FINAL REPORT

For

Roundstone Renewal

BMP Demonstration Project

NPS Application Number 01-11

EPA 319(h) Grant Number C999-4861-01

Memorandum of Agreement Number M-06039567

July 2003 - December 2007

REPORT SUBMITTED BY

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ROUNDSTONE CREEK WATERSHED PROJECT COORDINATOR

Figure 1 - Roundstone Creek

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Funding for this project was provided in part by a grant from the United States Environmental Protection Agency through the Kentucky Division of Water, Nonpoint Source Section and the Kentucky Division of Conservation to *The Nature Conservancy* as authorized by the Clean Water Act Amendments of 1987, Section 319(h) Nonpoint Source Implementation Grant #C999-4861-010. Mention of trade names or commercial products, if any, does not constitute endorsement.

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Thank you to Jack Stickney with Kentucky Rural Water; Joe Burns, Kentucky Rural Water; Richie Taylor, Western Kentucky University; Lake Linville Stakeholders Group; James Renner, Rockcastle County Solid Waste Coordinator; Debra Bledsoe , ASPI (Appalachia Science in the Public Interest); Notre Dame University college students and local volunteers assisting in clean up of trash and dumps in the Roundstone Creek watershed. Last, but not least, The Nature Conservancy is grateful to all the landowners, teachers, students, civic groups, local, state and federal officials who have been supportive of this project in any way. In particular we want to thank the farmers and landowners in the community for participation in this program, for allowing us to implement best management practices (BMPs) on your lands, giving this project the opportunity to help them make a difference in their watershed.

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EXECUTIVE SUMMARY

The Roundstone Renewal Demonstration Project was designed to protect water quality and the ecosystem biodiversity through nonpoint source pollution abatement and to promote consensus building among the stakeholders and inhabitants of the Roundstone Creek watershed. This watershed contains the federally endangered mussel, *Villosa trabalis*, commonly known as the Cumberland Bean mussel. Increased farming and logging in this watershed has affected this mussel as well as the water quality. Implementing best management practices (BMPs) on farms in this area has helped to remediate nonpoint source problems that affect the integrity of Roundstone Creek, prohibit further damage to the watershed and improve the habitat for the Cumberland Bean mussel.

This project involved a diverse group of partners so as to balance the efforts among agencies, industry, landowners, and schools. We feel that this helps to provide for a better understanding of the project among all stakeholders in the watershed as well as enabling communication and consensus building to occur. Partners include The Nature Conservancy (TNC) Natural Resource Conservation Service (NRCS), Kentucky Division of Conservation (KDOC), and United States Environmental Protection Agency (EPA), Kentucky Division of Water (KDOW), United States Department of Fish and Wildlife Resources (USDFWR), and the Rockcastle County Conservation District (RCCD). The BMP installations are located in Rockcastle County on the main stem and tributaries of Roundstone Creek.

Due to the late date on which the grant started (2003 instead of 2002), 18 months were added to complete the project. The project's best management practices installation began in July 2003 with work being completed by December 31, 2007. TNC took the lead with the project. The agency is committed to a long-term presence in the Rockcastle River watershed as witnessed by the Conservancy's presence in the adjoining Horse Lick Creek watershed since 1992. For this reason, the Conservancy and its partners will continually strive to improve the water quality of Roundstone Creek and its tributaries.

This final report will reflect initiatives taken by landowners and other concerned groups taking steps to improve and maintain the water quality of the Roundstone Creek Watershed for future generations. Landowners and farmers applied Best Management Practices to protect their property, and the waters of the Roundstone Creek drainage. This project was a joint effort with the above mentioned agencies to apply practices such as fencing cattle out of streams, putting in watering tanks to water the livestock with city water or spring developments, instead of watering cattle in a stream. A

total of eighteen different cooperators/landowners completed twenty-four projects were installed. Although water sampling and mussel study were not a part of the grant, I feel the water quality has improved due the implemented practices, and overall education of the farmers and landowners in this watershed.

INTRODUCTION AND BACKGROUND

The Roundstone Renewal BMP Demonstration Project purpose and overall objective is to improve the water quality in the Roundstone Creek watershed. Roundstone Creek is a Kentucky Outstanding Resource Water (*Kentucky Division of Water, 2000*) from its source to river mile 13.5. This section of the river contains the federally endangered mussel, *Villosa trabalis*, commonly known as the Cumberland Bean mussel. Implementation of BMPs on area farms has helped to remediate nonpoint source problems that affect the integrity of Roundstone Creek. Increased farming and logging have threatened this habitat in the main stem as well as the tributaries. Installing BMPs in the watershed will definitely improve the water quality of Roundstone Creek.

Roundstone Creek is located in Rockcastle County in southeastern Kentucky and extends from northern Rockcastle County near the Madison County line to its confluence with the main stem of the Rockcastle River at Livingston. (Appendix B-1 Rockcastle County Topographic map). The characteristics of Roundstone Creek are that of a low gradient stream that achieves fourth order. Tributaries include Clear Creek, Little Clear Creek, Clay Lick, Hurricane Creek, Little Hurricane Creek, Crooked Creek, Little Renfro Creek and Renfro Creek, all of which are of moderate gradient.

In contrast to many eastern Kentucky streams, the upper headwaters of Roundstone Creek have a wide flat river flood plain. Channel instability and stream degradation from nonpoint source pollution are caused by: (1) the reduction or loss of riparian zone vegetation; (2) row cropping too close to the channel; and (3) bank trampling, in-stream habitat destruction, and nutrient enrichment by livestock and in farmlands, the fords (low water stream crossings).

The entire watershed is karst with many sinkholes feeding groundwater basins that can disperse water over large areas. The lower reaches of Roundstone Creek have sinks in which the creek disappears entirely during low flow, only to reappear again in a resurgence shortly downstream. Pollutants discharged into sinkholes can also impair or destroy drinking water sources

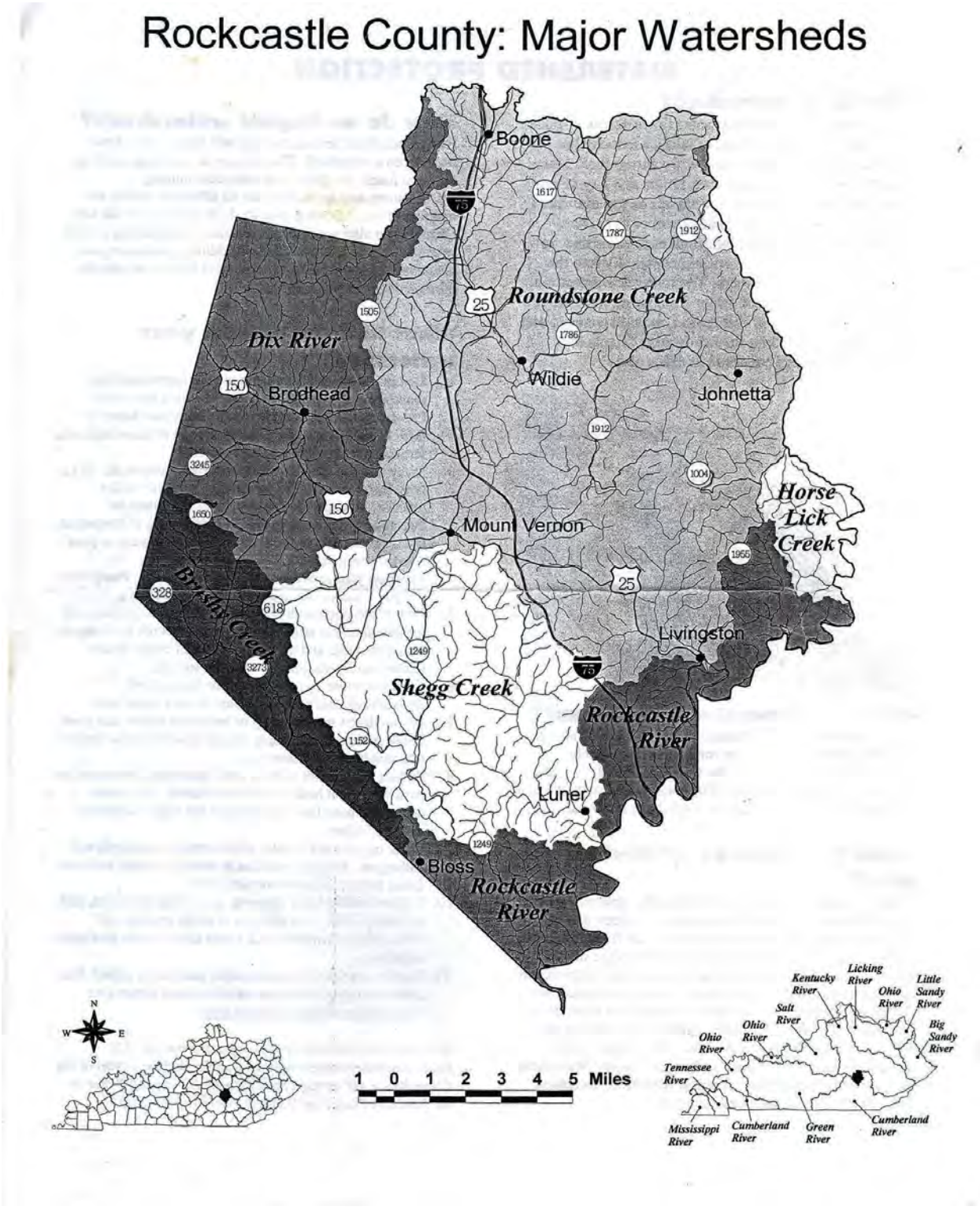
The riparian zone of Roundstone Creek and most of its tributaries are forested, but in many areas the zone is too narrow or it has been cleared of vegetation. Intact riparian habitats are associated with high water quality, and they function as “sponges” to reduce sediment and nutrient runoff into streams. Riparian vegetation regulates light and temperature regimes, provides food for aquatic and terrestrial organisms, influences water and nutrient movement from the land to the stream, and maintains biodiversity by supplying diverse habitat and ecological services.

The Nature Conservancy and the Rockcastle County Conservation District have determined that over four miles of riparian area are a high priority for restoration and other types of BMPs, and an additional seven miles of stream bank are a medium priority. High priority areas are denuded of forest cover and are badly eroded. Medium priority areas have limited forest cover and less bank erosion. Stream bank erosion appears to increase dramatically when the forested riparian corridor is less than 100 feet wide.

In tributary streams, riparian zones have been denuded of natural vegetation along segments of several of the tributaries to create more farmland. Where riparian vegetation has been retained, livestock use is intensified for shade and water. These streams are easier for livestock to access, which results in degraded stream banks, in-stream habitat, and water quality. The impact of these activities is greater in small streams because they have less assimilative capacity and livestock movement may not be limited by swift or deep water.

The following map breaks down the watershed drainage in Rockcastle County. The area this grant is focusing on is the Roundstone Creek watershed. This map was reprinted from *(Grant # C9994659-95) which was funded in part by a grant from the U. S. Environmental Protection Agency under Section 319 (h) of the Clean Water Act Through the Kentucky Division of Water to the Kentucky State Fair Board.* [2]

Figure- 2 - <u>Watersheds</u>



MATERIALS AND METHODS

Materials and methods used for this project were guided by the best management practices implemented. The practices contracted and implemented with this grant were based on the *United States Department of Agriculture, Technical Guide Section IV, Natural Resources Conservation Service, Conservation Practice Standards.*[1] (See standards and descriptions in Appendix B-2. The BMPs applied to the farms were to help prevent runoff into the Roundstone Creek watershed.).

Roundstone Creek is a Kentucky Outstanding Resource Waters (*Kentucky Division of Water, 2000*) from its source to river mile 13.5. This section of the river contains the federally endangered mussel, *Villosa trabalis,* commonly known as the Cumberland Bean mussel. This project will attempt to remediate nonpoint source problems that affect the integrity of Roundstone Creek.

The length of the mainstem of Roundstone Creek is 28.1 miles. The area of the watershed is 144 square miles, or 92,108 acres. This watershed has 310 stream miles.

The following is mileage for the larger sub watersheds within the Roundstone Creek watershed. These figures include the mainstem of the stream as well as tributaries:

Brush Creek is 12.6 square miles in area with 27.1 total miles of streams.

Clear Creek is 23.8 square miles in area with 52.1 miles of streams.

Crooked Creek is 24.0 square miles in area with 52.3 miles of streams.

Renfro Creek is 23.0 square miles in area with 37.3 miles of streams.

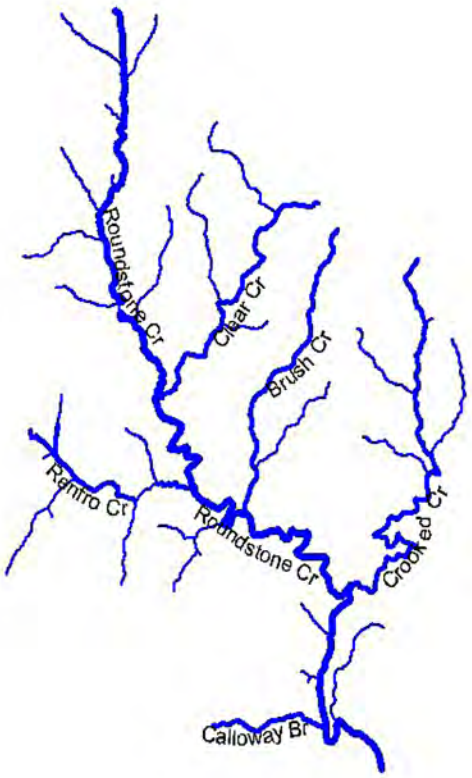
Calloway Branch is 3.9 square miles in area with 8.6 miles of streams.

Cove Branch is 3.7 square miles in area with 5.1 miles of streams.

Little Clear Creek is 4.3 square miles in area with 11.1 miles of streams.

Piney Branch is 2.7 square miles in area with 7.7 miles of stream.

Figure -3 Roundstone Creek Watershed and Tributaries[2]



Practices Utilized in this Project

As stated before, the practices contracted and implemented with this grant were based on the *United States Department of Agriculture, Technical Guide Section IV, Natural Resources Conservation Service, and Conservation Practice Standards.* Standards used were: fencing (382), sink hole protection (725), heavy use areas (561), pumping for water control (533), access roads (560), watering facilities (614), pipeline (516), and spring developments (574). Descriptions of each of the implemented standard used, and breakdown of each standard are in Appendix B-2. In order to implement the practices, projects, contracts, maps, and plans were drawn up and agreed upon with the landowners (a.k.a .cooperators) and The Nature Conservancy. Practices included materials such as fencing, wire, gravel, watering facilities, pipeline, geo-textile fabric and concrete. The cooperators

could chose to do the work themselves or hire local contractors to install the best management practice according to the contracts. A breakdown is attached showing the projects as well as practices installed. Best management data breakdown of expenses is listed on BMP Implementation Worksheet (Figure-4).

Nonpoint source project progress reports and milestones were submitted monthly or quarterly. Water protection and implementation of practices have improved the water and tributaries of Roundstone Creek.

All objectives have been met and are summarized in the following paragraphs.

Brochure

The milestone objectives required developing brochures showing some of the progress and results of the project. The brochure was printed and distributed to many local farmers, local groups, the county extension office, local feed stores, machinery stores, the county library, as well as state agencies such as the Kentucky Division of Conservation and Kentucky Division of Water (Appendix B-3) and shows a summation of the overall project and its successes.

Field Days

Ten field days were held to demonstrate best management practices and the installation of each to show the set up and cost of each project. These dates and locations were advertised in the local newspaper, the *Mount Vernon Signal*, (Appendix B-4a1-a2), on the local radio station (WRVK-AM) (Appendix B-4b) and by letter and memos to individuals, such as Division of Conservation [KDOC], and KDOW. (Appendix B-4c). The field days were advertised for landowners, government officials, public attendees such as other local farmers, and staff. Field day attendees varied in number due to weather. Some of the dates included joint projects with NRCS and USFWS, showing how all the agency partners worked together. Pre and Post Surveys for Field Days (Appendix B4-d.) were distributed to be filled out by individuals in attendance for feedback regarding the projects.

Other field days held were for educational purposes with local students attending and filling out the Pre and Post Survey forms for Students (Appendix B-4e) for their feedback. Educational programs are addressed in a later part of this report.

Figure-4 **BMP Implementation and Cost Chart**

Conserva-tion Practice	Jackie Miller	Cletis & Rose Brown	Jan & June Stevens	Clear Creek Farms*	Donnie & Brenda Parsons	Thomas & Kathy Coffey	Donald & Joyce Stephens	Timothy Mink	Joe C. & Kim Bullens	Edwin & Elizabeth Evans	Joseph B. & Catherine Bullens	Bill Gene & Nancy Sigmon	Terry & Reba Marlene Lawson	Delphia Cox & Buck Farthing	Kathy Parsons	Rick & Katherine Hysinger	Glen & Bonnie Coffey	Steven & Donna Towery	**Totals**
	Clear Creek	Renfro Creek	Medical Springs Creek	Round-stone Creek	Clear Creek	Round-stone Creek & Scaffold Cane Creek	Scaffold Cane Creek	Little Hurricane Creek	Scalfold Cane Creek	Little Hurricane Creek	Round-stone Creek	Little Hurricane Creek	Clear Creek	Little Renfro Creek	Little Hurricane Creek	Renfro Creek/ Lake Linville	Round-stone Creek	Little Round-stone Creek	
Access Road (560)								200 ft											200 ft
Heavy Use Area (561)								2,500 sq ft		2,750 sq ft		3,000 sq ft	6,750 sq ft					2,750 sq ft	17,750 sq ft
Spring Develop-ment (574)			1 system					1 system	1 system					1 system		1 system			5 systems
Stream Bank Protection (380)	630 ft																		630 ft
Trough or Tank (614)		1 tank	1 tank		1 tank	2 tanks	2 tanks	1 tank	1 tank	2 tanks			3 tanks		2 tanks	3 tanks		1 tank	20 tanks
Pipeline (516)		1,000 ft				200 ft		200 ft	200 ft				1,250 ft		800 ft	2,450 ft		190 ft	6,290 ft
Fence Existing Water Sources (382)					8,176 ft	1,500 ft							3,800 ft		6,700 ft		4,117 ft		24,293 ft
Sinkhole Protection (725)											3,440 ft								3,440 ft
Stream Crossing (376)																			
Pumping for Water Control (Pump and Housing) (533)					1 system				1 system					1 system		1 system			4 systems
Total Acres Addressed	102 acres	70 acres	523 acres	131 acres	117 acres	91 acres	296 acres	174 acres	396 acres						74 acres			144 acres	2,118 acres
Total Dollars Spent	8,006.15	1,636.72	2,580.00	0.00	14,428.27	3,923.10	2,613.75	8,199.53	3,008.50	4,813.73	5,160.00	4,012.88	11,714.25	2,494.76	26,631.45	13,288.82	6,842.96	4,603.50	$123,958.37

PowerPoint Presentation

The grant required making a video of this project, but that requirement was changed to a PowerPoint presentation. The PowerPoint presentation was expanded as different practices were implemented and projects were added (Appendix B-5).

Macroinvertebrate Mat Sets

In lieu of developing a poster, macroinvertebrates mat sets were reprinted from another 319(h) grant (Big Sandy Resource Conservation and Development Area, Inc., Grant #C9994861-97)[3]. The Roundstone Renewal Project reprinted 300 sets of these mats. The sets were distributed to schools, the Kentucky Division of Water, the Kentucky Division of Conservation, school libraries, the Rockcastle County Public Library, and to families that home school. These laminated mats were in sets of 25 sheets and were used to illustrate common macroinvertebrates found in local streams. The students could use the mats to identify the macroinvertebrate and determine if this was an indicator of good, fair or bad water quality of the stream. These sets were used as part of the education portion of the grant and met the Kentucky Department of Education core content standards. The students had programs at school as well as field experiments reflecting results of data they collected streamside. (Appendix B-6)

RESULTS AND DISCUSSION

The purpose and results of this grant were to improve the water quality of Roundstone Creek by installing best management practices and completing projects with schools and other agencies. Baseline water sampling before and after the grant was not a part of the plan of work, therefore, bacteria or other problems could not be measured. Photo documentation is used as a primary measure of success. Each landowner in this project was pleased with how much better the BMP installations improved their land. Twenty-four projects were put on the ground. Objectives of the grant have been completed. As mentioned in the previous section of Material and Methods, the following projects completed have shown the progress demonstrated in the earlier section. (Figure-4)

The objective to develop a brochure reflecting the purpose and results of the project was completed. The brochure is a summary of some of the projects completed, the purpose of the grant, and photos with descriptions of BMPs installed. The brochure was distributed to area farms, Rockcastle County Extension Service, various Rockcastle County Courthouse offices (such as the Property Valuation Administrator, Rockcastle County Library, at field days, speaking engagements with groups such as the Rockcastle County Kiwanis, the local Daughters of the Revolution Chapter, Rockcastle County Garden Club, Rockcastle County Homemakers, Kentucky Division of Water, Kentucky Division of Conservation and local farm stores. (Appendix B-3)

A PowerPoint presentation, developed in lieu of a video, depicts the project from beginning to end and was used with the groups mentioned in the previous paragraph. This PowerPoint was updated continually to demonstrate projects in the area (Appendix B-5).

Ten field days were advertised and held, demonstrating projects completed and successful BMPs installed. The field days were advertised in the local newspaper, on local radio, and by mail. Each field day consisted of meeting landowners, officials, and local citizens traveling to different farms site to show some of the practices implemented and how they were working. These field days really banded some of the landowners together to see how cooperation can help the water quality of the watershed. The more important information from their point of view was to see that the projects installed improved their land.

Another objective completed was the establishment of a local citizens group. The requirement to form and get support of community officials for the watershed began with the development of a Stakeholders group of concerned citizens. The group was formed around issues at Lake Linville which is in the Roundstone Creek watershed and is the local water supply. The Lake Linville Stakeholders

Group was formed of local interest groups including the Mayor of Mount Vernon, the Rockcastle County Judge Executive, several local and state agencies including Kentucky Division of Water and Kentucky Division of Fish and Wildlife Resources, Rockcastle County Natural Resource Conservation staff members, Farm Services Administration staff, Rockcastle County Extension Service, Western Rockcastle Water Representative, the city utilities manager, The Nature Conservancy, Rockcastle County Conservation District, Kentucky Rural Water, Western Kentucky University, Third Rock Consultants, and local citizens. This group continues to work to help conserve and lobby for protection of the lake. To address water monitoring and water quality, the group utilized Western Kentucky University, which obtained equipment and did a lake study and survey of depth and temperature of the lake. This study was done in conjunction with the Kentucky Rural Water Association's Jack Stickney and Joe Burns; Appalachia Science in the Public Interest (ASPI) Director, Debra Bledsoe; Rockcastle County Conservation Technician, Zachary Gentry; Rockcastle County NRCS office and The Nature Conservancy representing the Roundstone Creek Watershed Project. The results determined that fingers of the lake are extremely shallow due to runoff from agriculture and new construction in the Renfro Creek watershed. Renfro Creek is a tributary to Roundstone Creek and ultimately the Rockcastle River. The Lake Linville Depth Contour Map shows the depth of the lake at sampling points as indicated on the Lake Linville Water Quality Sampling Points map.

A web link has been put up by Western Kentucky University to access this information[4]: http://www.wku.edu/waterhealth/LakeLinville/ http://www.wku.edu/waterhealth/LakeLinville/Lake%20Linville%20Depth%20Map.pdf.

To address the problems as a result of the lake study, the Lake Linville Stakeholders Group requested that the Rockcastle County Conservation District apply for a 319(h) grant to further study and determine possible solutions to the problems of the lake, particularly the taste and odor problems. The grant was applied for and denied, but will be resubmitted in 2008.

