Chapter 4 Action Planning

In Chapter 1, the Darby Creek Watershed Team set four goals. This chapter uses these goals to translate data analyses into Best Management Practices (BMPs) and Action Items. The goals are reorganized here to help guide BMP planning. The original third goal, "Work with local governments to enforce current regulations and to create codes and ordinances that work to protect and restore the streams and the watershed," was applied as a BMP.

(1) Protect high quality areas.

(2) Decrease water pollution.

(3) Increase wildlife, fish, and aquatic life.

(4) Educate the public.

Working from those goals, this chapter examines objectives, sites, indicators, BMPs, expected pollutant load reductions, and action items for each BMP, based on needs presented in Chapter 3. The expected pollutant load reductions per each BMP are an important way to gauge the scope of the issue and the impact the BMP can have.

Best Management Practices

BMPs are the land use practices, educational initiatives, and policies that impact watersheds. Action items are the steps needed to encourage, plan, install, maintain, and monitor the success of BMPs, to create the changes in the real world of Darby Creek Watershed that are necessary to meet the goals.

The recommended BMPs are intended to address the specific issues affecting Darby Creek. The BMPs and their associated action items include the local information gathered in Chapter 2 and what we have learned about the watershed. The following is a list of the BMPs that are prescribed for various watershed problems. The explanations below are intended to connect the watershed problems to their BMPs and explain how they will improve water quality.

Education:

Community watershed education: Nonpoint source pollution does not come from a single source, but from the collective actions of a community. Education about watershed issues, in general, and Darby Creek issues, specifically, may go a long way to preventing future pollution issues. Educational messages may be incorporated into other BMPs, take the form of creek cleanups or festivals, or outreach materials for dissemination.

Ordinance assessment: Oldham County has already reviewed many of its ordinances dealing with stormwater issues such as curb and gutter restrictions, street and/or sidewalk width, and impervious surface cover. Further ordinance assessment may be useful in promoting water quality friendly design and retrofit and with riparian area health. In some cases, removing restrictions can create options for the city/county, developers, businesses, and homeowners to become better stewards of our watershed.

Soil Testing: Soil testing is a strategy to education ourselves on soil components and needs. It can help reduce nutrient overload by predetermining the need for N, P & K applications based on existing plant or forage stands and applying fertilizer to the extent that they are needed or can be utilized by the existing or planned crop (forages, lawns, gardens, or row crops).

Agricultural:

Agricultural Water Quality Plans: As discussed in Chapter 2, an Agricultural Water Quality Plan is pro-active way for farmers and producers to plan for the long term health of their resources, including surface waters. Encouraging farmers to complete or update their existing plan may help to protect our shared environment.

Fencing/Alternative Watering Systems: Agricultural BMPs like these help to keep domestic livestock out of Darby Creek and sensitive areas, thereby reducing erosion and pathogen issues and damage to stream bank vegetation. There are several existing programs helping farmers with these issues.

Grassed Waterways: A shaped or graded channel that is established with suitable vegetation to Convey surface water at a non-erosive velocity using a broad and shallow cross section to a stable outlet. A grassed waterway will convey runoff from terraces, diversions, or other water concentrations without causing erosion or flooding, prevent gully formation, and protect and improve water quality.

Heavy Use Area Protection: The stabilization of areas frequently and intensively used by people, animals, or vehicles by establishing vegetative cover, surfacing with suitable materials, and/or installing needed structures.

There are a number of other agricultural BMPS that may address pasture and vegetation conditions in Darby Creek: conservation cover, critical area planting, crop rotation, inner fencing, prescribed grazing, range planting etc. Individual landowners and conservation professionals will be able to best determine which BMP would be most suitable.

Wastewater:

Septic System Education: Education is key to properly maintaining onsite wastewater systems. Septic systems and other onsite waste water systems are affective at treating residential wastewater, if installed and maintained properly. The KY Onsite Wastewater Association recommends pumping out septic tanks every three to five years, depending on the number of people living in the home (KOWA, 1999). Community septic system education could take the form of mailers, workshops, and/or financial incentive programs for unsewered areas.

