Upper Kishacoquillas Creek

Watershed Implementation Plan

"A Community Watershed Restoration Strategy"

February 2020

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Prepared for:

Mifflin County Conservation District
Mifflin County, Pennsylvania

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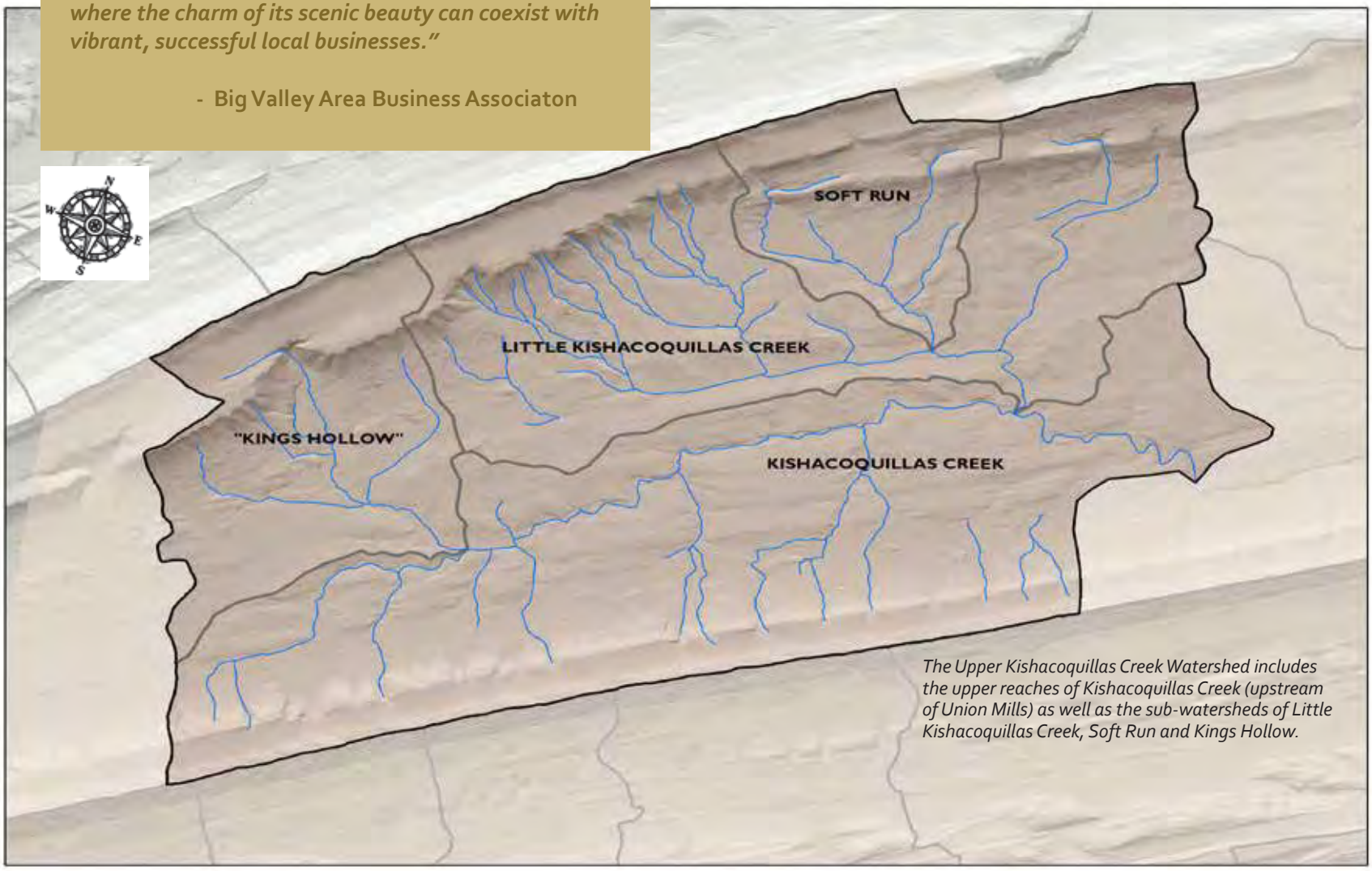
WATERSHED OVERVIEW

"We envision a thriving "Big Valley" area community where the charm of its scenic beauty can coexist with vibrant, successful local businesses."

- Big Valley Area Business Associaton



The Upper Kishacoquillas Creek Watershed includes the upper reaches of Kishacoquillas Creek (upstream of Union Mills) as well as the sub-watersheds of Little Kishacoquillas Creek, Soft Run and Kings Hollow.

WATERSHED OVERVIEW

The Watershed

The Upper Kishacoquillas watershed or "Upper Kish" watershed is located within the municipalities of Menno and Union townships in Mifflin County, Pennsylvania and drains approximately 21,036.1 acres or 32.9 square miles of Kishacoquillas Valley, known locally as "Big Valley". The Kishacoquillas Creek (Kish Creek) watershed is not formally divided into the "Upper Kish", so for the purpose of this report the Upper Kish is defined as the watershed area above a location 0.25 miles south-southeast from the village of Union Mills, itself located just east of Belleville, Pennsylvania. The Upper Kish above Union Mills includes the main stem of Kish Creek and Little Kish Creek, all the unnamed tributaries to both streams, as well as the named tributaries of King's Hollow and Soft Run.

The Upper Kish watershed drainage is defined by the crest of Stone Mountain ridge on the north, and Jacks Mountain on the south. The Watershed divide is less clear in the valley with the western edge of the Upper Kish watershed delineated from the Saddler Creek watershed by a subtle topographic transition just east of Allensville. The Upper Kish's eastern boundary is the delineation between the Upper Kish and larger Kish watershed with the delineation running east of Belleville near the village of Union Mills.

The Upper Kish Creek Watershed is defined by a Susquehanna River Basin Commission's delineation of the watershed boundary. Upper Kish Creek Watershed is composed of the following sub-watershed areas.

Watershed	***Acres***	***Square Miles***
Kish Creek –	9,454	14.8
Little Kish Creek –	6,463	10.1
Soft Run –	1,855	2.9
Kings Hollow –	3,264	5.1
Upper Kish Creek Watershed Area:	***21,036 acres***	***32.9 Sq. Miles***

Project Goals

The Upper Kish Creek Watershed Implementation Plan - "A Community Watershed Restoration Strategy" will update the watershed's existing Watershed Implementation Plan (WIP). A participatory planning process was used to better understand the residents of the watershed community and the factors limiting participation in existing best management practice (BMP) programs. The latest watershed modeling techniques were used to analyze current conditions and to establish benchmarks to improve water quality. The report culminates by defining priority BMPs and an implementation schedule neccesary to improve the health of the Upper Kish Creek Watershed in a timely manner.

Land Use	*Acres*	*Square Miles*	*% of Watershed Area*
Hay / Pasture	6,795.4	10.6	32.3%
Row Crops	4,312.0	6.7	20.5
Forest	8,653.6	13.5	41.1
Unpaved Roads	4.9	0.0	0.0
Low Density Development	1,257.8	2.0	6.0
High Density Development	12.4	0.0	0.1

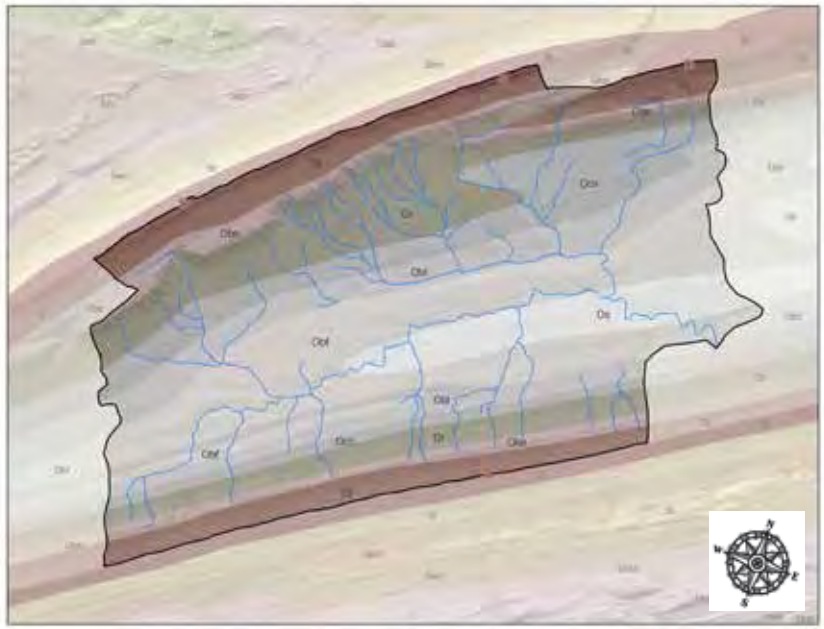
The Upper Kishacoquillas Creek Watershed is located in Menno and Union townships, Mifflin County. Agricultural land uses makes up a more than half of the watershed, while forest land occupies 41% of the total land area.

The Watershed Community

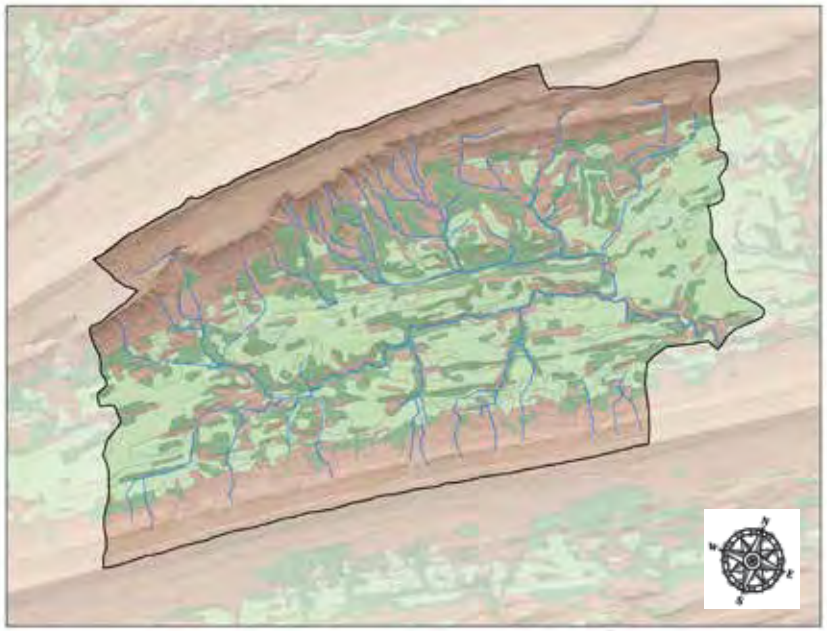
Upper Kish Creek Watershed is located in the Appalachian Mountain Section of the Ridge and Valley physiographic province. The major roadways of the Upper Kish Watershed include state highway route 655 and state highway route 305. The rock type found in the watershed is nearly evenly divided between carbonate (50%) and shale and sandstones (50%). These ridges are composed of shale and sandstone predominately associated with the Juniata, Bald Eagle, and Reedsville Formations.

The highest elevation found in the study area is located in the northern portion of the watershed on Stone Mountain. The total change in elevation in the watershed is approximately 1,400 feet from the headwaters to the mouth near Union Mills. Many watershed tributaries are in the forested ridges of Stone and Jacks mountains. The valley is formed on an upward fold in the sequence of Cambrian and Ordovician age limestone and dolomite predominately associated with the Coburn, Bellefonte, Axemann, and Benner Formations.

The valley's carbonate rock is very susceptible to sinkholes, cave and cavern formation. Depression areas that concentrate surface water are either indicators of sinkholes, or are areas especially prone to sinkhole formation. The soils in the Upper Kish vary depending on elevation and geology. The predominant soil association in Kishacoquillas Valley is Hagerstown-Duffield-Clarksburg series. This soil is listed as a silt-loam soil and is mostly associated with the rolling uplands of the watershed. Hagerstown soils (42% of the association), is well drained, has moderate permeability, and moderate to high available water capacity. These rich valley soils are very productive.



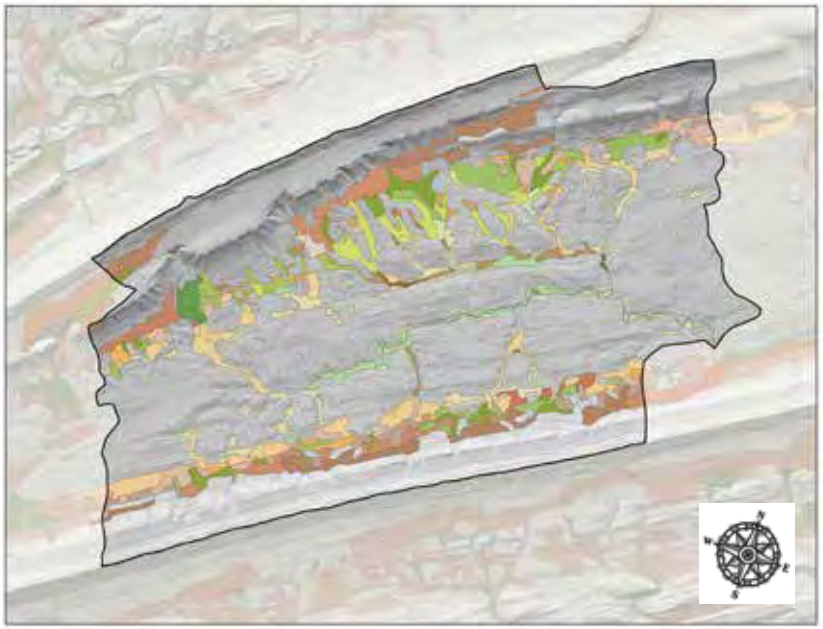
The Geology of the Upper Kish Watershed consists of forested ridges of sandstone, and transitional side slopes of pasture and trees underlain with shale.



The predominant soil association for the watershed's ridges include the Berks-Weikert-Bedington and Hazelton-Dekalb-Buchanan series found on the ridges. Slope ranges from 25-70 percent, and the soils are moderately deep, and extremely stony. Hazleton soils (26% of this association) are deep well drained soils. Buchanan soils (11% of the association) have slow permeability and moderate available water capacity. All three of these soils are strongly to very strongly acidic throughout un-limed areas. These associations are mainly wooded because it is too stony for cultivation. The places that are less stony are suited to farming uses if adequately managed to control erosion and conserve moisture.

The Upper Kish Watershed is bounded north and south by forested ridges, but the majority of the watershed is characterized by extensive and intensive agricultural land use.

The Valley of the Upper Kish Watershed, also known as 'Big Valley,' is underlain with limestone geology creating very productive farmland soils. The soils map (left) depicts prime agricultural soils (light green) and soils of state-wide significant (dark green).



The map above depicts the location of Hydric Soils - a soil that is formed under the conditions of saturation, flooding or ponding long enough during the growing season to develop anaerobic conditions in the upper soil profile. These locations are an important interface between land and water and represent strategic locations for projects designed to improve water quality.

There are 60.6 miles of stream in the Upper Kish Watershed with approximately 57% of those streams flowing through agricultural land use areas. The Upper Kish Watershed contains 140 farms, with old-order Amish farms comprising approximately 2/3 of the agricultural acres in the watershed. Water quality is negatively impacted by nutrient and sediment pollution from agriculture, especially in areas where livestock have direct access to the stream resulting in streambank trampling and severe erosion. Riparian buffers are nearly nonexistent in the agricultural valley landscapes. There are contiguous forest tracts remaining in the watershed, primarily in headwater areas on the ridges.

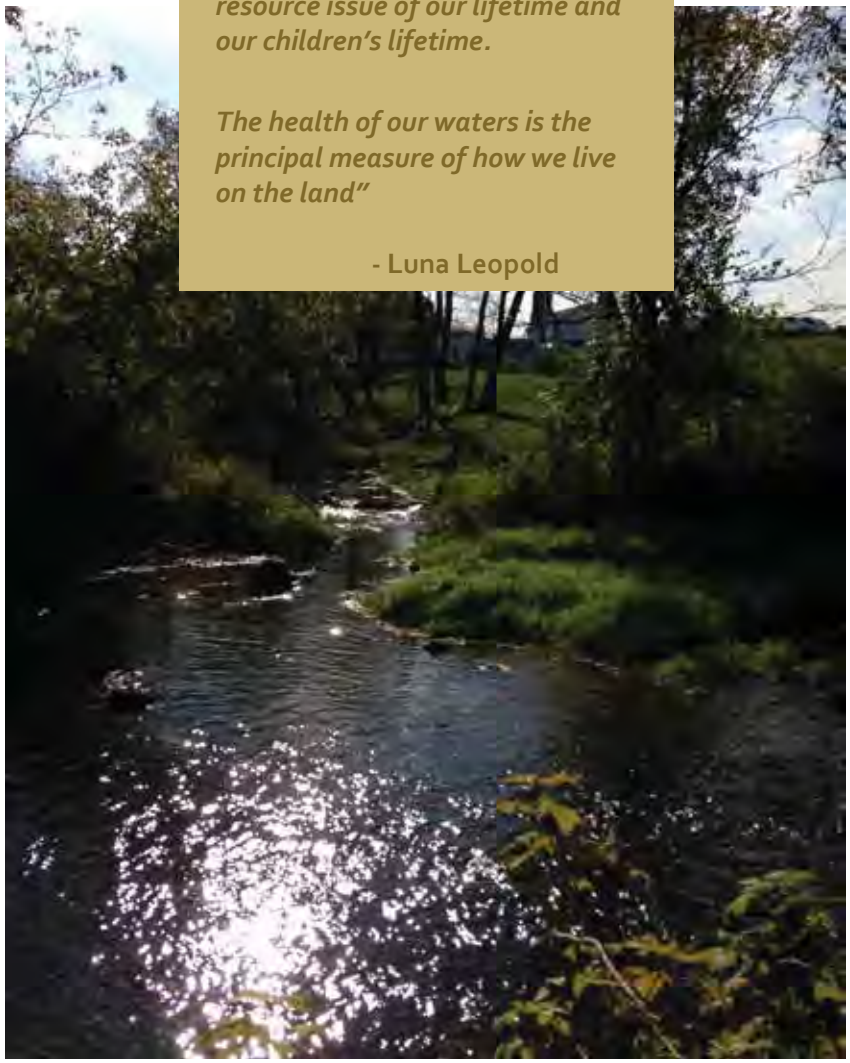
The Mifflin County Conservation District (MCCD) has prioritized improving water-quality in the Upper Kish Creek Watershed. The MCCD has secured funding to produce The Upper Kish Watershed Implementation Plan to guide efforts to work in collaboration with the community to plan, fund, and implement best management practices that benefit the landowner, while improving water quality.