Lake Linville Depth Contour Map

Lake Linville Sampling Points

The Lake Linville Stakeholders Group brought some information to the attention of the Kentucky Department of Transportation Cabinet in its I-75 project, which is widening the roadway to three lanes at the dam which crosses the interstate. A chemical spill to the left or right of the dam could devastate the water in the community. The lake is on one side of the interstate and the water treatment plant is on the other side. This group urged KDOT to establish emergency plans. For example, if there were a chemical spill, where would it drain, and where would runoff be diverted to. Renfro Creek is the main stream below the water plant and is also the stream through the lake flowing directly into Roundstone Creek. This concern had not been addressed by KDOT and several meetings were held to try to come to a resolution to the problem. This is an ongoing process that the Lake Linville Water Source Protection Group is still working on. As of this date, diversion ditches and holding basins are in the planning stages.

Education Objective

The education objective was addressed in several ways. In addition to the brochure, PowerPoint, field days, and macroinvertebrate identification laminated mats, the project coordinator visited county schools, promoting conservation of natural resources, describing the purpose of this project, and making sure the entire field and class work met the schools' core content.

Macroinvertebrate identification mats replaced the poster requirement of the objectives. These were used as an educational tool. The laminated mats were in sets of twenty-five and described, along with pictures, common macroinvertebrates found in streams and creeks in the area. The mats guided the students on how to determine good, fair, and poor water quality. The identification sheets were distributed to schools, educators, farm stores, libraries, and other groups. There were 300 sets printed and distributed. (Appendix B-6)

A demonstration of an Enviroscape (a teaching tool for students to identify point and nonpoint source pollution in a community), helped the students see the overall big picture of how pollution affects each one of them. A big part of the onsite and environmental education for this project was student participation in the observation and sampling of tributaries and the main stem of Roundstone Creek. Appendix B-7 depicts some of the students sampling, documenting water pH and temperature, and observing water insects and macroinvertebrates in the streams.

CONCLUSIONS

This grant was approved to utilize best management practices and farm programs to prevent nonpoint source pollution from farms into Roundstone Creek. Figure-4 shows the individual farm projects, the practices implemented, each cooperator listed, and a total cost of the projects.

In the Appendix are copies of the topographic map (Appendix B-1) and the BMP sites where the practices were installed (Appendix B-8a). Included are the Wildie Quad (Appendix B-8b), Mount Vernon Quad (Appendix B-8c), and the Berea Quad (Appendix B-8d). These maps illustrate areas that had practices implemented in Roundstone Creek watershed drainage in Rockcastle County. Projects included: Pipeline and Tanks, Fencing, Sinkhole Protection, Heavy Use Areas, Access Roads, and Spring Developments (Appendix B-2). Eighteen different landowners installed and completed a total of twenty-four projects during the course of this grant. All activities and best management practices installed were successful and continue to prevent nonpoint source pollution entering into Roundstone Creek and its tributaries.

All of the milestones, goals and objectives were accomplished. (1) A BMP Implementation Plan was developed and implemented. (2) Accomplishment of the grant objectives included organizing a citizens group (Lake Linville Stakeholders Group) to help make the community aware of water quality in the Roundstone Creek watershed. This group continues to work to conserve and protect the lake. Lake Linville is Rockcastle County's municipal drinking supply and is located in the Roundstone Creek Watershed. (Refer to the brochure B-3) (3) Educational objectives were completed. The school programs and assemblies were held to address core content and to develop students' understanding of their environment, focusing on water quality and what causes the problems. Another part of the educational objective was distribution of macroinvertebrate identification sets used by students as an educational tool to help them understand watersheds and to look for indicators of good or poor water quality. (Appendix B-6) (4) Ten field days (instead of eight) were advertised in the local newspaper, the *Mount Vernon Signal (*Appendix B-4a-b), the local radio station, WRVK-AM radio (Appendix B-4b), memos and e-mails. The purpose of the field days was for students, landowners, farmers, local officials and others to see current problems and the results of best management practices implemented by the landowners (Appendix B4, c, d, and e). Appendix B-7 contains photographs of school and farm field days and some of the BMPs installed in the watershed. The results of these field days and field trips were successful in informing the public about what is

going on in their watershed and what BMPs can do to improve their land and farming operations. (5) The brochure developed with pictures and descriptions of best management practices implemented in the watershed (Appendix B-3) actually summarizes and demonstrates the success of this project. (6) A PowerPoint presentation was developed to show ongoing projects in the watershed. This PowerPoint was an excellent tool for reaching out to help people understand this watershed project and its purposes (Appendix B-5). (7) One of the most important tools used to make this project so successful were the pre and post BMP photos. The before and after photos were used in summary in the brochure and in pictures of some of before and after implementation of BMPs (see Appendix B-7 and in Brochure, Appendix B-3). (8) Milestone reports were submitted, monthly or quarterly, to show progress on the grant. (9) A CD of the final report was completed and submitted with the grant final report (Appendix B-9).

The Nature Conservancy, the Rockcastle County Conservation District, the Kentucky Division of Conservation, and local citizens continue to work to improve water quality and habitat for fish and mussels in Roundstone Creek. By reducing nonpoint source pollution, storm-water runoff, and other chemical contaminants through installation of best management practices, the water quality in the Roundstone Creek watershed should continually improve. Most of the watershed cooperators (landowners) are committed to improving and maintaining the water quality and wildlife habitat in Roundstone Creek. All of the partnering agencies worked together well to make this project a success.

LITERATURE CITED

1. United States Department of Agriculture, Technical Guide Section IV, Natural Resources Conservation Service, Conservation Practice Standards.

2. United States Environmental Protection Agency under Section 319(h) of the Clean Water Act, Kentucky Division of Water , Kentucky State Fair Board (Grant #C9994659-95) (watershed map-figure 2)

3. Big Sandy Resource Conservation and Development Area, Inc. (Grant# C9994861-97) Reprinted Under grant funded in part by U.S. Environmental Protection Agency under 319(h) of the Clean Water Act, Kentucky Division of Water, Kentucky Division of Conservation and the Roundstone Renewal BMP Demonstration Project (Grant# C9994861-01) (macroinvertibrate mats).

4. Western Kentucky University, College of Health and Human Resources, Department of Public Health, Index of /waterhealth/LakeLinville
Link to the website for data collected and results:

http://www.wku.edu/waterhealth/LakeLinville/
http://www.wku.edu/waterhealth/LakeLinville/Lake%20Linville%20Water%20Quality %20Map.pdf

APPENDIX

APPENDIX

Appendix A

Work Plan Outputs

Milestone	Expected Begin Date	Expected End Date	Actual Begin Date	Actual End Date
1. Submit all draft materials to KDOC for review and approval prior to development and distribution.	Jan 03	Nov 07	July 03	Dec 07
2. Submit advanced written notice on all site visits, demonstrations, and/or field days to KDOC.	Jan 03	Nov 07	Sep 04	Oct 07
3. Develop a BMP Implementation Plan.	Jan 03	Jul 03	Feb 04	Feb 04
4. Implement BMPs.	Oct 03	Nov 07	Oct 03	Dec 07
5. Advertise and conduct field days.	Oct 03	Nov 07	Aug 06	Oct 06
6. Conduct pre-BMP and post-BMP site visits.	Feb 03	Nov 07	Sep 03	Dec 07
7. Produce photo Documentation of pre-BMP and post-BMP scenes.	Feb 03	Nov 07	Sep 03	Dec 07
8. Conduct site visits for school groups.	Oct 03	Nov 07	Sep 03	Oct 07
9. Conduct classroom or assembly programs.	Oct 03	Nov 07	Apr 04	Oct 07
10. Develop, produce, and distribute a macro-invertebrate handout	Oct 03	Dec 05	Apr 04	Mar 05
11. Develop, produce, and distribute a brochure, 120 copies going to the KDOC.	Oct 03	Dec 05	July 03	May 04
12. Conduct local landowner site visits.	Feb 03	Nov 07	Aug 03	Dec 07
13. Place articles in local newspapers to update public on projects in their watershed.	Feb 03	Nov 07	May 05	Nov 06
14. Form grassroots group and hold meetings.	Feb 03	Nov 07	Sep 04	Dec 07
15. Develop and conduct pre- and post-surveys.	Feb 03	Nov 07	Apr 05	Oct 07
16. At a KDOW/KDOC/TNC review meeting in early 2004, this milestone was changed from making a video to development of a PowerPoint presentation.	Jan 03	Nov 07	Sep 04	Oct 06
17. Evaluate education activities.	Nov 05	Dec 07	Oct 07	Nov 07
18. Evaluate BMPs.	Apr 06	Dec 07	Sept 07	Dec 07
19. Submit Annual Reports and/or participate in the Cabinet's sponsored biennial NPS Conference.	Sep 03	Dec 07	June 04	Dec 07
20. Submit four (4) copies of the Final Report and submit four (4) copies of all products produced by this project.	May 06	Dec 07	Oct 07	Dec 07

Appendix A

Budget Summary

(1) Original Budget:

Budget Categories	319(h) Dollars	TNC Match	Total
Personnel	$80,000.00	$92,000.00	$172,000.00
Supplies	$31,000.00	$22,000.00	$53,000.00
Equipment	-0-	-0-	-0-
Travel	$10,000.00	$4,000.00	$14,000.00
Contractual	$89,000.00	$20,000.00	$109,000.00
Operating Costs	-0-	$2,000.00	$2,000.00
Other/Indirect Costs	$46,200.00	$30,800.00	$77,000.00
TOTAL	**$256,200.00**	**$170,800.00**	**$427,000.00**
Percentages	**60.00%**	**40.00%**	**100.00%**

(2) Revised Budget – Revision #1:

Budget Categories	319(h) Dollars	TNC Match	Total
Personnel	$80,000.00	$106,588.00	$186,588.00
Supplies	$31,000.00	$22,000.00	$53,000.00
Equipment	$15,000.00	-0-	$15,000.00
Travel	$10,000.00	$4,000.00	$14,000.00
Contractual	$95,879.00	$20,000.00	$115,879.00
Other	-0-	$2,000.00	$2,000.00
Indirect Costs	$51,013.00	$34,009.00	$85,0230.00
TOTAL	**$282,892.00**	**$188,597.00**	**$471,490.00**
Percentages	**60.00%**	**40.00%**	**100.00%**

We received additional funding of $26,692 on the 319(h) side and provided an additional $17,797 on the match side. An equipment line item was added in order to purchase a truck for the project. This budget revision was approved by the KDOW.

Appendix A

Budget Summary (cont.)

(3) Revised Budget – Revision #2:

Budget Categories	319(h) Dollars	TNC Match	Total	Final Expenditures
Personnel	$96,000	$128,376	$224,376	$222,957.01
Supplies	$13,000	-0-	$13,000	$11,090.78
Equipment	$14,000	-0-	$14,000	$14,000.00
Travel	$10,000	$4,000	$14,000	$17,971.76
Contractual	$99,229	$20,000	$119,229	$123,898.37
Other	-0-	$2,500	$2,500	$2,801.26
Indirect Costs @ 22%	$51,090	$34,0735	$85,163	$86,398.22
Credit for 21% indirect	$ (428)	$ (351)	$ (779)	$ (778.52)
TOTAL	**$282,892**	**$188,598**	**$471,490**	**$478,338.88**
Percentages	**60.00%**	**40.00%**	**100.00%**	

Since this became a five-year project, personnel costs increased. This budget revision was approved by the KDOW.

The Nature Conservancy was reimbursed $282,892. All dollars were spent; there were no excess project funds to reallocate. This project did generate overmatch provided by The Nature Conservancy. This overmatch was not posted to the Grant.

Appendix A

Equipment Summary

The following equipment was purchased using 319(h) funds:

Vehicle:	2001 GMC K-19 Pickup (tan, 4wd, extended cab)
VIN:	2GTEK19T811238348
Mileage:	approx. 91,000 (currently)
Condition:	fair/good
Purchase date:	3/7/2005
Purchase price:	$14,000

It has not been determined if the fair market value of this vehicle exceeds $5,000, since it was a salvaged flood vehicle when it was purchased; however, we are treating this vehicle as having a FMV that exceeds $5,000.

Special Grant Conditions

There were no special grant conditions placed on this project.

APPENDIX B-2

NRCS Technical Guild Descriptions of Conservation Practices and BMPs

The Natural Resources and Conservation Service has specifications to install Best Management Practices. These standards were used in the proper construction and implementation of the practices in the watershed.

382 Fencing

516 Pipeline

533 Pumping Plant for Water Control

560 Access Road

561 Heavy Use Area

574 Spring Development

614 Water Facility

725 Sinkhole Protection

NATURAL RESOURCES CONSERVATION SERVICE

KENTUCKY CONSERVATION PRACTICE STANDARD

FENCE

Code 382

DEFINITION

A constructed barrier to animals or people.

PURPOSE

This practice is applied to facilitate the application of conservation practices by providing a means to control movement of animals and people.

Applicable purposes include, but are not limited to:

- Improving distribution and timing of livestock grazing.
- Reducing erosion and improving water quality by controlling livestock access to streams, springs, wetlands, and ponds.

- Facilitating handling, movement, and feeding of livestock.
- Protecting newly planted areas from disturbance until established.
- Protecting sensitive environmental areas and their flora from vehicular, pedestrian, or animal traffic and use.
- Protecting the safety of people, livestock, and wildlife by limiting or denying access to hazardous areas.

CONDITIONS WHERE PRACTICE APPLIES

This practice may be applied on any area where management of animal or people movement is needed. Fences are not needed where natural barriers will serve the purpose.

CRITERIA

General Criteria Applicable to All Purposes

Fencing materials and type and design of fence installed shall be of high quality and durability. The type and design of fence installed will meet the management objectives and topographic challenges of the site.

Fences shall be positioned to facilitate management requirements. Boundary and roadside fence design and installation shall follow federal, state, and local laws and regulations.

Height, size, spacing, and type of materials used will provide the desired control and management of people and animals of concern.

All manufactured fence materials such as chain link, vinyl, plank, or rail fence will be installed according to manufacturer's recommendations and approved prior to installation.

CONSIDERATIONS

The fence design will consider topography, soil properties, aesthetics, human access type, safety, management of livestock, moisture conditions, wildlife movement, durability of materials, flooding, and stream crossings.

Fences across gullies or streams require special braces and designs. Breakaway fences or swinging water gaps allow debris and water to flow past the fence line without destroying the fence adjacent to the stream or gully. Swinging or

floating water gaps should span running streams.

Place wood line posts in dips and on rises, then follow recommended spacing for different fence types.

Post spacing in shallow soils may vary with additional stays installed to maintain wire spacing. Use a probe to locate desirable post sites.

A double-brace assembly may be required at ends and corners for fences in poorly drained soils.

Electric fences must be grounded to ensure proper flow of electricity. Lightning arrestors or spark gap shall be installed as needed to limit damages to energizer; and avoid causing injury or death to animals and people.

Electric fences must have access to a dependable power supply, main line, solar power panel, or easily exchanged and properly sized deep cycle batteries. Electric fences must have adequate voltage, at all points along the fence, to repel the animals being controlled.

A ground rod should be installed at electric company's transformer pole (primary ground) and another ground rod installed at the electrical circuit breaker box (secondary ground), if they do not already exist. Contact the electric company for service.

Where applicable, cleared rights-of-way may be established that would facilitate fence construction and maintenance. All necessary erosion control measures will be applied to any cleared areas.

When possible, install fences in locations that will minimize maintenance, avoiding flood prone areas, irregular terrain such as gullies and/or water crossings, and locations susceptible to damage from tree or limb fall.

When planning and constructing a fence on steep slopes, locate fence where soil erosion from livestock trailing will be minimized.

When planning and constructing a fence in flood prone areas, consider using high tensile electric fence. Construct the fence with the fewest posts and wires as needed to control the animals of concern. Place the bottom wire as high as practical.

Consider wildlife movement needs when locating fences.

When using trees in lieu of fence posts, anchor a pressure treated 2X6 to the tree with galvanized screws or nails. Attach wire to the 2X6 instead of directly to the tree so the tree will not grow around the wire. Do not utilize high-value trees planned for harvest. Utilize trees for no more than 20% of line post needs in any fence.

Additional Criteria To Improve Grazing Management

Improve resource management by locating fences to separate areas with differences in forage seasons of growth and palatability, use, topography, or production potential.

Pasture/paddock divisions shall be consistent with grazing needs as projected by a grazing plan developed under Kentucky Conservation Practice Standard *Prescribed Grazing, (Code 528A).*

Locate fences to allow livestock access to water and handling facilities.

PLANS AND SPECIFICATIONS

Plans and specifications are to be prepared for specific sites. Plans and specifications for installing fences shall be in keeping with this standard and shall describe the requirements for applying the practice to achieve all of its intended purposes. See attached Construction Specifications for Standard Woven Wire, Standard Barbed Wire (Temporary and Permanent), High Tensile Non-Electric Fencing, High Tensile Electric Fencing (Temporary and Permanent), Wooden Fencing and other manufactured materials.

DOCUMENTATION AND VARIATIONS

The completed work is to be checked and documented to verify that the practice is complete according to NRCS standards and specifications. Supporting data for documentation included those features of this practice that can be measured and observed such as: length of fence installed, type of fence and materials installed and signature of the performance checker

Variations from the above materials and installation specifications may be approved by the responsible technician provided it is determined that such variation would result in an installation that would equal or exceed a fence installed according to this specification.

Such variations will be recorded with the reasons why it will result in an installation that will meet or exceed one installed in accordance with the specifications.

OPERATION AND MAINTENANCE

Regular inspection of fences should be part of an on-going management program. Inspection of fences after storm events is needed to facilitate the function of the intended use of the fence. For electrified fence, use a voltage tester to ensure adequate charge is being discharged along the entire fence span. Keep heavy vegetation away from fences, especially electric fences to avoid loss of charge. Installation of cut-off switches will assist in maintenance and repair of electric fences.

Maintenance and repairs will be performed as needed. Retain and properly discard all broken fencing material and hardware to prevent ingestion by animals or injury to equipment, people, or animals. Precautions should be taken to ensure the safety of construction and maintenance crews.

REFERENCES

Gallagher Power Fence Systems, Quality Down the Line.

Gerrish, James R. Missouri Agronomy Technical Note MO-19, Installation of Electrified Hi-Tensile Fence Systems.

Northeast Pasture Management Coordinating Committee. Pasture Profit Prophet, Vol. 1 No. 4, Chester PA 19013, May 1992.

Premier Fence Systems, A Guide to Fencing that Works.

USDA Forest Service. Fences. Technology and Development Program. USDI Bureau of Land Management.

TABLE 1: CONTAINMENT FENCE (PERMANENT)

TYPE FENCE	TYPICAL WIRE SPACING 1/	TYPICAL TYPE OF WIRE	MAXIMUM DISTANCE BETWEEN PULL ASSEMBLIES 2/	MAXIMUM LINE POST SPACING 3/	MINIMUM LINE POST DIAMETER (D) POST LENGTH (L) AND DEPTH (d)
Barbed Wire	5 or More Wires, Min. 42" high (8,	15.5 Gauge Type III	<= 1,320' Apart 3 ½"	14' Apart 18' with Stays on	Wood 3-4" D, 6' L, 24" d Steel 5.5' L, 18" D
Woven Wire	>=32" High Woven + (1 or 2 Barbed Wires or	12.5 Top and Bottom with 14.5 Gauge for	<= 330' Apart 3 ½" Horizontal Brace	14' Apart Conventional w.w. 25' Apart	Wood 3-4" D, 6' L, 24" d Steel 5.5' L, 18" D
High Tensile Electric	4 or More Wires, 42" High (12, 22,	12.5 Gauge 170,000 psi	<= 4,000' Apart 3 ½"	75' Apart with battens	Wood 3-4" D, 6' L, 24" d Steel, High
High Tensile Non-	7 or More Wires, 42" High (6,	12.5 Gauge 170,000 psi	<= 4,000' Apart 3 ½"	12' Apart or 15' with	Wood 3-4"D, 6' L, 24" d Steel, High

1/ Actual installed wire spacing will be as needed to contain the livestock. 2/ Corner and brace posts shall be 6" minimum and driven or set in the ground and tamped around 36" deep or set in 30" of concrete. 3/ Closer post spacing may be needed to accommodate certain situations such as steep landscapes, fragile soils, deer crossings and other concerns.

TABLE 2: DETERRENT FENCE (PERMANENT)

TYPE FENCE	TYPICAL WIRE SPACING 1/	TYPICAL TYPE OF WIRE	MAXIMUM DISTANCE BETWEEN PULL ASSEMBLIES 1/	MAXIMUM LINE POST SPACING 2/	MINIMUM LINE POST DIAMETER (D) POST LENGTH (L) AND DEPTH (d)
Barbed Wire	3-4 Wires, 42" High (22, 32, 42)	15.5 Gauge Type III Galvanized	<= 1,320' Apart 3 ½" Horizontal	14' apart / 18' apart w/ stays for conventiona	Wood 3-4"D, 6' L, 24" D Steel 5.5' L, 18"

High Tensile Electric	1-3 Wires, Min. Ht. of Animal's nose at rest (Cows26" to 32")	12.5 Gauge 170,000 psi	<= 4,000' Apart 3 ½" Horizontal Brace 6-8" Brace and	75' Apart	Wood 3-4"D, 6' L, 24" d Steel, High Density wood,

1/ Actual installed wire spacing will be as needed to control the livestock. 2/ Corner and brace posts shall be 6" minimum and driven or set in the ground and tamped around 36" deep or set in 30" of concrete. 3/ Closer post spacing may be needed to accommodate certain situations such as steep landscapes, fragile soils, deer crossings and other concerns.

TABLE 3: TEMPORARY FENCE (PORTABLE)

TYPE FENCE	TYPICAL WIRE SPACING	TYPICAL TYPE OF WIRE	MAXIMUM DISTANCE BETWEEN PULL ASSEMBLIES	MAXIMUM LINE POST SPACING	MINIMUM LINE POST DIAMETER (D) POST LENGTH (L) AND DEPTH (d)
Polytape or Polywi	1-3 wires/tapes, Ht. of	Poly and wire braided	No brace assemblies or permanent posts	Tread-in posts or permanent	Tread-in posts or permanent as terrain
High Tensile Electri	1 Wire, Ht. of Animal's	12.5 Gauge 170,000	No Brace Required Unless Site	75' Apart	Wood 3-4"D, 6' L, 24" d Steel, High

NATURAL RESOURCES CONSERVATION SERVICE

CONSTRUCTION SPECIFICATION

FOR

FENCE (FT.)

CODE 382 - CONTAINMENT WOVEN WIRE FENCE (PERMANENT CONSTRUCTION)

Wire

Fences will be constructed of at least five horizontal wires woven plus at least one wire either barbed or electrified smooth. Woven wire shall be at least 32 inches high, have 9-11 gauge or larger top and bottom strands, 12 1/2 -14 1/2 gauge or larger intermediate and stay wires, with stay wires spaced not more than twelve inches on center. At least 1 strand of barbed wire or energized, high tensile, smooth wire must be placed above the woven wire. Barbed wire shall be double strand 12 ½ - 15 ½ gauge or larger. High tensile energized wire will be 12 ½ gauge, minimum 170,000 p.s.i. break strength. Total height to the top (barbed or electrified) wire of the fence is to be determined on a site specific basis depending upon terrain and livestock species/class/frame score, but not less than 42 inches. All wire shall be new galvanized or aluminum coated material.

Note: In flood plain zones where the primary purpose of the fence is exclusion, woven wire is not recommended.

Line Posts

Wooden

Untreated posts of such species as cedar, locust or Osage Orange, or non-durable wood properly treated with a wood preservative may be used. Top diameter for wooden line posts shall be a minimum of 3-4 inches. The length of line posts must be a minimum of 6 feet and sufficient to provide for the construction of at least a 42 inch high (minimum) fence, permit stapling of the top wire without splitting, and to allow the post to be set in the ground to a minimum depth of 24 inches in deep soils or 18 inches in rocky soils. When line posts are set in depressions or low places, posts should be anchored. Wood preservative should meet industry standard for "ground contact".