Septic System Inspection Pump out: A properly installed septic systems may function well for decades if regularly inspected and pumped out. A financial cost-share program for watershed residents may help homeowners wary or unaware of septic maintenance issues have their system inspected and serviced. This program will require consultation with Health Department officials and local service providers.

Septic System Repair or Replacement: A financial cost-share program may encourage homeowners who know they have a broken or failing septic system to take care of the problems. This program will require consultation with Health Department officials and local service providers.

Habitat Protection:

Conservation Easements: Conservation easements are a way to preserve certain features of a landscape in perpetuity while keeping the property available for other activities, including changing ownership. For example, a landowner may want to sell his or her land, but make sure it remains in pasture land. Setting up a conservation easement could make this possible.

Riparian Buffers: This BMP is for agricultural, residential, and commercial areas of the watershed. Development of a streamside management zone, 25 – 200 feet wide, consisting of plant species adapted to the soils and topography and designed for single or multi-purpose objectives such as water quality enhancement, wildlife habitat, stream shading or bank stabilization.

4.1Goal 1: Protect High Quality Areas

The objective for protecting high quality areas is to see no reduction in water quality over time. Options for indicators for high quality areas include water quality parameters such as dissolved oxygen, *E. coli*, TSS, TP, TKN, and conductivity, as well as habitat quality. All of the sampling sites have issues with *E. coli,* but most sites have forested areas and/or intact stream buffers.

BMPs

Forested land and a good riparian zone can greatly contribute to high quality water. Therefore, BMPs are directed towards retaining and improving the forested streamside areas and vegetated riparian areas:

- Create or improve existing riparian area
- Conservation Easements to further protect high quality areas by specifying healthy riparian areas, not just undeveloped areas
- Follow progress on County Comprehensive Plan objectives concerning riparian areas, tree canopy initiatives, and the MS4 program

4.2 Goal 2: Decrease Water Pollution

Pathogens, Nitrogen, and Conductivity

Pathogens, as measured by *E. coli,* are by far the most excessive pollutant concern in the Darby Creek Watershed. Elevated nitrogen, measured as TKN, is also of concern. It is probable that elevated nitrogen concentrations come from the same sources as *E. coli.* Therefore, concerns about these two pollutants have been combined in terms of selecting BMPs and action items.

High conductivity concentrations, as explained in Chapter 3, are most likely the combination of the significant limestone geology in the watershed and dissolved ions associated with the same sources that cause high concentrations of pathogens. Thus, concerns about high conductivity have also been combined with pathogens in selecting BMPs and developing action items.

The objective for decreasing pathogen and nitrogen concentrations, as well as lowering conductivity, is to reduce the loads enough to meet water quality standards for contact recreation throughout the watershed. Pathogens are a concern at each site.

The common indicator for pathogens is *E. coli*.

BMPs

E. coli sources throughout the watershed are thought to be a combination of human and animal sources. The recommended BMPs, therefore, address both of these potential sources.

BMP recommendations would focus on a combination of:

- Add more SRWW sites and improve collection and data management of existing sites
- Financial cost-share program to promote inner fencing, alternative watering systems, and exclusion fencing to keep domestic livestock out of streams
- Create or improve existing riparian areas in all parts of the watershed
- Financial cost-share program to assist with septic tank inspection, pump out, and maintenance and repair
- Public education relating to septic tank maintenance

4.2.1 Total suspended solids

The objective for decreasing total solids suspended in streams is to reduce the loads enough to approach the benchmark mean in locations identified by monitoring. Targets are set using load reduction needs calculated by Third Rock Consulting. Sites of concern, in order of highest need, include Upper Darby Fork, DF2, Upper Darby Creek (headwaters), UDC2, and Upper Darby Fork tributary, DF3.

The *indicator* for suspended solids is TSS.

