Williamson Pond

Watershed Management Action Plan

Williamson Pond is envisioned to be a pristine publically owned lake that houses a diverse aquatic community.

Updated & Approved August 2009

Developed & Funded in Partnership with the following agencies:

Lucas County Soil and Water Conservation District

Iowa Department of Natural Resources

Iowa Department of Agriculture and Land Stewardship

Natural Resource Conservation Service

Environmental Protection Agency

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Williamson Pond is envisioned to be a pristine publically owned lake that houses a diverse aquatic community.

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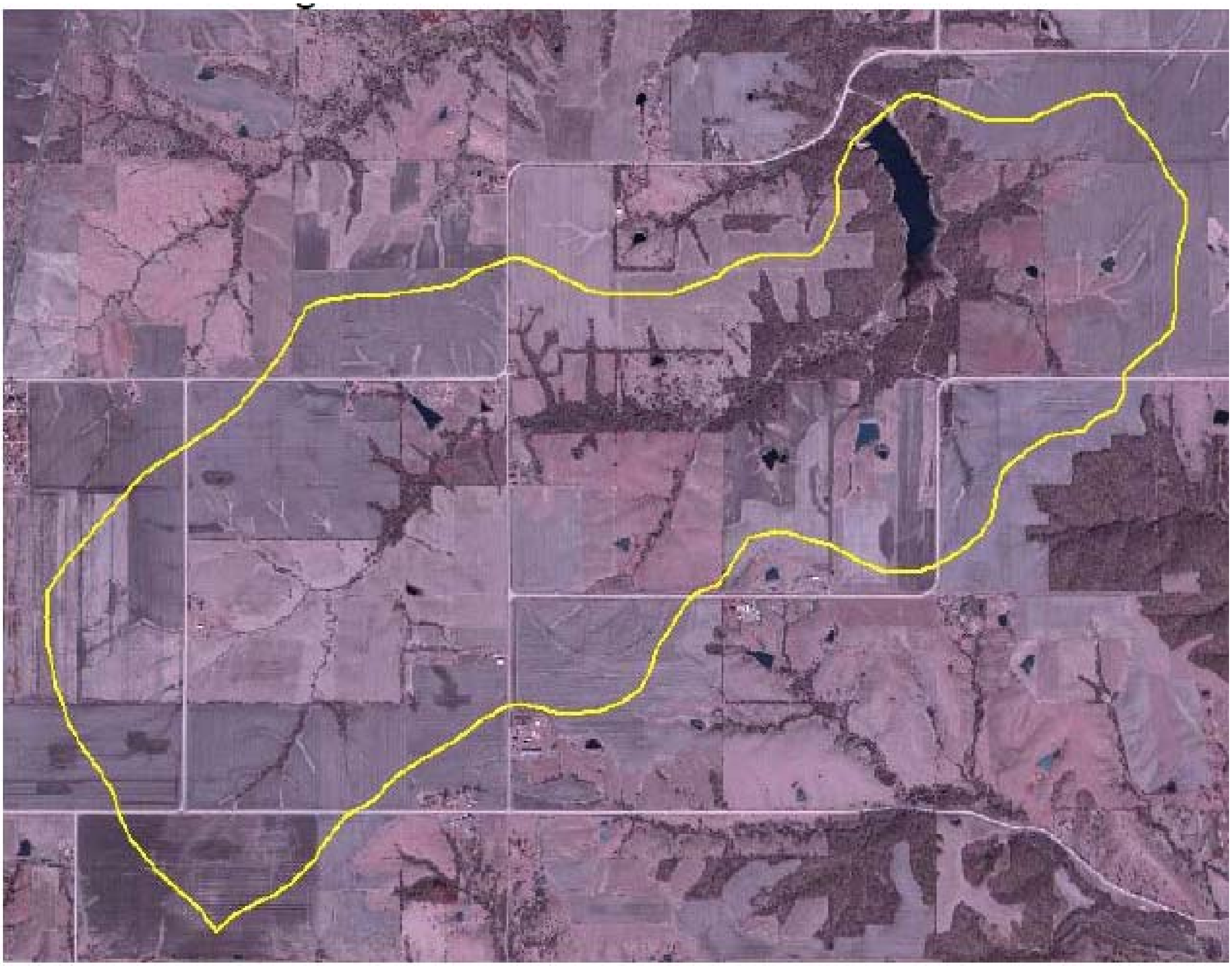
2.1 Watershed Map with Boundaries

Figure 1: Williamson Pond Watershed Map with Boundaries



2.2 Location Narrative and History

Williamson Pond is located 2 miles east of Williamson in south central Iowa, Lucas County, Section 25, T73N, R21W. Williamson Pond was constructed in 1913 by the Chicago, Rock Island and Pacific Railroad as a source of water for steam locomotives. The pond was used as a source of water for the steam locomotives until diesel locomotives were present in the 1950's. At this time, the State of Iowa assumed ownership and management of the lake. It has been managed since 1976 by the Lucas County Conservation Board (while still under state ownership) for fishing, boating, hunting, picnicking and other passive uses. Reports indicate annual lake and park use at approximately 3000 visits. Visitor use is focused on fishing, boating, hunting, picnicking and/or other passive uses.

2.3 Physical Characteristics

Hydrology

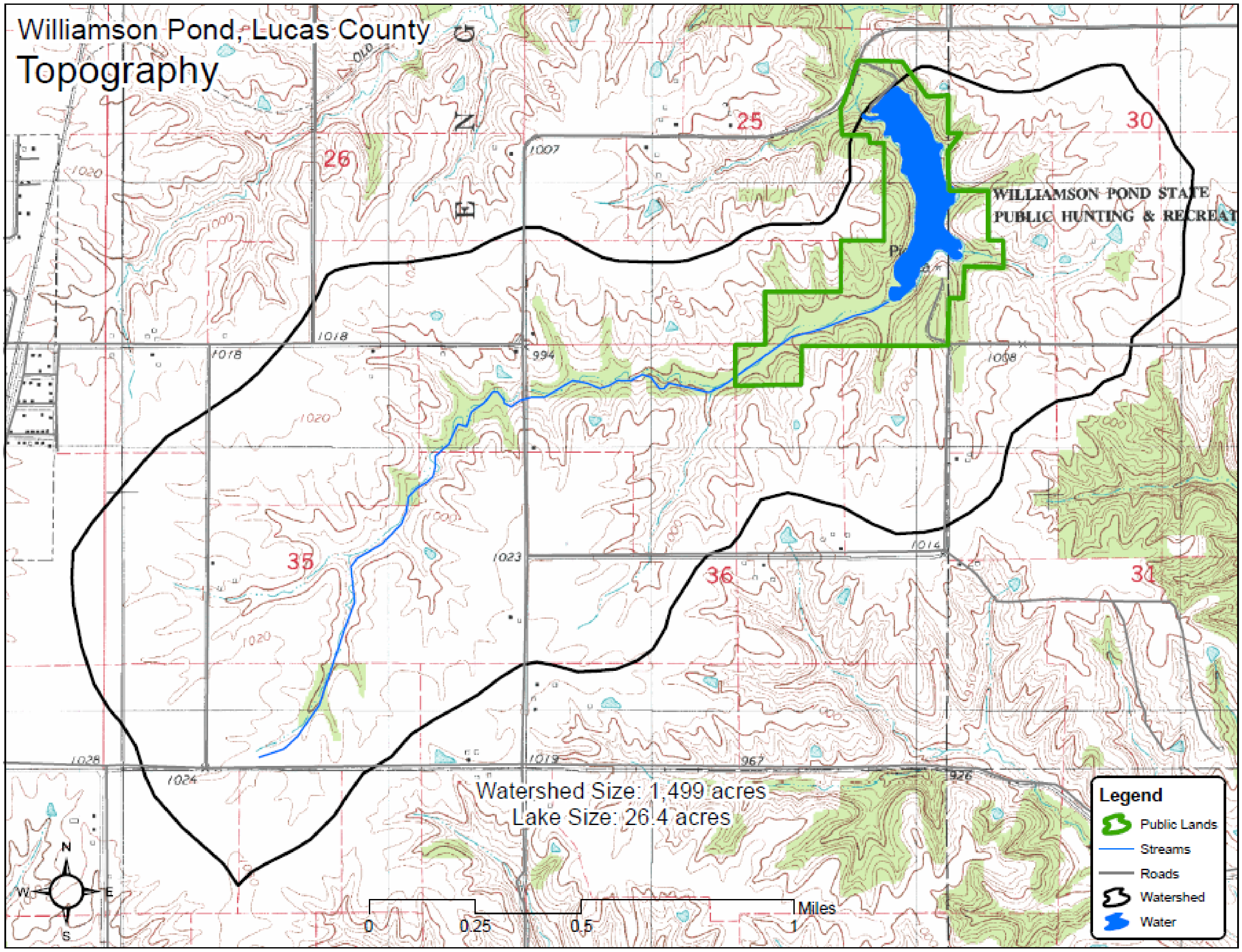
The watershed of Williamson Pond has an area of 1,499 acres and the impoundment has an area of 26 acres, which results in a large watershed to lake area ratio of approximately 57:1. Williamson Pond is fed by the headwaters of English Creek, and discharges into English Creek, a tributary of the Des Moines River. The estimated annual average detention time for Williamson Pond is 0.2 years based on outflow.

Soils

Soils in the watershed range in slope from 0% to 25%. By soil type, 35% of the watershed is composed of Haig (362), Grundy (364B), and Edina (211) soils. These soils are considered to be non-highly-erodible by NRCS and are very productive and suited for row crop production. Another 27% of the watershed is composed of productive but highly-erodible soils of the Pershing and Arispe class. The soils of the rest of the watershed are best suited to grass-based agriculture and forest management.

Topography

Figure 2: Williamson Pond Topography



Geology

Williamson Pond is located in the Southern Iowa Drift Plain landform region. The geology of this area has been influenced by the Nebraskan and Kansas glaciers which left deposits of glacial till on the land. Whenever cold weather checked the melting of the Wisconsin glacier farther north, southwesterly winds picked up materials and deposited it over southern Iowa in layers up to 100 inches thick. This fine material is called loess and is found on ridge tops overlaying the glacial till. On the sides of the hills, erosion has exposed glacially deposited materials. The relatively narrow valleys of the area are covered by alluvial material. In some areas, erosion has proceeded far enough into the valleys to expose glacial till or underlying sedimentary materials. Thus, the terrain at Williamson Pond is characterized by narrow, flat ridges separated by deeply cut drainages.

Climate
Iowa's climate, because of its latitude and interior continental location, is characterized by marked seasonal variations. The state is considered a temperate climate as it experiences four distinct seasons of weather. The average temperature is 49°F (9°C). The state averages 166 days of full sunshine and 199 days of cloudy or partly cloudy days. Williamson, IA climate is warm during summer when temperatures tend to be in the 70's and very cold during winter when temperatures tend to be in the 20's. The warmest month of the year is July with an average maximum temperature of 85.90 degrees Fahrenheit, while the coldest month of the year is January with an average minimum temperature of 9.90 degrees Fahrenheit. Temperature variations between night and day tend to be moderate during summer with a difference that can reach 23 degrees Fahrenheit, and moderate during winter with an average difference of 21 degrees Fahrenheit. The annual average precipitation at Williamson is 36.76 inches. Rainfall is fairly evenly distributed throughout the year. The wettest month of the year is June with an average rainfall of 4.76 Inches. However, annual totals vary widely from year to year and locality to locality.

Threatened & Endangered Species and Environments
Endangered Species means any species of fish, plant life, or wildlife which is in danger of extinction throughout all or a significant part of its range. Threatened Species means any species which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range in the above mentioned categories, but are protected by law.

Special Concern means any species about which problems of status or distribution are suspected, but not documented. Not protected by the Iowa Threatened and Endangered Species law, but many animal species listed as Special Concern are protected under other state and federal laws addressing hunting, fishing, collecting, and harvesting.

Lucas County has approximately 24 species of concern in which some may be found in the Williamson Pond watershed. The species of most concern would the Indiana Bat. Precautions will be taken if Indiana Bat habitat is found.

Table 1: Threatened, Endangered and Special Concern Species in Lucas County

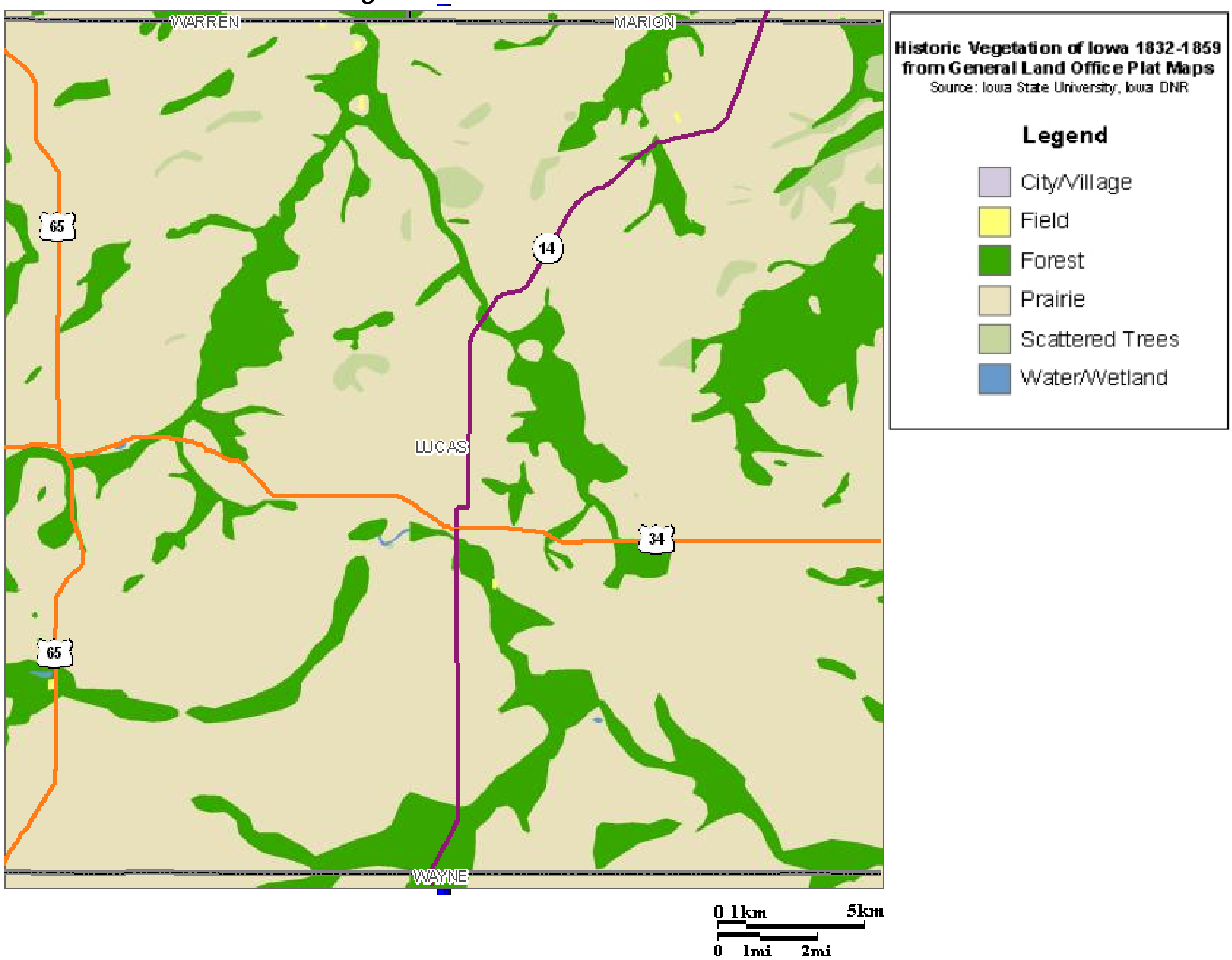
Summary by Species Report
Total Unique Listed Species In This County: 26

County	Common Name	Scientific Name	Class	State Status	Federal Status
LUCAS	Bald Eagle	Haliaeetus leucocephalus	BIRDS	E	
LUCAS	Barn Owl	Tyto alba	BIRDS	E	
LUCAS	Henslow's Sparrow	Ammodramus henslowii	BIRDS	T	
LUCAS	Long-eared Owl	Asio otus	BIRDS	T	
LUCAS	Northern Harrier	Circus cyaneus	BIRDS	E	
LUCAS	Red-shouldered Hawk	Buteo lineatus	BIRDS	E	
LUCAS	Byssus Skipper	Problema byssus	INSECTS	T	
LUCAS	Edwards' Hairstreak	Satyrium edwardsii	INSECTS	S	
LUCAS	Indiana Bat	Myotis sodalis	MAMMALS	E	E
LUCAS	Southern Bog Lemming	Synaptomys cooperi	MAMMALS	T	
LUCAS	Southern Flying Squirrel	Glaucomys volans	MAMMALS	S	
LUCAS	Spotted Skunk	Spilogale putorius	MAMMALS	E	
LUCAS	Cutleaf Water-milfoil	Myriophyllum pinnatum	PLANTS (DICOTS)	S	
LUCAS	Earleaf Foxglove	Tomanthera auriculata	PLANTS (DICOTS)	S	
LUCAS	False Loosestrife	Ludwigia peploides	PLANTS (DICOTS)	S	
LUCAS	Lance-leaf Ragweed	Ambrosia bidentata	PLANTS (DICOTS)	S	
LUCAS	Pink Milkwort	Polygala incarnata	PLANTS (DICOTS)	T	
LUCAS	Prairie Bush Clover	Lespedeza leptostachya	PLANTS (DICOTS)	T	T
LUCAS	Bush's Sedge	Carex bushii	PLANTS (MONOCOTS)	S	
LUCAS	Glomerate Sedge	Carex aggregata	PLANTS (MONOCOTS)	S	
LUCAS	Kidneyleaf Mud-plantain	Heteranthera reniformis	PLANTS (MONOCOTS)	S	
LUCAS	Slender Ladies'-tresses	Spiranthes lacera	PLANTS (MONOCOTS)	T	
LUCAS	Slender Sedge	Carex tenera	PLANTS (MONOCOTS)	S	
LUCAS	Yellow Trout-lily	Erythronium americanum	PLANTS (MONOCOTS)	T	
LUCAS	Slender Glass Lizard	Ophisaurus attenuatus	REPTILES	T	
LUCAS	Speckled Kingsnake	Lampropeltis getulus	REPTILES	T	

Historical Land Cover

Historically this area of the state was covered in tall grass prairies, with some wooded areas, forest and scattered trees.

Figure 3: Historical Land Cover



Current Land Cover

Land cover in the Williamson Pond watershed is typical of current rural areas in the Southern Iowa Drift Plain. A windshield survey was conducted in 2007 and results are shown below.

Figure 4: Williamson Pond Watershed Land Cover

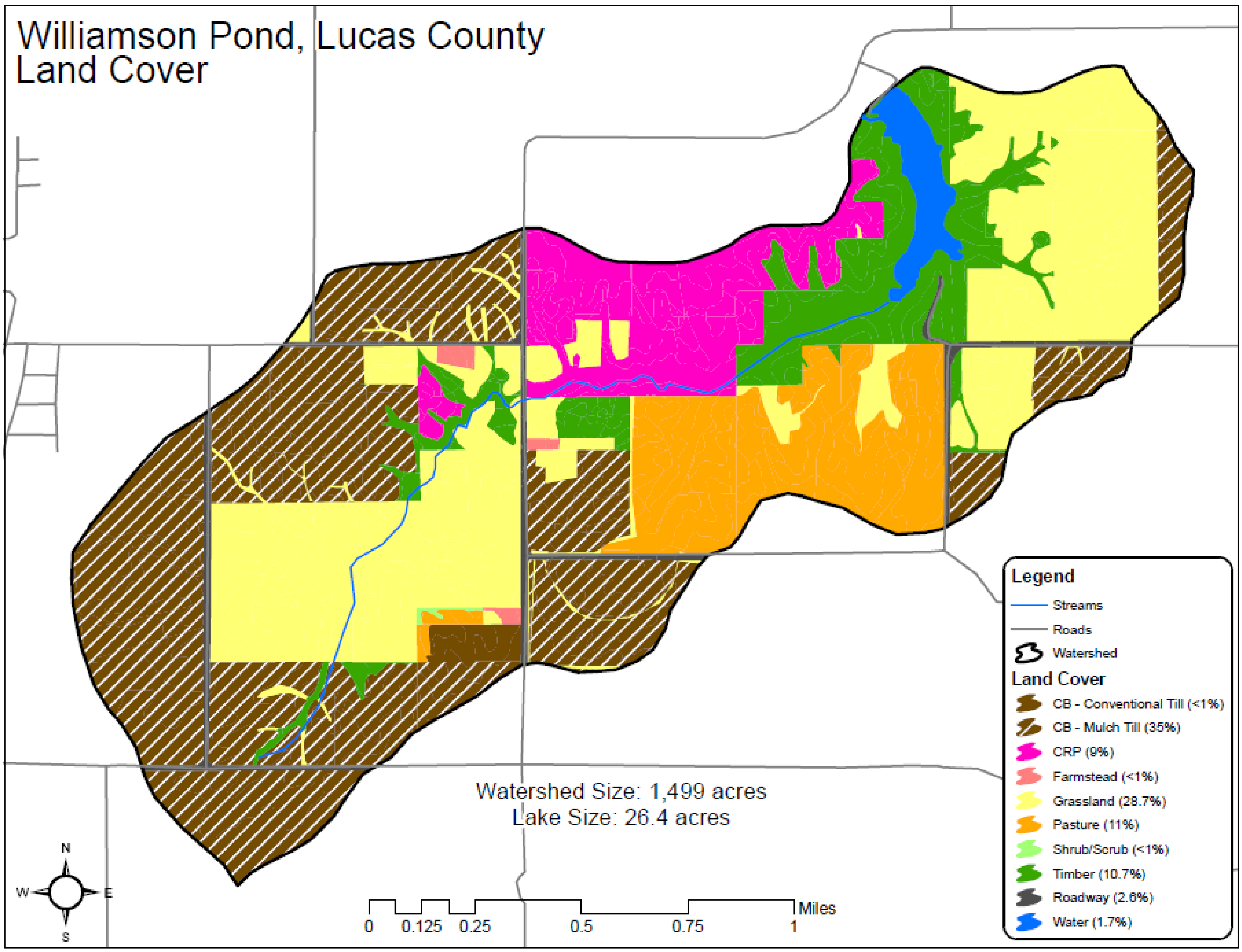


Table 2: Williamson Pond Land Cover Summary

Williamson Pond Land Cover Summary		
(2007 Windshield Survey)		
Land Cover	**Acres**	**%**
CB - Mulch	525	35.0%
Grassland	430	28.7%
Pasture	165	11.0%
Timber	161	10.7%
CRP	134.6	9.0%
Roads	38.7	2.6%
Water	26	1.7%
CB - Conventional	12	0.8%
Farmstead	5.6	0.4%
Scrub/Shrub	1	0.1%

The land use in the watershed is predominantly agricultural. They also show that, on acreage used for row crops, no-till practices (CB – Mulch) are well established, as compared to conventional practices.

Row crop acreage is largely (but not entirely) confined to upland sites of low to moderate slope, while steeper slopes, and land adjoining the watershed's main drainage way (English Creek), are largely under some sort of permanent cover. Numerous ponds, terraces, waterways and other conservation structures and practices are already present in the watershed, and operators are, in general, receptive to projects that can further improve the conservation aspects of their cropping operations.

There are currently two livestock operations in the watershed. One is a cow-calf operation with about 50 cows in the herd. This producer uses a rotational grazing system with three paddocks, and current forage conditions indicate slight overgrazing. The other operation raises meat goats. Its herd size is unknown, but appears to be about 30 head. It has limited grazing land available, but supplemental forage is supplied and the grazing land is adequately treated.

3 Pollutant(s) and Cause(s)

3.1 Designated Use

Williamson Pond is designated under Iowa Water Quality Standards. The designations are as follows:

Primary contact recreational use (Class “A1”). Waters in which recreational or other uses may result in prolonged and direct contact with the water, involving considerable risk of ingesting water in quantities sufficient to pose a health hazard. Such activities would include, but not be limited to, swimming, diving, water skiing, and water contact recreational canoeing.

Warm water—Type 1 (Class “B(WW-1)”). Waters in which temperature, flow and other habitat characteristics are suitable to maintain warm water game fish populations along with a resident aquatic community that includes a variety of native nongame fish and invertebrate species. These waters generally include border rivers, large interior rivers, and the lower segments of medium-size tributary streams.

3.2 Water Quality Data

The Class A1 (primary contact recreation) uses are assessed (monitored) as “not supported” due to poor water transparency that violates Iowa’s narrative criteria protecting against aesthetically objectionable conditions. Also, the presence of large populations of cyanobacteria suggests an additional impairment of these uses due to nuisance aquatic life. The Class B(WW-1) aquatic life uses are assessed (evaluated) as “partially supported” due to sediment related turbidity and the results of a fish kill investigation in May 2007. Fish consumption uses remain “not assessed” due to the lack of fish contaminant monitoring at this lake.

Sources of data for this assessment include: (1) results of the statewide survey of Iowa lakes conducted from 2002 through 2006 by Iowa State University (ISU), (2) results of the statewide ambient lake monitoring program conducted from 2005 through 2006 by University Hygienic Laboratory (UHL), (3) information from the IDNR Fisheries Bureau, and (4) results of a fish kill investigation in May 2007.