Steel

Standard "T" or "U" section steel posts may be used in lieu of wooden line posts. Wire shall be attached to the posts by wrapping with 12 1/2 to 14 gauge galvanized wire or by use of the manufacturer's specially designed clips. In rolling terrain, steel posts shall not be used exclusively as line posts. Every third or fourth post shall be wood.

Spacing

Line posts will be spaced at a maximum interval of 12 to 16 feet apart for conventional woven wire, or 25 feet apart for high tensile woven wire.

Corner, Gate, and Brace Posts

Wooden

Untreated posts of such species as cedar, locust or Osage Orange, or non-durable wood properly treated with a wood preservative may be used. Top diameter for wooden brace and corner posts shall be a minimum of 6-8 inches. Length must be sufficient to provide for the construction of at least a 42 inch high (minimum) fence. Length must also permit setting brace and corner posts at least 36 inches in the ground. Length must also permit stapling of the top wire without splitting. Gate posts shall be of sufficient construction to support the gate assembly. Gate posts used in brace and corner situations will require the same specifications as mentioned previously for brace and corner posts. Wood preservative should meet industry standard for "ground contact".

Bracing

Brace Assemblies

Bracing is required at all corners, gates, and at all definite horizontal or vertical angles in the fence. All fence bracing/pull post assemblies and stretch distances must be

NATURAL RESOURCES CONSERVATION SERVICE

CONSTRUCTION SPECIFICATION

FOR

FENCE (FT.)

CODE 382

CONTAINMENT BARBED WIRE FENCE (PERMANENT CONSTRUCTION)

Wire fences will be constructed of at least five wires barbed. Total height to the top wire of the fence is to be not less than 42 inches. Barbed wire shall be double strand 12 ½ - 15 ½ gauge or larger. All wire shall be new galvanized or aluminum coated material. Total height and spacing between wires shall be determined on a site specific basis depending upon terrain and livestock species being excluded.

Line Posts Wooden

Untreated posts of such species as cedar, locust or Osage Orange, or non-durable wood properly treated with a wood preservative may be used. Top diameter for wooden line posts shall be a minimum of 3-4 inches. The length of line posts must be a minimum of 6 feet and sufficient to provide for the construction of at least a 42 inch high fence, permit stapling of the top wire without splitting, and to allow the post to be set in the ground to a minimum depth of 24 inches in deep soils or 18 inches in rocky soils. When line posts are set in depressions or low places, posts should be anchored. Wood preservative should meet industry standard for "ground contact".

Steel

Standard “T” or “U” section steel posts may be used in lieu of wooden line posts. Wire shall be attached to the posts by wrapping with 12 ½ to 14 gauge galvanized wire or by use of the manufacturer’s specially designed clips. In rolling terrain, steel posts shall not be used exclusively as line posts. Every third or fourth post shall be wood.

Spacing

Line posts will be spaced at a maximum interval of 14 feet apart, or 18 feet with intervening stays.

Corner, Gate, and Brace Posts

Wooden

Untreated posts of such species as cedar, locust or Osage Orange, or non-durable wood properly treated with a wood preservative may be used. Top diameter for wooden brace and corner posts shall be a minimum of 6-8 inches. Length must be sufficient to provide for the construction of at least a 42 inch high fence. Length must also permit setting brace and corner posts at least 36 inches in the ground. Length must also permit stapling of the top wire without splitting. Gate posts shall be of sufficient construction to support the gate assembly. Gate posts used in brace and corner situations will require the same specifications as mentioned previously for brace and corner posts. Wood preservative should meet industry standard for “ground contact”.

Bracing

Brace Assemblies

Bracing is required at all corners, gates, and at all definite horizontal or vertical angles in the fence. All fence bracing/pull post assemblies and stretch distances must be installed in consideration of fence type, terrain, soil conditions and other site specific conditions. Generally stretch distances for all fencing shall be reduced on rough terrain. Brace assemblies should normally be installed at distances not to exceed 1,320 feet apart. All fence bracing/pull post assemblies

and stretch distances must be installed consistent with the wire manufacturers recommendations.

The brace wire shall be tightened to secure the brace and pull post assemblies. If a wide stream or gully is to be crossed, the fence section will be terminated on one bank with a brace assembly and a new section started on the other bank. A floodgate or water gap will be installed across the stream or gully to restrain livestock and constructed so as to minimize debris buildup and prevent structural damage to the line fence on either side during flooding events.

Brace Rails

Brace rails (horizontal brace) shall be either 2 inch diameter by 10 foot long galvanized steel tubing, or a 4 inch by 4 inch square eight foot long timber, or a 3 ½ inch minimum diameter long round post or pole. Horizontal braces will be attached to posts using galvanized steel pins.

CONSTRUCTION SPECIFICATION

FOR

FENCE (FT.)

CODE 382 CONTAINMENT HIGH TENSILE SMOOTH FENCE (NON-ELECTRIC PERMANENT CONSTRUCTION)

Wire

Non-electric high tensile smooth fences will be constructed of at least seven wires. Total height to the top wire of the fence is to be not less than 42 inches. Smooth wire shall be 12 ½ gauge (minimum) or equivalent in strength with a tensile strength of 170,000 psi or greater. All wire shall be new galvanized or aluminum coated material. Total height to the top wire and wire spacing is to be determined on a site specific basis depending upon terrain and livestock species/class/frame score, but not less than 42 inches.

Staples

Staples shall be 9 gauge, class IV galvanized or heavier with a minimum length of 1 ¼ - 1 ¾ inches long depending on wire and post type. They shall be driven diagonally across the wood grain to avoid splitting. For high tensile fencing material, the staples shall not be driven into the post so deeply (including line, corner, gate, and brace posts) that the wire will not move when tightened or with expansion and contraction.

Tension Springs

Tension springs shall be used in the top one or two strands in areas where the fence is near trees or where animal pressure will be heavy, and may be used for all strands.

Fastening

Wrap and twist or use crimping sleeves on end and gate panels. At corner posts, wrap and twist a separate wire to form an 18 to 20 inch loop to support fence strands or a wrap around insulator may be used.

If wire clips are used to hold wire in batten slots, they should allow the wire to slide freely.

Posts

Corner Posts and Gate Posts

Untreated posts of such species as cedar, locust or Osage Orange, or non-durable wood properly treated with a wood preservative may be used. Top diameter for wooden brace and corner posts shall be a minimum of 6-8 inches. Length must be sufficient to provide for the construction of at least a 42 inch high fence. Length must also permit setting brace and corner posts at least 36 inches in the ground. Gate posts shall be of sufficient construction to support the gate assembly. Gate posts used in brace and corner situations will require the same specifications as mentioned previously for brace and corner posts. Wood preservative should meet industry standard for "ground contact".

Bracing

Brace Assemblies

Bracing is required at all corners, gates, and at all definite horizontal or vertical angles in the fence. All fence bracing/pull post assemblies and stretch distances must be installed in consideration of fence type, terrain, soil conditions and other site specific conditions. Generally stretch distances for all fencing shall be reduced on rough terrain. Brace assemblies should be installed at distances not to exceed 4,000 feet apart. All fence bracing/pull post assemblies and stretch distances must be installed consistent with the wire manufacturer's recommendations.

Brace posts shall be a minimum of 6-8" top diameter and at least 8' long. Set posts at least 36" deep. A two post brace can be used for pulls up to 1,320 feet. A three post brace shall be used for pulls over 1320 feet. Pulls should not exceed 4000 feet.

The brace wire shall be tightened to secure the brace and pull post assemblies. If a wide stream or gully is to be crossed, the fence section will be terminated on one bank with a brace assembly and a new section started on the other bank. A floodgate or water gap will be installed across the

stream or gully to restrain livestock and constructed so as to minimize debris buildup and prevent structural damage to the line fence on either side during flooding events.

Brace Rails

Brace rails (horizontal brace) shall be either 2 inch diameter by 10 foot long galvanized steel tubing, or a 4 inch by 4 inch square eight foot long timber, or a 3 ½ inch minimum diameter long round post or pole. Horizontal braces will be attached to posts using galvanized steel pins.

Line Posts

Line posts may be 2" x 1 ½" x 6' long slotted, sawed hardwood or 3-4" diameter, 6 foot long pound pressure treated softwood, or equivalent. Set posts 24 inches deep and space up to 75 feet apart, if battens are used, depending on terrain. Maximum spacing between battens (or posts if no battens used) will be 35 feet.

Installation of hold-downs is recommended in depressions. Standard "T" or "U" steel posts may be used as line posts.

Battens

Battens may be 1 ¼" x 1 ¼" x 3 ½ feet long self insulating pressure treated, slotted hardwood or light duty fiberglass.

NATURAL RESOURCES CONSERVATION SERVICE

CONSERVATION PRACTICE STANDARD

PIPELINE

(Feet)

CODE 516

DEFINITION

Pipeline having an inside diameter of 8 inches or less.

PURPOSE

To convey water from a source of supply to points of use for livestock, wildlife, recreation, or other agricultural purposes.

CONDITIONS WHERE PRACTICE APPLIES

Where it is desirable or necessary to convey water in a closed conduit from one point to another.

CRITERIA

Capacity. For livestock water, the installation shall have a capacity to provide seasonal high daily water requirements for the number and species of animals to be supplied. Animal water requirements can be obtained from NRCS Conservation Practice Standard "Watering Facility (614) or table1. For dairy operations including washwater, provide for 35 gallons per head per day.

For recreation areas, the water capacity shall be adequate for all planned uses. Typical examples are drinking water, fire protection, showers, flush toilets, and irrigation of landscaped areas.

Pipelines used in wastewater recycling systems as part of an animal waste management system must have adequate capacity. Where flush tanks are used, the capacity must be adequate to refill flush tanks with the allotted time between flushing events. For pump flush systems or hose wash systems, the pipeline must be capable of supplying the required flow rate.

Additional water capacity will be provided for wildlife when applicable.

Sanitary protection. If water from the pipeline is to be used for human consumption, applicable state and local regulations shall be met. The design shall meet the requirements of the Kentucky Department of Health.

Backflow Protection. A suitable air gap or a backflow prevention device will be installed in pipeline systems where there is a potential for a cross-connection hazard to potable water supplies. Specific criteria for the type of backflow prevention device needed are dependent on applicable state and local regulations.

Pipe. All pipe must withstand the pressure it will be subjected to, including hydraulic transients, internal pressures and external pressures. As a safety factor against surge or water hammer, the working pressure should not exceed 72% of the pressure rating of the pipe and the design flow velocity at system capacity should not exceed 5 ft/sec. If either of these limits is exceeded, special consideration must be given to flow conditions and measures must be taken to adequately protect the pipeline against surge.

Steel pipe shall meet the requirements of AWWA Specification C-200.

Plastic pipe shall conform to the requirements of the following ASTM specifications, as applicable:

Field Office Technical Guide Section IV

NATURAL RESOURCES CONSERVATION SERVICE

CONSERVATION PRACTICE STANDARD

PIPELINE

(Feet)

CODE 516

DEFINITION

Pipeline having an inside diameter of 8 inches or less.

PURPOSE

To convey water from a source of supply to points of use for livestock, wildlife, recreation, or other agricultural purposes.

CONDITIONS WHERE PRACTICE APPLIES

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CRITERIA

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Steel pipe shall meet the requirements of AWWA Specification C-200.

Plastic pipe shall conform to the requirements of the following ASTM specifications, as applicable:

Conservation practice standards are reviewed periodically, and updated if needed. To obtain the current version of this standard, contact the Natural Resources Conservation Service. **NRCS, KY, April 2003** 516-2

D 1527 Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe, Schedules 40 and 80

D 1785 Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120

D 2104 Polyethylene (PE) Plastic Pipe, Schedule 40

D 2239 Polyethylene (PE) Plastic Pipe (SIDR-PR) Based on Controlled Inside Diameter

D 2241 Poly (Vinyl Chloride) (PVC), Pressure-Rated Pipe (SDR)

D 2282 Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe (SDR-PR)

D 2447 Polyethylene (PE) Plastic Pipe Schedules 40 and 80, Based on Outside Diameter

D 2513 Thermoplastic Gas Pressure Pipe, Tubing and Fittings

D 2737 Polyethylene (PE) Plastic Tubing D 2672 Joints for IPS PVC Using Solvent Cement

D 3035 Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Controlled Outside Diameter

AWWA C900 Polyvinyl Chloride (PVC) Pressure Pipe, 4 inches through 12 inches

AWWA C901 Polyethylene (PE) Pressure Pipe and Tubing, ½ inch through 3 inches

Plastic pressure pipe fittings shall conform to the following ASTM specifications, as applicable:

D 2464 Threaded Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80

D 2466 Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40

D 2467 Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80

D 2468 Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe Fittings, Schedule 40

D 2609 Plastic Insert Fittings for Polyethylene (PE) Plastic Pipe

D 2683 Socket-type Polyethylene Fittings for Outside Diameter-Controlled Polyethylene Pipe and Tubing

D 3139 Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals

D 3261 Butt Heat Fusion Polyethylene (PE) Plastic Fittings, for Polyethylene (PE) Plastic Pipe and Tubing

Solvents for solvent-welded plastic pipe joints shall conform to the following ASTM specifications, as applicable:

D 2235 Solvent Cement for Acrylonitrile- Butadiene-Styrene (ABS) Plastic Pipe and Fittings

D 2564 Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Pipe and Fittings

D 2855 Making Solvent-Cemented Joints with Poly (Vinyl Chloride) (PVC) Pipe and Fittings Rubber gaskets for pipe joints shall conform to the requirements of ASTM Specification
F 477, Elastomeric Seals (Gaskets) for Joining Plastic Pipe.

Drainage. Valves or unions shall be installed at low points in the pipeline so that the line can be drained as needed. Check valves shall be installed as needed to protect groundwater quality or maintain a full pipeline.

Vents. Design shall provide for entry and removal of air along the pipeline, as needed, to prevent air locking or pipe collapse. If parts of the line are above the hydraulic gradient, periodic use of an air pump may be required. Provisions shall be made for pressure relief, air relief and vacuum relief as needed to protect the pipeline.

Joints. Watertight joints that have a strength equal to that of the pipe shall be used. Couplings must be of material compatible with that of the pipe. If they are made of material susceptible to corrosion, provisions must be made to protect them.

Pressure relief valves. A pressure relief valve shall be installed between the pump discharge and the pipeline if excessive pressure can build

up when all valves are closed. Pressure relief valves or surge chamber shall be installed on the discharge side of check valves where a reversal of flow may occur and at the end of the pipeline if needed to relieve surges.

Pressure relief valves shall be no smaller than ¼-inch diameter nominal size for each inch of the pipeline diameter and set to open at a pressure no greater than 5 psi above the pressure rating of the pipe.

Protection. When steel pipe is used, interior protective coatings shall be provided in accordance with NRCS Kentucky Conservation Practice Standard Steel Pipe (Code 430FF). If a coal-tar enamel protective coating is needed for corrosion protection, the coating shall meet the requirements of AWWA Specification C-203.

Steel pipe installed above ground shall be galvanized or shall be protected with a suitable protective paint coating, including a primer coat and two or more final coats.

Plastic pipe installed above ground shall be resistant to ultraviolet light throughout the intended life of the pipe.

All pipes shall be protected from hazards presented by traffic, farm operations, freezing temperatures, fire, and thermal expansion and contraction. Reasonable measures should be taken to protect the pipe from potential vandalism. The minimum depth of cover for pipe shall be as shown in Table 1.

Table 1 – Minimum Depth of Cover for Pipelines

Pipe Diameter (inches)	Depth of Cover (inches)	
	Pipe susceptible to hazards imposed by farming operations	Pipe not susceptible to hazards imposed by farming operations
½ - 2 ½	18	12
3 – 5	24	18
6 - 8	30	24

Vegetation. Disturbed areas shall be established with vegetation or otherwise stabilized as soon as practical after construction. Seedbed preparation, seeding, fertilizing, and mulching shall conform to NRCS Kentucky Conservation Practice Standard Critical Area Planting (Code 342).

Visual Resources. The visual design of pipelines and appurtenances in areas of high public visibility shall be carefully considered.

CONSIDERATIONS

Installation of this practice should be in consideration of natural resource assessments that may be applicable, such as cultural resources, NEPA, wetland conservation provisions, existing wildlife habitat, and others.

Pipeline Chart (K-L-20) attached, can be used in designing the pipeline for animal drinking facilities only.

Other design aids (charts, computer programs, etc.) may be used as determined technically sound by a licensed professional engineer.

PLANS AND SPECIFICATIONS

Plans and specifications for installing pipelines shall be in keeping with this standard and shall describe the requirements for applying the practice to achieve its intended purpose. If the pipeline is a component of a system that includes additional conservation practices, the information necessary to construct these additional practices will also be conveyed on the plans.

The Engineering Field Handbook, Chapter 5, will guide the development of plans.

INSTALLATION GUIDANCE

1. Pipelines shall be placed so they are protected against hazards imposed by traffic, farm operations, freezing temperatures or soil cracking. Other means of protection must be provided where the depth required for protection cannot practically be achieved.
2. Trenches for plastic pipelines shall be free of rocks and other sharp edged materials.
3. Plastic pipelines shall be placed in a “snake like” position in the trench.

4. Before backfilling, the pipe shall be filled with water and tested at design working head or a minimum head of 10 feet, whichever is greater. All leaks shall be repaired and the test repeated before backfilling begins.

5. All backfilling shall be completed before the line is put into service. For plastic or copper pipe, the initial backfill shall be a minimum of 4 inches of select material, free from rocks or other sharp edged material that could damage the pipe. This initial fill shall be compacted around the pipe to a density of at least equal to the natural density of the trench sidewalls. Deformation or displacement of the pipe must not occur during backfilling.
6. Backfill of plastic pipe shall be done after the pipe reaches the same temperature as the water or soil.
7. Installation and backfilling shall be done in a workmanlike manner.
8. Provisions for stabilization of disturbed areas and control of erosion shall be installed according to Kentucky Conservation Practice Standard, Critical Area Planting (342).
9. Planning and implementation of this practice will be preceded by an environmental evaluation

DESIGN DATA

1. Record all design data in an engineering field book, and/or on a plan, or on a design sheet.
2. Estimate the rate of water required.
3. Estimate the rate of water supply.
4. If a pressure system, determine the needed pressure range in psi.
5. Profile along proposed line from source to point of delivery.
6. Determine the available head in feet.
7. Use chart K-L-20 to determine the required pipe size for livestock needs.
8. Detail profile/plan by sections, type, ASTM’s, length, sizes, and depths of pipe.
9. Complete Environmental Evaluation.

CHECK DATA

1. Record all check data in an engineering field book, and/or on a plan, or on a design sheet.

2. Document length, depth, size and type of pipe used.

3. A statement as to seeding, sodding, or successful establishment of vegetation.

4. A statement that the pipeline was pressure tested for leaks prior to backfill.

OPERATION AND MAINTENANCE

An Operation and Maintenance plan specific to the type of installed pipeline shall be provided to the landowner. The plan shall include, but not be limited to, the following provisions:

• Opening/closing valves to prevent excessive water hammer

• Filling at the specified rate requirements

• Inspecting and testing valves, pressure regulators, pumps, switches and other appurtenances

• Maintaining erosion protection at outlets

• Checking for debris, minerals, algae and other materials which may restrict system flow

• Draining and/or providing for cold weather operation of the system

REFERENCES

1. Engineering Field Handbook.

2. GM-190, ECOL SCI, Part 410,
Compliance with NEPA.

3. Midwest Plan Service, Structures and
Environment Handbook: MWPS-1.

PIPELINE DESIGN CHART FOR LIVESTOCK WATER FACILITIES (K-L-20) 1/ 2/

1/ An allowance for estimated bend losses (elbows, tees, etc.) has been included in the design of the chart.

2/ Use Copper/Plastic line for PVC pipelines also. Use galvanized iron line for steel pipelines also.

3/ The minimum size pipeline to be installed under a pond embankment shall be 1 inch PVC or HDPE and

1 ¼ gavanized iron or welded steel.

How to Use the Chart:

1. Determine available head in feet.

a. For Gravity Flow - This is the difference in elevation of water surface at the source of supply and the discharge elevation at the livestock water tank or fountain .

b. Pressure Flow - This includes water supply from pumps and water mains.

(1) Pumps - The capacity and operating head of the pump should be known. Convert the pump pressure to the pump's operating head in feet. Discharge head is the difference in elevation between the pump elevation and water elevation at the discharge point (tank).

[Pump Pressure (psi)] x [2.31] = Operating Pump Head (ft.)

How to Use the Chart (cont.):

Determine Available Head:

[Operating Pump Head (ft.)] – [Discharge Head (ft.)] = Available Head (ft.)

(2) Water Mains – The pressure head at the water meter should be known or measured. Discharge head is the difference in elevation between the meter elevation and the water elevation at the discharge point (tank).

[Pressure at meter (psi)] x [2.31] = Pressure Head at meter (ft.)

Determine Available Head: [Meter Head (ft.)] – [Discharge Head (ft.)] = Available Head (ft.)

If the pressure head at the meter cannot be determined, assume 50 feet of head.

If the pressure at the meter is known to exceed 50 psi, a pressure regulator should be considered.

2. Determine Flow - Gallons Per Hour.

To determine the diameter of the pipeline and size of the tank the amount of desired storage should be determined. Table 1 gives livestock needs. Table 2 lists the tank sizes and pipe flow for various water needs.

Table 1 – Daily consumption of water by livestock

Kind of Livestock	Gallons per Head per Day
Beef Cattle and Horses	12-15
Dairy Cows (drinking only)	15
Dairy Cows (w/wash water)	35
Hogs	4
Sheep	2

Table 2 - Flow-rate in Pipeline – Gallons per Hour with Storage 1/

Water Needs Tank Capacity Gallons

Gallons /Hour 100 200 300 400 500 750 1000 1250 1500 2000

50 10 10

100 25 10 10

150 50 25 15 15

200 100 50 25 20 20

250 150 75 50 25 25

300 200 100 75 50 30 25

350 250 150 100 75 50 35 35

400 300 200 125 100 75 40 40

450 350 250 150 1 25 100 45 45

500 400 300 200 150 125 75 50 50

600 500 400 300 200 175 125 60 60

700 600 500 400 300 200 175 100 70 70

800 700 600 500 400 300 225 150 90 75 75

900 800 700 600 500 400 275 200 150 75 75

1000 900 800 700 600 500 325 250 200 125 100

1/ Automatic livestock water facilities require 900 gallons per hour flow-rate in pipeline each.

EXAMPLE: The available head is 9 feet, pipeline length is 1000 feet, and flow rate is 50 gallons per hour. Find size of pipe from K-L-20.

1. Extend line from available head (9) through length of pipeline (1000) to intersection with pivot line.
2. Extend line from pivot line to intersection with flow – gallons per hour (50).
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3. The location at which this line intersects the pipeline size is within the ¾" plastic, PVC, PE, and copper pipe. The line also intersects within the 1" galvanized iron or steel pipe.

NATURAL RESOURCES CONSERVATION SERVICE

CONSTRUCTION SPECIFICATION

PIPELINE

SCOPE

This item shall consist of the installation of the pipeline. Construction shall be carried out in such a manner that erosion, water, air, and noise pollution will be minimized and held within legal limits as established by state regulations. The construction operations shall be performed in a workmanlike manner and the job site shall have a neat appearance when finished.

LOCATION

The tank or trough shall be installed at the location shown on the drawings, or at the location designated by the NRCS technicians.

PLACEMENT

Pipelines shall be placed so that they are protected against hazards imposed by traffic, farm operations, freezing temperatures, or soil cracking. Other means of protection must be provided if the depth required for protection is impracticable

because of shallow soils over rock or for other reasons. Abrupt changes in grade must be avoided to prevent rupture of the pipe.

The minimum depth for freeze protection shall be 18 inches.

Trenches for plastic pipelines shall be free of rocks and other sharp-edged materials, and the pipe shall be carefully placed to prevent damage.

Plastic pipelines may be placed by plow-in equipment if soils are suitable and rocks and boulders will not damage the pipe.