BMPs selected for this goal include:

- Create or improve existing riparian areas
- Fencing livestock out of streams and alternative watering systems
- Pasture renovation

Most development in the Darby Creek Watershed is actively taking place in the headwaters. This is also the area that was found to have the most significant loadings of total suspended solids. Either through livestock stream access, construction runoff, and/or stream bank erosion from excessive flows (due to increased impervious area), levels of TSS in excess of state standards are entering Darby Creek at sampling stations DF2, DF3, and UDC2. One complicating matter is that DF2 and DF3 are directly below small reservoirs, which could be contributing sediment accumulated from past disturbances that are re-suspended during storm flows.

4.3 Goal 3: Increase wildlife, fish, and aquatic life

Since intact, functional habitat appears to be the limiting factor for healthy aquatic biology, the objective for this goal is to increase and improve habitat in locations identified by monitoring.

All sites have need of improvements. Upper Darby Creek (headwaters, UDC2) is generally in good shape, except near the school and where landowners mow up to the stream.

Potential indicators include biological monitoring, but in this situation it is also reasonable to use physical habitat scores as key indicators. Because loss of habitat is frequently related to land uses adjacent to streams and to excessive stormwater, the BMPs under this goal also address these concerns.

BMPs selected for this goal include:

- Create or improve existing riparian buffers
- Conservation easements
- Grassed waterways

4.4 Goal 4: Educate the Public

The objective for educating the public is to have adequate public support for each aspect of the watershed plan and increased citizen and public governance understanding of the necessity for and methods of watershed protection.

Indicators of public support and understanding are difficult to measure, so actions can be measured by public involvement in events such as tree plantings, Creek Celebrations, and Roundtables, by local government support for Action Items, and by change of behaviors to protect streams.

BMPs for education include:

- Community educational outreach
- Social media outreach
- Environmental Education activities

4.5 Action Item Planning

Action items are the tasks that will serve to complete the recommended BMPs. The action items and other details in the following tables were arrived at by meeting with community partners and watershed team meetings. Tables 4.1 and 4.2 address septic system BMPs, and Table 4.3 addresses agricultural sources of *E. coli,* and Table 4.4 addresses TKN, TSS, and community education.

With the high levels of *E. coli* from the 2008 and 2014 water quality testing, it is likely that there is a combination of agricultural and septic systems issues in the watershed. The recommended

agricultural BMPs have their associated estimated pollutant load reductions from the U.S. EPA and the Natural Resources Conservation District. For septic system work, the expected pollutant load reductions need to be calculated.

4.5.1 Septic system *E. coli* BMPs

As discussed in Chapters 2 and 3, the septic system and sewered landscape has changed a great deal in Oldham County and the Darby Creek Watershed since the first iteration of the this plan. More homes in the watershed are on sewer lines, and area package treatment plants have been taken offline and/or rerouted. With information from consultation with Oldham County Health Department and data collected for Chapter 2, a triage map will be created for the implementation plan to help target watershed areas for implementation based on water quality data, age of housing development, proximity to creek, soil type, homeowner willingness, and other community input.

Septic system tank pump outs and septic system repair or replacement will be implemented on a case-by-case basis to mitigate pollution loads. This means that before any work is done, many factors will be considered such as surrounding land uses, soils, proximity to creek, and site location within sub-watershed.

Estimated Pollutant Load Reductions for septic system replacement

A conservative estimate of daily wastewater flow for a single home with 2.5 occupants is 150 gallons per day (see Appendix D table from US EPA "Onsite Wastewater Treatment Systems Manual"). An estimate of fecal coliform in raw wastewater reaching the stream (see Appendix D table from Mayer et al.) is 10,000,000 cfu per 100 ml. Removing a straight pipe or failing system that flows into a surface water by replacing it with a working system will remove 56,781,176,700 fecal coliform colonies per day per home. This equates to 13,056,831,582,165 *E. coli* cfu/year for each septic system remediated.

In consultation with the Oldham County Health Department, it was determined the total number of homes relying on septic systems in the Darby Creek Watershed is approximately 400. The number of failing septic systems or straight pipes is not known. The exact percentage of human source bacteria (versus animal) is not known, therefore estimated load reductions are based on the entire *E. coli* load being of human origin.