Results from the ISU and UHL lake surveys suggest that the Class A1 (primary contact recreation) uses at Williamson Pond are “not supported” due to poor water transparency caused by both algal and non-algal turbidity. Using the median values from these surveys from 2002 through 2006 (approximately 23 samples), Carlson’s (1977) trophic state indices for Secchi depth, chlorophyll a, and total phosphorus were 72, 70, and 79 respectively for Williamson Pond. According to Carlson (1977) the Secchi depth, chlorophyll a, and total phosphorus values all place Williamson Pond in the hypereutrophic category. These values suggest very high levels of chlorophyll a and suspended algae in the water, very poor water transparency, and extremely high levels of phosphorus in the water column.

The level of inorganic suspended solids is moderately high at Williamson Pond and suggests that non-algal turbidity may contribute to the impairment at this lake. The median inorganic suspended solids concentration at Williamson Pond was 4.8 mg/L, which was the 58th highest of the 132 monitored lakes.

Data from the 2002-2006 ISU and UHL surveys suggest a large population of cyanobacteria exists at Williamson Pond, which contributes to the impairment due to nuisance aquatic life. These data show that cyanobacteria comprised 92% of the phytoplankton wet mass at this lake. The median cyanobacteria wet mass (107.9 mg/L) was the 5th highest of the 132 lakes sampled. This median is in the worst 25% of the 132 lakes sampled. The presence of a large population of cyanobacteria at this lake suggests a potential violation of Iowa’s narrative water quality standard protecting against the occurrence of nuisance aquatic life. This assessment is based strictly on the distribution of the lake-specific median cyanobacteria values from 2002-2006. Median levels greater than the 75th percentile of this distribution were arbitrarily considered to represent potential impairment. No other criteria exist, however, upon which to base a more accurate identification of impairments due to cyanobacteria. The assessment category for assessments based on level of cyanobacteria will be considered "evaluated" (indicating an assessment with relatively lower confidence) as opposed to "monitored" (indicating an assessment with relatively higher confidence) to account for this lower level of confidence.

The Class B(WW-1) (aquatic life) uses are assessed (evaluated) as “partially supported” due to the results of a fish kill investigation in May 2007. A fish kill that occurred on or before May 14, 2007 suggests impairment of the Class B(WW-1) uses at Williamson Pond. The cause of the fish kill was spawning stress related to warm water conditions along with high densities of crappie and bluegill. Water temperatures had risen approximately 10 degrees in the week preceding the fish kill. Dissolved oxygen concentrations were found to be normal at the time of the investigation. The number of fish killed was estimated to be 673. According to the IDNR assessment/listing methodology, the occurrence of a single pollutant-caused fish kill, or a fish kill of unknown origin, on a waterbody or waterbody reach during the most recent assessment period (2004-2007) indicates a severe stress to the aquatic community and suggests that the aquatic life uses should be assessed as “impaired.” If a cause of the kill was not identified during the IDNR investigation, or if the kill was attributed to non-pollutant causes (e.g., winterkill), the assessment type will be considered “evaluated.” Such assessments, although suitable for Section 305(b) reporting, lack the degree of confidence to support addition to the state Section 303(d) list of impaired waters (IR Category 5). Waterbodies affected by such fish kills will be placed in IR subcategories 2b or 3b and will be added to the state list of waters in need of further investigation.

Data from the ISU and UHL lake surveys however, show relatively good chemical water quality at Williamson Pond. Results from these surveys show that during 2002-2006 there were no violations of the Class B(WW-1) criterion for ammonia in 16 samples or dissolved oxygen in 23 samples. There were 4 violations of the Class A1,B(WW-1) criterion for pH in 23 samples (17%). However, based on IDNR's assessment methodology these violations are not significantly greater than 10% of the samples and therefore do not suggest an impairment of the Class A1 and Class B(WW-1) uses at Williamson Pond.

3.3 TMDL (Existing Loads, Pollutant Allocation, and Summary)

A TMDL for turbidity and nutrients at Williamson Pond was prepared by IDNR in 2005 and approved by EPA in 2006. Because all Section 303(d) impairments identified for the 2008 assessment/listing cycle (turbidity and noxious aquatic plants) are potentially addressed by the TMDL, this waterbody remains in IR Category 4a (impaired; TMDL approved) for the 2008 cycle.

There has been additional information and assessments completed in addition to the TMDL completed in 2005. Some of the inconsistencies due to additional assessment information for this watershed will be addressed later in this plan.

Please see Appendix A for the TMDL.

4 Identify Pollutant Sources

4.1 Assessments

The Lucas Soil and Water Conservation District completed assessments in 2007 to determine and pinpoint high priority land in the Williamson Pond watershed.

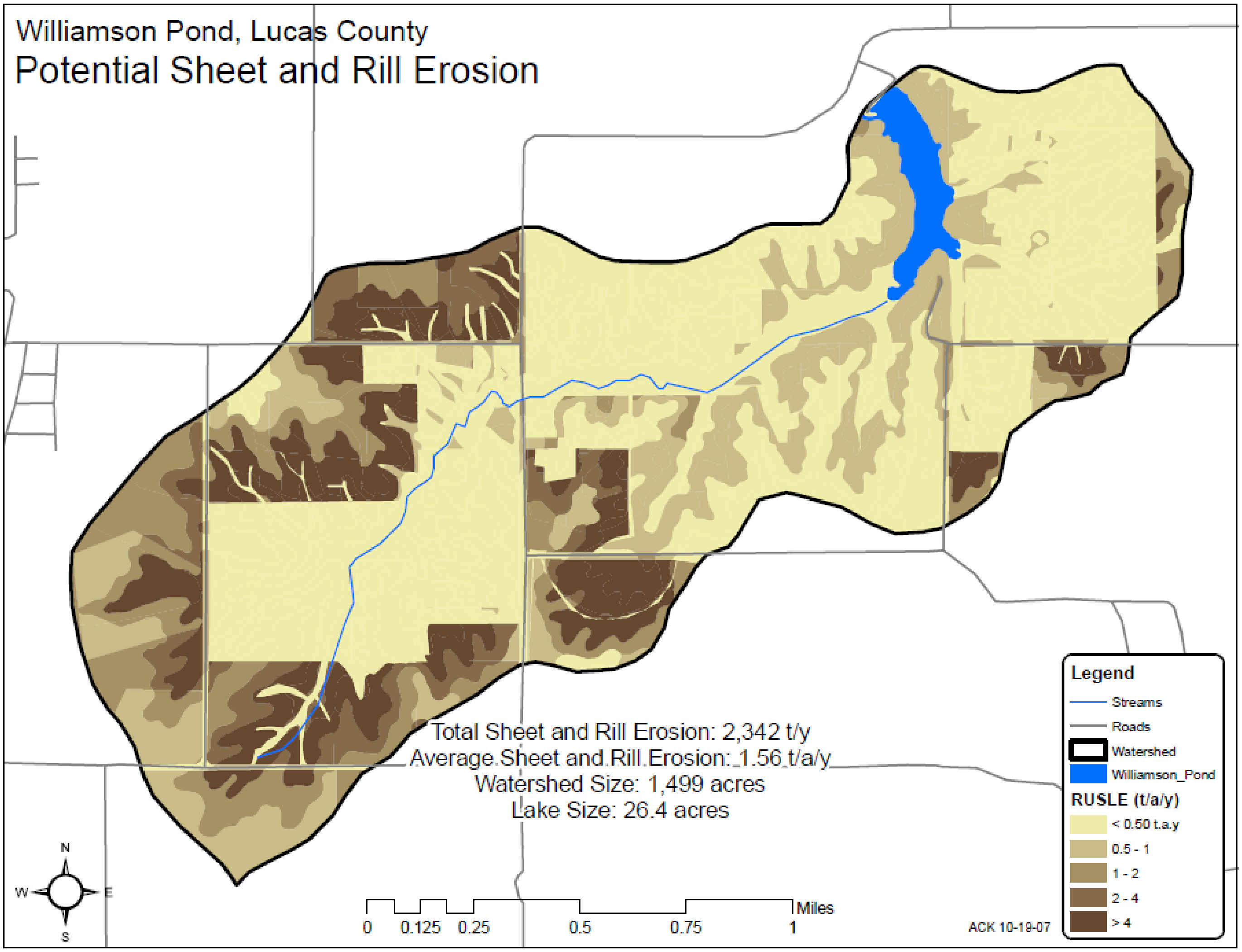
Land Use, Management & Tillage Assessment

Refer to page 11 and 12, of this document for the Current Land Use coverage.

Sheet & Rill Erosion

Sheet and rill erosion is the detachment and removal of soil from the land surface by raindrop impact, and/or overland runoff. It occurs on slopes with overland flow and where runoff is not concentrated. The Revised Universal Soil Loss Equation (RUSLE) is used to calculate sheet and rill erosion and estimates average annual erosion in tons/acre/year.

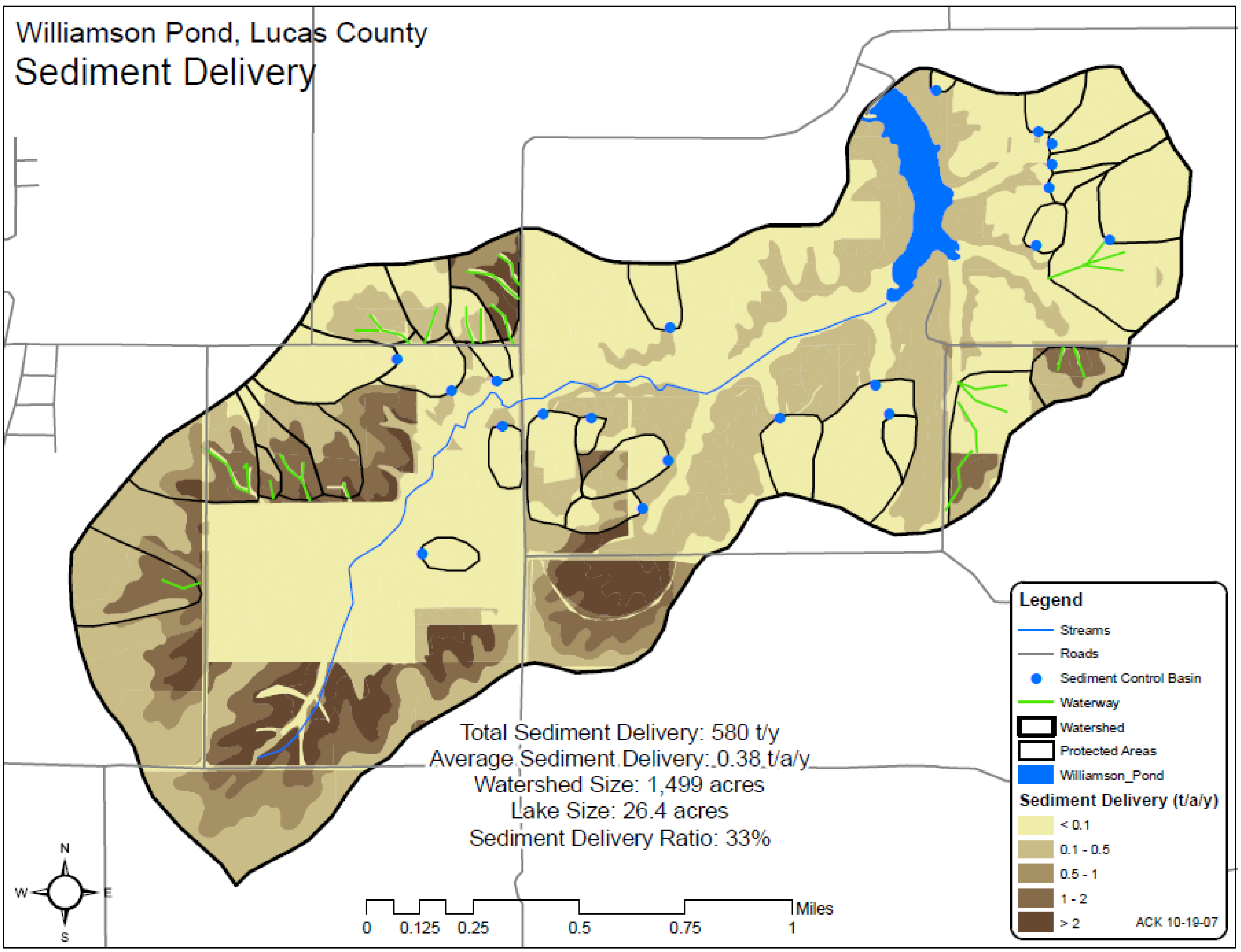
Figure 5: Potential Sheet and Rill Erosion – Williamson Pond



Sediment Delivery

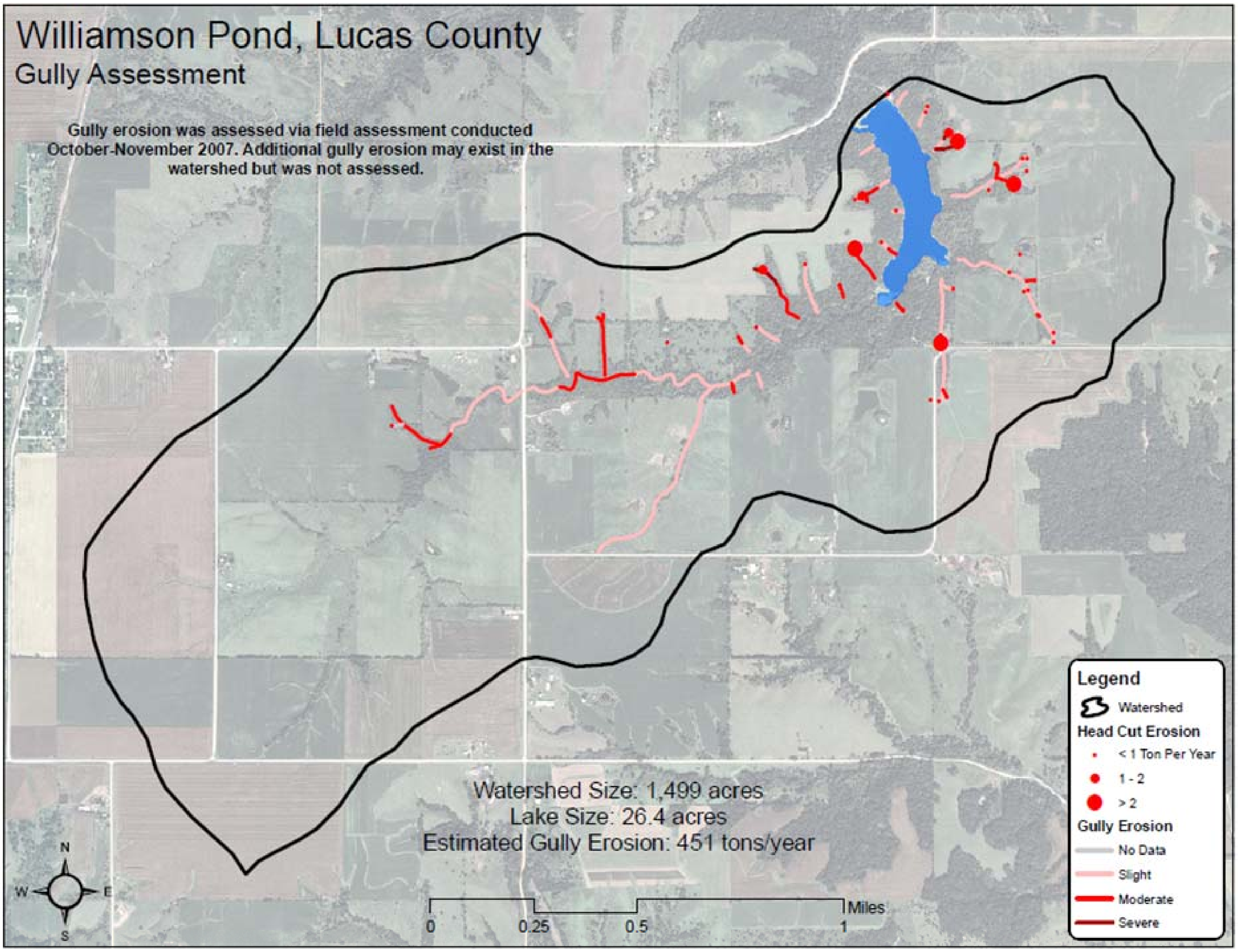
Sediment delivery can be defined as the amount of net erosion that is delivered to a specific location, typically the outlet of a watershed. Sediment delivery modeling incorporates the beneficial impacts of watershed improvement practices (i.e. sediment basins, waterways, etc.) to estimate the amount of sediment reaching the waterbody of interest. The sediment delivery ratio is expressed as a percentage and reflects the watersheds efficiency of moving soil particles from the point of erosion to the outlet of the watershed. The Sediment Delivery Ratio takes into account watershed size, landform region and watershed shape to calculate a percentage of sheet and rill erosion reaching the waterbody. Information based on the most recent assessment estimates the total sediment delivery to be approximately 580 t/y (tons per year).

Figure 6: Sediment Delivery – Williamson Pond



Gully Assessment
Sediment contributions from gully erosion can account for a significant portion of the total sediment reaching a lake or stream. Gully erosion numbers can be compared to sediment delivered from sheet and rill erosion and streambank erosion to help prioritize the most critical lands in a watershed. Information based on the most recent assessments estimates sediment delivery from gullies is approximately 451 t/y.

Figure 7: Gully Assessment – Williamson Pond



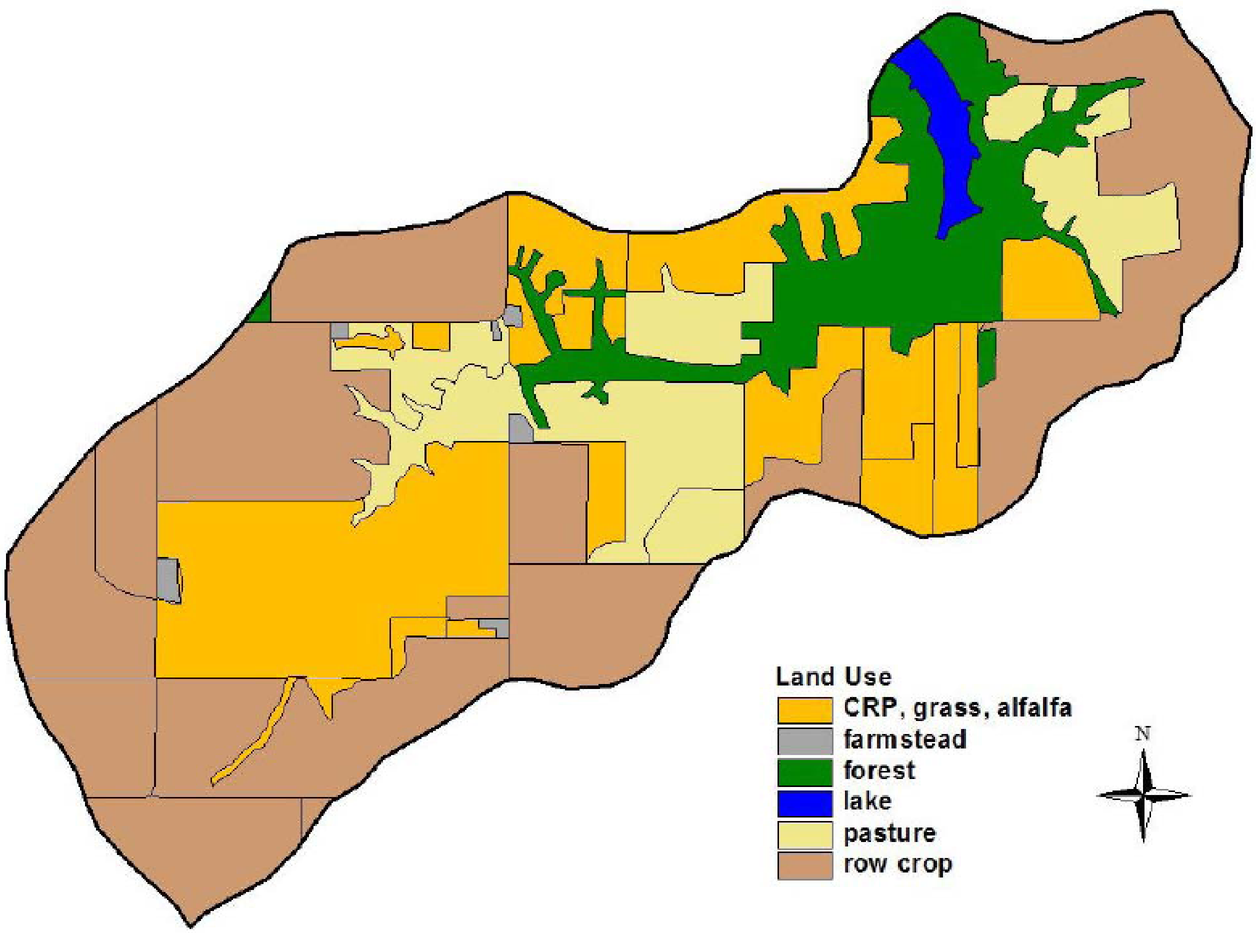
4.2 Pollutant Data Analysis

Pollution Source Assessment – Information from Williamson Pond TMDL

Existing Load

Turbidity levels in Williamson Pond are created by a current estimated sediment load of 1,765 t/y delivered to or resuspended in the lake. This sediment delivery was determined using RUSLE and 2002 landuses. The phosphorus load was determined using the Vollenweider 1982 Shallow Lake and Reservoir model. This model estimated current phosphorous delivery at 2,282 lbs/y (pounds per year).

Figure 8: 2002 Land Uses of Williamson Pond



Departure from Load Capacity
The non-algal turbidity load capacity is 388 tons of sediment. The existing non algal turbidity load is 1,765 t/y resulting in a departure from load capacity of 1377 t/y. The phosphorus loading capacity is 804 lbs/y. The phosphorus load is 2,282 lbs/y, resulting in a departure from the loading capacity of 1,478 lbs/y.

Identification of Pollutant Sources
There are no point sources of pollution in Williamson Pond watershed. Therefore, all the non-algal turbidity is attributed to non-point sources.

Linkage of Sources to Target
The load capacity of Williamson Pond is 388 t/y. The estimated sediment load is 1,765 t/y. The total phosphorus load capacity is 804 lbs/y. The phosphorus load is 2,282 lbs/y. The loads originate from nonpoint sources in the watershed and internal lake resuspension.

5 Watershed Management Plan Goals and Objectives

5.1 Statement of Goals and Objectives

The goal is to reduce pollutant loads of sediment and phosphorus so this waterbody can achieve its fully supported designation and ultimately be delisted from Iowa's impaired waters list. The target load allocation for sediment and phosphorus is 388 t/y and 804 lbs/y, respectively.

Assessment information and TMDL information are inconsistent in their evaluations of sediment delivery and corresponding phosphorus delivery to the pond. At the time the TMDL was written, conservation practices in the watershed were not evaluated. Land use and gully assessment methods have improved since finalization of the TMDL. Therefore, specific sediment & phosphorus reduction goals are based on most current assessment data. The inconsistencies of sediment are shown in Table 3.

Table 3: Inconsistencies in TMDL and Assessment Data

Estimated Sediment Delivery to Williamson Pond		
	TMDL Estimates	Assessment Estimates
Potential Sheet/Rill Erosion	1765 t/y	580 t/y
Gully Erosion	N/A	451 t/y
Total	**1765 t/y**	**1031 t/y**

Table 4: Updated Pollutant Loads for Williamson Pond

Pollutant Load and Allocation for Williamson Pond				
	TMDL Estimated Load	Assessment Estimated Load	Load Capacity	**Reductions Needed**
Sediment	1765 t/y	1031 t/y	388 t/y	**643 t/y**
Phosphorus	2285 lbs/y	1538 lbs/y	804 lbs/y	**734 lbs/y**

As shown in Table 3 & 4, updated assessment estimates are less than the TMDL estimate for sediment delivery to the pond. Consequently, the Williamson Pond TMDL estimated the mass of total phosphorus per unit mass of sediment therefore over-estimating total phosphorus load from surface delivery. The same equation was used to update the total phosphorus load from surface delivery. The mass of total phosphorus per unit mass of sediment used to develop the Williamson Pond TMDL total phosphorus load was 575 mg TP to one kg of sediment. This value was obtained using Iowa Phosphorus Index Equation 1. This value is then multiplied by an enrichment factor of 1.3 to account for the larger surface area of the typically smaller particles that erode to a waterbody. Thus, the phosphorus load corresponding with updated sediment delivery estimates is calculated to be 1538 lbs/y from surface delivery. It is uncertain how much phosphorus is from surface delivery and how much is from internal load.

The updated assessment information for this watershed estimates load reductions needed for sediment and phosphorus are 643 t/y and 734 lbs/y, respectively.

Phase 1 of this plan is to reduce sediment delivery to Williamson Pond by 453 t/y, with the expectation that this will also result in a corresponding reduction in phosphorus delivery. For phosphorus, there is an accepted load reduction figure of 1.3 lbs for every ton of sediment reduction. A sediment delivery reduction of 453 t/y would thus produce a phosphorus delivery reduction of 589 lbs/y.

Phase 2 of this plan is to reduce an additional 485 t/y of sediment delivery and 631 lbs/y of phosphorus delivery to Williamson Pond.

Phase 3 of this plan is to reassess the land uses and gullies in the watershed. There are also plans to pursue restoration of the fishery in the watershed. Dredging and eliminating nuisance fish species such as carp will be sought out options in the final phase of this plan.