TESTING

Pipelines shall be pressure tested by one of the following methods:

1. Before backfilling, fill the pipe with water and test at the design working head or at a head of 10 feet whichever is greater. All leaks must be repaired, and the test must be repeated before backfilling.
2. Pressure test at the working pressure for 2 hours. The allowable leakage shall not be greater than one gallon per diameter inch per mile. If leakage exceeds this rate, the defect must be repaired, until retest show that the leakage is within the allowable limits, but all visible leaks must be repaired.

BACKFILLING

All backfilling shall be completed before the line is placed in service. For plastic or copper pipe, the initial backfill shall be of selected material that is free of rocks or other sharp-edged material that can damage the pipe. Deformation or displacement of the pipe must not occur during backfilling.

Plastic pipelines installed by the plow-in method require surface compaction and shaping in addition to the normal plow-in operations.

Provisions shall be made for stabilizing disturbed areas and controlling erosion.

INSTALLATION

The foundation area shall be cleared of all material not suitable for subgrade and be leveled to allow the trough or tank to be placed on firm ground. The area

surrounding the trough or tank shall be smoothed and graded to permit free drainage of surface water away from it, yet allow access by the animals for which it is being installed. All backfill for underground pipes shall be compacted to the degree required to prevent caving after construction is completed.

HEAVY USE AREA The trough or tank shall be located so that a dry surface is maintained around the base, extending 10 feet from all sides of the trough or tank. The minimum gravel mat thickness shall be 6 inches.

NATURAL RESOURCES CONSERVATION SERVICE

CONSERVATION PRACTICE STANDARD

PIPELINE

(Feet)

CODE 516

DEFINITION

Pipeline having an inside diameter of 8 inches or less.

PURPOSE

To convey water from a source of supply to points of use for livestock, wildlife, recreation, or other agricultural purposes.

CONDITIONS WHERE PRACTICE APPLIES

Where it is desirable or necessary to convey water in a closed conduit from one point to another.

CRITERIA

Capacity. For livestock water, the installation shall have a capacity to provide seasonal high daily water requirements for the number and species of animals to be supplied. Animal water requirements can be obtained from NRCS Conservation Practice Standard "Watering Facility (614) or table1. For dairy operations including washwater, provide for 35 gallons per head per day.

For recreation areas, the water capacity shall be adequate for all planned uses. Typical examples are drinking water, fire protection, showers, flush toilets, and irrigation of landscaped areas.

Pipelines used in wastewater recycling systems as part of an animal waste management system must have adequate capacity. Where flush tanks are used, the capacity must be adequate to refill flush tanks with the allotted time between flushing events. For pump flush systems or hose wash systems, the pipeline must be capable of supplying the required flow rate.

Additional water capacity will be provided for wildlife when applicable.

Sanitary protection. If water from the pipeline is to be used for human consumption, applicable state and local regulations shall be met. The design shall meet the requirements of the Kentucky Department of Health.

Backflow Protection. A suitable air gap or a backflow prevention device will be installed in pipeline systems where there is a potential for a cross-connection hazard to potable water supplies. Specific criteria for the type of backflow prevention device needed are dependent on applicable state and local regulations.

Pipe. All pipe must withstand the pressure it will be subjected to, including hydraulic transients, internal pressures and external pressures. As a safety factor against surge or water hammer, the working pressure should not exceed 72% of the pressure rating of the pipe and the design flow velocity at system capacity should not exceed 5 ft/sec. If either of these limits is exceeded, special consideration must be given to flow conditions and measures must be taken to adequately protect the pipeline against surge.

Steel pipe shall meet the requirements of AWWA Specification C-200.

Plastic pipe shall conform to the requirements of the following ASTM specifications, as applicable:

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NATURAL RESOURCES CONSERVATION SERVICE

CONSERVATION PRACTICE STANDARD

PUMPING PLANT FOR WATER CONTROL

(No.)

Code 533

DEFINITION

A pumping facility installed to transfer water for a conservation need, including removing excess surface or groundwater; filling ponds, ditches, or wetlands; or pumping from wells, ponds, streams, and other sources.

PURPOSE

To provide a dependable water source or disposal facility for water management on wetlands or to provide a water supply for such purposes as irrigation, recreation, livestock, or wildlife.

CONDITIONS WHERE PRACTICE APPLIES

Wherever water must be pumped to accomplish a conservation objective, which may include but is not limited to one of the following:

- To provide a water supply for such purposes as irrigation, recreation, livestock, or wildlife.
- To maintain critical water levels in swamps, marshes, open water, or for newly constructed wetlands and ponds.
- To transfer wastewater for utilization as part of a waste management system
- To provide drainage by the removal of surface runoff water or groundwater.

CRITERIA

Design, installation, and operation of a pumping plant shall comply with all federal, state, and local laws, rules and regulations.

The efficiency of units, type of power, quality of building, automation, and accessories installed shall be in keeping with the value and importance of the system and shall accomplish the conservation and environmental objectives.

Pump requirements. Capabilities, range of operating lifts, and general class and efficiency of equipment shall be determined from appropriate technical means. Size and number of pumps and their performance requirements shall be determined on the basis of system conservation requirements in order to meet the intended purpose. Total head shall be determined for critical operating conditions, taking into account all hydraulic losses. Automatic controls shall be included in the plans as required.

Pumps utilized for the transfer of wastewater or manure shall be sized to transfer material at the required system head and flow rate determined by the waste management plan. The pump type shall be based on the consistency of material being pumped and manufacturer’s recommendations.

Power units. Power units shall be selected on the basis of availability of fuel or power costs, operating conditions, conservation needs, and objectives, including need for automation. The power unit shall be matched to the pump and be capable of operating the pump effectively within the range of operating conditions. The horsepower requirements, pump efficiency, and total head on the pump shall be computed. **Suction and discharge pipes.** The size of suction and discharge pipes shall be based on a hydraulic analysis, operating cost, and compatibility with other system components. The arrangement and length of discharge pipe shall be based on the need for recovery of head

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NATURAL RESOURCES CONSERVATION SERVICE
CONSERVATION PRACTICE STANDARD
PUMPING PLANT FOR WATER CONTROL

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Power units. Power units shall be selected on the basis of availability of fuel or power costs, operating conditions, conservation needs, and objectives, including need for automation. The power unit shall be matched to the pump and be capable of operating the pump effectively within the range of operating conditions. The horsepower requirements, pump efficiency, and total head on the pump shall be computed.

Suction and discharge pipes. The size of suction and discharge pipes shall be based on a hydraulic analysis, operating cost, and compatibility with other system components. The arrangement and length of discharge pipe shall be based on the need for recovery of head through siphoning action, and for delivery of

h siphoning action, and for delivery of Conservation practice standards are reviewed periodically, and updated if needed. To obtain the current version of this standard, contact the Natural Resources Conservation Service. **NRCS, KY, April 2003** 533-2

water in keeping with conservation and environmental objectives. Gates, valves, pipe connections, discharge bays, and other protective works shall be installed, as needed, for satisfactory plant operation.

Federal, State, and local laws and regulations concerning backflow prevention shall be followed when pumping from wells or when chernigating.

Building and accessories. The design of the plant and associated housing, if required, shall consider accessibility for equipment maintenance and repairs, and the need for protecting equipment from the elements, vandalism, and fire. The appearance of the plant shall be compatible with the surrounding environment as applicable.

Foundations shall be designed to safely support the loads imposed. Sheet piling or other measures shall be used, as required, to prevent piping beneath the foundation.

Pumps may be mounted in the open, on piling or concrete foundations, or in a well or pit or by other appropriate means.

Suction bays (or sumps) shall be designed to conform to the hydraulic characteristics established by the pump manufacturer.

The discharge bay or connection with distribution system shall be ample to meet hydraulic and structural requirements. Provisions for repair or removal of pumps and engines shall be provided. Trash racks shall be provided, as needed, to exclude debris and trash from the pump.

All structural features and equipment shall provide adequate safety features to protect workers and public against injury.

CONSIDERATIONS

 When planning this practice the following items should be considered, as applicable:

 Effects on downstream flows or aquifer recharge volumes.

 Effects on existing wetland hydrology.

 Effects on surface and ground water by leaked or spilled fuels and lubricants.

 Secondary containment of spilled fuel for water quality as may be required by federal and state laws or regulations.

 Protection of system components from " natural" events such as floods.

PLANS AND SPECIFICATIONS

Plans and specifications for constructing pumping plants for water control shall be in keeping with this standard and shall describe the requirements for properly installing the practice to achieve its intended purpose.

OPERATION AND MAINTENANCE

An Operation and Maintenance plan specific to the facilities installed shall be prepared for use by the landowner or responsible operator. The plan shall provide specific instructions for operating and maintaining facilities to ensure the pumping plant functions properly. The plan shall include provisions to address the following, as a minimum:

• Inspection or testing of all pumping plant components and appurtenances, as applicable.

• Proper start-up procedures for the operation of the pumping plant.

• Routine maintenance of all mechanical components (power unit, pump, drive train, etc.) in accordance with the manufacturer's recommendations.

• When applicable, the power unit, fuel storage facilities and fuel lines should be frequently checked for fuel or lubricant leaks and repaired as needed.

• Periodic checks and removal of debris as necessary from trash racks and structures to assure adequate capacity reaches the pumping plant.

• Periodic removal of sediment in suction bays to maintain design capacity and efficiency.

• Inspect and maintain anti-siphon devices, if applicable.

• Routinely test and inspect all automation

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• components of the pumping plant to assure they are functioning as designed.

• Inspect and maintain secondary containment facilities, if applicable.

• Periodic inspection of all safety features to ensure they are in place and functional.

• Prior to retrofitting any electrically powered equipment, electrical service must be disconnected and the absence of stray electrical current verified.

REFERENCES

1. Midwest Plan Service Structures and Environment Handbook, MWPS-1.

2. USDA, NRCS, NEH Part 650 Engineering Field Handbook.

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Technical Guide Section IV

NATURAL RESOURCES CONSERVATION SERVICE

CONSERVATION PRACTICE STANDARD

ACCESS ROAD

(Feet)

CODE 560

DEFINITION

A travel way for equipment and vehicles constructed as part of a conservation plan.

PURPOSE

To provide a fixed route for vehicular travel for resource activities involving the management of timber, livestock, agriculture, wildlife habitat, and other conservation enterprises while protecting the soil, water, fish, wildlife, and other adjacent natural resources.

CONDITIONS WHERE PRACTICE APPLIES

Where access is needed from a private or public road or highway to a land use enterprise or conservation measure, or where travel ways are needed in a planned land use area.

Access roads range from seasonal use roads, designed for low speed and rough driving conditions, to all-weather roads heavily used by the public and designed with safety as a high priority. Some roads are only constructed for a single purpose; i.e., control of forest fires, logging and forest management activities, access to remote recreation areas, or access for maintenance of facilities.

Conservation practice standards are reviewed periodically, and updated if needed. To obtain the current version of this standard, contact the Natural Resources Conservation Service.

CRITERIA

Access roads shall be designed to serve the enterprise or planned use with the expected vehicular or equipment traffic. The type of vehicle or equipment, speed, loads, soil, climatic, and other conditions under which vehicles and equipment are expected to operate need to be considered. Planned work shall comply with all federal, state, and local laws and regulations.

Where general public use is anticipated, roads shall be designed to meet applicable federal, state, and local criteria.

Sound engineering practices shall be followed to ensure that the road meets the requirements of its intended use and that maintenance requirements are acceptable.

Location. Roads shall be located to serve the purpose intended, to facilitate the control and disposal of surface and subsurface water, to control or reduce erosion, to make the best use of topographic features, and to include scenic vistas where possible. The roads should generally follow natural contours and slopes to minimize disturbance of drainage patterns. Roads shall be located where they can be maintained and where water management problems are not created. To reduce potential pollution, roads shall be located away from watercourses where possible. Where roads must be located adjacent to water bodies, buffers shall be utilized to the extent practicable.

Alignment. The gradient and horizontal alignment shall be adapted to the intensity of use, mode of travel, the type of equipment and load weights, and the level of development.

Grades normally should not exceed 10 percent except for short lengths, but maximum grades of 18 percent or more may be used if necessary for special uses such as logging roads, field access roads, fire protection roads, or other roads not intended for public access.

For stream crossings, the road should be aligned so that it crosses perpendicular to the channel as much as possible.

Width. The minimum width of the roadbed is 14 feet for one-way traffic and 20 feet for two-way traffic. The roadbed width includes a tread-width of 10 feet for

one-way traffic or 16 feet for two-way traffic. Each type of road also requires 2 feet of shoulder width on each side. Single-lane logging or special-purpose roads can have a minimum width of 10 feet, with greater widths at curves and turnouts. The two-way traffic width shall be increased approximately 4 feet for trailer traffic. The shoulder width may be either gravel or grass.

Turnouts shall be used on single lane roads where vehicles travel in both directions on a limited basis. Where turnouts are used, road width shall be increased to a minimum of 20 feet for a distance of at least 30 feet.

Side Slopes. All cuts and fills shall be designed to have stable slopes of a minimum of 2 horizontal to 1 vertical on heights of less than 4 feet. For short lengths, rock areas, or very steep hillsides, steeper slopes may be permitted, if soil conditions warrant and special stabilization measures are installed.

Areas with geological conditions and soils subject to slides shall be avoided or treated to prevent slides.

Drainage. The type of drainage structure used will depend on the intended use and runoff conditions. Culverts, bridges, fords, or grade dips for water management shall be provided at all natural drainage ways. The capacity and design shall be consistent with sound engineering principles and shall be adequate for the class of vehicle, type of road, development, or use. When a culvert or bridge is installed in a drainage way, its minimum capacity shall convey the design storm runoff without causing erosion or road overtopping. Table 1 lists minimum design storm frequencies for various road types.

Table 1. Minimum Design Storm Frequencies

Road Type	**Storm Frequency**
Forest Access Roads, Farm Field Access Roads	2 year – 24 Hour
Farm Driveways,	10 year – 24 Hour

Recreation	
Facility Access	
Roads	
Public Access	25 year – 24
Roads,	Hour
Campgrounds,	
etc.	

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NATURAL RESOURCES CONSERVATION SERVICE

CONSERVATION PRACTICE STANDARD

ACCESS ROAD

(Feet)

CODE 560

DEFINITION

A travel way for equipment and vehicles constructed as part of a conservation plan.

PURPOSE

To provide a fixed route for vehicular travel for resource activities involving the management of timber, livestock, agriculture, wildlife habitat, and other conservation enterprises while protecting the soil, water, fish, wildlife, and other adjacent natural resources.

CONDITIONS WHERE PRACTICE APPLIES

Where access is needed from a private or public road or highway to a land use enterprise or conservation measure, or where travel ways are needed in a planned land use area.

Access roads range from seasonal use roads, designed for low speed and rough driving conditions, to all-weather roads heavily used by the public and designed with safety as a high priority. Some roads are only constructed for a single purpose; i.e., control of forest fires, logging and forest management activities, access to remote recreation areas, or access for maintenance of facilities.

CRITERIA

Access roads shall be designed to serve the enterprise or planned use with the expected vehicular or equipment traffic. The type of vehicle or equipment, speed, loads, soil, climatic, and other conditions under which vehicles and equipment are expected to operate need to be considered. Planned work shall comply with all federal, state, and local laws and regulations.

Where general public use is anticipated, roads shall be designed to meet applicable federal, state, and local criteria.

Sound engineering practices shall be followed to ensure that the road meets the requirements of its intended use and that maintenance requirements are acceptable.

Location. Roads shall be located to serve the purpose intended, to facilitate the control and disposal of surface and subsurface water, to control or reduce erosion, to make the best use of topographic features, and to include scenic vistas where possible. The roads should generally follow natural contours and slopes to minimize disturbance of drainage patterns. Roads shall be located where they can be maintained and where water management problems are not created. To reduce potential pollution, roads shall be located away from watercourses where possible. Where roads must be located adjacent to water bodies, buffers shall be utilized to the extent practicable.

Alignment. The gradient and horizontal alignment shall be adapted to the intensity of use, mode of travel, the type of equipment and load weights, and the level of development.

Grades normally should not exceed 10 percent except for short lengths, but maximum grades of 18 percent or more may be used if necessary for special uses

such as logging roads, field access roads, fire protection roads, or other roads not intended for public access.

For stream crossings, the road should be aligned so that it crosses perpendicular to the channel as much as possible.

Width. The minimum width of the roadbed is 14 feet for one-way traffic and 20 feet for two-way traffic. The roadbed width includes a tread-width of 10 feet for one-way traffic or 16 feet for two- way traffic. Each type of road also requires 2 feet of shoulder width on each side. Single-lane logging or special-purpose roads can have a minimum width of 10 feet, with greater widths at curves and turnouts. The two-way traffic width shall be increased approximately 4 feet for trailer traffic. The shoulder width may be either gravel or grass.

Turnouts shall be used on single lane roads where vehicles travel in both directions on a limited basis. Where turnouts are used, road width shall be increased to a minimum of 20 feet for a distance of at least 30 feet.

Side Slopes. All cuts and fills shall be designed to have stable slopes of a minimum of 2 horizontal to 1 vertical on heights of less than 4 feet. For short lengths, rock areas, or very steep hillsides, steeper slopes may be permitted, if soil conditions warrant and special stabilization measures are installed.

Areas with geological conditions and soils subject to slides shall be avoided or treated to prevent slides.

Drainage. The type of drainage structure used will depend on the intended use and runoff conditions. Culverts, bridges, fords, or grade dips for water management shall be provided at all natural drainage ways. The capacity and design shall be consistent with sound engineering principles and shall be adequate for the class of vehicle, type of road, development, or use. When a culvert or bridge is installed in a drainage way, its minimum capacity shall convey the design storm runoff without causing erosion or road overtopping. Table 1 lists minimum design storm frequencies for various road types.

Table 1. Minimum Design Storm Frequencies

Road Type	**Storm Frequency**

Forest Access Roads, Farm Field Access Roads	2 year – 24 Hour
Farm Driveways, Recreation Facility Access Roads	10 year – 24 Hour
Public Access Roads, Campgrounds, etc.	25 year – 24 Hour

NRCS, KY, April 2003 560- 2

TECHNICAL GUIDE SECTION IV NATURAL RESOURCES CONSERVATION SERVICE

CONSERVATION PRACTICE STANDARD

HEAVY USE AREA PROTECTION

(Acre)

CODE 561

DEFINITION

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

PURPOSES

This practice may be used as a part of a conservation management system to support one or more of the following purposes.

- Reduce soil erosion
- Improve water quantity and quality
- Improve air quality
- Improve aesthetics
- Improve livestock health

CONDITIONS WHERE PRACTICE APPLIES

This practice applies to urban, agricultural, recreational or other frequently and intensively used areas requiring treatment to address one or more resource concerns.

This practice applies to animal feeding operations where applied as a component of a planned waste management system.

CRITERIA

General Criteria Applicable to All Purposes

All planned work shall comply with Federal, state, and local laws and regulations.

Safety of the users shall be incorporated into the design of the heavy use area protection.

Design Load. The design load will be based on the type of traffic, (vehicular, animal, or human) anticipated on the heavy use area. The minimum design load for areas that support vehicular traffic will be a wheel load of 4000 lbs.

Foundation. All site foundations shall be evaluated for soil moisture, permeability, texture and bearing strength in combination with the design load and anticipated frequency of use.

A base course of gravel, crushed stone, other suitable material and/or geotextile shall be provided on all sites with a need for increased load bearing strength, drainage, separation of material and soil reinforcement. Natural Resources Conservation Service (NRCS), National Engineering Handbook (NEH), Parts 642 and 643 (formerly, NEH, Section 20) and AASHTO M-288 (latest edition) provide guidance in quality specification and

NRCS, KY April 2003 Conservation practice standards are reviewed periodically, and updated if needed. To obtain the current version of this standard, contact the Natural Resources Conservation Service.

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Technical Guide Section IV

NATURAL RESOURCES CONSERVATION SERVICE

CONSERVATION PRACTICE STANDARD

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Purpose

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- Improve water quantity and quality
- Improve air quality
- Improve aesthetics
- Improve livestock health

Conditions where Practice Applies

This practice applies to urban, agricultural, recreational or other frequently and intensively used areas requiring treatment to address one or more resource concerns.

Criteria

General Criteria Applicable to All Purposes

All planned work shall comply with Federal, state, and local laws and regulations.

Measures shall be taken to limit the generation of particulate matter.

Safety of the users shall be incorporated into the design of the heavy use area protection.

Design Load. The design load will be based on the type of traffic, (vehicular, animal, or human) anticipated on the heavy use area. The minimum design load for areas that support vehicular traffic will be a wheel load of 4000 lbs.

Foundation. All site foundations shall be evaluated for soil moisture, permeability, texture and bearing strength in combination with the design load and anticipated frequency of use.

A base course of gravel, crushed stone, other suitable material and/or geotextile shall be provided on all sites with a need for increased load bearing strength, drainage, separation of material and soil reinforcement. Natural Resources Conservation Service (NRCS), National Engineering Handbook (NEH), Parts 642 and 643 (formerly, NEH, Section 20) and AASHTO M-288 (latest edition)

provide guidance in quality specification and geotextile selection.

An impervious barrier shall be provided on sites with a porous foundation (high permeability rate), where there is a need to protect ground water from contamination.

Foundation preparation shall consist of removal and disposal of soil and other material that are not adequate to support the design loads.

Surface Treatment. The surface treatment shall meet the following criteria:

Bituminous Pavement. The thickness of the pavement course, the kind and size of aggregate, the type of proportioning of bituminous materials, and the mixing and placing of these materials shall be in accordance with Department of Transportation criteria for the expected loading.

Concrete. The quality and thickness of concrete and the spacing and size of reinforcing steel shall be appropriate for the expected loading.

Other Cementitious Materials. Soil cement, roller compacted concrete, and coal combustion by-products (flue gas desulphurization sludge and fly ash) may be used as surface material if designed and installed to withstand the anticipated loads and surface abrasion.

Aggregate. A fine or coarse aggregate surface shall be minimum 2-inches thick.

Other. Surfacing materials, such as cinders, tanbark, bark mulch, brick chips, shredded rubber and/or sawdust, shall have a minimum layer thickness of 2 inches.

Structures. All structures shall be designed according to appropriate NRCS standards and specifications or Engineering Handbook recommendations.

Sprays and Artificial Mulches. When utilizing sprays of asphalt, oil, plastic, manufactured mulches, and similar materials, the manufacturer's recommendations for application shall be incorporated into the design.

Drainage and Erosion Control. Provision shall be made for surface

and subsurface drainage, as needed, and for disposal of runoff without causing erosion or water quality impairment. Provision shall be made to exclude unpolluted run-on water from the treatment area. All treatment areas shall be shaped to prevent ponding of water.

Vegetative Measures. Liming, fertilizing, soil preparation, seeding, mulching, sodding and vegetation management shall be according to the planned use and appropriate conservation practice standard in the local technical guide. If vegetation is not appropriate, other measures shall be used to accomplish the intended purpose.

Additional Criteria for Areas Utilized by Livestock

The treated area shall extend an appropriate distance from facilities such as portable hay rings, water troughs, feeding troughs, mineral boxes and other facilities where livestock concentrations cause resource concerns.

NRCS conservation practice standards Critical Area Planting (342); Fencing (382); Prescribed Grazing (528a); Filter Strip (393); or Use Exclusion (472) shall be used as companion practices, when needed to meet the intended purpose of the heavy use area protection.

Provisions shall be made to collect, store, utilize and/or treat manure accumulations and contaminated runoff in accordance with other NRCS conservation practice standards.

Additional Criteria for Areas Utilized for Recreation

The treated area shall be conducive to the overall recreation area and aesthetically blend with the general landscape and surroundings.

Plants, landscaping timbers, traffic control measures, wooden walkways, etc. shall be evaluated for effectiveness, aesthetics and accessibility as covered by the Americans with Disabilities Act.

CONSIDERATIONS

When stabilizing heavily used areas consider adjoining land uses and the proximity to residences, utilities, cultural resource areas, wetlands or other environmentally sensitive

areas, and areas of special scenic value.