WATERSHED PLANNING & MODELING

"Water is the most critical resource issue of our lifetime and our children's lifetime.

The health of our waters is the principal measure of how we live on the land"

- Luna Leopold



WATERSHED PLANNING

The Clean Water Act

The Clean Water Act sets a national minimum goal that all waters be "fishable" and "swimmable." To support this goal, states must adopt water quality standards - state regulations that have two components. The first component is a designated use, and the Upper Kish Watershed is designated as a Cold Water Fishery. The second component relates to the in-stream conditions necessary to protect the designated use (Cold Water Fishery). These conditions or "criteria" are physical, chemical, or biological characteristics such as temperature and minimum levels of dissolved oxygen, and maximum concentrations of toxic pollutants. It is the combination of the "designated use" and the "criteria" to support that use that make up a water quality standard. If any criteria are being exceeded, then the use is not being met and the water is said to be in violation of water quality standards.

The Clean Water Act requires states to compile lists of water bodies that do not fully support beneficial uses such as aquatic life, fisheries, drinking water, recreation, industry or agriculture. These inventories are known as 303(d) Lists and characterize waters as fully supporting, impaired, or in some cases threatened for beneficial uses.

The Pennsylvania Department of Environmental Protection (PA DEP) has listed Kishacoquillas (Kish) Creek as an impaired stream, for not meeting in-stream conditions necessary to protect the cold-water fishery.

Total Maximum Daily Load (TMDL) – A Pollution Diet for the Watershed

A Total Maximum Daily Load (TMDL) is a regulatory term in the U.S. Clean Water Act, describing a value of the maximum amount of a pollutant that a body of water can receive while still meeting water quality standards. Upper Kish Creek, by not meeting water quality standards, required the state to calculate how much of a substance can be put in the water without violating the standard, and then distribute that quantity to all the sources of the pollutant on that waterbody. A Total Maximum Daily Load (TMDL) plan includes waste load allocations for point sources, load allocations for nonpoint sources, and a margin of safety.

Chesapeake Bay Connections

The Upper Kish Creek Watershed is located in Mifflin County and in the Susquehanna River watershed. The Susquehanna River supplies roughly 50% of the water to the Chesapeake Bay. The Chesapeake Bay water quality has degraded to a poor condition and, despite extensive restoration efforts, the poor water quality has continued. This necessitated the US EPA to establish a "pollution diet" for the Bay, called a Total Maximum Daily Load (TMDL). The TMDL identifies pollutant reductions from major sources of nitrogen, phosphorus and sediment that are needed to restore the Bay and sets pollution limits to meet water quality standards established for the Bay and its tidal rivers. The pollution limits are now mandates for the states within the Chesapeake Bay Watershed to achieve.

Pennsylvania has developed a Chesapeake Bay Watershed Implementation Plan (WIP), which sets forth a strategy for the Commonwealth to achieve the required pollutant reductions mandated by the TMDL. This involves finite reductions in nutrients (nitrogen and phosphorus), as well as sediment. The Pennsylvania WIP acknowledges that success of the WIP implementation depends largely upon active engagement by municipalities and voluntary actions by residents, and private landowners, and Mifflin County Conservation District is leading that effort in the Upper Kish Creek Watershed.

PA DEP established a pollution reduction plan for the watershed in its 2011 report entitled: Kishacoquillas Creek Subwatershed TMDL (PA DEP 2011). This report was later replaced by the Kishacoquillas Creek Watershed Alternative Restoration Plan developed in 2017. The Upper Kish Watershed Implemenation plan is a response to these reports and will outline a strategy, schedule, and budget to achieve the necessary pollutant reductions established by the PA DEP.

Upper Kish Creek's Pollution Source

The Upper Kish Creek Watershed is impaired due to sediment and phosphorus emanating from agricultural runoff. Mean annual sediment and phosphorus loadings are estimated at 36,136 lbs/day and 112 lbs/day, respectively.
In order to ensure attainment and maintenance of water-quality standards in the Upper Kish Watersehd, allowable loadings (AL) for sediment and phosphorous will need to be limited to 23,297 pounds of sediment per day and 55 pounds of phosphorous per day, requiring reductions of 42 percent and 62 percent respectively.

Summary of the allowable load (AL) components for the UpperKishacoquillas Creek Watershed :

Table 11. AL Components for the Kishacoquillas Creek Watershed

Component	Sediment (lbs./yr.)	TP (lbs./yr.)
AL (Allowable Load)	8,503,413	19,940
UF (Uncertainty Factor)	850,341	1,994
NPSL (Non-Point Source Load) = (LNR+ANPSL)	7,653,071	16,363
LNR (Loads Not Reduced)	36,800	2,544
ANPSL (Adjusted Nonpoint Source Load)	7,616,271	13,819
PSL (Point Source Load)		1,583

Kishacoquillas Creek Watershed Alternative Restoration Plan Table 11

WATERSHED MODELING

2016 Watershed Modeling

Original modeling for this project was completed in 2016 in response to the PA DEP draft TMDL. Multiple model runs were completed in an effort to find remaining reductions neccesary to meet targets outlined in the draft TMDL. Difficulties were encountered during these model runs do to several factors...

1. The TMDL model did not account for animal numbers
2. The reference watershed had several major differences from the study watershed
3. Duplicate model runs showed that attainment had been reached

The watershed model tool used for this study was MapShed. This specific product was selected due to its familiarity and compatibility with PA DEP's previous modeling of the Upper Kish Creek Watershed. MapShed is Geographic Information Systems (GIS) based watershed modeling tool that uses hydrology, land cover, soils, topography, weather, pollutant discharges, and other critical environmental data to model sediment and nutrient transport within a watershed. MapShed, and its predecessor AVGWLF, has been used for TMDL studies in Pennsylvania since 1999. The MapShed program was developed by Dr. Barry Evans at Penn State University, and is the watershed modeling tool of choice for PA DEP as well as several regions in the United States and in Mexico. With MapShed, a user selects areas of interest, creates model input files, runs the simulations model, and is provided with data output.

Importance of Comparing Apples-to-Apples

A critical challenge to the MapShed modeling for this WIP was to ensure that the 2016 analysis was fundamentally equal to the 2011 analysis. The TMDL duplicate runs for both watersheds served as the first equal comparison runs to the original DEP analysis. The differences between the TMDL duplicates runs and the original TMDL numbers reported by DEP were nominal, thus validating that the model numbers using the 2016 GWLF-E software are a fair comparison to software version used in DEP's 2011 analysis. Building on this logic, "corrected" Mapshed runs for the Upper Kishacoquillas included:

2011 Corrected with and without Animal Numbers
2016 Existing Conditions with and without Animal Numbers
Future Scenarios with and without Animal Numbers

These various "corrected" runs can still be equally compared to the TMDL duplicate, but they include animal and BMP data that are critical factors in calculating accurate nutrient and sediment load calculations for a watershed.

Because of the complexity of nutrient and sediment load modeling, and the many variables in play, these various model runs were necessary to create meaningful comparisons regarding the best available loading estimates and progress towards the TMDL goal. Notably, animal data was not considered in the original TMDL model for either the Kish or the Middle Creek watersheds. This made an evaluation of progress impossible with regard to BMPs that directly control loading from animal sources such as nutrient management, grazing management, and manure storage facilities. Therefore there was a need to develop multiple levels of model runs with varying assumptions (original TMDL assumptions vs. updated data, Reference watershed, 2011 Kish data, and current conditions all with and without animals, etc.) in order to build data sets that could be compared relative to various input variables. Watershed modeling from 2016 is available in Appendix III, but was replaced by subsequent modeling relating to the Kishacoquillas Creek Watershed Alternative Restoration Plan.

TMDL Model – Take Home Message

Pollutant load modeling is an imperfect indicator for actual stream health. While it does give us a measure of the progress made by BMP implementation, the standard measure is still macroinvertebrate population indices. Although the 2016 modeling suggested that the TMDL targets had been met (if animal data was not included) the Mifflin County Conservation District recognized that there was still work to be done to improve the health of the watershed.

Kishacoquillas Creek Watershed Alternative Restoration Plan

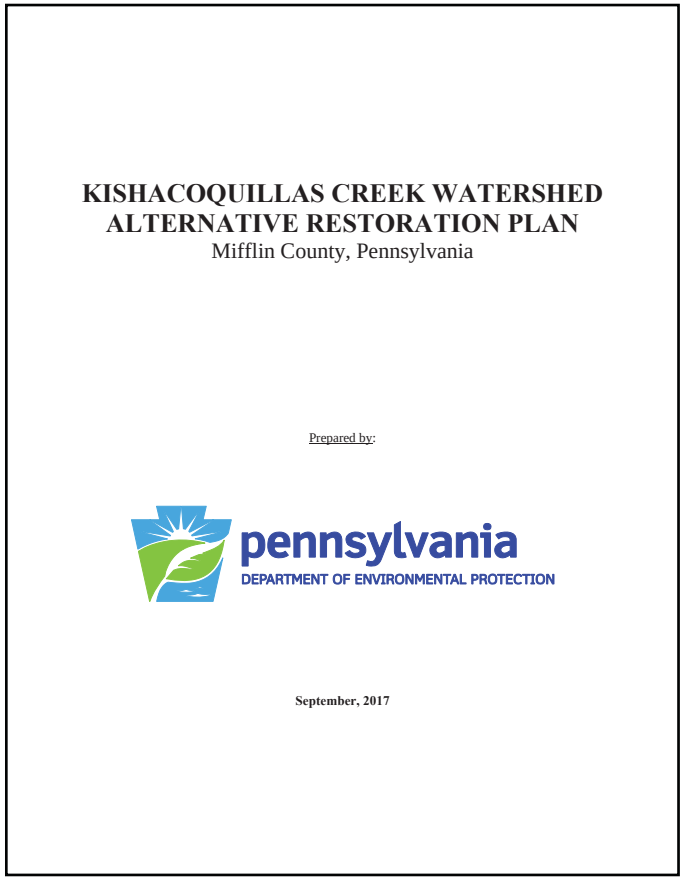
TMDL Alternative

Through the process of updateing the Upper Kish WIP and the associated modeling the MCCD was in close contact with PA DEP regarding modeling difficulties. After difficulty with "apples-to-apples" comparisons from the TMDL and 2016 modeling, the WIP update stalled until the Kishacoquillas Creek Watershed Alternative Restoration Plan (ARP) was developed as an alternative to the TMDL. Essentially, the ARP was a recallibrated version of the previous draft TMDL. The ARP allowed for an apples-to-apples comparison between the reference and impaired watersheds and provided a means for the MCCD to realize WIP update objectives.

ARP & Future Modeling

The ARP modeling methods, results and analysis can be found in the Kishacoquillas Creek Watershed Alternative Resotration Plan (pg. 12-23). The ARP selected a new reference watershed and ran several modeling scenarios to establish benchmark numbers for sediment, nitrogen, and phosphorus pollution. The ARP outlines existing loads in both the reference (Spring Creek) and impaired (Upper Kish) watersheds; documents reductions attained in the impaired watershed, and sets future reductions needed based on the comparision of the reference and impaired watersheds.

Based on this new modeling through the ARP, the MCCD ran additional future scenario models for the Upper Kish Watershed to develop a plan to acheive necessary or remaining load reductions. This modeling is outlined later in this document under the Past, Current and Future Non-Point Source Mangment Measures section. Modeling was completed using the same .gms file and programs used in the development of the ARP.



KISHACOQUILLAS CREEK WATERSHED ALTERNATIVE RESTORATION PLAN

Mifflin County, Pennsylvania

Prepared by:

pennsylvania
DEPARTMENT OF ENVIRONMENTAL PROTECTION

September, 2017

PUBLIC PARTICIPATION

"Be patient. Come out and talk to people. Some will respect. Others may ignore. All things are possible."

- Upper Kish Watershed Public Survey Response

PUBLIC PARTICIPATION

Overview

The process of developing this Watershed Implementation Plan (WIP) employed key person interviews as a way to better understand the Amish community of the Upper Kish Creek Watershed. Amish participation in existing Agricultural-BMP programs has been quite limited. These interviews were an opportunity to learn about the community and potential barriers to BMP adoption. In addition, a survey was also developed and distributed to farmers in the watershed. Both the key stakeholder interviews and written survey results are summarized below.

Stakeholder Interviews

During the winter and early spring 2016, eight interviews were conducted with identified key stakeholders selected for their experience of working closely with those in the Amish Community in a range of capacities. While this is clearly a small sample size there was considerable agreement among interviewees on a wide range of interview topics. The interviewees come from different backgrounds, including: agricultural business professionals, conservation education and technical assistance providers, and outreach and educational professionals. The following summarizes these interview responses:

Q1. What do you think are the most important things to understand about working with the Amish community?

- Strong relationships and trust matter most. Finding key and willing community members open to discussing conservation practices and options, and with whom we can build direct and strong relations and trust is critical. There seems to be little agreement about common demographic characteristics of these individuals. They do not necessarily have to be wise elders, church leaders, or others with particular prominence within the community – these are always good folks to have as partners but it is not always essential. (This is especially important when these same folks can sometimes be impediments to changing conservation or operational practices.) It can often be the case that a young man or woman willing to undertake BMPs within their operation or on their farm is enough to catalyze interest, discussions, and information-sharing within the community. It is important to understand though that all members within the community are closely watched. Even the most 'progressive' individual may be reluctant to undertake activities that are considered too far from the norm. Being sensitive to these concerns is important and can only be assessed through a trusted relationship.
- Flexibility is critical. While conservation professionals may have particular goals or projects they would like to see developed, Amish farmers (and English farmers for that matter) have a range of other issues, concerns, and operational challenges they also need to address. Being willing and able to address these concerns, provide relevant information or assistance where feasible, or 'go the extra mile' can often help build the relationships necessary to foster more in-depth discussion or interest in undertaking conservation practices.
- A strong knowledge base in agriculture and agricultural practices and concerns is important. Many, if not most, in the Amish community are skeptical of outside 'experts' asking them to do things differently. This is especially the case if it is clear that those professionals do not fully understand, or aren't conversant in the day to day operations, practices, and challenges of farming. They can smell it a mile away and it can show itself in small and subtle ways. This does not necessarily mean a professional has to be deeply knowledgeable in all aspects of farming. It does, however, require

that professionals approach their job with a deep and broad appreciation of farming, and are willing to learn and genuinely consider a wide range of agricultural issues, concerns and practices that may on the face of it seem tangential to their primary job responsibilities and tasks.

Q2. What strategies or approaches do you think will be the most successful for improving the participation in Agricultural BMP related programs and practices of the Amish community? Are there distinctions among orders that you think we should be aware of?

- See responses to #1 above. It simply takes time, patience, flexibility, and persistence. Since there is considerable reluctance to external funding incentives, being able to structure options or even discuss BMPs is more likely to be successful if profit and/or cost savings are key focal points. While there are considerable differences between orders, participation in BMPs has occurred in all communities though it remains far less than optimal.

Q3. Who in the Amish community do you think we should talk with to gain insight into the most effective ways to i increase the Amish community participation in Agricultural BMP related programs and practices?

- Not disclosed.

Q4. As we meet with members of the Amish community what questions should we be asking - as it relates to either Agricultural-BMPs or other issues that might inform our efforts? What themes may resonate with the community (work, stewardship, family legacy - caring for the land of our children and grandchildren, etc.)?

- Issues that resonate appear to be so varied across communities and individuals that this can likely only be discovered through direct communications and/or further discussions with community members and leaders. Even within the same family there are likely to be different priorities. Aesthetics matter to some, income and economic impacts matter to others, caring for, and protecting the land matters to still others. The most important issue is to ensure a respectful dialogue that both asks, and is able to speak honestly and accurately to the benefits and costs of each.

Q5. What suggestions do you have for us regarding either venue or approach as we reach out to talk with members of the Amish community?

- It varies by community, order and individual. Simply have to ask this question individually of each.

Q6. How do we engage decision makers (Bishops), as well as women, young people, etc.?

- See #5 above

Watershed Public Survey

Several attempts were made to conduct landowner interviews in the beginning of 2016 to record landowner input and attitudes towards conservation practices for the update of the Upper Kish Creek Watershed Implementation Plan (WIP). After vague responses were received from the first few interviews, hard copy written surveys were distributed instead. It was felt that by sending surveys I would receive more thoughtful answers and honest opinions.