5.2 Targets and Load Reductions

Figure 9: Phase 1 Proposed Structures – Williamson Pond (Numbered structures are on state land – Lettered structures are on private land)

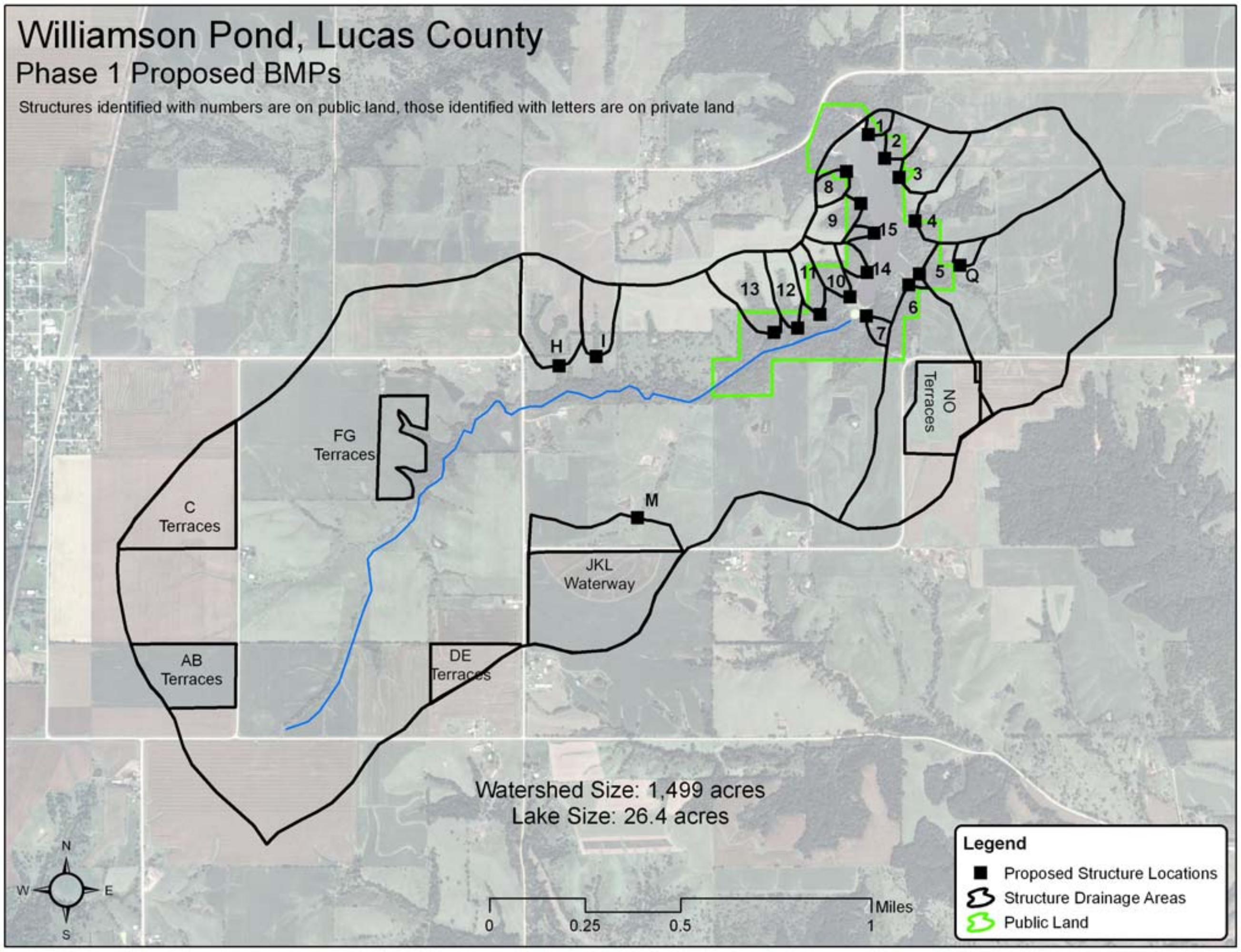


Figure 10: Phase 2 Proposed Structures – Williamson Pond (Numbered structures are on state land – Lettered structures are on private land)

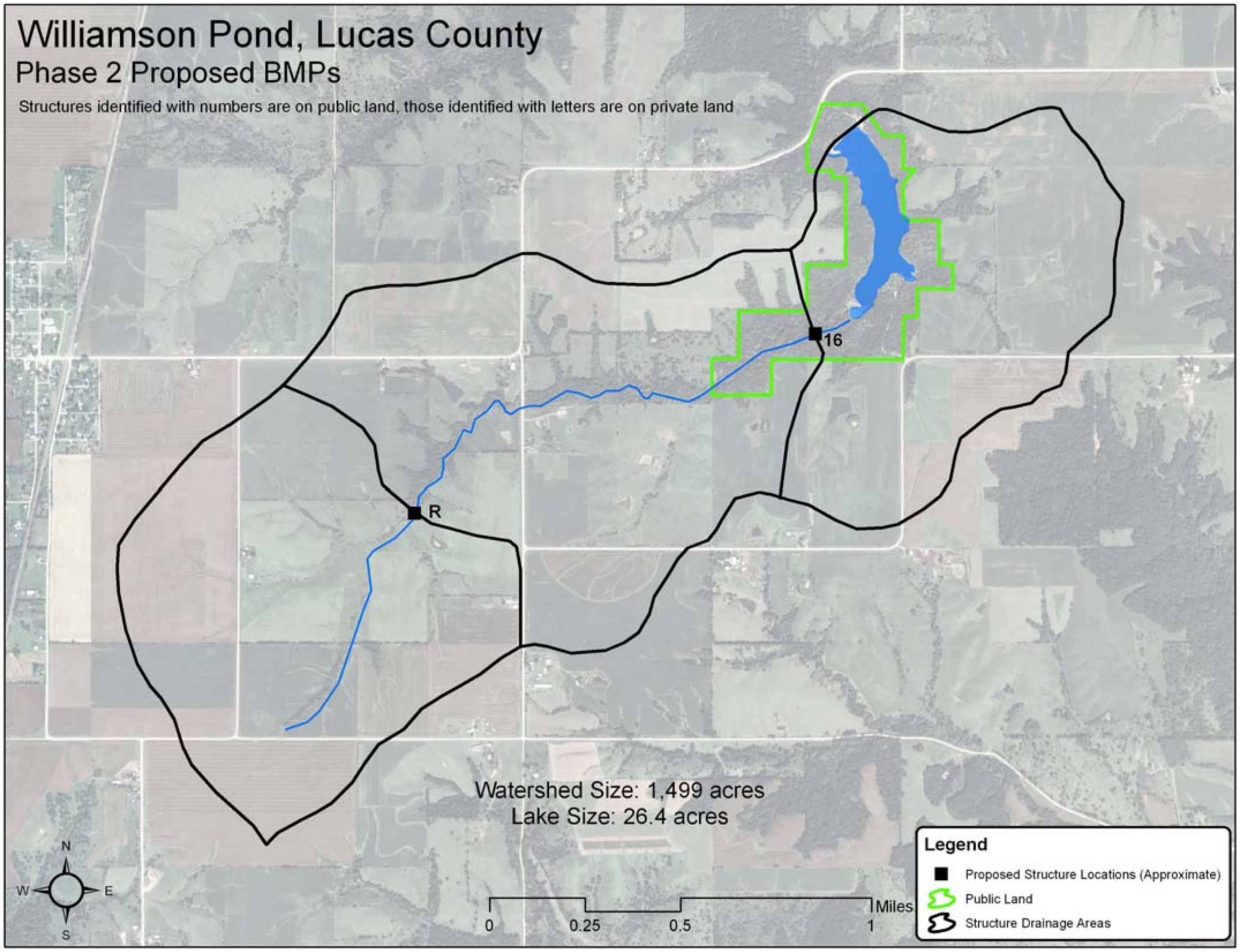


Table 5: Estimated sediment reduction – Williamson Pond

Williamson Pond Proposed Structure Sediment Reduction					
Phase 1					
Site No.	Drainage Area Acreage	Estimated Existing SD (t/y)	Estimated Existing Gully Erosion (t/y)	BMP Type	Estimated Reduction in Sediment Delivered to Williamson Pond (t/y)
1	2.4	0.44	2.25	Sediment Basin	2.42
2	5.8	0.70	3.09	Sediment Basin	3.41
3	12.4	0.97	34.65	Sediment Basin	32.06
4	63.6	2.09	31.32	Grade Stabilization Structure	30.07
5	122.8	5.55	25.84	Grade Stabilization Structure	28.25
6	85.8	16.20	31.89	Grade Stabilization Structure	43.28
7	2.3	0.42	4.78	Sediment Basin	4.68
8	4.1	0.67	2.19	Sediment Basin	2.57
9	7.8	0.88	23.18	Sediment Basin	21.65
10	6.4	0.70	19.31	Sediment Basin	18.01
11	5.9	0.75	6.29	Sediment Basin	6.34
12	8.2	0.88	7.14	Sediment Basin	7.21
13	15.9	1.76	47.90	Sediment Basin	44.70
14	3.1	0.55	5.47	Sediment Basin	5.42
15	1.2	0.22	1.34	Sediment Basin	1.40
AB	32.4	28.52	*	Terrace	12.80
C	10.7	5.73	*	Terrace	9.90
DE	41.2	33.43	*	Terrace	6.53
FG	18.0	63	*	Terrace (Possible Site for Grade Stabilization Structures)	31.50
H	26.2	1.65	17.65	Grade Stabilization Structure	17.37
I	10.5	0.42	14.14	Grade Stabilization Structure	13.10
JKL	52.8	60.64	*	Waterway	15.16
M	73.7	104.71	*	Livestock/Sed Bas.	94.24
NO	9.6	1.11	0.33	Terrace	0.50
Q	2.4	0.15	*	Sediment Basin	0.14
				Estimated Total	**453**
Phase 2					
Site No.	Drainage Area Acreage	Estimated Existing SD (t/y)	Estimated Existing Gully Erosion (t/y)	BMP Type	Estimated Reduction in Sediment Delivered to Williamson Pond (t/y)
16	1,060.0	145.25	146.02	Wetland	218.45
R	487.0	296.4	*	Silt Damn Structure	266.76
				Estimated Total	**485**
**No gully erosion assessed or no gully erosion occurring*					

5.3 Best Management Practices (BMPs)

The greatest need identified with the assessments is for structures that will reduce gully erosion. A large proportion of that need exists on publicly owned land surrounding the lake.

Phase 1:

This phase is to install/implement the following structures, most of them targeted toward high-priority gullies that drain directly into the lake, ultimately achieved sediment reduction of 453 t/y:

-- 5 grade stabilization structures
-- 13 sediment control basins
-- 5 acres of grass waterway
-- 5000 feet of terraces
-- 1 livestock facility improvement

Phase 2:

The second phase of this plan is to install structures to reduce 485 t/y of sediment.

-- 1 (4-acre) wetland upper end of Williamson Pond
-- 1 silt damn structure

Phase 3:

The third phase is to reassess the watershed to determine if additional structures are need. Also develop plans for dredging and fishery restoration to address internal pollutant load, if needed.

6 Water Monitoring Plan

The primary goal of a water monitoring plan is to evaluate the effectiveness of implementation efforts to improve water quality over time. The TMDL set reduction targets for both suspended sediment and phosphorus. Problems within the lake directly related to turbidity include a loss of recreational value and reduced recreational use. To the extent that the lake's turbidity results from ongoing influx of sediment (rather than from resuspension of existing sediment), there is also an accumulating problem with sedimentation of the lake, reducing its depth and surface area, and thus further reducing its recreational value. A recent DNR Fisheries analysis of Williamson Pond reports only small numbers of bullhead and common carp, indicating that its turbidity does not significantly result from resuspension of sediment. DNR's 2004 and draft 2006 305(b) reports on water quality recognize Williamson Pond's turbidity impairment, and rate the lake as “partially supporting” its Class A1 and Class B(LW) uses. The goal of the project is to reduce sediment and phosphorus loading to meet TMDL limits through structures and near-shore BMPs. The monitoring plan has been developed in coordination with the Iowa Department of Natural Resources Water Monitoring Section. Specifics are detailed below.

Monitoring Needs:

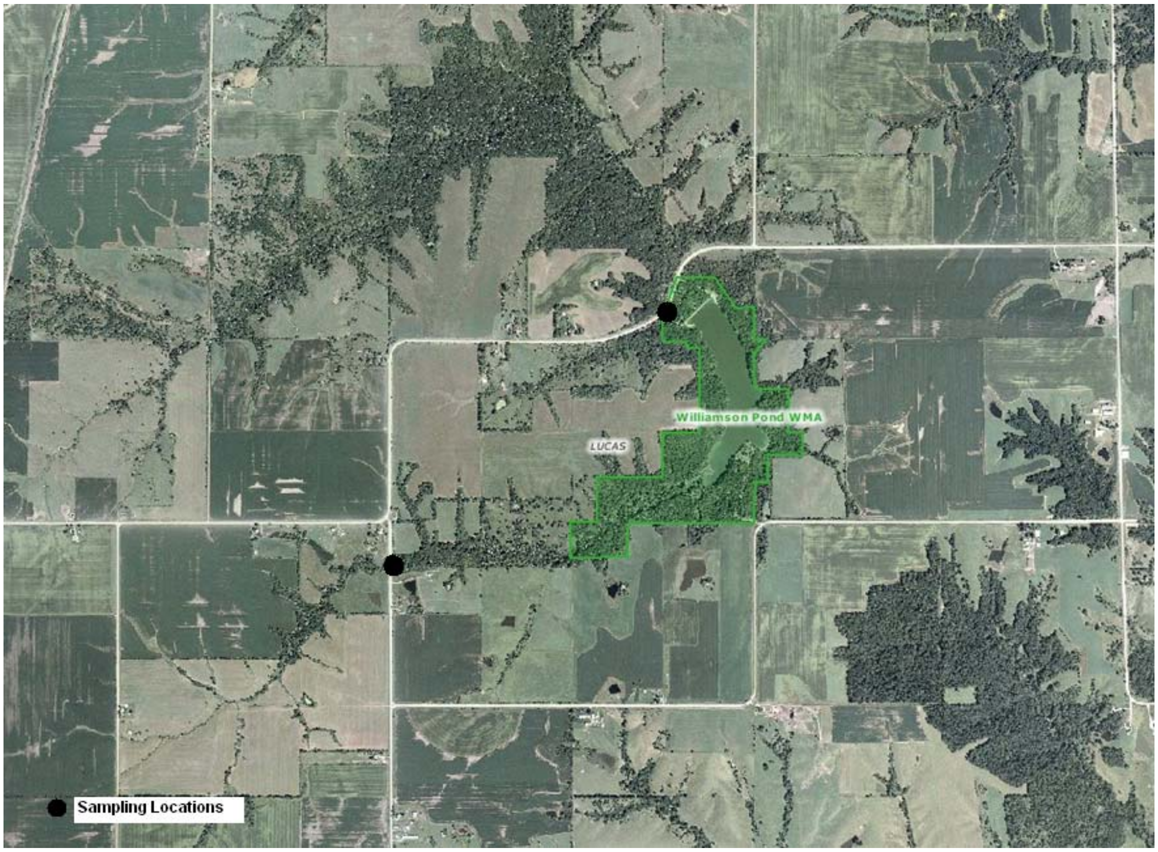
1. Annual lake monitoring to determine if water quality “standards” are being met (progress toward secchi, TSI, P goals).
2. Monitoring upstream and downstream of clusters of structures/basins to determine reduction in loading.
3. Add flow monitoring to monitoring of structures/basins.
4. Conduct and repeat RASCAL stream bank and gully erosion assessment after BMP implementation to quantify reduction in sediment delivery from these sources.

Plan:

1. Conduct annual lake monitoring.
    a. Ambient program will continue to monitor the lake three times during the spring-fall season according to standard protocols. (see DNR Lake monitoring for specific parameters, schedule, and analysis).
    b. Determine if Williamson Pond is on the Fisheries Restoration Priority List or is scheduled for any other in-lake work.
    c. Conduct an IOWATER monitoring workshop in 2009 to train volunteers for lake monitoring above.
    d. IOWATER volunteers will collect monthly secchi disk depth readings, total p, nitrate, and visual assessments of the lake from May – Oct each year during the project.
2. Monitor stream sediment and phosphorus loads to the lake
    a. One ISCO sampler with flow measurement will be placed in the main channel leading to Williamson Pond.
        a. ISCO will collect 6 events each year with a possibility of additional samples based on the rainfall pattern and timing. Decisions to modify the sampling regime will be discussed between the DNR, SWCD, and UHL.
        b. Samples will be tested for N-series, P-series, TSS.
        c. Stream flow will be calculated using the stage measured by the ISCO and manual measurements taken by UHL staff at the time of sample collection.
        d. UHL will be subcontracted for ISCO sampling work under the existing DNR 319 contract with UHL.
        e. UHL will follow DNR and UHL Standard Operating Procedures.

   b. Second ISCO sampler with flow measurement in secondary drainage. This ISCO may be discontinued if the flow is not sufficient to maintain the bubbler mechanism.
      a. ISCO will collect 6 events each year with a possibility of additional samples based on the rainfall pattern and timing. Decisions to modify the sampling regime will be discussed between the DNR, SWCD, and UHL.
      b. Samples will be tested for N-series, P-series, TSS
      c. Stream flow will be calculated using the stage measured by the ISCO and manual measurements taken by UHL staff at the time of sample collection.
      d. UHL will be subcontracted for ISCO sampling work under the existing DNR 319 contract with UHL.
      e. UHL will follow DNR and UHL Standard Operating Procedures.
   c. Sample at the outlet of the one or more structures or below a cluster of structures/basins depending on final configuration of BMPs.
   d. In-situ turbidimeter to measure sediment. In-situ turbidimeter will be co-located with the ISCO in the main channel leading to the pond.
3. Project staff to conduct pre and post-implementation RASCAL assessment including estimates of reduction in sediment delivery from bank and gully erosion.

Figure 11: Stream Sampling Locations



7 Information and Education

There are 16 landowners within the Williamson Pond watershed. Less than 10 landowners have been determined to have problematic areas that will benefit the watershed area by having structures completed on them.

Phase 1 – Information/Education Action Steps

District staff will actively engage the local landowners with the following actions:

- Update SWCD commissioners and local interested parties on watershed work.
- Personally contact the proposed structure landowners at least two times per year noting progress of their proposed projects.
- Contacts officially will be made after July 1, 2009.
- Field visits with these landowners will take place to discuss possible projects. Maps will be provided showing placement of the proposed structures.

- Personally contact proposed structure landowners by letter or phone of any updated information concerning the project.
- Press releases, newsletters and or/ mailings will be sent accordingly to update these landowners on the progress of the phases of this plan.

Additional action items to be addressed in Phase 1 include:

- Develop Technical Advisory Committee
- Develop Local Advisory Committee
- Meet with Advisory committees quarterly
- Notify local landowners and other stakeholders of the project
- Send press releases when necessary
- Notify public of public land work through press releases and/or public meetings
- Hold public meetings to introduce plans for phase 2 and phase 3

Phase 2 – Information/Education Action Steps

- Update stakeholders, landowners, advisory committees on progress
- Hold public meetings on progress and introduce plans for phase 3

Phase 3 – Information/Education Action Steps

- Update stakeholders, landowners and advisory committees on progress.
- Hold public meetings on progress; determine if additional action is needed.

Additional and specific measures of I/E activities will be determined on a year to year basis and will be documented in yearly work plans from the District.

8 Implementation Schedule

Goal	Remove Williamson Pond from 303(d) Impaired Waters List	Milestone Metric	Milestone Totals	Phase 1: 2009-2012			
				2009	2010	2011	2012
Objective 1	*Target Secchi depth of 0.7 meters of turbidity*						
Objective 2	*Reduce Sediment Delivery by 453 tons/year*						
Task 1	Install 5 grade stabilization structures	# installed	5		2	1	2
Task 2	13 sediment control basins	# installed	13		3	5	5
Task 3	Construct 5 acres of grass waterways	Acres constructed	5		2	1	2
Task 4	Construct 5000 feet of terraces	Feet installed	5000		2000	2000	1000
Task 5	Improve 1 livestock facilities	# improved	1		1		
Objective 3	*Increase funding opportunities for projects in the watershed.*						
Task 1	Apply for public owned lakes funding.	Dollars received	$80,000.00		$40,000	$40,000	
Task 2	Implement EQIP on private owned land.	Dollars received	$20,000.00	$5,000	$7,500	$7,500	
Objective 4	*Evaluate progress in watershed.*						
Task 1	Water Monitoring	Increasing Clarity	Secci Depth	Record Baseline Data	Record Baseline Data	Average of 0.5 meters	Average of 0.5 meters
Task 2	Reducing Sediment Delivery to Williamson Pond	Sediment Reductions	Tons/year	**Cumulative of ~453 t/y**			
Task 3	Update Watershed Management Plan (yearly)	Watershed Management Document Update	4	1	1	1	1
Task 4	Submit plan, proposals for additional funding, based on progress and need	Proposal	1				1

Goal	Remove Williamson Pond from 303(d) Impaired Waters List	Milestone Metric	Milestone Totals	Phase 2: 2013-2016			
				2013	2014	2015	2016
Objective 1	*Target Secchi depth of 0.7 meters of turbidity*						
Objective 2	*Reduce Sediment Delivery by485 t/y tons/year*						
Task 1	Restore wetland	Acres restored	4		4		
Task 2	Install silt damn structure	# installed	1			1	
Objective 3	*Increase funding opportunities for projects in the watershed.*						
Task 1	Apply for WIRB grant	Dollars received	$144,500	$144,500			
Objective 4	*Evaluate progress in watershed.*						
Task 1	Water Monitoring	Increasing Clarity	Secci Depth	Average of 0.5 meters	Average of 0.6 meters	Average of 0.7 meters	Average of 0.7 meters
Task 2	Reducing Sediment Delivery to Williamson Pond	Sediment Reductions	Tons/year	**Cumulative of ~485 t/y**			
Task 3	Update Watershed Management Plan (yearly)	Watershed Management Document Update	4	1	1	1	1
Task 4	Submit plan, proposals for additional funding, based on progress and need	Proposal	1				1

Goal	**Remove Williamson Pond from 303(d) Impaired Waters List**	**Milestone Metric**	**Milestone Totals**	**Phase 3: 2017 - future**	
				2017	Future
Objective 1	*Evaluate progress in watershed.*				
Task 1	Water Monitoring	Increasing Clarity	Secci Depth	Average of 0.7 meters	Average of 0.8 meters
Task 2	Assess Sediment and Phosphorus loading to Williamson Pond	Sediment Delivery Phosphorus Delivery	Tons/year Pounds/year	**Not to exceed 388 t/y, 806 lbs/y, respectively**	**Not to exceed 388 t/y, 806 lbs/y, respectively**
Task 3	Update Watershed Management Plan – Determine if additional dollars are needed for pond	Watershed Management Document Update	1	1	1
Task 4	Submit plan, proposals for additional funding for possible dredging of pond	Proposal	1	1	If needed

9 Resource Needs

Participating Agencies and Organizations

Lucas County SWCD
Arnold Schneider
Technical support
Financial assistance
641-774-2512

IDALS-DSC
Vince Sitzmann
Technical support
Financial assistance
515-242-6008

Iowa DNR
Section 319 Program
Rachel Glaza
Technical support
Financial assistance
515-281-8158

USDA-NRCS
Jeff Matthias
Technical support
Financial assistance
641-774-2512

Lucas County
Conservation Board
Skylar Hobbs
Resource management
Site maintenance
641-774-2438

Goal	Remove Williamson Pond from 303(d) Impaired Waters List.	Funding Source*	Costs	Phase 1: 2009-2012			
				2009	2010	2011	2012
Objective 1	*Implement watershed restoration practices in targeted areas to reduce sediment delivery by 453 tons/year and increase water clarity.*						
Task 1	Construct 5 grade stabilization structures	319,SIDCA,POL,Landowners	$120,000	$15,000	$15,000	$45,000	$45,000
Task 2	Construct 13 Sediment control basins	319,POL,Landowners	$137,500	$32,500	$30,000	$37,500	$37,500
Task 3	Construct 5 acres of grass waterways	319,POL,Landowners	$7,500	$3,000	$3,000	$1,500	
Task 4	Construct 5000 feet of terraces	319,POL,Landowners,EQIP	$45,000	$18,000	$18,000	$9,000	
Task 5	Improve 1 livestock facility	319,Landowners	$5,000		$5,000		
Objective 2	*Promote the Williamson Pond Watershed project.*						
Task 1	Salary & Benefits for 1/4 time Project Coordinator	319	$48,000	$12,000	$12,000	$12,000	$12,000
Task 2	Travel/Training	319	$2,800	$1,000	$600	$600	$600
Task 3	Supplies	319	$2,000	$500	$500	$500	$500
Objective 3	*Increase funding opportunities for projects in the watershed.*						
Task 1	Apply for public owned lakes funding.	District, DNR	Staff Time	x	x		
Task 2	Implement EQIP on private owned land.	District	Staff Time	x	x	x	X
Objective 4	*Evaluate progress in watershed.*						
Task 1	Water Monitoring	319	To be determined	To be determined	To be determined	To be determined	To be determined
Task 2	Reducing Sediment Delivery to Williamson Pond	District, DNR	Staff Time	x	x	x	x
Task 3	Update Watershed Management Plan (yearly)	District, DNR, IDALS-DSC	Staff Time	x	x	x	x
Task 4	Submit plan, proposals for additional funding, based on progress and need	District, DNR, IDALS-DSC	Staff Time			x	
TOTALS			**$367,800**	**$82,000**	**$84,100**	**$106,100**	**$95,600**