For heavy use areas conducive to protection by vegetation, consideration must be given to the effect(s) of treading and/or miring. The vegetative species selected should tolerate and persist under heavy use conditions. If practicable, consider increasing the size of the area and/or establishing a rest/non-use period to allow plant recovery and increase vigor.

Heavy use area protection effects on the water budget, especially on volumes and rates of runoff, infiltration, and transpiration due to the installation of less pervious surfaces should be considered in the selection of surfacing materials.

The transport of sediments, nutrients, bacteria, organic matter from animal manures; oils, chemicals and particulate matter associated with vehicular traffic; and soluble and sediment-attached substances carried by runoff should be considered in selection of companion conservation practices.

Consider using additional air quality conservation practices such as Windbreak/Shelterbelt Establishment (code 380) or Herbaceous Wind Barriers (code 603) to impede transport of particulate matter between the source (i.e., heavy use area) and nearby sensitive areas.

If the purpose of the heavy use area protection is improvement of water quality, the heavy use area should be relocated as far away from the water body or watercourse as possible. Any work in and/or discharges near streams, wetlands or water bodies may require a permit from the US Army Corps of Engineers, state water quality (permitting) authority, or local authority.

The size of heavy use areas utilized by livestock is dependent on the landowner’s operation including type and number of animal, confinement periods, and/or the intended use. The size of treatment areas can range from 30 square feet per animal in partial-confinement to 400 square feet per animal in total

confinement to 4000 or more square feet for animal exercise areas. Heavy use protection areas should be kept as small as practicable.

When surface treatments such as bark mulch, wood-fiber or other non-durable materials are used for short-term livestock containment areas, consideration should be given to vegetation of the affected area with a cover crop.

For areas with aggregate surfaces that will be frequently scraped, consideration should be given to the use of concrete or cementitious materials to lessen the recurring cost of aggregate replacement.

Plans and specifications

Plans and specifications for heavy use area protection shall be in keeping with this standard and shall describe the requirements for applying the practice to achieve its intended purpose. Plans and specifications shall include construction plans, drawings, job sheets or other similar documents. These documents shall specify the requirements for installing the practice, including the kind, amount and quality of materials to be used.

Operation and maintenance

An Operation and Maintenance (O&M) plan shall be prepared for and reviewed with the landowner or operator. The plan shall specify that the treated areas and associated practices are inspected annually and after significant storm events to identify repair and maintenance needs.

The O&M plan shall detail the level of repairs needed to maintain the effectiveness and useful life of the practice.

For livestock operations, the O&M plan for heavy use areas may be included as a part of the overall waste management plan. Periodic removal and management of manure accumulations will be addressed in the O&M plan.

Conservation practices should be implemented that limit particulate matter emission into long-term maintenance plans.

Technical Guide Section IV NATURAL RESOURCES CONSERVATION SERVICE

CONSERVATION PRACTICE STANDARD

561-CS-1 HEAVY USE AREA PROTECTION CONSTRUCTION SPECIFICATIONS

Scope

This item shall include all plans, specifications, construction operations, and vegetation required for the installation of heavy use areas. Construction operations shall be done in such a manner that soil erosion and pollution will be minimized and held within legal limits as specified by state and local laws.

Foundation preparation. All incompact, wet, organic or other undesirable materials shall be removed to depths, widths, and lengths as required by the design. The subgrade shall be compacted according to design specifications. All waste materials shall be disposed of in designated areas. All burning shall conform to Kentucky laws and regulations.

Geotextile. The minimum requirements for geotextile shall be as indicated in **Table 1** for non-woven geotextile and **Table 2** for woven geotextile.

Base Course Materials. Aggregates may be crushed stone of KYDOH DGA, #8, #610, #57, or #4 gradation. The base course material shall be thoroughly compacted before application of a surface course treatment.

Surface Aggregate Materials. Surface materials for treatment areas shall be a minimum compacted layer of 2 inches KYDOH class I sand, dense grade aggregate (DGA), #8, #610, or #57stone. The surface aggregate material shall be spread evenly over the base course material to a minimum depth of 2 inches. The final grade shall be positive to the edges of the heavy use area and outlet onto a vegetative grass buffer.

Protection. Vegetation shall be applied as shown on the plans and specifications. Vegetation shall include seedbed preparation, liming, fertilizing, seeding, and either mulching or netting when needed and specified.

Fencing. Fencing shall be installed as necessary to control all animal traffic and to positively effect water quality. Fencing shall be built in accordance with NRCS Conservation Practice Standard, Fence, Code 382.

Table 1 - Minimum Requirements for Non - Woven Geotextile

Property	Test Method	Value
Tensile Strength (pounds)1/	ASTM D 4632 Grab Test	150 min.
Bursting Strength (psi)1/	ASTM D 3786 Diaphragm Tester	320 min.
Elongation @ Failure (percent)1/	ASTM D 4632 Grab Test	> 50
Puncture (pounds)1/	ASTM D 4833	80 min.
Ultraviolet Light (% residual tensile strength)	ASTM D 4755 150 hours exp.	70 min.
Apparent Opening Size - AOS	ASTM D 4751	# 40 max.2/
Permittivity (1/sec)	ASTM D 4491	0.70 min.

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Technical Guide Section IV NATURAL RESOURCES CONSERVATION SERVICE

CONSERVATION PRACTICE STANDARD

SPRING DEVELOPMENT

(No.)

Code 574

DEFINITION

Utilizing springs and seeps to provide water for conservation need.

PURPOSES

This practice may be applied as part of a resource management system to support one or more of the following purposes:

- Improve the distribution of water
- Increase the quantity and quality of water for livestock, wildlife, or other uses
- Obtain water for irrigation if water is available in a suitable quantity and quality

CONDITIONS WHERE PRACTICE APPLIES

In areas where spring or seep development will provide a dependable supply of suitable water for the planned times of use, and where the intended purpose can be achieved by using this practice alone or combined with other conservation practices.

CRITERIA

GENERAL CRITERIA APPLICABLE TO ALL PURPOSES

Spring developments shall be planned, designed, and constructed in compliance with federal, state and local laws and regulations.

All loose rock, sediment, travertine (calcium deposits), logs and vegetation that obstruct the free discharge shall be removed.

Construction operations will be carried out in such a manner that erosion and air and water pollution will be minimized.

Impacts to existing wetland functions shall be assessed. USDA wetland conservation provisions apply. The practice must comply with NRCS wetland

technical assistance policy contained in GM 190, Part 410.26, Subpart C, and Part 410.37, Subpart C.

An investigation of site conditions shall be made. Water quality shall be determined to the extent required for the intended purpose. Water quantity shall be measured from existing flows, as practicable, to determine if the development will meet requirements.

The developed spring should be evaluated for the land user's need. Yield should be based on the seasonal low flow. Flow rate should be measured as gallons per minute. This rate should be converted into a daily yield value (by multiplying by 1,440) to determine if livestock needs are met based on the minimum rate(s) shown in Table1.

Table 1 – Daily consumption of water by livestock

Kind of Livestock	Gallons per Head per Day
Beef Cattle and Horses	12-15
Dairy Cows (drinking only)	15
Dairy Cows (w/wash water)	35
Hogs	4
Sheep	2

Code 574

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water)	
Hogs	
Sheep	

Where seasonal flow variation decreases to less than that required to fill the stock-watering trough on demand, a storage tank of sufficient size shall be designed.

Conservation practice standards are reviewed periodically, and updated if needed. To obtain the current version of this standard, contact the Natural Resources Conservation Service. **NRCS, KY, April 2003** 574-2

Fracture and Tubular Springs

This type of spring is associated with cavernous rock. If water issues from rock fractures, the individual openings shall be cleaned and enlarged, as needed, to

improve flow. The water from these individual openings shall be collected by means of tile or perforated pipeline or by a gravel-filled ditch. The collection works shall be constructed an adequate distance below the elevation of the openings to permit free discharge.

If water issues from a single opening, such as a solution channel in a soluble rock formation, the opening shall be cleaned or enlarged as needed. A collection system usually is not required.

If a spring box or sump is used, it shall be installed at an elevation low enough so that water will not pond over the spring opening to a depth that will materially reduce the yield.

Perched or Contact Springs

Perched or contact springs occur when an impermeable layer lies beneath a water-bearing permeable layer. These springs shall be developed by intercepting and collecting the flow from the water-bearing formation. Collection trenches shall be used for developing these types of springs.

Artesian Springs

Artesian springs normally occur at a fissure or break in the impervious stratum with the water source being an under-lying pervious water-bearing layer so positioned that the water surface elevation (water table) is always above the outlet point of the spring. Artesian springs shall be developed by removing obstructions, cleaning or enlarging joints or fractures, or by lowering the outlet elevation as needed to improve flow. Sumps and/or spring boxes shall be located as needed. Free outlet discharge or minimum restriction to the spring flow is required to protect and maintain yield.

Collection Systems

If a collection trench is used, the trench shall be excavated so that it extends into the impervious layer. Minimum length of the trench shall be based on site conditions. Preferably, it will extend the entire length of the water-bearing outcrop.

A cutoff wall shall be constructed along the downstream side of the trench if needed to ensure that the flow enters the collection system. The cutoff wall may

be constructed of plastic sheeting, well-tamped clay, masonry, concrete, or other impervious materials.

The collection system shall consist of subsurface drainage tubing or perforated pipe not less than 4-inches in diameter, a wood box drain, or other suitable manufactured system enclosed in a sand-gravel filter. Geotextile fabric may be used as a filter on suitable sites. The type of filter selected will be dependent on the soils of the site. The designer must ensure that the filter system will not become clogged and cause the collection system to fail. Cleanouts are recommended for all collection systems.

Crushed rock or gravel backfill, not less than 1 foot thick, may be used as a collection system if site conditions warrant, in lieu of other materials.

Sand, gravel, and crushed rock shall be composed of clean, hard, durable particles. Use of these materials must be appropriate for their purpose and compatible with the soils on site.

Spring Boxes

Spring boxes, if needed, shall be made of plastic, concrete, or other durable material, with a tight access cover and impervious floor. A “shoebox” type access cover or manhole attachment, with gasket, is recommended for tightness. The floor may be omitted when the underlying material is stable and impervious.

The boxes shall have a minimum cross-sectional area of 1½ ft^2, and the floor of the box shall be not less than 6 inches below the outlet of the collection system. Spring box overflows, if needed, shall be piped to a desirable point of release. The outlet pipe will be protected from freezing and ice damage if this is a potential problem.

Outlets

The outlet pipe from a spring box shall be placed not less than 6 inches above the floor to provide a sediment trap. The spring outlet pipe should be at the same elevation or lower than the collection system outlet to avoid causing head on the spring that may reduce spring flow. The intake to the outlet pipe shall be screened as necessary, and installed to the box with a

watertight connection.

The outlet pipe must have positive grade away from the spring box or collection system unless vent pipe(s) are added to prevent air locks.

The outlet pipe shall have minimum 1¼-inch (3-cm) diameter. In lieu of site-specific spring flow and pipe vent calculations, the outlet pipe shall have the following minimum size based on line grades:

1. 1¼ inches inside diameter for line grades greater than 1.0 percent.
2. 1½ inches inside diameter for line grades greater than or equal to 0.5 percent but less than or equal to 1.0 percent.
3. 2 inches inside diameter for line grades less than 0.5 percent.

Minimum outlet pipe material and strength requirements shall equal those found in Kentucky Conservation Practice Standard Pipeline (Code 516).

Component Protection

Measures required protecting components from damage by freezing, flooding, sedimentation, contamination, vehicular traffic, and livestock shall be included in the design.

Environmental Protection

Spring developments with potential to jeopardize wetlands, bogs, fens, or other unique ecological sites shall be designed with measures required to maintain the existing habitat, unless acceptable mitigation is provided. A functional assessment/mitigation plan will be made at potential spring development areas to determine existing ecological functions and to mitigate potential losses.

Operation and maintenance plans for ecologically sensitive sites shall include any specific measures such as fencing, valve installation and operation requirements needed to protect existing site habitat values.

Vegetative Establishment

Establishing vegetation on disturbed areas shall be in accordance with the Conservation Practice Standard Critical Area Planting (Code 342). Lime and fertilize according to soil needs.

CONSIDERATIONS

Installation of this practice should be in consideration of natural resource assessments that may be applicable, such as cultural resources, NEPA, wetland conservation provisions, existing wildlife habitat, and others.

A shutoff valve and vent system on the spring box outlet pipe should be considered for winter shutdown, flow control, and maintenance.

Native vegetation adapted to wet conditions may be used as an alternative to introduced grasses on some wet sites. Allow native/natural plants to revegetate on sites where erosion is not a problem.

The need for protection from flooding, sedimentation, and contamination shall be considered in determining the suitability of a site for development.

PLANS AND SPECIFICATIONS

Plans and specifications for spring development shall be in keeping with this standard and shall describe the requirements for applying the practice to achieve its intended purpose.

OPERATION AND MAINTENANCE

The operation and maintenance plan shall include such items as winter freeze and flooding protection, overflow and valve operations, spring box sediment removal, rodent damage repair, maintaining vegetative cover and stable outlet, and other site specific items as needed.

REFERENCES

1. National Engineering Handbook - Part 650 - Engineering Field Handbook, Chapter 12, Springs and Wells.

2. General Manual-190, Part 410, Subparts A, B, and C, Compliance with NEPA.

3. NRCS KY Conservation Practice Standard

Critical Area Planting, Code 342

NRCS, KY, April 2003

NRCS, KY, April 2003 574-3

CONSERVATION PRACTICES INSTALLED

Field Office Technical Guide

Section IV

Conservation practice standards are reviewed periodically, and updated if needed. To obtain the current version of this

standard, contact the Natural Resources Conservation Service.

NRCS, KY, JUNE, 1999

NATURAL RESOURCES CONSERVATION SERVICE

CONSERVATION PRACTICE STANDARD

WATERING FACILITY
CODE 614

DEFINITION

A device (tank, trough, or other watertight container) for providing animal access to water.

Purpose

To provide watering facilities for livestock and/or wildlife at selected locations in order to:

- protect and enhance vegetative cover through proper distribution of grazing;
- provide erosion control through better grassland management; or
- protect streams, ponds and water supplies from contamination by providing alternative access to water.

Conditions where practice applies

This practice applies to all land uses where there is a need for new or improved watering facilities.

Criteria

General Criteria Applicable To All Purposes

A trough or tank shall have adequate capacity to meet the water requirements of the livestock and/or wildlife. This will include the storage volume necessary to carry over between periods of replenishment. Animal water requirements can be obtained from the NRCS Engineering Field Handbook, Table 11-1.

Where water supplies are dependable and livestock are checked daily, troughs with little water storage capacity may be used. Troughs or tanks must provide the daily water requirement of the livestock and provide access to the entire herd within a short period of time.

The site shall be well drained; if not, drainage measures shall be provided. Areas adjacent to the trough or tank that will be trampled by livestock shall be graveled, paved, or otherwise treated to provide firm footing and reduce erosion. Design of the protective surface around the trough shall be in accordance with NRCS Conservation Practice Standard 561, Heavy Use Area Protection.

Automatic water level control and/or overflow facilities shall be provided as appropriate. Valves or pipes shall be protected by shields or covers to prevent damage by livestock. Overflow shall be piped to a stable or suitable point of release. The trough and outlet pipes shall be protected from freezing and ice damage. Freeze-proof troughs or electric heaters may be used.

When a roof is placed over the trough to provide shade, the roof shall be designed for appropriate snow and wind loads and shall be durable to withstand anticipated livestock and wildlife activities.

All materials shall have a life expectancy that meets or exceeds the planned useful life of the installation. Common construction materials are reinforced concrete, steel, fiberglass, plastic and wood. All designs shall meet the industry standards for the material being used. Generally applicable design requirements and procedures can be found in the documents referenced at the end of this standard.

Concrete structures shall be constructed from a concrete mix producing a minimum compressive strength of 3,000 psi at 28 days. Galvanized steel tanks shall have a minimum thickness of 20 gauge. Plastic and fiberglass structures shall be made of ultraviolet resistant materials or shall have a durable coating to protect the structure from deterioration due to sunlight.

Considerations

This practice may adversely affect cultural resources and must comply with GM 420, Part 401.

Topography should be evaluated to minimize trail erosion and flooding erosion from tank overflow.

Watering facilities should be accessible to small animals. Escape ramps for birds and small animals should be installed.

Adequate protection for livestock during the winter should be considered.

Plans and specifications

Plans and specifications for installing troughs and tanks shall be in keeping with this standard and shall describe the requirements for applying the practice to achieve its intended purpose. If the trough and/or tank is a component of a system that includes additional conservation practices, the information necessary to construct these additional practices will also be conveyed on the plans.

Development of plans will be guided by Engineering Field Handbook, Chapter 5, and shall be in accordance with National Engineering Manual, Parts 541 and 542.

Operation and maintenance

An O&M plan specific to the type of installed trough or tank shall be provided to the landowner. The plan shall include, but not be limited to, the following provisions:

- check for debris, algae, sludge or other materials in the trough which may restrict the inflow or outflow system;
- check for leaks and repair immediately if any leaks are found;
- check the automatic water level device to insure proper operation;
- check to ensure that adjacent areas are well protected against erosion;
- check to ensure the outlet pipe is freely operating and not causing erosion problems; and
- prepare guidance for winter weather, such as adding material in the storage area to allow for ice expansion without damage.

Algae and iron sludge accumulation should be addressed in areas with water quality that is known to cause problems. Chemicals such as copper sulfate and chlorine can be recommended as needed, as long as local rules and regulations are followed.

REFERENCES

Engineering Field Handbook

National Engineering Manual

Manual of Steel Construction, American Institute of Steel Construction

Timber, National Design Specification for Wood, American Forest and Paper Association

Concrete, ACI 318, American Concrete Institute

Masonry, Building Code Requirement for Masonry Structures, ACI 530, American Concrete Institute

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• protect streams, ponds and water supplies from contamination by providing alternative access to water

CONDITIONS WHERE PRACTICE APPLIES

This practice applies to all land uses where there is a need for new or improved watering facilities.

CRITERIA

Capacity. A trough or tank shall have adequate capacity to meet the water requirements of the livestock and/or wildlife. This will include the storage volume necessary to carry over between periods of replenishment.

Table 1 shall be used for determining minimum daily requirements, capacity and depth of individual watering facilities.

Where water supplies are dependable and livestock are checked daily, troughs with little water storage capacity may be used. Troughs or tanks must provide the daily water requirement of the livestock and provide access to the entire herd within a short period of time.

Where water is supplied by undependable means (i.e., solar, RAM, etc.), the minimum watering system storage capacity shall be 3 days. However, if an alternate permanent water source (i.e., pond, lake, stream, etc.) is available and readily accessible, then the 3-day storage period is not required.

Kind of Livestock	Water Facility Capacity (gal)	Depth (inches)	**Minimum Daily Requirement** [1/] (Gal/hd/day)	**Maximum Height above Normal Ground (inches)**
Beef cattle	100 (25) 2/	12	12-20	30
Horse	100 (25) 2/	12	6-14	30
Dairy cattle (drinking only)				
Lactating	100 (25) 2/	12	25-30	30
Non-lactating	100 (25) 2/	12	10-15	30
Sheep & Goats	15	6	2-3	18
Swine	15	6	2-4	18

1/ These requirements vary with climatic conditions, kind of feed, size of animals, and other factors and may be increased as necessary.

2/ The minimum capacity of individual watering facilities may be reduced to 25 gallons provided all of the following conditions are met.

1. The pasture is 14 acres or less.
2. Water supply into the watering facility is at least 5 gpm.

3/ The minimum water facility storage capacity is met.

Table 1 – Minimum Requirements of Individual Watering Facilities

Replenishment rate. The inflow of water in a 3-hour period plus the individual watering facility (watering facility/tank) capacity shall equal or exceed one-half the daily requirement for the livestock using the facility.

Conservation practice standards are reviewed periodically, and updated if needed. To obtain the current version of this standard, contact the Natural Resources Conservation Service. **NRCS, KY, April 2003** 614- 2

Location. The site should be well drained, if not, drainage measures will be provided. Areas adjacent to the trough or tank that will be trampled by livestock shall be graveled, paved, or otherwise treated to provide firm footing and reduce erosion. Design of the protective surface around the trough or tank shall be in accordance with NRCS Kentucky Conservation Practice Standard 561 Heavy Use Area Protection: Agricultural Areas - Surface Treatment.

Locate the watering facility in such a manner that runoff from the facility does not have the potential to enter wells at the well head. The location shall have easy access by livestock and also provide good grazing distribution.

Backflow Protection. Watering facilities that have a potential to cross-connect with the public water supply system shall have a properly installed backflow prevention device or air gap as required by the local water utility's cross-connection control program.

Watering facilities that are connected to potable well systems shall include measures to prevent backflow or back-siphonage to the well. Acceptable measures to prevent backflow are the use of an air gap or double check valve.

Air gap. Air gaps shall be a minimum of 2 times the diameter of the supply line above the crest or overflow device of the watering facility. (Example: If the supply line is 1 inch, then the minimum air gap required is 2 inches above the crest of the overflow device.) The supply line and air gap shall be protected from contact by livestock. This shall include measures to protect the air gap from inadvertent splashing by the livestock during watering.

Components. Automatic water level control and/or overflow facilities shall be provided as appropriate. Valves or pipes shall be protected by shields or covers to prevent damage by livestock. Overflow shall be piped to a stable or suitable point of release. The trough and outlet pipes will be protected from freezing and ice damage. Freeze-proof troughs or electric heaters may be used.
Watering facilities shall be installed in a manner that will prevent the facility from leaking or being overturned.

Watering facilities with a capacity larger than 100 gallons shall be equipped with a minimum 1-inch drain plug to facilitate maintenance of the watering facility.

All exposed pipes, fittings, and etc. shall be galvanized or ultraviolet protected as appropriate.

Gravity fed systems shall have sufficient head to supply the water for the design number of animals. Minimum elevation head shall be 4 feet (planned permanent water surface of pond or spring box to lip of watering facility) when water level is

controlled by a valve. Minimum elevation head shall be 1 foot when water flows through the watering facility.

Materials. All materials shall have a life expectancy that meets or exceeds the planned useful life of the installation. Common construction materials are reinforced concrete, steel, fiberglass, and plastic. All designs shall meet the industry standards for the material being used. Generally applicable design requirements and procedures can be found in the documents referenced at the end of this standard.

Reinforced concrete facilities shall have at least 3-inch thick walls and 4-inch thick floor with a minimum of 8-gauge welded wire. It shall be constructed from a concrete mix producing a minimum compressive strength of 3,000 psi at 28 days.

Galvanized steel tanks shall have a minimum thickness of 20 gauge.

Plastic and fiberglass structures shall be made of ultraviolet resistant materials or shall have a durable coating to protect the structure from deterioration due to sunlight. Minimum thickness of the walls and floor shall be ¼ inch.

When a large equipment tire is used as a watering facility, it shall be of suitable quality to perform as intended for the useful life of the practice. The tire shall be free of chemicals injurious to livestock. An approved standard drawing shall be used to prepare site specific designs for this type of tank.

Water supply and outlet pipe. The watering facility shall be equipped with a suitable water supply pipe, drainage outlet, and overflow outlet, either as individual outlets or a combination of outlets. Drainage outlets for systems with flow-through water must extend at least 10 feet from

NRCS, KY, April 2003 614-3

the watering facility. Plumbing shall be new galvanized steel, copper, bronze, or plastic pipe and fittings in conformance with Conservation Practice Standard, Pipeline, Code 516. Water supply pipelines are to have a minimum inside diameter of 1 ¼ inch for gravity flow systems or ¾ inch for pressurized systems. The supply lines shall be connected in a manner to prevent leakage and provide proper sanitary protection (i.e., backflow prevention).