Original surveys were adjusted and a cover letter was developed. Survey packets were sent out to Amish landowners that were familiar with the District (received multiple visits, technical assistance, or BMP implementations). Survey packets included a letter, landowner survey, and a self-addressed envelope. Twenty survey packets were sent in total, of which 7 were returned to the District.

Overall responses were consistent. Some surveys were partially completed and others were completely filled out with additional comments. The overarching tones seemed to be positive. Most Amish farmers stated conservation practices that related to row crop fields (cover crop, strip cropping, tillage, etc.) and others stated stream related conservation practices (stream fencing, pasture management, etc.). The majority of respondents were discontent with current buffer models, and suggested that making stream buffers profitable would be the best option for encouraging stream fencing. Some respondents seemed agreeable to working with the district and most, if not all, refused government funding.

The key tones that stem from this round of surveys, from my view as a conservation professional, are:

- The need to derive profits from a buffer
- Demonstrate an understanding of conservation issues among the Amish community
- Skepticism to implement practices as we (MCCD) promote them

Key Person Interviews & Public Survey Summary by:

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and

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Watershed Success Stories

The Mifflin County Conservation District (MCCD) has achieved a lot of success in putting Ag BMPs on-the-ground. A list of Mifflin County Conservation District's success in the Upper Kish watershed include:

- 4 miles of stream fencing
- 12 Manure Storage Facilities
- 35 Nutrient / Manure Management Plans
- 709 Acres in Cover Crops
- 22 Acres of Riparian Buffers
- 19 Stabilized Stream Crossings
- 5 Off-Stream Watering Systems
- 3,000 L.F. of Stream Channel Stabilization (with 1,330 L.F. due in 2015)
- 25 Roof Run-Off Management Systems
- 59,505 S.F. of Heavy Livestock Use Area Improvements

Watershed Success Stories include this stabilized stream crossing that will improve livestock health and safety, while also improving water quality.

However, nearly all of the implemented projects have occurred on 'English' farms. To advance towards meeting TMDL pollutant reductions goals, more BMPs are needed on farms and other properties throughout the watershed. The MCCD must continue their education and outreach efforts to build trust and collaborative partnerships with the Amish and 'English' farm community. In addition the MCCD should not overlook other potential partners that also play a potential role in watershed improvement projects, and include municipal officials, woodland owners, industry, private businesses, and individual landowners. Fostering a message that 'everyone has a role to play in improving the watershed' will help to develop the next generation of watershed stewards.

Opportunities and Challenges

The task of continual improvement for the water-quality of the Upper Kish Watershed will be a challenge for the community. There is significant pressure on the Mifflin County Conservation District to achieve a delisting of the watershed from the impaired waters list, but they cannot do it alone. Continued success will take a significant increase in BMP participation from a skeptical public. If progress is to be made, it will be based on relationships, understanding and trust.

The residents of the watershed are hesitant to participate in government programs. Recent moves by PA DEP and US EPA with farm inspections and regulatory enforcement actions against the agricultural community will only grow the level of distrust. The staff of the Mifflin County Conservation District, while still government, is viewed differently than state and federal agency staff, having spent decades building relationships based on mutual understanding and respect. Conservation District staff represent the best interface with the local farm community. A brief summary of the opportunities, challenges and needs for the future, include:

Profits from Buffers - It has long been known that we need to find a profitable option for riparian buffers. This is not a new idea by any means, but models that test economic viability in the past, have failed or proven unsuccessful (locally). Efforts are still in the works, here in Mifflin County, to provide economic buffers through improved aesthetics, sap production, sustainable wood harvesting, wildlife, etc. It is likely that one model will not fit all, so it is important to have a suite of profitable solutions. Example: CREP and Buffer Bonus Program work well as economic options for the English...

Understanding the Community - It is also evident from these surveys that the Amish population, in this area (Upper Kish Watershed), is aware of conservation practices and concerns (more so than in the past). Put simply, they can talk the talk. Unfortunately, the Amish community in general has adopted only a small portion of BMPs, mainly those related to crops and/or rotational grazing. Some have adopted stream fencing, and some have planted trees in riparian areas.

Skepticism and the Way Forward - Finally, there seems to be a stark skepticism to taking direct recommendations from conservation professionals. I cannot tell if this is a reflection of distrust in the relationships between the Amish and MCCD, or if they feel that they truly need to make the ideas their own. We, I, or MCCD are not seen as "wise" among the Amish community. They do not often "take our word for it". While this is frustrating, and we may well be justified in our frustration, I have learned that we (conservation professionals) need to humble ourselves and focus on small signs of progress. As stated in one of the surveys, "Stay Ever Cool and Calm".

Examples of Watershed Success Stories. The Mifflin County Conservation District, working with interested farmers installed these two Best Management Practices. The eroding streambank (left) was graded and stabilized to reduce erosion and on-going loss of land. The farm (right) installed fencing and established a stream buffers to exclude livestock from the stream channel. Both project result in reducing sediment and nutrients entering the stream.

"When we look at what is truly sustainable, the only real model that has worked over long periods of time is the natural world"

- Janine Benyus

Upper Kish Creek Watershed Display - created to raise awareness of water quality challenges and helpto identify potential community partners willing to work towards solutions.

WATERSHED IMPLEMENTATION PLAN (WIP)

Pennsylvania's Watershed Approach

Pennsylvania is committed to a watershed approach for water resource management. Locally managed and monitored watershed improvement projects are essential to enhancing, maintaining, and reclaiming the Commonwealth's water resources.

More and more people are working to improve and protect Pennsylvania's watersheds by learning about their watersheds and sharing that information with their neighbors, restoring water quality through hands-on projects, and planning for the future through water resources management.

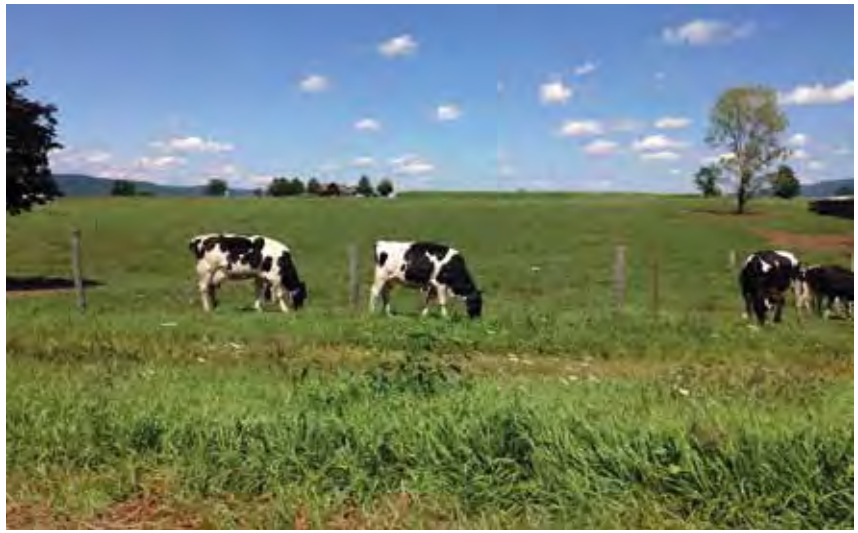
DEP provides assistance to local groups planning to implement restoration measures in watersheds where one or more TMDLs have been identified. The goal is to help such groups develop implementation plans more expeditiously and in a manner that fully complies with EPA requirements for additional funding under the Section 319 Grant program.

Watershed Implementation Plan (WIP) Requirements

The development of a Watershed Implementation Plan (WIP) begins with a detailed assessment of a watershed. The detailed assessment includes an analysis of the known water quality, identification of quantities and locations of pollutant and pollution sources, and selection of priorities for corrective action. It concludes with a description of the management measures needed to restore and maintain water quality, and it provides for public input concerning water quality problems and the restoration measures needed. The result of these activities is a management plan that includes the goals and objectives for improving water quality, an estimate of the technical and financial resources needed to implement the plan, outreach and educaton efforts, and monitoring to demonstrate the success of the plan. The document also includes a budget and restoration schedule for implementation that identifies interim milestones.

As per the Pennsylvania Department of Environmental Protection (PA DEP), the Watershed Implementation Plan (WIP) requires the following elements:

1. Identification of pollution sources
2. Pollutant load reductions required to meet TMDLs
3. Management measures required to achieve prescribed load reductions
4. Technical and financial assistance needed to implement BMPs
5. Public information and participation
6. Implementation schedule and evaluation
7. Water-quality monitoring and evaluation
8. Remedial actions



Mifflin County's Commitment to the Watershed

The Mifflin County Conservation District has prioritized the restoration of the Upper Kish Creek Watershed. The watershed is currently listed on Pennsylvania Department of Environmental Protection (PA DEP) 303 d list of impaired streams. The TMDL/ARP has set specific goals for nutrient and sediment reductions, and the conservation district's stated goal is to implement the best management practices necessary to qualify the surface waters of the Upper Kish Watershed for removal from the impaired streams list.

The Mifflin County Conservation District has established the following objectives for the Watershed Implementation Plan, including:

- Enhanced data on the individual farms in the Upper Kish; prioritization of farms with ready-to-go projects; watershed restoration plan identifying on-farm and 'regional' BMPs; mapping and evaluation of implemented BMPs
- Updated WIP to include the extensive amount of on-the-ground enhancements completed since 2005, and document 'Conservation Success Stories' (project summaries) featuring individual farmers making a difference in the watershed
- Update the WIP to address the impaired watershed area which has expanded since the 2005 WIP
- Update BMP cost data and document the expanded BMPs available to farmers
- Integrate the TMDL/ARP into the updated WIP, to allow tracking of progress in improving water quality
- Strategically invest limited resources to projects that offer the best return-on-investment for improving water quality in the Upper Kish watershed

Upper Kish WIP Prioritization

In the Upper Kishacoquillas (Upper Kish) Creek Watershed, there are 1,802 individually identified parcels (Mifflin County GIS Department) with 181 of those parcels being identified as farms or parcels with greater than, or equal to, 20 acres of agricultural land use. For the purposes of this Community Watershed Restoration Plan strategy, each parcel contained within this watershed has water quality improvement potential through the installation of best management practices (BMPs) for water quality improvements. From rain barrels and rain gardens to manure storages and riparian forest buffers, each parcel has the potential for sediment and nutrient reductions. Regardless of parcel size or land use, these reductions can count towards the ultimate goals outlined in the Kishacoquillas Creek Watershed Alternative Restoration Plan (ARP).

It is evident; however, that certain parcels will have a greater reduction potential than others. For example, since the original impairment for the streams in this watershed are attributed to excess nutrients and sediment from agriculture, parcels with an agricultural land use will be prioritized more heavily. For this prioritization, a watershed wide suitability analysis was completed. The analysis provides a prioritization score for each individual parcel.

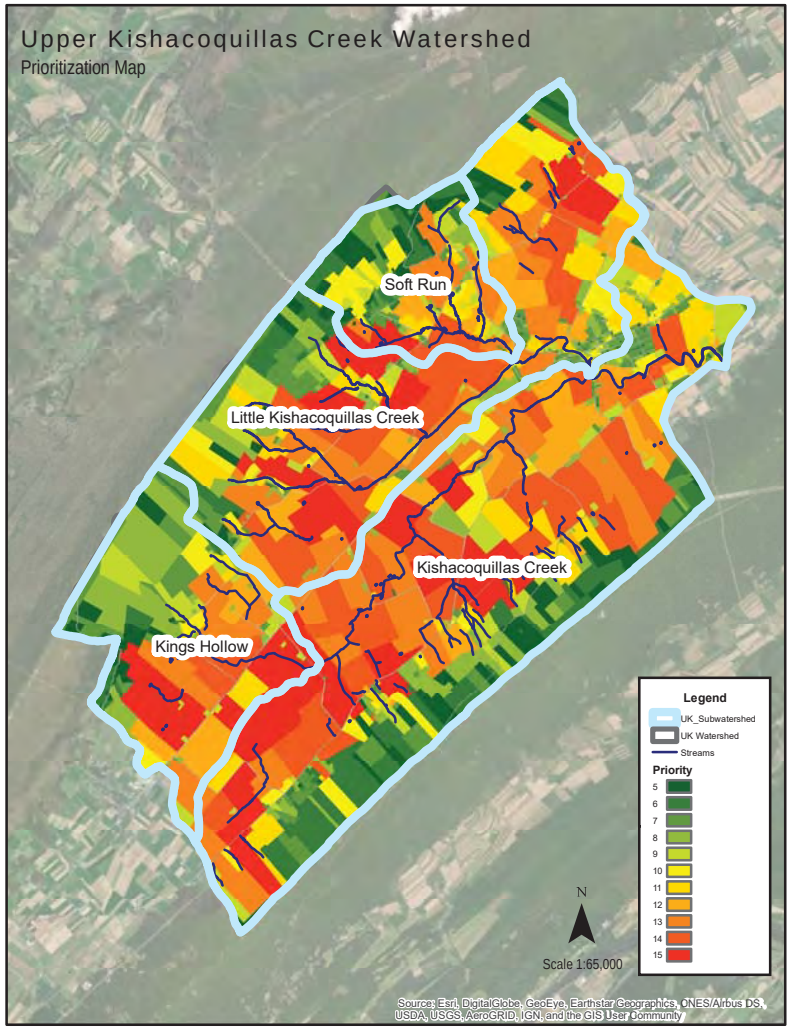
Suitability Analysis and Prioritization

To prioritize BMP installations, each parcel in the Upper Kish Watershed was scored on 5 general category characteristics. For each characteristic, a given parcel received a score between 1 and 3 (1 being low priority and 3 being high priority). Scores from each category were compiled for each given parcel, resulting in a minimum parcel priority score of 5 and a maximum parcel priority score of 15.

Critical Area Characteristics

1. Parcel Size
2. Land Use
3. Stream Presence
4. Concentrated Upland Flow Paths
5. Impervious Surface

The prioritization was completed using ArcGIS and data provided by the Mifflin County GIS Department and PASDA. This prioritization is intended to guide restoration efforts in the Upper Kish watershed by identifying parcels with high nutrient and sediment reduction potential. This prioritization is by no means perfect, and future field verification may reveal inaccuracies in the given score due to land use changes, changes in operation, or inaccuracies in spatial data or data processing. It is the intention of this prioritization to lead conservation professionals to priority restoration areas so that current conditions can be assessed for water quality impacts. If field assessments reveal discrepancies, a parcel should be rescored using the same criteria. Prioritization methods are included in Appendix I.



The Upper Kish Creek WIP Prioritization Mapping

Subwatersheds of Focus

The subwatersheds of the Upper Kish, while not called out in the modeling or Kischacoquillas Creek Watershed Alternative Restoration Plan, provide natural boundaries to distinguish restoration efforts. Since the subwatersheds of the Upper Kish have very similar characteristics and are closely connected, this plan intends to continue a watershed wide approach (Upper Kish) in regard to BMP modeling and implementation. However, it is evident that a major barrier to increased BMP implementation is landowner willingness to adopt BMPs. For this reason, prioirty will be given to those subwatersheds of the Upper Kish with the highest landowner adoption rates. The subwatersheds with the highest adoption rates (319 projects completed/area) are the Kishacoquillas Creek subwatershed followed by the Soft Run, Little Kishacoquillas Creek, and Kings Hollow subwatersheds.

Past, Current and Future Non-Point Source Management Measures

As part of the ongoing restoration of the Upper Kish Watershed many projects have been completed to improve water quality. The first Watershed Implementation Plan for the Upper Kishacoquillas Creek Watershed was completed in 2005, and opened the door for many BMP installations through a multitude of 319 grants as well as other associated grant and cost share programs (USDA-NRCS, NFWF, Growing Greener etc.). To date, significant progress has been made in the restoration of this watershed, as documented in BMP records and watershed modeling completed as part of the Kishacoquillas Creek Watershed ARP (ARP Table 15 and 16).

ARP Table 15. WIP BMP Load Reductions Attained to date in the Upper Kishacoquillas Creek Subwatershed

Source/ Subwatershed	Current Load	Allowable Load	Reduced Load	Reduction Goal	Reduction Achieved	Reduction Remaining
Sediment	lbs/day	lbs/day	lbs/day			
Upper Kish	36,136	23,297	26,084	42%	28%	14%
Total Phosphorus						
Upper Kish	112	55	84	62%	25%	37%

Upper Kishacoquillas Creek Alternative Restoration Plan: Table 15

ARP Table 16. Source Load Pollution Reduction Goals, Reductions Achieved to date and Reductions Outstanding in the Upper Kishacoquillas Creek Subwatershed to date, Annual Values

Source	Sediment Reduction Goal	Sediment Reduction Achieved	Sediment Reduction Remaining	TP Reduction Goal	TP Reduction Achieved	TP Reduction Remaining
Hay/Past	42%	6%	36%	49%	10%	39%
Cropland	42%	40%	2%	49%	43%	6%
Stream Bank	42%	22%	20%	49%	23%	26%
Farm Animals				70%	26%	44%
Total						
Subwatershed	42%	28%	14%	62%	25%	37%

Kishacoquillas Creek Watershed Alternative Restoration Plan: Table 16

Nutrient and sediment reduction progress is also reaffirmed by the discovery of trout reproduction in the Upper Kish Watershed through Pennsylvania Fish and Boat Commission (PFBC) fish sampling and the MCCDs Surface Water Assessment Program (SWAP). This discovery has ultimately led to the classification of the Little Kishacoquillas Creek as a Wild Trout Fishery. Furthermore, positive trending IBI scores in this watershed also suggest realized water quality improvements.

