APPENDIX C Multi-species Riparian Buffer Characteristics

Site/Design	Area	Soil	Aspect	Design Makeup	Species
1/I Open field	1.4 A L600 W100	Colo SCL	Northwest Sun	100 width grass filter 60 % warm & cool season grass 40% Legumes	Mix E. gamagrass, Orchard-grass, Big bluestem, Indian-grass, Switchgrass Red & White clover, Birdsfoot trefoil
2/II Open field Previous streambed	2.3 A L1000 W100	Colo SCL	Northwest Sun	50 Ft width shrubs 50 Ft. width 60 % warm & cool season grass 40% Legumes	Redosier dogwood, Sandbar willow. Mix E. gamagrass, Orchardgrass, Big bluestem, Indiangrass, Red & White clover, Birdsfoot trefoil
3/III Down hill of concentrated flow	1.6 A L700 W100	Colo SCL	North Partial Shade	25 Ft Fast growing trees with cool season grass understory 40 Ft Shrubs 35 Ft mixed grasses	Mix Sandbar willow on stream bank with Eastern cottonwood, Quaking aspen, Redosier dogwood on top of bank and Reed canarygrass understory, Blue dogwood, Common elderberry. Mix of warm & cool grasses from Site II above
4/IV Flat subject to frequent flooding	3.0 A L1300 W100	Colo SCL	Northwest Sun	48 Ft Mix of open canopy trees & shrubs with cool season grass understory 20 FT shrubs 42 Ft mix of cool & warm season grass	Mix Black walnut, Weeping willow, Quaking aspen & Eastern cottonwood Redosier dogwood & Sandbar willow with cool season Reed canarygrass understory Mix of warm & cool season grasses from Site II above
5/IV Open field with slope to southeast	2.3 A L1020 W100	Clyde SCL	Northeast Sun	48 Ft Mix of open canopy trees 20 Ft shrubs with cool season grass understory 42 Ft mix of cool & warm season grass	Mix Quaking aspen, Eastern cottonwood & Weeping willow, Redosier dogwood & Common elderberry with Orchardgrass Understory mix of warm & cool season grasses from Site II above
6/IV Flat open field	3.7 A Both sides of a drain ditch L800 W100	Colo SCL Muscati ne SCL	North Sun	48 Ft Fast growing trees with cool season grass understory 20 Ft Shrubs 42 Ft mixed grasses	Mix Sandbar willow on stream bank with Eastern cottonwood, Quaking aspen, Redosier dogwood on top of bank and Reed canarygrass understory, Redosier dogwood & Common elderberry Mix of warm & cool grasses from Site II above

(Schultz et al. 1995, Little 1997, Purdue University Agronomy Extension 1997, Johnson 1999)

APPENDIX D

Buffer Descriptions

Design Number 1

This design is a modification of the model used by the Leopold Center for Sustainable Agriculture and established at the Bear Creek farm located in Story County, Iowa. Based on recommendations of the NRCS Conservationist for Grundy County and the landowner's preference the width of the buffer will be 100 feet versus 70 feet. The primary difference will take place overtime. Maintenance of the three distinct zones of vegetation, identified in the Schultz et al. (1995) study, will be relaxed to encourage a natural evolution of a presettlement grassland savannah that dominated the ecosystem in this north central Iowa grassland. It is anticipated the increased width of vegetation will produce a higher level of subsurface biomass filtration of agrochemical fertilizers transported from the row crop fields. Future studies may compare sampling of this increased spatial area (100 feet) to results of 70 foot buffers (Schultz et al. 1995) and 82 foot buffers (Johnston 1998).

Design Number 2

The second design is based entirely on grass buffers between the field and the stream. The buffers will consist of native warm season and naturalized cool season grasses intermixed with selected legumes. Cool season grasses will dominate the area closest to the field edge while warm season grasses will be adjacent to the stream. This arrangement is based on the need for an early emergent vegetative barrier to become an effective diffusing agent when agrochemicals are initially distributed and most susceptible to movement from the early spring rains. The native warm season species with their height and wider stem structure will contribute to diffuse surface runoff volume and velocity to increase infiltration along deep root structure channels.

Design Number 3

The third design will place a mix of warm and cool season grasses beneath shrubs adjacent to the row cropped fields. This model will continue to use fast growing trees

adjacent to the stream. The purpose of this design is to provide a strong wood stem barrier closer to the cropped field. Repositioning the woody plants closer to the field will compensate for a grassed waterway that concentrates the surface runoff flow directly toward the stream. Clinnick (1985) and Jin et al. (2002) studies indicate the large diameter stem and other surface oriented characteristics associated with the identified species enable the plant to stand up to high volume surface runoff, deflect the sheet flow from forming channels, retard the velocity of flow as it moves across the surface of the buffer and allow surface water to pool next to the barriers. The deep fine root structure biomass is often three times deeper than the corresponding surface height. This greatly enhances the ability to hold soil in place (Schultz et al. 1995). This physical feature enhances infiltration and interception of sediment and agricultural chemicals suspended in the surface runoff, which is the principal transport mechanism of excess nutrients (Lee et al. 2003). Greater infiltration will also increase the time of contact between water transported non-point source pollutants and the subsurface elements of the biomass filter of a multi-species riparian buffer (Schultz et al. 1995).