Ram pumps. Ram pumps require falling water to pump water uphill. The minimum vertical fall from drive pipe inlet to the ram shall be two feet. In order to provide a constant supply and uniform head of water, the water shall be collected in a durable trash-resistant device (inverted PVC pipe, concrete or galvanized metal) before it enters the drive pipe to the ram. The length of drive pipe shall be 5 times the vertical fall to ensure proper operation. It shall be buried on a constant grade with no turns to the ram. The ram pump shall be located on a concrete foundation and appropriately protected or housed. A gate valve shall be installed near the ram entrance so that periodic maintenance can be done.

Nose pumps. Nose pumps shall be anchored to concrete or other approved device to prevent damage by livestock.

CONSIDERATIONS

Installation of this practice should be in consideration of natural resource assessments that may be applicable, such as cultural resources, NEPA, wetland conservation provisions, existing wildlife habitat, and others.

Topography should be evaluated to minimize trail erosion and flooding erosion from tank overflow.

The maximum travel distance for livestock to watering facilities should not exceed 800 feet.

Watering facilities should be accessible to small animals. Escape ramps for small animals should be installed.

Adequate protection for livestock during the winter should be considered.

Cut-off values, removable risers, or other devices should be considered if freezing may be a problem during winter months if water facility is not used.

Provide room for at least 1 animal in 20 to drink from a watering facility at a time. Plan on 20 inches of perimeter for circular watering facilities and 30 inches of length for the straight side of a watering facility for each animal drinking. (Circumference equals diameter X 3.1416. Diameter equals circumference divided by 3.1416).

The water level in open watering facilities should be a approximately 1.5 inches below the top of the watering facility to avoid water saturating area surrounding the watering facility.

Where rotational grazing is practiced use portable water watering facilities that can be relocated to disperse impacts from trampling vegetation.

To ensure uniform grazing and waste distribution in the field, cattle should not travel more than 800 feet to the watering facility.

Generally, watering facilities should be located within 500 feet of where lactating dairy cattle are grazing. (See publication “Prescribed Grazing and Feeding Management for Lactating Dairy Cows”, New York State Grazing lands Conservation Initiative and USDA NRCS, January 2000).

Where possible, a watering facility can provide water for 2 to 4 pastures. Gates or gaps may be placed adjacent to the watering facility to allow livestock access to the entire watering facility from any one paddock at a time. Avoid placing feeding areas or other concentrated animal activities above a water source.

Ponds serving as a water source for a watering facility should be fenced to prevent cattle from damaging pond banks and creating water quality problems with the water source. The fenced boundary around the pond provides a vegetative filter strip for water entering the pond. Fencing should be installed according to Conservation Practice Standard Code 382 - Fence.

The watering facility should be located so that loafing of the cattle around it is not encouraged. The watering facility placed under trees encourages loafing and also creates maintenance problems with leaves dropping into it. If water temperature is a concern, the watering facility can be partially buried or shaded with a roof.

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An alternate permanent water source (such as a pond, lake, stream, etc.) is recommended to have water available for livestock if the normal water source becomes inoperable.

PLANS AND SPECIFICATIONS

Plans and specifications for installing troughs and tanks shall be in keeping with this standard and shall describe the requirements for applying the practice to achieve its intended purpose. If the trough and/or tank is a component of a system that includes additional conservation practices, the information necessary to construct these additional practices will also be conveyed on the plans.

Development of plans will be guided by the Engineering Field Handbook, Chapter 5, and shall be in accordance with the National Engineering Manual, Parts 541 and 542.

OPERATION AND MAINTENANCE

An Operation and Maintenance plan specific to the type of installed trough or tank shall be provided to the landowner. The plan shall include, but not be limited to, the following provisions:

• check for debris, algae, sludge or other materials in the trough which may restrict the inflow or outflow system;

• check for leaks and repair immediately if any leaks are found;

• check the automatic water level device to ensure proper operation;

• check to ensure that adjacent areas are well protected against erosion;

• check to ensure the outlet pipe is freely operating and not causing erosion problems;

• prepare guidance for winter weather, such as adding material in the storage area to allow for ice expansion without damage.

Algae and iron sludge accumulation should be addressed in areas with water quality that is known to cause problems. Chemicals such as copper sulfate and chloride can be recommended as needed, as long as local rules and regulations are followed.

REFERENCES

NRCS. National Engineering Handbook
Engineering Field Handbook
National Engineering Manual
Manual of Steel Construction, American Institute of Steel Construction
American Concrete Institute ACI 318, ACI 530
Building Code Requirement for Masonry Structures
General Manual, 190, Part 410, Compliance with NEPA.

KENTUCKY CONSERVATION PRACTICE STANDARD

WATERING FACILITY

Code 614

SCOPE

This item shall consist of the installation of a watering facility to provide drinking water for livestock. Construction shall be carried out in such a manner that erosion, water, air, and noise pollution shall be minimized and held within legal limits as established by state regulations.

LOCATION

The watering facility shall be installed at the location shown on the drawings, or at the location designated by the NRCS official.

MATERIALS

The tank or watering facility shall be equal in size and quality to that specified or shown on the drawings. A concrete watering facility shall be constructed from concrete per construction specifications for plain and reinforced concrete. All pipes and fittings shall be of the size and material shown on the drawings. A galvanized steel watering facility shall be 20 gauge minimum.

CONCRETE

This work shall consist of furnishing, forming, placing, finishing, and curing Portland cement concrete. The concrete mixture shall be no less than a five (5)

bags of cement per yard mix. The water content shall not exceed 6 gallons per bag of cement. The concrete will be thoroughly rodded or vibrated and spaded to remove air voids and produce dense, watertight concrete. Concrete shall contain Portland cement that meets the requirements of ASTM Specification C150, with washed sand and gravel. Clean water shall be used in the mix.

Suggested ratio of aggregates in mix:
94 lbs. cement (1 bag), 6 gallons water, 170 lbs. clean dry sand, 315 lbs. dry gravel.

Smaller batches: 1 part cement, 2 parts sand, and 3 parts gravel; add water at the rate of 1 gallon per 16 lbs of cement.

INSTALLATION

The foundation area shall be cleared of all material not suitable for subgrade and be leveled to allow the watering facility or tank to be placed on firm ground. The area surrounding the watering facility shall be smoothed and graded to permit free drainage of surface water away from it, yet allow access by the animals for which it is being installed. All backfill for underground pipes shall be compacted to the degree required to prevent caving after construction is completed.

HEAVY USE AREA

The watering facility shall be located so that a dry surface is maintained around the base, extending 10 feet from all sides of the watering facility. The minimum gravel mat thickness shall be 6 inches.

The construction shall be performed in a workmanlike manner and the job site shall have a neat appearance when finished.

VEGETATION

Vegetation shall be applied to all disturbed areas as critical area planting and shall include liming, fertilizing, seedbed preparation, seeding, and mulching.

NRCS, KY, April 2003

NATURAL RESOURCES CONSERVATION SERVICE

CONSERVATION PRACTICE STANDARD

SINKHOLE PROTECTION (INTERIM)

(Acres)

CODE 725

DEFINITION

Protection of sinkholes or areas of internal drainage (sinkhole watersheds) which deliver runoff waters to a groundwater system and/or pose a threat to public safety.

PURPOSES

This practice may be applied as part of a conservation management system to support one or more of the following purposes:

_ to improve quality of recharge waters entering the groundwater system.

_ to improve quality of the groundwater resource.

_ improve chemical and nutrient management within sinkhole watersheds.

_ reduce soil erosion within sinkhole watersheds

CONDITIONS WHERE PRACTICE APPLIES

This practice is applicable in areas where karst features (sinkholes) are present which exhibit the potential to deliver surface water pollutants or contaminants to the groundwater system. This practice also applies where public safety is a concern. This practice is only applicable in areas where it is not in violation of local, state, or federal zoning regulations or other laws. It is also applicable only in areas where there is a “low” hazard potential as determined in the NRCS National Engineering Manual (NEM), Part 501and Part 503.

CRITERIA

General Criteria Applicable To All Purposes

The role of sinkholes in providing recharge to the groundwater system shall be maintained. Do not seal sinkholes where such action will increase detrimental flooding within the area of internal drainage. Provide for public safety in and around sinkholes. Drains or backfill should only be utilized for active

unstable sinkholes, which have the potential to void the land resource, cause a public nuisance, or endanger public safety. This procedure should not increase discharge to the sinkhole unless the underground solution channels are capable of removing the additional flow. No additional flooding should result. If additional discharge is deemed feasible, it should be of reasonable quality. Use criteria in the VERTICAL DRAIN (630) standard as a guide. Guidelines for rock backfill are available from NRCS engineering criteria. Pipe installed for discharge into groundwater is defined by US Environmental Protection Agency as a Class V Injection Well. EPA should be notified for inventory purposes. Locate on a USGS 7 ½ minute quadrangle map and send to US EPA Region IV Office, Atlanta, GA.

Sinkholes within 75 feet of structures and roads that serve as outlets for karst basins should only be protected by use of filter strips, riparian forest buffers, and fencing.

Sinkholes may be sealed if they develop in pool areas or foundations of impoundments, or other areas where structural elements are endangered.

Remove trash, debris, or other materials from sinkholes, which may pollute or contaminate the groundwater system and interfere with normal discharge. Use criteria in OBSTRUCTION REMOVAL (500) standard as a guide. Material removed from sinkholes shall be disposed of in a proper manner and in compliance with all relevant regulations.

Additional Criteria To Improve Quality of Recharge Waters Entering the Groundwater System

Provide vegetative buffers around sinkhole rims to act as filters for polluted or concentrated runoff. Vegetation selected may consist of grass, shrubs, and/or trees and shall be suited to the site conditions and capable of removing sediment and other pollutants from overland flow. Follow criteria in the CRITICAL AREA PLANTING (342), FILTER STRIP (386) and RIPARIAN FOREST BUFFER (391) standards. Livestock shall be excluded from the buffer and immediate sinkhole area.

Additional Criteria To Improve Chemical and Nutrient Management Within Sinkhole Watersheds

Chemical, pesticide, nutrient, or waste management programs shall be adopted to improve the quality of surface waters flowing to sinkhole areas. Follow criteria in WASTE UTILIZATION (633) and NUTRIENT MANAGEMENT (590) standards. Utilize PRESCRIBED GRAZING (528A) standard to improve forage utilization, manure/nutrient distribution, and limit livestock access to sinkhole drainage areas.

Additional Criteria To Reduce Soil Erosion Within Sinkhole Watersheds

Reduce amounts of pollutants/contaminants delivered to the aquifer systems. Select practices that reduce sheet-and-rill and concentrated flow erosion (classic or ephemeral gullies). Prevent formation of cattle trails and subsequent concentrated flow through the use of a management system that may include PRESCRIBED GRAZING (528A) standard within the sinkhole area.

CONSIDERATIONS

Caution should be taken when working around or operating equipment near the rims of active unstable sinkholes. Some cities and counties have enacted sinkhole zoning regulations, which restrict the practices that can be implemented in karst areas. These regulations should be considered when planning or applying conservation practices in sinkhole areas. Construction related effects on groundwater resources must be considered. Measures shall be taken during design, construction, and vegetative establishment to minimize erosion and pollution. This may include details and specifications for such items as silt fences, hay bale barriers, temporary vegetation, mulching, etc.

PLANS AND SPECIFICATIONS

Plans and specifications, including standard drawings, construction specifications, land treatment and management criteria, vegetation requirements, etc. shall be prepared for each treatment unit and shall describe actions for properly installing the practice to achieve its intended purposes.

OPERATION AND MAINTENANCE

Provisions must be made for timely and necessary maintenance to insure that the

practices utilized by this standard function properly. Practices that may require maintenance include, but are not limited to filter strips, forest buffers, vertical drains, rock backfill, and fencing.

REFERENCES

- NEFH, Part 650, Chapter 14

- NRCS Conservation Practice Standards, Codes 342, 382, 393, 500, 590, 528A, 612, 620, and 630. **725 – 3 NRCS, KY, JUNE, 1999**

Field Office Technical Guide
Section IV
Conservation practice standards are reviewed periodically, and updated if needed. To obtain the current version of this standard, contact the Natural Resources Conservation Service.

NRCS, KY, JUNE, 1999

NATURAL RESOURCES CONSERVATION SERVICE
CONSERVATION PRACTICE STANDARD

SINKHOLE PROTECTION (INTERIM)

(Acres)
CODE 725

DEFINITION

Protection of sinkholes or areas of internal drainage (sinkhole watersheds) which deliver runoff waters to a groundwater system and/or pose a threat to public safety.

PURPOSES

This practice may be applied as part of a conservation management system to support one or more of the following purposes:

_ to improve quality of recharge waters entering the groundwater system.

_ to improve quality of the groundwater resource.

_ improve chemical and nutrient management within sinkhole watersheds.

_ reduce soil erosion within sinkhole watersheds

CONDITIONS WHERE PRACTICE APPLIES

This practice is applicable in areas where karst features (sinkholes) are present which exhibit the potential to deliver surface water pollutants or contaminants to the groundwater system. This practice also applies where public safety is a concern.

This practice is only applicable in areas where it is not in violation of local, state, or federal zoning regulations or other laws. It is also applicable only in areas where there is a “low” hazard potential as determined in the NRCS National Engineering

Manual (NEM), Part 501and Part 503.

CRITERIA

General Criteria Applicable To All Purposes

The role of sinkholes in providing recharge to the groundwater system shall be maintained. Do not seal sinkholes where such action will increase detrimental flooding within the area of internal drainage.

Provide for public safety in and around sinkholes. Drains or backfill should only be utilized for active unstable sinkholes, which have the potential to void the land resource, cause a public nuisance, or endanger public safety. This procedure should not increase discharge to the sinkhole unless the underground solution channels are capable of removing the additional flow. No additional flooding should result. If additional discharge is deemed feasible, it should be of reasonable quality. Use criteria in the VERTICAL DRAIN (630) standard as a guide. Guidelines for rock backfill are available from NRCS engineering criteria.

Pipe installed for discharge into groundwater is defined by US Environmental Protection Agency as a Class V Injection Well. EPA should be notified for inventory purposes. Locate on a USGS 7 ½ minute quadrangle map and send to US EPA Region IV Office, Atlanta, GA.

Sinkholes within 75 feet of structures and roads that serve as outlets for karst basins should only be protected by use of filter strips, riparian forest buffers, and fencing.

NRCS, KY, JUNE, 1999

Sinkholes may be sealed if they develop in pool areas or foundations of impoundments, or other areas where structural elements are endangered.

Remove trash, debris, or other materials from sinkholes, which may pollute or contaminate the groundwater system and interfere with normal discharge. Use criteria in OBSTRUCTION REMOVAL (500) standard as a guide. Material removed from sinkholes shall be disposed of in a proper manner and in compliance with all relevant regulations.

Additional Criteria To Improve Quality of Recharge Waters Entering the Groundwater System

Provide vegetative buffers around sinkhole rims to act as filters for polluted or concentrated runoff. Vegetation selected may consist of grass, shrubs, and/or trees and shall be suited to the site conditions and capable of removing sediment and other pollutants from overland flow. Follow criteria

in the CRITICAL AREA PLANTING (342), FILTER STRIP (386) and RIPARIAN FOREST BUFFER (391) standards.

Livestock shall be excluded from the buffer and immediate sinkhole area.

Additional Criteria to Improve Chemical and Nutrient Management Within Sinkhole Watersheds

Chemical, pesticide, nutrient, or waste management programs shall be adopted to improve the quality of surface waters flowing to sinkhole areas. Follow criteria in WASTE UTILIZATION (633) and NUTRIENT MANAGEMENT (590) standards.

Utilize PRESCRIBED GRAZING (528A) standard to improve forage utilization, manure/nutrient distribution, and limit livestock access to sinkhole drainage areas.

Additional Criteria To Reduce Soil Erosion Within Sinkhole Watersheds

Reduce amounts of pollutants/contaminants delivered to the aquifer systems. Select practices that reduce sheet-and-rill and concentrated flow erosion (classic or ephemeral gullies).

Prevent formation of cattle trails and subsequent concentrated flow through the use of a management system that may include PRESCRIBED GRAZING (528A) standard within the sinkhole area.

CONSIDERATIONS

Caution should be taken when working around or operating equipment near the rims of active unstable sinkholes.

Some cities and counties have enacted sinkholezoning regulations, which restrict the practices that can be implemented in karst areas. These regulations should be considered when planning or applying conservation practices in sinkhole areas.

Construction related effects on groundwater resources must be considered. Measures shall be taken during design, construction, and vegetative establishment to minimize erosion and pollution. This may include details and specifications for such items as silt fences, hay bale barriers, temporary vegetation, mulching, etc.

PLANS AND SPECIFICATIONS

Plans and specifications, including standard drawings, construction specifications, land treatment and management criteria, vegetation requirements, etc. shall be prepared for each treatment unit and shall describe actions for properly installing the practice to achieve its intended purposes.

OPERATION AND MAINTENANCE

Provisions must be made for timely and necessary maintenance to insure that the practices utilized by this standard function

properly. Practices that may require maintenance include, but are not limited to filter strips, forest buffers, vertical drains, rock backfill, and fencing.

REFERENCES

- NEFH, Part 650, Chapter 14
- NRCS Conservation Practice Standards, Codes 342, 382, 393, 500, 590, 528A, 612, 620, and 630.

If flooding should result. If additional discharge is deemed feasible, it should be of reasonable quality. Use criteria in the VERTICAL DRAIN (630) standard as a guide. Guidelines for rock backfill are available from NRCS engineering criteria.

Pipe installed for discharge into groundwater is defined by US Environmental Protection Agency as a Class V Injection Well. EPA should be notified for inventory purposes. Locate on a USGS 7 ½ minute quadrangle map and send to US EPA Region IV Office, Atlanta, GA.

Sinkholes within 75 feet of structures and roads that serve as outlets for karst basins should only be protected by use of filter strips, riparian forest buffers, and fencing.

APPENDIX B-4a1
NEWSPAPER ANNOUNCEMENT OF FIELD DAYS

TO MOUNT VERNON SIGNAL

ANNOUNCEMENT

The Rockcastle County Conservation District, and the Natural Resource Conservation Service, in partners with United States Fish and Wildlife Service, The Nature Conservancy's Roundstone Renewal BMP Demonstration Project and Buck Creek Watershed Project announce a list of ten field days to be held this fall. These field days will demonstrate Best Management Practices (BMPs) installed through projects with these agencies.

Each field day will be held from 10:00 a.m. until noon on the dates set. These farms have a variety of best management practices installed such as fencing, pipeline and tanks, pressure tanks and pumps, heavy use areas, waste management facilities, stream crossings, fencing of sinkholes, and tree planting for Conservation Reserve Program. etc. The dates are from September 1st, 8th, 11th, 15th, 18th, 22nd, 25th, 29th, October 2nd, and 6th, 2006.

These days are tentative and are subject to change due to inclement weather. We will meet at the USDA Service Center, 2019 New Brodhead Road, in Mount Vernon, KY 40456 at 10:00 am on the above dates. Transportation will be the responsibility of the attendees. Maps and directions will be available to show directions to the project areas. Parking may be a problem on some of these sites, so it is ***imperative we get tentative numbers on attendees***. Please RSVP as soon as possible by contacting the NRCS Office in Mount Vernon at (606) 256-2525 extension three for directions to each location.

APPENDIX B-4b RADIO ANNOUNCEMENTS for upcoming Field Days

This is the form used for the radio announcements each week. The names of the farms change when there was a different farm and location to be visited.

Radio announcement WRVK-AM

The Nature Conservancy, the Rockcastle County Conservation District, and the Natural Resource Conservation Service, in partners with United States Fish and Wildlife Service, will be holding ten field days in the upcoming weeks. Roundstone Renewal BMP Demonstration Project and the Buck

Creek Watershed Project announce a list of ten field days to be held this fall. These field days will demonstrate Best Management Practices (BMPs) installed through projects with these agencies.

This weeks field day will be **FRIDAY 9/8/06 at Terry and Marlene Lawson's farm on Clear Creek.**

We will meet at the Mount Vernon USDA office at 10:00am. If you wish to attend, please call the USDA SERVICE CENTER OFFICE at 606 256-2525 ext 3 and put your name on the list. The field day will be from 10:00am to noon.

APPENDIX B-4c Memo announcing the schedule for ten field days

MEMORANDUM

TO: Steve Coleman, Kentucky Director of Conservation; Rosetta Fackler, Non- point source section of Kentucky Division of Water; Kentucky Conservation Districts Area Three, Lake Linville Watershed Stake Holder's Group, Kentucky Field Staff of The Nature Conservancy, local farmers and citizens

FROM: Joan Garrison, Roundstone Watershed Coordinator
TNC/Rockcastle County Conservation Service

Randall Templeman, District Conservationist
NRCS Rockcastle County Office

DATE: August 15, 2006

SUBJECT: Announcement Field days and schedule

The Rockcastle County Conservation District, and the Natural Resource Conservation Service, in partners with United States Fish and Wildlife Service, The

Nature Conservancy's Roundstone Renewal and Best Management Practices Demonstration Project and Buck Creek Watershed Project announce a list of ten field days to be held this fall. These field days will demonstrate Best Management Practices (BMPs) installed through projects with these agencies.

Each field day will be held from 10:00 a.m. until noon on the dates set. These farms have a variety of best management practices installed such as fencing, pipeline and tanks, pressure tanks and pumps, heavy use areas, waste management facilities, stream gaps, etc.

1. Field day one will be a visit to Joe and Catherine Bullen's Farm on Friday , September 1, 2006.. This is a farm where several practices have been installed through all the above agencies. BMPs installed are pipeline and tank, stream gap, beef animal waste facility, high tinsel fencing of stream banks, and fencing of sinkhole protection.

2. Field day two is a farm visit to Terry and Marlene Lawson's Farm on Friday, September 8, 2006. This farm has had several projects completed through NRCS and Roundstone Creek Project Grant. BMP's installed demonstrate stream bank protection, heavy use areas, pipeline and tanks, and fencing.

3. Field day three is a farm visit to Joe and Kimberly Bullen's Farm Monday, September 11, 2006. NRCS and the Roundstone Creek Watershed Project installed the following BMPS: a spring development, pressure tank, and housing, and pipeline and tanks.

4. The fourth field day will be to Steve and Donna Towery Farm on September 15, 2006. They have a dairy and have recently installed pipeline and a tank. Other projects are scheduled to do in the future.

5. Field day for two area farms will be held on Monday, September 18, 2006. The first is Mike and Sherry Barron's Farm in the Buck Creek Watershed with projects installed through NRCS and USFWS. The Barrons have done a bank stabilization demonstration project by installing a cedar tree revetment. They also installed stream crossings with stream gap, pipeline and tanks, spring development, and fencing.

   The second farm is Cletis and Rose Brown Farm in the Roundstone Creek Watershed. You will see a fencing project, pipeline and watering tank.

6. Field day to Donnie and Brenda Parson's Farm will be Friday, September 22, 2006, to show spring development, pressure pump and tanks, as well as fencing BMPS.

7. Katherine Parson's Farm will be the seventh field day on Monday, September 25, 2006, demonstrating installed fencing, pipeline and watering tanks through both NRCS and Roundstone Creek Project.

8. On Friday, September 29, 2006, we will be visiting two farms in the Roundstone Watershed. The first site visit is to Suzanne Parson's Farm showing fencing, and pipeline and tanks.

   The other farm, Jackie Miller Farm, will show stream bank stabilization through USFW and NRCS.

9. The ninth field day on Monday, October 2, 2006, at the Jerry and Vicki Cox Farm demonstrating BMPs installed by a NRCS project. They have installed stream crossings, fencing, a beef animal waste management facility and concrete watering tanks.

10. The last field day scheduled for this fall will be held Friday, October 6, 2006, on the Jan and June Steven's farm in Wildie, Kentucky. This site has a spring development, pipeline, and tanks installed. Also, you can observe Medical Springs School House which is one of our county's remaining one-room schools.

These days are tentative and are subject to change due to inclement weather. We will meet at the USDA Service Center, 2019 New Brodhead Road, in Mount Vernon, KY 40456 at 10:00 am on the above dates. Transportation will be the responsibility of the attendees. Maps and directions will be available to show directions to the project areas. Parking may be a problem on some of these sites, so it is ***imperative we get tentative numbers on attendees***. Please RSVP as soon as possible by contacting the NRCS Office in Mount Vernon at (606) 256-2525 extension three for directions to each location.