The pollutant load reductions provided in Table 4.1 are rough estimates as many variables affect the rates including household habits, distance from stream, soil type and depth, groundwater interaction, and *E. coli* concentration.

Table 4.1: Septic system BMPs and Action Items.

BMP	Indicator	Subwatershed -Site	*E. coli* load*	Load Reduction Needed**	Percent Load Reduction Needed	Number of septic systems recommended
Education on residential septic system function and maintenance	n/a	All unsewered areas of watershed and areas highlighted on triage map	n/a	n/a	Not measureable	n/a
Financial incentive program for septic system inspection and tank pump out	*E. coli*	All unsewered areas of watershed and areas highlighted on triage map	n/a	n/a	Not measureable	n/a
Financial incentive program for septic system tank repair or replacement	*E. coli*	DC1	22	7.75	35%	1
		UDC1	20	15.2	74%	1
		UDC2	6.49	4.75	73%	1
		DF1	7.13	4.12	58%	1
		New Site	2.10	3.65 billion	17%	1
		USF1	8.03	4.56	57%	1
		USF2	11.3	9.07	80%	1

*units of trillion *E. coli* cfu/100 mL/yr. **based on 13 trillion *E. coli* cfu/100 mL/yr. reduction for each corrected failing septic system. Literature values from U.S. EPA, National Environmental Services Center, and AWWA Research Foundation.

Table 4.2: Septic system BMPs and Action Items.

BMP	Action Items	Responsible Party	Technical assistance	Cost	Funding Mechanism
Education on residential septic system function and maintenance.	Develop mailer and create targeted mailing list for areas on septic	Project Watershed Coordinator and Watershed Team	Health Department of Oldham County, KOWA, and KDOW	Fees for facility rental, printed materials, and other supplies.	319 grant
Financial incentive program for septic system inspection and tank pump out	Reach out to homeowner in unsewered areas about incentive program	Project Watershed Coordinator, Watershed Team, and homeowner	Health Department of Oldham County, KOWA, and KDOW	Inspections and pump outs depend on contractors, but may be $150-$300	319 grant Matching funds from homeowners
Financial incentive program for septic system tank repair or replacement	Reach out to homeowner in unsewered areas about incentive	Project Watershed Coordinator, Watershed Team, and homeowner	Health Department of Oldham County, KOWA, and KDOW	$2,000 to $7,000 per septic system	319 grant Matching funds from homeowners

4.5.2 Agricultural BMPs

There are pollutant load reduction needed in agricultural portions of the Darby Creek Watershed for *E. coli*, nutrients, and sediment. Most of the recommended agricultural BMP will address all of these pollutants (see Tables 4.3 and 4.4). There will be a focus on grassland areas. In consultation with local NRCS experts, a strategy to target BMPs in locations where there is the greatest potential of pollutant reduction with a triage map was developed. The map will include information on land use, soil type, stream proximity, and NRCS knowledge of agricultural operations. The specific locations to target agricultural BMPs will include places that exhibit some of the following characteristics:

- existing grazing heights of pastures < 1" canopy with about 30% of the soil surface showing),
- lack of riparian buffers (absence of herbaceous or woody vegetation and canopy overhang along the stream along with evidence of stream bank erosion of lateral recession or livestock deteriorating the banks),
- areas of heavy use (evidence of compaction of the surface along with absence of vegetation on areas such as gateways and compaction, deep hoof prints and organic accumulation in winter feeding sites or locations where minerals/salt is distributed)

E. coli BMPs will target specific heavy use areas in the fall, winter, spring and summer livestock feeding and loafing concentration areas of pastures. These are areas where livestock concentrate, eat, and defecate. The placement of these areas should be at least 150' from streams or intermittent streams with seasonal flows. Placement consideration should be guided by access (both of livestock and the delivery of feed) and an adequate grass buffer should be maintained down slope of the heavy use area feed pad.

Table 4.3: BMPs and Action Items for agricultural sources of *E. coli*.

