample		User Settings	NF	524598	NF	NA	NF	NF	NF	Not Found	NA		NF	1					
Blank12	Blank Sample		User Settings	NF	569248	NF	NA	NF	NF	NF	Not Found	NA		NF	1					
Blank13	Blank Sample		User Settings	NF	587728	NF	NA	NF	NF	NF	Not Found	NA		NF	1					
blank2	Blank Sample		User Settings	1152	475290	0.002	NA	0.509	NA	NA	Response Low	NA		2.52	1					
blank3	Blank Sample		User Settings	NF	497320	NF	NA	NF	NF	NF	Not Found	NA		NF	1					
blank4	Blank Sample		User Settings	NF	551303	NF	NA	NF	NF	NF	Not Found	NA		NF	1					
Blank5	Blank Sample		Manual Integr	1438	575682	0.002	NA	0.513	NA	NA	Response Low	NA		2.60	1					
Blank6	Blank Sample		User Settings	NF	562336	NF	NA	NF	NF	NF	Not Found	NA		NF	1					
Blank7	Blank Sample		User Settings	NF	565576	NF	NA	NF	NF	NF	Not Found	NA		NF	1					
Blank8	Blank Sample		User Settings	NF	570871	NF	NA	NF	NF	NF	Not Found	NA		NF	1					
Blank9	Blank Sample		User Settings	NF	620730	NF	NA	NF	NF	NF	Not Found	NA		NF	1					
BB1_1	**Unknown Sample**		**Manual Inte**	**NF**	**898623**	**NF**	**NA**	**NF**	**NF**	**NF**	**Not Found**	**NA**		**NF**	**1**	**200**	**8**	**25**	**0**	**25**
BB1_2	**Unknown Sample**		**Manual Inte**	**NF**	**921219**	**NF**	**NA**	**NF**	**NF**	**NF**	**Not Found**	**NA**		**NF**	**1**	**200**	**8**	**25**	**0**	**25**
BB1_3	**Unknown Sample**		**Manual Inte**	**NF**	**906220**	**NF**	**NA**	**NF**	**NF**	**NF**	**Not Found**	**NA**		**NF**	**1**	**200**	**8**	**25**	**0**	**25**
BB2_1	**Unknown Sample**		**Manual Inte**	**NF**	**853723**	**NF**	**NA**	**NF**	**NF**	**NF**	**Not Found**	**NA**		**NF**	**1**	**200**	**8**	**25**	**0**	**25**
BB2_2	**Unknown Sample**		**Method Sett**	**NF**	**901207**	**NF**	**NA**	**NF**	**NF**	**NF**	**Not Found**	**NA**		**NF**	**1**	**200**	**8**	**25**	**0**	**25**
BB2_3	**Unknown Sample**		**Method Sett**	**NF**	**835800**	**NF**	**NA**	**NF**	**NF**	**NF**	**Not Found**	**NA**		**NF**	**1**	**200**	**8**	**25**	**0**	**25**
MC1_1	**Unknown Sample**		**Method Sett**	**NF**	**367881**	**NF**	**NA**	**NF**	**NF**	**NF**	**Not Found**	**NA**		**NF**	**1**	**200**	**8**	**25**	**0**	**25**
MC1_2	**Unknown Sample**		**Manual Inte**	**NF**	**367530**	**NF**	**NA**	**NF**	**NF**	**NF**	**Not Found**	**NA**		**NF**	**1**	**200**	**8**	**25**	**0**	**25**
MC1_3	**Unknown Sample**		**Manual Inte**	**NF**	**370463**	**NF**	**NA**	**NF**	**NF**	**NF**	**Not Found**	**NA**		**NF**	**1**	**200**	**8**	**25**	**0**	**25**
MC2_1	**Unknown Sample**		**Method Sett**	**NF**	**459721**	**NF**	**NA**	**NF**	**NF**	**NF**	**Not Found**	**NA**		**NF**	**1**	**200**	**8**	**25**	**0**	**25**
MC2_2	**Unknown Sample**		**Manual Inte**	**5649**	**438027**	**0.013**	**NA**	**1.144**	**NA**	**NA**	**Response Low**	**NA**		**2.60**	**1**	**200**	**8**	**25**	**0**	**25**
MC2_3	**Unknown Sample**		**Manual Inte**	**NF**	**471695**	**NF**	**NA**	**NF**	**NF**	**NF**	**Not Found**	**NA**		**NF**	**1**	**200**	**8**	**25**	**0**	**25**

Table F2. This table shows the sucralose data obtained from samples taken from Williston Lake beach (B1 and B2) and from unnamed tributaries to the lake.