Goal	Remove Williamson Pond from 303(d) Impaired Waters List.	Funding Source*	Costs	Phase 2: 2013-2016			
				2013	2014	2015	2016
Objective 1	*Target Secchi depth of 0.7 meters of turbidity*						
Objective 2	*Reduce Sediment Delivery by 485 t/y tons/year*						
Task 1	Construct wetland	WIRB	$80,000		$80,000		
Task 2	Construct Silt Damn Structure	WIRB	$40,000			$40,000	
Objective 3	*Promote the Williamson Pond Watershed project.*						
Task 1	Salary & Benefits for 1/4 time Project Coordinator	319	$50,000	$12,500	$12,500	$12,500	$12,500
Task 2	Travel/Training	319	$3,000	$750	$750	$750	$750
Task 3	Supplies	319	$2,500	$625	$625	$625	$625
Objective 4	*Evaluate progress in watershed.*						
Task 1	Water Monitoring	319	To be determined	To be determined	To be determined	To be determined	To be determined
Task 2	Reducing Sediment Delivery to Williamson Pond	District, DNR	Staff Time	x	x	x	x
Task 3	Update Watershed Management Plan (yearly)	District, DNR, IDALS-DSC	Staff Time	x	x	x	x
Task 4	Submit plan, proposals for additional funding, based on progress and need	District, DNR, IDALS-DSC	Staff Time	x			
TOTALS			**$144,500**	**$13,875**	**$97,875**	**$53,875**	**$13,875**

Goal	Remove Williamson Pond from 303(d) Impaired Waters List.	Funding Source*	Costs	Phase 3: 2017 - future			
				2017	Future		
Objective 1	*Evaluate progress in watershed.*						
Task 1	Water Monitoring	DNR	To be determined	To be determined	To be determined		
Task 2	Assess Sediment & Phosphorus loading to Williamson Pond	District, DNR, IDALS-DSC	Staff Time	**Staff Time**	Staff Time		
Task 3	Update Watershed Management Plan – Determine if additional dollars are needed for pond	District	Staff Time	Staff Time	Staff Time		
Task 4	Submit plan, proposals for additional funding for possible dredging of pond	District	Staff Time	Staff Time	Staff Time		
TOTALS			**To be determined**	**To be determined**	**To be determined**	**To be determined**	**To be determined**

*Funding Source Acronyms & Abbreviations:

SIDCA - Southern Iowa Development and Conservation Authority
District – Lucas Soil and Water Conservation District
DNR – Department of Natural Resources (Iowa)
IDALS-DSC – Iowa Department of Agriculture and Land Stewardship-District of Soil Conservation
POL – Publically Owned Lakes
319 – Section 319
EQIP - Environmental Quality Incentives Program
WIRB – Watershed Improvement Review Board

APPENDIX A – WILLIAMSON POND TMDL

Total Maximum Daily Load
For Turbidity and Nutrients
Williamson Pond
Lucas County, Iowa

2005

Iowa Department of Natural Resources
Watershed Improvement Section

Table of Contents

1. Executive Summary

Table 1. Williamson Pond Summary

Waterbody Name:	Williamson Pond
County: Lucas	
Use Designation Class:	A1 (primary contact recreation) B(LW) (aquatic life)
Major River Basin:	Des Moines River Basin
Pollutant: Turbidity	
Pollutant Sources:	Nonpoint
Impaired Use(s):	A1 (primary contact recreation)
2002 303d Priority:	Low
Watershed Area:	1,474 acres
Lake Area:	26 acres
Lake Volume:	237 acre-ft
Detention Time:	0.2 years
Transparency Target:	Secchi Depth of more than 0.7 meters for turbidity
Existing Total Suspended Solids Load:	1,765 tons of sediment per year
Load Capacity	388 tons of sediment per year
Load Reduction to Achieve TMDL:	1,377 tons of sediment per year
Load Allocation:	349 tons of sediment per year
Wasteload Allocation:	0
Margin of Safety	39 tons of sediment per year
Total Phosphorous Target:	TSI of 70 = 804 pounds per year
Existing Phosphorous Load:	2,282 pounds per year
Load Capacity:	804 pounds per year
Load Reduction to achieve TMDL:	1,478 pounds per year (65% reduction)
Load Allocation:	724 pounds per year
Wasteload Allocation:	0
Margin of Safety:	80 pounds per year

The Federal Clean Water Act requires the Iowa Department of Natural Resources (IDNR) to develop a total maximum daily load (TMDL) for waters that have been identified on the state's 303(d) list as impaired by a pollutant. Williamson Pond has been identified as impaired by turbidity. The purpose of this TMDL for Williamson Pond is to calculate the maximum allowable suspended sediment loading for the lake associated with turbidity levels that will meet water quality standards. In addition, a phosphorous target has been developed to minimize algal blooms as water transparency increases.

This document consists of a TMDL for turbidity designed to provide Williamson Pond with water quality that fully supports its designated uses. Suspended sediment and phosphorous, which are related through the Trophic State Index (TSI) to Secchi depth, is targeted to address the turbidity impairment.

Phasing TMDLs is an iterative approach to managing water quality that becomes necessary when the origin, nature and sources of water quality impairments are not well understood. In Phase 1, the waterbody load capacity, existing pollutant load in excess of this capacity, and the source load allocations are estimated based on the limited information available. A monitoring plan will be used to determine if prescribed load reductions result in attainment of water quality standards and whether or not the target values are sufficient to meet designated uses. Monitoring activities may include routine sampling and analysis, biological assessment, fisheries studies, and watershed and/or waterbody modeling.

Section 5.0 of this TMDL includes a description of planned monitoring. The TMDL will have two phases. Phase 1 will consist of setting specific and quantifiable targets for suspended sediment, phosphorous and Secchi depth expressed as Carlson's Trophic State Index (TSI). Phase 2 will consist of implementing the monitoring plan, evaluating collected data, and readjusting target values if needed.

Monitoring is essential to all TMDLs in order to:

- Assess the future beneficial use status;
- Determine if the water quality is improving, degrading or remaining status quo;
- Evaluate the effectiveness of implemented best management practices.

The additional data collected will be used to determine if the implemented TMDL and watershed management plan have been or are effective in addressing the identified water quality impairments. The data and information can also be used to determine if the TMDLs have accurately identified the required components (i.e. loading/assimilative capacity, load allocations, in-lake response to pollutant loads, etc.) and if revisions are appropriate.

This TMDL has been prepared in compliance with the current regulations for TMDL development that were promulgated in 1992 as 40 CFR Part 130.7. These regulations and consequent TMDL development are summarized below:

1. **Name and geographic location of the impaired or threatened waterbody for which the TMDL is being established:** Williamson Pond, S25, T73N, R21W, 2 miles east of Williamson, Lucas County.

2. **Identification of the pollutant and applicable water quality standards:** The pollutant causing the water quality impairment is turbidity. Designated uses for Williamson Pond are Primary Contact Recreation (Class A1) and Aquatic Life (Class B(LW)). Excess turbidity has impaired aesthetic and aquatic life water quality standards (8) narrative criteria (567 IAC 61.3(2)) and hindered the designated uses.

3. **Quantification of the pollutant load that may be present in the waterbody and still allow attainment and maintenance of water quality standards:** The Phase 1 target of this TMDL is a Secchi depth of 0.7 m, equivalent to 388 tons of total suspended solids. A second target for total phosphorous has been set at a TSI of 70, which is equivalent to a load of 804 pounds per year.

4. **Quantification of the amount or degree by which the current pollutant load in the waterbody, including the pollutant from upstream sources that is being accounted for as background loading, deviates from the pollutant**

load needed to attain and maintain water quality standards: The existing mean value for Secchi depth based on 2000-2004 sampling in 0.5 meters. The existing sediment load is 1,765 tons per year. In order to increase Secchi depth (transparency) to the target 0.7 meters, the sediment load must be decreased by 1,377 tons per year. The existing mean total phosphorous concentration in Williamson Pond is 241 ug/L. To achieve the total phosphorous target, a reduction of 1,478 pounds per year (65%) is needed.

5. **Identification of pollution source categories:** Sediment and nutrients (phosphorous) from nonpoint sources and internal recycling has been identified as causing the turbidity impairment.

6. **Wasteload allocations for pollutants from point sources:** No point sources have been identified in the Williamson Pond watershed. Therefore, the wasteload allocation for sediment and phosphorous are set at zero.

7. **Load allocations for pollutants from nonpoint sources:** Transparency as measured by Secchi depth is a function of non-algal and algal components. The load allocation for sediment is set at 349 tons to meet the transparency target of 0.7 meters Secchi depth. The phosphorous load allocation for Williamson Pond is set at 724 lbs/year.

8. **A margin of safety:** The Margin of Safety (MOS) for this TMDL is an explicit numerical MOS of 39 tons of sediment per year (10% of the calculated allowable sediment load) and has been included to ensure that the required load reduction will result in attainment of water quality targets. In addition, an explicit MOS has been calculated for the phosphorous load at 80 pounds per year (10% of the calculated allowable phosphorous load).

9. **Consideration of seasonal variation:** This TMDL was developed based on transparency that will result in attainment of targets on an average annual basis.

10. **Allowance for reasonably foreseeable increases in pollutant loads:** An allowance for increased sediment and nutrient loading was not included in this TMDL. Significant changes in the Williamson Pond watershed landuse are unlikely. Future increases in the rough fish population or intensification of activities that add to lake turbulence could increase re-suspension of settled solids and nutrients. Because such events cannot be predicted or quantified at this time, a future allowance for their potential occurrence was not included in the TMDL.

11. **Implementation plan:** Although not required by the current regulations, an implementation plan is outlined in the body of the report.

2. Williamson Pond, Description and History

2.1 The Lake

Williamson Pond is located 2 miles east of Williamson pond in south central Iowa. Williamson Pond was constructed in 1913 by the Chicago, Rock Island and Pacific Railroad as a source of water for steam locomotives. The pond was used as a source of water for the stream locomotives until diesel locomotives were present in the 1950's. At this time, the State of Iowa assumed the lake and managed it until the early 1990's. Williamson Pond has a surface area of 20 acres and is managed for water-based recreation and fishing.

Williamson Park is now managed by the Lucas County Conservation Board. Bachmann (2) reported annual lake and park use at approximately 3000 visits. Visitor use is focused on fishing, boating, hunting, and picnicking or other passive uses. Although the lake is designated for contact recreation, there is no beach or swimming facilities and no reported swimming use at Williamson Pond.

Table 3. Williamson Pond Features

Waterbody Name:	Williamson Pond
Hydrologic Unit Code:	HUC10 0710000901
IDNR Waterbody ID:	IA 04-LDM-01995-L
Location:	Section 25 T73N R21W
Latitude:	41° 5' N
Longitude:	93° 13' W
Water Quality Standards Designated Uses:	1. Primary Contact Recreation (A1) 2. Aquatic Life Support (B(LW))
Tributaries: English	Creek
Receiving Waterbody:	English Creek
Lake Surface Area:	26 acres
Maximum Depth:	18 feet
Mean Depth:	8 feet
Volume: 237	acre-feet
Length of Shoreline:	8,189 feet
Watershed Area:	1,474 acres
Watershed/Lake Area Ratio:	57:1
Estimated Detention Time:	0.2 years

Morphometry

Williamson Pond has a mean depth of 8 feet and a maximum depth of 18 feet. The lake has a surface area of 26 acres and a storage volume of approximately 237 acre-feet. Temperature and dissolved oxygen sampling indicate that temperature and oxygen levels in Williamson Pond decrease with increased depth through much of the growing season.

Hydrology

Williamson Pond is fed by the headwaters of English Creek, and discharges into English Creek, a tributary of the Des Moines River. The estimated annual average detention time for Williamson Pond is 0.2 years based on outflow. The methodology and calculations used to determine the detention time are shown in Appendix A.

2.2 The Watershed

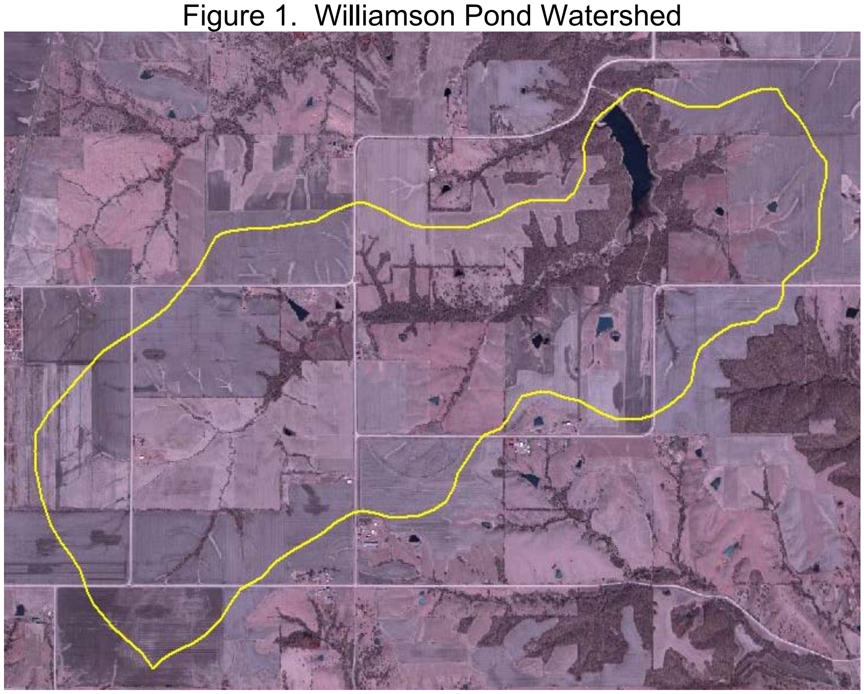
The watershed of Williamson Pond has an area of 1,474 acres, which results in a large watershed to lake area ratio of approximately 57:1. The 2005 landuses and associated areas for the watershed were obtained from a field level assessment and are shown in Table 4.

Table 4. 2005 Landuse in Williamson Pond watershed.

Landuse	**Area in Acres**	**Percent of Total Area**
Row Crop	630	43
Pasture,Grass, CRP	645	44
Forest 165		11
Residential, Roads,Other	34	2
Total 1,473		100

The watershed is predominately nearly level to strongly sloping (0-14%) with some moderately steep (2-18%) areas. Soils are developed from loess, pre-Wisconsin till, or pre-Wisconsin till-derived paleosols. Native vegetation was typically prairie grasses with some forested areas. Typical soils include Grundy, Haig, Shelby, and Adair.

Figure 1. Williamson Pond Watershed



3. TMDL for Turbidity

3.1 Problem Identification

Impaired Beneficial Uses and Applicable Water Quality Standards

The Iowa Water Quality Standards (8) list the designated uses for Williamson Pond as Primary Contact Recreational Use (Class A1) and Aquatic Life (Class B(LW)). In 1998, Williamson Pond was included on the impaired water list due to turbidity and organic enrichment. In 2002, the organic enrichment listing was removed, but the turbidity impairment remained on the list.

The State of Iowa does not have numeric water quality criteria for turbidity that apply to Williamson Pond. Williamson Pond was assessed for the 2000 and 2002 305(b) report as partially supporting due to poor water clarity impairing the primary contact uses. This is a violation of the narrative water quality standards stating that waters shall be free from aesthetically objectionable conditions (8). The aesthetically objectionable conditions present at Williamson Pond are impairing the Class A use for primary contact recreation.

Impairments at Williamson Pond to the Class A1 (primary contact) use is due to reductions in water clarity caused primarily by moderately high levels of inorganic turbidity caused by suspended solids. Class B(LW) aquatic life uses are evaluated as partially supported due to hyper-eutrophic conditions at this lake, along with recommendations from the IDNR Fisheries Bureau.

Data Sources

Water quality surveys have been conducted on Williamson Pond in 1979, 1990, 2000, and 2002-04 (1, 2, 3, 4, 5, 6). Data from these surveys is available in Appendix B.

Iowa State University Lake Study data from 2000 to 2004 were evaluated for this TMDL. This study approximates a sampling scheme used by Roger Bachman in earlier Iowa lake studies. Samples were collected three times during the early, middle and late summer. A number of water quality parameters are measured including Secchi disk depth, phosphorus series, nitrogen series, TSS, and VSS.

In addition to these more recent water quality surveys, studies were also conducted on Williamson Pond in 1979 and 1990, (1; 2).

Data collected in 1979 as part of Iowa's lake classification survey identified Williamson Pond as a eutrophic lake. The mean total phosphorous concentration was 55.5 µg/L (n=8), mean total Kjeldahl nitrogen was 0.6 mg/L (n=2), and mean Secchi disk depth was 0.8 m (n=5).

From the Classification of Iowa's Lakes for Restoration in 1994, data collected in 1990 indicated that Williamson Pond was still a eutrophic lake. The mean total phosphorous concentration was 386 µg/L (n=9), mean total nitrogen was 3.7 mg/L (n=9) and mean Secchi disk depth was 0.1 m (n=3).

Interpreting Williamson Pond Water Quality Data

Based on mean values from ISU sampling during 2000 - 2004, the inorganic suspended solids is 11.3 mg/L, the phosphorus level is 241 ug/L, the chlorophyll level is 33 ug/L, and the Secchi disk depth is 0.5 meters. Data on inorganic suspended solids from the ISU sampling suggest that this lake may be subject to high levels of non-algal turbidity.

Comparisons of the TSI values for chlorophyll, Secchi depth and total phosphorus for 2000 - 2004 in-lake sampling indicate possible limitation of algal growth attributable to light attenuation by elevated levels of inorganic suspended solids (see Figure 2 and Appendix C).

TSI values for 2000 - 2004 monitoring data are shown in Table 5. TSI values for all historical monitoring data and an explanation of Carlson's Trophic State Index are given in Appendix C.

Table 5. Williamson Pond TSI Values (3,4,5,6)

Sample Date	TSI (SD)	TSI (CHL)	TSI (TP)
6/29/2000 78		39	93
7/26/2000 67		61	93
8/24/2000 66		45	89
6/5/2002 72		47	78
7/10/2002 67		70	74
8/7/2002 69		61	79
6/4/2003 43		41	67
7/9/2003 74			84
8/7/2003 73		65	85
6/2/2004 79		61	80
6/30/2004 61		69	70
8/4/2004 67		63	79

Figure 2. Williamson Pond 2000 - 2004 Mean TSI Multivariate Comparison Plot (7).

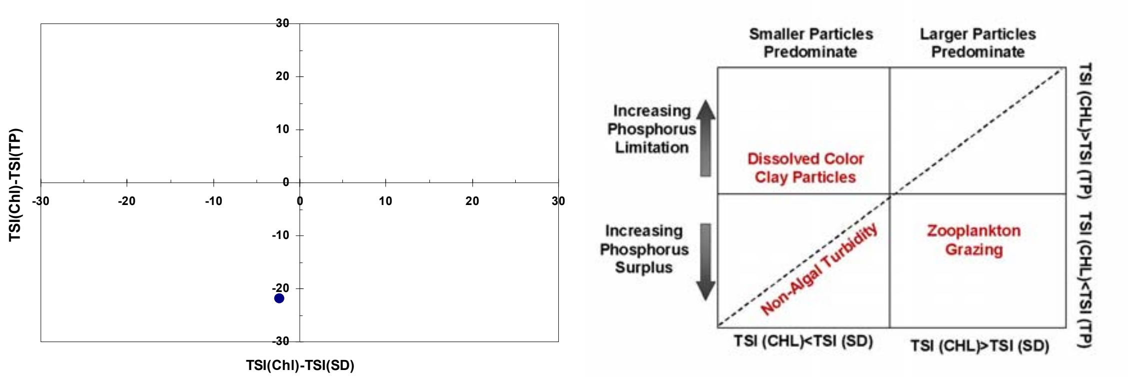


Figure 2 is a multivariate plot of mean TSI values. The blue dot on the left-hand graphic shows the relationship between TSI (SD), TSI (CHL), and TSI (TP) for Williamson Pond on the graph area. The lower left-hand quadrant on the graph area indicates that the water column is dominated by smaller particles and is not limiting in phosphorus. Also, being below the diagonal line from the lower left to the upper right indicates the water body is impaired by non-algal turbidity based on TSI values. A more complete discussion of this multivariate comparison plot and TSI interpretation can be found in Appendix C.

Data on the zooplankton community (13, 14) show that the zooplankton community at Williamson Pond has a large population of species known as algal grazers, thus reducing algal levels at this lake. Data from ISU phytoplankton sampling in 2000 and 2001 indicate that bluegreen algae (Cyanophyta) dominate the summertime phytoplankton community of Williamson Pond. The number of available samples (three per summer) is insufficient to fully characterize the frequency of algal blooms. However, the sampling does indicate a high level of bluegreen mass relative to other Iowa lakes. The 2000 average summer wet mass of bluegreen algae at this lake (62.7 mg/l) was in the upper quartile of 131 lakes sampled.

Potential Pollution Sources

There are no point sources of pollution in the Williamson Pond watershed. Turbidity is caused by the addition of sediment from the watershed and resuspension of sediment from the lake bottom. These sediments also contain attached phosphorus which contribute to the high phosphorus levels in the water and resulting algal production.

Natural Background Conditions

Background levels of sediment and nutrients were not separated from nonpoint sources.

3.2 TMDL Target

The Phase 1 target for this TMDL is an average water transparency level measured by Secchi depth greater than 0.7 meters. This target is equivalent to a TSI value of 65 which is the minimum depth considered to be fully supporting/threatened for the Section 305(b) use support category. In addition, a TSI target of 70 will be established for total phosphorous. This will help reduce algal impacts that may occur as light penetration is increased.

Criteria for Assessing Water Quality Standards Attainment

The State of Iowa does not have numeric water quality criteria for turbidity. Sediment and nutrients delivered from the watershed or resuspended from within the lake are causing increased turbidity, and may cause increased algal blooms. The transparency objective is defined by a mean Secchi depth of 0.7 meters, and the total phosphorous objective is a TSI of 70.

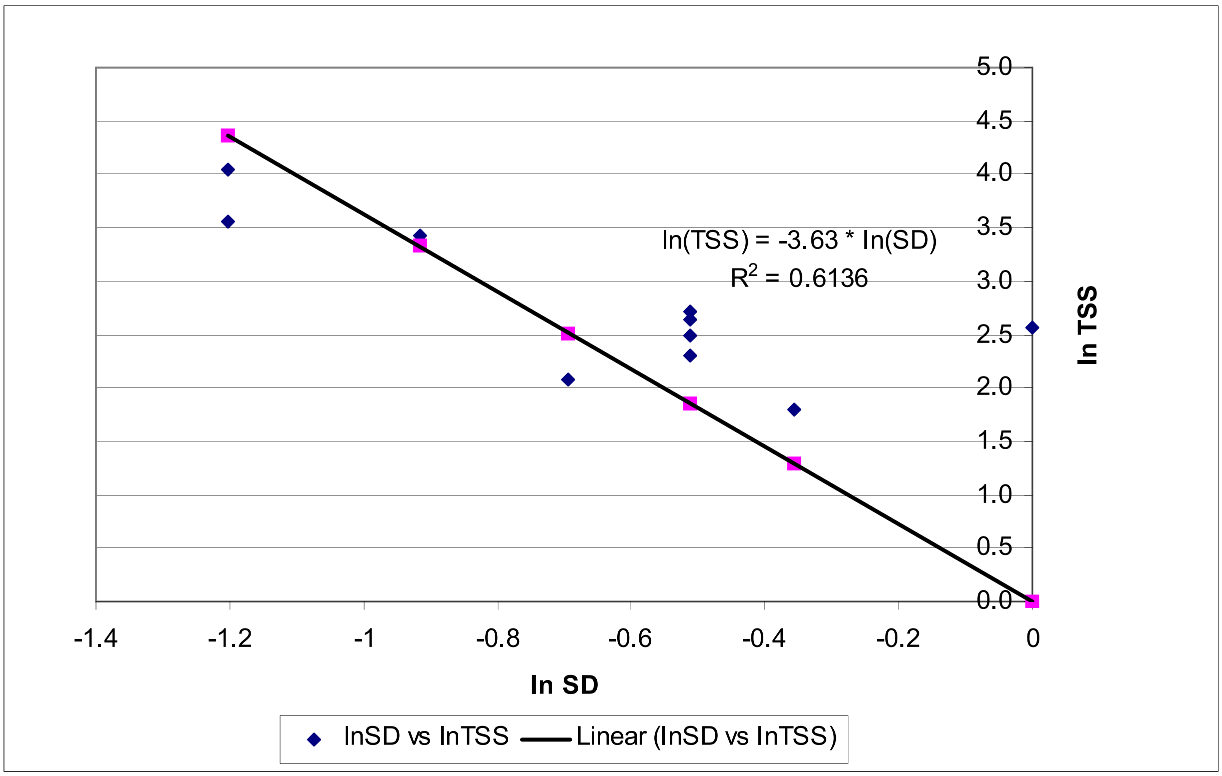
Selection of Environmental Conditions

The critical condition for the TMDL target transparency applies to the annual average transparency value. The existing and target values of Secchi depth are expressed as annual averages. Growing season mean (GSM) in-lake total phosphorus concentrations are used to calculate an annual average total phosphorus loading.