APPENDIX B-4d Pre and Post Survey for Field Days

PRE-SURVEY ROCKCASTLE COUNTY SOIL CONSERVATION SERVICE/ THE NATURE CONSERVANY

Field Day _____ Farm hosting field day _____

How long have you been farming?
_____

Have you used the NRCS office, or the Roundstone Creek Watershed Grant for information or funding on a farm project?_____

If so what programs have you used?_____

Do you feel the programs available through the local NRCS/ Roundstone Creek Watershed Grant are helpful to you. ____
Comments_____
_____
_____

POST- SURVEY ROCKCASTLE COUNTY SOIL CONSERVATION SERVICE/ THE NATURE CONSERVANCY

(Please complete after field day and drop in box , or complete and return to USDA Farm Center, Rt. 4, Box 374 A, Mount Vernon, KY 40456

Field Day_____ Farm hosting Field _____

Did you enjoy the program and was it informative? _____ Have you used this practice on your farm?_____ If not would you consider using this practice to improve your farm?

_____

Did the farm practices shown help you on your farm if you implemented them? _____
How? _____

_____

Do you see how these practices have a positive affect on your farming operation as well as on conservation and preventing non-point source?_____
Would you like someone to contact you with more information regarding conservation and farm programs?_____

_____

Comments_____

_____

_____

APPENDIX B-4e Pre and Post Educational Survey for Students
PRE SURVEY
Before your field trip please fill out to the best of your ability.

Do you know what a watershed is? Yes___ No ___
If yes please explain:

_____

_____

Can you name two watersheds in Rockcastle County?

_____

Do you know what watershed you live in? Yes___ No___ If yes, which watershed?

_____

Are you able to name any creeks or streams near your home? Yes ___ No ___

_____

Can you name two things than can affect water quality?

_____

_____

POST SURVEY

Please complete this portion after you come back from your class field trip.

Before your field trip –

Had you ever been wading or playing in a stream or creek.? Yes___ No___
Had you ever seen a mussel? Yes ___ No ___
Had you ever seen a crawfish ? Yes___ No___
Had you ever seen water snails? Yes___ No___
Had you ever considered what pH was? Yes___ No___

Do you know what sediment is and what it's affects are? Yes___ No___
Explain:_____
_____

Can you describe something you learned or discovered on this field trip?
_____
_____

Roundstone Watershed Renewal
BMP Demonstration Project

By

Joan Garrison

Roundstone Creek Watershed Coordinator

APPENDIX B-4c Memo announcing the schedule for ten field days

MEMORANDUM

TO: Steve Coleman, Kentucky Director of Conservation; Rosetta Fackler, Non- point source section of Kentucky Division of Water; Kentucky Conservation Districts Area Three, Lake Linville Watershed Stake Holder's Group, Kentucky Field Staff of The Nature Conservancy, local farmers and citizens

FROM: Joan Garrison, Roundstone Watershed Coordinator
TNC/Rockcastle County Conservation Service

Randall Templeman, District Conservationist
NRCS Rockcastle County Office

DATE: August 15, 2006

SUBJECT: Announcement Field days and schedule

The Rockcastle County Conservation District, and the Natural Resource Conservation Service, in partners with United States Fish and Wildlife Service, The Nature Conservancy's Roundstone Renewal and Best Management Practices Demonstration Project and Buck Creek Watershed Project announce a list of ten field days to be held this fall. These field days will demonstrate Best Management Practices (BMPs) installed through projects with these agencies.

Each field day will be held from 10:00 a.m. until noon on the dates set. These farms have a variety of best management practices installed such as fencing, pipeline and tanks, pressure tanks and pumps, heavy use areas, waste management facilities, stream gaps, etc.

1. Field day one will be a visit to Joe and Catherine Bullen's Farm on Friday , September 1, 2006.. This is a farm where several practices have been installed through all the above agencies. BMPs installed are pipeline and tank, stream gap, beef animal waste facility, high tinsel fencing of stream banks, and fencing of sinkhole protection.

2. Field day two is a farm visit to Terry and Marlene Lawson's Farm on Friday, September 8, 2006. This farm has had several projects completed through NRCS and Roundstone Creek Project Grant. BMP's installed demonstrate stream bank protection, heavy use areas, pipeline and tanks, and fencing.

3. Field day three is a farm visit to Joe and Kimberly Bullen's Farm Monday, September 11, 2006. NRCS and the Roundstone Creek Watershed Project installed the following BMPS: a spring development, pressure tank, and housing, and pipeline and tanks.

4. The fourth field day will be to Steve and Donna Towery Farm on September 15, 2006. They have a dairy and have recently installed pipeline and a tank. Other projects are scheduled to do in the future.

5. Field day for two area farms will be held on Monday, September 18, 2006. The first is Mike and Sherry Barron's Farm in the Buck Creek Watershed with projects

installed through NRCS and USFWS. The Barrons have done a bank stabilization demonstration project by installing a cedar tree revetment. They also installed stream crossings with stream gap, pipeline and tanks, spring development, and fencing.

The second farm is Cletis and Rose Brown Farm in the Roundstone Creek Watershed. You will see a fencing project, pipeline and watering tank.

6. Field day to Donnie and Brenda Parson's Farm will be Friday, September 22, 2006, to show spring development, pressure pump and tanks, as well as fencing BMPS.

7. Katherine Parson's Farm will be the seventh field day on Monday, September 25, 2006, demonstrating installed fencing, pipeline and watering tanks through both NRCS and Roundstone Creek Project.

8. On Friday, September 29, 2006, we will be visiting two farms in the Roundstone Watershed. The first site visit is to Suzanne Parson's Farm showing fencing, and pipeline and tanks.

   The other farm, Jackie Miller Farm, will show stream bank stabilization through USFW and NRCS.

9. The ninth field day on Monday, October 2, 2006, at the Jerry and Vicki Cox Farm demonstrating BMPs installed by a NRCS project. They have installed stream crossings, fencing, a beef animal waste management facility and concrete watering tanks.

10. The last field day scheduled for this fall will be held Friday, October 6, 2006, on the Jan and June Steven's farm in Wildie, Kentucky. This site has a spring development, pipeline, and tanks installed. Also, you can observe Medical Springs School House which is one of our county's remaining one-room schools.

These days are tentative and are subject to change due to inclement weather. We will meet at the USDA Service Center, 2019 New Brodhead Road, in Mount Vernon, KY 40456 at 10:00 am on the above dates. Transportation will be the responsibility of the attendees. Maps and directions will be available to show directions to the project areas. Parking may be a problem on some of these sites, so it is ***imperative we get tentative numbers on attendees***. Please RSVP as soon as possible by contacting the NRCS Office in Mount Vernon at (606) 256-2525 extension three for directions to each location.

APPENDIX B-4d Pre and Post Survey for Field Days

PRE-SURVEY ROCKCASTLE COUNTY SOIL CONSERVATION SERVICE/ THE NATURE CONSERVANY

Field Day _____ Farm hosting field day _____

How long have you been farming?

_____

Have you used the NRCS office, or the Roundstone Creek Watershed Grant for information or funding on a farm project?_____

If so what programs have you used?_____

Do you feel the programs available through the local NRCS/ Roundstone Creek Watershed Grant are helpful to you. ____
Comments_____
_____
_____

POST- SURVEY ROCKCASTLE COUNTY SOIL CONSERVATION SERVICE/ THE NATURE CONSERVANCY

(Please complete after field day and drop in box , or complete and return to USDA Farm Center, Rt. 4, Box 374 A, Mount Vernon, KY 40456

Field Day_____ Farm hosting Field _____

Did you enjoy the program and was it informative? _____ Have you used this practice on your farm?_____ If not would you consider using this practice to improve your farm?

_____
Did the farm practices shown help you on your farm if you implemented them? _____
How? _____
_____
Do you see how these practices have a positive affect on your farming operation as well as on conservation and preventing non-point source?_____
Would you like someone to contact you with more information regarding conservation and farm programs?_____

_____
Comments_____
_____
_____

APPENDIX B-4e Pre and Post Educational Survey for Students
PRE SURVEY
Before your field trip please fill out to the best of your ability.

Do you know what a watershed is? Yes___ No ___
If yes please explain:

_____
_____
Can you name two watersheds in Rockcastle County?

_____
Do you know what watershed you live in? Yes___ No___ If yes, which watershed?
_____

Are you able to name any creeks or streams near your home? Yes ___ No ___

_____

Can you name two things than can affect water quality?

_____

_____

POST SURVEY

Please complete this portion after you come back from your class field trip.

Before your field trip –

Had you ever been wading or playing in a stream or creek.? Yes___ No___
Had you ever seen a mussel? Yes ___ No ___
Had you ever seen a crawfish ? Yes___ No___
Had you ever seen water snails? Yes___ No___
Had you ever considered what pH was? Yes___ No___

Do you know what sediment is and what it's affects are? Yes___ No___
Explain:_____

_____

Can you describe something you learned or discovered on this field trip?

_____

_____

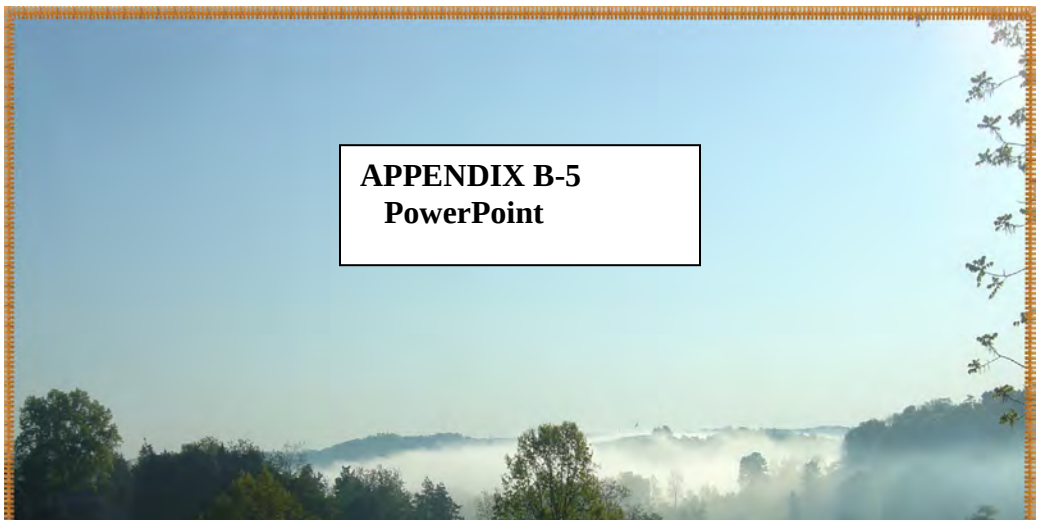
Student Name _____(optional)

Appendix B-5

PowerPoint Cover sheet

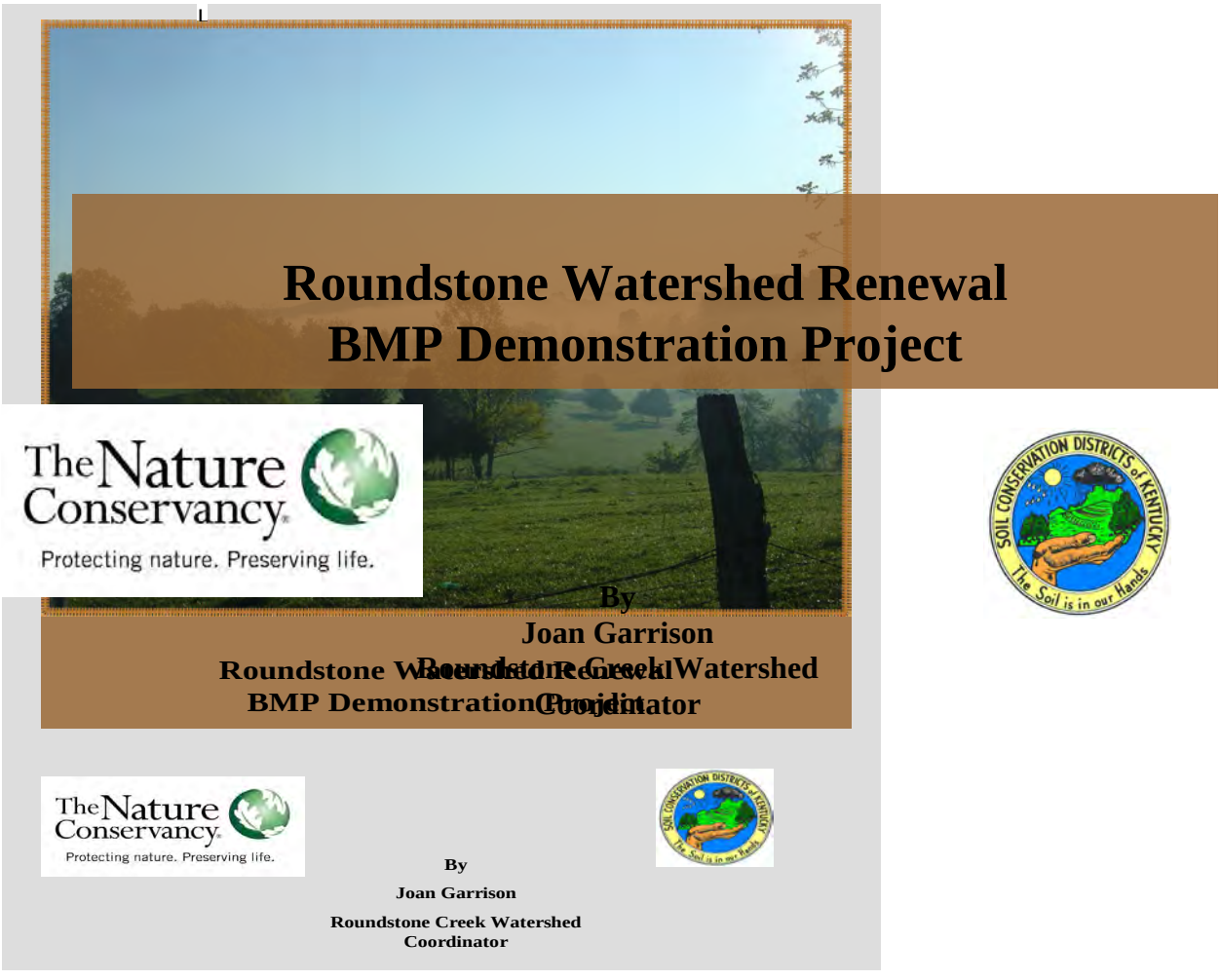
ROUNDSTONE RENEWAL BMP DEMONSTRATION PROJECT

I



Appendix B-5 PowerPoint Cover sheet

pgs 130 – 134 (PowerPoint printed in pages of 4 slides per sheet in report but PowerPoint is on disc)



APPENDIX B-6 MACROINVERTIBRATE MAT SETS

Appendix B-7 Sample Project Photos

ROUNDSTONE RENEWAL BMPs DEMONSTRATION PROJECT

MORE GENERAL PHOTOS OF SOME BEFORE AND AFTER BMPS INSTALLED AND OTHER GENERAL PHOTOGRAPHS

Before and after pictures of some of the spring developments, access road, and heavy use area

Before and after heavy use area and access road

Before and after heavy use area

Before picture installed

After picture of frost free tank

BEFORE AND AFTER WATERERS PUT IN

Before and after

BEFORE AND AFTER Heavy Use Area

The above area would get very muddy in the winter

After is a heavy use area to feed on in winter

Before this farmer watered in this sunken bathtub and after is the frost free watering tank

Here is before of one of several sink holes that are dangerous for livestock and people. Below is after the sink hole is fenced.

BEFORE ABOVE

Here is a field (at woodline) that runs beside Roundstone Creek. There is no fence to Keep livestock out of stream .

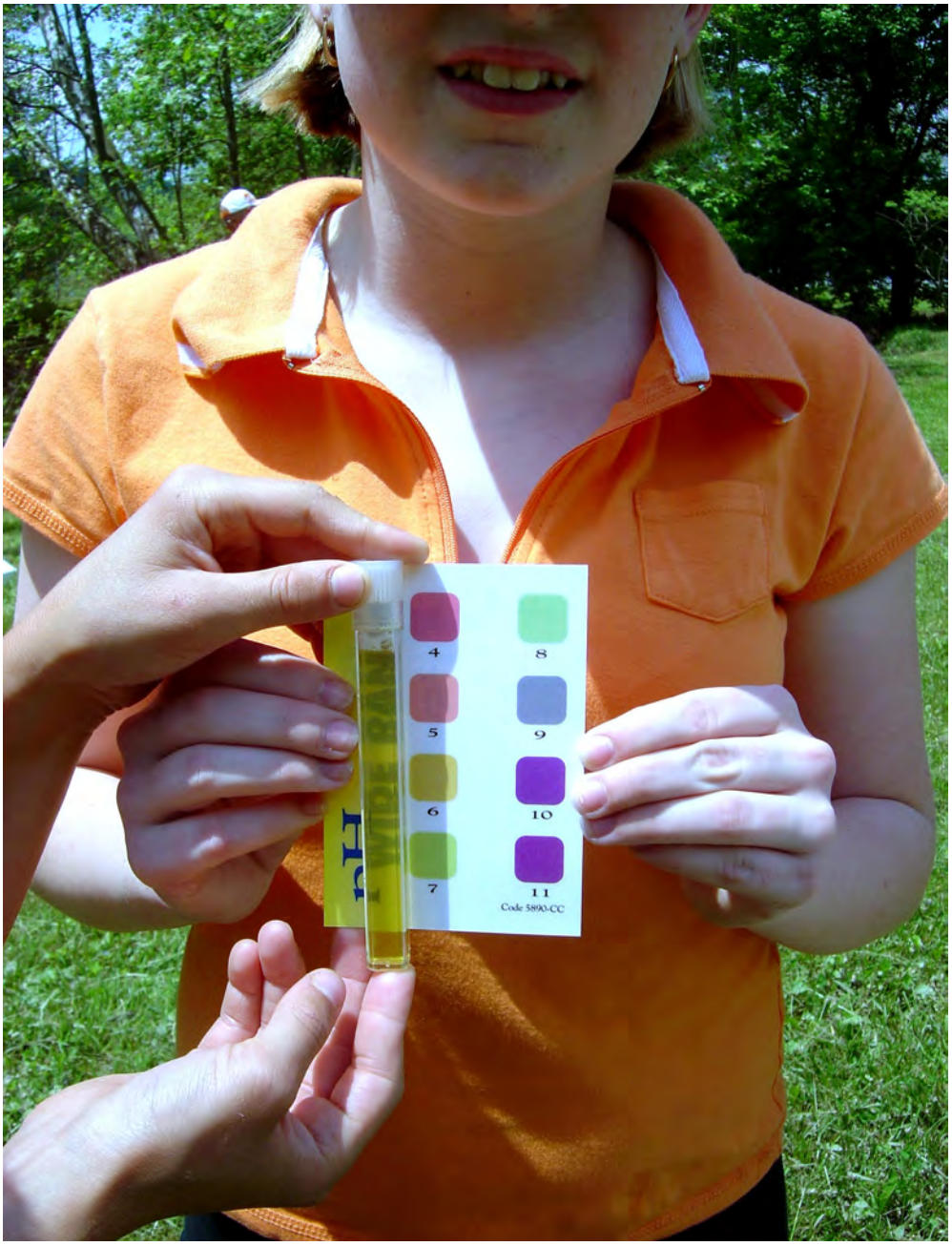
BELOW AFTER

8176 feet of fence(or 1.55 miles) is installed protecting the stream.

Here are students using an Enviroscape, which is a learning tool to show how nonpoint source affects our environment. Cocoa is sprinkle to represent dirt, green and red powered gelatin represents herbicides, and pesticides. When “rain” from the spray bottle affects nonpoint source pollution, the students observe how the landscape and water are affected.

Middle School students sampling in Renfro Creek that flows into Roundstone

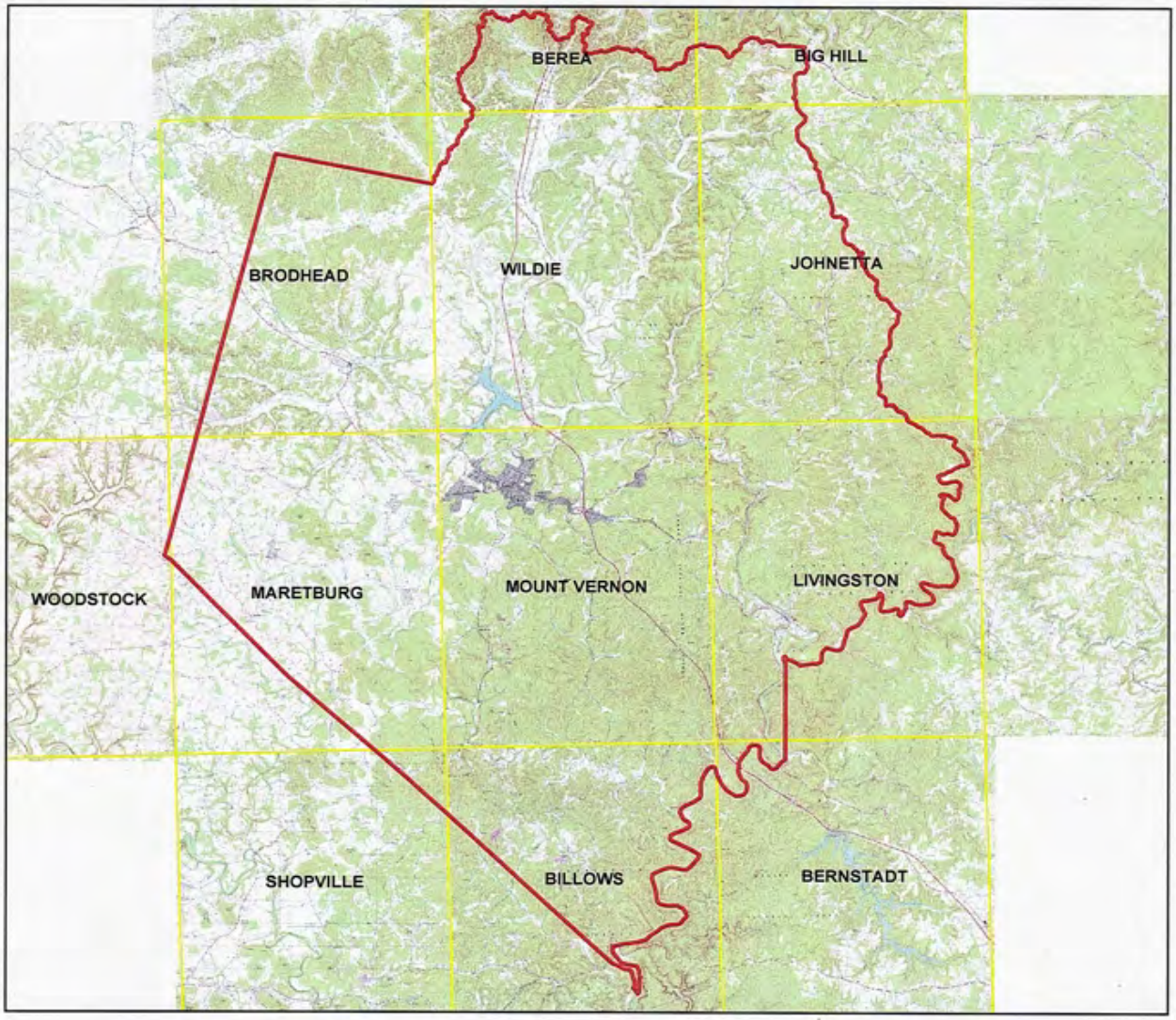
Below teachers are assisting students in water sampling.



Middle school student checking the pH of the water.

Students here are trying to net some macroinvertebrates.