APPENDIX E

Estimated Grass Mix Cost

(Welter Seed & Honey Company 2004)

Forage	# of Acres	PLS Lbs/Acre	%	$ Per Lbs	Total Cost	Cost per Acre
Legumes						
Birdsfoot trefoil	58	4	22	2.25	522	
Medium Red Clover	58	2	11	1.14	133	
Alice White Clover	58	2	11	4.15	482	
Cool Season						
Kentucky Bluegrass						
Tekapo Orchardgrass	58	2	11	1.95	227	
Palaton Reed Canarygrass	58	2	11	2.95	343	
Paddock Meadow Bromegrass	58	4	22	2.10	488	
Tuukka Timothy	58	2	11	1.28	149	
Subtotal					**2344**	**40.41**
Warm Season						
Big bluestem	30	8	40	6.00	1440	
Indiangrass	30	8	40	7.00	1680	
Medium Red Clover	30	4	20	1.14	137	
Eastern Gamagrass	14	3	100	8.25	347	
Subtotal					**3604**	**81.90**
Total					**5948**	**58.31**

APPENDIX F

Estimated Fencing Cost

(Premier 1 2004**)**

Pasture Location	Length Ft	Type	Cost/ft	Qty	Total
Permnt. Pasture N Side	2900				
Permnt. Pasture S Side	3200				
Small Pasture N Side	1200				
Small Pasture S Side	1400				
North Farm W Side	1100				
North Farm E Side	1000				
Drainage Ditch West Side	650				
Drainage Ditch East Side	850				
Buffer Adjacent to BHC	4500				
Total Woven	16,800	Woven	$138/330 ft.	51	$7,038
Permnt. Pasture N Side	5800				
Permnt Pasture S Side	6400				
Small Pasture N Side	2400				
Small Pasture S Side	2800				
North Farm W Side	2200				
North Farm E Side	2000				
Drainage Ditch W Side	1300				
Drainage Ditch E Side	1700				
Buffer Adjacent to BHC	9000				
Total Smooth E. 2 strands	33,600	Smooth	$56/2,100 ft.	16	$ 896
Stream Crossing Path					
6 locations	1440	Polyrope	$.03/ft		$ 43
6 locations	660	Polytape	Min. Purchase		$ 27
6 locations	72	60” step-in post	$3.95/post		$ 285
Misc. connectors					$ 300
Temporary fence for cells	3960	Polyrope	$40/1320 ft.	3	$ 120
EzeReel		Reel for rope	$24 ea.	3	$ 72
Ezereel Bracket		Bracket T post	$12 ea.	3	$ 36
Step in Post		54” step post	$3.80/ea.	70	$ 266
Misc. connectors					$ 300
110 AC fence energizer			$390/ea	3	$1,170
Energizer support box			$ 46/ea	3	$ 128
Six light fence tester			$ 18/ea	1	$ 18
Post material available from BHBF resources					
Estimated Total					$10,699

APPENDIX G

Estimated Water Distribution System

Cool and Warm Season Permanent Pastures

(Spangenburg 2004)

	Distance	Pipe Diameter	PVC $/Ft	Total Cost
Cool Season Pasture				
From Source	1,700	1.5	2.50	3,485
Main CS Pasture	2,400	1.5	2.50	6,000
From Source	* 800	1.5	2.50	2,000
Small CS Pasture	1,200	1.5	2.50	3,000
Warm Season Pasture				
From Source	Same line as *	1.5		
26-Acre Pasture	3,200	1.5	2.50	8,000
Option gamagrass	2,600	1.5	2.50	6,500
Additional Hardware				
Iowa Water Hydrant (5)				500
Pump*				
Water trough (6)*				
Sled (5)*				
Total**				29,485