Waterbody Pollutant Loading Capacity

Excessive levels of total suspended solids (TSS) is causing high levels of turbidity. The loading capacity of the lake is determined by a Secchi depth TSI of 65, equivalent to a Secchi depth of 0.7 meters. The relationship between total suspended solids and transparency is shown in Figure 3.

Figure 3. Natural log transformed relationship between total suspended solids (TSS) and Secchi depth (SD).



Using the relationship between Secchi depth and TSS from Figure 3, the target total suspended solids (TSS) concentration is calculated as:

$$\ln(TSS) = -3.63*\ln(SD)$$
$$\ln(TSS) = -3.63*\ln(0.7)$$
$$\ln(TSS) = 1.295$$
$$TSS = 3.6 \text{ mg/L}$$

To achieve the desired secchi depth target of 0.7 meters, the in-lake total suspended solids value should be 3.6 mg/L. The current mean total suspended solids value is 16.6 mg/L. This is equivalent to a 78% reduction.

Sediment delivery to Williamson Pond was calculated using RUSLE and land uses derived from the 2002 CIR photography. Gross sheet and rill erosion in the Williamson Pond watershed is estimated at 6,930 tons/year. From this, the estimated current sediment delivery to Williamson Pond is 1,765 tons/year.

Assuming a direct relationship between the TSS concentration in Williamson Pond and sediment delivery to the lake, a 78% reduction is needed in sediment delivery to the lake. This results in a sediment loading capacity of 388 tons/year.

To achieve a lake phosphorous TSI of 70, the phosphorous loading capacity of Williamson Pond was determined to be 804 lbs/year based on the Vollenweider 1982 Shallow Lake and Reservoir model (Appendix F).

3.3 Pollution Source Assessment

Existing Load

Turbidity levels in Williamson Pond are created by a current estimated sediment load of 1,765 tons/year delivered to or resuspended in the lake. This current sediment delivery was determined using RUSLE and 2002 landuses (Appendix E).

The current phosphorous load was determined using the Vollenweider 1982 Shallow Lake and Reservoir model. This model estimated current phosphorous delivery at 2,282 lbs./yr.

Departure from Load Capacity

The non-algal turbidity load capacity is 388 tons of sediment. The existing non-algal turbidity load is 1,765 tons resulting in a departure from load capacity of 1377 tons of sediment. The phosphorous loading capacity is 804 lbs./yr. The current phosphorous load is 2,282 lbs/yr, resulting in a departure from the loading capacity of 1,478 lbs.

Identification of Pollutant Sources

There are no point sources of pollution in Williamson Pond watershed. Therefore, all the non-algal turbidity is attributed to non-point sources.

Linkage of Sources to Target

The load capacity of Williamson Pond is 388 tons of sediment per year. The current sediment load is 1,765 tons per year. The total phosphorous load capacity is 804 lbs. per year. These loads originate from nonpoint sources in the watershed and internal lake resuspension.

3.4 Pollutant Allocation

Wasteload Allocation

There are no known point sources of pollution in the watershed. Therefore, the wasteload allocations for sediment and phosphorous are set at zero.

Load Allocation

The load allocation for turbidity is 349 tons of sediment in the lake allocated to nonpoint sources, and lake resuspension. A load allocation for phosphorous is set at 724 lbs. per year.

Margin of Safety

An explicit margin of safety for non-algal turbidity is set at 10% of the load capacity, or 39 tons sediment (388 tons x 10%) and 80 lbs. of phosphorous (804 lbs. x 10%).

TMDL Summary

Sediment:

TMDL = WLA + LA + MOS
= 0 + 349 tons/yr + 39 tons/yr
= 388 tons/yr

Phosphorous:

TMDL = WLA + LA + MOS
= 0 + 724 lbs/yr + 80 lbs/yr
= 804 lbs/yr

4. Implementation Plan

The Iowa Department of Natural Resources recognizes that an implementation plan is not a required component of a Total Maximum Daily Load. However, the IDNR offers the following implementation strategy to DNR staff, partners, and watershed stakeholders as a guide to improving water quality at Williamson Pond. Comments received at the public meeting to discuss the draft TMDL identified that there were areas of significant gully erosion within the watershed. To address these concerns and to better understand the current sources within the Williamson Pond watershed two assessments will be completed. The first is a detailed field level watershed assessment to identify current needs and potential sites for best management practice implementation. This assessment should include an analysis of the trapping efficiencies of the numerous existing ponds and grade stabilization structures located in the watershed.

The second assessment includes development of a forestry management plan for the public lands in the Williamson Pond watershed by the IDNR Forestry Bureau. This plan will identify management objectives for the forestry resource and also identify currently contributing areas of sediment and phosphorous within the forested portion of the watershed.

If the entire sediment load were attributed to watershed sources, the estimated loading from watershed sources would need to be reduced from 1.2 tons/acre/year to about 0.24 tons/acre/year to meet the TMDL target. Similarly, if the entire phosphorous load is attributed to the watershed, the estimated watershed loading would need to be reduced from 1.5 lbs/acre/year to 0.5 lbs/acre/year. However, this does not account for the in-lake resuspension or shoreline erosion.

Among the mechanisms of resuspension are bottom feeding rough fish such as carp, and wind-driven waves and currents.

Because of the uncertainty as to how much of the sediment and phosphorous load originates in the watershed and how much is resuspended from the lake bottom, an adaptive management approach is recommended. In this approach management practices to reduce both watershed loads and resuspension loads are incrementally applied and the results monitored to determine if water quality goals have been achieved. Also, the reductions in watershed loads will require land management changes that take time to implement. For these reasons, the following timetable is suggested for watershed improvements:

- By 2010, reduce watershed and resuspension loading:
    1. for sediment from 1,765 tons per year to 1,400 tons per year.
    2. for phosphorous from 2282 pounds per year to 1500 pounds per year.
- By 2015, reduce watershed and resuspension loading:
    1. for sediment from 1,400 tons per year to 900 tons per year.
    2. for phosphorous from 1500 pounds per year to 1000 pounds per year.
- By 2020, reduce watershed and resuspension loading:
    1. for sediment from 900 tons per year to 349 tons per year.
    2. for phosphorous from 1000 pounds per year to 724 pounds per year.

To reduce the amount of non-algal turbidity from being delivered to, or being resuspended in the lake, the following management suggestions are presented:

- Remove the common carp from the lake.
- Install additional buffer strips and filterstrips along the streams and channels in the watershed to filter runoff and reduce the amount of sediment delivered to Williamson Pond.
- Construct ponds, terraces and erosion control structures in the watershed to reduce soil erosion, trap sediment, and lower peak runoff rates.
- Adopt continuous no till to increase the amount of infiltration, reducing runoff and erosion.
- Outlet terrace underground outlets into artificial wetlands or detention basins to reduce the amount of fine sediments being delivered directly into the streams.

Water quality monitoring indicates a high concentration of phosphorus in the water column. Most of this phosphorus may be attached to suspended sediment particles. However, if significant dissolved phosphorus remains in the water column after water transparency improves, this may result ina rapid increase in algal production. To reduce the amount of total phosphorus from being delivered to, or being re-suspended in the lake, all of the suggestions listed above apply. In addition, specific phosphorus management suggestions include:

- Practice nutrient best management practices. Specifically, manage for the optimum soil test category for phosphorus and inject or incorporate phosphorus fertilizers and manure.
- Dredge the lake to remove phosphorus-containing sediments.
- Increase the average depth of the lake so that it more completely stratifies. A deep lake that stratifies will "turn over" only twice per year resulting in a well-mixed conditions. Shallow lakes are continually well-mixed leading to higher phosphorus amounts in the water column.

5. Monitoring

Further monitoring is needed at Williamson Pond to follow-up on the implementation of the TMDL. This monitoring will, at a minimum, meet the minimum data requirements established by Iowa's 305(b) guidelines for a complete water quality assessment (3 lake samples per year over 3 years, 10 lake samples over 2 years, etc.). This data will be collected by 2010. Williamson Pond has been included in the five-year lake study conducted by Iowa State University under contract with the IDNR. Although this lake monitoring program concluded in 2004, the Department is continuing a lake monitoring program.

Current measurements of gully, shoreline, streambed, and stream bank erosion need to be obtained. The IDNR will work with local NRCS and DSC staff to collect this data to verify and improve the implementation of this TMDL. A forestry management plan will be completed by the IDNR Forestry Bureau in cooperation with the Lucas County Conservation Board. This plan will not only identify forestry management priorities, but identify currently eroding areas within the forested portion of the watershed, such as active gully erosion. In addition, lake water chemistry and sediment particle size analyses should be completed to better understand why the sediments remain suspended and determine how these suspended particles can flocculate and settle.

6. Public Participation

A public meeting was held at the Pin Oak Nature Center on May 16, 2005 to discuss the water quality at Williamson Pond and the TMDL process. A second public meeting was held on October 27, 2005 at the Pin Oak Nature Center in Chariton to present and discuss the draft TMDL. Comments received were reviewed and given consideration and, where appropriate, incorporated into the development of the TMDL.

7. References

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8. Appendix A - Lake Hydrology

General Methodology

Purpose

There are approximately 127 public lakes in Iowa. The contributing watersheds for these lakes range in area from 0.028 mi^2 to 195 mi^2 with mean and median values of 10 mi^2 and 3.5 mi^2, respectively. Few, if any, of these lakes have gauging data available to determine flow statistics for the tributaries that feed into them. A select few have some type of stage information that may be useful in determining historical discharge from the lake itself.

With the large number of lakes on the State's 303(d) list and the requirement for rapid development of TMDLs for these lakes, it was realized that a method to quickly estimate flow statistics for required lake response model inputs would be desirable. In an attempt to achieve this goal, flow data and watershed characteristics for a number of USGS gauging stations with small contributing watershed areas were compiled and evaluated via both simple and multiple linear regressions. The primary focus of this evaluation was estimation of the average annual flow statistic for input to empirical lake response models. However, regression equations for monthly average and calendar year flow statistics were also developed that may be of additional use.

It should be noted that attempts were made to develop regression equations for low-flow streamflow statistics (1Q10, 7Q10, 30Q10, 30Q5 and harmonic mean) but the relationships derived were for the most part considered too weak (R^2 adj.< 70%) to be of practical use. One exception to this is the 30Q5 statistic, which gave an R^2 adj. of 85%. In addition, regression equations were developed for monthly flow prediction models for two months (January and May). Once again, the relationships did not exhibit a high level of correlation and due to the large amount of data required to develop these models, development of equations for additional months was not attempted.

Data

Flow data and watershed characteristics from 26 USGS gauging stations were used to derive the regression equations. The ranges of basin characteristics used to develop the regression equations are shown in Table A-1.

Drainage areas were taken directly from USGS gauge information available at http://water.usgs.gov/waterwatch/ . Precipitation values were obtained through the Iowa Environmental Mesonet IEM Climodat Interface at http://mesonet.agron.iastate.edu/climodat/index.phtml . Where weather and gauging stations were not located in the same town, precipitation information was obtained from the weather station located in the town with the shortest straight-line distance from the gauging station.

Average basin slope and land cover percentages were determined using Arc View and statewide coverages clipped within HUC-12 sub-watersheds. It should be noted that the smallest basin coverages used in determining land cover percentages and average basin slopes were single HUC-12 units (i.e. no attempt was made to subdivide HUC-12 basins into smaller units where the drainage area was less than the area of the HUC-12 basin). Therefore, the regression models assume that for very small watersheds the land cover percentages of the HUC-12 basin are representative of the watershed located within the basin.

The Hydrologic Region for each station was determined from Figure 1 of USGS Water-Resources Investigation Report 87-4132, Method for Estimating the Magnitude and Frequency of Floods at Ungaged Sites on Unregulated Rural Streams in Iowa. None of the stations included in the analyses were located in Regions 1 or 5. This is reflected in the regression equations developed that utilize the hydrologic region as a variable.

Table A-1. Ranges of Basin Characteristics Used to Develop the Regression Equations

Basin Characteristic	Name in equations	Minimum Mean		Maximum
Drainage Area (mi^2)	DA 2.94		80.7	204
Mean Annual Precip (inches)	$\overline{P}_A$	26.0 34.0		36.2
Average Basin Slope (%)	S 1.53		4.89	10.9
Landcover - % Water	W 0.020		0.336	2.80
Landcover - % Forest	F 2.45		10.3	29.9
Landcover - % Grass/Hay	G 9.91		31.3	58.7
Landcover - % Corn	C 6.71		31.9	52.3
Landcover - % Beans	B 6.01		23.1	37.0
Landcover - % Urban/Artificial	U 0		2.29	7.26
Landcover - % Barren/Sparse	B'	0 0.322		2.67
Hydrologic Region	H	Regions 1 - 5 used for delineation but data for USGS stations in Regions 2, 3 & 4 only.		

Methods

Simple regression models were developed for annual average and monthly average statistics with drainage area as the sole explanatory variable. Multiple linear regression models considering all explanatory variables were developed utilizing stepwise regression in Minitab. All data with the exception of the Hydrologic Region were log transformed. Explanatory variables with regression coefficients that were not statistically different from zero (p-value greater than 0.05) were not utilized.

Equation Variables

Table A-2. Regression Equation Variables

Annual Average Flow (cfs)	$\overline{Q}_{A}$
Monthly Average Flow (cfs)	$\overline{Q}_{MONTH}$
Annual Flow – calendar year (cfs)	Q_{YEAR}
Drainage Area (mi^2) DA	
Mean Annual Precip (inches)	$\overline{P}_{A}$
Mean Monthly Precip (inches)	$\overline{P}_{MONTH}$
Antecedent Mean Monthly Precip (inches)	$\overline{A}_{MONTH}$
Annual Precip – calendar year (inches)	P_{YEAR}
Antecedent Precip – calendar year (inches)	A_{YEAR}
Average Basin Slope (%)	S
Landcover - % Water	W
Landcover - % Forest	F
Landcover - % Grass/Hay	G
Landcover - % Corn	C
Landcover - % Beans	B
Landcover - % Urban/Artificial	U
Landcover - % Barren/Sparse	B′
Hydrologic Region	H

Equations

Table A-3. Drainage Area Only Equations

Equation R	**^{2} adjusted (%)**	**PRESS (log transform)**
$\overline{Q}_{A} = 0.832DA^{0.955}$	96.1 0.2072	90
$\overline{Q}_{JAN} = 0.312DA^{0.950}$	85.0 0.9682	53
$\overline{Q}_{FEB} = 1.32DA^{0.838}$	90.7 0.4191	38
$\overline{Q}_{MAR} = 0.907DA^{1.03}$	96.6 0.2203	84
$\overline{Q}_{APR} = 0.983DA^{1.02}$	93.1 0.4635	54
$\overline{Q}_{MAY} = 1.97DA^{0.906}$	89.0 0.6037	66
$\overline{Q}_{JUN} = 2.01DA^{0.878}$	88.9 0.5728	63
$\overline{Q}_{JUL} = 0.822DA^{0.977}$	87.2 0.8038	08
$\overline{Q}_{AUG} = 0.537DA^{0.914}$	74.0 1.6992	9
$\overline{Q}_{SEP} = 0.123DA^{1.21}$	78.7 2.6499	3
$\overline{Q}_{OCT} = 0.284DA^{1.04}$	90.2 0.7132	57
$\overline{Q}_{NOV} = 0.340DA^{0.999}$	89.8 0.6973	53
$\overline{Q}_{DEC} = 0.271DA^{1.00}$	86.3 1.0245	5

Table A-4. Multiple Regression Equations

Equation	**R^2 adjusted (%)**	**PRESS (log transform)**
$\overline{Q}_A = 1.17 \times 10^{-3} DA^{0.998} \overline{P}_A^{1.54} S^{-0.261} (1+F)^{0.249} C^{0.230}$	98.7 0.177	2 68 (n=26)
$\overline{Q}_{JAN} = 0.213 DA^{0.997} \overline{A}_{JAN}^{0.949}$	89.0 0.729	6 10 (n=26;same for all $\overline{Q}_{MONTH}$)
$\overline{Q}_{FEB} = 2.98 DA^{0.955} \overline{A}_{FEB}^{0.648} G^{-0.594} (1+F)^{0.324}$	97.0 0.070	8 9
$\overline{Q}_{MAR} = 6.19 DA^{1.10} B^{-0.386} G^{-0.296}$	97.8 0.072	7 6
$\overline{Q}_{APR} = 1.24 DA^{1.09} \overline{A}_{APR}^{1.64} S^{-0.311} B^{-0.443}$	97.1 0.257	0 64
$\overline{Q}_{MAY} = 10^{(-3.03+0.114H)} DA^{0.846} \overline{P}_A^{2.05}$ Hydrologic Regions 2, 3 & 4 Only	92.1 0.958	8 59
$\overline{Q}_{MAY} = 1.86 \times 10^{-3} DA^{0.903} \overline{P}_A^{1.98}$	90.5 1.072	3 1
$\overline{Q}_{JUN} = 10^{(-1.47+0.0729H)} DA^{0.891} C^{0.404} \overline{P}_{JUN}^{1.84} (1+F)^{0.326} G^{-0.387}$ Hydrologic Regions 2, 3 & 4 Only	97.0 0.193	7 15
$\overline{Q}_{JUN} = 8.13 \times 10^{-3} DA^{0.828} C^{0.478} \overline{P}_{JUN}^{2.70}$	95.9 0.256	9 41
$\overline{Q}_{JUL} = 1.78 \times 10^{-3} DA^{0.923} \overline{A}_{JUL}^{4.19}$	91.7 0.542	9 40
$\overline{Q}_{AUG} = 4.17 \times 10^{7} DA^{0.981} (1+B')^{-1.64} (1+U)^{0.692} \overline{P}_A^{-7.2} \overline{A}_{AUG}^{4.59}$	90.4 1.114	1 3
$\overline{Q}_{SEP} = 1.63 DA^{1.39} B^{-1.08}$	86.9 1.530	7 2
$\overline{Q}_{OCT} = 5.98 DA^{1.14} B^{-0.755} S^{-0.688} (1+B')^{-0.481}$	95.7 0.375	2 96
$\overline{Q}_{NOV} = 5.79 DA^{1.17} B^{-0.701} G^{-0.463} (1+U)^{0.267} (1+B')^{-0.397}$	95.1 0.492	6 86
$\overline{Q}_{DEC} = 0.785 DA^{1.18} B^{-0.654} (1+U)^{0.331} (1+B')^{-0.490}$	92.4 0.590	5 76
$Q_{YEAR} = 3.164 \times 10^{-4} DA^{0.942} P_{YEAR}^{2.39} A_{YEAR}^{1.02} S^{-0.206} \overline{P}_A^{1.27} C^{0.121} (1+U)^{0.0966}$	83.9 32.63	5 7 (n=716)

<u>General Application</u>

In general, the regression equations developed using multiple watershed characteristics will be better predictors than those using drainage area as the sole explanatory variable. The single exception to this appears to be for the <u>May Average Flow</u> worksheet where the PRESS statistic values indicate that use of drainage area alone results in the least error in the prediction of future observations.

Although 2002 land cover grids for the state are now available with 19 different classifications, the older 2000 land cover grids with 9 different classifications were used in developing the regression equations. The 2000 land cover grids should be used in development of flow estimates using the equations.

The equations were developed from stream gauge data for watersheds with relatively minor open water surface percentages relative to other types of land cover (see Table A-1). For application to lake watersheds, particularly those with small watershed/lake area ratios, the basin slope and land cover percentages taken from HUC-12 basins may need to be adjusted so that the hydraulic budget components of surface inflow and direct precipitation on the lake itself can be treated separately. One method of accomplishing this is by subtraction of lake water surface acreage from the total land cover and slope (lakes will have 0% slope) acreages and recalculation of the % coverages. The watershed (drainage) area used in the equations should not include the area of the lake surface.

Application to Williamson Pond – Calculations

Table A-5. Williamson Pond Hydrology Calculations

Lake	Williamson Pond	
Type Impound	ment	
Inlet(s) English	Creek	
Outlet(s) English	Creek	
Volume 237		acre-feet
Surface Area	26	acres
Drainage Area	1474	acres
Mean Annual Precipitation	35.4	inches
Average Basin Slope	4.1	%
% Forest (2000 Land Cover)	12.8	
% Corn (2000 Land Cover)	24.8	
% Rowcrop (2002 Land Cover)	42.8	
Mean Annual Class A Pan Evaporation	50	inches
Mean Annual Class A Pan Evaporation	50	inches
Mean Annual Lake Evaporation	6067.2	inches
Annual Average Inflow	4395349	acre-feet/year
Direct Precipitation on Lake Surface	9085	acre-feet/year
Est. Annual Det. Time (Inflow + Precip)	23.29	year
Est. Annual Det. Time (Outflow)	0.13	year

9. Appendix B - Sampling Data

Table B-1. Data collected in 1979 by Iowa State University (1)

Parameter 7/19/197	**9**	**8/21/1979**	**9/27/1979**
Secchi Depth (m)	0.7	1.2	0.6
Total Kjeldahl Nitrogen (mg/L as N)	-	-	0.63
NO_3+NO_2-N (mg/L)	-	-	0.1
Total Phosphate (mg/l as PO4)	0.375	0.16	0.17
Alkalinity (mg/L)	90	102	106

Data above is averaged over the upper 6 feet.

Table B-2. Data collected in 1990 by Iowa State University (2)

Parameter 6/8/1990		**7/7/1990**	**8/5/1990**
Secchi Depth (m)	.01	0.05	0.05
Chlorophyll (ug/L)	2.2	2.7	4.1
Total Nitrogen (mg/L as N)	4.6	4.0	2.5
Total Phosphorus (ug/l as P)	283.7	494	381
Total Suspended Solids (mg/L)	158.3	180.1	133.3
Inorganic Suspended Solids (mg/L)	154.5	120.1	106.9

Data above is for surface depth.

Table B-3. Data collected in 2000 by Iowa State University (3)

Parameter 6/29/200	**0**	**7/26/2000**	**8/24/2000**
Secchi Depth (m)	0.3	0.6	0.7
Chlorophyll (ug/L)	2.5	22.9	4.2
NO_3+NO_2-N (mg/L)	0.44	0.14	0.18
Total Nitrogen (mg/L as N)	3.72	1.45	1.61
Total Phosphorus (ug/l as P)	474	491	366
Silica (mg/L as SiO_2)			
pH 6.8		7.8	7.2
Alkalinity (mg/L)	121	173	87
Total Suspended Solids (mg/L)	35	10	6
Inorganic Suspended Solids (mg/L)	30	5	3
Volatile Suspended Solids (mg/L)	4	5	3

Table B-4. Data collected in 2002 by Iowa State University (4)

Parameter 6/5/2002		**7/10/2002**	**8/7/2002**
Secchi Depth (m)	0.5	0.6	0.6
Chlorophyll (ug/L)	5.2	56.4	23.4
NO_3+NO_2-N (mg/L)	3.51	0.13	0.11
Total Nitrogen (mg/L as N)	4.33	1.01	1.37
Total Phosphorus (ug/l as P)	175	125	186
Silica (mg/L as SiO_2) 7.65		2.82	5.20
pH 7.7		8.9	8.3
Alkalinity (mg/L)	99	88	95
Total Suspended Solids (mg/L)	8	12	14
Inorganic Suspended Solids (mg/L)	4	2	5
Volatile Suspended Solids (mg/L)	4	11	9

Table B-5. Data collected in 2003 by Iowa State University (5)

Parameter 6/4/2003		**7/9/2003**	**8/7/2003**
Secchi Depth (m)	3.3	0.4	0.4
Chlorophyll (ug/L)	3.0	-	33.6
NH_3+NH_4^+ -N (ug/L)	566 267		315
NH_3 –N (un-ionized) (ug/L)	20	96	23
NO_3+NO_2-N (mg/L)	0.66	0.14	0.11
Total Nitrogen (mg/L as N)	1.94	1.76	1.88
Total Phosphorus (ug/l as P)	80	251	274
Silica (mg/L as SiO_2) 3.38		5.12	8.50
pH 8.0		8.9	8.1
Alkalinity (mg/L)	86	67	83
Total Suspended Solids (mg/L)	7	31	28
Inorganic Suspended Solids (mg/L)	5	6	16
Volatile Suspended Solids (mg/L)	3	24	12

Table B-6. Data collected in 2004 by Iowa State University (6)

Parameter 6/2/2004		**6/30/2004**	**8/4/2004**
Secchi Depth (m)	0.3	1.0	0.6
Chlorophyll (ug/L)	22.8	48.9	28.6
NH_3+NH_4^+ -N (ug/L)	229 79		306
NH_3 –N (un-ionized) (ug/L)	10	33	16
NO_3+NO_2-N (mg/L)	4.16	1.02	0.11
Total Nitrogen (mg/L as N)	5.66	2.42	1.69
Total Phosphorus (ug/l as P)	198	97	175
Silica (mg/L as SiO_2) 15.58		5.76	3.02
pH 8.1		9.1	7.9
Alkalinity (mg/L)	85	105	104
Total Suspended Solids (mg/L)	57	13	15
Inorganic Suspended Solids (mg/L)	46	6	8
Volatile Suspended Solids (mg/L)	11	7	7

Table B-7. 2000-2004 Phytoplankton Data (3)

	2000 2001 2002			2003 2004	
Division	**Wet Mass (mg/L)**	**Wet Mass (mg/L)**	**Wet Mass (mg/L)**	**Wet Mass (mg/L)**	**Wet Mass (mg/L)**
Bacillariophyta	0.220 -		0.385	0.003 2.961	
Chlorophyta	1.261 -		3.999	0.015 0.438	
Cryptophyta	0.315 -		1.296	0.095 1.763	
Cyanophyta 58.882		-	247.235	278.614	70.461
Dinophyta	2.016 -		3.526	0.039 0.000	
Euglenophyta	0.038 -		0.177	0.017 0.076	
Total 62.732		**-**	**256.618**	**278.783**	**75.700**

Additional lake sampling results and information can be viewed at:
http://limnology.eeob.iastate.edu/

10. Appendix C - Trophic State Index

Carlson's Trophic State Index

Carlson's Trophic State Index is a numeric indicator of the continuum of the biomass of suspended algae in lakes and thus reflects a lake's nutrient condition and water transparency. The level of plant biomass is estimated by calculating the TSI value for chlorophyll-a. TSI values for total phosphorus and Secchi depth serve as surrogate measures of the TSI value for chlorophyll.