Moving forward the MCCD proposes to implement a suite of BMPs that will obtain the remaining nutrient and sediment reductions necessary to restore the streams of the Upper Kish Watershed (ARP Table 15 & 16). As outlined in the Kishacoquillas Creek Watershed ARP, the MCCD will focus on a phased approach to achieve these reductions. The MCCD will first strive to ensure compliance with Chapter 91 and Chapter 102 regulations among the agricultural operations in the Upper Kish Watershed. Over 109 educational farm visits were conducted in the Upper Kish between 2010-2015. Currently, these education visits are being followed up with newly mandated DEP compliance inspections. During the next 10 years a compliance rate of 80% is intended to be realized.

Additionally the MCCD plans to continue substantial BMP installations in the Upper Kish Watershed. The MCCD plans to implement a suite of BMPs that achieve the necessary nutrient and sediment reductions as set forth in the Upper Kish ARP. The suite of BMPs will achieve a 30% effective reduction of sediment and a 40% effective reduction of Phosphorus to meet the allowable loads listed in the ARP (ARP Table 17 & 18).

Essentially, as directed by the Upper Kish ARP, focus needs to be put on BMPs that deal with animal waste systems, pasture lands, and riparian areas. Cropland practices are surprisingly close to reaching their maximum reduction potential (ARP Table 16). To reach our goal of attainment for Upper Kish Streams according to the Phase 2 scenario in the Kishacoquillas Creek Watershed ARP, nearly 100% implementation will need to be reached for Nutrient Management Plans, Conservation Plans, Livestock Waste Management Systems, Barnyard Runoff Controls, as well as nearly all streams within the agricultural land use area will need Livestock Exclusion Fencing and some type of established vegetative buffer. Since it is unlikely that we can effectively reach 100% implementation for all of those particular BMPs (especially in the next 10 years) and since the reductions realized by the Kishacoquillas Creek Watershed ARP Phase 2 modeling exceeded necessary reductions, the MCCD completed new Phase 1 and Phase 2 modeling scenarios (Table 1 and Table 2).

ARP Table 17. Phased Sediment Load Reductions (Upper Kish)

Source Sediment	Current Load lbs/day	Existing WIP BMP Reduced Load lbs/day	Phase 1 Load lbs/day	Allowable Load lbs/day	Phase 2 Load lbs/day
Upper Kish	36,136	26,084	22,418	23,297	12,654

Kishacoquillas Creek Watershed Alternative Restoration Plan: Table 17

ARP Table 18. Phased Total Phosphorus Load Reductions (Upper Kish)

Source TP	Current Load lbs/day	Existing WIP BMP Reduced Load lbs/day	Phase 1 Load lbs/day	Allowable Load lbs/day	Phase 2 Load lbs/day
Upper Kish	**112	**84	**72	55	**40

Kishacoquillas Creek Watershed Alternative Restoration Plan: Table 18

To reach our goal of attainment for the Upper Kish streams, model scenarios were run using new agricultural compliance rates for Phase 1 reductions and new proposed BMP implementation amounts (Table 3, pg. 48) for Phase 2 reductions. These models were completed using MapShed software and utilized the same scenario file (.gms file) used by PA DEP in the modeling for the Upper Kish ARP. The model scenario reductions for Phase 1 and Phase 2 are listed in Table 1 and Table 2. These model runs propose Phase 1 reductions through 80% realization of Nutrient Management Plans and Conservation Plans and Phase 2 reductions through 35.4% cropland cover cropped, 46.8% of cropland with conservation tillage, 19% cropland acres strip cropped or contour farmed, 19% of pastureland with implemented grazing plans, 86% Livestock Waste Management Systems for Livestock as well as 24 km of streams with Livestock Exclusion Fencing and an established vegetative buffer. Additionally, 4 km of streambank stabilization is proposed including stream restoration and wetland restoration and Phase 2 also proposes 100% implementation of runoff controls through storm water management (See Appendix II for modeling tables).

The BMPs called out in Table 3 represent the bulk of implementation costs. It is important to note that while much focus will be on agriculture, BMP installations should not be limited to this group. As part of a true Community Watershed Restoration Strategy, BMPs should be installed across all landuses. Other potential BMPs (non-ag) to be installed in the Upper Kish include urban stormwater BMPs, residential stormwater BMPs, wetland/floodplain restoration, and stream restoration. Table 3 lists major BMPs with proposed amounts and associated costs. Costs of each individual BMP includes the labor and materials to complete that BMP installation. The Unit Cost does not include associated BMPs (such as pipelines, seeding and mulching, pumps, etc.). Since this is a difficult cost to estimate, a lump sum has been included for each major project proposed. Engineering costs are also included in a lump sum figure per project. Due to the high workloads the District has relied on private engineers/ technical service providers (TSPs) to complete project designs, quality assurance, and BMP certification on engineered structures.

UK WIP Phased Sediment Load Reductions Adjusted

Source	Current Load	Existing WIP BMP Reduced Load	Phase 1 Load	Allowable Load	Phase 2 Load
Sediment	lbs/day	lbs/day	lbs/day	lbs/day	lbs/day
Upper Kish	36,136	26,084	23,864	23,297	15,493

Table 1

UK WIP Phased Total Phosphorus Load Reductions Adjusted

Source	Current Load	Existing WIP BMP Reduced Load	Phase 1 Load	Allowable Load	Phase 2 Load
TP	lbs/day	lbs/day	lbs/day	lbs/day	lbs/day
Upper Kish	**112	**84	69	55	54

Table 2

Public Participation

Two public meetings were held to inform the public and receive feedback on the update to the Upper Kishacoquillas Creek Watershed Implementation Plan. Meeting fliers were posted throughout the community and announcements were run in the local paper and radio stations. Meetings were attended by a variety of people and included participants from local townships, local businesses, farms, and interested residents.

WATERSHED RESTORATION SCHEDULE

A Two-Phase Approach to Achieve Regulatory Compliance and Watershed Restoration

Restoration of the Upper Kishacoquillas Creek Watershed will be conducted in two five year phases as recomended by the Kishacoquillas Creek Alternative Restoration Plan. Phase 1 will focus on landowner compliance while Phase 2 will focus on BMP implementation.

Phase 1 - Regulatory Compliance by 2022

Phase 1 has begun with outreach to farmers by the Mifflin County Conservation District. During Phase 1, the majority of farms in the watershed will develop a Conservation Plan/ Ag. E&S Plan and a Nutrient Management Plan/Manure Management Plan. Conservation Plans are represented by BMP 4 in the model. Nutrient Management Plans are represented by BMP 6 in the model. A future scenario of Phase 1 BMPs was run for the Upper Kish Watershed with BMPs 4 and 6 both set to 80%. The Phase 1 BMP entries for the Hungry Run and Upper Kishacoquillas Subwatersheds includes BMPs 4 and 6 at 80% as well as the BMPs that have already been constructed to date by WIP implementation. Phase 1 is projected to conclude by 2022.

Phase 2 – Attaining Restoration Goals by 2027

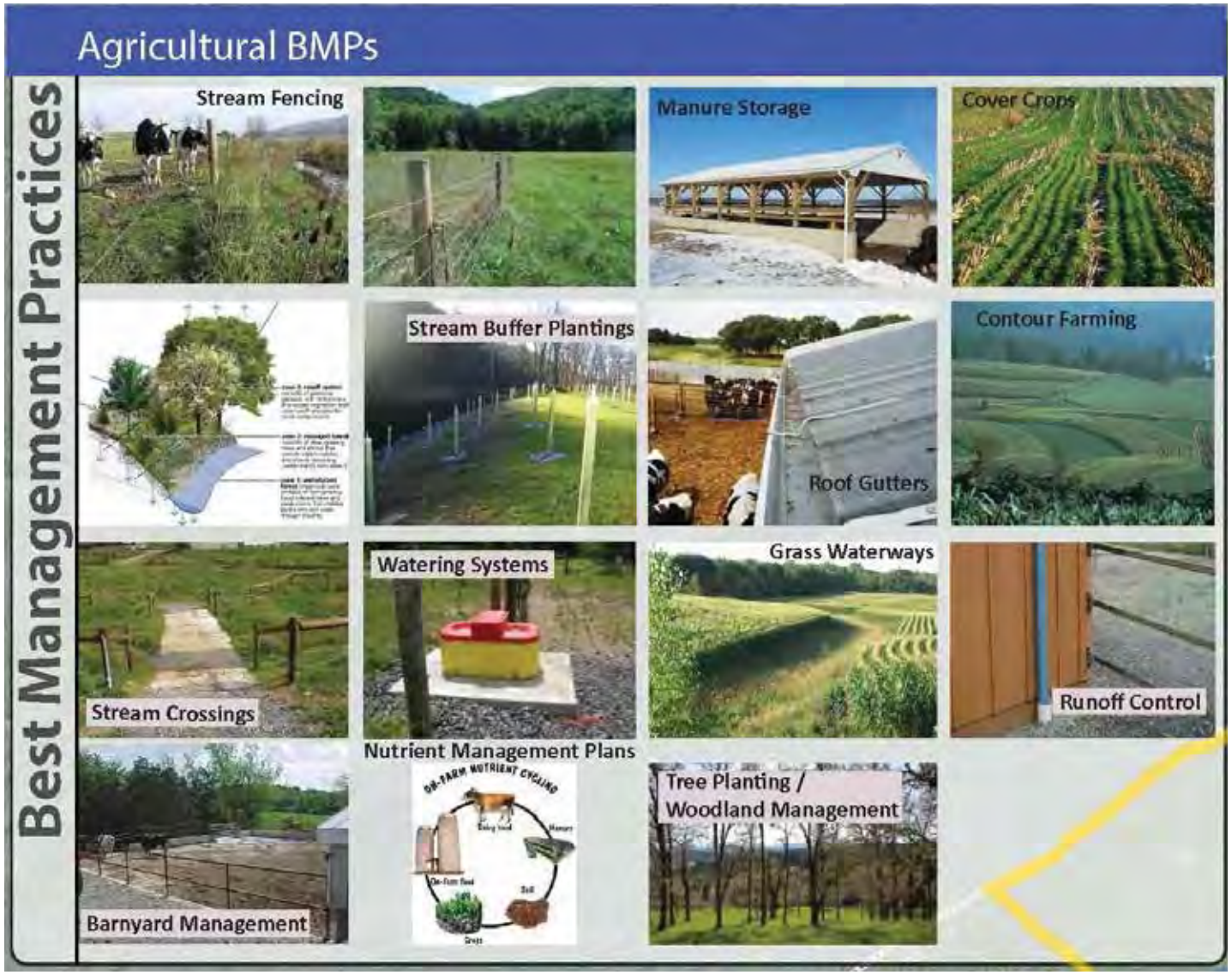
A future scenario of Phase 2 BMPs was run for the Upper Kish Watershed with the implementation of a 30% effective suite of BMPs for sediment reduction and a 40% effective suite of BMPs for phosphorus reductions which were added to the BMPs of Phase 1. The major BMPs of Phase 2 include 24km of stream with livestock exclusion fencing, 4 km of streambank stabilization, 19% of pastureland with implemented grazing plans, and 86% of farms with Animal Waste Management Systems and Runoff Controls. The remainder of neccesary reductions will be acheived by a suite of additional BMPs such as Cover Crops, Vegetated Buffer Strips Stream and Wetland Restoration, and Stormwater Management Systems.

IMPROVING WATER QUALITY

Best Management Practices

Best Management Practices (BMPs) are methods or techniques found to be most effective in preventing water pollution, while making optimal use of limited resources. Various water-quality BMPs will be encouraged throughout the watershed to achieve the necessary load reductions.

The Mifflin County Conservation District will take a lead role in working with interested landowners to plan, design, and construct site specific BMPs to improve water quality while achieving land management goals and objectives of the landowner. Some commonly prescribed BMP's include waste management systems, livestock exclusion fencing, streambank stabilization and grazing land managment.



An example of some of the Best Management Practices (BMPs) available to the agricultural community to help better manage the farming operation while protecting water quality.

IMPLEMENTATION STRATEGY

Understanding the Community

The Mifflin County Conservation District seeks to find creative ways to work with all residents of the watershed to improve the water-quality of Upper Kish Creek. The Conservation District has experienced and knowledgeable staff that understands the watershed and the people that live there. The MCCD has committed years of effort to build trust with the Amish and other residents of the watershed. Understanding the cultural context and community decision making process affecting adoption of Ag BMPs is key to an effective and sustainable watershed restoration approach.

- The effort to improve water quality in the Upper Kish Creek Watershed is at a critical juncture – with two distinct needs:
- Expanded farmer and landowner participation in Best Management Practices
- Strategic investment in projects with greatest benefit to water-quality

"All of the Above" Watershed Restoration Strategy

Improving the water quality of the Upper Kish Creek Watershed will need to be a community-wide effort. While Agriculture is the predominant land use in the watershed, what follows is an 'all of the above' strategy that asks every community leader, resident and business owner to play an active role in the effort. It is easy to place all the burden of watershed improvement on agriculture – but this focus may not be the best way to achieve the desired result. By taking a more holistic approach of identifying issues and formulating creative solutions – the goal is to build broad partnerships and achieve greater levels of active public engagement, developing long-term commitments and sustainable practices.

Watershed Scale Restoration –

Wetland Restoration – The facility will consist of a forebay and treatment wetland in an impaired headwater or small tributary area of the watershed. The facility will be designed to capture sediment and uptake nutrients, while improving wildlife habitat and other objectives of the landowner.

Stream/Floodplain Restoration (Rural Area) – Identify area with significant streambank erosion with enough space to reconnect floodplain and establish riparian wetlands and buffers.

Stream/Floodplain Restoration (Urban Area) - Identify in-town opportunities to address nuisance flooding, streambank erosion and opportunities to restore the floodplain (e.g. Case New Holland site).

Landowner Strategies –

Wood Lot Land Owners – Implement Reforestation and Tree Plantings, Implement Timber Harvest BMPs, and Erosion & Sedimentation Controls

Naturalized Landscaping – Encourage residential and commercial properties to install more natural landscaping using native trees and shrubs.

Rural Residential Areas – Promote lawn alternatives such as native grass and wildflower meadows. Install rain barrels, rain gardens and cisterns. Plant shade and street trees.

Townships and Municipal Road Crews – Stabilize eroding roadside swales and drainage systems. Participate in the Dirt and Gravel Road and Low Volume Road Programs. Plant street trees.

In-Town Residents – Install rain gardens and rain barrels, naturalized landscaping, and shade and street trees.

Private Gravel Road – Identify poor condition private roadways adjacent to streams and major swales and encourage environmentally sensitive maintenance practices as perscribed in the Dirt and Gravel Road program.

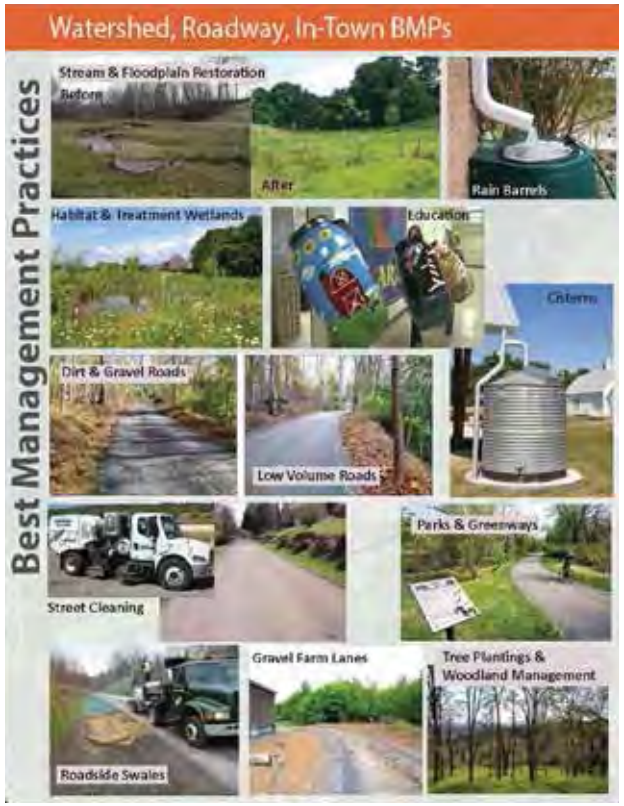
Farm and Roadway Tree Planting Program – Trees have been proven to provide the following benefits:

- Reduce Motor Vehicle Speed (improved safety)
- Provide Shade / Reduce Summer Temperatures (improved comfort)
- Reduce Home Heating and Cooling Bills
- Manage Trees as a Crop (harvest for fuel or building material)

Business and Industry – Work with a local large-scale industry to install a stormwater management retrofit using native plants and naturalistic landscaping. Projects will improve water quality and quantity, while improving wildlife habitat.

Faith-Based Group – Work with local churches to install a stormwater management retrofit using native plants and naturalistic landscaping. Projects will improve water quality and quantity, while improving wildlife habitat.

Wildlife Habitat Enhancement – Work with a private landowner and conservation organizations such as Pheasants Forever, Ducks Unlimited or Trout Unlimited to design and install a wildlife habitat enhancement project that will also address water quality and water quantity issues.



Best Management Practices (BMPs) to improve water quality are not limited to the agricultural community. All community members have a role to play in restoring the watershed in the ways we manage runoff from our homes, maintain our private and public roadways, and in the way we landscape our yards and public spaces.

Innovative Buffer Strategy –

Develop a "Working Riparian Buffer" strategy that is attractive to the agrcultural community and beneficial to water quality and stream health. It would be an intensively managed woodlot along the streams and drainage ways, consisting of willow, maple, and forage and pollinator species. These plantings are intended to harvest (building material and biomass), or assist in the production of secondary products (syrup and honey). The plant species within the buffer will provide the landowner with a tangible economic benefit, while stabilizing soils, shading the stream, up-taking nutrients and filtering sediment.