Target Pollutant or Protection Object	BMP	Specific sites or watershed area	Cost	Estimated Load Reduction	Action Items	Responsible Parties	Technical Assistance	Funding Sources
E. coli	KY Ag. Water Quality Plans	Agricultural areas in UDC2, New site, DF1, USF2	n/a	Not measurable	Work with NRCS and County Extension to promote completion or updating of plans	Land owner, Watershed Coordinator, Watershed Team	NRCS, County Extension	319 grant
E. coli	Exclusion fencing and alternative watering	Agricultural areas in UDC2, New site, DF1, USF2	Fencing = $4 - $5 per foot. Watering = $250-$600 ea. Site dependent	Fencing = 50-90% Watering = n/a	Work with NRCS and County Extension to develop cost-share program	Land owner, Watershed Coordinator, Watershed Team	NRCS, County Extension	319 grant, matching funds from landowners
E. coli	Heavy use area protection	Agricultural areas in UDC2, New site, DF1, USF2	$2000-$4000 each depending on size	85%	Work with NRCS and County Extension to develop cost-share program	Land owner, Watershed Coordinator, Watershed Team	NRCS, County Extension	319 grant, matching funds from landowners
E. coli	Riparian buffers	Agricultural areas in UDC2, New site, DF1, USF2	$400/acre	55%	Work with NRCS and County Extension to develop cost-share program	Land owner, Watershed Coordinator, Watershed Team	NRCS, County Extension	319 grant, matching funds from landowners

* Estimated Load Reduction: provides a gross estimate of practice effectiveness as reported in research literature. The actual effectiveness of a practice will depend on site-specific variables such as soil type, crop rotation, topography, tillage, and harvesting methods. http://water.epa.gov/polwaste/nps/guidance.cfm

Table 4.4: BMPs and Action Items for TKN, TSS, habitat issues, and community education.

Target Pollutant or Protection Object	BMP	Specific sites or watershed area	Cost	Estimated Load Reduction	Action Items	Responsible Parties	Technical Assistance	Funding Sources
Total Kjeldahl Nitrogen	KY Ag. Water Quality Plans	Agricultural areas in UDC2, New site, DF1, USF2	n/a	Not measurable	Work with NRCS and County Extension to promote completion or updating of plans	Land owner, Watershed Coordinator, Watershed Team	NRCS, County Extension	319 grant, matching funds from landowners
Total Kjeldahl Nitrogen	Exclusion fencing Alternative watering	Agricultural areas in UDC2, New site, DF1, USF2	Fencing = $4 -$5 per foot. Waterer = $250-600/ea. Water line install site dependent	65% reduction in TN load	Work with NRCS and County Extension to develop cost-share program	Land owner, Watershed Coordinator, Watershed Team	NRCS, County Extension	319 grant, matching funds from landowners
Total Suspended Solids	Create or improve riparian buffers	Watershed-wide, especially in UDC2 and New site	90 lbs/yr/dollar 10 per linear foot of stream	50% removal of sediment and nutrients	Plant native trees, shrubs, and/or grasses along streams. Reach out to community about riparian areas	Land owner, Watershed Coordinator, Watershed Team	NRCS, County Extension	319 grant, matching funds from landowners
Total Suspended Solids	Grassed waterways	Watershed-wide, especially in UDC2 and New site	$440 per acre	80% removal	Work with NRCS and County Extension to develop cost-share program	Land owner, Watershed Coordinator, Watershed Team	NRCS, County Extension	319 grant, matching funds from landowners

(Table continued on next page)

Table 4.4: BMPs and Action Items for TKN, TSS, habitat issues, and community education (continued).