The TSI equations for total phosphorus, chlorophyll and Secchi depth are:

$$TSI\ (TP) = 14.42\ \ln(TP) + 4.15$$

$$TSI\ (CHL) = 9.81\ \ln(CHL) + 30.6$$

$$TSI\ (SD) = 60 - 14.41\ \ln(SD)$$

TP = in-lake total phosphorus concentration, ug/L

CHL = in-lake chlorophyll-a concentration, ug/L

SD = lake Secchi depth, meters

The three index variables are related by linear regression models and *should* produce the same index value for a given combination of variable values. Therefore, any of the three variables can theoretically be used to classify a waterbody.

Table C-1. Changes in temperate lake attributes according to trophic state (7, 11).

TSI Value	Attributes	Primary Contact Recreation	Aquatic Life (Fisheries)
50-60	eutrophy: anoxic hypolimnia; macrophyte problems possible	[none]	warm water fisheries only; percid fishery; bass may be dominant
60-70	blue green algae dominate; algal scums and macrophyte problems occur	weeds, algal scums, and low transparency discourage swimming and boating	Centrarchid fishery
70-80	hyper-eutrophy (light limited). Dense algae and macrophytes	weeds, algal scums, and low transparency discourage swimming and boating	Cyprinid fishery (e.g., common carp and other rough fish)
>80	algal scums; few macrophytes	algal scums, and low transparency discourage swimming and boating	rough fish dominate; summer fish kills possible

Table C-2. Summary of ranges of TSI values and measurements for chlorophyll-a and Secchi depth used to define Section 305(b) use support categories for the 2004 reporting cycle.

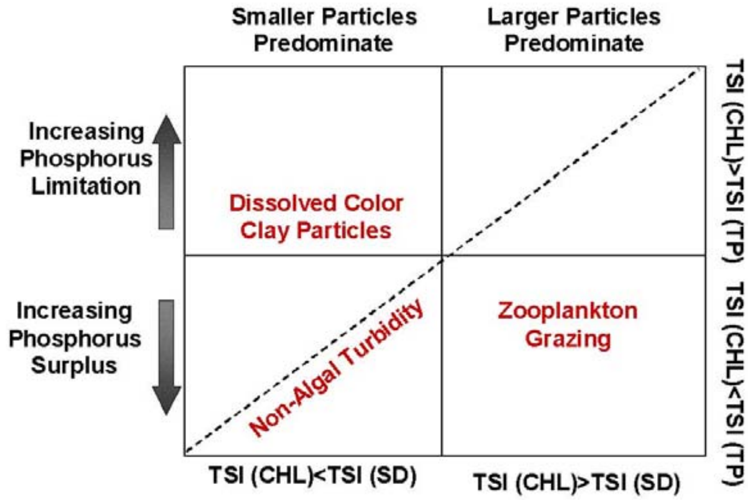
Level of Support	TSI value	Chlorophyll-a (ug/l)	Secchi Depth (m)
fully supported	<=55	*<=12 >1.*	*4*
fully supported / threatened	55 ➔ 65	*12 ➔ 33*	*1.4 ➔ 0.7*
partially supported (evaluated: in need of further investigation)	65 ➔ 70	*33 ➔ 55*	*0.7 ➔ 0.5*
partially supported (monitored: candidates for Section 303(d) listing)	65-70	*33 ➔ 55*	*0.7➔ 0. 5*
not supported (monitored or evaluated: candidates for Section 303(d) listing)	>70	*>55*	*<0.5*

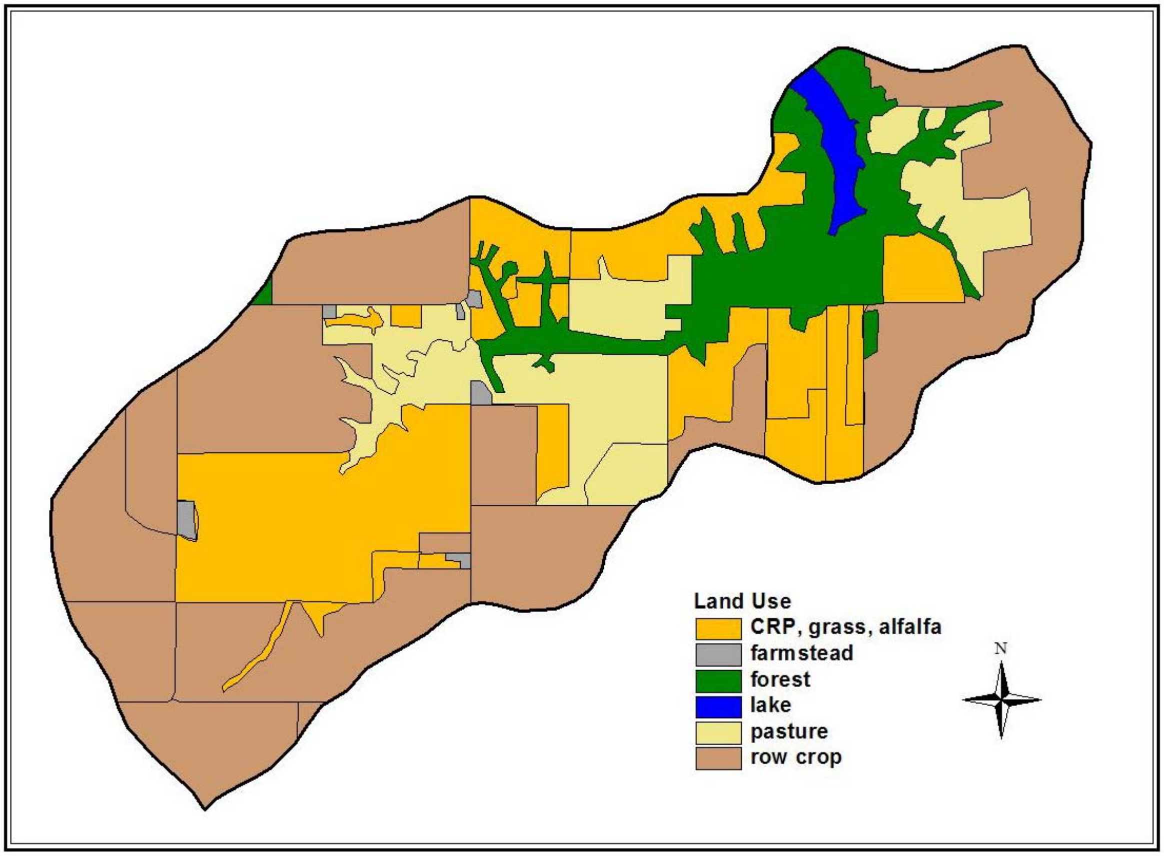
Table C-3. Descriptions of TSI ranges for Secchi depth, phosphorus, and chlorophyll-a for Iowa lakes.

TSI value	Secchi description	Secchi depth (m)	Phosphorus & Chlorophyll-a description	Phosphorus levels (ug/l)	Chlorophyll-a levels (ug/l)
> 75	extremely poor	< 0.35	extremely high	> 136	> 92
70-75	very poor	0.5 – 0.35	very high	96 - 136	55 – 92
65-70	poor	0.71 – 0.5	high	68 – 96	33 – 55
60-65	moderately poor	1.0 – 0.71	moderately high	48 – 68	20 – 33
55-60	relatively good	1.41 – 1.0	relatively low	34 – 48	12 – 20
50-55	very good	2.0 – 1.41	low	24 – 34	7 – 12
< 50	exceptional	> 2.0	extremely low	< 24	< 7

The relationship between TSI variables can be used to identify potential causal relationships. For example, TSI values for chlorophyll that are consistently well below those for total phosphorus suggest that something other than phosphorus limits algal growth. The TSI values can be plotted to show potential relationships as shown in Figure C-1.

Figure C-1. Multivariate TSI Comparison Chart (Carlson)




Land Use
CRP, grass, alfalfa
farmstead
forest
lake
pasture
row crop
N

12. Appendix E - Erosion Model and Model inputs

The Revised Universal Soil Loss Equation (RUSLE) (12) is an erosion model designed to predict the longtime annual average soil loss (A) carried by runoff from specific field slopes in specified cropping and management systems. The equation used by RUSLE is:

A=(R)x(K)x(L)x(S)x(C)x(P)

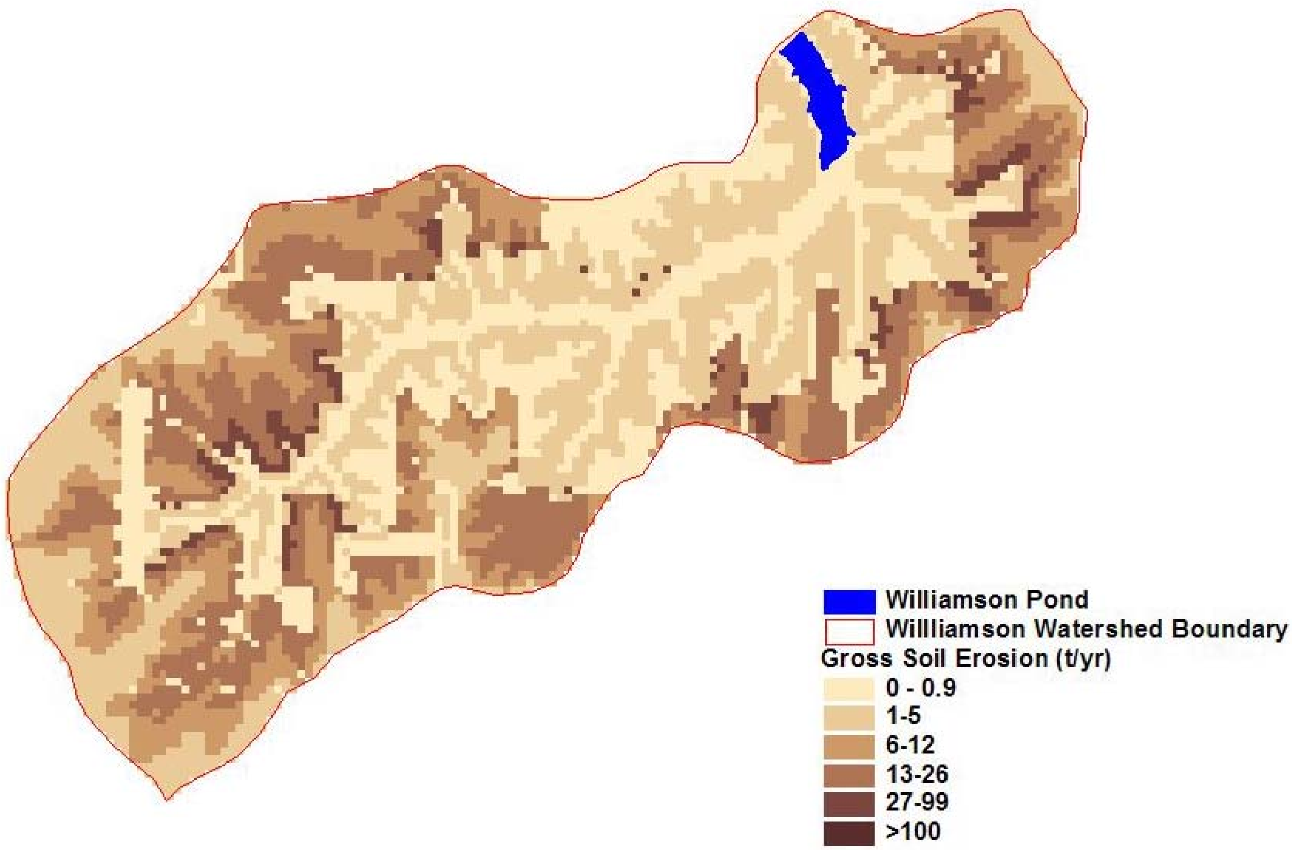
- A= computed spatial average soil loss and temporal average soil loss per unit of area expressed in the selected units for K and for the period selected for R. Typically, A is expressed as tons/acre/year.
- R= rainfall-runoff erosivity factor. The rainfall erosion index plus a factor for any significant runoff from snowmelt.
- K= soil erodibility factor. The soil loss rate per erosion index unit for a specified soil as measured on a standard plot, which is defined as a 72.6-ft length of uniform 9% slope in continuous clean-till fallow.
- L= slope length factor. The ratio of soil loss from the field slope length to soil loss from a standard plot length under identical conditions.
- S= slope steepness factor. The ratio of soil loss from the field slope gradient to soil loss from a standard plot gradient under identical conditions.
- C= cover management factor. The ratio of soil loss from an area with specified cover and management to soil loss from an identical area in tilled continuous fallow.
- P= support practice factor. The ratio of soil loss with a support practice like contouring, strip-cropping, or terracing to soil loss with straight row farming up and down the slope.

Data from IDNR soil, landuse and other GIS coverages have been used as input to the RUSLE equation. The IDNR RUSLE erosion model uses a grid of 30 by 30 meter cells to estimate sheet and rill erosion. Sediment yield is the quantity of gross erosion that is delivered to a specific location such as a water body.

Williamson Pond RUSLE Map

Figure E-1 identifies the potential gross sheet and rill erosion from the Williamson Pond watershed based on 2002 satellite imagery. The calculations do not take credit for installed best management practices, and is intended to identify priority areas within the watershed.

Figure E-1. Sheet and rill erosion in the watershed of Williamson Pond.



13. Appendix F – Lake Modeling Results

A number o f different empirical models that pr edict annual phosphorus load base d on measured in-lake phosphorus con centrations were evalua ted. In add ition, watershed phosphorus delivery using both export coefficients and an annual loading function model as outlined in Reckhow's EUTROMOD User's Manual (10) was calcula ted. The re sults from both approaches were compared to select the best-fit empirical model.

Table F-1. Model Results for existing conditions.

Model	Predicted Exi sting An nual T otal Phosphorus L oad (lbs/ yr) f or i n-lake GSM TP = 241 ug/L	Comments
Loading Function	6235	Reckhow (10)
EPA Export	1438	EPA/5-80-011
WILMS Export	922	"most likely" export coefficients
Reckhow 1991 EUTROMOD Equation	18825	GSM model
Canfield-Bachmann 1981 Natural Lake	1685	GSM model
Canfield-Bachmann 1981 Artificial Lake	3624	GSM model
Reckhow 1977 Anoxic Lake	886	GSM model
Reckhow 1979 Natural Lake	1552	GSM model. P out of range
Reckhow 1977 Oxic Lake (z/Tw < 50 m/yr)	1161	GSM model. P out of range
Nurnberg 1984 Oxic Lake	1439	Annual model. P out of range
Walker 1977 General Lake	4276	SPO model.
Vollenweider 1982 Combined OECD	2158	Annual model.
Vollenweider 1982 Shallow Lake	2282	Annual model.

The Loading Function appears to overestimat e current total phospho rous loadin g to Williamson Pond. This is due in part to the location of Williamson Pond in the South ern Iowa Drift Plain and the lack of a current detailed field level assessment. Th e Vollenweider 1982 Shallow Lake model estimated loading more in line with the e xport coefficient estimates. This model is an annual model, not a growing season model, but may reasonably be used for well mixed lakes such as Williamson Pond. This model was selected ov er the Vollenweider OECD model because it was delop ed based o n a specific set of lakes (sh allow reservoirs), while the OECD model is based on vari ous lakes located throughout the world.

Table F-2. Model Results for target conditions.

Model	Predicted Exi sting An nual T otal Phosphorus L oad (lbs/ yr) f or i n-lake GSM TP = 96 ug/L	Comments
Reckhow 1991 EUTROMOD Equation	864	GSM model
Canfield-Bachmann 1981 Natural Lake	519	GSM model
Canfield-Bachmann 1981 Artificial Lake	759	GSM model
Reckhow 1977 Anoxic Lake	354	GSM model
Reckhow 1979 Natural Lake	619	GSM model. P out of range
Reckhow 1977 Oxic Lake (z/Tw < 50 m/yr)	464	GSM model. P out of range
Nurnberg 1984 Oxic Lake	575	Annual model. P out of range
Walker 1977 General Lake	876	SPO model.
Vollenweider 1982 Combined OECD	704	Annual model.
Vollenweider 1982 Shallow Lake	804	Annual model.

Using the results of the Vollenweider 1982 Shallow Lake model, to achieve the desired TSI target of 70, the expected annual total phosphorous load is 804 lbs./year.

APPENDIX B – WILLIAMSON POND FY 2008 – 319 APPLICATION

IOWA
WATER QUALITY/WATERSHED PROTECTION PROJECT APPLICATION

Application Number **Date Received**

Project Title: Williamson Pond Watershed Project

District(s) Submitting Application: Lucas County Soil and Water Conservation District

Contact Person: Name: Arnold Schneider Telephone: 641-774-2512
Address: 21792 490th Street Fax: 641-774-2700
Chariton, IA 50049

Total Funding Requested for the Life of the Project: $238,425

Project Executive Summary:

Williamson Pond is a 26-acre publicly owned lake in Lucas County, with a watershed area of 1499 acres. Built in the 1910s to provide a water source for steam locomotives, it was transferred, with 100 acres of adjoining land, to state ownership in the 1950s and dedicated to recreational use. It has been managed since 1976 by Lucas County Conservation Board (while still under state ownership) for fishing, boating, hunting, picnicking and other passive uses. Private land use within the watershed is predominantly agricultural.

Williamson Pond is on the 2004 EPA 303(d) List of Impaired Waters for turbidity. Iowa DNR completed a TMDL for Williamson Pond in 2005, which set reduction targets for both suspended sediment and phosphorus. In the TMDL, the one quantified source of sediment influx was sheet and rill erosion, which was estimated to be delivering 1765 tons/year to the lake. More recent field assessment work by Lucas SWCD has indicated a sheet and rill sediment delivery rate of 580 tons/year and, additionally, a sediment delivery rate of 451 tons/year from gully erosion occurring on both public and private land around the lake.

Lucas SWCD proposes to reduce sediment delivery to Williamson Pond from sheet and rill and gully erosion by installing 5 grade stabilization structures and 15 sediment control basins on public land around the lake. In addition, and with the same goal, Lucas SWCD proposes installing 2 grade stabilization structures, 5 sediment control basins, 5 acres of grass waterway, 5000 feet of terraces, and 2 livestock facility improvements on private land within the watershed. Because phosphorus delivery is closely tied to sediment delivery, Lucas SWCD believes that a focus on reducing sediment delivery will simultaneously contribute to reaching the TMDL's reduction targets for both suspended sediment and phosphorus.

This application has been reviewed and approved by a motion at the March 24, 2008 meeting of Lucas Soil and Water Conservation District Commissioners. Discussions and actions taken appear in the official minutes on file at the District office.

____________________________________, District Chair

I. BACKGROUND INFORMATION

Water Resource and Related Problems

Williamson Pond is a 26-acre publicly owned lake located about 2 miles east of the town of Williamson, in Lucas County. It has a watershed area of 1499 acres (including the lake itself). Built in the 1910s to provide a water source for steam locomotives, it was transferred, with 100 acres of adjoining land, to state ownership in the 1950s and dedicated to recreational use. It has been managed since 1976 by the Lucas County Conservation Board (while still under state ownership) for fishing, boating, hunting, picnicking and other passive uses. Its designated uses are Class A1, primary contact, and Class B(LW), aquatic life. Its usage level has been estimated at about 3000 visits/year. Private land use within the watershed is predominantly agricultural.

Williamson Pond is on the 2004 EPA 303(d) List of Impaired Waters. It is also on Iowa's 2000 Nonpoint Source Management Program (NPSMP) list of priority lakes, and it is considered a priority watershed within Lucas County by Lucas SWCD. Iowa DNR completed a TMDL for Williamson Pond in 2005.

The nature of Williamson Pond's 303(d) impairment is excessive turbidity caused primarily by suspended sediment. The TMDL set reduction targets for both suspended sediment and phosphorus. Problems within the lake directly related to turbidity include a loss of recreational value and reduced recreational use. To the extent that the lake's turbidity results from ongoing influx of sediment (rather than from resuspension of existing sediment), there is also an accumulating problem with sedimentation of the lake, reducing its depth and surface area, and thus further reducing its recreational value. A recent DNR Fisheries analysis of Williamson Pond reports only small numbers of bullhead and common carp, indicating that its turbidity does not significantly result from resuspension of sediment. DNR's 2004 and draft 2006 305(b) reports on water quality recognize Williamson Pond's turbidity impairment, and rate the lake as "partially supporting" its Class A1 and Class B(LW) uses.

Numerous soil conservation structures and practices, such as grade stabilization structures, terraces, etc. have already been installed in the Williamson Pond watershed, providing some protection for the lake. However, untreated sources of sediment influx remain, and no concerted effort at implementing a watershed plan for Williamson Pond has been undertaken until now. Furthermore, the work that has been done in the watershed to date has focused primarily on private land, with little attention given to problems existing on public land adjoining the lake.

Current Level of Pollutant Loading

Two sets of sediment loading data are available for Williamson Pond. They disagree with each other significantly, so it is worthwhile to consider them both in some detail. Doing so will provide a better context for setting a goal for this project and evaluating its success.

For the Williamson Pond TMDL, DNR collected land use data for the watershed from 2002 aerial photography. These data were then used with RUSLE to produce an estimated sediment delivery rate to Williamson Pond of 1765 tons/year. Based on data from ISU sampling during 2000-2004, the mean Secchi disk depth at Williamson Pond is 0.5 meters, and the mean value for Total Suspended Solids (TSS) is 16.6 mg/L. The TMDL set a target for turbidity of a Secchi depth of 0.7 meters, which is consistent with a TSS value of 3.6 mg/L. The amount of reduction in TSS needed to reach the turbidity target is thus 16.6 – 3.6 = 13.0 mg/L, or about 78%. Assuming a direct relationship between TSS and sediment delivery, the sediment delivery reduction target is thus 1765 x 0.78 = 1377 tons/year. The sediment load capacity of Williamson Pond, with a 10% margin of safety, is then (1765 – 1377) x 0.9 = 349 tons/year.

For phosphorus, the TMDL started with ISU monitoring data, which include a mean Carlson's Trophic State Index (TSI) value for phosphorus of 81 (Carlson's TSI is described in Appendix C of the TMDL). Then, using calculations similar to those for sediment, the TMDL estimated the current phosphorus delivery rate for Williamson Pond at 2282 lbs/year. The TMDL also set a target phosphorus TSI value of 70, which corresponds to a load capacity, again with a 10% margin of safety, of 804 lbs/year. The TMDL's phosphorus delivery reduction target is thus 2282 – 804 = 1478 lbs/year, or about 65%.

Considering that phosphorus delivery is known to be closely tied to sediment delivery, and that the TMDL's reduction target for phosphorus (65%) is smaller than its reduction target for sediment (78%), Lucas SWCD believes that a focus on reducing sediment delivery to Williamson Pond will serve to simultaneously contribute to reaching the TMDL's targets for both sediment and phosphorus.

However, the validity of the TMDL's reduction targets is not clear. Its approach to estimating sediment delivery, for example, looked only at sheet and rill erosion, and ignored possible contributions from gully and streambank erosion. It also made no adjustments for soil and water conservation structures and practices already installed in the Williamson Pond watershed.

A more recent assessment, based on field work done by Lucas SWCD in 2007, provides another set of sediment delivery data. This work was funded by a Watershed Development Grant from IDALS-DSC. In the spring of 2007, the watershed was assessed for sheet and rill erosion based on current field observations (tillage method, land cover, and land use) and on FSA records of past cropping history for rotations. These new data were digitized and put through another RUSLE analysis, this time adjusting for the effects of conservation structures (ponds, terraces, etc.) within the watershed. The result was an estimated sediment delivery rate of 580 tons/year from sheet and rill erosion (see attached Sediment Delivery map). In the autumn of 2007, gully erosion was assessed in the watershed using the RASCAL method; field work was done by Lucas SWCD staff, and the resulting data were analyzed by DNR. The result was an estimated sediment delivery rate of 451 tons/year from gully erosion (see attached Gully Assessment map). Streambeds were assessed as part of the gully assessment; no separate streambank erosion assessment was done because stream flow into the lake is intermittent. The combined result is an estimated sediment delivery rate of 580 + 451 = 1031 tons/year. This is about 42% less than the TMDL's estimate. Lucas SWCD has greater confidence in its own estimate, because this newer estimate avoids the problems with the TMDL's estimate that were cited in the previous paragraph. Both estimates, however, are appropriate for inclusion in this application, and both will be referenced later in discussion of this project's goal.