Flexibility, Innovation & Responsiveness –

There has been a recent move towards more rigid requirements for the widths and limits to the management options of stream buffers. This move towards more rigid requirements is discouraging participation in these stream buffer programs. Additionally, some recent research suggesting requirements for even greater widths could essentially stall the adoption of this important BMP tool. Flexibility and innovation should be encouraged in how buffers are installed and how these areas are managed.

In addition to providing farmers and other landowners more flexibility in the design and management of BMPs, the Conservation District should look at ways to streamline the design, funding, permitting and installation process to better meet the needs and expectation of the landowner.

Staffing and Funding Needs

The Mifflin County Conservation District will need to maintain or increase staff levels if there is any hope to achieve nutrient and sediment reduction goals. Funding for staff has been a challenge in the past and dependable funding is necessary to retain the highly qualified and knowledgeable staff so essential to maintaining continuity and relationships built over many years.

In addition to base staff funding the Conservation District needs funding for project implementation. As identified in the public participation process government funding is not accepted by many watershed residents. Alternative funding mechanism from private sources and self-funding of projects are alternatives that need to be explored.

The Belleville Stream Restoration project (right) took a degraded segment of stream constricted by walls and parking lots, and transformed the corridor by reconnecting the stream with its floodplain. The in-town stream was also enhanced by planting a more naturalized landscape that will stabilize banks, shade the stream to reduce water temperature, while providing enhanced wildlife habitat.

Cost table reflecting proposed BMPs and amounts needed to reach neccessary reductions in sediment, nitorgen and phosporous for the restoration of the Upper Kish Watershed. BMPs are categorized with expressed unit costs, amounts, # of projects and total costs.

BMP Title and Code	Unit Cost	Amount Proposed	# projects	Unit	Total BMP Cost
Agricultural Plans					
Nutrient Management (590)	$2,500.00	10	10	plan	$25,000.00
Conservation Plan (003)	$2,500.00	10	10	plan	$25,000.00
Manure Management Plan	$1,500.00	75	75	plan	$112,500.00
Ag. Erosion and Sediment Control Plan	$1,500.00	75	75	plan	$112,500.00
Cropland BMPs					
Contour Farming (328)					$0.00
Cover Crop (340)	$50.00	1000	10	ac.	$50,000.00
Conservation Cover (327)					$0.00
Pasture BMPs					
Prescribed Grazing (528)	$100.00	200	5	ac.	$20,000.00
Fence (382)	$1.50	5000	5	ft.	$7,500.00
Watering Facilities (614)	$1,500.00	5	5	ea.	$7,500.00
Stream BMPs					
Fencing (382)	$1.50	100000	20	ft.	$150,000.00
Riparian Forest Buffers (391)	$3,000.00	40	20	ac.	$120,000.00
Stream Habitat Improvement (395)	$50.00	5000	5	ft.	$250,000.00
Livestock Stream Crossing (587)	$3,000.00	10	10	ea.	$30,000.00
Animal BMPs					
Waste Storage Facility (313)	$1.50	2000000	20	$ft.^3$	$3,000,000.00
Heavy Use Area Protection (561)	$11.00	100000	20	$ft.^2$	$1,100,000.00
Barnyard Runoff Control (357)	$15,000.00	5	5	ea.	$75,000.00
Watering Facilities (614)	$1,500.00	10	10	ea.	$15,000.00
Water Well (642)	$2,000.00	5	5	ea.	$10,000.00
Trails and Walkways (575)	$2.00	20000	20	$ft.^2$	$40,000.00
Access Lane (560)	$25.00	5000		ft.	$125,000.00
Roofs and Covers (367)	$10.00	80000	20	$ft.^2$	$800,000.00
Associated BMPs					
Component BMPs	$35,000.00	20	20	ea.	$700,000.00
Ag. Engineering Costs					
I&E, Designs, Quality Control, Cert.	$15,000.00	20	20	ea.	$300,000.00
Other BMPs					
Stream Restoration	$100.00	2500	2	ft.	$250,000.00
Wetland Restoration	$12,000.00	2	1	ac.	$24,000.00
Stormwater Management Systems	$25,000.00	10	5	ac.	$250,000.00
		Total WIP Cost			**$7,599,000.00**

Table 3

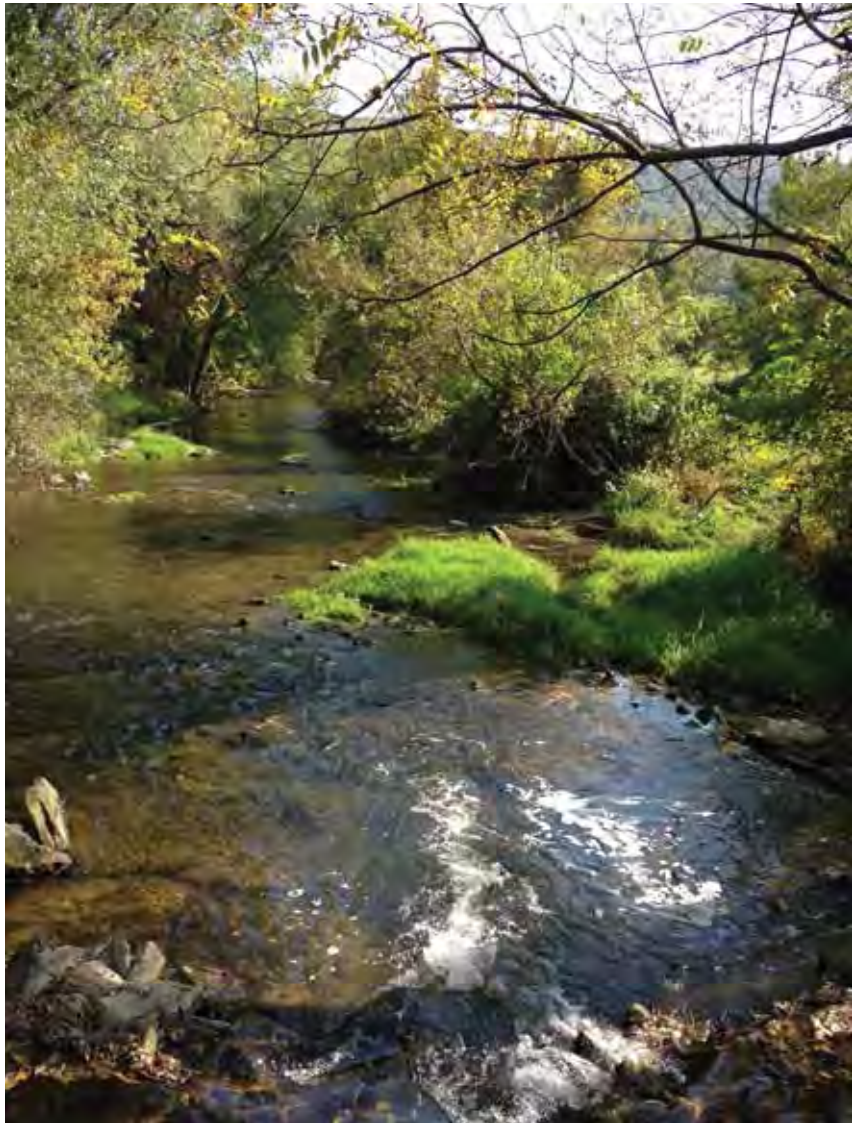
Keys to Success

Cultural Acceptance of Funding Programs - There appears to be little change in the Amish community's reluctance to accept government money for BMP projects. This "take care of their own" philosophy aligns with the community's other values of independence and self-reliance. While some Amish communities in the state of Pennsylvania have become more open to government BMP programs, the Amish in the Upper Kish Creek Watershed do not appear to be moving in that direction.

Prove Economic Value of BMPs – One way to overcome the Amish community's reluctance to participate in government funding / cost share programs is to prove the economic value of the various BMPs. If economic data shows a return on investment, farmers state that they would self-fund the improvements. This perspective represents an opportunity for state and federal agencies, in collaboration with the region's colleges and universities, to quantify the economics value of BMPs on the farmer's bottom line. Specifically, farmers were interested in the value that can be derived from a 'working' stream buffer (wood, biomass, forage, syrup and honey production, etc.), as well as value of BMPs designed to improve livestock health.

Business Opportunity – If examples of return on investment can be provided for various agricultural BMPs, this may provide an excellent business opportunity for an enterprising Amish or Mennonite community member, to start a business providing planning, design and installation services. Many farmers seek off-farm work opportunities to better provide for their families. An Amish or Mennonite owned business geared towards design and installation of agricultural BMPs could help streamline the project construction process through self-funding projects, while eliminating the cultural barriers and reluctance of working with the government.

BMP Project Streamlining - There has been expressed frustration in the complexity and length of time required to implement agricultural BMPs. The time it takes for an interested landowner to get a project built often requires 3 years, to write a funding request, design and engineer the project, secure necessary permits, and construct the project. The process should be evaluated to identify ways to streamline the process to better serve interested landowners.



Outreach and Education - All watershed community residents play a part in the health of the Upper Kish. While agriculture is the dominant land use in the watershed, playing a significant role in the restoration of Kish Creek's water quality, we must remember the role that each of us can play. Other partners in the restoration of the Upper Kish Creek Watershed, include:

Mifflin County Conservation District / NRCS / USDA – Coordinate efforts to more efficiently offer services such as Farmer-to-Farmer Outreach and Education, Technical Assistance, BMP Design and Implementation, Funding Procurement, Water Quality Monitoring.

Union Township (Mifflin County) – Improved Road Maintenance, Dirt and Gravel Roadway Program Participation, Roadside Drainage Improvements, Advocacy for Smart-Growth and Low Impact Design Principles, Stormwater Management.

Menno Township (Mifflin County) – Improved Road Maintenance, Dirt and Gravel Roadway Program Participation, Roadside Drainage Improvements, Advocacy for Smart-Growth and Low Impact Design Principles, Stormwater Management.

Mifflin County Planning & Development Department - County Comprehensive Planning, Innovative Subdivision and Land Development Ordinances, Plan Review, Smart Growth and Low Impact Development Advocacy.

Conservation Organizations – Organizations such as Trout Unlimited, Pheasants Forever, and Ducks Unlimited have the potential to provide private funding for stream and watershed protection projects, as well as volunteer labor and advocacy.

Penn State Cooperative Extension – Build upon information and insight gained through this public participation planning process. Encourage extension and faculty research in quantifying the economics of agricultural BMPs. Disseminate information and lessons learned through extension's statewide network.

University Research – The region's colleges and universities are one of Central Pennsylvania's greatest assets. Understanding and quantifying the economics of agricultural BMPs is a knowledge gap that needs to be filled. This work needs to be done on farms of the size and scale that are representative of the region.

Commercial and Industrial Businesses – There are many business in the watershed that have large roof and impervious surface areas, and several predate mandatory stormwater management regulations. Consider options for retrofitting the building and site to capture water and reduce run-off.

Private Landowners –Reduce runoff from your home and property by using a rain barrels or cisterns, installation of a rain garden, planting trees, and converting lawn to a grass/wildflower meadow.

Primary and Secondary Schools – Use Upper Kish Creek as an outdoor classroom, to learn about: hydrology, watersheds, stream health, and stream restoration. Engage students in community-service projects that improve the watershed.

Service, Religions and Church-Based Organizations – Speak and Present to all the organizations in the watershed and look for ways to collaborate with these groups on community-service projects.

Support Local Businesses – Part of the return on investment in agricultural BMPs needs to include the benefit to local businesses and suppliers for the materials used in the construction and installation. Buy local to support the local economy.

Mifflin County Conservation District staff host a rain barrel workshop for interested residents. With limited staff and budgets - the conservation district needs to expand the partnership of individuals and organizations committed to restoring the watershed. Additional partners need to include municipalities, conservation organizations, universities, landowners, businesses, schools, and church-based organizations.

WATER-QUALITY MONITORING

How Is a Stream Segment Delisted?

The Mifflin County Conservation District stated goal is for the impaired stream segments of the Upper Kish Creek Watershed to be removed from PA DEP's 303(d) List of Impaired Waters. As this plan is implemented, and a wide range of BMPs are implemented, the water quality in the Upper Kish Creek will improve. When impaired stream reaches are thought to be successfully recovered, PA DEP will be invited to conduct an official reassessment of the stream reach condition.

PA DEP monitoring to determine stream impairment and recovery includes collection of water samples for laboratory analysis for a suite of parameters determined by the cause of impairment, field analysis of parameters such as water temperature, pH, dissolved oxygen and specific conductance, determination of flow in streams, macroinvertebrate surveys, pebble counts and habitat assessments.

The Biological Health of Kish Creek

In addition to water chemistry, another important tool to measure stream health examines the organisms that live in the stream. Benthic Macroinvertebrates are small aquatic insects that live in the bottom of streams, ponds, lakes, and wetlands, and they can be used to assess the biological health of aquatic ecosystems because they are excellent bio-indicators. Bio-indicators can be used to monitor changes in environmental conditions over time.

Changes in Benthic Macroinvertebrate communities can reflect changes in pollutant levels in water, which is why they are often used to monitor water quality. For example, some insects are only found in clean water with very little or no pollution, which, when found, means the water is clean.

Surface Waters Assessment Program (SWAP)

The Surface Water Assessment Program (SWAP) administered by the Mifflin County Conservation District with guidance and direction by the PA DEP and funding from Section 319 grants has now completed 1 year of fish sampling and 5 years of water quality sampling at 13 sites in the Upper Kish Watershed. The SWAP sampling is conducted annually and collects chemical, physical, and biological data.

The main focus of this effort is the site Index of Biological Integrity (IBI) score. The IBI score, collected over several years, provides essential information on the health and trajectory of various stream segements. The IBI scores are also the criteria by which the streams were originally assessed for impairment and serve as an important benchmark in restoration efforts.

The Surface Water Assessment Program (SWAP) in action (above and previous page) measuring the biological health of the Upper Kish Creek Watershed. Five years of data were collected at 13 sites in the watershed. The SWAP monitoring program is invaluable to the Upper Kish Creek restoration effort, identifying stream reaches in need of the most attention, as well as quantifying progress towards watershed improvement.

The Surface Water Assessment Program (SWAP) data generally shows a positive trend towards improved water quality. From 2014 to 2018 – 3 sites showed slight degradation, while 9 sites show improvement with some sites showing significant improvements in IBI scores (see Appendix IV). Funding for the SWAP sampling program has been secured for 2019 and may extend into 2020.

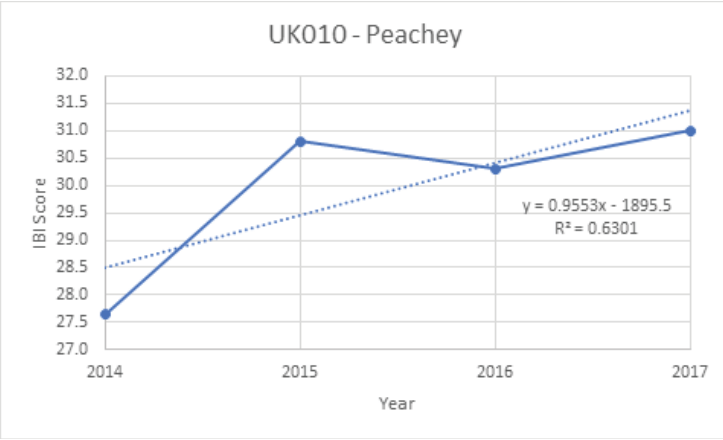


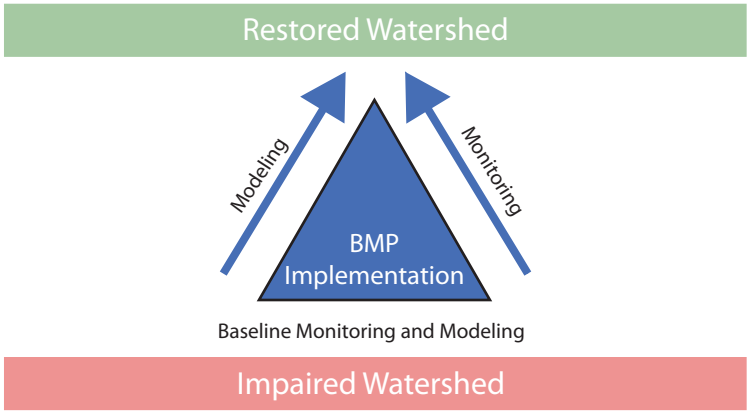
Figure 2: IBI Scores from a site in the Upper Kish (UK010-Peachey) site from 2014-2017

Milestones and Monitoring

The progress in implementing the management measures specified in this WIP can be tracked through several methods including water quality improvement milestones, water quality monitoring data, or subsequent modeling. Since the end game of this WIP is to restore water quality, pertaining to the Aquatic Life Use, it makes the most sense that we measure our progress relative to macroinvertebrate and fish sampling data. Currently, 10 out of 13 sites in the Upper Kish Watershed display an improving trend in their respective IBI scores (Figure 2). While this growth is minimal, we feel that the continuation of this positive trend is a very appropriate method in which to measure the success of the specified management measures. The MCCD has completed 5 years of Surface Water Assessment Program (SWAP) monitoring and has secured funding for 2 additional years of monitoring. At best, not only will the positive trend continue, but it will display growth as well over time.