Appendix B-1: Rockcastle County Topo Map



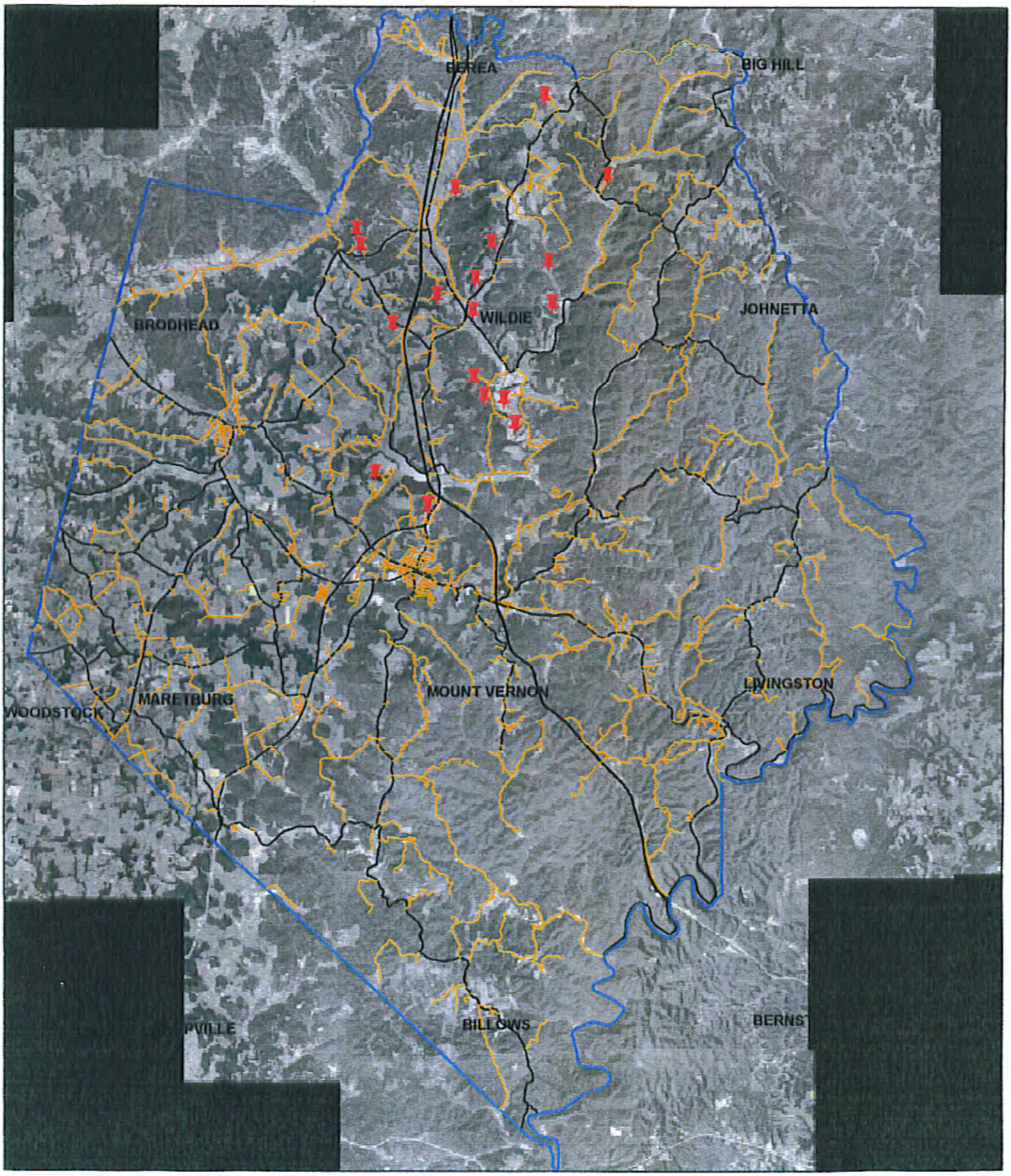
Legend

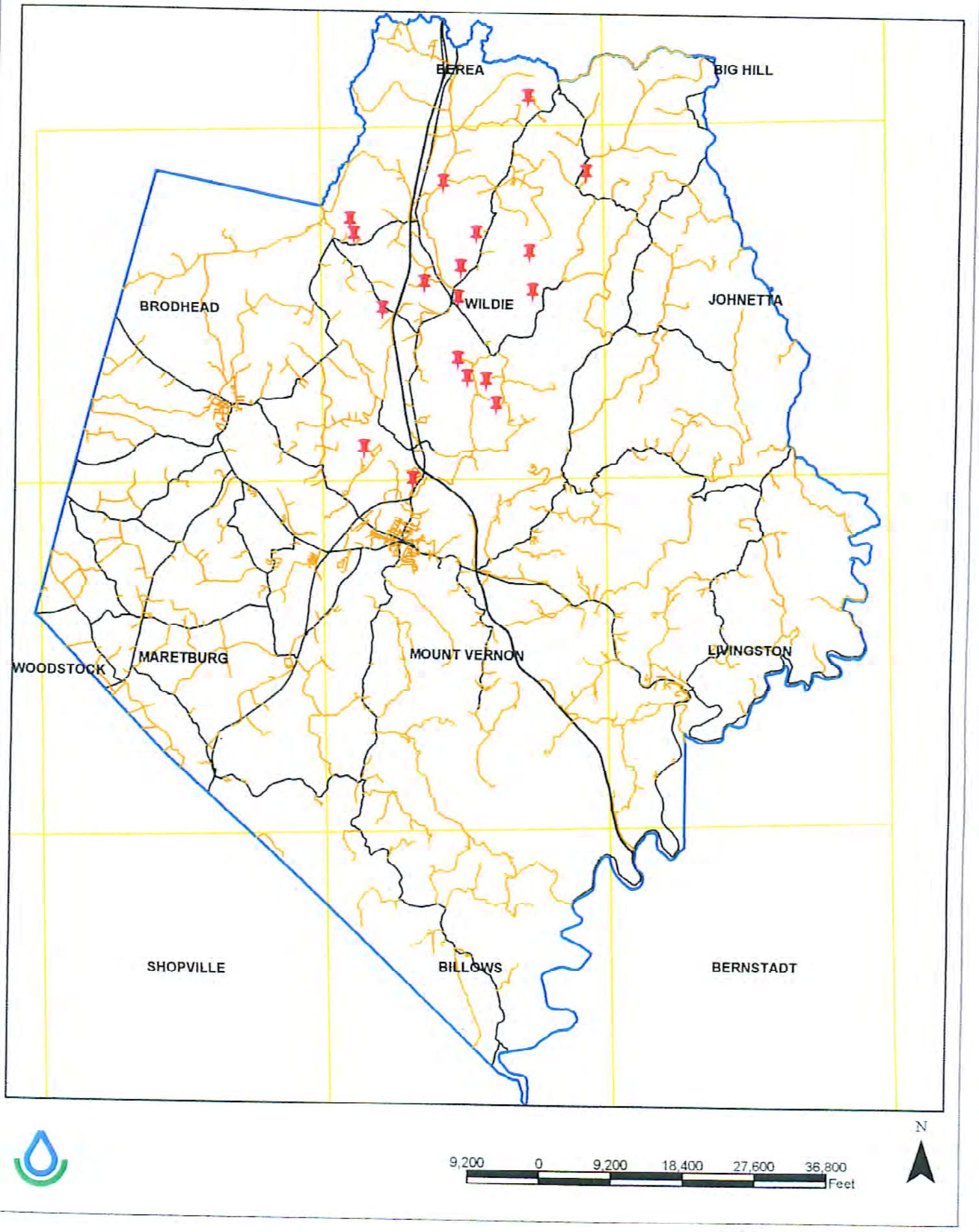
County Bndry

Quad Bndrys

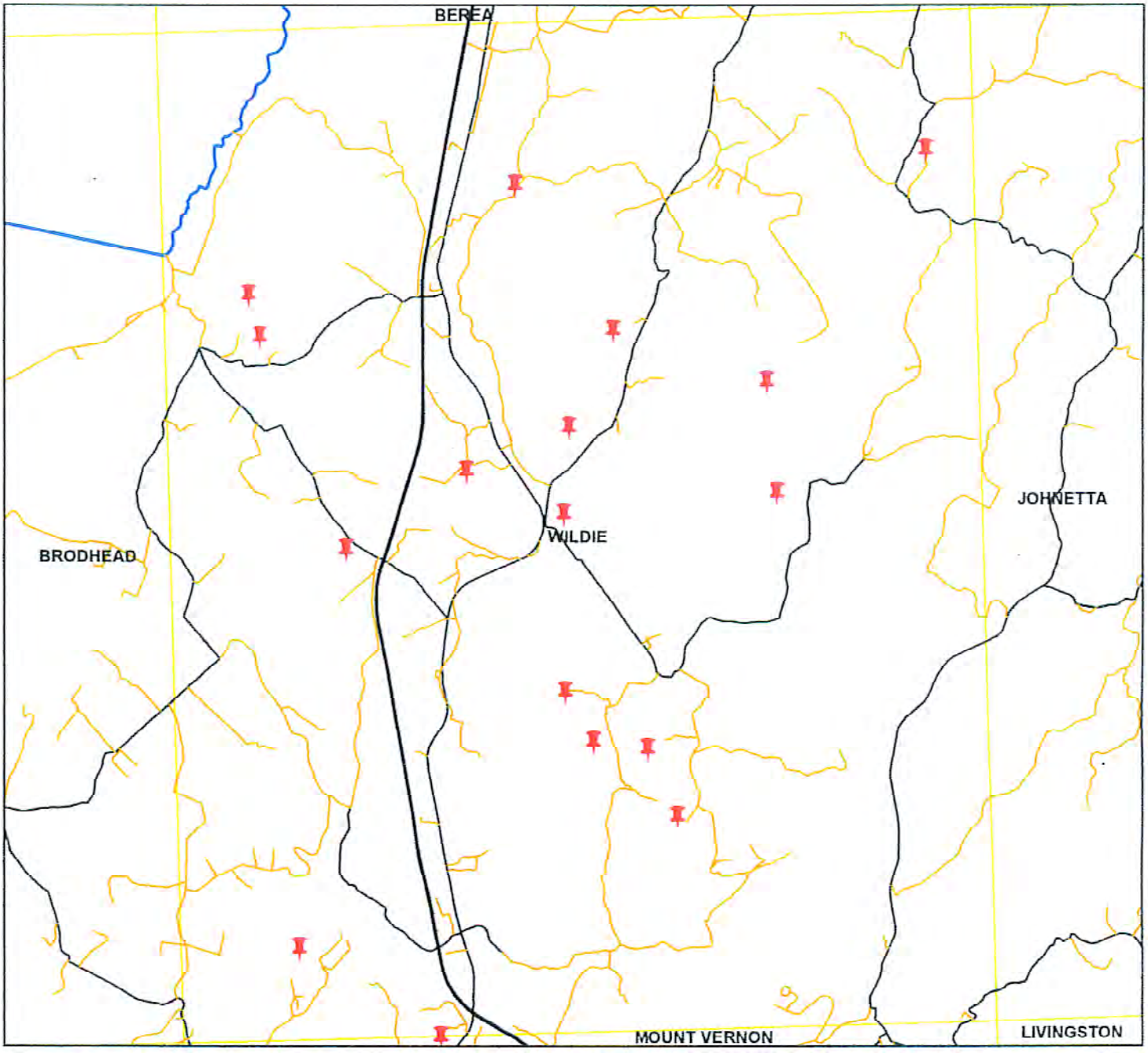
10,000 0 10,000 20,000 30,000 40,000 Feet

N


BEREA
BIG HILL
BRODHEAD
WILDIE
JOHNETTA
MOUNT VERNON
LIVINGSTON
WOODSTOCK
MARETBURG
BILLOWS
N
9,200
0
9,200
18,400
27,600
36,800
Feet


BEREA
BIG HILL
BRODHEAD
WILDIE
JOHNETTA
WOODSTOCK
MARETBURG
MOUNT VERNON
LIVINGSTON
SHOPVILLE
BILLOWS
BERNSTADT
N
9,200
0
9,200
18,400
27,600
36,800
Feet

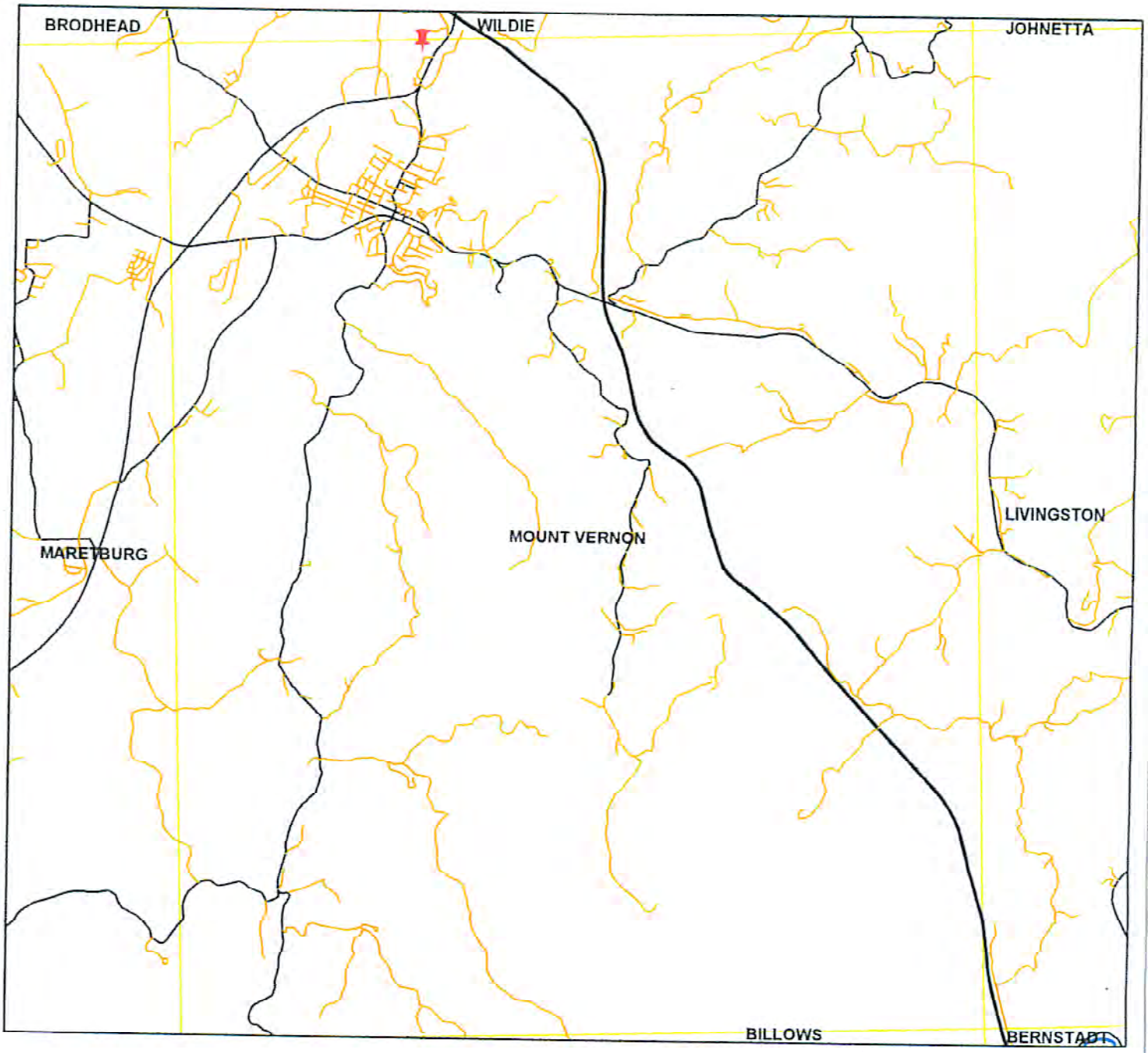
Projects in WILDIE Quad



3,900 0 3,900 7,800 11,700 15,600 Feet

N

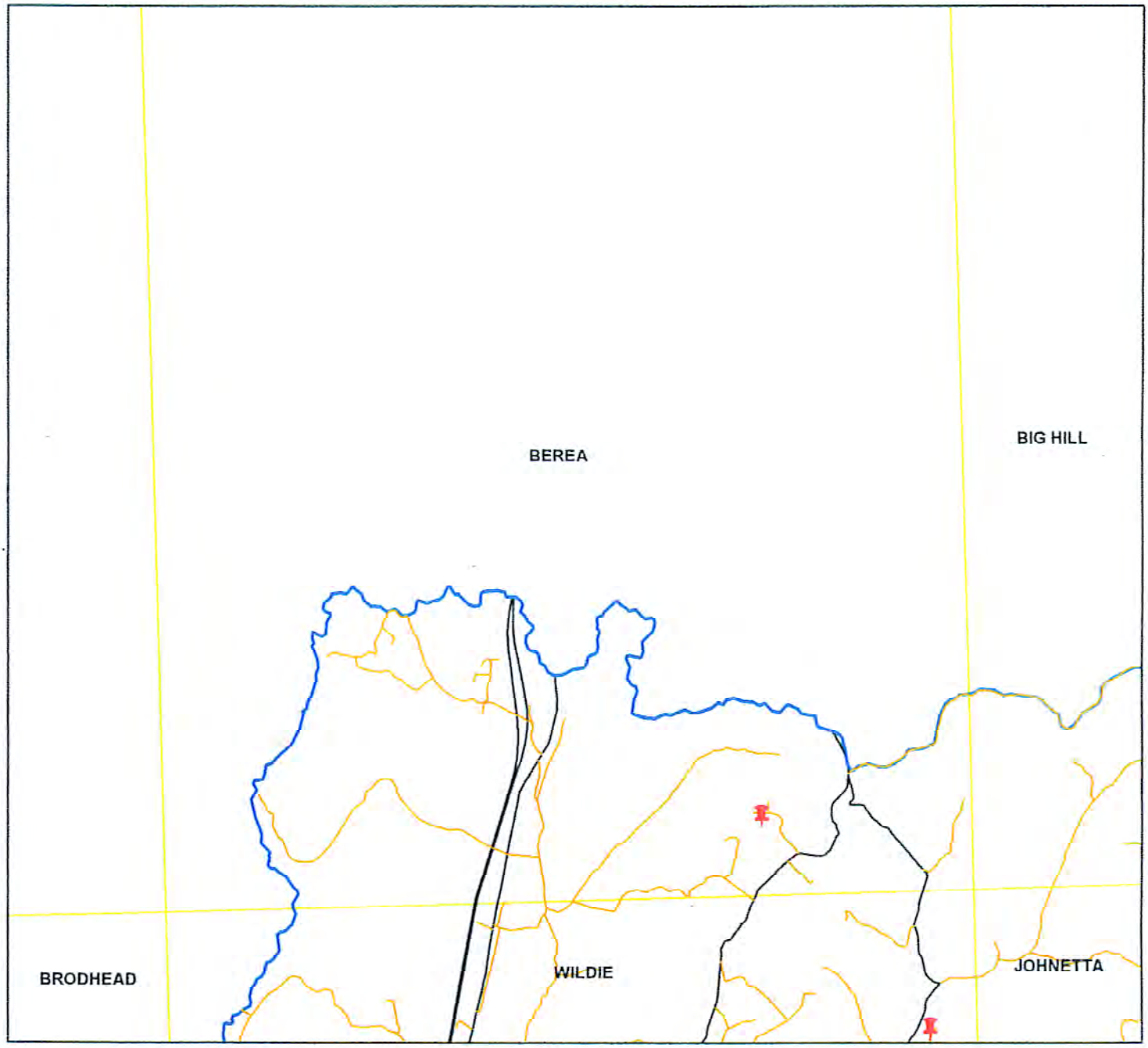
Projects in MOUNT VERNON Quad



N

3,900 0 3,900 7,800 11,700 15,600
Feet

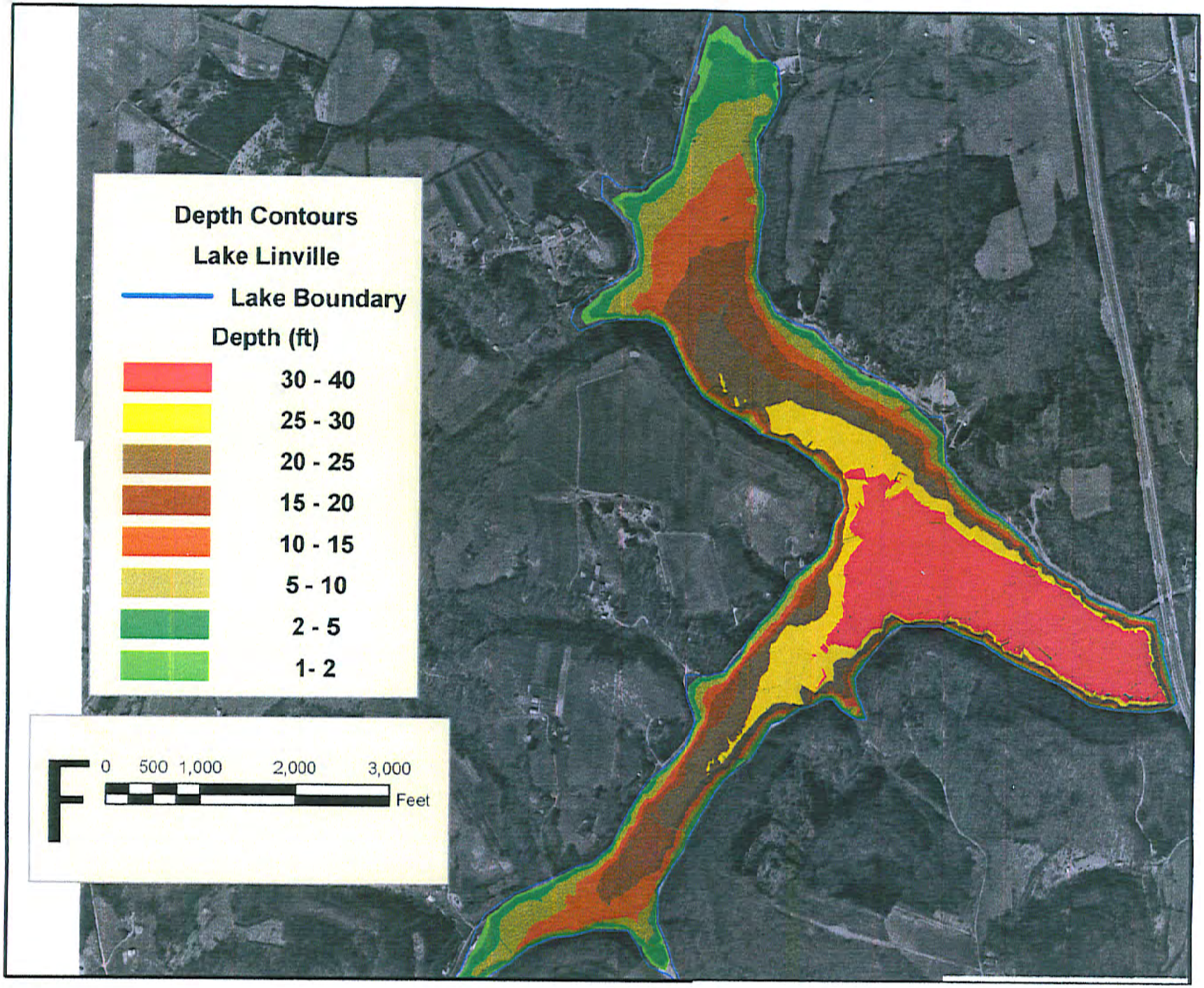
Projects in BEREA Quad



3,900 0 3,900 7,800 11,700 15,600
Feet

N

Lake Linville Depth Contours - August 12, 2005
Western Kentucky University and Kentucky Rural Water Association



WESTERN KENTUCKY UNIVERSITY

Kentucky Rural Water Association
"helping water and wastewater utilities help themselves"

Lake Linville Water Quality Sampling Points - August 12, 2005