These estimates, and the differences between them, provide grounds for making three observations here. First, the difference between the two estimates for sheet and rill erosion, in particular, illustrates that much of what could be done to reduce that form of erosion within the watershed has already been done. Second, the difference between the overall estimates suggests that sediment delivery reductions may be less valuable as quantitative targets than estimated load capacities would be. Reducing sediment delivery to an identified load capacity may be more meaningful than reducing delivery by some potentially less accurate amount. Third, the magnitude of the gully erosion estimate for Williamson Pond, combined with the fact that most of these gullies have direct, unprotected access to the lake, indicates that effort directed toward closing that access could be very effective at reducing sediment delivery to the lake. Gully treatment is therefore given a high priority in this project.

Whichever sediment delivery estimate is more valid, Lucas SWCD supports the TMDL's targets of a Secchi depth of 0.7 meters for turbidity and a TSI value of 70 for phosphorus. Other measures will be used in monitoring short-term progress, but these TMDL targets are accepted as longer-term goals for Williamson Pond, and the Pond's current values of 0.5 meters for Secchi depth and 81 for phosphorus TSI show how far we have to go.

On the bright side, little of Williamson Pond's sediment problem can be attributed to shoreline erosion. The TMDL noted that shoreline erosion was a possibility and should be monitored. This question was subsequently considered twice, in a Woodland Stewardship Plan prepared by Duane Bedford (DNR Forestry) and again in a Fishery Status report prepared by Mark Flammang (DNR Fisheries). Both agreed that shoreline erosion should continue to be monitored at Williamson Pond, but that it does not appear to be a problem now.

Watershed Characteristics

Land cover in the Williamson Pond watershed is typical of rural areas in the Southern Iowa Drift Plain. A windshield survey was conducted in 2007. Results are illustrated in the attached Land Cover map, and summarized here:

Land cover	acres	percent
CB – Mulch	525	35.0
Grassland	430	28.7
Pasture	165	11.0
Timber	161	10.7
CRP	134.6	9.0
Roads	38.7	2.6
Water	26	1.7
CB – Conventional	12	0.8
Farmstead	5.6	0.4
Scrub/Shrub	1	0.1
	1498.9	100.0

These numbers show that land use in the watershed is predominantly agricultural. They also show that, on acreage used for row crops, no-till practices (CB – Mulch) are well established, as compared to conventional practices.

Comparison of the attached Land Cover and Topography maps shows that row crop acreage is largely (but not entirely) confined to upland sites of low to moderate slope, while steeper slopes, and land adjoining the watershed's main drainageway (English Creek), are largely under some sort of permanent cover. Numerous ponds, terraces, waterways and other conservation structures and practices are already present in the watershed, and operators are, in general, receptive to projects that can further improve the conservation aspects of their cropping operations.

There are currently two livestock operations in the watershed. One is a cow-calf operation with about 50 cows in the herd. This producer uses a rotational grazing system with three paddocks, and current forage conditions indicate slight overgrazing. The other operation raises meat goats. Its herd size is unknown, but appears to be about 30 head. It has limited grazing land available, but supplemental forage is supplied and the grazing land is adequately treated.

Soils in the watershed range in slope from 0% to 25%. By soil type, 35% of the watershed is composed of Haig (362), Grundy (364B), and Edina (211) soils. These soils are considered to be non-highly-erodible by NRCS and are very productive and suited for row crop production. Another 27% of the watershed is composed of productive but highly-erodible soils of the Pershing and Arispe class. The soils of the rest of the watershed are best suited to grass-based agriculture and forest management.

The attached Topography map shows the boundaries of the publicly owned land surrounding Williamson Pond. There are no urban or industrial areas in the watershed.

For graphic information, see the attached maps of Sediment Delivery, Gully Assessment, Land Cover, Topography, Potential Sheet and Rill Erosion, and Proposed Structure Drainages.

Practices Needed to Protect Water Quality

The TMDL for Williamson Pond describes itself as part of an iterative process in which watershed goals are set, plans are made and implemented to reach those goals, and results are monitored. Goals and plans are then adjusted accordingly, and the cycle begins again. Such a process anticipates an inability to precisely know, beforehand, what will be needed to reach the goals, and that anticipation is justified in the present case.

However, with that said, it is possible to identify in a general way some practices that are or may be needed to improve and protect the water quality of Williamson Pond.

The watershed assessment work recently done by Lucas SWCD, described earlier, found that much of what could be done to reduce sheet and rill erosion in the watershed has already been done. Some such work does remain, but the greatest need that was identified in the assessment is for structures that will reduce gully erosion. Furthermore, a large proportion of that need exists on publicly owned land surrounding the lake, where little erosion control work of any kind has been done before now. This project will address much of that work, but not all of it.

Other needs, some of them outside the scope of this project, include: expanding protection of tilled cropland with the installation of structural or management practices that reduce sheet and rill erosion and sediment delivery; continuing and expanding the use of cropland rotations with multiple years of hayland; converting the remaining conventionally-tilled cropland to no-till; converting cropland on too-steep slopes to permanent cover; and increasing the exclusion of livestock from streams. If permanent access can be gained to affected private land, it would be beneficial to construct a sediment-trapping wetland at the upper end of Williamson Pond. The concrete spillway structure over which the lake drains should be inspected to assess its need for repair. Finally, if significant sediment influx continues, the lake will eventually need to be dredged.

II. WATER QUALITY PROTECTION PLAN

Project Goals and Objectives

The overall goal of this project is to reduce sediment delivery to Williamson Pond by 484 tons/year, with the expectation that this will also result in a corresponding reduction in phosphorus delivery. Using data from the 2005 TMDL, this translates to a 27% reduction in sediment delivery, to a load of 1281 tons/year. Using, instead, data from the 2007 Lucas SWCD field assessment work, this translates to a 47% reduction in sediment delivery, to a load of 547 tons/year. For reasons given earlier, Lucas SWCD has more confidence in the latter rate. In either case, however, the resulting sediment load still significantly exceeds the TMDL's identified load capacity for Williamson Pond of 349 tons/year. That can be taken as a strong indication that this project does not overreach. It indicates that this project is, instead, designed conservatively, in the context of the iterative process of watershed improvement that was described in the TMDL and alluded to earlier in this application.

The stated sediment delivery reduction goal of 484 tons/year is itself a conservative estimate of what may result from this project. The attached map of Proposed Structure Drainages illustrates the locations and drainage areas of the structures proposed for this project. Numbered structures are those proposed for public land; those identified with letters are proposed for private land. In the attached table titled Williamson Pond Proposed Structure Sediment Reduction, each of these structures is associated with an estimated value for reduction of sediment delivery. However, in a few cases, there are structures proposed which will be physically located above other structures, in which cases the combined sediment reduction effect will not be simply additive. For example, structures J, K and L will be installed above structure M, such that structure M may partially mask the sediment reduction effects of J, K and L. Structures J, K and L will still have a sediment delivery reduction effect, but that effect is difficult to accurately quantify, so it is not included in setting the overall sediment reduction goal. With such cases excluded (besides J, K and L, these include N, O, P and Q), the stated sediment reduction goal of 484 tons/year then comes from a simple addition of the column titled Estimated Reduction in Sediment Delivered, in the referenced table. Those exclusions are what make the stated goal conservative.

For phosphorus, there is an accepted load reduction figure of 1.3 lbs for every ton of sediment reduction. A sediment delivery reduction of 484 tons/year would thus produce a phosphorus delivery reduction of 629.2 lbs/year. As with sediment, this is still well below the TMDL's phosphorus reduction target of 1478 lbs/year.

This project will work toward its sediment reduction goal using a variety of tools, but will focus primarily on addressing gully erosion. Within the watershed, numerous gullies and head cuts have been identified in which active erosion has been rated as moderate or severe. These critical areas are found on both public and private land, and the bulk of this project will consist of addressing them (see attached Gully Assessment map).

Where other, less critical problems have been identified, they have been included in this project because of the importance of the larger resource. As noted earlier, Williamson Pond is on the 2004 EPA 303(d) list, and is a priority lake for NPSMP. Lucas SWCD therefore feels that less critical problems should also be addressed "while the time is ripe," to try to determine whether enough improvement can eventually be made in the watershed to justify Williamson Pond's removal from the impaired waters list.

Project Description

This project has plans to install/implement the following structures, most of them targeted toward high-priority gullies that drain directly into the lake:

-- 7 grade stabilization structures
-- 20 sediment control basins
-- 5 acres of grass waterway
-- 5000 feet of terraces
-- 2 livestock facility improvements

Of these, 5 grade stabilization structures and 15 sediment control basins will be installed on the public land adjoining Williamson Pond; the rest will be installed on private land elsewhere in the watershed. These structures should be sufficient to reach the project's goal of a 484 tons/year reduction of sediment delivery to Williamson Pond. Lucas SWCD has communicated with potentially affected private landowners and, in most cases, has already received assurance of their cooperation, with cost-share set at 75%. Private landowner commitments which have not already been secured will be solicited in the course of the project.

This project has a planned duration of four years. Because the installation of structures on public land must be preceded by mandated assessments of that land for significant cultural and biological/environmental resources, and because those assessments can take time, the structures planned for public land are scheduled to be installed in the last two years. Those mandated assessments can then be conducted during the first two years, during which this project will install structures on private land.

Cost details for these structures are given in the project budget, attached to this application. The total amount requested from 319/WPF/WSPF is $230,425, of which $106,975 (or 46%) will be spent during the first two years, working on private land, and $123,450 (or 54%) will be spent during the last two years on public land.

Iowa Nonpoint Source Management Program

Williamson Pond is one of the 118 significant publicly owned lakes listed in Appendix 9 of DNR's September 2000 document, *State Nonpoint Source Management Program – Iowa*. That document also contains a table of statewide "Short-term Objectives (WSS) for Watershed and Water Quality Projects" (pp. 80-81). Of the objectives given in that table, this project would directly contribute to at least two:

WSS-1a – Develop 15 new water quality projects (annually) that address priority lakes, trout streams, surface or groundwater supplies or urban issues.

WSS-1m – Work with producers and/or landowners to reduce gully erosion damages to infrastructure and ag land by implementing 60 degrading stream control structures and 150 gully control structures within planned projects.

That table is somewhat dated (WSS-1m was scheduled for 2002), but it can be assumed that what was a desirable objective then remains one now.

Status of TMDL Development and/or Impaired Waters

As noted earlier, Williamson Pond is on the final 2004 303(d) List of Impaired Waters, and a TMDL was completed for Williamson Pond in 2005.

Schedule

See the attached schedule sheet:

Williamson Pond Watershed Project / Annual Activity Schedules

Measures of Success

Success would ideally be defined as documented improvement in the water quality of Williamson Pond. However, that is not likely to occur within the time span of this project, considering that the bulk of the planned gully treatment work will not be done until the last two years of the project. Lucas SWCD will therefore request that ISU continue its monitoring work at Williamson Pond for three years after the completion of this project.

In the meantime, for the duration of this project, success will be defined as the timely completion of installation of the structures listed in the Project Description, above.

Evaluation and Feedback Mechanisms

Monthly, quarterly, annual and final reports will be produced (see Project Reports, below). In the process of report preparation, actual work progress will be compared to the established schedule, and adjustments or redirections of effort will be made as needed.

Participating Agencies and Organizations

Project Partners	Project Role	Contact
Lucas County SWCD	Technical support, Financial assistance	Arnold Schneider 641-774-2512
IDALS-DSC	Technical support, Financial assistance	Vince Sitzmann 515-242-6008
Iowa DNR Section 319 Program	Technical support, Financial assistance	Steve Hopkins 515-281-6402
Iowa DNR Fisheries	Technical support, Financial assistance	Mark Flammang 641-647-2406
Iowa DNR Lake Restoration Program	Technical support, Financial assistance	Mike McGhee 515-281-6281
USDA-NRCS	Technical support, Financial assistance	Jeff Matthias 641-774-2512
Lucas County Conservation Board	Resource management, Site maintenance	Skylar Hobbs 641-774-2438

Project Reports

Monthly, quarterly, annual and final reports will be produced. Quarterly reports will include information on completion of scheduled BMPs. Annual reports will include GIS analysis of load reductions resulting from completed BMPs. A final report will be written at the end of the project. These reports, collectively, will constitute the information/education component of this project.

Project Costs and Funding Sources

See the attached budget sheets:

Williamson Pond Watershed Project Budget Summary (2 pages)

Williamson Pond Watershed Project Annual Budget (4 pages)

Elements of a Watershed Based Plan

This EPA-required table is included at the beginning of this application, immediately after the cover page.

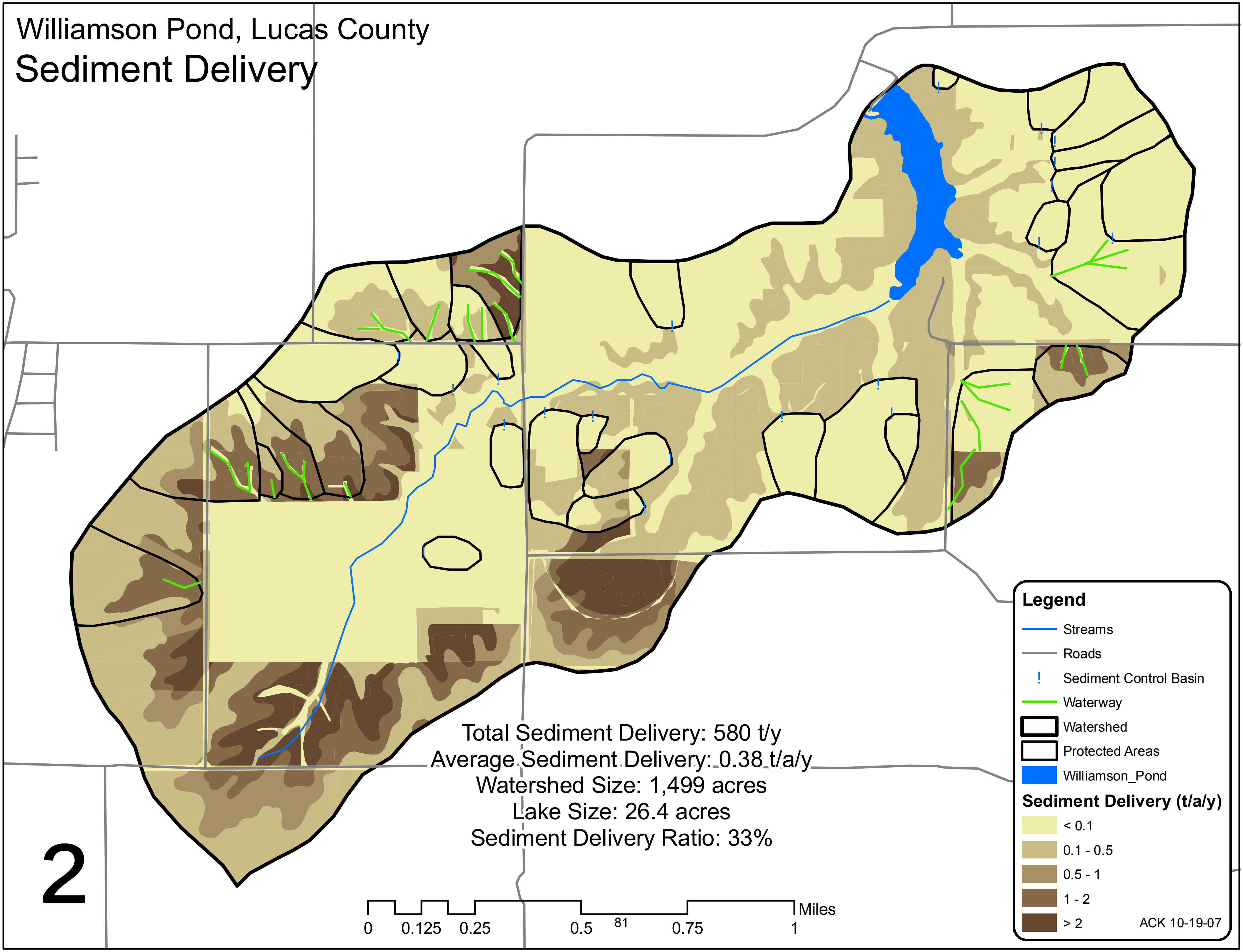
Attachments   (begin after this page)

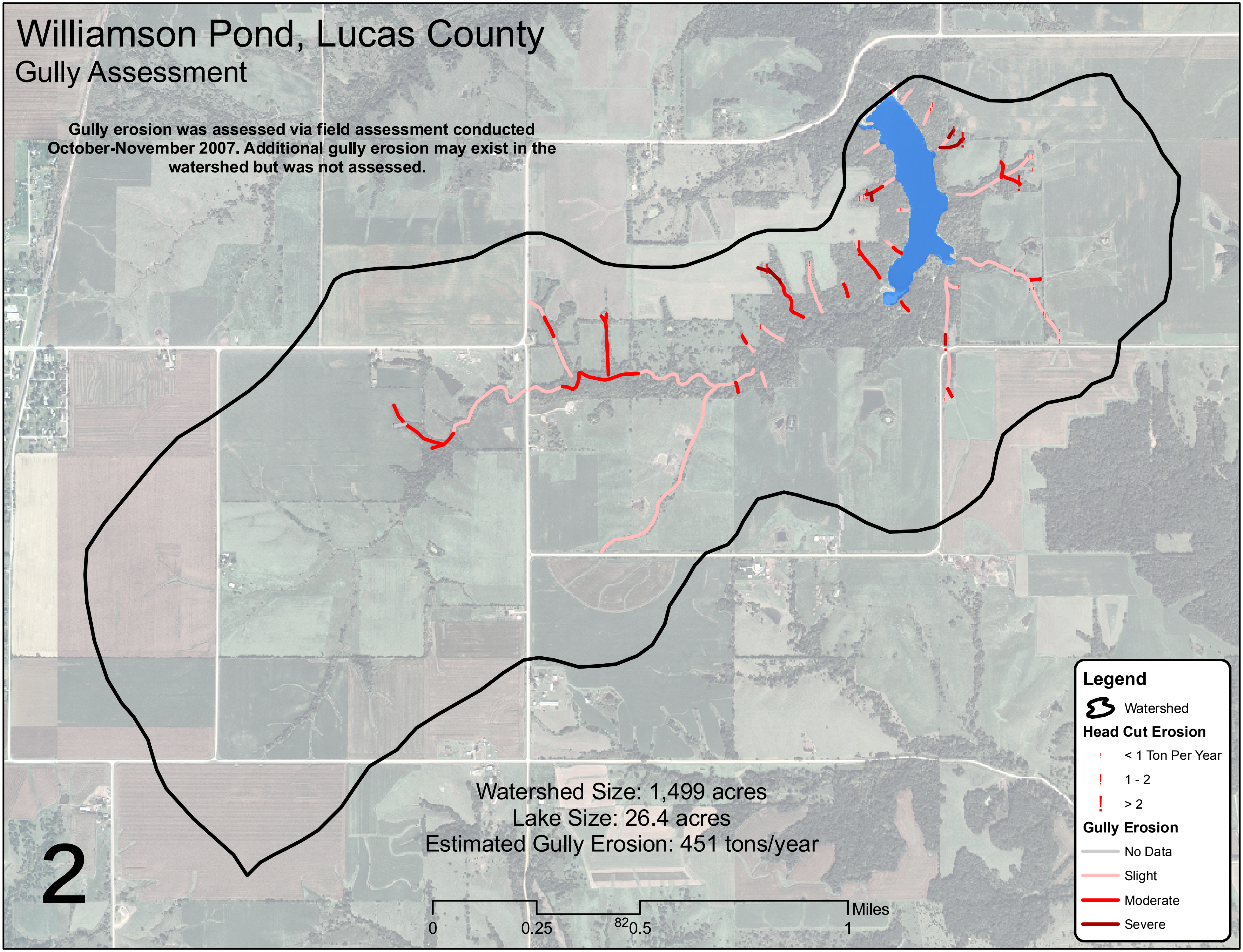
These are listed here:

Sediment Delivery (map)
Gully Assessment (map)
Land Cover (map)
Topography (map)
Potential Sheet and Rill Erosion (map)
Proposed Structure Drainages (map)
Williamson Pond Proposed Structure Sediment Reduction (table)
Williamson Pond Watershed Project Annual Activity Schedules (table)
Williamson Pond Watershed Project Budget Summary (table, 2 pages)
Williamson Pond Watershed Project Annual Budget (table, 4 pages)

Elements of a Watershed-Based Plan

EPA Required Element	Page or location in the Application
1. Identification of the causes and sources that will need to be controlled to achieve the load reductions estimated in this plan (Sources that need to be controlled should be identified at the significant subcategory level with estimates of the extent to which they are present in the watershed; i.e., X number of cattle present, Y acres of row crop needing nutrient management or sediment control, Z miles of streambank needing stabilization, etc.).	Gully erosion as a priority: -- p. 3, first paragraph -- pp.4-5, wrapping paragraph -- p. 6, second paragraph Gully Assessment Map
2. An estimate of the load reductions expected for the management measures implemented below (number 3) to address items identified above (number 1)	pp. 5-6, section "Project Goals and Objectives"
3. Description of NPS management measures need to be implemented to achieve load reductions (number 2) and an identification of critical areas (map or narrative)	pp. 6-7, section "Project Description" Proposed Structure Drainages map Gully Assessment map (also see #1 above)
4. Estimate of financial and technical assistance needed	p. 9, section "Project Costs…"
5. Identification of an information/education component	pp. 8-9, section "Project Reports"
6. A schedule	p. 7, section "Schedule" attachment "Annual Activity Schedules"
7. Description of interim, measurable milestones for determining whether NPS management measures or control actions are being implemented	pp. 7-8, section "Measures of Success" p. 8, section "Evaluation and Feedback…"
8. Set of criteria to be used to determine whether load reductions are being achieved	pp. 7-8, section "Measures of Success" p. 8, section "Evaluation and Feedback…"
9. A monitoring component to evaluate effectiveness of the implementation efforts	To be developed in cooperation with DNR.