BMP Tracking and Future Modeling

While the main criteria for restoration success will be based on macroinvertebrate data, it is still important to track BMP implementation and to complete follow up modeling runs to measure progress in BMP implementation and reduction goals. With continuous water quality monitoring as well as follow up watershed model runs we will be able to better calibrate future efforts towards watershed restoration. Future model runs are expected to be completeded annually.



BMP implementation will be tracked in several ways. Once installed BMPs will be recorded on spreadsheets with appropriate information (amount, size, location, etc.) as well as spatially represented in geographic information systems (GIS). This data will then be passed on to the appropriate reporting agencies through interim and final grant reporting as well as project updates to web based GIS data management systems.

Remedial Actions

The Upper Kish Creek Watershed Implementation Plan was developed to inform the watershed restoration effort and establish goals for BMP implementation and nutrient and sediment reductions to achieve water quality targets and to protect or restore beneficial uses and protect human health.

The US EPA is clear that there will be consequences if Pennsylvania does not make significant progress and/or achieve its required reductions. These consequences will include the US EPA taking action to ensure the reductions happen including increased permitting, monitoring, and oversight.

The Upper Kish Creek Watershed community would like to avoid enforcement action by PA DEP and US EPA. In keeping with the Amish philosophy of "take care of their own" the watershed community is seeking trust, understanding and flexibility to create a better future for the next generation. In the words of one watershed resident "Be patient. Come out and talk to people. Some will respect. Others may ignore. All things are possible." The Upper Kish Creek Watershed Community has the knowledge, skill and ability to solve these problems, and a patient, interactive, and participatory process will take a little longer to reach the goal. But in the end, the community will get there together.

REFERENCES AND PROJECT CD

REFERENCES

Report References

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Davies, S.P. and S.K. Jackson. 2006. The biological condition gradient: a descriptive model for interpreting change in aquatic ecosystems. Ecological Applications 16(4):1251-1266.

Hawkins, C.P. 2006. Quantifying biological integrity by taxonomic completeness: its utility in regional and global assessments. Ecological Applications 16(4): 1277-1294.

Mifflin County Conservation District. 2005. 319 Watershed Implementation Plan: Upper Kishacoquillas Creek.

PA Department of Environmental Protection. April 30, 2011. Kishacoquillas Creek Subwatershed TMDL (DRAFT).

PA Department of Environmental Protection, Bureau of Point and Non-Point Source Management. December 2013. An index of biotic integrity for benthic macroinvertebrate communities in Pennsylvania's wadeable, freestone, riffle-run streams.

Notes

Project CD

CONTENT OF CD

Upper Kish Creek
Watershed Implementation Plan
"A Community Watershed Restoration Strategy"
PDF File

Upper Kishacoquillas Creek Watershed Modeling
Final Report Narrative
PFD File

Kishacoquillas MapShed Model Run Data
EXCEL Spreadsheet

Kishacoquillas Creek Watershed
Key Stakeholder and Watershed Survey Summary
PDF File

Upper Kish Creek
Display Board
PDF File

APPENDIX I

Suitability Analysis and Prioritization Methods

General Categories

Parcel Size

Low - Parcels ≤ 20 acres
Medium – Parcels between 20 and 80 acres
High - Parcels ≥ 80 acres

Land Use

Low – Parcels that contain a Forested Land Use (at least 75%)
Medium – All other Land Uses
High – Parcels with an Agricultural Land Use

Riparian Forest Buffer

Low – Parcels that contain no stream
Medium – Parcels that contain a stream or pond
High – Parcels that contain an impaired stream

Upland Flow Paths

Low – Parcels with little to no upland flowpaths
Medium – Parcels with a concentrated flow path that drain 30 – 60 acres (minus hydrography)
High – Parcel with a concentrated flow path draining 60 acres or more (minus hydrography)

Impervious Surface

Low – Parcel with little to no impervious surface (under 2500 sq. ft.)
Medium - Parcels with impervious surface between 2500 sq. ft. and 1 acre
High – Parcels with impervious area ≥ 1 acre

Shapefiles are stored in folder Server\MCCDCommon\MifflinCountyGISData\ArcData\UK_WIP

Parcel Size

- Load UK_Parcels. Open attributes table and add new field titled WIP_Acres.
- Change data frame projection to Cylindrical Equal Area Projection. Calculate geometry (acres) for new field (WIP_Acres) for each parcel.
- Open attributes table for UK_Parcels. Add new field titled Parcel_Rank.
- Select by attributes for each parcel size group (≤ 20 acres, between 20 and 80 acres, > 80 acres). After each individual selection, open the UK_Parcels attribute table, show selected records, and use the field calculator to adjust values in the Parcel_Rank field for each size class (≤ 20 = 1, between 20 and 80 = 2, ≥ 80 = 3).

Land Use

- Add UK_LandUse 2010. Select attributes : Code = 'F' from the UK_Landuse_2010. Export selected data as UK_Forest_LandUse.
- Clip UK_Parcels to UK_Forest_Landuse and save clipped file as UK_Forest _Parcels.

- Open UK_Forest_ Parcels attribute table. Add new field titled Forest_Acr. Calculate geometry for new field (ensure that data frame projection is changed to Cylindrical Equal Area Projection).
- Create another new field titled F_Percent. Perform field calculation Forest_Acr/Acres_WIP. Select parcels ≥ 75%. Export as UK_Forest_LU_Parcels.
- Open UK_Parcel attribute table. Create new field titled WIP_LU. Use the field calculator to enter a value of 2.
- Add UK_Ag_Landuse to data frame.
- Go to Selection - Select by Location and select from the UK_Parcels layer, set the source layer as UK_Ag_Landuse and select features that contain the source feature.
- Open UK_Parcles attribute table and show selected records. Use the field calculator to change WIP_LU to a value of 3 for selected records.
- Go to selection - select by location, and select features from UK_Parcels, set the source layer to UK_Forest_LU_Parcels, and select parcels that contain the source layer feature.
- Open UK_Parcel attribute table and show selected records. Use the field calculator to change WIP_LU to a value of 1 for selected records.

Stream Presence

- Load hydrography layer and UK_Impaired Streams layer.
- To create these layers the hydrography layer and impaired streams 2015 layer were clipped to the Kishacoqui2_shdpadep.
- Create new field in the UK_Parcels attribute table titled Strm_Rank. Right click on field heading and choose the field calculator, enter a value of 1 for all records.
- Go to Selectio - Select by Location. Select from the UK_Parcels layer with the source layer set to UK_Hydrography and select a spatial selection that intersects the target layer feature.
- Review selection for accuracy and remove or add any parcels that are missing or escaped the selection using the Interactive Selection method add or remove and use the Select Features button to add or subtract parcels.
- Go to the UK_Parcels attribute table and display selected records. Then go the Strm_Rank field and use the field calculator to enter a value of 2.
- Go to Selection - Select by Location. Select from the UK_Parcels layer with the source layer set to UK_ImpairedStreams and select a spatial selection that intersects the target layer feature.
- Review selection for accuracy and remove or add any parcels that are missing or escaped the selection using the Interactive Selection method add or remove and use the Select Features button to add or subtract parcels.
- Go to the UK_Parcels attribute table and display selected

records. Then go the Strm_Rank field and use the field calculator to enter a value of 3.

Concentrated Upland Flowpaths

- Create FlowPath shapefiles by using PAMAP DEM 1M resolution raster file. Use process outlined in Watershed Delineation with ArcGIS10.2.x to create FlowPath data set. Classify data set to display flow paths that drain > 30 acres (127,692 cells) and > 60 acres (255,384 cells).
- Export using the raster calculation function in ArcTooblbox - SpatialAnalyst - MapAlgebra - RasterCalculation. Enter respective expression code: OutRas+Raster ("Save file as rastercalc_60_Final and rastercalc_30_final)
- Convert raster to polyline using ArcTooblbox - ConversionTools - FromRaster - Raster to olyline. Export as UK_FP_60 and UK_FP_30.
- Import new shapefiles into UK_WIP_Priortization map document.
- To select only the upland flow paths (excluding streams as outlined in UK_hydrography_Clip layer) select from the UK_FP_60 layer using the Selection - Select by location all stream segments within 5 feet of the source layer UK_Hydrography_Clip layer.
- Use the Selection - Interactive Selection method - Remove from selection or add to selection to all features that overlap features the UK_Hydrography_Clip layer.
- Open UK_FP_60 attribute table and create new field titled drainage. Show selected records and use the field calculator to enter a value of 1.
- Select by attributes from UK_FP_60 all values in the drainage field equal to zero. Use the Selection - Interactive Selection method - Remove from selection or add to selection to add/subtract segments to best represent upland flow paths. Note: The objective for this is to represent all flowpaths that drain 60 acres or more and are not listed as streams.
- Right click UK_FP_60 and go to Data - Export data as UK_Upland_60.
- Open attributes table for UK_Parcels and create new field title FPath_Rank. Select entire field and use the Field Calculator to enter a value of 1.
- Exit attribute table and go to Selection - Select by Location. Select features from UK_Parcels, set the source layer as UK_FP_30, and select parcels that ntersect source layer feature.
- Open UK Parcels attribute table, show selected records, and select field calculator for the Fpath_Rank field and enter a value of 2.
- Go to Selection - Select by Location and choose UK_Parcels, set the source to UK_Upland_60, and select parcels that intersect the source layer feature.
- Open UK_Parcels attribute table, show selected records, select field calculator for Fpath_Rank field, enter a value of 3.

APPENDIX I

Impervious Surface

- Go to PASDA.org and search for landcover data. Download commonwealth of Pennsylvania landcover data sets for the Chesapeake Bay Watershed.
- Load data into a new ArcGIS map document and load Upper Kish boundary shapefile Kishacoqui2_shdpadep.
- Use the raster clip function in the ArcToolbox to clip the raster data to the Upper Kish Watershed boundary. Save the output file as UK_Landcover.
- Open UK_Landcover attribute table and highlight the Structure and Other Impervious Surfaces values. Open the ArcToolbox - DataConversion - From Raster - Raster to Polygon tool. Save exported layer as UK_Imp_Surface. Do not create and output table (erase pathway).
- Use the Geoprocessing -Dissolve tool to Dissolve polygons into on cohesive data set. Save output as UK_Imp_Surface_ Diss.
- Use the Geoprocessing - Clip tool to Clip the UK_Imp_Surface_ Diss layer. Save output file as UK_Imp_Surface_Diss_Clip. shp to clean up the polygons to parcel boundaries (mostly separates public road features from the individual parcel)
- Go to ArcToolbox - CartographyTools - Generalization - AggreagatePolygons. Select UK_Imp_Surface_Diss_Clip into the input field. Save output feature class as UK-Imp_Surface_ Diss_Clip_Agg10. Choose Aggregation Distance as 10 feet. Minimum area size as 2500sq. ft. and a miniumum hole size of 2500 sq. ft.
- Go to ArcToolbox - CartographTools-Generalization - SimplifyPolygons. Select UK-Imp_Surface_Dis_Clip_Agg10 as the input. Save the output feature class as UK_Imp_Agg10_ Simp. Select the Bend-Simplify method. Enter 15 as the simplification tolerance. Do not keep collapsed points.
- Open UK_Imp_Agg10_Simp attribute table. Add new field titled Acres. Calculate geometry for new field (ensure that data frame projection is changed to Cylindrical Equal Area Projection).
- Go to Selection - Select by Attributes and select Acres ≥ 1. Export selection (UK_Imp_Agg10_Simp - Data - ExportData) and save as UK_ImpSurf_Agg10GE_1acre.
- Go to Selection - Select by Attributes and select Acres < 1. Export selection (UK_Imp_Agg10_Simp - Data - ExportData) and save as UK_ImpSurf_Agg10_Less_1acre.
- Overall Prioritization
- From the respective prioritization fields with the Parcel.shp shapefile, each respective ranking field is converted to raster. Arctoolbox - Conversion - ToRaster -FeaturetoRaster. Each output file is saved with a new output name and cell size is set to 1.

- After completing the conversion to raster the individual raster data sets are combined into a complete prioritization raster. Arctoolbox - SpatialAnalyst - MapAlgebra - RasterCalc. Each output file made above is entered into the equation for calculation.
- Save the master file as uk_wip_priori
- To display the ranking in table form, open the attributes table for the Parcels.shp file. Add a new field titled WIP_Priori (double). Then run the field calculator to sum the previous ranking fields for each ranking category. This the gives the prioritization number for each parcel and matches the raster prioritization file.

APPENDIX II

Upper Kish Creek Watershed Implemenation Plan - Phase 1 BMP's

Upper Kish Creek Watershed Implemenation Plan - 1 BMP Reduction Table

APPENDIX II

Upper Kish Creek Watershed Implemenation Plan - Phase 2 BMP's

Upper Kish Creek Watershed Implemenation Plan - Phase 2 BMP Reduction Table

APPENDIX III

2016 Modeling for Upper Kish WIP Update:

These various model runs were completed for both the Upper Kish watershed as well as the Middle Creek Watershed, which was used as a reference watershed in the original TMDL study.

Upper Kish Creek MapShed Runs -
Mode Notes, Observations and Findings
Comparisons between Original TMDL (PA DEP 2011) and MapShed Duplicate models -

- Sediment: Original – 41,090.1208 lbs/day; Duplicate– 40,467.47 lbs/day; As there is only about 1.5% difference between these two models, the Duplicate run completed by GWLF-E is an accurate representation of the Original run completed by AVGWLF;
- Total Phosphorous (TP): Original – 33.1929 lbs/day; Duplicate – 33.11 lbs/day; As there is less than 1.0% difference between these two models, the Duplicate run completed by GWLF-E is an accurate representation of the Original run completed by AVGWLF;
- A similar evaluation of the Middle Creek TMDL data versus the Middle Creek Duplicate MapShed model showed that the GWLF-E results were similar to the original AVGWLF results given the same data input.

Comparisons between Kish and Middle Creek (From the original TMDL report, nothing new) -

- A comparison of the Unit Area Loading (UAL) of sediment between Original TMDL for Middle Creek and the Kish Creek was 46% less for Middle Creek (0.193 Tons/Year/Acre), compared to Kish (0.356 Tons/Year/Acre). For TP, Middle Creek (0.395 Lbs/Year/Acre) was 31% less compared to Kish (0.576 Lbs/Year/Acre). The comparison of the UAL between the Kish TMDL Duplicate and the Middle Creek TMDL Duplicate showed similar results compared to the original TMDL Runs:
  - Sediment UAL: Kish – 0.351 Tons/Year/Acre; Middle Creek – 0.191 Tons/Year/Acre
  - TP UAL: Kish – 0.575 Tons/Year/Acre; Middle Creek – 0.356 Tons/Year/Acre;
  - The comparative similarities between the UALs for the Original and Duplicate runs for the two different watersheds indicates that the most recent GWLF-E analysis yields similar results for these watershed given the same input data;

Comparisons between 2011 Kish Corrected Without Animal Data and the TMDL Target -

- Sediment: The Corrected Run is 6% below the 22,264.61 lbs/day TMDL Target-> This model satisfies the TMDL Target for Sediment;
- TP: The Corrected Run is 5.55% below the 23.114 lbs/day TMDL Target -> This model satisfies the TMDL Target for TP;

Comparisons between 2011 Kish Corrected With Animals and Middle Creek Duplicate With Animals:

- A comparison of the Unit Area Loading (UAL) of sediment between Middle Creek Duplicate with Animals and the Kish Creek Corrected With Animals showed higher UALs for the Middle Creek Watershed:
  - Sediment UAL: Kish – 0.206 Tons/Year/Acre; Middle Creek – 0.255 Tons/Year/Acre
  - TP UAL: Kish – 1.79 Tons/Year/Acre; Middle Creek – 6.27 Tons/Year/Acre;
  - The comparison between the two watersheds with animal numbers shows that animal agricultural activities do make a notable impact on loading rates and that the Kish Creek actually has lower UAL than Middle Creek with animal numbers factored into the MapShed runs. This also shows that the BMPs being implemented in the Kish are effectively reducing loading rates.

Comparisons between 2011 Kish Corrected With Animal Data and the Middle Creek Duplicate With Animals and the Kish TMDL Target -

- Compared to the TMDL Target for the Kish: The 2011 Corrected Run With Animals is 6.10% higher than the TMDL Target for sediment and 343.3% higher than the TMDL Target for TP; These loading rates, particularly the TP values, are strongly influenced by Animal Data -> comparing models with animal data to models without animal data is not an "apples to apples" comparison.
- Compared to the Middle Creek Duplicate With Animals, the Kish 2011 Corrected Run With Animals is 16.34% lower than Middle Creek's sediment loading rates and 70.46% lower than Middle Creek's TP loading rates.

Comparisons between 2016 Existing Conditions With Animals and the Middle Creek Duplicate Model and TMDL Target -

- Compared to the TMDL Target for the Kish: The 2016 Existing Conditions Run With Animals is 2.64% higher than the TMDL Target for sediment and 332.01% higher than the TMDL Target for TP; These loading rates, particularly the TP values, are strongly influenced by Animal Data -> comparing models with animal data to models without animal data is not an "apples to apples" comparison.
- Compared to the Middle Creek Duplicate With Animals, the Kish 2016 Existing Conditions Run With Animals is 19.06% lower than Middle Creek's sediment loading rates and 71.23% lower than Middle Creek's TP loading rates.