Target Pollutant or Protection Object	BMP	Specific sites or watershed area	Cost	Estimated Load Reduction	Action Items	Responsible Parties	Technical Assistance	Funding Sources
Habitat Protection	Conservation Easements	Sites will depend on landowner willingness and site assessment	Conservation Easements	Sites will depend on landowner willingness and site assessment	Work with area land trust groups on programs to promote and maintain easements	Watershed Coordinator, Watershed Team	Oldham Ahead, River Fields	319 grant
Habitat Protection	Create or improve riparian buffers	Watershed-wide	90 lbs/yr/dollar 10 per linear foot of stream	50% removal of sediment and nutrients	Plant native trees, shrubs, and/or grasses along streams. Encourage do not disturb and no mow areas near streams. Reach out to community about riparian areas	Watershed Coordinator, Watershed Team	NRCS, County Extension, Oldham Ahead	319 grant
Habitat Protection	Follow County Comprehen-sive Plan progress	Watershed-wide	n/a	n/a	Check regularly with officials on plan progress Encourage officials to follow initiatives	Watershed Coordinator, Watershed Team	DOW, NRCS, County Extension	n/a
Community Outreach and Education	Creek cleanups	Watershed-wide	$300 per cleanup	Not measurable	Find suitable cleanup sites, spread the word, and pick up trash	Watershed Coordinator, Watershed Team	County Solid Waste	319 grant, community partners

* Estimated Load Reduction: provides a gross estimate of practice effectiveness as reported in research literature. The actual effectiveness of a practice will depend exclusively on site-specific variables such as soil type, crop rotation, topography, tillage, and harvesting methods. http://water.epa.gov/polwaste/nps/guidance.cfm

Milestones

To assist with the implementation plan it is important to develop indicators and milestones for each BMP. Table 4.5 describes these indicators and milestones. The grant secured from KY Division of Water in 2014 will fund many of the short term milestones BMPs. For the medium term and long term BMP goals, additional funding will be needed.

Table 4.5: Indicators and Milestones for each BMP.

BMP	Indicators to Measure Progress	Milestones		
		Short term	Medium term	Long term
Financial incentive program for septic system inspection and tank pump out	Homeowners making necessary upgrades to failing septic systems	5	10	20
Financial incentive program for septic system tank repair or replacement	Homeowners making necessary upgrades to failing septic systems	2	5	10
Create or improve riparian buffers	Total number of land areas protected or enhanced	2	5	20
Agricultural water quality plans	Number of plans completed or updated	5	10	20
All agricultural BMPs recommended in this plan	Number of BMP completed	4	4 more	4 more
Conservation Easements	Number of conservation easements established in watershed	1	3	10
Creek Cleanup	Number of cleanups	2	1 annual event	2 annual events

Chapter 5 Implementation organization, monitoring, and evaluation

Organization

The Darby Creek Watershed Team has many options for its future. The grant project that involved the Oldham County engineer, Kentucky Division of Water, and the Kentucky Waterways Alliance came to a close with the completion of this watershed-based plan in 2010. The plan was not accepted by Kentucky Division of Water at that time.

Successful implementation and monitoring of the BMPs recommended will depend on the continued work of the Darby Creek Watershed team, public and local government officials, and key partners such as the Kentucky Department of Fish and Wildlife Resources, the Kentucky Division of Water, Oldham County Health Department, and OCEA.

The watershed coordinator will keep the watershed team updated on progress through e-mail, web site postings and periodic meetings, including public roundtables and presentations to the Oldham County Fiscal Court and other community organizations.

The Kentucky Waterways Alliance and community partners applied for and won a Kentucky Division of Water 319 (h) nonpoint source grant in 2014. The basis of the grant proposal is a strategy to update the watershed plan and then implement it with an active watershed group including community members and local county government entities.

Success Monitoring

The Kentucky Division of Water conducted a water quality sampling for *E. coli* in the watershed in June and July of 2014. There are no plans at this time for future monitoring, but additional implementation funding should include an allocation for success monitoring after the first round and before subsequent rounds of BMPs are implemented.

Adaptive Management

The ultimate, long-term goal of the Darby Creek Watershed-based Plan is to improve water quality, preferably to the point where Darby Creek can be removed from the KDOW impaired waterways list (i.e., the Integrated Report Volume I). The watershed team will use adaptive management strategies as needed. In this strategy we will use the information available to choose best management options and regular committee meetings to solicit feedback and review new information.

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