Component Name		Curve Index	Weighting Ir	Origin Index	Equation															
Sucralose		Quadratic	Equal	Ignore	Y = -0.0150361+0.017473*X+4.03654e-005*X^2 R^2 = 0.9989															
							Specified	Calculated												
Filename	Sample Type	Sample Name	Integ. Type	Area	ISTD Area	Area Ratio	Amount	Amount	%Diff	%RSD-AMT	Peak Status	Level	Units	RT	Sample ID	Volume Extracted (ml)	Extract Volume (ml)	Sample Concentration factor	Dilution Factor	Final Concentration Factor
std18	Std Bracket Sample		Method Setti	237858	748656	0.318	18.520	18.272	-1%	6.2%		cal20		2.57	1					
std18_180912202354	Std Bracket Sample		Method Setti	214017	729606	0.293	18.520	16.982	-8%	6.2%		cal20		2.57	1					
std18_180912203446	Std Bracket Sample		Method Setti	244365	727057	0.336	18.520	19.241	4%	6.2%		cal20		2.57	1					
std3	Std Bracket Sample		Method Setti	35389	865627	0.041	3.130	3.177	2%	4.1%		cal3		2.57	1					
std31	Std Bracket Sample		Method Setti	443187	755906	0.586	31.250	32.043	3%	1.8%		cal30		2.57	1					
std31_180912205628	Std Bracket Sample		Method Setti	460010	815539	0.564	31.250	30.932	-1%	1.8%		cal30		2.60	1					
std31_180912210720	Std Bracket Sample		Method Setti	449316	783293	0.574	31.250	31.410	1%	1.8%		cal30		2.57	1					
std3_180912191846	Std Bracket Sample		Method Setti	35246	868217	0.041	3.130	3.161	1%	4.1%		cal3		2.57	1					
std3_180912192938	Std Bracket Sample		Method Setti	32508	881853	0.037	3.130	2.950	-6%	4.1%	Response Low	cal3		2.60	1					
std50	Std Bracket Sample		Method Setti	679253	708907	0.958	50.000	49.937	0%	1.1%		cal50		2.57	1					
std50_180912212902	Std Bracket Sample		Method Setti	693563	732171	0.947	50.000	49.430	-1%	1.1%		cal50		2.57	1					
std50_180912213952	Std Bracket Sample		Method Setti	678690	699316	0.971	50.000	50.510	1%	1.1%	Response High	cal50		2.60	1					
std9	Std Bracket Sample		Method Setti	117830	770786	0.153	9.430	9.405	0%	4.3%		cal10		2.57	1					
std9_180912195120	Std Bracket Sample		Method Setti	116713	763745	0.153	9.430	9.402	0%	4.3%		cal10		2.57	1					
std9_180912200212	Std Bracket Sample		Method Setti	126039	758984	0.166	9.430	10.128	7%	4.3%		cal10		2.57	1					
QC1	QC Sample		Method Setti	229317	697588	0.329	18.520	18.853	2%	2.9%		cal20		2.57	1					
QC2	QC Sample		Method Setti	228228	661804	0.345	18.520	19.701	6%	2.9%		cal20		2.57	1					
QC3	QC Sample		Method Setti	240193	738087	0.325	18.520	18.679	1%	2.9%		cal20		2.57	1					
blank1	Blank Sample		User Settings	NF	500833	NF	NA	NF	NF	NF	Not Found	NA		NF	1					
Blank10	Blank Sample		User Settings	NF	446566	NF	NA	NF	NF	NF	Not Found	NA		NF	1					
Blank11	Blank Sample		Manual Integ	2525	458390	0.006	NA	1.173	NA	NA	Response Low	NA		2.60	1					
Blank12	Blank Sample		User Settings	NF	464131	NF	NA	NF	NF	NF	Not Found	NA		NF	1					
Blank13	Blank Sample		User Settings	NF	456863	NF	NA	NF	NF	NF	Not Found	NA		NF	1					