Upper Kish Creek Watershed – Future Scenario Runs

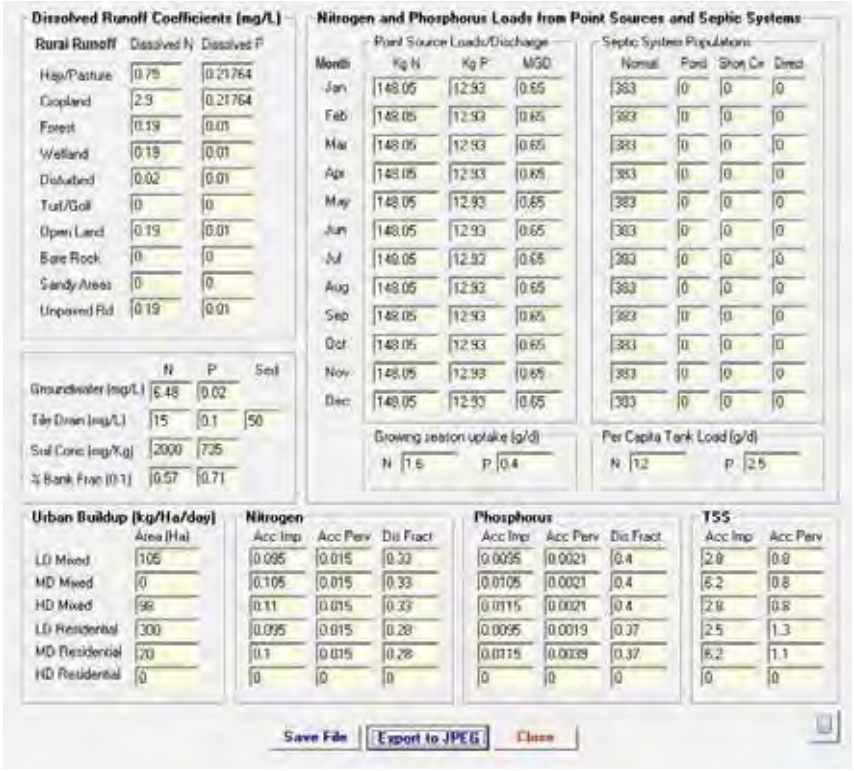
Comparisons between Example Future Scenarios Without Animals and the Duplicate Model and TMDL Target -

- Without animals, the existing loading rates for the Kish are 55.10% and 40.24% lower than the sediment and TP values, respectively, compared to the Kish Duplicate Model. Compared to the TMDL Target, the existing loading rates for the Kish are 18.39% and 14.49% below the sediment and TP targets, respectively. This model satisfies the TMDL Target for Sediment and TP.

Comparisons between Example Future Scenarios With Animals and the Middle Creek Duplicate Model and TMDL Target -

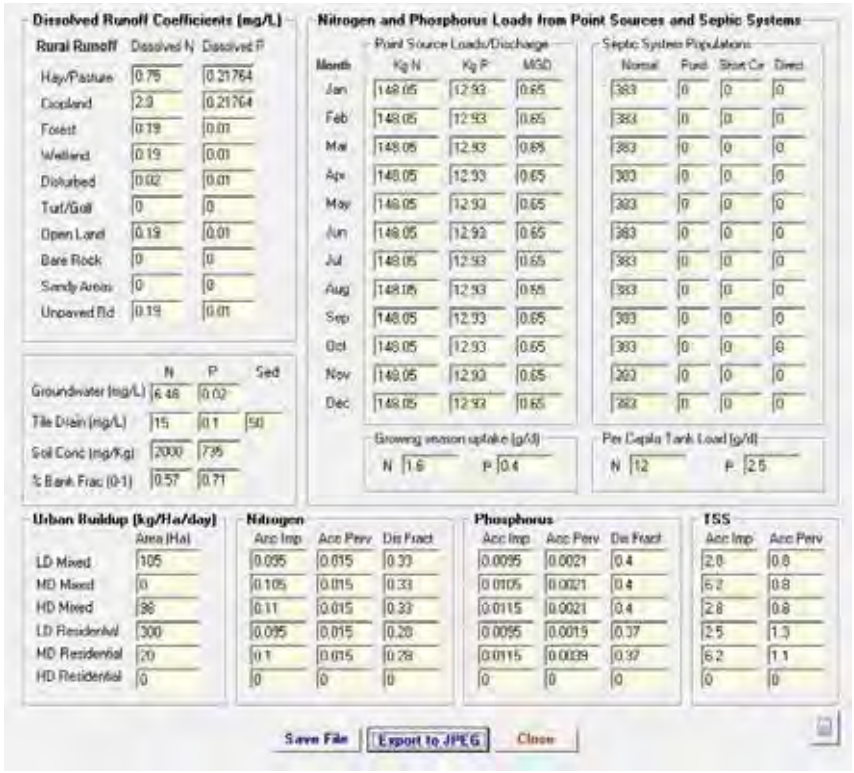
- Compared to the TMDL Target for the Kish: The Future Scenarios Run With Animals is 7.16% below the TMDL Target for sediment, but remains 306.82% higher than the TMDL Target for TP; These loading rates, particularly the TP values, are strongly influenced by Animal Data -> comparing models with animal data to models without animal data is not an "apples to apples" comparison.
- Compared to the Middle Creek Duplicate With Animals, the Future Scenarios Run With Animals is 26.79% lower than Middle Creek's sediment loading rates and 72.90% lower than Middle Creek's TP loading rates.
- Of the different models completed, the 2011 Corrected Without Animals MapShed Run appears to be the closest "apples to apples" comparison to actual 2011 loading rates in comparison to Original TMDL, TMDL Duplicate and the TMDL Target. If animal numbers are not factored into the loading rates for the watershed, then Kish loading rates were meeting the TMDL targets for Sediment and TP in 2011 and would continue to meet those targets in 2016.

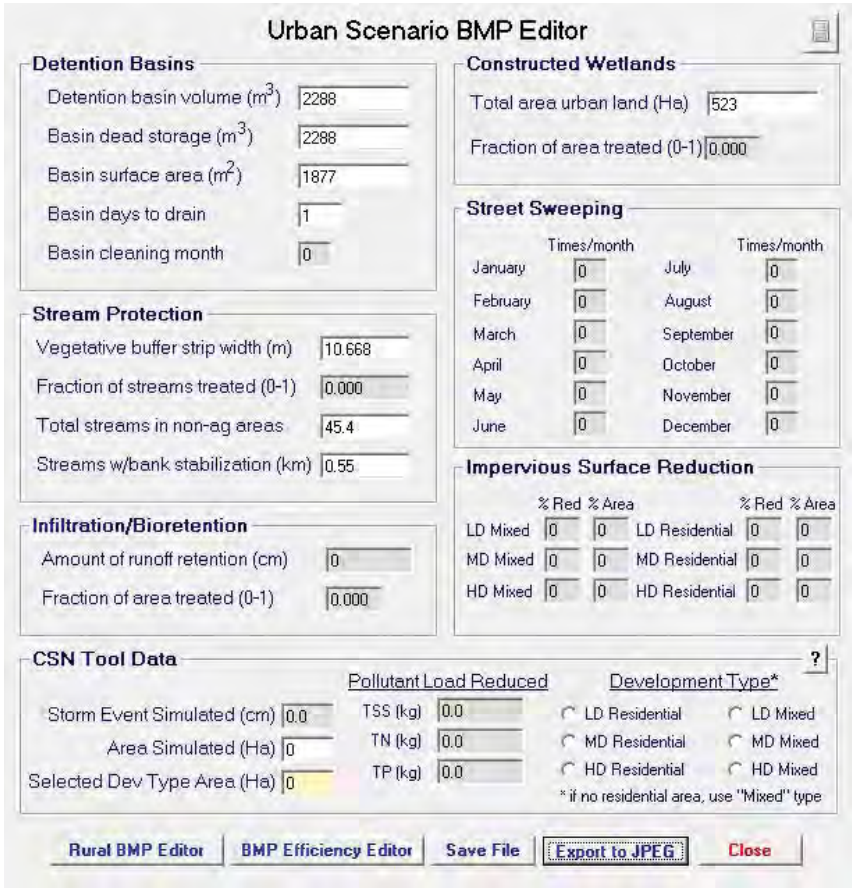
APPENDIX III



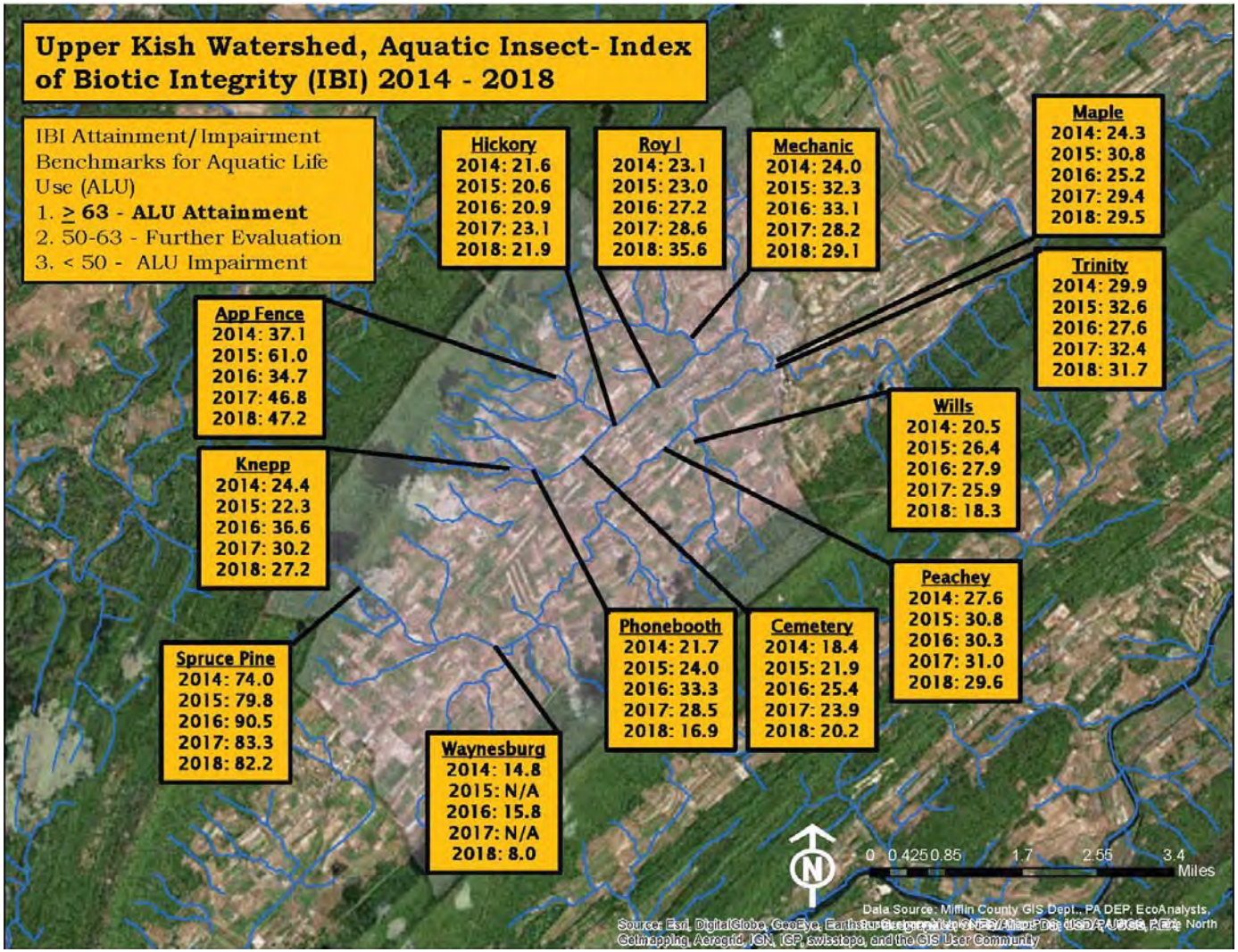
Examples of the MapShed program data input (above and following page) used to produce the TMDL model for Upper Kish Creek Watershed.

APPENDIX III

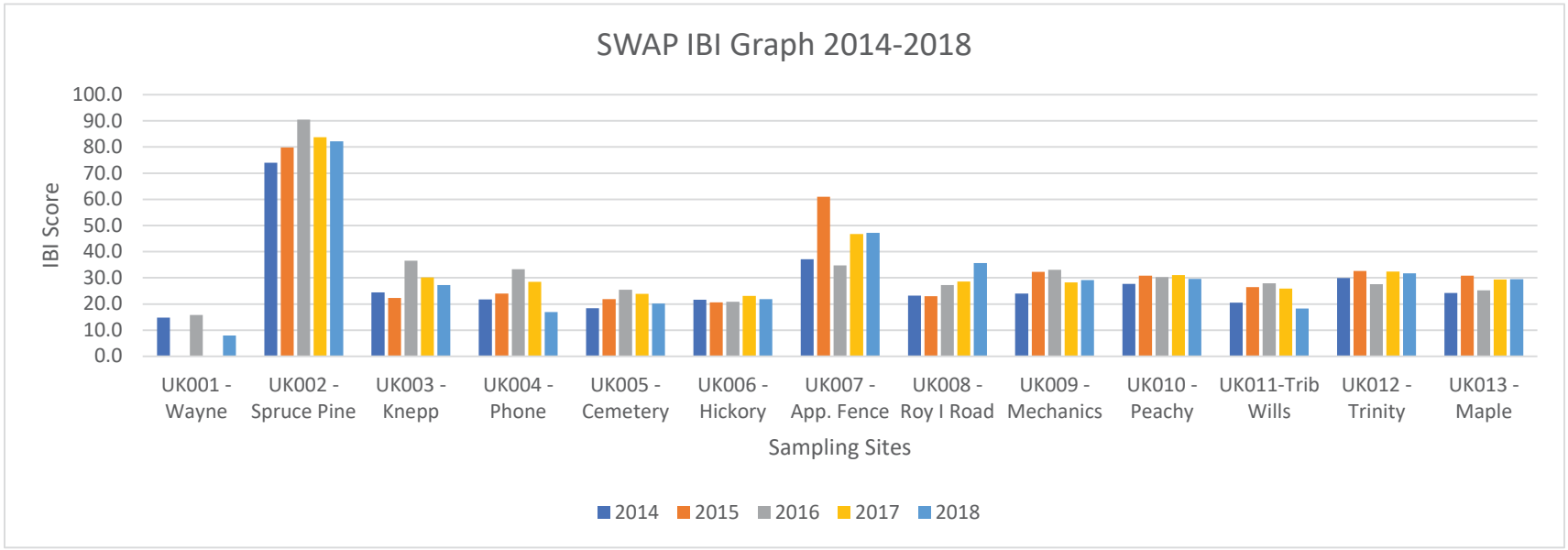




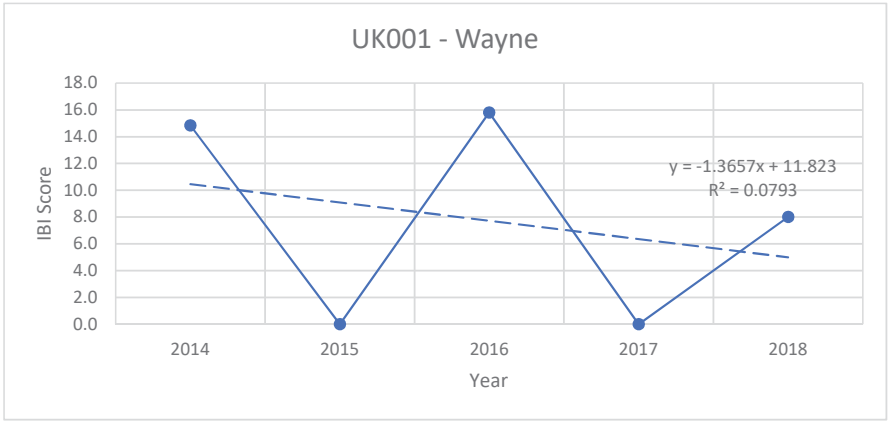
APPENDIX IV

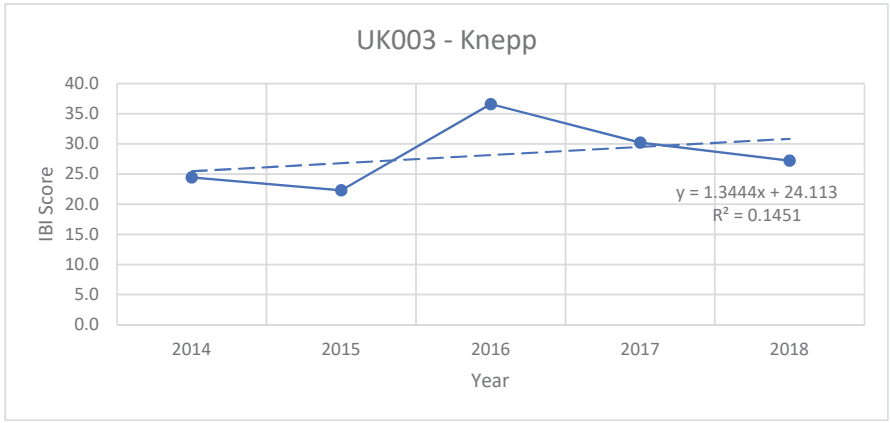

Upper Kish Watershed, Aquatic Insect- Index of Biotic Integrity (IBI) 2014 - 2018
IBI Attainment/Impairment Benchmarks for Aquatic Life Use (ALU)
1. ≥ 63 - ALU Attainment
2. 50-63 - Further Evaluation
3. < 50 - ALU Impairment
Hickory
2014: 21.6
2015: 20.6
2016: 20.9
2017: 23.1
2018: 21.9
Roy I
2014: 23.1
2015: 23.0
2016: 27.2
2017: 28.6
2018: 35.6
Mechanic
2014: 24.0
2015: 32.3
2016: 33.1
2017: 28.2
2018: 29.1
Maple
2014: 24.3
2015: 30.8
2016: 25.2
2017: 29.4
2018: 29.5
Trinity
2014: 29.9
2015: 32.6
2016: 27.6
2017: 32.4
2018: 31.7
App Fence
2014: 37.1
2015: 61.0
2016: 34.7
2017: 46.8
2018: 47.2
Knepp
2014: 24.4
2015: 22.3
2016: 36.6
2017: 30.2
2018: 27.2
Wills
2014: 20.5
2015: 26.4
2016: 27.9
2017: 25.9
2018: 18.3
Peachey
2014: 27.6
2015: 30.8
2016: 30.3
2017: 31.0
2018: 29.6
Spruce Pine
2014: 74.0
2015: 79.8
2016: 90.5
2017: 83.3
2018: 82.2
Phonebooth
2014: 21.7
2015: 24.0
2016: 33.3
2017: 28.5
2018: 16.9
Cemetery
2014: 18.4
2015: 21.9
2016: 25.4
2017: 23.9
2018: 20.2
Waynesburg
2014: 14.8
2015: N/A
2016: 15.8
2017: N/A
2018: 8.0
N
0 0.425 0.85 1.7 2.55 3.4
Miles
Data Source: Mifflin County GIS Dept., PA DEP, EcoAnalysts,
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