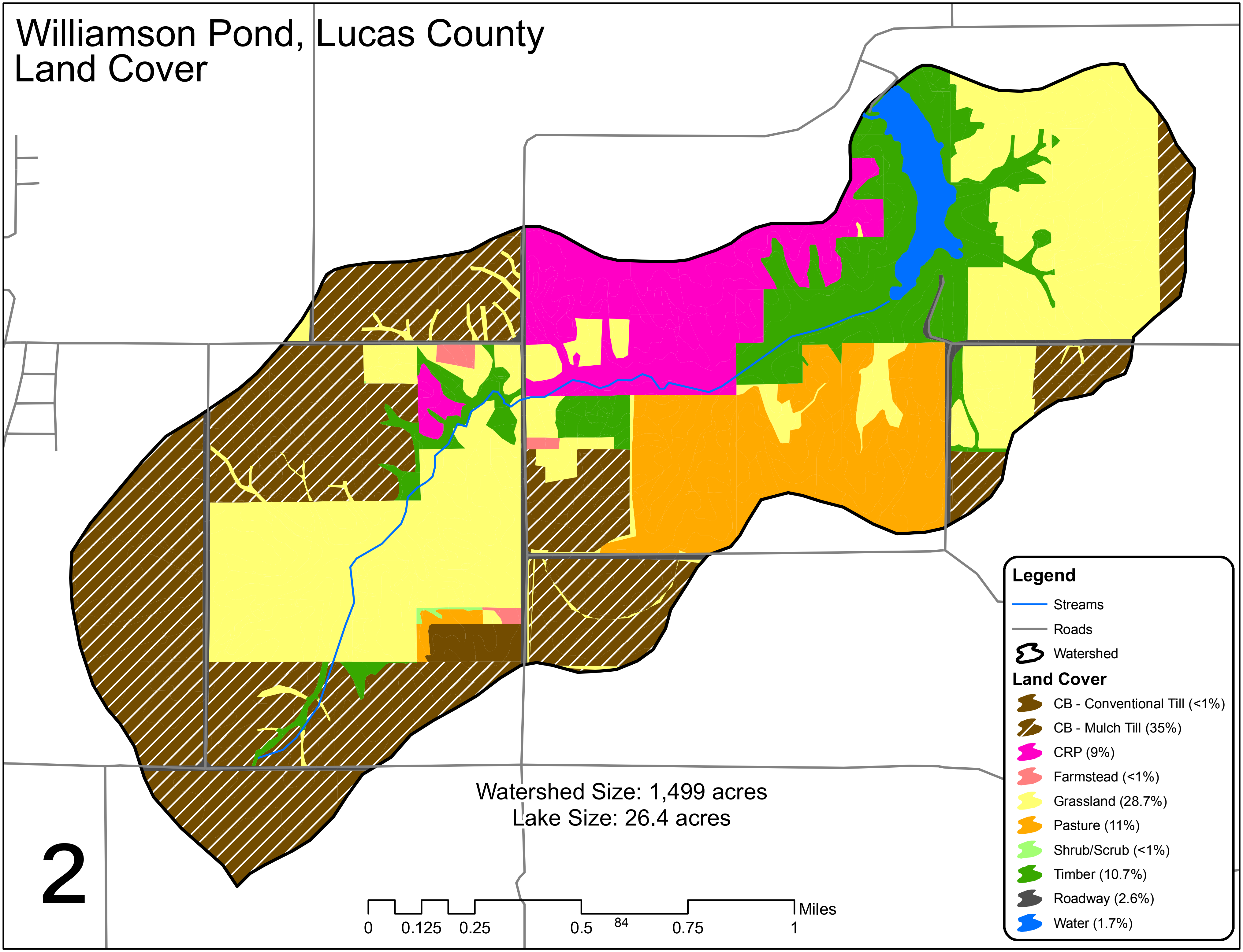

Williamson Pond, Lucas County
Sediment Delivery
Total Sediment Delivery: 580 t/y
Average Sediment Delivery: 0.38 t/a/y
Watershed Size: 1,499 acres
Lake Size: 26.4 acres
Sediment Delivery Ratio: 33%
Legend
Streams
Roads
Sediment Control Basin
Waterway
Watershed
Protected Areas
Williamson_Pond
Sediment Delivery (t/a/y)
< 0.1
0.1 - 0.5
0.5 - 1
1 - 2
> 2
ACK 10-19-07
0
0.125
0.25
0.5
0.75
1
Miles
2


Williamson Pond, Lucas County
Gully Assessment
Gully erosion was assessed via field assessment conducted October-November 2007. Additional gully erosion may exist in the watershed but was not assessed.
Watershed Size: 1,499 acres
Lake Size: 26.4 acres
Estimated Gully Erosion: 451 tons/year
2
0
0.25
0.5
1
Miles
Legend
Watershed
Head Cut Erosion
< 1 Ton Per Year
1 - 2
> 2
Gully Erosion
No Data
Slight
Moderate
Severe

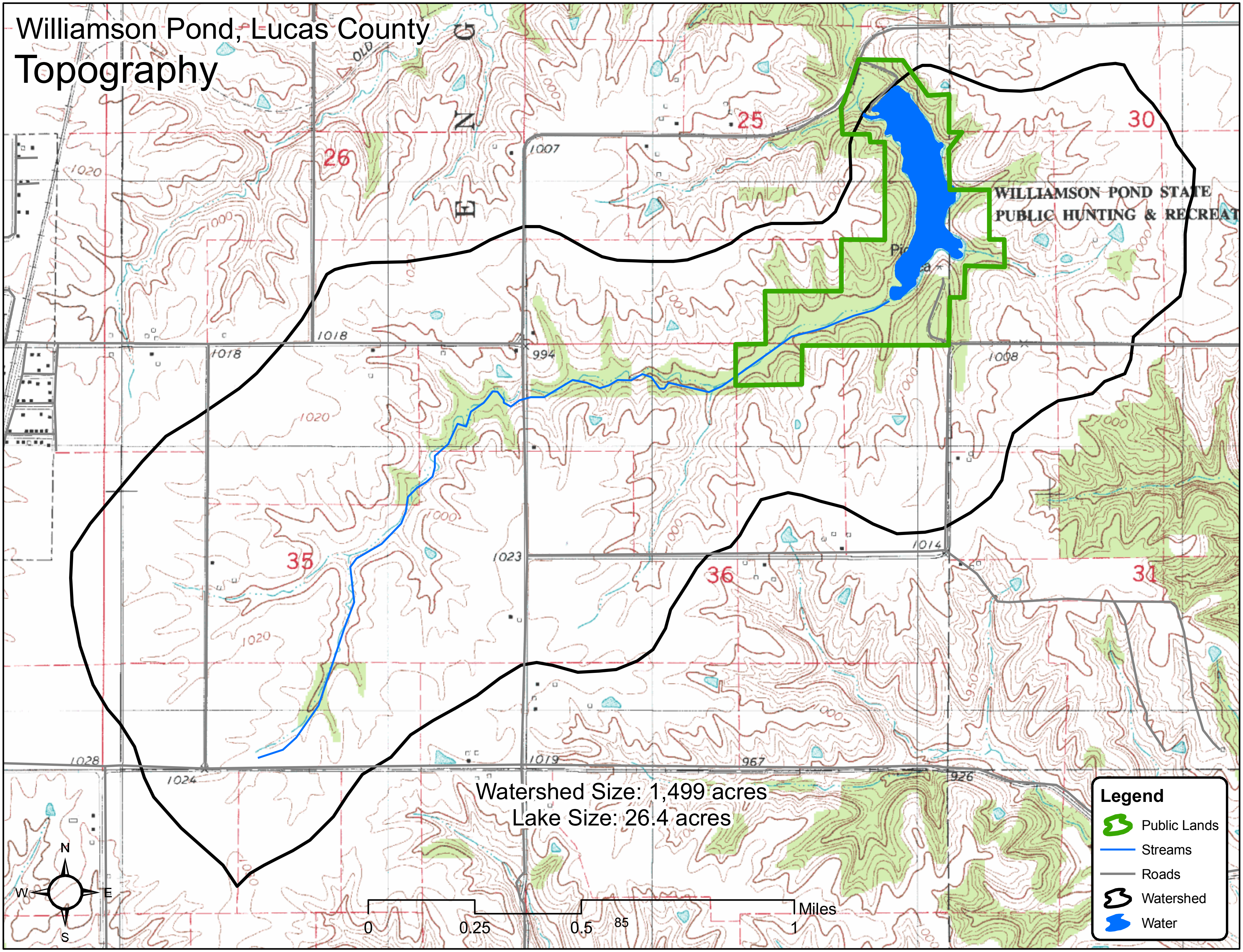
Williamson Pond Land Cover Summary

(per 2007 Windshild Survey)

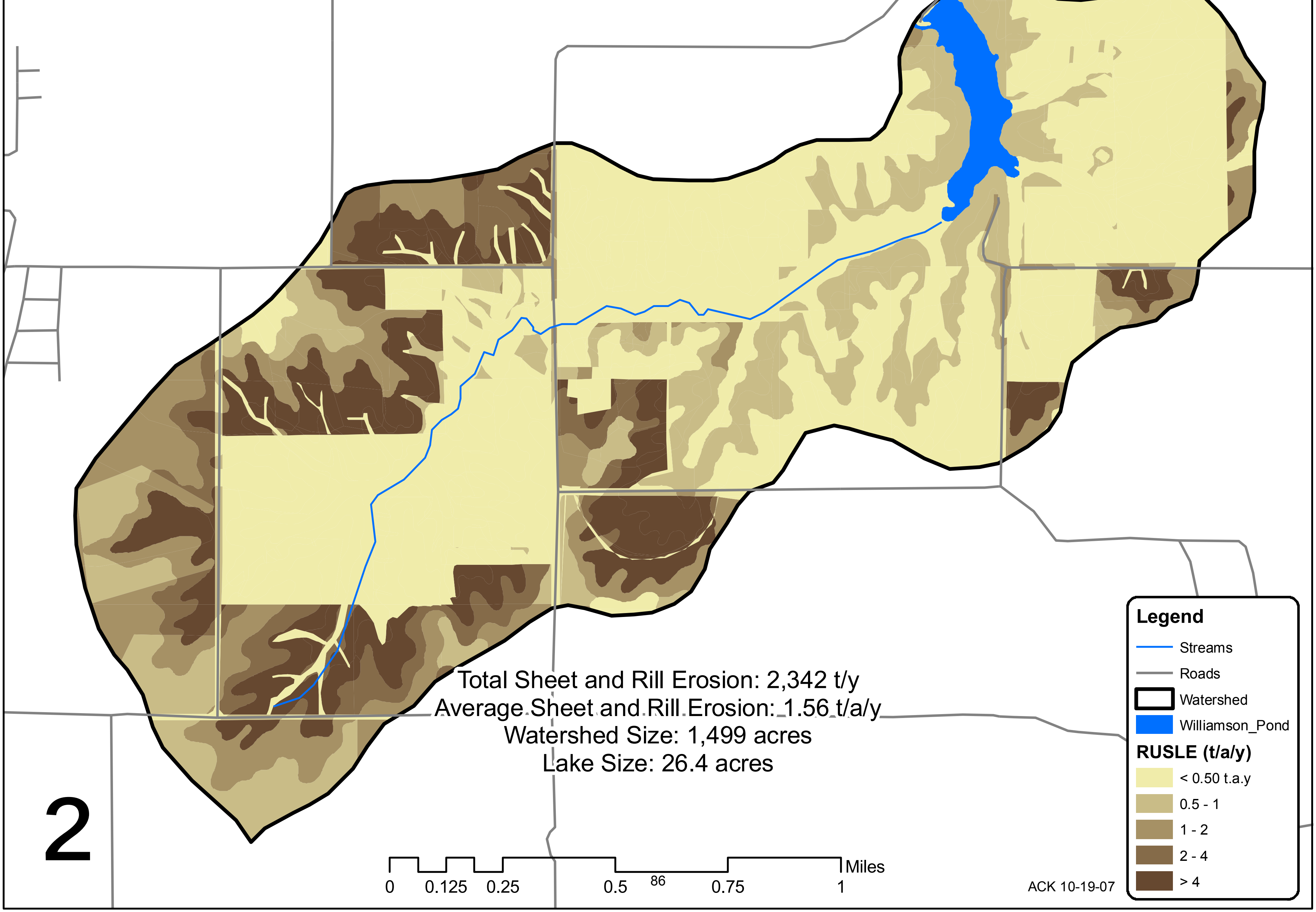
Land Cover	Acres	%
CB - Mulch	525	35.0%
Grassland	430	28.7%
Pasture	165	11.0%
Timber	161	10.7%
CRP	134.6	9.0%
Roads	38.7	2.6%
Water	26	1.7%
CB - Conventional	12	0.8%
Farmstead	5.6	0.4%
Scrub/Shrub	1	0.1%

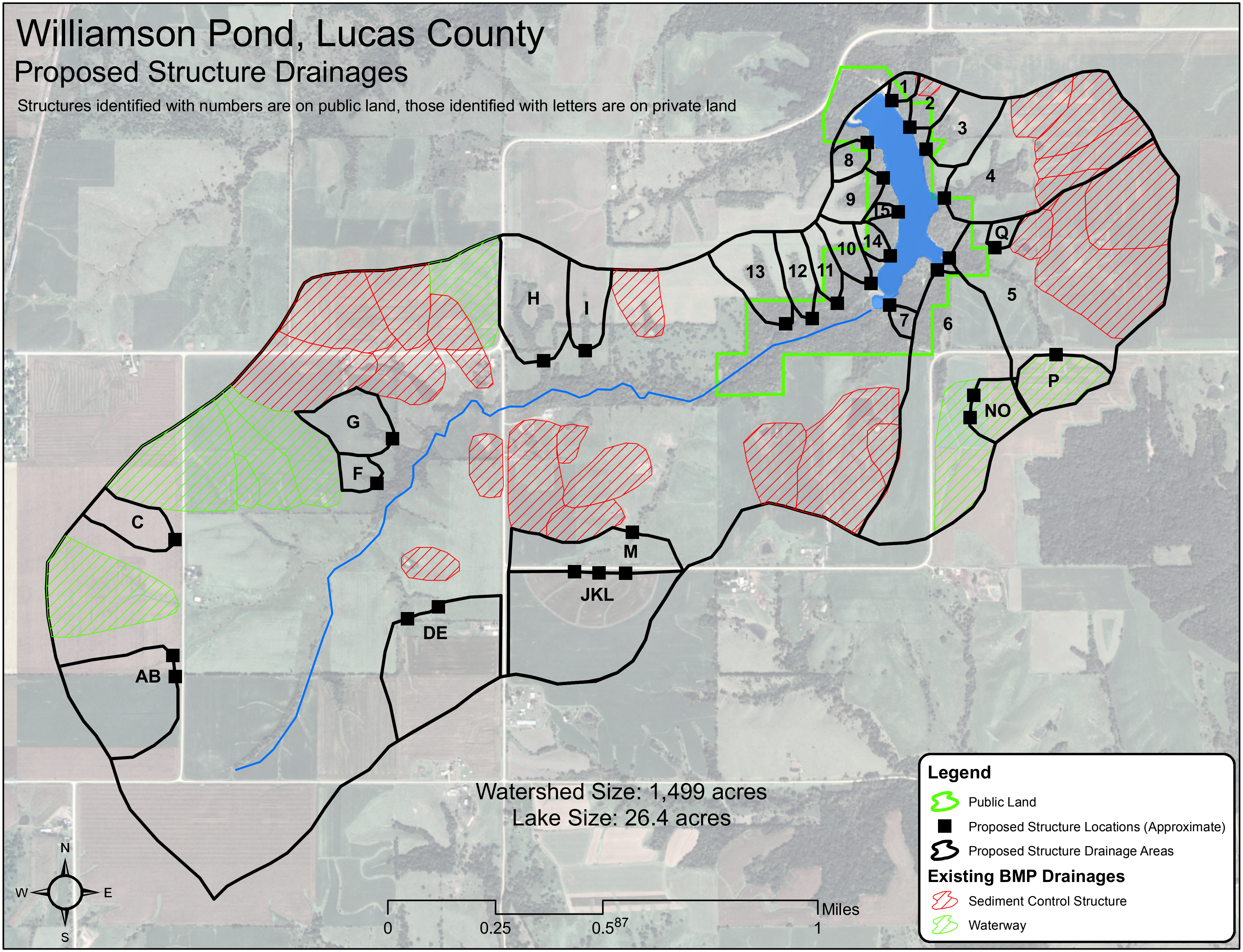

Williamson Pond, Lucas County
Land Cover
Legend
Streams
Roads
Watershed
Land Cover
CB - Conventional Till (<1%)
CB - Mulch Till (35%)
CRP (9%)
Farmstead (<1%)
Grassland (28.7%)
Pasture (11%)
Shrub/Scrub (<1%)
Timber (10.7%)
Roadway (2.6%)
Water (1.7%)
Watershed Size: 1,499 acres
Lake Size: 26.4 acres
0
0.125
0.25
0.5
0.75
1
Miles
2

Williamson Pond, Lucas County
Topography



Williamson Pond, Lucas County
Potential Sheet and Rill Erosion




Williamson Pond, Lucas County
Proposed Structure Drainages
Structures identified with numbers are on public land, those identified with letters are on private land
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
Q
P
NO
H
I
G
F
C
M
JKL
DE
AB
Watershed Size: 1,499 acres
Lake Size: 26.4 acres
Legend
Public Land
Proposed Structure Locations (Approximate)
Proposed Structure Drainage Areas
Existing BMP Drainages
Sediment Control Structure
Waterway
N
S
E
W
0
0.25
0.5
1
Miles

Williamson Pond Proposed Structure Sediment Reduction

Each structure's sediment delivery reduction was calculated individually. If multiple structures are built within the same drainage area, the combined effect will not be additive.

Site No.	Drainage Area Acreage	Estimated Existing SD (t/y)	Estimated Existing Gully Erosion (t/y)	Structure Trapping Efficiency	Estimated Reduction in Sediment Delivered to Williamson Pond (t/y)
1	2.40	0.43	2.25	90%	2.41
2	5.80	0.77	3.44	90%	3.79
3	12.40	0.97	32.04	90%	29.71
4	63.60	2.09	29.43	90%	28.37
5	122.80	14.44	26.96	90%	37.26
6	85.80	16.20	31.09	90%	42.56
7	2.30	0.77	4.94	90%	5.14
8	4.10	0.67	2.19	90%	2.57
9	7.80	0.88	21.90	90%	20.50
10	6.40	0.70	17.21	90%	16.12
11	5.90	0.75	6.15	90%	6.21
12	8.20	0.88	7.14	90%	7.21
13	15.90	1.76	47.90	90%	44.70
14	3.10	0.71	4.68	90%	4.85
15	1.20	1.79	1.55	90%	3.01
AB	32.37	28.52	*	90%	25.67
C	10.71	5.73	*	90%	5.16
DE	41.18	33.43	*	90%	30.09
F	4.45	5.95	*	90%	5.36
G	13.98	15.85	27.01	90%	38.57
H	26.24	1.65	17.65	90%	17.37
I	10.5	0.42	14.14	90%	13.10
JKL	52.77	84.91	*	90%	76.42
M	73.66	104.71	*	90%	94.24
NO	9.61	0.33	*	90%	0.30
P	13.52	9.69	*	90%	8.72
Q	2.44	0.15	*	90%	0.14

**No gully erosion assessed or no gully erosion occurring*

Williamson Pond Proposed Structure Sediment Reduction

Each structure's sediment delivery reduction was calculated individually, if multiple structures are built within in the same drainage area these estimates would not be accurate.

Site No.	Drainage Area Acreage	Estimated Existing SD (t/y)	Estimated Existing Gully Erosion (t/y)	Structure Trapping Efficiency	Estimated Reduction in Sediment Delivered to Williamson Pond (t/y)
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13	15.90	1.76	47.90	90%	44.70
14	3.10	0.71	4.68	90%	4.85
15	1.20	1.79	1.55	90%	3.01
AB	32.37	28.52	*	90%	25.67
C	10.71	5.73	*	90%	5.16
DE	41.18	33.43	*	90%	30.09
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M	73.66	104.71	*	90%	94.24
NO	9.61	0.33	*	90%	0.30
P	13.52	9.69	*	90%	8.72
Q	2.44	0.15	*	90%	0.14

**No gully erosion assessed or no gully erosion occurring*

Williamson Pond Proposed Structure Sediment Reduction

Site No.	Drainage Area Acreage	Estimated Existing SD (t/y)	Estimated Existing Gully Erosion (t/y)	Structure Trapping Efficiency	Estimated Reduction in Sediment Delivered to Williamson Pond (t/y)
1	2.40	0.43	2.25	90%	2.41
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5	122.80	14.44	26.96	90%	37.26
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7	2.30	0.77	4.94	90%	5.14
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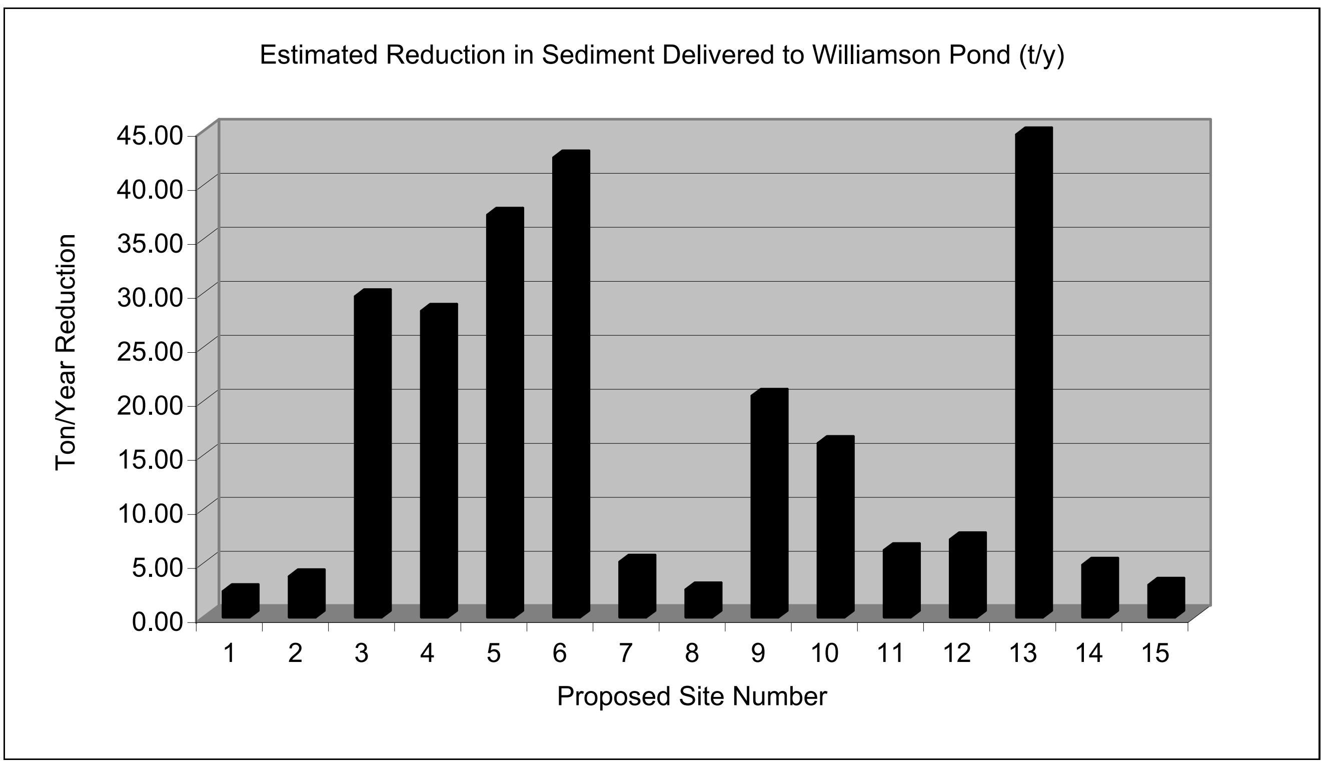
9	7.80	0.88	21.90	90%	20.50
10	6.40	0.70	17.21	90%	16.12
11	5.90	0.75	6.15	90%	6.21
12	8.20	0.88	7.14	90%	7.21
13	15.90	1.76	47.90	90%	44.70
14	3.10	0.71	4.68	90%	4.85
15	1.20	1.79	1.55	90%	3.01
TOTAL	347.70	43.80	238.87		254.41



Major Project Activities	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Year 1 -- 2009												
Hire project coordinator	X											
Develop annual workplan	X											
Initiate mandated cultural and natural inventories	X	X										
Identify and contact cooperating landowners	X	X	X				X	X	X			
Update conservation plans			X	X				X	X			X
Survey and design structures				X	X	X				X	X	X
Install 1 grade stabilization structure							X					
Install 2 sediment basins							X					
Install 3 acres grass waterway										X	X	
Install 3000 ft terraces										X	X	X
Install 1 livestock facility improvement							X					
Prepare monthly reports	X	X	X	X	X	X	X	X	X	X	X	X
Prepare quarterly reports			X			X			X			X
Prepare annual report												X
Year 2 -- 2010												
Develop annual workplan	X											
Identify and contact cooperating landowners	X	X	X				X	X	X			
Update conservation plans			X	X				X	X			X
Survey and design structures				X	X	X				X	X	X
Install 1 grade stabilization structure							X					
Install 3 sediment basins							X				X	
Install 2 acres grass waterway											X	
Install 2000 ft terraces											X	X
Install 1 livestock facility improvement							X					
Prepare monthly reports	X	X	X	X	X	X	X	X	X	X	X	X
Prepare quarterly reports			X			X			X			X
Prepare annual report												X
Year 3 -- 2011												
Develop annual workplan	X											
Survey and design structures				X	X	X						
Install 2 grade stabilization structures							X	X	X			
Install 10 sediment basins							X	X	X			
Prepare monthly reports	X	X	X	X	X	X	X	X	X	X	X	X
Prepare quarterly reports			X			X			X			X
Prepare annual report												X
Year 4 -- 2012												
Develop annual workplan	X											
Survey and design structures				X	X	X						
Install 3 grade stabilization structures							X	X	X			
Install 5 sediment basins							X	X	X			
Prepare monthly reports	X	X	X	X	X	X	X	X	X	X	X	X
Prepare quarterly reports			X			X			X			X
Prepare annual report												X
Prepare final report												X

BUDGET FOR YEAR #: **1** FY: **2009**

PROJECT NAME: **Williamson Pond Watershed Project** SWCD(s): **Lucas County** DSC PROJ ECT #:

Component	Number, Acres or Other Units	Total Cost	Landowner Cost	Cost Share Rate	Project Cost	319, WPF, WSPF Cost	Other Funding Source(s) Cost	Other Funding Source(s) ID
Salary & Benefits*		$12,000			$12,000	$12,000		
DSC Indirect Costs								
Travel/Training		$1,000			$1,000	$1,000		
Supplies		$500			$500	$500		
Inform./Educ.								
Contractual (DSC)								
Contractual (SWCD)								
Equipment								
Other								
Practices:								
Grade stabilization structure	1	$15,000	$3,750	75%	$11,250	$11,250		
Sediment basin	2	$10,000	$2,500	75%	$7,500	$7,500		
Grass waterway	3 ac	$4,500	$1,125	75%	$3,375	$3,375		
Terraces	3000 ft	$27,000	$6,750	75%	$20,250	$20,250		
Livestock improvement	1	$2,500	$625	75%	$1,875	$1,875		
Totals		$72,500	$14,750		$57,750	$57,750		

* For a 1/4-time Project Coordinator

WILLIAMSON POND WATERSHED PROJECT BUDGET SUMMARY
Page 1 of 2
(Funding requested from **Section 319, WPF and/or WSPF**)

Budget Category	**Project Funding**					
	Year 1	Year 2	Year 3	Year 4	Year 5	TOTAL
Personnel	12,000	12,000	12,000	12,000		48,000
Fringe Benefits						
Travel	500	300	300	300		1,400
Training	500	300	300	300		1,400
Supplies	500	500	500	500		2,000
Equipment						
Contractual Services						
Financial Incentives and Cost-Share	44,250	40,125	60,000	41,250		185,625
Other						
TOTAL	57,750	53,225	73,100	54,350		238,425

WILLIAMSON POND WATERSHED PROJECT BUDGET SUMMARY
Page 2 of 2
(Contributions from **Other Agencies and Organizations**)

Budget Category	**Project Funding**					
	Year 1	Year 2	Year 3	Year 4	Year 5	TOTAL
Personnel						
Fringe Benefits						
Travel						
Training						
Supplies						
Equipment						
Contractual Services						
Financial Incentives and Cost-Share	14,750 (Landowners)	13,375 (Landowners)	15,000 (SIDCA*) + 45,000 (DNR Fisheries)	41,250 (DNR Fisheries)		129,375
Other						
TOTAL	14,750	13,375	60,000	41,250		129,375

* -- Southern Iowa Development and Conservation Authority