Blank14	Blank Sample		User Settings	NF	450733	NF	NA	NF	NF	NF	Not Found	NA		NF	1					
Blank15	Blank Sample		Manual Integ	1077	516470	0.002	NA	0.978	NA	NA	Response Low	NA		2.60	1					
blank2	Blank Sample		User Settings	NF	539269	NF	NA	NF	NF	NF	Not Found	NA		NF	1					
blank4	Blank Sample		Manual Integ	1660	565166	0.003	NA	1.026	NA	NA	Response Low	NA		2.68	1					
Blank5	Blank Sample		User Settings	NF	454755	NF	NA	NF	NF	NF	Not Found	NA		NF	1					
Blank6	Blank Sample		User Settings	NF	463560	NF	NA	NF	NF	NF	Not Found	NA		NF	1					
Blank7	Blank Sample		Manual Integ	1471	497471	0.003	NA	1.027	NA	NA	Response Low	NA		2.52	1					
Blank8	Blank Sample		User Settings	NF	512847	NF	NA	NF	NF	NF	Not Found	NA		NF	1					
Blank9	Blank Sample		Manual Integ	1388	461653	0.003	NA	1.030	NA	NA	Response Low	NA		2.46	1					
B1_1	**Unknown Sample**		**Method Sett**	**NF**	**199809**	**NF**	**NA**	**NF**	**NF**	**NF**	**Not Found**	**NA**		**NF**	**1**	**419**	**5**	**83.8**	**5**	**16.76**
B1_2	**Unknown Sample**		**Method Sett**	**NF**	**195486**	**NF**	**NA**	**NF**	**NF**	**NF**	**Not Found**	**NA**		**NF**	**1**	**419**	**5**	**83.8**	**5**	**16.76**
B1_3	**Unknown Sample**		**Method Sett**	**NF**	**197604**	**NF**	**NA**	**NF**	**NF**	**NF**	**Not Found**	**NA**		**NF**	**1**	**419**	**5**	**83.8**	**5**	**16.76**
B2_1	**Unknown Sample**		**Method Sett**	**NF**	**203573**	**NF**	**NA**	**NF**	**NF**	**NF**	**Not Found**	**NA**		**NF**	**1**	**490**	**5**	**98**	**5**	**19.6**
B2_2	**Unknown Sample**		**Method Sett**	**NF**	**200880**	**NF**	**NA**	**NF**	**NF**	**NF**	**Not Found**	**NA**		**NF**	**1**	**490**	**5**	**98**	**5**	**19.6**
B2_3	**Unknown Sample**		**Manual Inte**	**NF**	**191030**	**NF**	**NA**	**NF**	**NF**	**NF**	**Not Found**	**NA**		**NF**	**1**	**490**	**5**	**98**	**5**	**19.6**
TRIB1_1	**Unknown Sample**		**Method Sett**	**NF**	**259914**	**NF**	**NA**	**NF**	**NF**	**NF**	**Not Found**	**NA**		**NF**	**1**	**448**	**5**	**89.6**	**5**	**17.92**
TRIB1_2	**Unknown Sample**		**Method Sett**	**NF**	**243108**	**NF**	**NA**	**NF**	**NF**	**NF**	**Not Found**	**NA**		**NF**	**1**	**448**	**5**	**89.6**	**5**	**17.92**
TRIB1_3	**Unknown Sample**		**Method Sett**	**NF**	**247245**	**NF**	**NA**	**NF**	**NF**	**NF**	**Not Found**	**NA**		**NF**	**1**	**448**	**5**	**89.6**	**5**	**17.92**
TRIB2_1	**Unknown Sample**		**Method Sett**	**NF**	**297243**	**NF**	**NA**	**NF**	**NF**	**NF**	**Not Found**	**NA**		**NF**	**1**	**430**	**5**	**86**	**5**	**17.2**
TRIB2_2	**Unknown Sample**		**Method Sett**	**NF**	**308721**	**NF**	**NA**	**NF**	**NF**	**NF**	**Not Found**	**NA**		**NF**	**1**	**430**	**5**	**86**	**5**	**17.2**
TRIB2_3	**Unknown Sample**		**Method Sett**	**NF**	**304320**	**NF**	**NA**	**NF**	**NF**	**NF**	**Not Found**	**NA**		**NF**	**1**	**430**	**5**	**86**	**5**	**17.2**