APPENDIX IV

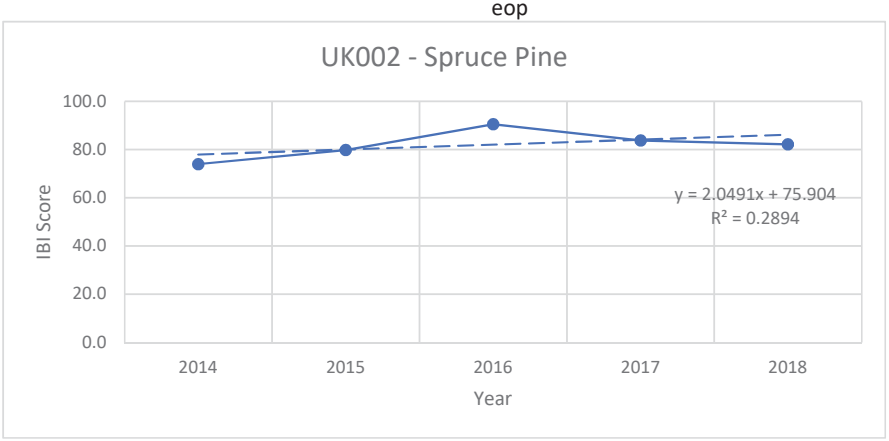

SWAP IBI Graph 2014-2018
IBI Score
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
UK001 - Wayne
UK002 - Spruce Pine
UK003 - Knepp
UK004 - Phone
UK005 - Cemetery
UK006 - Hickory
UK007 - App. Fence
UK008 - Roy I Road
UK009 - Mechanics
UK010 - Peachy
UK011-Trib Wills
UK012 - Trinity
UK013 - Maple
Sampling Sites
2014
2015
2016
2017
2018

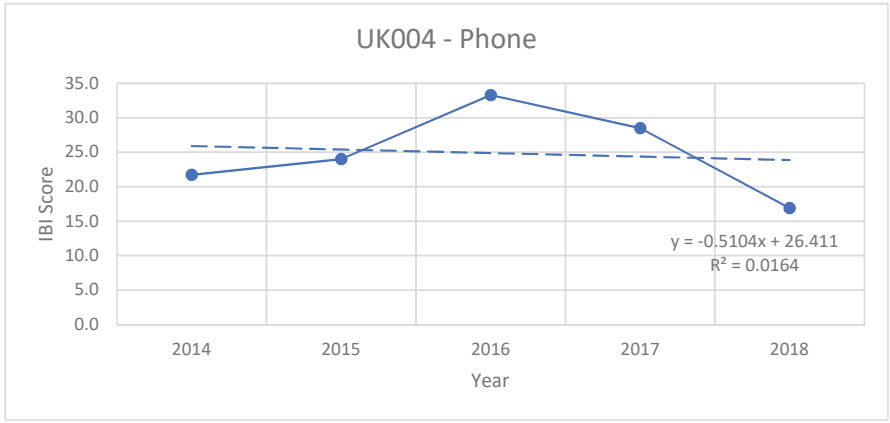
APPENDIX IV



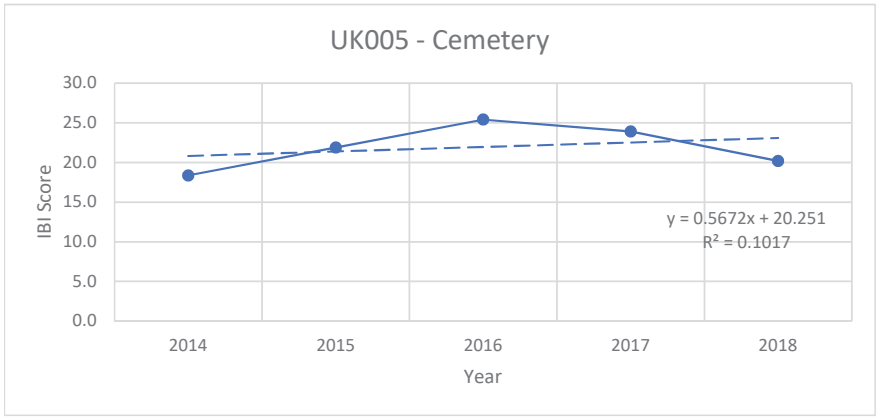


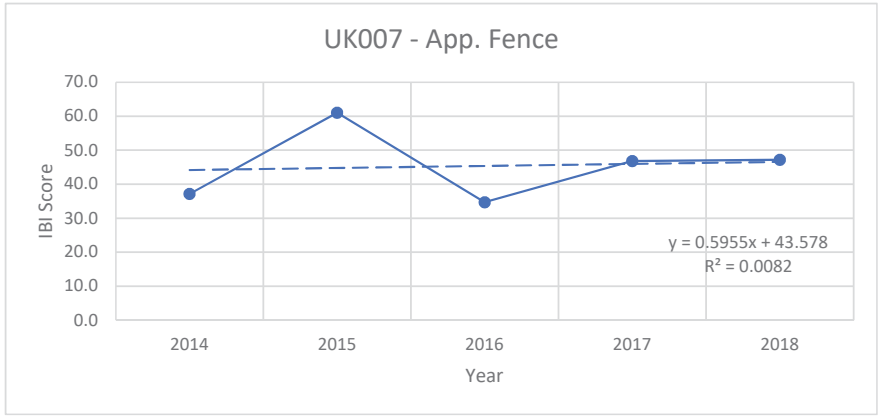
eop

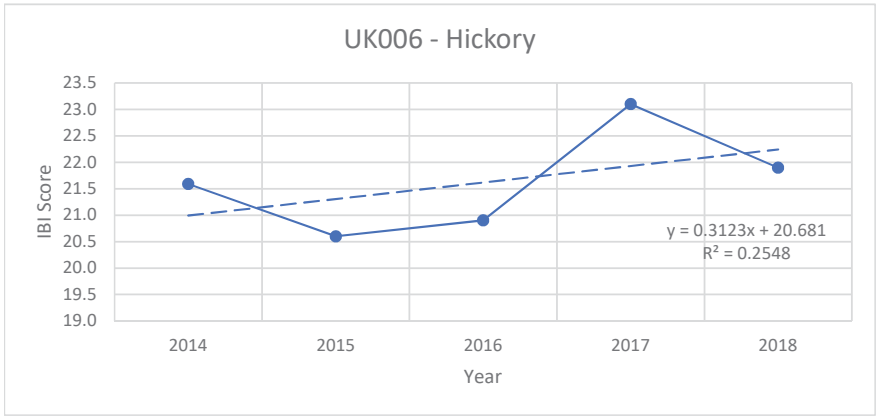


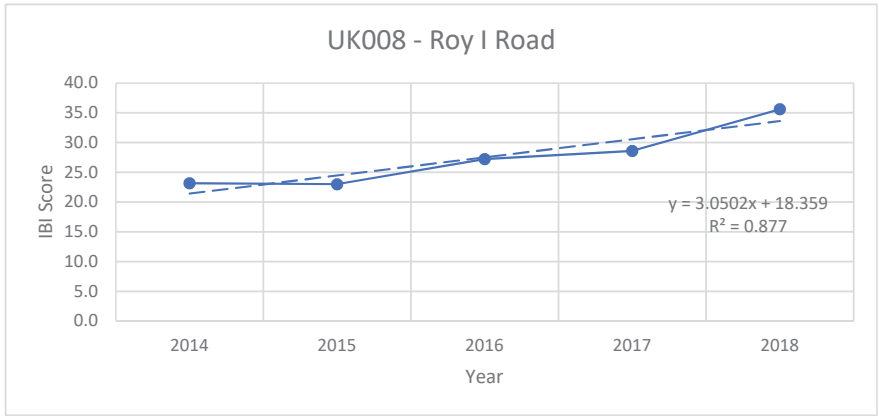


APPENDIX IV

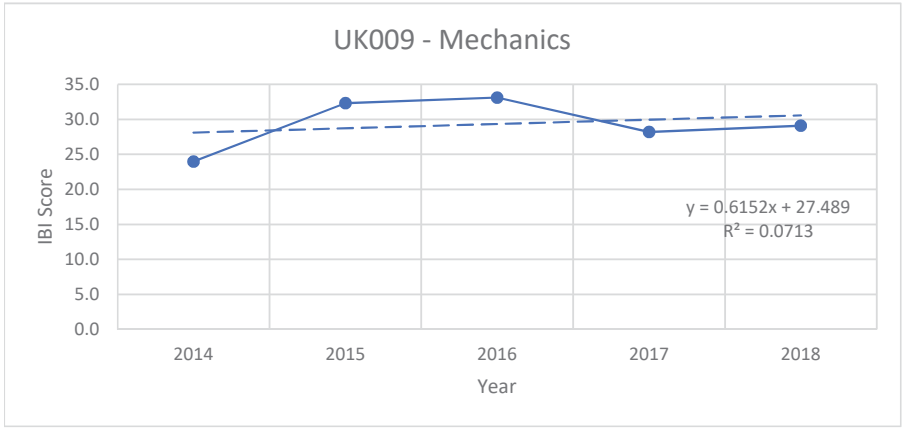

UK005 - Cemetery
IBI Score
30.0
25.0
20.0
15.0
10.0
5.0
0.0
2014
2015
2016
2017
2018
Year
y = 0.5672x + 20.251
R² = 0.1017

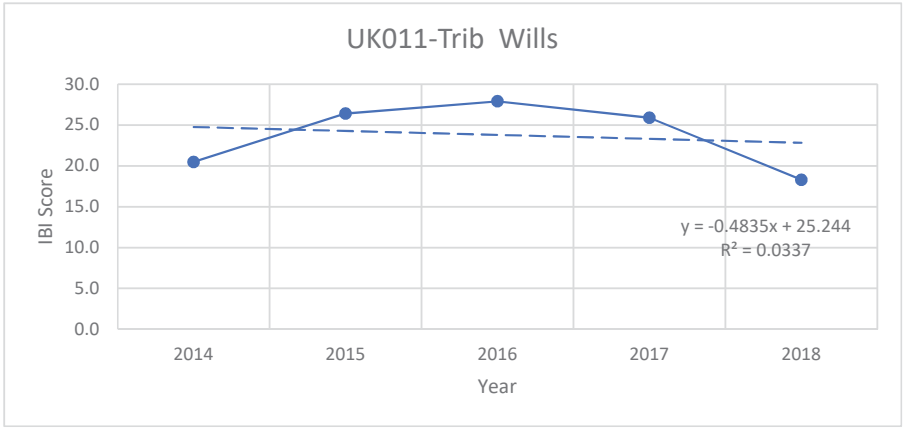

UK007 - App. Fence
IBI Score
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
2014
2015
2016
2017
2018
Year
y = 0.5955x + 43.578
R² = 0.0082

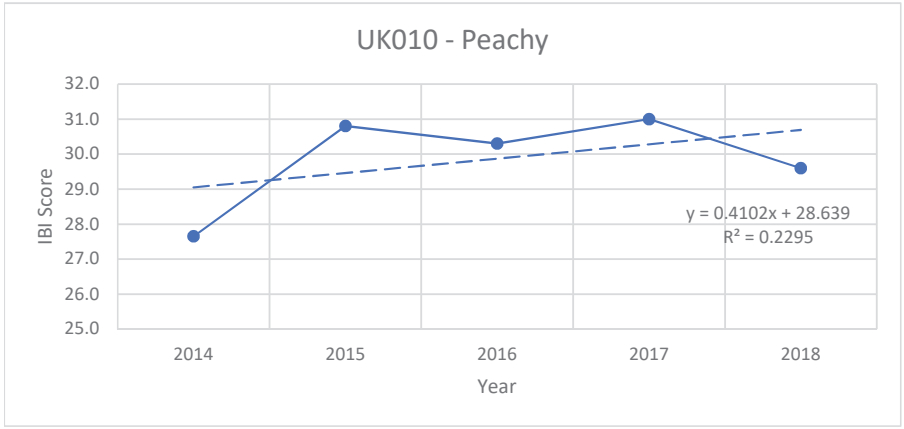

UK006 - Hickory
IBI Score
23.5
23.0
22.5
22.0
21.5
21.0
20.5
20.0
19.5
19.0
2014
2015
2016
2017
2018
Year
y = 0.3123x + 20.681
R² = 0.2548

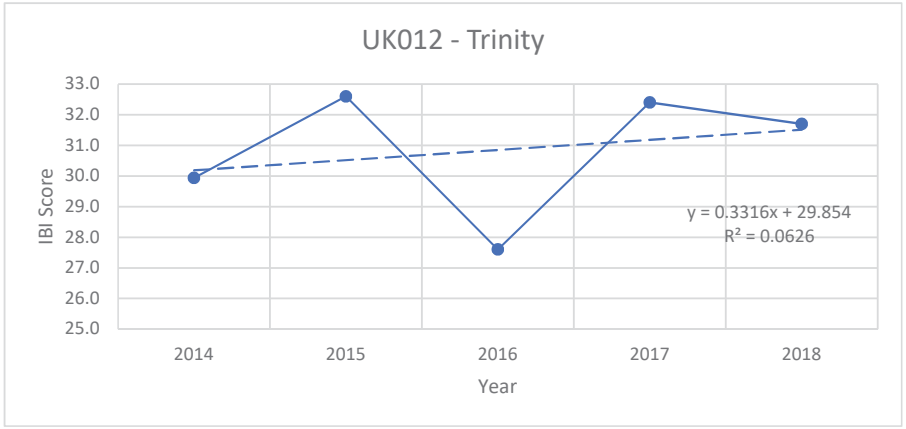

UK008 - Roy I Road
IBI Score
40.0
35.0
30.0
25.0
20.0
15.0
10.0
5.0
0.0
2014
2015
2016
2017
2018
Year
y = 3.0502x + 18.359
R² = 0.877

APPENDIX IV

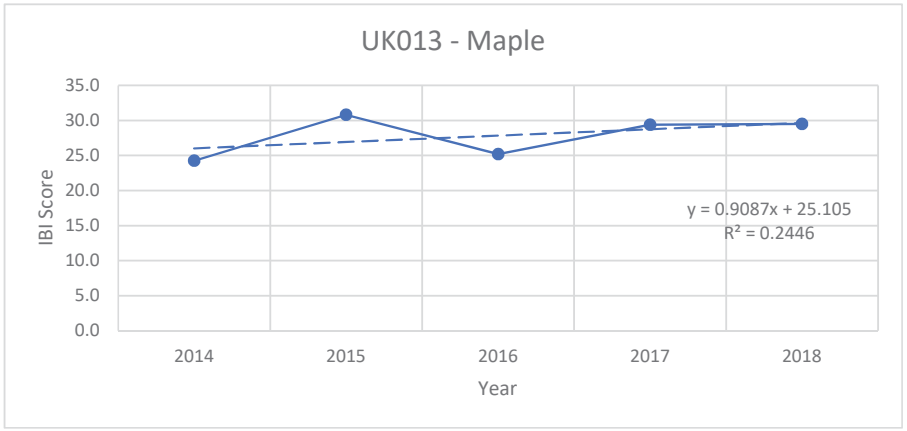

UK009 - Mechanics
IBI Score
35.0
30.0
25.0
20.0
15.0
10.0
5.0
0.0
2014
2015
2016
2017
2018
Year
y = 0.6152x + 27.489
R² = 0.0713


UK011-Trib Wills
IBI Score
30.0
25.0
20.0
15.0
10.0
5.0
0.0
2014
2015
2016
2017
2018
Year
y = -0.4835x + 25.244
R² = 0.0337


UK010 - Peachy
IBI Score
32.0
31.0
30.0
29.0
28.0
27.0
26.0
25.0
2014
2015
2016
2017
2018
Year
y = 0.4102x + 28.639
R² = 0.2295


UK012 - Trinity
IBI Score
33.0
32.0
31.0
30.0
29.0
28.0
27.0
26.0
25.0
2014
2015
2016
2017
2018
Year
y = 0.3316x + 29.854
R² = 0.0626

APPENDIX IV


UK013 - Maple
IBI Score
35.0
30.0
25.0
20.0
15.0
10.0
5.0
0.0
2014
2015
2016
2017
2018
Year
y = 0.9087x + 25.105
R² = 0.2446