*Material and equipment available at BHBF to construct items

**Total may be reduced with modifications to layout scheme

APPENDIX H

Scientific Names of Plants and Animals

	Common Name	Scientific Name
Cool-season grass		
	Kentucky bluegrass	Poa pratensis
	Orchardgrass	Dactylis glomerata
	Reed canarygrass	Phalaris arundinacea
	Smooth bromegrass	Bromus inermis L.
	Timothy	Phleum pretense L.
Warm-season Grass		
	Big bluestem	Andropogon gerardii Vitman
	Eastern gamagrass	Tripsacum dactyloides L.
	Indiangrass	Sorghastrum nutans L.
Legumes		
	Alfalfa	Medicago sativa L.
	Birdsfoot trefoil	Lotus corniculatus L.
	Red clover	Trifolium pretense L.
	White clover	Trifolium repens L.
Production Crops		
	Corn	Zea mays L.
	Soybean	Glycine max L.
Shrubs		
	Blue dogwood	Cornus alternifolia
	Red-oiser dogwood	cornus stolonifera
	Sandbar willow	Salix exigua Nutt.
	Common elderberry	Sambucus canadensis
Trees		
	Black walnut	Juglans nigra L.
	Eastern cottonwood	Populus deltoides
	Eastern red cedar	Juniperus virginiana
	Quaking aspen	Populus tremuloides
	Shagbark hickory	Carya ovata
	Weeping willow	Salix babylonica
Mammals		
	American Red Devon	Bos taurus
	American Simmental	Bos Taurus
	Black Angus	Bos Taurus
	Whitetail deer	Odocoileus virginianus
	Cougar	Felis concolor

APPENDIX I

Herbaceous and Woody Species

Plant Materials

The plant materials selected are similar to the plant mix that would be found in a pre-settlement Iowa grassland savannah. The savannah ecosystem was dominated by herbaceous materials that evolved in reaction to fast moving low temperature fires moving across the prairie. This ecosystem also accommodated a scattering of woody plants that adapted well to fire and lower moisture levels than those found further to the east. The overall goal of replicating the plant material in pasture and buffer areas must be modified to accommodate for the presence of introduced plants and wildlife brought in during the 1700 and 1800's. These materials were introduced by well meaning farmers and sportsmen supported by government project managers. The introduced grasses now dominate the cool season grass ecosystem. Warm season grasses will be those native grasses that have adapted over eons to the mid-west prairie environment previously mentioned. Plants selected will contribute toward recreating a functioning ecosystem found in the grassland savannah. This mix of plants inhibited precipitation runoff and contributed to high levels of infiltration. This cyclical process contributed to a good water quality in the streams and relatively few watercourses cutting across the savannah landscape.

Species

Herbaceous plants of grass and legume species are listed below. These species will be utilized in the three different type of buffer designs and in the permanent pastures to improve the existing Kentucky bluegrass dominated forage. Woody plants of shrubs and trees are also provided. These species will be limited to utilization within the confines of the riparian buffers.

Grass	Native/Naturalized	CS/WS	Growth	Height
K. bluegrass	Introd. & Naturalized	CS	Sod/Rhizome	12”-40”
Orchardgrass	Introd. & Naturalized	CS	Bunch	24”-48”
Reed canarygrass	Introduced	CS	Sod/Rhizome	24”-72”
Smooth bromegrass	Introduced	CS	Sod/Rhizome	20”-40”
Timothy	Introduced	CS	Bunch	20”-40”
Big bluestem	Native	WS	Bunch w & w/o Rhizome	3’-8’
E. gamagrass	Native	WS	Bunch	6’-7’
Indiangrass	Native	WS	Sod/Rhizome	4’-8’
Switchgrass	Native	WS	Bunch/Rhizome	3’-6’
Legume				
Alfalfa	Introd. & Naturalized	CS	Long, deep taproot	15”-36”
Birdsfoot trefoil	Introd. & Naturalized	CS	Taproot	15”-44”
Red clover	Introd. & Naturalized	CS	Taproot	12”-36”
White clover	Introd. & Naturalized	CS	Taproot	3”-10”

Species established or to be introduced (Purdue University Agronomy Extension 1997 and ARS 1999)

Shrubs	Trees
Blue dogwood	Black walnut
Common elderberry	E. cottonwood
Redosier dogwood	Quaking aspen
Sandbar willow	Shagbark hickory

Species established or to be introduced (Little 1997)

VITA

Robert S. Slusser

Robert Slusser did undergraduate studies at the University of Maryland and received a Bachelor of Arts degree from the University College in 1969. He received a Certificate of Natural Resources from Virginia Polytechnic Institute and State University in 2002. He was a participating member of Virginia Tech's Urban Biodiversity Research Project: Holmes Run/Tripps Run Watersheds 2001-2002, conducted jointly by the U.S. Geological Survey, Virginian Polytechnic Institute and State University, and the Metropolitan Washington Council of Governments. He was also awarded a Graduate Teaching Assistant position in the Fall Semester of 2004 at Virginia Polytechnic Institute and State University. Mr. Slusser has been an active volunteer In Fairfax County and a certified stream monitor utilizing the Izaak Walton League protocol for stream water quality. He has also participated as a member of the steering committee for the Subwatershed Plan of Little Hunting Creek located in the southeast part of Fairfax County in 2004.